BIDDING AND CONTRACT DOCUMENTS

FOR

West Lothian Air Handler Replacement
PROJECT NO. 956394
CONTRACT NO. 956394-LF-2019-105

UCR | Planning, Design & Construction

City of Riverside, County of Riverside
California

April 18, 2019

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CERTIFICATION

WEST LOTHIAN AIR HANDLER REPLACEMENT

Bidding Documents Prepared By:

Company Name: Goss Engineering, Inc.

255 E. Rincon St., Suite 301
(Street Address)

Corona, CA 92879
(City, State & Zip Code)

Signed: _____ Date: 04/17/2019
(Signature of an Officer of the Firm Named Above)

Nick Ubrun, Principal
(Print Name & Title)

Certification:

(Affix professional registration stamp of the person named above with signature and expiration date.)

ADVERTISEMENT FOR BIDS

Subject to conditions prescribed by the University of California, Riverside, sealed bids for a lump sum contract are invited for the following Project:

West Lothian Air Handler Replacement
PROJECT NO. 956394
CONTRACT NO. 956394-LF-2019-105
UNIVERSITY OF CALIFORNIA, RIVERSIDE
RIVERSIDE, CALIFORNIA

Replace two existing air handler units located at the West Lothian Mechanical Room with two like kind units.

Bidding and Contract Documents will be available at **2:00 PM,** on **April 16, 2019**, and will issued only at:

IB Reprographics
3363 Durahart Street
Riverside, CA 92507

Phone: (951) 682-1850
Fax: (951) 682-2315
www.ibrepro.com

Each set of Bidding and Contract Documents will require a non-refundable payment to **IB Reprographics**. If paying by check, make your checks payable to "**IB Reprographics**." Bidding and Contract Documents will be mailed/shipped at the requestor's expense.

PRE-BID CONFERENCE & SITE VISIT

Bidders must attend a **mandatory** Pre-Bid Conference and Site Visit at **9:00 AM,** on **April 19, 2019**, at:

University of California, Riverside
1223 University Avenue, Suite 210-16
Riverside, CA 92507

(Located in University Village, corner of University Avenue and Iowa Avenue.)

Phone: (951) 827-2610 Fax: (951) 827-4556

Bidders must provide their contact information and sign the Pre-Bid Conference and Site Visit attendance sheet. Only bidders who sign the attendance sheet will be eligible to submit bids for the Project as prime contractors.

Any bidder who enters the Pre-Bid Conference after 9:10 A.M. will be precluded from bidding as a prime contractor and may only bid as a subcontractor. Subcontractors are not required to attend; however we encourage their attendance.

UCR Planning, Design & Construction will provide parking validation to anyone attending the Conference. We suggest that you arrive early to allow time to park and walk to the Conference location.

BID DEADLINE

Sealed bids must be received on or before **2:00 PM**, on **May 3, 2019**. Bids will be received only at:

Planning, Design & Construction
UNIVERSITY OF CALIFORNIA, RIVERSIDE
1223 University Avenue, Suite 240
Riverside, CA 92507

Immediately following the Bid Deadline, bids will be opened at the same location.

Bid Security in the amount of 10% of the Lump Sum Base Bid shall accompany each Bid. The Surety issuing the Bid Bond shall be, on the Bid Deadline, an admitted surety insurer (as defined in California Code of Civil Procedure Section 995.120).

The successful Bidder and its subcontractors will be required to follow the nondiscrimination requirements set forth in the Bidding and Contract Documents and to pay prevailing wage rates at the location of the Work.

Every effort will be made to ensure that all persons have equal access to contracts and other business opportunities with the University within the limits imposed by law or University policy. Each Bidder may be required to show evidence of its equal employment opportunity policy. The successful Bidder and its subcontractors will be required to follow the nondiscrimination requirements set forth in the Bidding Documents and to pay prevailing wage at the location of the work.

The successful Bidder must have the following State of California Contractor's license current and active at the time of submission of the Bid:

C-20 Warm-Air Heating, Ventilating and Air Conditioning or B General Building with a C-20 or a B – General Building with a C-20 subcontractor.

The work described in the contract is a public work subject to section 1771 of the California Labor Code.

The successful Bidder shall pay all persons providing construction services and/or any labor on site, including any University location, no less than the UC Fair Wage (defined as $13 per hour as of 10/1/15, $14 per hour as of 10/1/16, and $15 per hour as of 10/1/17) and shall comply with all applicable federal, state and local working condition requirements.

Estimated construction cost: **$450,000.00**

THE REGENTS OF THE UNIVERSITY OF CALIFORNIA
University of California, Riverside
Publication Dates: April 4, 2019 through April 18, 2019

PROJECT DIRECTORY

Project Name:	**West Lothian Air Handler Replacement**
Project Number:	**956394**
Location:	**University of California, Riverside**
University:	**The Regents of the University of California**
University's Representative:	**John Franklin** **Senior Project Manager** Planning, Design & Construction University of California, Riverside 1223 University Avenue, Suite 240 Riverside, CA 92521 Tel: (951) 827-1270 Fax: (951) 827-5442 Email: john.franklin@ucr.edu **Kara Longtin** **Project Specialist** Planning, Design & Construction University of California, Riverside 1223 University Avenue, Suite 240 Riverside, CA 92521 Tel: (951) 827-2610 Fax: (951) 827-5442 Email: kara.longtin@ucr.edu **Chuck Blumer** **Senior Construction Inspector** Planning, Design & Construction University of California, Riverside 1223 University Avenue, Suite 240 Riverside, CA 92521 Tel: (951) 827-1535 Fax: (951) 827-2402 Email: chuck.blumer@ucr.edu
Design Professional:	**Nick Ubrun** **Principal Engineer** Goss Engineering 320 S. Main Street, Suite 102 Corona, CA. 92992 Tel: 951-340-1977 Email: nubrun@goss-eng.com
Address for Stop Notices:	University of California, Riverside Accounting Office -002 Riverside, CA 92521-0123

Address for Demand for Arbitration:	Western Case Management Center 6795 N. Palm Avenue, 2nd Floor Fresno, CA 93704
A copy of the Demand for Arbitration must be sent to:	University of California Office of the General Counsel 1111 Franklin Street, 8th Floor Oakland, CA 94607-5200

END OF PROJECT DIRECTORY

INSTRUCTIONS TO BIDDERS

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ARTICLE 1

DEFINITIONS

1.1 Except as otherwise specifically provided, definitions set forth in the General Conditions or in other Contract Documents are applicable to all Bidding Documents.

1.2 The term “Addenda” means written or graphic instruments issued by University prior to the Bid Deadline which modify or interpret the Bidding Documents by additions, deletions, clarifications, or corrections.

1.3 The term “Alternate” means a proposed change in the Work, as described in the Bidding Documents which, if accepted, may result in a change to either the Contract Sum or the Contract Time, or both.

1.4 The term “Bid Deadline” means the date and time on or before which Bids must be received, as designated in the Advertisement for Bids and which may be revised by Addenda.

1.5 The term “Bidder” means a person or firm that submits a Bid.

1.6 The term “Bidding Documents” means the construction documents prepared and issued for bidding purposes including all Addenda thereto.

1.7 The term “Estimated Quantity” means the estimated quantity of an item of Unit Price Work.

1.8 As used in these Instructions to Bidders, the term “Facility” means the University's Facility office issuing the Bidding Documents.

1.9 The term “Lump Sum Base Bid” means the sum stated in the Bid for which Bidder offers to perform the Work described in the Bidding Documents, but not including Unit Price items or Alternates.

1.10 The term “Planholder” means a person or entity known by the Facility to have received a complete set of Bidding Documents and who has provided a street address for receipt of any written pre-bid communications.

1.11 The term “Unit Price” means an amount stated in the Bid for which Bidder offers to perform an item of Unit Price Work for a fixed price per unit of measurement.

1.12 As used in these Instructions to Bidders, the term “Business Day” means any day other than a Saturday, a Sunday, and the holidays specified herein, and to the extent provided herein, if the Facility or applicable office of the University is closed for the whole of any day, insofar as the business of that office is concerned, that day shall be considered as a holiday for the purposes of computing time in these Instructions to Bidders. Holidays include January 1st, the third Monday in January, the third Monday in February, the last Monday in May, July 4th, the first Monday in September, November 11th, Thanksgiving Day, December 25th, and every day designated by the University as a holiday**.**

ARTICLE 2

BIDDER'S REPRESENTATIONS

2.1 Bidder, by making a Bid, represents that:

2.1.1 Bidder has read, understood, and made the Bid in accordance with the provisions of the Bidding Documents.

2.1.2 Bidder has visited the Project site and is familiar with the conditions under which the Work is to be performed and the local conditions as related to the requirements of the Contract Documents.

2.1.3 The Bid is based upon the materials, equipment, and systems required by the Bidding Documents without exception.

2.1.4 At the time of submission of the Bid, Bidder and all Subcontractors, regardless of tier, have the appropriate current and active licenses issued by the State of California Contractors State License Board for the Work to be performed and any licenses specifically required by the Bidding Documents. If Bidder is a joint venture, at the time of submission of the Bid, Bidder shall have the licenses required by the preceding sentence in the name of the joint venture itself. The State of California Business and Professions Code, Division 3, Chapter 9, known as the "Contractor's License Law," establishes licensing requirements for contractors.

2.1.5 Bidder has read and shall abide by the nondiscrimination requirements contained in the Bidding Documents.

2.1.6 Bidder has the expertise and financial capacity to perform and complete all obligations under the Bidding Documents.

2.1.7 The person executing the Bid Form is duly authorized and empowered to execute the Bid Form on behalf of Bidder.

2.1.8 Bidder is aware of and, if awarded the Contract, will comply with Applicable Code Requirements in its performance of the Work.

ARTICLE 3

BIDDING DOCUMENTS

3.1 COPIES

3.1.1 Bidders may obtain complete sets of the Bidding Documents from the issuing office designated in the Advertisement for Bids for the sum stated therein, if any. Documents are only available in full sets and shall not be returned.

3.1.2 Bidders shall use a complete set of Bidding Documents in preparing Bids.

3.1.3 University makes copies of the Bidding Documents available, on the above terms, for the sole purpose of obtaining Bids for the Work and does not confer a license or grant permission for any other use of the Bidding Documents.

3.2 INTERPRETATION OR CORRECTION OF BIDDING DOCUMENTS

3.2.1 Bidder shall, before submitting its Bid, carefully study and compare the components of the Bidding Documents and compare them with any other work being bid concurrently or presently under construction which relates to the Work for which the Bid is submitted; shall examine the Project site, the conditions under which the Work is to be performed, and the local conditions; and shall at once report to University's Representative errors, inconsistencies, or ambiguities discovered. If Bidder is awarded the Contract, Bidder waives any claim arising from any errors, inconsistencies or ambiguities, that Bidder, its subcontractors or suppliers, or any person or entity under Bidder on the Contract became aware of, or reasonably should have become aware of, prior to Bidder's submission of its Bid.

3.2.2 Requests for clarification or interpretation of the Bidding Documents shall be addressed only to the person or firm designated in the Supplementary Instructions to Bidders.

3.2.3 Clarifications, interpretations, corrections, and changes to the Bidding Documents will be made by Addenda issued as provided in Article 3.5. Clarifications, interpretations, corrections, and changes to the Bidding Documents made in any other manner shall not be binding and Bidders shall not rely upon them.

3.3 PRODUCT SUBSTITUTIONS

3.3.1 No substitutions will be considered prior to award of Contract. Substitutions will only be considered after award of the Contract and as provided for in the Contract Documents.

3.4 SUBCONTRACTORS

3.4.1 Each Bidder shall list in the Bid Form all first-tier Subcontractors that will perform work, labor or render such services as defined in Article 9 of the Bid Form. The Bid Form contains spaces for the following information when listing Subcontractors: (1) portion of the Work; (2) name of Subcontractor; (3) city of Subcontractor's business location. The failure to list, on the Bid Form, any one of the items set forth above will result in the University treating the Bid as if no Subcontractor was listed for that portion of the Work and Bidder will thereby represent to University that Bidder agrees that it is fully qualified to perform that portion of the Work and shall perform that portion of the Work.

3.4.2 Subcontractors listed in the Bid Form shall only be substituted after the Bid Deadline with the written consent of University and in accordance with the State of California “Subletting and Subcontracting Fair Practices Act.”

3.5 ADDENDA

3.5.1 Addenda will be issued only by University and only in writing. Addenda will be identified as such and will be mailed or delivered to all Planholders. At its sole discretion, the University may elect to deliver Addenda via facsimile to Planholders who have provided a facsimile number for receipt of Addenda.

3.5.2 Copies of Addenda will be made available for inspection wherever Bidding Documents are on file for inspection.

3.5.3 Addenda will be issued such that Planholders should receive them no later than 3 full business days prior to the Bid Deadline. Addenda withdrawing the request for Bids or postponing the Bid Deadline may be issued anytime prior to the Bid Deadline.

3.5.4 Each Bidder shall be responsible for ascertaining, prior to submitting a Bid, that it has received all issued Addenda.

3.6 BUILDER'S RISK PROPERTY INSURANCE

3.6.1 University will provide builder's risk property insurance subject to the deductibles in the policy as required by the General Conditions if the Contract Sum exceeds $200,000 at the time of award and the requirements of the Project are not excluded by such coverage. A summary of the provisions of the policy is included as an Exhibit to the Contract; the policy may be reviewed at the Facility’s office. Bidder agrees that the University’s provision of builder’s risk property insurance containing said provisions meets the University’s obligation to provide builder’s risk property insurance under the Contract and, in the event of a conflict between the provisions of the policy and any summary or description of the provisions contained herein or otherwise, the provisions of the policy shall control and shall be conclusively presumed to fulfill the University’s obligation to provide such insurance.

ARTICLE 4

PRE-BID CONFERENCE

4.1 Bidder shall attend the Pre-Bid Conference at which the requirements of the Bidding Documents are reviewed by University, comments and questions are received from Bidders, and a Project site visit is conducted. University requires all Pre-Bid Conference attendees to arrive for the meeting on time and to sign an attendance list, which in turn is used to determine if Bidders meet this requirement. Any Bidder not attending the Pre-Bid Conference in its entirety will be deemed to have not complied with the requirements of the Bidding Documents and its Bid will be rejected.

ARTICLE 5

BIDDING PROCEDURES

5.1 FORM AND STYLE OF BIDS

5.1.1 Bids shall be submitted on the Bid Form included with the Bidding Documents. Bids not submitted on the University's Bid Form shall be rejected.

5.1.2 The Bid Form shall be filled in legibly in ink or by typewriter. All portions of the Bid Form must be completed and the Bid Form must be signed before the Bid is submitted. Failure to comply with the requirements of this Article 5.1.2 will result in the Bid being rejected as nonresponsive.

5.1.3 Bidder's failure to submit a price for any Alternate or Unit Price will result in the Bid being considered as nonresponsive. If Alternates are called for and no change in the Lump Sum Base Bid is required, indicate “No Change” by marking the appropriate box.

5.1.4 Bidder shall make no stipulations on the Bid Form nor qualify the Bid in any manner.

5.1.5 The Bid Form shall be signed by a person or persons legally authorized to bind Bidder to a contract. Bidder's Representative shall sign and date the Declaration included in the Bid Form. Failure to sign and date the declaration will cause the Bid to be rejected.

5.2 BID SECURITY

5.2.1 Each Bid shall be accompanied by Bid Security in the amount of 10% of the Lump Sum Base Bid as security for Bidder's obligation to enter into a Contract with University on the terms stated in the Bid Form and to furnish all items required by the Bidding Documents. Bid Security shall be a Bid Bond on the form provided by University and included herein, or a certified check made payable to “The Regents of the University of California.” When a Bid Bond is used for Bid Security, failure to use University's Bid Bond form will result in the rejection of the Bid. Bidder must use the Bid Bond form provided by the University or an exact, true and correct photocopy of such form. The Bid Bond form may not be retyped, reformatted, transcribed onto another form, or altered in any manner except for the purpose of completing the form.

5.2.2 If the apparent lowest responsible Bidder fails to sign the Agreement and furnish all items required by the Bidding Documents within the time limits specified in these Instructions to Bidders, University may reject such Bidder’s Bid and select the next apparent lowest responsible Bidder until all Bids have been exhausted or University may reject all Bids. The Bidder whose Bid is rejected for such failure(s) shall be liable for and forfeit to University the amount of the difference, not to exceed the amount of the Bid Security, between the amount of the Bid of the Bidder so rejected and the greater amount for which University procures the Work.

5.2.3 If a Bid Bond is submitted, the signature of the person executing the Bid Bond must be notarized. If an attorney-in-fact executes the Bid Bond on behalf of the surety, a copy of the current power of attorney bearing the notarized signature of the appropriate corporate officer shall be included with the Bid Bond.

Additionally, the surety issuing the Bid Bond shall be, on the Bid Deadline, an admitted surety insurer (as defined in the California Code of Civil Procedure Section 995.120).

5.2.4 Bid Security will be returned after the contract has been awarded. Notwithstanding the preceding, if a Bidder fails or refuses, within 10 days after receipt of notice of selection, to sign the Agreement or submit to University all of the items required by the Bidding Documents, the University will retain that Bidder's Bid Security. If the Bid Security is in the form of a Bid Bond, the Bid Security will be retained until the University has been appropriately compensated; if the Bid Security is in the form of certified check, the University will negotiate said check and after deducting its damages, return any balance to Bidder.

5.3 SUBMISSION OF BIDS

5.3.1 The Bid Form, Bid Security, and all other documents required to be submitted with the Bid shall be enclosed in a sealed opaque envelope. The envelope shall be addressed to the office designated in the Supplementary Instructions to Bidders for receipt of Bids. The envelope shall be identified with the Project name, Bidder's name and address, and, if applicable, the designated portion of the Project for which the Bid is submitted. If the Bid is sent by mail, the sealed envelope shall be enclosed in a separate mailing envelope with the notation "SEALED BID ENCLOSED" on the face thereof.

5.3.2 Bids shall be deposited at the designated location on or before the Bid Deadline. A Bid received after the Bid Deadline will be returned to Bidder unopened.

5.3.3 Bidder shall assume full responsibility for timely delivery at the location designated for receipt of Bids.

5.3.4 Oral, telephonic, electronic mail (e-mail), facsimile, or telegraphic Bids are invalid and will not be accepted.

5.4 MODIFICATION OR WITHDRAWAL OF BID

5.4.1 Prior to the Bid Deadline, a submitted Bid may be modified or withdrawn by notice to the Facility receiving Bids at the location designated for receipt of Bids. Such notice shall be in writing over the signature of Bidder and, in order to be effective, must be received on or before the Bid Deadline. A modification so made shall be worded so as not to reveal the amount of the original Bid.

5.4.2 A withdrawn Bid may be resubmitted on or before the Bid Deadline, provided that it then fully complies with the Bidding Requirements.

5.4.3 Bid Security shall be in an amount sufficient for the Bid as modified or resubmitted.

5.4.4 Bids may not be modified, withdrawn, or canceled within 60 days after the Bid Deadline unless otherwise provided in Supplementary Instructions to Bidders.

ARTICLE 6

CONSIDERATION OF BIDS

6.1 OPENING OF BIDS

6.1.1 Bids which have the required identification as stipulated in Article 5.3.1 and are received on or before the Bid Deadline will be opened publicly.

6.2 REJECTION OF BIDS

6.2.1 University will have the right to reject all Bids.

6.2.2 University will have the right to reject any Bid not accompanied by the required Bid Security or any other item required by the Bidding Documents, or a Bid which is in any other way incomplete or irregular.

6.3 AWARD

6.3.1 University will have the right, but is not required, to waive nonmaterial irregularities in a Bid. If the University awards the Contract, it will be awarded to the responsible Bidder submitting the lowest responsive Bid as determined by University and who is not rejected by University for failing or refusing, within 10 days after receipt of notice of selection, to sign the Agreement or submit to University all of the items required by the Bidding Documents.

6.3.2 University will have the right to accept Alternates in any order or combination, unless otherwise specifically provided in the Bidding Documents. The opening of Bids and evaluation of Alternates will be conducted in accordance with a procedure that, at University's option, either (i) prescribes, prior to the time of Bid opening, the order in which Alternates will be selected or (ii) prevents, before the determination of the apparent low Bidder has been made, information that would identify which Bid belongs to which Bidder from being revealed to the representative of the University selecting the Alternates to be used in determining the low Bidder. After determination of the apparent low Bidder has been made, University will publicly disclose the identity of each Bidder that submitted a Bid and the amount of each such Bid.

6.3.3 University will determine the low Bidder on the basis of the sum of the Lump Sum Base Bid plus all Unit Prices multiplied by their respective Estimated Quantities as stated in the Bid Form, if any, plus the daily rate for Compensable Delay multiplied by the "multiplier" as stated in the Bid Form, plus the amounts of all Alternates to be included in the Contract Sum at the time of award. The Contract Sum will be the sum of the Lump Sum Base Bid and the additive or deductive amounts for all Alternates that University has elected to be included in the Contract Sum as of the time of award.

6.3.4 The University will post the Bid results in a public place at the address where the Bids are received (unless another address is specified in the Bidding Documents).

6.3.5 University will select the apparent lowest responsive and responsible Bidder and notify such Bidder on University's form within 50 days (unless the number of days is modified in Supplementary Instructions to Bidders) after the Bid Deadline or reject all Bids. Within 10 days after receipt of notice of selection as the apparent lowest responsive and responsible Bidder, Bidder shall submit to University all of the following items:

.1 One original of the Agreement signed by Bidder.

.2 One original of the Payment Bond required under Article 11 of the General Conditions.

.3 One original of the Performance Bond required under Article 11 of the General Conditions.

.4 Certificates of Insurance on form provided by University required under Article 11 of the General Conditions.

.5 Name of, qualifications of, and references for the Superintendent proposed for the Work.

.6 Names of all Subcontractors, with their addresses, telephone number, facsimile number, contact person, portion of the Work and designation of any Subcontractor as a Small Business Enterprise (SBE), Disadvantaged Business Enterprise (DBE), Women-owned Business Enterprise (WBE) and Disabled Veteran Business Enterprise (DVBE) on Report of Subcontractor Information in the form

contained in the Exhibits. Evidence, as required by University, of the reliability and responsibility of the proposed Subcontractors such as statements of experience, statements of financial condition, and references.

.7 Preliminary Contract Schedule as required under Article 3 of the General Conditions.

.8 If Bidder wishes to utilize securities in lieu of retention beginning with the first Application for Payment, Selection of Retention Options accompanied by a completed Escrow Agreement for Deposit of Securities in Lieu of Retention and Deposit of Retention in the form contained in the Exhibits.

.9 Cost Breakdown as required by Article 9 of the General Conditions.

6.3.6 Prior to award of the Contract, University will notify Bidder in writing, if University, after due investigation, objects to a Subcontractor or Superintendent proposed by Bidder, in which case Bidder shall propose a substitute acceptable to University. Substitution of Superintendent shall be made in accordance with Article 3 of the General Conditions. Substitution of a Subcontractor shall be made in accordance with Article 5 of the General Conditions. Failure of University to object to a proposed Superintendent or Subcontractor prior to award shall not preclude University from requiring replacement of Superintendent or any Subcontractor based upon information received subsequent to award, information which cannot be properly evaluated prior to award due to time constraints, or information relating to a failure to comply with the requirements of the Contract.

6.3.7 If Bidder submits the original of the signed Agreement and all other items required to be submitted to University within 10 days after receipt of notice of selection as the apparent lowest responsive and responsible Bidder, and if all such items comply with the requirements of the Bidding Documents and are acceptable to University, University will award the Contract to Bidder by signing the Agreement and returning a signed copy of the Agreement to Bidder.

6.3.8 If University consents to the withdrawal of the Bid of the apparent lowest responsive and responsible Bidder, or the apparent lowest responsive and responsible Bidder fails or refuses to sign the Agreement or submit to University all of the items required by the Bidding Documents, within 10 days after receipt of notice of selection, or that Bidder is not financially or otherwise qualified to perform the Contract, University may reject such Bidder's Bid and select the next apparent lowest responsible Bidder, until all Bids are exhausted, or reject all Bids. Any Bidder whose Bid is rejected because the Bidder has failed or refused, within 10 days after receipt of notice of selection, to sign the Agreement or submit to University all of the items required by the Bidding Documents, shall be liable to the University for all resulting damages.

ARTICLE 7

BID PROTEST

7.1 FILING A BID PROTEST

7.1.1 Any Bidder, person, or entity may file a Bid protest. The protest shall specify the reasons and facts upon which the protest is based and shall be in writing and received by with the Facility not later than 5:00 PM on the 3rd business day following:

.1 if the Bid Form does not contain any Alternate(s), the date of the Bid opening;

.2 if the Bid Form contains any Alternate(s), the date of posting in a public place of Bid results.

7.1.2 If a Bid is rejected by the Facility, and such rejection is not in response to a Bid protest, any Bidder, person or entity may dispute that rejection by filing a Bid protest (limited to the rejection) in writing and received by the Facility not later than 5:00 PM on the 3rd business day following the rejected Bidder's receipt of the notice of rejection.

7.1.3 For the purpose of computing any time period in this Article 7, the date of receipt of any notice shall be the date on which the intended recipient of such notice actually received it. Delivery of any notice may be by any means, with verbal or written confirmation of receipt by the intended recipient.

7.2 RESOLUTION OF BID CONTROVERSY

7.2.1 Facility will investigate the basis for the Bid protest and analyze the facts. Facility will notify Bidder whose Bid is the subject of the Bid protest of evidence presented in the Bid protest and evidence found as a result of the investigation, and, if deemed appropriate, afford Bidder an opportunity to rebut such evidence, and permit Bidder to present evidence that it should be allowed to perform the Work. If deemed appropriate by Facility, an informal hearing will be held. Facility will issue a written decision within 15 days following receipt of the Bid protest, unless factors beyond Facility's reasonable control prevent such a resolution, in which event such decision will be issued as expeditiously as circumstances reasonably permit. The decision will state the reasons for the action taken by Facility. A written copy of the decision will be furnished to the protestor, the Bidder whose Bid is the subject of the Bid protest, and all Bidders affected by the decision. As used in this Article 7, a Bidder is affected by the decision on a Bid protest if a decision on the protest could have resulted in the Bidder not being the lowest responsible and responsive Bidder for the Contract. A written copy of the Facility's decision must be received by the protester, the Bidder whose Bid is the subject of the Bid protest, and all Bidders affected by the decision no later than 3 business days prior to award of the contract.

7.2.2 Notwithstanding the provisions of Article 7.2.1, at the election of Facility, a Bid protest may be referred directly to University's Construction Review Board without prior investigation and review by Facility. The Chair of the Construction Review Board will either decide the Bid protest or appoint a Hearing Officer. If a Hearing Officer is appointed, the Hearing Officer will review the Bid protest in accordance with the provisions of Article 7.2.4.

7.2.3 Bidder whose Bid is the subject of the protest, all Bidders affected by the Facility's decision on the protest, and the protestor have the right to appeal to the Construction Review Board if not satisfied with Facility's decision. The appeal must be in writing and shall specify the decision being appealed and all the facts and circumstances relied upon in support of the appeal. A copy of the appeal must be received by the Chair, Construction Review Board, not later than 5:00 pm on the 3rd business day following appellant's receipt of the written decision of Facility, at the following address:

Chair, Construction Review Board
University of California
Office of the President
1111 Franklin Street, 6th Floor
Oakland, CA 94607-5200
Attention: Associate Director, Design & Construction Policy

And, by email to:

constructionreviewboard@ucop.edu

A copy of the appeal must be sent to all parties involved in the Bid protest and to Facility, to the same address and in the same manner as the original protest. An appeal received after 5:00 pm is considered received as of the next business day. If the final date for receipt of an appeal falls on a Saturday, Sunday, or University holiday, the appeal will be considered timely only if received by 5:00 pm on the following business day. The burden of proving timely receipt of the appeal is on the appealing party.

7.2.4 The Chair of the Construction Review Board will review the Facility's decision and the appeal, and issue a written decision, or if appropriate, appoint a Hearing Officer to conduct a hearing and issue a written decision. If a hearing is held, the hearing shall be held not later than the 10th day following the appointment of the Hearing Officer unless the Hearing Officer for good cause determines otherwise. The written decision of the Chair or Hearing Officer will state the basis of the decision, and the decision will be

final and not subject to any further appeal to University. The Chair or Hearing Officer may consult with the University's Office of the General Counsel on the decision as to legal form. The University will complete its internal Bid protest procedures before award of the Contract.

END OF INSTRUCTIONS TO BIDDERS

SUPPLEMENTARY INSTRUCTIONS TO BIDDERS

1. Contract Time: As specified in Section 1 of the Bid Form.

2. List of Subcontractors (Bid Form Paragraph 9.0) and List of Changes in Subcontractors Due to Alternates (Bid Form Paragraph 10.0).

   The default rule is that, if a Bidder lists one subcontractor for a Work Activity (such as "Electrical") under Bid Form Paragraph 9.0 and a different subcontractor for the same Work Activity (such as "Electrical") for the Alternate Work under Bid Form Paragraph 10.0 without reference to the Alternate, then it is deemed that the second subcontractor listed in Paragraph 10.0 will perform the Base Bid Work and the Alternate Work, unless the Bidder expressly writes otherwise.

   A Bidder may list more than one subcontractor per trade, provided that the Work Activity to be performed by each listed subcontractor is adequately described on the spaces provided on the Bid Form, so that which subcontractor will perform which Work Activity can be determined.

   For example, in case of Alternates, if a Bidder wants one subcontractor to perform the electrical Base Bid Work and another subcontractor to perform the electrical Alternate Work, then the Bidder should list the first subcontractor under Bid Form Paragraph 9.0 as performing the "Electrical" Work Activity, and list the second subcontractor under Bid Form Paragraph 10.0 (for listing changes in subcontractors due to Alternates) as performing the "Electrical Alt" or "Electrical Alt Work" or "Electrical Alt Only" or similarly to define the Alternate Work Activity separately to be performed.

3. Requests for clarification or interpretation of the Bidding Documents must be submitted in writing, and shall be addressed only to:

   Kara Longtin
   Email: kara.longtin@ucr.edu
   Tel: 951.827.2610

   The deadline to submit requests for clarification or interpretation is on or before 3:00 PM, on April 25, 2019.

4. The mandatory Pre-Bid Conference and Site Visit will be conducted at the time and location specified in the **ADVERTISEMENT FOR CONTRACTOR BIDS**, bound herein. (Attendance is mandatory. As evidence of attendance, bidders must sign the attendance sheet provided by University at the Pre-Bid Conference and Site Visit.)

5. Bids must be received on or before the Bid Deadline and only at the location specified in the **ADVERTISEMENT FOR CONTRACTOR BIDS**.

6. Bids will be opened at the same location specified in the **ADVERTISEMENT FOR CONTRACTOR BIDS** for the receipt of bids.

7. Contractor will be assessed as liquidated damages the sum of **$750.00** for each day the Work remains incomplete beyond the expiration of the Contract Time. After Substantial Completion, the rate for liquidated damages shall be reduced to the sum of **$500.00** per day. See Article 5 of the Agreement for detailed requirements

8. Replace the existing Paragraph 1.4 with the following:

1.4 The term "Bid Deadline" means the date and time on or before which Bids must be received, as designated in the **ADVERTISEMENT FOR CONTRACTOR BIDS** and which may be revised by Addenda.

9. Replace the existing Paragraph 3.1.1 with the following:

3.1.1 Bidders may obtain complete sets of the Bidding Documents from the issuing office designated in the **ADVERTISEMENT FOR CONTRACTOR BIDS**.

10. Replace the existing Paragraph 3.5.1 with the following:

3.5.1 Addenda will be issued only by University and only in writing. Addenda will be identified as such and will be mailed or delivered to all Planholders. At its sole discretion, the University may elect to deliver Addenda via facsimile or email to Planholders who have provided a facsimile number or email address for receipt of Addenda or communications.

11. Replace the existing Paragraph 3.5.3 with the following:

3.5.3 Addenda will be issued such that Planholders should receive them no later than 72 hours prior to the Bid Deadline. Addenda withdrawing the request for Bids or postponing the Bid Deadline may be issued anytime prior to the Bid Deadline.

12. Replace the existing Paragraph 5.2.4 with the following:

5.2.4 Bid Security will be returned after the contract has been awarded. Notwithstanding the preceding, if a Bidder fails or refuses, within **10** days after receipt of notice of selection, to sign the Agreement or submit to University all of the items required by the Bidding Documents, the University will retain that Bidder's Bid Security. If the Bid Security is in the form of a Bid Bond, the Bid Security will be retained until the University has been appropriately compensated; if the Bid Security is in the form of certified check, the University will negotiate said check and after deducting its damages, return any balance to Bidder.

13. Not Used

14. Replace the existing Paragraph 5.4.4 with the following:

5.4.4 Bids may not be modified, withdrawn, or canceled within **60** days after the Bid Deadline.

15. Replace the existing Paragraph 6.3.1 with the following:

6.3.1 University will have the right, but is not required, to waive nonmaterial irregularities in a Bid. If the University awards the Contract, it will be awarded to the responsible Bidder submitting the lowest responsive Bid as determined by University and who is not rejected by University for failing or refusing, within **10** days after receipt of notice of selection, to sign the Agreement or submit to University all of the items required by the Bidding Documents.

16. Replace the existing Paragraph 6.3.5 with the following:

6.3.5 University will select the apparent lowest responsive and responsible Bidder and notify such Bidder on University's form within **50** days (unless the number of days is modified in Supplementary Instructions to Bidders) after the Bid Deadline or reject all Bids. Within **10** days after receipt of notice of selection as the apparent lowest responsive and responsible Bidder, Bidder shall submit to University all of the following items:

.1 One original of the Agreement signed by Bidder.

.2 One original of the Payment Bond required under Article 11 of the General Conditions.

.3 One original of the Performance Bond required under Article 11 of the General Conditions.

.4 Certificates of Insurance on form provided by University required under Article 11 of the General Conditions.

.5 Names of all Subcontractors, with their addresses, telephone and facsimile numbers, contact persons, portions of the Work and designation of any Subcontractor as a Small Business Enterprise (SBE), Disadvantaged Business Enterprise (DBE), Women-owned Business Enterprise (WBE) and Disabled Veteran Business Enterprise (DVBE) on the Report of Subcontractor Information form, along with a completed Self-Certification form, contained in the Exhibits. Evidence, as required by University, of the reliability and responsibility of the proposed Subcontractors such as statements of experience, statements of financial condition, and references.

.6 Preliminary Contract Schedule as required under Article 3 of the General Conditions.

.7 If Bidder wishes to utilize securities in lieu of retention beginning with the first Application for Payment, a completed Selection of Retention Options form accompanied by a completed Escrow Agreement for Deposit of Securities in Lieu of Retention and Deposit of Retention in the form contained in the Exhibits.

.8 Cost Breakdown as required by Article 9 of the General Conditions.

17. Replace the existing Paragraph 6.3.7 with the following:

6.3.7 If Bidder submits the original of the signed Agreement and all other items required to be submitted to University within **10** days after receipt of notice of selection as the apparent lowest responsive and responsible Bidder, and if all such items comply with the requirements of the Bidding Documents and are acceptable to University, University will award the Contract to Bidder by signing the Agreement and returning a signed copy of the Agreement to Bidder.

18. Replace the existing Paragraph 6.3.8 with the following:

6.3.8 If University consents to the withdrawal of the Bid of the apparent lowest responsive and responsible Bidder, or the apparent lowest responsive and responsible Bidder fails or refuses to sign the Agreement or submit to University all of the items required by the Bidding Documents, within **10** days after receipt of notice of selection, or that Bidder is not financially or otherwise qualified to perform the Contract, University may reject such Bidder's Bid and select the next apparent lowest responsible Bidder, until all Bids are exhausted, or reject all Bids. Any Bidder whose Bid is rejected because the Bidder has failed or refused, within **10** days after receipt of notice

of selection, to sign the Agreement or submit to University all of the items required by the Bidding Documents, shall be liable to the University for all resulting damages.

19. The University has negotiated contracts with certain suppliers (listed in the "Information Available to Bidders") to supply materials to University construction projects. Bidders may be able to obtain favorable pricing from the listed suppliers for materials required for this Contract. Bidders are not obligated to obtain any required materials from the listed suppliers. Use of any of the listed suppliers is at the Bidder's risk, and the University does provide any warranties, express or implied, with respect to the listed suppliers, their products and/or services. In particular, University does not warrant that the listed suppliers, their products and/or services are suitable for this Project.

20. **PREVAILING WAGE INFORMATION:** A bidder can obtain the prevailing wage information through the internet at www.dir.ca.gov or at http://www.dir.ca.gov/DLSR/PWD.

END OF SUPPLEMENTARY INSTRUCTIONS TO BIDDERS

INFORMATION AVAILABLE TO BIDDERS

The following information is made available for the convenience of bidders and is not a part of the Contract. The information is provided subject to the provisions of Article 3 of the General Conditions.

1. The University of California has contracts for materials, equipment and/or services with the suppliers listed on the Office of the President Procurement Services website at: http://www.ucop.edu/procurement-services/for-suppliers/ucop-designated-construction-agreements.html

   General Contractors or others submitting bids for University construction projects may enter into agreements with these suppliers that utilize the pricing and terms contained in the University-supplier agreements. The university does not represent or warrant that materials/equipment/services of these suppliers meet the requirements of the University's construction contracts.

   Use of such suppliers shall not relieve Contractor from its obligation to meet all contractual requirements in any contracts with the University. The university will not be a party to any agreements with such suppliers and accepts no performance obligations or liability with respect to such agreements.

END OF INFORMATION AVAILABLE TO BIDDERS

BID FORM

FOR: WEST LOTHIAN AIR HANDLER REPLACEMENT
PROJECT NUMBER: 956394
CONTRACT NUMBER: 956394-LF-2019-105
UNIVERSITY OF CALIFORNIA, RIVERSIDE
RIVERSIDE, CALIFORNIA

April 18, 2019

BID TO:

Planning, Design & Construction
UNIVERSITY OF CALIFORNIA, RIVERSIDE
1223 University Avenue, Suite 240
Riverside, CA 92507

(951) 827-2610

BID FROM: _____
(Name of Bidder)

_____
(Contact Name)

_____
(Address)

_____
(City, State, Zip Code)

_____ _____
(Telephone Number) (Facsimile Number)

_____
(E-mail)

_____
(Date Bid Submitted)

Note: All portions of this Bid Form must be completed and the Bid Form must be signed before the Bid is submitted. Failure to do so will result in the Bid being rejected as non-responsive.

BIDDER'S NAME: _____

1. 0 BIDDER'S REPRESENTATIONS

Bidder, represents that a) Bidder and all Subcontractors, regardless of tier, has the appropriate current and active Contractor's licenses required by the State of California and the Bidding Documents; b) it has carefully read and examined the Bidding Documents for the proposed Work on this Project; c) it has examined the site of the proposed Work and all Information Available to Bidders; d) it has become familiar with all the conditions related to the proposed Work, including the availability of labor, materials, and equipment; e) Bidder and all Subcontractors, regardless of tier, are currently registered with the California Department of Industrial Relations pursuant to California Labor Code Section 1725.5 and 1771.1. Bidder hereby offers to furnish all labor, materials, equipment, tools, transportation, and services necessary to complete the proposed Work on this Project in accordance with the Contract Documents for the sums quoted. Bidder further agrees that it will not withdraw its Bid within **60** days after the Bid Deadline, and that, if it is selected as the apparent lowest responsive and responsible Bidder, that it will, within 10 days after receipt of notice of selection, sign and deliver to University the Agreement in triplicate and furnish to University all items required by the Bidding Documents. If awarded the Contract, Bidder agrees to complete the proposed Work within **80** days after the date of commencement specified in the Notice to Proceed.

2.0 ADDENDA

Bidder acknowledges that it is Bidder's responsibility to ascertain whether any Addenda have been issued and if so, to obtain copies of such Addenda from University's Facility at the appropriate address stated on Page 1 of this Bid Form. Bidder therefore agrees to be bound by all Addenda that have been issued for this Bid.

3.0 NOT USED

4.0 LUMP SUM BASE BID

$ | | | , | | | | , | | | | . | | |

(Place figures in appropriate boxes.)

5.0 SELECTION OF APPARENT LOW BIDDER

Refer to the Instructions to Bidders for selection of apparent low bidder.

6.0 UNIT PRICES- NOT USED

7.0 NOT USED

8.0 ALTERNATES- NOT USED

BIDDER'S NAME: _____

9.0 LIST OF SUBCONTRACTORS

Bidder will use Subcontractors for the Work:

☐ No ☐ Yes

If "yes", provide in the spaces below (a) the name, the location of the place of business, and the California contractor license number of each subcontractor who will perform work or labor or render service to the prime contractor in or about the construction of the work or improvement, or a subcontractor licensed by the state of California who, under subcontract to the prime contractor, specially fabricates and installs a portion of the work or improvement according to detailed drawings contained in the plans and specifications, in an amount in excess of one-half of 1 percent of the prime contractor's total bid, (b) the portion of the work which will be done by each subcontractor. The prime contractor shall list only one subcontractor for each such portion as is defined by the prime contractor in its bid.

	Subcontractor			
Portion of the Work Activity (e.g. electrical, mechanical, concrete)	Name of Business	Location of Business (City)	License No.	DIR Registration No.

(Note: Add additional pages if required.)

BIDDER'S NAME: _____

10.0 Not Used

11.0 BIDDER INFORMATION

TYPE OF ORGANIZATION

_____
(Corporation, Partnership, Individual, Joint Venture, etc.)

IF A CORPORATION, THE CORPORATION IS ORGANIZED UNDER THE LAWS OF:

THE STATE OF _____ .
(State)

NAME OF PRESIDENT OF THE CORPORATION:

_____ .
(Insert Name)

NAME OF SECRETARY OF THE CORPORATION:

_____ .
(Insert Name)

IF A PARTNERSHIP, NAMES OF ALL GENERAL PARTNERS:

_____ .
(Insert Name(s))

_____

CALIFORNIA CONTRACTORS LICENSE(S):

_____ _____ _____
(Classification(s)) (License Number) (Expiration Date)

(For Joint Venture, list Joint Venture's license and licenses for all Joint Venture partners.)

BIDDER'S NAME: _____

12.0 REQUIRED COMPLETED ATTACHMENTS

The following documents are submitted with and made a condition of this Bid:

1. Bid Security in the form of _____
(Bid Bond or Certified Check)

13.0 DECLARATION

I, _____ , hereby declare that I am the
(Printed Name)

_____ of _____
(Title) (Name of Bidder)

submitting this Bid Form; that I am duly authorized to execute this Bid Form on behalf of Bidder; and that all information set forth in this Bid Form and all attachments hereto are, to the best of my knowledge, true, accurate, and complete as of its submission date.

I further declare that this bid is not made in the interest of, or on behalf of, any undisclosed person, partnership, company, association, organization, or corporation; that the bid is genuine and not collusive or sham; that the bidder has not directly or indirectly induced or solicited any other bidder to put in a false or sham bid, and has not directly or indirectly colluded, conspired, connived, or agreed with any bidder or anyone else to put in a sham bid, or that anyone shall refrain from bidding; that the bidder has not in any manner, directly or indirectly, sought by agreement, communication, or conference with anyone to fix the bid price of the bidder or any other bidder, or to fix any overhead, profit, or cost element of the bid price, or of that of any other bidder, or to secure any advantage against the public body awarding the contract of anyone interested in the proposed contract; that all statements contained in the bid are true; and, further, that the bidder has not, directly or indirectly, submitted his or her bid price or any breakdown thereof, or the contents thereof, or divulged information or data relative thereto, or paid, and will not pay, any fee to any corporation, partnership, company association, organization, bid depository, or to any member or agent thereof to effectuate a collusive or sham bid.

I declare, under penalty of perjury, that the foregoing is true and correct and that this Declaration was executed at:

_____ , in the State of _____ ,
(Name of City if within a City, otherwise Name of County) (State)

on _____ .
(Date)

_____
(Signature)

BID BOND

KNOW ALL PERSONS BY THESE PRESENTS:

That we, _____, as Principal, and _____, as Surety, are held and firmly bound unto THE REGENTS OF THE UNIVERSITY OF CALIFORNIA, hereinafter called THE REGENTS, in the sum of 10% of the Lump Sum Base Bid amount for payment of which in lawful money of the United States, well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents.

THE CONDITION OF THE ABOVE OBLIGATION IS SUCH THAT, WHEREAS, Principal has submitted a Bid for the work described as follows:

Project Name: West Lothian Air Handler Replacement
Project Number: 958394, Contract Number: 958394-LF-2019-105
Location: 900 University Avenue, Riverside, CA. 92521

NOW, THEREFORE, if Principal shall not withdraw said Bid within the time period specified after the Bid Deadline, as defined in the Bidding Documents, or within **60** days after the Bid Deadline if no time period be specified, and, if selected as the apparent lowest responsible Bidder, Principal shall, within the time period specified in the Bidding Documents, do the following:

(1) Enter into a written agreement, in the prescribed form, in accordance with the Bid.
(2) File two bonds with THE REGENTS, one to guarantee faithful performance and the other to guarantee payment for labor and materials, as required by the Bidding Documents.
(3) Furnish certificates of insurance and all other items as required by the Bidding Documents.

In the event of the withdrawal of said Bid within the time period specified, or within **60** days if no time period be specified, or the disqualification of said Bid due to failure of Principal to enter into such agreement and furnish such bonds, certificates of insurance, and all other items as required by the Bidding Documents, if Principal shall pay to THE REGENTS an amount equal to the difference, not to exceed the amount hereof, between the amount specified in said Bid and such larger amount for which THE REGENTS procure the required work covered by said Bid, if the latter be in excess of the former, then this obligation shall be null and void, otherwise to remain in full force and effect.

In the event suit is brought upon this bond by THE REGENTS, Surety shall pay reasonable attorneys' fees and costs incurred by THE REGENTS in such suit.

IN WITNESS WHEREOF, we have hereunto set our hands this _____ day of _____, 20___.

PRINCIPAL:

_____
(Name of Company)

By: _____
(Signature)

_____
(Printed Name)

_____
(Title)

SURETY:

_____
(Name of Company)

By: _____
(Signature)

_____
(Printed Name)

_____
(Title)

Address for Notices:

_____
(Street Address)

_____
(City, State & Zip Code)

NOTE: Notary acknowledgement for Surety and Surety's Power of Attorney must be attached.

AGREEMENT

This AGREEMENT is made on_____, between THE REGENTS OF THE UNIVERSITY OF CALIFORNIA ("University"),

whose Facility is:	University of California, Riverside
whose address for notices is:	UCR Planning, Design & Construction UNIVERSITY OF CALIFORNIA, RIVERSIDE 1223 University Avenue, Suite 240 Riverside, CA 92507
and Contractor:	**Name**
whose address for notices is:	Street Address City, State & Zip
for the Project:	WEST LOTHIAN AIR HANDLER RELACEMENT Project Number: 958394 University of California, Riverside County of Riverside Riverside, California 92521
University's Responsible Administrator:	Blythe R. Wilson, Architect Director of Project Management Planning, Design & Construction
University's Representative is:	John Franklin Senior Project Manager planning, Design & Construction
whose address for notices is:	UCR Planning, Design & Construction UNIVERSITY OF CALIFORNIA, RIVERSIDE 1223 University Avenue, Suite 240 Riverside, CA 92521
Contract Documents for the Work Prepared by:	Nick Ubrun GOSS ENGINEERING 320 South Main Street, Suite 102 Corona, CA. 92992 Tel: 951-834-1977

University and Contractor hereby agree as follows:

ARTICLE 1 WORK

Contractor shall provide all work required by the Contract Documents (the "Work"). Contractor agrees to do additional Work arising from changes ordered by the University pursuant to Article 7 of the General Conditions. Contractor shall (1) pay all sales, consumer and other taxes and (2) obtain and pay for any governmental licenses and permits necessary for the work, other than building and utility permits.

ARTICLE 2 CONTRACT DOCUMENTS

"Contract Documents" means the **Advertisement for Contractor Bids**, Instructions To Bidders, Supplementary Instructions to Bidders, Bid Form, this Agreement, General Conditions, Supplementary Conditions, Exhibits, Specifications, List of Drawings, Drawings, Addenda, Notice to Proceed, Change Orders, Notice of Completion, and all other documents identified in this Agreement that together form the contract between University and Contractor for the Work (the "Contract"). The Contract constitutes the complete agreement between University and Contractor and supersedes any previous agreements or understandings.

ARTICLE 3 CONTRACT SUM

Subject to the provisions of the Contract Documents University shall pay to Contractor, for the performance of the Work, **$** , the "Contract Sum".

ARTICLE 4 CONTRACT TIME

Contractor shall commence the Work on the date specified in the Notice to Proceed and fully complete the work within **80** days, the "Contract Time".

By signing this agreement, Contractor represents to University that the Contract Time is reasonable for completion of the work and that Contractor will complete the Work within the Contract Time. Time limits stated in the Contract Documents are of the essence of the Contract.

ARTICLE 5 LIQUIDATED DAMAGES

If Contractor fails to complete the Work within the Contract Time, Contractor shall pay to University, as liquidated damages and not as a penalty, the sum of **$750.00** for each day after the expiration of the Contract Time that the Work remains incomplete. After Substantial Completion, the rate for liquidated damages shall be reduced to the sum of **$500.00** per day. University and Contractor agree that if the Work is not completed within the Contract Time, University's damages would be extremely difficult or impracticable to determine and that the aforesaid amounts are reasonable estimates of and reasonable sums for such damages. University may deduct any liquidated damages due from Contractor from any amounts otherwise due to Contractor under the Contract Documents. This provision shall not limit any right or remedy of University in the event of any other default of Contractor other than failing to complete the Work within the Contract Time.

ARTICLE 6 NOT USED

ARTICLE 7 DUE AUTHORIZATION

The person or persons signing this Agreement on behalf of Contractor hereby represent and warrant to University that this Agreement is duly authorized, signed, and delivered by Contractor.

CONTRACTOR:

_____ California Contractor's License(s):
(Name of Company)

a _____ _____
(Type of Organization) (Name of Licensee)

By: _____ _____
(Signature) (Classification and License Number)

_____ _____
(Print Name) (Expiration Date)

_____ _____
(Title) (Employer Identification Number)

Recommended:
By University's Representative:

_____
(Signature & Date)

John Franklin
Senior Project Manager
Planning, Design & Construction
(Print Name & Title)

Funds Sufficient:
By Financial Administrative Officer:

_____
(Signature & Date)

Susan McFadden
Senior Financial Analyst
Planning, Design & Construction
(Print Name & Title)

UNIVERSITY:
By The Regents of the University of California:

_____
(Signature & Date)

Blythe R. Wilson, Architect
Director of Project Management
Planning, Design & Construction
(Print Name & Title)

Account No.: _____ Activity Code: _____
Fund: _____ Function: _____
Cost Center: _____ Project Code: _____

Attach notary acknowledgement for all signatures of Contractor. If signed by other than the sole proprietor, a general partner, or corporate officer, attach original notarized Power of Attorney or Corporate Resolution.

GENERAL CONDITIONS – LONG FORM
TABLE OF CONTENTS

ARTICLE 15. MISCELLANEOUS PROVISIONS

ARTICLE 1
GENERAL PROVISIONS

1.1 BASIC DEFINITIONS

1.1.1 APPLICABLE CODE REQUIREMENTS
The term "Applicable Code Requirements" means all laws, statutes, the most recent building codes, ordinances, rules, regulations, and lawful orders of all public authorities having jurisdiction over University, Contractor, any Subcontractor, the Project, the Project site, the Work, or the prosecution of the Work including without limitation the requirements set forth in Article 3.7.

1.1.2 APPLICATION FOR PAYMENT
The term “Application For Payment” means the submittal from Contractor wherein payment for certain portions of the completed Work is requested in accordance with Article 9.

1.1.3 BENEFICIAL OCCUPANCY
The term “Beneficial Occupancy” means the University's occupancy or use of any part of the Work in accordance with Article 9.

1.1.4 CERTIFICATE FOR PAYMENT
The term “Certificate For Payment” means the form signed by University's Representative attesting to the Contractor's right to receive payment for certain completed portions of the Work in accordance with Article 9.

1.1.5 CHANGE ORDER
See Article 7.2 of the General Conditions.

1.1.6 CLAIM
See Article 4.3 of the General Conditions.

1.1.7 COMPENSABLE DELAY
The term “Compensable Delay” means a delay that entitles the Contractor to an adjustment of the Contract Sum and an adjustment of the Contract Time pursuant to Articles 7 and 8 of the General Conditions.

1.1.8 CONTRACT
The term “Contract” shall have the meaning identified in Article 2 of the Agreement.

1.1.9 CONTRACT DOCUMENTS
The term “Contract Documents” means all documents listed in Article 2 of the Agreement, as modified by Change Order, including but not limited to the Drawings and Specifications.

1.1.10 CONTRACT MILESTONE
The term “Contract Milestone” means any requirement in the Contract Documents that reflects a planned point in time for the start or completion of a portion of the Work measured from i) the date of the Notice to Proceed or ii) the date of another Contract Milestone defined in the Contract Documents, as applicable.

1.1.11 CONTRACT SCHEDULE
The term “Contract Schedule” means the graphical representation of a practical plan, in accordance with the Specifications, to perform and complete the Work within the Contract Time in accordance with Article 3.

1.1.12 CONTRACT SUM
The term “Contract Sum” means the amount of compensation stated in the Agreement for the performance of the Work, as adjusted by Change Order.

1.1.13 CONTRACT TIME
The term “Contract Time” means the number of days set forth in the Agreement, as adjusted by Change Order, within which Contractor must achieve Final Completion.

1.1.14 CONTRACTOR
The term “Contractor” means the person or firm identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number.

1.1.15 CONTRACTOR FEE
See Article 7.3 of the General Conditions.

1.1.16 COST OF EXTRA WORK
See Article 7.3 of the General Conditions.

1.1.17 DAY
The term “day,” as used in the Contract Documents, shall mean calendar day, unless otherwise specifically provided.

1.1.18 DEFECTIVE WORK
The term “Defective Work” means work that is unsatisfactory, faulty, omitted, incomplete, deficient, or does not conform to the requirements of the Contract Documents, directives of University's Representative, or the requirements of any inspection, reference standard, test, or approval specified in the Contract Documents.

1.1.19 DRAWINGS
The term “Drawings” means the graphic and pictorial portions of the Contract Documents showing the design, location, and dimensions of the Work, generally including plans, elevations, sections, details, schedules, and diagrams. The Drawings are listed in the List of Drawings.

1.1.20 EXCUSABLE DELAY
The term “Excusable Delay” means a delay that entitles the Contractor to an adjustment of the Contract Time but not an adjustment of the Contract Sum, pursuant to Articles 7 and 8 of the General Conditions.

1.1.21 EXTRA WORK
The term “Extra Work” means Work beyond or in addition to the Work required by the Contract Documents.

1.1.22 FIELD ORDER
See Article 7.2 of the General Conditions.

1.1.23 FINAL COMPLETION
The term “Final Completion” means the date at which the Work has been fully completed in accordance with the requirements of the Contract Documents pursuant to Article 9.8.1 of the General Conditions.

1.1.24 GUARANTEE TO REPAIR PERIOD
See Article 12.2 of the General Conditions.

1.1.25 HAZARDOUS MATERIAL
The term “Hazardous Material” means any substance or material identified as hazardous under any California or federal statute governing handling, disposal and/or cleanup of any such substance or material.

1.1.26 PROJECT
The term “Project” means the Work of the Contract and all other work, labor, equipment, and materials necessary to accomplish the Project . The Project may include construction by University or by Separate Contractors.

1.1.27 PROJECT SITE
The term “Project Site” or “Project site” or “Site” or “site” means lands and facilities upon which the Work pertaining to physical construction operations is performed, including such access and other lands and facilities designated in the Contract Documents for use by Contractor.

1.1.28 SEPARATE CONTRACTOR
The term “Separate Contractor” means a person or firm under separate contract with University performing other work related to the Project.

1.1.29 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES
See Article 3.12 of the General Conditions.

1.1.30 SPECIFICATIONS
The term “Specifications” means that portion of the Contract Documents consisting of the written requirements

for materials, equipment, construction systems, standards and workmanship for the Work, and performance of related services.

1.1.31 SUBCONTRACTOR
The term “Subcontractor” means a person or firm that has a contract with Contractor or with a Subcontractor to perform a portion of the Work. Unless otherwise specifically provided, the term Subcontractor includes Subcontractors of all tiers.

1.1.32 SUBSTANTIAL COMPLETION
See Article 9.7 of the General Conditions.

1.1.33 SUPERINTENDENT
The term “Superintendent” means the person designated by Contractor to represent Contractor at the Project site in accordance with Article 3.

1.1.34 TIER
The term “tier” means the contractual level of a Subcontractor or supplier with respect to Contractor. For example, a first-tier Subcontractor is under subcontract with Contractor, a second-tier Subcontractor is under subcontract with a first-tier Subcontractor, and so on.

1.1.35 UNEXCUSABLE DELAY
The term “Unexcusable Delay” means a delay that does not entitle the Contractor to an adjustment of the Contract Sum and does not entitle the Contractor to an adjustment of the Contract Time.

1.1.36 UNILATERAL CHANGE ORDER.
See Article 7.2 of the General Conditions.

1.1.37 UNIVERSITY
The term “University” means The Regents of the University of California.

1.1.38 UNIVERSITY’S BUILDING OFFICIAL
The term “University’s Building Official,” or “Certified Building Official,” means the individual the University has designated to act in the capacity as the “Building Official” as defined by the California Building Standards Code. The University’s Building Official will determine whether the Work complies with Applicable Code Requirements and will determine whether and when it is appropriate to issue a Certificate of Occupancy.

1.1.39 UNIVERSITY'S REPRESENTATIVE
The term “University's Representative” means the person identified as such in the Agreement.

1.1.40 UNIVERSITY’S RESPONSIBLE ADMINISTRATOR
The term “University’s Responsible Administrator“ means the person, or his or her authorized designee, who is authorized to execute the Agreement, Change Orders, Field Orders, and other applicable Contract Documents on behalf of the University.

1.1.41 WORK
The term “Work” means all construction, services and other requirements of the Contract Documents as modified by Change Order, whether completed or partially completed, and includes all labor, materials, equipment, tools, and services provided or to be provided by Contractor to fulfill Contractor's obligations. The Work may constitute the whole or a part of the Project.

1.2 OWNERSHIP AND USE OF CONTRACT DOCUMENTS

1.2.1 The Contract Documents and all copies thereof furnished to or provided by Contractor are the property of the University and are not to be used on other work.

1.3 INTERPRETATION

1.3.1 The Contract Documents are complementary and what is required by one shall be as binding as if required by all. In the case of conflict between terms of the Contract Documents, the following order of precedence shall apply:

.1 The Agreement,
.2 The Supplementary Conditions,
.3 The General Conditions,
.4 The Specifications,
.5 The Drawings.

1.3.2 With respect to the Drawings, figured dimensions shall control over scaled measurements and specific details shall control over typical or standard details.

1.3.3 With respect to the Contract Documents, Addenda shall govern over other portions of the Contract Documents to the extent specifically noted; subsequent Addenda shall govern over prior Addenda only to the extent specifically noted.

1.3.4 Organization of the Specifications into various subdivisions and the arrangement of the Drawings shall not control Contractor in dividing the Work among Subcontractors or in establishing the extent of work to be performed by any trade.

1.3.5 Unless otherwise stated in the Contract Documents, technical words and abbreviations contained in the Contract Documents are used in accordance with commonly understood construction industry meanings; and non-technical words and abbreviations are used in accordance with their commonly understood meanings.

1.3.6 The Contract Documents may omit modifying words such as “all” and “any,” and articles such as “the” and “an,” but the fact that a modifier or an article is absent from one statement and appears in another is not intended to affect the interpretation of either statement. The use of the word “including,” when following any general statement, shall not be construed to limit such statement to specific items or matters set forth immediately following such word or to similar items or matters, whether or not nonlimiting language (such as “without limitation,” “but not limited to,” or words of similar import) is used with reference thereto, but rather shall be deemed to refer to all other items or matters that could reasonably fall within the broadest possible scope of such general statement.

1.3.7 Whenever the context so requires, the use of the singular number shall be deemed to include the plural and vice versa. Each gender shall be deemed to include any other gender, and each shall include corporation, partnership, trust, or other legal entity whenever the context so requires. The captions and headings of the various subdivisions of the Contract Documents are intended only for reference and convenience and in no way define, limit, or prescribe the scope or intent of the Contract Documents or any subdivision thereof.

ARTICLE 2
UNIVERSITY

2.1 INFORMATION AND SERVICES PROVIDED BY UNIVERSITY

2.1.1 If required for performance of the Work, as determined by University's Representative, University will make available a survey describing known physical characteristics, boundaries, easements, and utility locations for the Project site.

2.1.2 University is not subject to any requirement to obtain or pay for local building permits, inspection fees, plan checking fees, or certain utility fees. Except as otherwise provided in the Contract Documents, University will obtain and pay for any utility permits, demolition permits, easements, and government approvals for the use or occupancy of permanent structures required in connection with the Work.

2.1.3 Contractor will be furnished, free of charge, such copies of the Contract Documents as University deems reasonably necessary for execution of the Work.

2.2 ACCESS TO PROJECT SITE

2.2.1 University will provide, no later than the date designated in the Contract Schedule accepted by University's Representative, access to the lands and facilities upon which the Work is to be performed, including such access and other lands and facilities designated in the Contract Documents for use by

Contractor.

2.3 UNIVERSITY'S RIGHT TO STOP THE WORK

2.3.1 If Contractor fails to correct Defective Work as required by Article 12.2 or fails to perform the Work in accordance with the Contract Documents, University or University's Representative may direct Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated by Contractor. Contractor shall not be entitled to any adjustment of Contract Time or Contract Sum as a result of any such order. University and University's Representative have no duty or responsibility to Contractor or any other party to exercise the right to stop the Work.

2.4 UNIVERSITY'S RIGHT TO CARRY OUT THE WORK

2.4.1 If Contractor fails to carry out the Work in accordance with the Contract Documents, fails to provide sufficient labor, materials, equipment, tools, and services to maintain the Contract Schedule, or otherwise fails to comply with any material term of the Contract Documents, and, after receipt of written notice from University, fails within 2 days, excluding Saturdays, Sundays and legal holidays, or within such additional time as the University may specify, to correct such failure, University may, without prejudice to other remedies University may have, correct such failure at Contractor's expense. In such case, University will be entitled to deduct from payments then or thereafter due Contractor the cost of correcting such failure, including without limitation compensation for the additional services and expenses of University's consultants made necessary thereby. If payments then or thereafter due Contractor are not sufficient to cover such amounts, Contractor shall pay the additional amount to University.

2.5 UNIVERSITY'S RIGHT TO REPLACE UNIVERSITY'S REPRESENTATIVE

2.5.1 University may at any time and from time to time, without prior notice to or approval of Contractor, replace University's Representative with a new University's Representative. Upon receipt of notice from University informing Contractor of such replacement and identifying the new University's representative, Contractor shall recognize such person or firm as University's Representative for all purposes under the Contract Documents.

ARTICLE 3
CONTRACTOR

3.1 REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS BY CONTRACTOR

3.1.1 Contractor and its Subcontractors shall review and compare each of the Contract Documents with the others and with information furnished or made available by University, and shall promptly report in writing to University's Representative any errors, inconsistencies, or omissions in the Contract Documents or inconsistencies with Applicable Code Requirements observed by Contractor or its Subcontractors.

3.1.2 Contractor and its Subcontractors shall take field measurements, verify field conditions, and carefully compare with the Contract Documents such field measurements, conditions, and other information known to Contractor before commencing the Work. Errors, inconsistencies, or omissions discovered at any time shall be promptly reported in writing to University's Representative.

3.1.3 If Contractor and its Subcontractors performs any construction activity involving an error, inconsistency, or omission referred to in Articles 3.1.1 and 3.1.2, without giving the notice required in those Articles and obtaining the written consent of University's Representative, Contractor shall be responsible for the resultant losses, including, without limitation, the costs of correcting Defective Work.

3.2 SUPERVISION AND CONSTRUCTION PROCEDURES

3.2.1 Contractor shall supervise, coordinate, and direct the Work using Contractor's best skill and attention. Contractor shall be solely responsible for and have control over construction means, methods, techniques, sequences, procedures, and the coordination of all portions of the Work.

3.2.2 Contractor shall be responsible to University for acts and omissions of Contractor's agents, employees, and Subcontractors, and their respective agents and employees.

3.2.3 Contractor shall not be relieved of its obligation to perform the Work in accordance with the Contract Documents either by acts or omissions of University or University's Representative in the administration of the Contract, or by tests, inspections, or approvals required or performed by persons or firms other than Contractor.

3.2.4 Contractor shall be responsible for inspection of all portions of the Work, including those portions already performed under this Contract, to determine that such portions conform to the requirements of the Contract and are ready to receive subsequent Work.

3.2.5 Contractor shall at all times maintain good discipline and order among its employees and Subcontractors. Contractor shall provide competent, fully qualified personnel to perform the Work.

3.3 LABOR AND MATERIALS

3.3.1 Unless otherwise provided in the Contract, Contractor shall provide and pay for all labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for proper execution and Final Completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work.

3.4 CONTRACTOR'S WARRANTY

3.4.1 Contractor warrants to University that all materials and equipment used in or incorporated into the Work will be of good quality, new, and free of liens, claims, and security interests of third parties; that the Work will be of good quality and free from defects; and that the Work will conform with the requirements of the Contract. If required by University's Representative, Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

3.5 TAXES

3.5.1 Contractor shall pay all sales, consumer, use, and similar taxes for the Work or portions thereof provided by Contractor.

3.6 PERMITS, FEES, AND NOTICES

3.6.1 Except for the permits and approvals which are to be obtained by University or the requirements with respect to which University is not subject as provided in Article 2.1.2, Contractor shall secure and pay for all permits, approvals, government fees, licenses, and inspections necessary for the proper execution and performance of the Work. Contractor shall deliver to University all original licenses, permits, and approvals obtained by Contractor in connection with the Work prior to the final payment or upon termination of the Contract, whichever is earlier.

3.7 APPLICABLE CODE REQUIREMENTS

3.7.1 Contractor shall perform the Work in accordance with the following Applicable Code Requirements:

.1 All laws, statutes, the most recent building codes, ordinances, rules, regulations, and lawful orders of all public authorities having jurisdiction over University, Contractor, any Subcontractor, the Project, the Project site, the Work, or the prosecution of the Work.
.2 All requirements of any insurance company issuing insurance required hereunder.
.3 The Federal Occupational Safety and Health Act and all other Applicable Code Requirements relating to safety.
.4 Applicable titles in the State of California Code of Regulations.
.5 Applicable sections in the State of California Labor Code.
.6 All Applicable Code Requirements relating to nondiscrimination, payment of prevailing wages, payroll records, apprentices, and work day.

Without limiting the foregoing, Contractor shall comply with the provisions regarding nondiscrimination, payment of prevailing wages, payroll records, apprentices, and work day set forth in Article 14.

3.7.2 Contractor shall comply with and give notices required by all Applicable Code Requirements,

including all environmental laws and all notice requirements under the State of California Safe Drinking Water and Enforcement Act of 1986 (State of California Health and Safety Code Section 25249.5 and applicable sections that follow). Contractor shall promptly notify University's Representative in writing if Contractor becomes aware during the performance of the Work that the Contract Documents are at variance with Applicable Code Requirements.

3.7.3 If Contractor performs Work which it knows or should know is contrary to Applicable Code Requirements, without prior notice to University and University's Representative, Contractor shall be responsible for such Work and any resulting damages including, without limitation, the costs of correcting Defective Work.

3.8 SUPERINTENDENT

3.8.1 Contractor shall employ a competent Superintendent satisfactory to University who shall be in attendance at the Project site at all times during the performance of the Work. Superintendent shall represent Contractor and communications given to and received from Superintendent shall be binding on Contractor.

3.8.2 Contractor shall provide the Key Personnel, in addition to the Superintendent, as named in the Key Personnel Exhibit to this Contract. Substitution or replacement of any named individual requires the written approval of the University's Representative and approval will be at the sole discretion of University. Failure to maintain a Superintendent on the Project site at all times Work is in progress shall be considered a material breach of this Contract, entitling University to terminate the Contract or alternatively, issue a stop Work order until the Superintendent is on the Project site. If, by virtue of issuance of said stop Work order, Contractor fails to complete the Contract on time, Contractor will be assessed Liquidated Damages in accordance with the Agreement.

3.8.3 The Superintendent approved for the Project must be able to read, write and verbally communicate in English.

3.8.4 The Superintendent may not perform the Work of any trade, pick-up materials, or perform any Work not directly related to the supervision and coordination of the Work at the Project site when Work is in progress.

3.9 SCHEDULES REQUIRED OF CONTRACTOR

3.9.1 Contractor shall submit a Preliminary Contract Schedule to University's Representative in the form and within the time limit required by the Specifications. University's Representative will review the Preliminary Contract Schedule with Contractor within the time limit required by the Specifications, or, if no such time period is specified, within a reasonable period of time.

3.9.2 Contractor shall submit a Contract Schedule and updated Contract Schedules to University's Representative in the form and within the time limits required by the Specifications and acceptable to University's Representative. University's Representative will determine acceptability of the Contract Schedule and updated Contract Schedules within the time limits required by the Specifications, or if no such time period is specified, within a reasonable period of time. If University's Representative deems the Contract Schedule or updated Contract Schedule unacceptable, it shall specify in writing to Contractor the basis for its objection.

3.9.3 The Preliminary Contract Schedule, the Contract Schedule, and updated Contract Schedules shall represent a practical plan to complete the Work within the Contract Time. Schedules showing the Work completed in less than the Contract Time may be acceptable if judged by University's Representative to be practical. Schedules showing the Work completed beyond the Contract Time may be submitted under the following circumstances:

.1 If accompanied by a Change Order Request seeking an adjustment of the Contract Time consistent the requirements of paragraph 8.4 for Adjustment of the Contract Time for Delay.; or

.2 If the Contract Time has passed, or if it is a practical impossibility to complete the Work within the Contract Time, then the updated Contract Schedule or fragnet schedule shall show completion at the earliest practical date.

University's Representative will timely review the updated Contract Schedule or Fragnet Schedule submitted by Contractor. If University's Representative determines that additional supporting data are necessary to fully evaluate the updated Contract Schedule or Fragnet Schedule, University's Representative will request such additional supporting data in writing. Such data shall be furnished no later than 10 days after the date of such request. University's Representative will render a decision promptly and in any case within 30 days after the later of the receipt of the updated Contract Schedule or Fragnet Schedule or the deadline for furnishing such additional supporting data. Failure of University's Representative to render a decision by the applicable deadline will be deemed a decision denying approval of the updated Contract Schedule or Fragnet Schedule.
Acceptance of any schedule showing completion beyond the Contract Time by University's Representative shall not change the Contract Time and is without prejudice to any right of the University. The Contract Time, not the Contract Schedule, shall control in the determination of liquidated damages payable by Contractor under Article 4 and Article 5 of the Agreement and in the determination of any delay under Article 8 of the General Conditions.

3.9.4 If a schedule showing the Work completed in less than the Contract Time is accepted, Contractor shall not be entitled to extensions of the Contract Time for Excusable Delays or Compensable Delays or to adjustments of the Contract Sum for Compensable Delays until such delays extend the Final Completion of the Work beyond the expiration of the Contract Time.

3.9.5 Contractor shall prepare and keep current to the reasonable satisfaction of University's Representative, a Submittal Schedule in the form contained in the Exhibits, for each submittal, as required by the Specifications, and that are coordinated with the other activities in the Contract Schedule.

3.9.6 The Preliminary Contract Schedule, Contract Schedule, and the Updated Contract Schedules shall meet the following requirements:

.1 Schedules must be suitable for monitoring progress of the Work.
.2 Schedules must provide necessary data about the timing for University decisions and University furnished items.
.3 Schedules must be in sufficient detail to demonstrate adequate planning for the Work.
.4 Schedules must represent a practical plan to perform and complete the Work within the Contract Time.

3.9.7 University's Representative's review of the form and general content of the Preliminary Contract Schedule, Contract Schedule, and Updated Contract Schedules is for the purpose of determining if the above-listed requirements have been satisfied.

3.9.8 Contractor shall plan, develop, supervise, control, and coordinate the performance of the Work so that its progress and the sequence and timing of Work will permit its completion within the Contract Time, any Contract milestones and any Contract phases.

3.9.9 In preparing the Preliminary Contract Schedule, the Contract Schedule, and updated Contract Schedules, Contractor shall obtain such information and data from Subcontractors as may be required to develop a reasonable and appropriate schedule for performance of the work and shall provide such information and data to the University's Representative upon request. Contractor shall continuously obtain from Subcontractors information and data about the planning for and progress of the Work and the delivery of equipment, shall coordinate and integrate such information and data into updated Contract Schedules, as appropriate, and shall monitor the progress of the Work and the delivery of equipment.

3.9.10 Contractor shall act as the expeditor of potential and actual delays, interruptions, hindrances, or disruptions for its own forces and those forces of Subcontractors, regardless of tier.

3.9.11 Contractor shall cooperate with University's Representative in the development of the Contract Schedule and updated Contract Schedules. University's Representative's acceptance of or its review comments about any schedule or scheduling data shall not relieve Contractor from its sole responsibility to plan for, perform, and complete the Work within the Contract Time. Acceptance of or review comments about any schedule shall not transfer responsibility for any schedule to University's Representative or University nor imply their agreement with (1) any assumption upon which such schedule is based or (2) any matter underlying or contained in such schedule. Failure of University's Representative to discover errors or omissions in schedules that it has reviewed, or to inform Contractor that Contractor, Subcontractors, or others are behind schedule, or to direct or enforce procedures for complying with the Contract Schedule shall not relieve

Contractor from its sole responsibility to perform and complete the Work within the Contract Time and shall not be a cause for an adjustment of the Contract Time or the Contract Sum.

3.10 AS-BUILT DOCUMENTS

3.10.1 Contractor shall maintain one set of As-built drawings and specifications, which shall be kept up to date during the Work of the Contract. All changes which are incorporated into the Work which differ from the documents as drawn and written shall be noted on the As-built set. Notations shall reflect the actual materials, equipment and installation methods used for the Work and each revision shall be initialed and dated by Superintendent. Prior to filing of the Notice of Completion each drawing and the specification cover shall be signed by Contractor and dated attesting to the completeness of the information noted therein. As-built Documents shall be turned over to the University's Representative and shall become part of the Record Documents.

3.11 DOCUMENTS AND SAMPLES AT PROJECT SITE

3.11.1 Contractor shall maintain the following at the Project site:

.1 One as-built copy of the Contract Documents, in good order and marked to record current changes and selections made during construction.
.2 The current accepted Contract Schedule.
.3 Shop Drawings, Product Data, and Samples.
.4 All other required submittals.

These shall be available to University's Representative and shall be delivered to University's Representative for submittal to University upon the earlier of Final Completion or termination of the Contract.

3.12 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

3.12.1 Definitions:

.1 Shop Drawings are drawings, diagrams, schedules, and other data specially prepared for the Work by Contractor or a Subcontractor to illustrate some portion of the Work.
.2 Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams, and other information furnished by Contractor to illustrate or describe materials or equipment for some portion of the Work.
.3 Samples are physical examples which illustrate materials, equipment, or workmanship and establish standards by which the Work will be judged.

3.12.2 Shop Drawings, Product Data, Samples, and similar submittals are not Contract Documents. Their purpose is to demonstrate, for those portions of the Work for which submittals are required, how Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents.

3.12.3 Contractor shall review, approve, and submit to University's Representative Shop Drawings, Product Data, Samples, and similar submittals required by the Contract Documents with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of University or of Separate Contractors. Submittals made by Contractor which are not required by the Contract Documents may be returned without action by University's Representative.

3.12.4 Contractor shall perform no portion of the Work requiring submittal and review of Shop Drawings, Product Data, Samples, or similar submittals until the respective submittal has been reviewed by University's Representative and no exceptions have been taken by University's Representative. Such Work shall be in accordance with approved submittals and the Contract Documents.

3.12.5 By approving and submitting Shop Drawings, Product Data, Samples, and similar submittals, Contractor represents that it has determined or verified materials and field measurements and conditions related thereto, and that it has checked and coordinated the information contained within such submittals with the requirements of the Contract Documents and Shop Drawings for related Work.

3.12.6 If Contractor discovers any conflicts, omissions, or errors in Shop Drawings or other submittals, Contractor shall notify University's Representative and receive instruction before proceeding with the affected Work.

3.12.7 Contractor shall not be relieved of responsibility for deviations from requirements of the Contract Documents by University's Representative's review of Shop Drawings, Product Data, Samples, or similar submittals, unless Contractor has specifically informed University's Representative in writing of such deviation at the time of submittal and University's Representative has given written approval of the specific deviation. Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples, or similar submittals by University's Representative's review, acceptance, comment, or approval thereof.

3.12.8 Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data, Samples, or similar submittals, to revisions other than those requested by University's Representative on previous submittals.

3.13 USE OF SITE AND CLEAN UP

3.13.1 Contractor shall confine operations at the Project site to areas permitted by law, ordinances, permits, and the Contract Documents. Contractor shall not unreasonably encumber the Project site with materials or equipment.

3.13.2 Contractor shall, during performance of the Work, keep the Project site and surrounding area free from the accumulation of excess dirt, waste materials, and rubbish caused by Contractor. Contractor shall remove all excess dirt, waste material, and rubbish caused by the Contractor; tools; equipment; machinery; and surplus materials from the Project site and surrounding area at the completion of the Work.

3.13.3 Personnel of Contractor and Subcontractors shall not occupy, live upon, or otherwise make use of the Project site during any time that Work is not being performed at the Project site, except as otherwise provided in the Contract Documents.

3.14 CUTTING, FITTING, AND PATCHING

3.14.1 Contractor shall do all cutting, fitting, or patching of the Work required to make all parts of the Work come together properly and to allow the Work to receive or be received by work of Separate Contractors shown upon, or reasonably implied by, the Contract Documents.

3.14.2 Contractor shall not endanger the Work, the Project, or adjacent property by cutting, digging, or otherwise. Contractor shall not cut or alter the work of any Separate Contractor without the prior consent of University's Representative.

3.15 ACCESS TO WORK

3.15.1 University, University's Representative, their consultants, and other persons authorized by University will at all times have access to the Work wherever it is in preparation or progress. Contractor shall provide safe and proper facilities for such access and for inspection.

3.16 ROYALTIES AND PATENTS

3.16.1 Contractor shall pay all royalties and license fees required for the performance of the Work. Contractor shall defend suits or claims resulting from Contractor's or any Subcontractor's infringement of patent rights and shall Indemnify, defend and hold harmless University and University's Representative from losses on account thereof.

3.17 DIFFERING SITE CONDITIONS

3.17.1 If Contractor encounters any of the following conditions at the site, Contractor shall immediately notify the University's Representative in writing of the specific differing conditions before they are disturbed and before any affected Work is performed, and permit investigation of the conditions:

.1 Subsurface or latent physical conditions at the site (including Hazardous Materials) which differ materially from those indicated in this Contract, or if not indicated in this Contract, in the Information Available to Bidders; or

.2 Unknown physical conditions at the site, of an unusual nature, which differ materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract.

3.17.2 Contractor shall be entitled to an adjustment to the Contract Sum and/or Contract Time as the result of extra costs and/or delays resulting from a materially differing site condition, if and only if Contractor fulfills the following conditions:

.1 Contractor fully complies with Article 3.17.1; and

.2 Contractor fully complies with Article 4 (including the timely filing of a Change Order Request and all other requirements for Change Orders Requests and Claims).

3.17.3 Adjustments to the Contract Sum and/or Contract Time shall be subject to the procedures and limitations set forth in Articles 7 and 8.

3.18 CONCEALED, UNFORESEEN, OR UNKNOWN CONDITIONS OR EVENTS

3.18.1 Except and only to the extent provided otherwise in Articles 3.17, 7 and 8 of the General Conditions, by signing the Agreement, Contractor agrees:

.1 To bear the risk of concealed, unforeseen or unknown conditions or events, if any, which may be encountered in performing the Contract; and
.2 That Contractor's bid for the Contract was made with full knowledge of this risk.

In agreeing to bear the risk of concealed, unforeseen or unknown conditions or events, Contractor understands that, except and only to the extent provided otherwise in Articles 3.17, 7 and 8, concealed, unforeseen or unknown conditions or events shall not excuse Contractor from its obligation to achieve Final Completion of the Work within the Contract Time, and shall not entitle the Contractor to an adjustment of the Contract Sum.

3.18.2 If Contractor encounters concealed, unforeseen or unknown conditions or events that may require a change to the design shown in the Contract Documents, Contractor shall immediately notify University's Representative in writing such that University's Representative can determine if a change to the design is required. Contractor shall be liable to University for any extra costs incurred as the result of Contractor's failure to immediately give such notice.

3.18.3 If, as the result of concealed, unforeseen or unknown conditions or events, the University issues a Change Order or Field Order that changes the design from the design depicted in the Contract Documents, Contractor shall be entitled, subject to compliance with all the provisions of the Contract, including those set forth in Articles 4, 7 and 8, to an adjustment of the Contract Sum and/or Contract Time, for the cost and delay resulting from implementing the changes to the design. Except as provided in this Article 3.18.3, or as may be expressly provided otherwise in the Contract, there shall be no adjustment of the Contract Sum and/or Contract Time as a result of concealed, unforeseen or unknown conditions or events. .

3.18.4 Contractor shall, as a condition precedent to any adjustment in Contract Sum or Contract Time under Article 3.18.3, fully comply with Article 4 (including the timely filing of a Change Order Request and all other requirements for Change Orders Requests and Claims).

3.19 HAZARDOUS MATERIALS

3.19.1 The University shall not be responsible for any Hazardous Material brought to the site by the Contractor.

3.19.2 If the Contractor: (i) introduces and/or discharges a Hazardous Material onto the site in a manner not specified by the Contract Documents; and/or (ii) disturbs a Hazardous Material identified in the Contract

Documents, the Contractor shall hire a qualified remediation contractor at Contractor's sole cost to eliminate the condition as soon as possible. Under no circumstance shall the Contractor perform Work for which it is not qualified. University, in its sole discretion, may require the Contractor to retain at Contractor's cost an independent testing laboratory.

3.19.3 If the Contractor encounters a Hazardous Material which may cause foreseeable injury or damage, Contractor shall immediately: (i) secure or otherwise isolate such condition; (ii) stop all Work in connection with such material or substance (except in an emergency situation); and (iii) notify University (and promptly thereafter confirm such notice in writing)

3.19.4 Subject to Contractor's compliance with Article 3.19.3, the University shall verify the presence or absence of the Hazardous Material reported by the Contractor, except as qualified under Section 3.19.1 and 3.19.3, and, in the event such material or substance is found to be present, verify that the levels of the hazardous material are below OSHA Permissible Exposure Levels and below levels which would classify the material as a state of California or federal hazardous waste. When the material falls below such levels, Work in the affected area shall resume upon direction by the University. The Contract Time and Sum shall be extended appropriately as provided in Articles 7 and 8.

3.19.5 The University shall indemnify and hold harmless the Contractor from and against claims, damages, losses and expenses, arising from a Hazardous Material on the Project site, if such Hazardous Material: (i) was not shown on the Contract Documents or Information Available to Bidders; (ii) was not brought to the site by Contractor; and (iii) exceeded OSHA Permissible Exposure Levels or levels which would classify the material as a state of California or federal hazardous waste. The indemnity obligation in this Article shall not apply to:

.1 Claims, damages, losses or expenses arising from the breach of contract, negligence or willful misconduct of Contractor, its suppliers, its Subcontractors of all tiers and/or any persons or entities working under Contractor; and

.2 Claims, damages, losses or expenses arising from a Hazardous Material subject to Article 3.19.2.

3.19.6 In addition to the requirements in Article 3.22, Contractor shall indemnify and hold harmless the University from and against claims, damages, losses and expenses, arising from a Hazardous Material on the Project site, if such Hazardous Material exceeded OSHA Permissible Exposure Levels or levels which would classify the material as a state of California or federal hazardous waste, and was either i) shown on the Contract Documents or Information Available to Bidders; or (ii) brought to the site by Contractor. Nothing in this paragraph shall obligate the Contractor to indemnify University in the event of the sole negligence of the University, its officers, agents, or employees.

3.20 INFORMATION AVAILABLE TO BIDDERS

3.20.1 Any information provided pursuant to INFORMATION AVAILABLE TO BIDDERS is subject to the following provisions:

.1 The information is made available for the convenience of Bidders and is not a part of the Contract.
.2 The Contractor may rely on written descriptions of physical conditions included in the information to the extent such reliance is reasonable.
.3 Other components of the information, including but not limited to recommendations, may not be relied upon by Contractor. University shall not be responsible for any interpretation of or conclusion drawn from the other components of the information by the Contractor.

3.21 LIABILITY FOR AND REPAIR OF DAMAGED WORK

3.21.1 Contractor shall be liable for any and all damages and losses to the Project (whether by fire, theft, vandalism, earthquake or otherwise) prior to University's acceptance of the Project as fully completed except that Contractor shall not be liable for damages and losses to the Project caused by earthquake in excess of magnitude 3.5 on the Richter Scale, tidal wave, or flood, provided that the damages or losses were not caused in whole or in part by the negligent acts or omissions of Contractor, its officers, agents or employees (including all Subcontractors and suppliers of all tiers). As used herein, "flood" shall have the same meaning as in the builder's risk property insurance.

3.21.2 Contractor shall promptly repair and replace any Work or materials damaged or destroyed for which the Contractor is liable under Article 3.21.1.

3.22 INDEMNIFICATION

3.22.1 Contractor shall indemnify, defend and hold harmless University, University's consultants, University's Representative, University's Representative's consultants, and their respective directors, officers, agents, and employees from and against losses (including without limitation the cost of repairing defective work and remedying the consequences of defective work) arising out of, resulting from, or relating to the following:

.1 The failure of Contractor to perform its obligations under the Contract.
.2 The inaccuracy of any representation or warranty by Contractor given in accordance with or contained in the Contract Documents.
.3 Any claim of damage or loss by any Subcontractor against University arising out of any alleged act or omission of Contractor or any other Subcontractor, or anyone directly or indirectly employed by Contractor or any Subcontractor.
.4 Any claim of damage or loss resulting from Hazardous Materials introduced, discharged, or disturbed by Contractor as required per Article 3.19.6.

3.22.2 The University shall not be liable or responsible for any accidents, loss, injury (including death) or damages happening or accruing during the term of the performance of the Work herein referred to or in connection therewith, to persons and/or property, and Contractor shall fully indemnify, defend and hold harmless University and protect University from and against the same as provided in paragraph 3.22.1 above. In addition to the liability imposed by law upon the Contractor for damage or injury (including death) to persons or property by reason of the negligence of the Contractor, its officers, agents, employees or Subcontractors, which liability is not impaired or otherwise affected hereby, the Contractor shall defend, indemnify, hold harmless, release and forever discharge the University, its officers, employees, and agents from and against and waive any and all responsibility of same for every expense, liability, or payment by reason of any damage or injury (including death) to persons or property suffered or claimed to have been suffered through any negligent act, omission, or willful misconduct of the Contractor, its officers, agents, employees, or any of its Subcontractors, or anyone directly or indirectly employed by either of them or from the condition of the premises or any part of the premises while in control of the Contractor, its officers, agents, employees, or any of its Subcontractors or anyone directly or indirectly employed by either of them, arising out of the performance of the Work called for by this Contract. Contractor agrees that this indemnity and hold harmless shall apply even in the event of negligence of University, its officers, agents, or employees, regardless of whether such negligence is contributory to any claim, demand, loss, damage, injury, expense, and/or liability; but such indemnity and hold harmless shall not apply (i) in the event of the sole negligence of University, its officers, agents, or employees; or (ii) to the extent that the University shall indemnify and hold harmless the Contractor for Hazardous Materials pursuant to Article 3.19.5 .

3.22.3 In claims against any person or entity indemnified under this Article 3.22 that are made by an employee of Contractor or any Subcontractor, a person indirectly employed by Contractor or any Subcontractor, or anyone for whose acts Contractor or any Subcontractor may be liable, the indemnification obligation under this Article 3.22 shall not be limited by any limitation on amount or type of damages, compensation, or benefits payable by or for Contractor or any Subcontractor under workers' compensation acts, disability benefit acts, or other employee benefit acts.

3.22.4 The indemnification obligations under this Article 3.22 shall not be limited by any assertion or finding that the person or entity indemnified is liable by reason of a non-delegable duty.

3.22.5 Contractor shall indemnify University from and against Losses resulting from any claim of damage made by any Separate Contractor against University arising out of any alleged acts or omissions of Contractor, any Subcontractor, anyone directly or indirectly employed by either of them, or anyone for whose acts either of them may be liable.

3.22.6 Contractor shall indemnify Separate Contractors from and against Losses arising out of the negligent acts, omissions, or willful misconduct of Contractor, any Subcontractor, anyone directly or indirectly employed by either of them, or anyone for whose acts either of them may be liable.

ARTICLE 4

ADMINISTRATION OF THE CONTRACT

4.1 ADMINISTRATION OF THE CONTRACT BY UNIVERSITY'S REPRESENTATIVE

4.1.1 University's Representative will provide administration of the Contract as provided in the Contract Documents and will be the representative of University. University's Representative will have authority to act on behalf of University only to the extent provided in the Contract Documents.

4.1.2 University's Representative will have the right to visit the Project site at such intervals as deemed appropriate by the University's Representative. However, no actions taken during such Project site visit by University's Representative shall relieve Contractor of its obligations as described in the Contract Documents.

4.1.3 University's Representative will not have control over, will not be in charge of, and will not be responsible for construction means, methods, techniques, sequences, or procedures, or for safety precautions and programs in connection with the Work, since these are solely Contractor's responsibility.

4.1.4 Except as otherwise provided in the Contract Documents or when direct communications have been specifically authorized, University and Contractor shall communicate through University's Representative. Except when direct communication has been specifically authorized in writing by University Representative, communications by Contractor with University's consultants and University's Representative's consultants shall be through University's Representative. Communications by University and University's Representative with Subcontractors will be through Contractor. Communications by Contractor and Subcontractors with Separate Contractors shall be through University's Representative. Contractor shall not rely on oral or other non-written communications.

4.1.5 Based on University's Representative's Project site visits and evaluations of Contractor's Applications For Payment, University's Representative will recommend amounts, if any, due Contractor and will issue Certificates For Payment in such amounts.

4.1.6 University's Representative will have the authority to reject the Work, or any portion thereof, which does not conform to the Contract Documents. University's Representative will have the authority to stop the Work or any portion thereof. Whenever University's Representative considers it necessary or advisable for implementation of the intent of the Contract Documents, University's Representative will have the authority to require additional inspection or testing of the Work in accordance with the Contract Documents, whether or not such Work is fabricated, installed, or completed. However, no authority of University's Representative conferred by the Contract Documents nor any decision made in good faith either to exercise or not exercise such authority, will give rise to a duty or responsibility of University or University's Representative to Contractor, or any person or entity claiming under or through Contractor.

4.1.7 University's Representative will have the authority to conduct inspections as provided in the Contract Documents, to take Beneficial Occupancy and to determine the dates of Substantial Completion and Final Completion; will receive for review and approval any records, written warranties, and related documents required by the Contract Documents and assembled by Contractor; and will issue a final Certificate For Payment upon Contractor's compliance with the requirements of the Contract Documents.

4.1.8 University's Representative will be, in the first instance, the interpreter of the requirements of the Contract Documents and the judge of performance thereunder by Contractor. Should Contractor discover any conflicts, omissions, or errors in the Contract Documents; have any questions about the interpretation or clarification of the Contract Documents; question whether Work is within the scope of the Contract Documents; or question that Work required is not sufficiently detailed or explained, then, before proceeding with the Work affected, Contractor shall notify University's Representative in writing and request interpretation, clarification, or furnishing of additional detailed instructions. University's Representative's response to questions and requests for interpretations, clarifications, instructions, or decisions will be made with reasonable promptness. Should Contractor proceed with the Work affected before receipt of a response from University's Representative, any portion of the Work which is not done in accordance with University's Representative's interpretations, clarifications, instructions, or decisions shall be removed or replaced and Contractor shall be responsible for all resultant losses.

4.2 CONTRACTOR CHANGE ORDER REQUESTS

4.2.1 Contractor may request changes to the Contract Sum and/or Contract Time for Extra Work, materially differing site conditions, or Delays to Final Completion of the Work.

4.2.2 Conditions precedent to obtaining an adjustment of the Contract Sum and/or Contract Time , payment of money, or other relief with respect to the Contract Documents, for any other reason, are:

.1 Timely submission of a Change Order Request that meets the requirements of Articles 4.2.3.1 and 4.2.3.2; and

.2 If requested, timely submission of additional information requested by the University Representative pursuant to Article 4.2.3.3.

4.2.3 Change Order Request:

4.2.3.1 A Change Order Request will be deemed timely submitted if, and only if, it is submitted within 7 days of the date the Contractor discovers, or reasonably should discover the circumstances giving rise to the Change Order Request, unless additional time is allowed in writing by University's Representative for submission of the Change Order Request, provided that if :

.1 the Change Order Request includes compensation sought by a Subcontractor; AND
.2 the Contractor requests in writing to the University's Representative, within the 7-day time period, additional time to permit Contractor to conduct an appropriate review of the Subcontractor Change Order Request,

the time period for submission of the actual Change Order Request shall be extended by the number of days specified in writing by the University's Representative.

4.2.3.2 A Change Order Request must state that it is a Change Order Request, state and justify the reason for the request, and specify the amount of any requested adjustment of the Contract Sum, Contract Time, and/or other monetary relief. If the Contractor requests an adjustment to the Contract Sum or other monetary relief, the Contractor shall submit the following with the Change Order Request:

.1 a completed Cost Proposal in the form contained in the Exhibits meeting the requirements of Article 7; OR
.2 a partial Cost Proposal and a declaration of what required information is not then known to Contractor. If Contractor failed to submit a completed Cost Proposal with the Change Order Request, Contractor shall submit a completed Cost Proposal meeting the requirements of Article 7 within 7 days of the date the Contractor submitted the Change Order Request unless additional time is allowed by the University's Representative.

4.2.3.3 Upon request of University's Representative, Contractor shall submit such additional information as may be requested by University's Representative for the purpose of evaluating the Change Order Request. Such additional information may include:

.1 If Contractor seeks an adjustment of the Contract Sum or other monetary relief, actual cost records for any changed or extra costs (including without limitation, payroll records, material and rental invoices and the like), shall be submitted by the deadline established by the University's Representative, who may require such actual cost records to be submitted and reviewed, on a daily basis, by the University's Representative and/or representatives of the University's Representative.

.2 If Contractor seeks an adjustment of the Contract Time, written documentation demonstrating Contractor's entitlement to a time extension under Article 8.4, which shall be submitted within 15 days of the date requested. If requested, Contractor may submit a fragnet in support of its request for a time extension. The University may, but is not obligated to, grant a time extension on the basis of a fragnet alone which,

by its nature, is not a complete schedule analysis. If deemed appropriate by University Representative, Contractor shall submit a more detailed schedule analysis in support of its request for a time extension.

.3 If Contractor seeks an adjustment of the Contract Sum or other monetary relief for delay, written documentation demonstrating Contractor's entitlement to such an adjustment under Article 7.3.9, which shall be submitted within 15 days of the date requested.

.4 Any other information requested by the University's Representative for the purpose of evaluating the Change Order Request, which shall be submitted by the deadline established by the University's Representative.

4.2.4 University's Representative will make a decision on a Change Order Request, within a reasonable time, after receipt of a Change Order Request. In the event the Change Order Request is submitted pursuant to Article 8.4.1, the University's Representative shall promptly review and accept or reject it within thirty (30) days. A final decision is any decision on a Change Order Request which states that it is final. If University's Representative issues a final decision denying a Change Order Request in whole or in part, Contractor may contest the decision by filing a timely Claim under the procedures specified in Article 4.4.

4.2.5 Contractor may file a written demand for a final decision by University's Representative on all or part of any Change Order Request as to which the University's Representative has not previously issued a final decision pursuant to Article 4.2.4; such written demand may not be made earlier than the 30th day after submission of the Change Order Request. Within 30 days of receipt of the demand, University's Representative will issue a final decision on the Change Order Request. The University's Representative's failure to issue a decision within the 30-day period shall be treated as the issuance, on the last day of the 30-day period, of a final decision to deny the Change Order Request in its entirety.

4.3 CLAIMS

4.3.1 The term "Claim" means a written demand or assertion by Contractor seeking an adjustment or interpretation of the terms of the Contract Documents, payment of money, extension of time, or other relief with respect to the Contract Documents, including a determination of disputes or matters in question between University and Contractor arising out of or related to the Contract Documents or the performance of the Work. However, the term "Claim" shall not include, and the Claims procedures provided under this Article 4, including but not limited to arbitration, shall not apply to the following:

.1 Claims respecting penalties for forfeitures prescribed by statute or regulation which a government agency is specifically authorized to administer, settle, or determine.
.2 Claims respecting personal injury, death, reimbursement, or other compensation arising out of or resulting from liability for personal injury or death.
.3 Claims by University, except as set forth in Articles 4.5, 4.6, and 4.7.
.4 Claims respecting stop payment notices.

4.3.2 A Claim arises upon the issuance of a written final decision denying in whole or in part Contractor's Change Order Request pursuant to Articles 4.2.4 and 4.2.5.

4.3.3 A Claim must include the following:

.1 A statement that it is a Claim and a request for a decision pursuant to Article 4.5.
.2 A detailed factual narrative of events fully describing the nature and circumstances giving rise to the Claim, including but not limited to, necessary dates, locations, and items of work affected.
.3 A certification, executed by Contractor, that the claim is filed in good faith. The certification must be made on the Claim Certification form, included in the Exhibits to the Contract. The language of the Claim Certification form may not be modified.
.4 A certification, executed by each Subcontractor claiming not less than 5% of the total monetary amount sought by the claim, that the subcontractor's portion of the claim is filed in good faith. The certification must be made on the Claim Certification form, included in the Exhibits to the Contract. The language of the Claim Certification form may not be modified.

.5 A statement demonstrating that a Change Order Request was timely submitted as required by Article 4.2.3

.6 If a Cost Proposal or declaration was required by Article 4.2.3, a statement demonstrating that the Cost Proposal or the declaration was timely submitted as required by Article 4.2.3.

.7 A detailed justification for any remedy or relief sought by the Claim, including to the extent applicable, the following:

.1 If the Claim involves Extra Work, a detailed cost breakdown of the amounts claimed, including the items specified in Article 7.3.2. An estimate of the costs must be provided even if the costs claimed have not been incurred when the Claim is submitted. To the extent costs have been incurred when the Claim is submitted, the Claim must include actual cost records (including without limitation, payroll records, material and rental invoices and the like) demonstrating that costs claimed have actually been incurred. To the extent costs have not yet been incurred at the time the Claim is submitted, actual cost records must be submitted on a current basis not less than once a month during any periods costs are incurred. A cost record will be considered current if submitted within 30 days of the date the cost reflected in the record is incurred. At the request of the University's Representative, claimed extra costs may be subject to further verification procedures (such as having an inspector verify the performance of alleged Extra Work on a daily basis). The cost breakdown must include an itemization of costs for i) labor including workers' names, classifications, regular hours and overtime hours worked, dates worked, and other pertinent information; ii) materials stored or incorporated in the work including invoices, purchase orders, location of materials either stored or incorporated into the work, dates materials were transported to the project or incorporated into the work, and other pertinent information; and iii) itemization of machinery and equipment including make, model, hours of use, dates of use and equipment rental rates of any rented equipment.

.2 If the Claim involves an extension of the Contract Time, written documentation demonstrating the Contractor's entitlement to a time extension under Article 8.4, including the specific dates for which a time extension is sought and the specific reasons for entitlement of a time extension.

.3 If the Claim involves an adjustment of the Contract Sum for delay, written documentation demonstrating the Contractor's entitlement to such an adjustment under Article 7.3.9, including but not limited to, a detailed time impact analysis of the Contract Schedule. The Contract Schedule must demonstrate Contractor's entitlement to such an adjustment under Article 7.3.9.

4.4 ASSERTION OF CLAIMS

4.4.1 Claims by Contractor shall be first submitted to University's Representative for decision.

4.4.2 Notwithstanding the making of any Claim or the existence of any dispute regarding any Claim, unless otherwise directed by University's Representative, Contractor shall not cause any delay, cessation, or termination in or of Contractor's performance of the Work, but shall diligently proceed with performance of the Work in accordance with the Contract Documents.

4.4.3 Contractor shall submit a Claim in writing, together with all supporting data specified in Article4.3.3, to University's Representative as soon as possible but not later than 30 days after the date the Claim arises under Article 4.3.2, provided that after written notification to the University's Representative within such time period, the time period for submission of the Claim shall be extended by the number of days specified in writing by the University's Representative where the Claim includes compensation sought by a Subcontractor and the Contractor requests an extension of time to permit it to discharge its responsibilities to conduct an appropriate review of the Subcontractor claim.

4.4.4 Strict compliance with the requirements of Articles 4.2, 4.3 and 4.4 are conditions precedent to Contractor's right to an informal conference to meet and confer to resolve a Claim, mediate a Claim, or arbitrate or litigate a Claim. Contractor specifically agrees to assert no Claims via an informal conference, mediation, arbitration or litigation unless there has been strict compliance with Articles 4.2, 4.3, and 4.4. The failure of Contractor to strictly comply with the requirements of Articles 4.2, 4.3 and 4.4 constitutes a failure by Contractor to exhaust its administrative remedies with the University, thereby denying any court or arbitration panel of jurisdiction to adjudicate the Claim.

4.5 DECISION OF UNIVERSITY'S REPRESENTATIVE ON CLAIMS

4.5.1 University's Representative will timely review Claims submitted by Contractor. If University's Representative determines that additional supporting data are necessary to fully evaluate a Claim, University's Representative will request such additional supporting data in writing. Such data shall be furnished no later than 10 days after the date of such request. University's Representative will render a decision promptly and in any case within 30 days after the later of the receipt of the Claim or the deadline for furnishing such additional supporting data; provided that, if the amount of the Claim is in excess of $50,000, the aforesaid 30-day period shall be 45 days. Failure of University's Representative to render a decision by the applicable deadline will be deemed a decision denying the Claim on the date of the deadline, unless, upon receipt of a Claim, Contractor and University mutually agree to extend the time periods provided herein, or unless otherwise extended by law. The decision of University's Representative will be final and binding unless appealed in accordance with Articles 4.5.2, 4.6, and 4.7. The University's Representative's decision on a Claim or dispute will include a written statement both identifying all disputed and undisputed portions of the Claim and substantially including the following:

> "This is a decision under Article 4.5 of the General Conditions of your contract. If you are dissatisfied with the decision, and if you complied with the procedural requirements for asserting claims specified in Article 4 of the General Conditions of your contract, you may have the right to demand in writing an informal conference to meet and confer for settlement of any remaining issues in dispute, following which, if still dissatisfied, you may demand in writing a further resolution via nonbinding mediation, after which you have the right to arbitrate or litigate this decision. If you fail to take appropriate action within 30 days of the date of this decision, the decision shall become final and binding and not subject to further appeal."

4.5.2 If either Contractor or University disputes University's Representative's decision on a Claim, then, within 30 days after the decision of University's Representative on the Claim, or, if no decision has been issued, within 30 days from the date of the applicable deadline in Article 4.5.1 for University Representative to render a decision, such party (the "Disputing Party") must provide written notice demanding an informal conference to meet and confer. University shall schedule the conference within 30 days upon receipt of the notice demanding an informal conference. The parties will attempt in good faith to resolve any controversy or Claim arising out of or relating to this Contract by negotiation at the conference.

4.6 MEDIATION

4.6.1 Within 10 business days following the informal conference to meet and confer stated in Article 4.5.2, if the Claim or any portion of the Claim remains in dispute, the University shall provide a written statement identifying the disputed and undisputed portions of the Claim. Within 30 days of receipt of the statement, if either Contractor or University disputes any portion of the Claim, then the Disputing Party must provide written notice to the non-disputing party demanding non-binding mediation. The Contractor and the University shall share the associated costs equally and shall mutually agree to a mediator within 10 business days. If the parties cannot agree upon a mediator, each party shall select a mediator and those mediators shall select a qualified neutral third party to mediate with regard to the disputed portion of the Claim, with each party bearing the fees and costs of its respective mediator. Mediation shall include, but not be limited to, neutral evaluation, a dispute review board, or other negotiation or evaluation through an independent third party or board. The Contractor and the University may mutually agree to waive any individual mediation in writing and proceed to arbitration or litigation pursuant to this Contract.

4.7 LITIGATION AND ARBITRATION

4.7.1 Either party may provide a written notice of its election to arbitrate or provide written notice of its election to litigate the Claim within 30 days after the mediation pursuant to Article 4.6.1, or, if the parties mutually agreed in writing to waive mediation, within 30 days after the agreement is signed by both parties.

4.7.2 If a notice of election to arbitrate or litigate is not given by either party within 30 days pursuant to Article 4.7.1, University's Representative's decision on the Claim will be final and binding and not subject to appeal or challenge.

4.7.3 If the Disputing Party gives timely notice of its election to arbitrate the University's Representative's decision on a Claim, Disputing Party shall have the right, within 120 days after a Notice of Completion, or a Notice of Cessation, as applicable, is filed for the Contract, to make a demand for arbitration in accordance with Article 4.7. Failure to perfect a Claim for which a timely election to arbitrate has been made by the timely filing of a demand for arbitration and timely payment of all applicable and required fees to the American Arbitration Association ("AAA") shall result in the University's Representative's decision on said Claim becoming final and binding and not subject to appeal or challenge. If the Disputing Party makes a timely demand for arbitration, and the amount of the Claim in question, when combined with all other Claims, if any, which are the subject of previously filed demands for arbitration that have not been resolved by settlement or arbitration award, is $100,000 or more, then the other party may elect to litigate all such Claims by filing a written notice with the "AAA" within 30 days after its receipt of notice from the AAA of the Disputing Party's demand for arbitration of the Claim that raises the total amount of Claims subject to arbitration to $100,000 or more. If the other party fails to give notice of its election to litigate within such 30-day period, it shall be deemed to have consented to arbitration and waived the right to litigate. If after commencement of arbitration the amount of unresolved Claims in arbitration are allowed to be increased to $100,000 or more, through an AAA-allowed amendment or otherwise, either party may elect to litigate within 30 days following the date that the electing party first receives written notification from the AAA that total Claims in arbitration equal or exceed $100,000. If neither party gives notice of its election to litigate within such 30-day period as applicable, then both parties shall be deemed to have consented to arbitration and waived the right to litigate.

4.7.4 A demand for arbitration pursuant to Article 4.7.3 shall include a copy of the Claim presented to University's Representative pursuant to Article 4.4, a copy of the decision of University's Representative pursuant to Article 4.5, if any, a copy of the University's written statement identifying the portion of the Claim that remained in dispute following the informal conference pursuant to Article 4.6.1, and a summary of the remaining portions of the Claim in dispute. The demand shall state the amount in controversy, if any, and state the remedy sought. The demand shall identify the University's Responsible Administrator as the representative of the responding party and the Office of the General Counsel as counsel for the responding party. The demand shall be filed with the AAA and shall not be deemed to have been made until all applicable fees have been paid to the AAA by the demanding party. Copies of the demand and attachments shall be sent to University's Responsible Administrator as the representative of the responding party and the University's Office of General Counsel as attorney for the responding party, at the addresses set forth in the Project Directory, at the time the demand for arbitration is initiated with the AAA.

4.7.5 Except as modified by this Article 4.7, arbitration shall be initiated and conducted in accordance with the Construction Industry Arbitration Rules of the AAA then in effect. The following additional modifications shall be made to the aforesaid AAA rules:

.1 Civil discovery shall be permitted for the production of documents and taking of depositions. Other discovery may be permitted at the discretion of the arbitrator. All disputes regarding discovery shall be decided by the arbitrator.

.2 University's Representative and/or University's consultants, shall if required by agreement with University, upon demand by University join in and be bound by the Arbitration. University's Representative and University's consultants will have the same rights in any arbitration proceeding as are afforded by the AAA rules to Contractor and University.

.3 Contractor's sureties shall be bound by any arbitration award and may join in any arbitration proceeding.

.4 Except as provided in Articles 4.7.5.2. and 4.7.5.3 above, no Subcontractor or other person shall have a right or obligation to join in or be a party to any arbitration proceeding provided for in this Article 4 either directly, by joinder, by consolidation or actions, by counterclaim or crossclaim, or otherwise without the express written consent of University, Contractor, and the joining party.

.5 If more than one demand for arbitration is made by a party with respect to Claims referred to University's Representative, all such Claims shall be consolidated into a single arbitration unless the parties otherwise agree in writing.

.6 If total Claims are less than $50,000, the AAA expedited procedures as modified by this Article 4 shall apply. If total Claims are between $50,000 and $100,000 they shall be heard by a single arbitrator who shall be an attorney. If total Claims are in excess of $100,000 and are submitted to arbitration, either by agreement or by failure to elect litigation the controversy shall be heard by a panel of three arbitrators, one of which shall be an attorney.

.7 No arbitrator shall be appointed and no discovery may be commenced prior to the date of Final Completion unless University and Contractor otherwise agree.

.8 The exclusive forum for determining arbitrability shall be the Superior Court of the State of California. The AAA shall not submit to any arbitrator any matter concerning the arbitrability of the dispute if the arbitrability is contested.

9 If the expedited procedures of the AAA are applicable, the AAA shall submit simultaneously to each party an identical list of 7 proposed arbitrators drawn from the National Panel of Commercial Arbitrators, and each party may strike 3 names from the list on a peremptory basis and return the list to the AAA within 10 days from the date of receipt.

.10 Except as provided herein, the arbitration shall be conducted and enforced under California law, including the California Arbitration Act (California Code of Civil Procedure section 1280 and following). The Federal Arbitration Act shall not apply to the arbitration.

4.7.6 Unless University and Contractor otherwise agree in writing, the arbitration decision shall be binding upon the parties, made under and in accordance with the laws of the State of California, supported by substantial evidence, and in writing. If the total of all Claims or cross Claims submitted to arbitration is in excess of $50,000, the award shall contain the basis for the decision, findings of fact, and conclusions of law. Any arbitration award shall be subject to confirmation, vacation, or correction under the procedures and on the grounds specified in the California Code of Civil Procedure including without limitation Section 1296. The expenses and fees of the arbitrators and the administrative fees of the AAA shall be divided among the parties equally. Each party shall pay its own counsel fees, witness fees, and other expenses incurred for its own benefit.

4.7.7 University may, but is not required, to assert as a counterclaim any matter arising out of the claims asserted by Contractor in the arbitration. University's failure to assert any such counterclaim in an arbitration shall be without prejudice to the University's right to assert the counterclaim in litigation or other proceeding.

4.7.8 Any litigation shall be filed in the Superior Court of the State of California for the County in which the contract was to be performed.

4.8 WAIVER

4.8.1 A waiver of or failure by University or University's Representative to enforce any requirement in this Article 4 in connection with any Claim shall not constitute a waiver of, and shall not preclude the University or University's Representative from enforcing such requirements in connection with any other Claims.

4.8.2 The Contractor agrees and understands that no oral approval, either express or implied, of any Claim shall be binding upon University unless and until such approval is ratified by execution of a written Change Order.

ARTICLE 5
SUBCONTRACTORS

5.1 AWARD OF SUBCONTRACTS AND OTHER CONTRACTS FOR PORTIONS OF THE WORK

5.1.1 Unless otherwise stated in the Contract Documents, Contractor shall submit in writing, prior to entering into subcontract agreements, the names and addresses of all Subcontractors proposed for the Work that were not previously listed in Contractor's Bid.

5.1.2 Any Subcontractor may be disqualified if University or University's Representative determines that such Subcontractor fails to meet the requirements of the Contract Documents or for any other reason.

5.1.3 In accordance with the Subletting and Subcontracting Fair Practices Act, nothing herein shall be deemed to entitle Contractor, without the approval of University, to substitute other subcontractors for those named in Contractor's List of Subcontractors and List of Changes in Subcontractors Due to Alternates contained in the completed Bid Form; and, except with such approval, no such substitution shall be made.

5.1.4 Except as hereinafter provided, any increase in the cost of the Work resulting from the replacement or substitution of a Subcontractor, as required by University or University's Representative pursuant to Article 5.1.1 shall be borne solely by Contractor and Contractor shall not be entitled to any increase in Contract Sum or extension of Contract Time on account of such replacement or substitution.

5.2 SUBCONTRACTUAL RELATIONS

5.2.1 Any part of the Work performed for Contractor by a first-tier Subcontractor shall be pursuant to a written subcontract. Each such subcontract shall require the Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to Contractor by the terms of the Contract Documents, to assume toward Contractor all the obligations and responsibilities which Contractor assumes towards University by the Contract Documents, and to perform such portion of the Work in accordance with the Contract Documents. Each such subcontract shall preserve and protect the rights of University under the Contract Documents, with respect to the Work to be performed by Subcontractor, so that subcontracting thereof will not prejudice such rights. Contractor shall cause each such subcontract to expressly include the following requirements:

.1 Subcontractor waives all rights that Subcontractor may have against University for damages caused by fire or other perils covered by builder's risk property insurance carried by Contractor or University, except for such rights Subcontractor may have to the proceeds of such insurance held by University under Article 11.

.2 University and entities and agencies designated by University will have access to and the right to audit and the right to copy at University's cost all of Subcontractor's books, records, contracts, correspondence, instructions, drawings, receipts, vouchers, purchase orders, and memoranda relating to the Work. Subcontractor shall preserve all such records and other items for a period of at least 3 years after Final Completion.

.3 Subcontractor recognizes the rights of University under Article 5.3, Contingent Assignment of Subcontracts, and agrees, upon notice from University that University has elected to accept said assignment and to retain Subcontractor pursuant to the terms of the subcontract, to complete the unperformed obligations under the subcontract and, if requested by University, to execute a written agreement confirming that Subcontractor is bound to University under the terms of the subcontract.

5.2.2 Upon the request of University, Contractor shall promptly furnish to University a true, complete, and executed copy of any subcontract.

5.2.3 Nothing contained in the Contract Documents shall create any contractual relationship between any Subcontractor and University, except when, and only to the extent that, University elects to accept the assignment of the subcontract with such Subcontractor pursuant to Article 5.3, Contingent Assignment of Subcontracts.

5.3 CONTINGENT ASSIGNMENT OF SUBCONTRACTS

5.3.1 Contractor hereby assigns to University all its interest in first-tier subcontracts now or hereafter entered into by Contractor for performance of any part of the Work. The assignment will be effective upon acceptance by University in writing and only as to those subcontracts which University designates in writing. University may accept said assignment at any time during the course of the Work and prior to Final Completion in the event of a suspension or termination of Contractor's rights under the Contract Documents. Such assignment is part of the consideration to University for entering into the Contract with Contractor and may not be withdrawn prior to Final Completion.

ARTICLE 6
CONSTRUCTION BY UNIVERSITY OR BY SEPARATE CONTRACTORS

6.1 UNIVERSITY'S RIGHT TO PERFORM CONSTRUCTION AND TO AWARD SEPARATE CONTRACTS

6.1.1 University reserves the right to award separate contracts for, or to perform with its own forces, construction or operations related to the Work or other construction or operations at or affecting the Project site, including portions of the Work which have been deleted by Change Order. Contractor shall cooperate with University's forces and Separate Contractors.

6.1.2 University will provide coordination of the activities of University's forces and of each Separate Contractor with the Work of Contractor. Contractor shall participate with University and Separate Contractors in joint review of construction schedules and Project requirements when directed to do so. Contractor shall make necessary revisions to the Contract Schedule after such joint review.

6.2 MUTUAL RESPONSIBILITY

6.2.1 Contractor shall afford University and Separate Contractors reasonable opportunity for introduction and storage of their materials and equipment and performance of their activities. Contractor shall connect, schedule, and coordinate its construction and operations with the construction and operations of University and Separate Contractors as required by the Contract Documents.

6.2.2 If a portion of the Work is dependent upon the proper execution or results of other construction or operations by University or Separate Contractors, Contractor shall inspect such other construction or operations before proceeding with that portion of the Work. Contractor shall promptly report to University's Representative apparent discrepancies or defects which render the other construction or operations unsuitable to receive the Work. Unless otherwise directed by University's Representative, Contractor shall not proceed with the portion of the Work affected until apparent discrepancies or defects have been corrected. Failure of Contractor to so report within a reasonable time after discovering such discrepancies or defects shall constitute an acknowledgment that the other construction or operations by University or Separate Contractors is suitable to receive the Work, except as to defects not then reasonably discoverable.

6.3 UNIVERSITY'S RIGHT TO CLEAN UP

6.3.1 If a dispute arises between Contractor and Separate Contractors as to the responsibility under their respective contracts for maintaining the Project site and surrounding areas free from waste materials and rubbish, University may clean up and allocate the cost between those firms it deems to be responsible.

ARTICLE 7
CHANGES IN THE WORK

7.1 CHANGES

7.1.1 University may, from time to time, order or authorize additions, deletions, and other changes in the Work by Change Order or Field Order without invalidating the Contract and without notice to sureties. Absence of such notice shall not relieve such sureties of any of their obligations to University.

7.1.2 Contractor may request a Change Order under the procedures specified in Article 4.2.

7.1.3 A Field Order may be issued by University, does not require the agreement of Contractor, and shall be valid with or without the signature of Contractor.

7.1.4 Contractor shall proceed promptly with any changes in the Work, unless otherwise provided in the relevant Change Order or Field Order.

7.2 DEFINITIONS

7.2.1 A Change Order is a Contract Document (as shown in the Exhibits) which has been signed by both University and Contractor, and states their agreement, as applicable, to the following:

.1 A change in the Work, if any.
.2 The amount of an adjustment of the Contract Sum, if any.
.3 The amount of an adjustment of the Contract Time, if any.

.4 A modification to any other Contract term or condition.

7.2.2 A Unilateral Change Order may be issued by University, without the Contractor' signature, where the University determines that a change in the Work requires an adjustment of the Contract Sum or Contract Time, even though no agreement has been reached between University and Contractor with regard to such change in the Work.

7.2.3 A Field Order (as shown in the Exhibits) is a Contract Document issued by the University that orders the Contractor to perform Work. A Field Order may, but need not, constitute a change in the Work and may, but need not, entitle Contractor to an adjustment of the Contract Sum or Contract Time.

7.3 CHANGE ORDER PROCEDURES

7.3.1 Contractor shall provide a Change Order Request and Cost Proposal pursuant to Article 4.2 and this Article 7.3 of the General Conditions. Adjustments of the Contract Sum resulting from Extra Work and Deductive Work shall be determined using one of the methods described in this Article 7.3. Adjustments of the Contract Time shall be subject to the provisions in Article 8. Contractor's obligation to provide Cost Proposals shall be subject to the following:

.1 The obligation of Contractor to provide Cost Proposals is not Extra Work, and shall not entitle the Contractor to an adjustment of the Contract Sum or Contract Time.

.2 The failure of Contractor to timely provide a Cost Proposal pursuant to Article 4.2 and this Article 7.3.1 is a material breach of the Contract. Contractor shall be responsible for any delay in implementing a change for which Contractor failed to timely provide a Cost Proposal consistent with the requirements of Article 4.2 and this Article 7.3.1.

7.3.2 The term "Cost of Extra Work" as used in this Article 7.3 shall mean actual costs incurred or to be incurred by Contractor and each Subcontractor regardless of tier involved, to the extent not otherwise disallowed under Article 7.3.3, and shall be limited to the following (to the extent the Contractor demonstrates that the costs are both reasonable and actually incurred, if such costs have been incurred):

.1 Straight-time wages or salaries for employees employed at the Project site, or at fabrication sites off the Project site, incurred as a result of the performance of the Extra Work.2 Fringe Benefits and Payroll Taxes for employees employed at the Project site, or at fabrication sites off the Project site, incurred as a result of the performance of the Extra Work.

.3 Overtime wages or salaries, specifically authorized in writing by University's Representative, for employees employed at the Project site, or at fabrication sites off the Project site, incurred as a result of the performance of the Extra Work.

.4 Fringe Benefits and Payroll Taxes for overtime Work specifically authorized in writing by University's Representative, for employees employed at the Project site, or at fabrication sites off the Project site, incurred as a result of the performance of the Extra Work.

.5 Costs of materials and consumable items which are furnished and incorporated into the Extra Work, as approved by University's Representative. Such costs shall be charged at the lowest price available to the Contractor but in no event shall such costs exceed competitive costs obtainable from other subcontractors, suppliers, manufacturers, and distributors in the area of the Project site. All discounts, rebates, and refunds and all returns from sale of surplus materials and consumable items shall accrue to University and Contractor shall make provisions so that they may be obtained.

.6 Sales taxes on the costs of materials and consumable items which are incorporated into and used in the performance of the Extra Work pursuant to Article 7.3.2.5 above.

.7 Rental charges for necessary machinery and equipment, whether owned or hired, as authorized in writing by University's Representative, exclusive of hand tools, used directly in the performance of the Extra Work. Such rental charges shall not exceed the current Equipment Rental Rates published by the California Department of Transportation for the area in which the work is performed. Such rental rates are found at *http://www.dot.ca.gov/hq/construc/equipmnt.html* . Contractor shall attach a copy of said schedule to the Cost Proposal. The charges for any machinery and equipment shall cease when the use thereof is no longer

necessary for the Extra Work.

.8 Additional costs of royalties and permits due to the performance of the Extra Work.

.9 The cost for Insurance and Bonds shall not exceed 2% of items .1 through .8 above.

University and Contractor may agree upon rates to be charged for any of the items listed in this Article 7.3.2. Such agreed upon rates shall be subject to audit pursuant to Article 15.7. Contractor shall promptly refund to University any amounts (including associated mark-ups) in excess of the actual costs of such items.

7.3.3 Cost of Extra Work shall not include any of the following:

.1 Supervision
.2 Superintendent(s).
.3 Assistant Superintendent(s).
.4 Project Engineer(s).
.5 Project Manager(s).
.6 Scheduler(s).
.7 Estimator(s).
.8 Small tools (Replacement value does not exceed $300).
.9 Office expenses including staff, materials and supplies.
.10 On-site or off-site trailer and storage rental and expenses.
.11 Site fencing.
.12 Utilities including gas, electric, sewer, water, telephone, facsimile, copier equipment.
.13 Data processing personnel and equipment.
.14 Federal, state, or local business income and franchise taxes.
.15 Overhead and Profit.
.16 Costs and expenses of any kind or item not specifically and expressly included in Article 7.3.2.

7.3.4 The term “Contractor Fee” shall mean the full amount of compensation, both direct and indirect (including without limitation all overhead and profit), to be paid to Contractor for its own Work and the Work of all Subcontractors, for all costs and expenses not included in the Cost of Extra Work, whether or not such costs and expenses are specifically referred to in Article 7.3.3. The Contractor Fee shall not be compounded.

The Contractor Fee shall be computed as follows:

.1 Fifteen percent (15%) of the cost of that portion of the Extra Work to be performed by the prime contractor with its own forces.
.2 Fifteen percent (15%) of the cost of that portion of the Work to be performed by a Subcontractor with its own forces, plus 5% for the prime contractor. Total combined Contractor and Subcontractor fee shall not exceed 20%.
.3 Fifteen percent (15%) of the cost of that portion of the Work to be performed by a sub-subcontractor with its own forces, or any lower tier of Subcontractor, plus 5% for the Subcontractor, plus 5% for the prime contractor. Total combined Contractor, Subcontractor and all sub-subcontractor fee shall not exceed 25%.

7.3.5 Compensation for Extra Work shall be computed on the basis of one or more of the following:

.1 Where the Work involved is covered by Unit Prices contained in the Contract Documents, by application of the Unit Prices to the quantities of the items involved.
.2 Where Unit Prices are not applicable, a mutually agreed upon lump sum supported by a Cost Proposal pursuant to 7.3.1.
.3 Where Contractor and University cannot agree upon a lump sum, by Cost of Extra Work plus Contractor Fee applicable to such Extra Work.

7.3.6 As a condition to Contractor's right to an adjustment of the Contract Sum pursuant to Article 7.3.5.3, Contractor must keep daily detailed and accurate records itemizing each element of cost and shall provide

substantiating records and documentation, including time cards and invoices. Such records and documentation shall be submitted to University's Representative on a daily basis.

7.3.7 For Work to be deleted by Change Order, the reduction of the Contract Sum shall be computed on the basis of one or more of the following:

.1 Unit Prices stated in the Contract Documents.
.2 Where Unit Prices are not applicable, a lump sum agreed upon by University and Contractor, based upon the actual costs which would have been incurred in performing the deleted portions of the Work as calculated in accordance with Articles 7.3.2 and 7.3.3, supported by a Cost Proposal pursuant to Article 7.3.1.

7.3.8 If any one Change involves both Extra Work and Deleted Work in the same portion of the Work, a Contractor fee will not be allowed if the deductive cost exceeds the additive cost. If the additive cost exceeds the deductive cost, a Contractor Fee will be allowed only on the difference between the two amounts.

7.3.9 The Contract Sum will be adjusted for a delay if, and only if, Contractor demonstrates that all of the following three conditions are met:

.1 Condition Number One: The delay results in an extension of the Contract Time pursuant to Article 8.4.1.

.2 Condition Number Two: The delay is caused solely by one or more of the following:

.1 An error or omission in the Contract Documents; or
.2 The University's decision to change the scope of the Work, where such decision is not the result of any default or misconduct of the Contractor; or
.3 The University's decision to suspend the Work, where such decision is not the result of any default or misconduct of the Contractor; or
.4 The failure of the University (including the University acting through its consultants, Design Professionals, Separate Contractors or the University's Representative) to perform any Contract obligation where the failure to so perform is not the result of any default or misconduct of the Contractor.
.5 A materially differing site condition pursuant to Article 3.17.

.3 Condition Number Three: The delay is not concurrent with a delay caused by an event other than those listed in Article 7.3.9.2.

7.3.10 For each day of delay that meets all three conditions prescribed in Article 7.3.9 the Contract Sum will be adjusted by the daily rate included in the Agreement and specifically identified as the rate to be paid to Contractor for Compensable Delays. Pursuant to Article 9.7.4, said daily rate shall not apply to delays occurring after Substantial Completion.

7.3.11 Except as provided in Articles 7 and 8, Contractor shall have no claim for damage or compensation for any delay, interruption, hindrance, or disruption.

7.3.12 If for any reason one or more of the conditions prescribed in Article 7.3.9 is held legally unenforceable, the remaining conditions must be met as a condition to obtaining an adjustment of the Contract Time under Article 7.3.10.

7.4 FIELD ORDERS

7.4.1 Field Orders issued by the University Representative shall be subject to the following:

.1 A Field Order may state that it does or does not constitute a change in the Work.

.2 If the Field Order states that it does not constitute a change in the Work and the Contractor asserts that the Field Order constitutes a change in the Work, in order to obtain

an adjustment of the Contract Sum or Contract Time for the Work encompassed by the Field Order, Contractor must follow all procedures set forth in Article 4, starting with the requirement of submitting a timely Change Order Request within 7 days of Contractor's receipt of the Field Order; failure to strictly follow those procedures is a bar to any Claim for an adjustment of the Contract Sum or Contract Time arising from performance of the Work described in the Field Order.

.3 If the Field Order states that it does constitute a change in the Work, the Work described in the Field Order shall be considered Extra Work and the Contractor shall be entitled to an adjustment of the Contract Sum and Contract Time, calculated under and subject to Contractor's compliance with the procedures for verifying and substantiating costs and delays in Articles 7 and 8.

.4 In addition, if the Field Order states that it does constitute a change in the Work, the Field Order may or may not contain University's estimate of adjustment of Contract Sum and/or Contract Time. If the Field Order contains an estimate of adjustment of Contract Sum or Contract Time, the Field Order is subject to the following:

.1 The Contractor shall not exceed the University's estimate of adjustment to Contract Sum or Contract Time without prior written notification to the University's Representative.

.2 If the Contractor asserts that the change in the Work encompassed by the Field Order may entitle Contractor to an adjustment of Contract Sum or Contract Time in excess of the University's estimate, in order not to be bound by University's estimate Contractor must follow all procedures set forth in Article 4, starting with the requirement of submitting a timely Change Order Request within 7 days of Contractor's receipt of the Field Order; failure to strictly follow those procedures is a bar to any Claim for an adjustment of the Contract Sum or Contract Time, in excess of the University's estimate, arising from performance of the Work described in the Field Order.

7.4.2 Upon receipt of a Field Order, Contractor shall promptly proceed to perform the Work as ordered in the Field Order notwithstanding any disagreement by the Contractor concerning whether the Work is extra.

7.5 VARIATION IN QUANTITY OF UNIT PRICE WORK

7.5.1 University has the right to increase or decrease the quantity of any Unit price item for which an Estimated Quantity is stated in the Bid Form.

7.6 WAIVER

7.6.1 A waiver of or failure by University or University's Representative to enforce any requirement in this Article 7, including without limitation the requirements in Articles 7.3.6, 7.3.8, 7.3.9, 7.3.10, 7.3.11, or 7.3.12 in connection with any adjustment of the Contract Sum, will not constitute a waiver of, and will not preclude the University or University's Representative from enforcing, such requirements in connection with any other adjustments of the Contract Sum.

7.6.2 The Contractor agrees and understands that no oral approval, either express or implied, of any adjustment of the Contract Sum by University or its agents shall be binding upon University unless and until such approval is ratified by execution of a written Change Order.

ARTICLE 8
CONTRACT TIME

8.1 COMMENCEMENT OF THE WORK

8.1.1 The date of commencement of the Work shall be set forth in the Notice To Proceed. The date of commencement of the Work shall not be postponed by the failure of Contractor, Subcontractors, or of persons or firms for whom Contractor is responsible, to act.

8.2 PROGRESS AND COMPLETION

8.2.1 By signing the Agreement:

.1 Contractor represents to University that the Contract Time is reasonable for performing the Work and that Contractor is able to perform the Work within the Contract Time.

.2 Contractor agrees that University is purchasing the right to have the Contractor present on the Project site for the full duration of the Contract Time, even if Contractor could finish the Contract in less than the Contract Time.

8.2.2 Contractor shall not, except by agreement or instruction of University in writing, commence operations on the Project site or elsewhere prior to the effective date of insurance required by Article 11 to be furnished by Contractor. The dates of commencement and Final Completion of the Work shall not be changed by the effective date of such insurance.

8.2.3 Contractor shall proceed expeditiously with adequate forces and shall achieve full completion of the Work within the Contract Time. If University's Representative determines and notifies Contractor that Contractor's progress is such that Contractor will not achieve full completion of the Work within the Contract Time, Contractor shall immediately and at no additional cost to University, take all measures necessary, including working such overtime, additional shifts, Sundays, or holidays as may be required to ensure that the Work is fully completed within the Contract Time. Upon receipt of such notice from University's representative, Contractor shall immediately notify University's Representative of all measures to be taken to ensure full completion of the Work within the Contract Time. Contractor shall reimburse University for any extra costs or expenses (including the reasonable value of any services provided by University's employees) incurred by University as the result of such measures.

8.3 DELAY

8.3.1 Except and only to the extent provided otherwise in Articles 7 and 8, by signing the Agreement, Contractor agrees:

.1 to bear the risk of delays to the Work; and

.2 that Contractor's bid for the Contract was made with full knowledge of this risk.

In agreeing to bear the risk of delays to the Work, Contractor understands that, except and only to the extent provided otherwise in Articles 7 and 8, the occurrence of events that delay the Work shall not excuse Contractor from its obligation to achieve Final Completion of the Work within the Contract Time, and shall not entitle the Contractor to an adjustment of the Contract Sum.

8.4 ADJUSTMENT OF THE CONTRACT TIME FOR DELAY

8.4.1 Subject to Article 8.4.2, the Contract Time will be extended for each day of delay for which Contractor demonstrates that all of the following four conditions have been met; a time extension will not be granted for any day of delay for which Contractor fails to demonstrate compliance with the four conditions:

.1 Condition Number One: The delay is critical. A delay is critical if and only to the extent it delays a work activity that cannot be delayed without delaying Final Completion of the Work beyond the Contract Time. Under this Article 8.4.1.2, if the Contract Schedule shows Final Completion of the Work before expiration of the Contract Time, a delay is critical if and only to the extent the delay pushes Final Completion of the Work to a date that is beyond the Contract Time.

.2 Condition Number Two: Within 7 days of the date the Contractor discovers or reasonably should discover an act, error, omission or unforeseen condition or event causing the delay is likely to have an impact on the critical path of the Project, (even if the Contractor has not yet been delayed when the Contractor discovers or reasonably should discover the critical path impact of the act, error, omission or unforeseen condition giving rise to the delay) the Contractor submits both a timely and complete Change Order Request that meets the requirements of Article 4.2.

.3 Condition Number Three: The delay is not caused by:

.1 A concealed, unforeseen or unknown condition or event except for a materially differing site condition pursuant to Article 3.17;or

.2 The financial inability, misconduct or default of the Contractor, a Subcontractor or supplier; or

.3 The unavailability of materials or parts.

.4 Condition Number Four: The delay is caused by:

.1 Fire; or

.2 Strikes, boycotts, or like obstructive actions by labor organizations; or

.3 Acts of God (As used herein, “Acts of God” shall include only earthquakes in excess of a magnitude of 3.5 on the Richter Scale and tidal waves); or

.4 A materially differing site condition pursuant to Article 3.17; or

.5 An error or omission in the Contract; or

.6 The University's decision to change the scope of the Work, where such decision is not the result of any default or misconduct of the Contractor; or

.7 The University's decision to suspend the Work, where such decision is not the result of any default or misconduct of the Contractor; or

.8 The failure of the University (including the University acting through its consultants, Design Professionals, Separate Contractors or the University's representative) to perform any Contract obligation unless such failure is due to Contractor's default or misconduct.

.9 “Adverse weather,“ but only for such days of adverse weather, or on-site conditions caused by adverse weather, that are in excess of the number of days specified in the Supplementary Conditions. In order for a day to be considered a day of adverse weather for the purpose of determining whether Contractor is entitled to an adjustment in Contract Time, both of the following conditions must be met:

.1 the day must be a day in which, as a result of adverse weather, less than one half day of critical path work is performed by Contractor; and

.2 the day must be identified in the Contract Schedule as a scheduled work day.

8.4.2 If and only if a delay meets all four conditions prescribed in Article 8.4.1, then a time extension will be granted for each day that Final Completion of the Work is delayed beyond the Contract Time, subject to the following:

.1 When two or more delays (each of which meet all four conditions prescribed in Article 8.4.1) occur concurrently on the same day, and each such concurrent delay by itself without consideration of the other delays would be critical, then all such concurrent delays shall be considered critical. For the purpose of determining whether and to what extent the Contract Time should be adjusted pursuant to Article 8.4.2, such concurrent critical delays shall be treated as a single delay for each such day.

.2 Contractor shall be entitled to a time extension for a day of delay that meets all four requirements of Article 8.4.1 if the delay is concurrent with a delay that does not meet all four conditions of Article 8.4.1.

8.4.3 If for any reason one or more of the four conditions prescribed in Article 8.4.1 is held legally unenforceable, then all remaining conditions must be met as a condition to obtaining an extension of the Contract Time under Article 8.4.2.

8.5 COMPENSATION FOR DELAY

8.5.1 To the maximum extent allowed by law, any adjustment of the Contract Sum as the result of delays shall be limited to the amounts specified in Article 7. Such adjustment shall, to the maximum extent allowed by law, constitute payment in full for all delay related costs (including costs for disruption, interruption and hindrance, general conditions, on and off-site overhead and profit) of Contractor, its Suppliers and Subcontractors of all tiers and all persons and entities working under or claiming through Contractor in connection with the Project.

8.5.2 By signing the Agreement, the parties agree that the University is buying the right to do any or all of the following, which are reasonable and within the contemplation of the parties:

.1 To order changes in the Work, regardless of the extent and number of changes, including without limitation:

.1 Changes to correct errors or omissions, if any, in the Contract Documents.
.2 Changes resulting from the University's decision to change the scope of the Work subsequent to execution of the Contract.
.3 Changes due to unforeseen conditions.

.2 To suspend the Work or any part thereof.

.3 To delay the Work, including without limitation, delays resulting from the failure of the University or the University's Representative to timely perform any Contract obligation and delays for University's convenience.

8.6 WAIVER

8.6.1 A waiver of or failure by University or University's Representative to enforce any requirement in this Article 8, including without limitation the requirements in Article 8.4, in connection with any or all past delays shall not constitute a waiver of, and shall not preclude the University or University's Representative from enforcing, such requirements in connection with any present or future delays.

8.6.2 Contractor agrees and understands that no oral approval, either express or implied, of any time extension by University or its agents shall be binding upon University unless and until such approval is ratified by execution of a written Change Order.

ARTICLE 9
PAYMENTS AND COMPLETION

9.1 COST BREAKDOWN

9.1.1 Within 10 days after receipt of the Notice of Selection as the apparent lowest responsible Bidder, and with the Agreement, Contractor shall submit to University's Representative a Cost Breakdown of the Contract Sum in the form contained in the Exhibits. The Cost Breakdown shall itemize as separate line items the cost of each Work Activity and all associated costs, including but not limited to warranties, as-built documents, overhead expenses, and the total allowance for profit. Insurance and bonds shall each be listed as separate line items. The total of all line items shall equal the Contract Sum. The Cost Breakdown, when approved by the University's Representative, shall become the basis for determining the cost of Work performed for Contractor's Applications for Payment.

9.2 PROGRESS PAYMENT

9.2.1 University agrees to pay monthly to Contractor, subject to Article 9.4.3, an amount equal to 95% of the sum of the following:

.1 Cost of the Work in permanent place as of the date of the Contractor’s Application For Payment.
.2 Plus cost of materials not yet incorporated in the Work, subject to Article 9.3.5.

.3 Less amounts previously paid.

Under this Article 9.2.1, University may, but is not required, to pay Contractor more frequently than monthly.

9.2.2 After Substantial Completion and subject to Article 9.4.3, University will make any of the remaining progress payments in full.

9.3 APPLICATION FOR PAYMENT

9.3.1 On or before the 10th day of the month or such other date as is established by the Contract Documents, Contractor shall submit to University's Representative an itemized Application For Payment, for the cost of the Work in permanent place, as approved by University's Representative, which has been completed in accordance with the Contract Documents, less amounts previously paid.

The Application For Payment shall be prepared as follows:

.1 Use the form contained in the Exhibits.
.2 Itemize in accordance with the Cost Breakdown.
.3 Include such data substantiating Contractor's right to payment as University's Representative may reasonably require, such as invoices, certified payrolls, daily time and material records, and, if securities are deposited in lieu of retention pursuant to Article 9.5, a certification of the market value of all such securities as of a date not earlier than 5 days prior to the date of the Application For Payment.
.4 Itemize retention.

9.3.2 Applications For Payment shall not include requests for payment on account of (1) changes which have not been authorized by Change Orders or (2) amounts Contractor does not intend to pay a Subcontractor because of a dispute or other reason.

9.3.3 If required by University, an Application For Payment shall be accompanied by (1) a summary showing payments that will be made to Subcontractors covered by such application and conditional releases upon progress payment or final payment and (2) unconditional waivers and releases of claims and stop payment notices, in the form contained in the Exhibits, from each Subcontractor listed in the preceding Application For Payment covering sums disbursed pursuant to that preceding Application For Payment.

9.3.4 Contractor warrants that, upon submittal of an Application For Payment, all Work, for which Certificates For Payment have been previously issued and payment has been received from University, shall be free and clear of all claims, stop payment notices, security interests, and encumbrances in favor of Contractor, Subcontractors, or other persons or firms entitled to make claims by reason of having provided labor, materials, or equipment relating to the Work.

9.3.5 At the sole discretion of University, University's Representative may approve for inclusion in the Application For Payment the cost of materials not yet incorporated in the Work but already delivered and suitably stored either at the Project site or at some other appropriate location acceptable to University's Representative. In such case, Contractor shall furnish evidence satisfactory to University's Representative (1) of the cost of such materials and (2) that such materials are under the exclusive control of Contractor. Only materials to be incorporated in the Work will be considered for payment. Any payment shall not be construed as acceptance of such materials nor relieve Contractor from sole responsibility for the care and protection of such materials; nor relieve Contractor from risk of loss to such materials from any cause whatsoever; nor relieve Contractor from its obligation to complete the Work in accordance with the Contract; nor act as a waiver of the right of University to require fulfillment of all terms of the Contract. Nothing contained within this Article 9.3.5 shall be deemed to obligate University to agree to payment for any non-incorporated materials or any part thereof, payment being in the sole and absolute discretion of University.

9.4 CERTIFICATE FOR PAYMENT

9.4.1 If Contractor has submitted an Application For Payment in accordance with Article 9.3, University's Representative shall, not later than 5 working days after the date of receipt of the Application For Payment, issue to University, with a copy to Contractor, a Certificate For Payment for such amount as University's Representative determines to be properly due.

9.4.2 If any such Application For Payment is determined not to be in accordance with Article 9.3, University will inform Contractor as soon as practicable, but not later than 5 working days after receipt. Thereafter, Contractor shall have 3 days to revise and resubmit such Application For Payment; otherwise University's Representative may issue a Certificate For Payment in the amount that University's Representative determines to be properly due without regard to such Application For Payment.

9.4.3 Approval of all or any part of an Application For Payment may be withheld, a Certificate For Payment may be withheld, and all or part of a previous Certificate For Payment may be nullified and that amount withheld from a current Certificate For Payment on account of any of the following:

.1 Defective Work not remedied.
.2 Third-party claims against Contractor or University arising from the acts or omissions of Contractor or Subcontractors.
.3 Stop payment notices.
.4 Failure of Contractor to make timely payments due Subcontractors for material or labor.
.5 A reasonable doubt that the Work can be completed for the balance of the Contract Sum then unpaid.
.6 Damage to University or Separate Contractor for which Contractor is responsible.
.7 Reasonable evidence that the Work will not be completed within the Contract Time; and that the unpaid balance of the Contract Sum would not be adequate to cover University's damages for the anticipated delay.
.8 Failure of Contractor to maintain and update as-built documents.
.9 Failure of Contractor to submit schedules or their updates as required by the Contract Documents.
.10 Failure to provide conditional or unconditional releases from any Subcontractor or supplier, if such waiver(s) have been requested by University's Representative.
.11 Performance of Work by Contractor without properly processed Shop Drawings.
.12 Liquidated damages assessed in accordance with Article 5 of the Agreement.
.13 Failure to provide updated Reports of Subcontractor Information and Self-Certifications, as applicable.
.14 Failure to provide a Final Distribution of Contract Dollars with final Application for Payment.
.15 Any other failure of Contractor to perform its obligations under the Contract Documents.

9.4.4 Subject to the withholding provisions of Article 9.4.3, University will pay Contractor the amount set forth in the Certificate For Payment no later than 10 days after the issuance of the Certificate For Payment.

9.4.5 Neither University nor University's Representative will have an obligation to pay or to see to the payment of money to a Subcontractor, except as may otherwise be required by law.

9.4.6 Neither a Certificate For Payment nor a progress payment made by University will constitute acceptance of Defective Work.

9.5 DEPOSIT OF SECURITIES IN LIEU OF RETENTION AND DEPOSIT OF RETENTION INTO ESCROW

9.5.1 At the request and expense of Contractor, a substitution of securities may be made for any monies retained by University under Article 9.2 to ensure performance under the Contract Documents. Securities equivalent in value to the retention amount required by the Contract Documents for each Certificate For Payment shall be deposited by Contractor with a state or federally chartered bank in the State of California ("Escrow Agent"), which shall hold such securities pursuant to the escrow agreement referred to in Article 9.5.3 until retention is due in accordance with Article 9.8. Securities shall be valued as often as conditions of the securities market warrant, but in no case less than once per month. Contractor shall deposit additional securities so that the current market value of the total of all deposited securities shall be at least equal to the total required amount of retention.

9.5.2 Alternatively to Article 9.5.1, and at the request and expense of Contractor, University will deposit

retention directly with Escrow Agent. Contractor may direct the investment of such deposited retention into interest bearing accounts or securities, and such deposits or securities shall be held by Escrow Agent upon the same terms provided for securities deposited by Contractor. Contractor and its surety shall bear the risk of failure of the Escrow Agent selected.

9.5.3 A prerequisite to the substitution of securities in lieu of retention or the deposit of retention into escrow shall be the execution by Contractor, University, and Escrow Agent of an Escrow Agreement for Deposit of Securities in Lieu of Retention and Deposit of Retention in the form contained in the Exhibits. The Contractor shall submit the Selection of Retention Options and the Escrow Agreement for Deposit of Securities in Lieu of Retention and Deposit of Retention not later than the date when 50% of the Work has been completed. The terms of such escrow agreement are incorporated into the requirements of this Article 9.5.

9.6 BENEFICIAL OCCUPANCY

9.6.1 University reserves the right, at its option and convenience, to occupy or otherwise make use of any part of the Work at any time prior to Substantial Completion or Final Completion upon 10 days' notice to Contractor. Such occupancy or use is herein referred to as “Beneficial Occupancy.” Beneficial Occupancy shall be subject to the following conditions:

.1 University's Representative will make an inspection of the portion of the Project to be beneficially occupied and prepare a list of items to be completed or corrected prior to Final Completion. Prior to Beneficial Occupancy, University will issue a Certificate of Beneficial Occupancy on University's form.

.2 Beneficial Occupancy by University shall not be construed by Contractor as an acceptance by University of that portion of the Work which is to be occupied.

.3 Beneficial Occupancy by University shall not constitute a waiver of existing claims of University or Contractor against each other.

.4 Contractor shall provide, in the areas beneficially occupied and on a 24 hour and 7 day week basis as required, utility services, heating, and cooling for systems which are in operable condition at the time of Beneficial Occupancy. All responsibility for the operation and maintenance of equipment shall remain with Contractor while the equipment is so operated. Contractor shall submit to University an itemized list of each piece of equipment so operated with the date operation commences.

.5 The Guarantee to Repair Periods, as defined in Article 12.2, will commence upon the occupancy date stated in the Certificate of Beneficial Occupancy except that the Guarantee to Repair Periods for that part of equipment or systems that serve portions of the Work for which University has not taken Beneficial Occupancy or issued a Certificate of Substantial Completion shall not commence until the University has taken Beneficial Occupancy for that portion of the Work or has issued a Certificate of Substantial Completion with respect to the entire Project.

.6 University will pay all normal operating and maintenance costs resulting from its use of equipment in areas beneficially occupied.

.7 University will pay all utility costs which arise out of the Beneficial Occupancy.

.8 Contractor shall not be responsible for providing security in areas beneficially occupied.

.9 University will use its best efforts to prevent its Beneficial Occupancy from interfering with the conduct of Contractor's remaining Work.

.10 Contractor shall not be required to repair damage caused by University in its Beneficial Occupancy.

.11 Except as provided in this Article 9.6, there shall be no added cost to University due to Beneficial Occupancy.

.12 Contractor shall continue to maintain all insurance required by the Contract in full force and effect.

9.7 SUBSTANTIAL COMPLETION

9.7.1 “Substantial Completion” means the stage in the progress of the Work, as determined by University's Representative, when the Work is complete and in accordance with the Contract Documents except only for completion of minor items which do not impair University's ability to occupy and fully utilize the Work for its intended purpose and a Certificate of Occupancy has been issued by the University.

9.7.2 When Contractor gives notice to University's Representative that the Work is substantially complete, unless University's Representative determines that the Work is not sufficiently complete to warrant an inspection to determine Substantial Completion, University's Representative will inspect the Work. If the University's Representative determines that the Work is not substantially completed the University's Representative will prepare and give to Contractor a comprehensive list of items to be completed or corrected before establishing Substantial Completion. Contractor shall proceed promptly to complete and correct items on the list. Failure to include an item on such list does not alter the responsibility of Contractor to complete all Work in accordance with the Contract Documents. Upon notification that the items on the list are completed or corrected, as applicable, the University's Representative will make an inspection to determine whether the Work is substantially complete. Costs for additional inspection by University's Representative shall be deducted from any monies due and payable to Contractor.

9.7.3 When University's Representative determines that the Work is substantially complete, University's Representative will arrange for inspection by University's Building Official and other officials, as appropriate, for the purpose of issuing a Certificate of Occupancy. After a Certificate of Occupancy has been issued by the University, the University's Representative will prepare a Certificate of Substantial Completion on University's form as contained in the Exhibits, which, when signed by University, shall establish the date of Substantial Completion and the responsibilities of University and Contractor for security, maintenance, utilities, insurance, and damage to the Work. The University's Representative will prepare and furnish to the Contractor a comprehensive "punch list" of items to be completed or corrected prior to Final Completion.

9.7.4 Unless otherwise provided in the Certificate of Substantial Completion, the Guarantee To Repair Period for the Work covered by the Certificate of Substantial Completion, shall commence on the date of Substantial Completion of the Work except that Substantial Completion shall not commence the Guarantee to Repair Period for any equipment or systems that:

.1 Are not operational (equipment or systems shall not be considered operational if they cannot be used to provide the intended service; or
.2 Are not accepted by the University.

The Guarantee To Repair Period for equipment or systems which become operational and accepted subsequent to Substantial Completion will begin on the date of their written acceptance by University.

9.7.5 The daily rate included in the Agreement and specifically identified as the rate to be paid to Contractor for Compensable Delays shall not apply to any delays occurring after the Work is substantially completed.

9.8 **FINAL COMPLETION, FINAL PAYMENT, AND RELEASE OF RETENTION**

9.8.1 Upon receipt of notice from Contractor that the Work is ready for final inspection, University's Representative will make such inspection. Final Completion shall be when University's Representative determines that the Work is fully completed and in accordance with the Contract Documents, including without limitation, satisfaction of all "punch list" items, and determines that a Certificate of Occupancy has been issued by the University. University will file a Notice of Completion within 15 days after Final Completion. After receipt of the final Application For Payment, if University's Representative determines that Final Completion has occurred, University's Representative will issue the final Certificate For Payment.

9.8.2 Final payment and retention shall be released to Contractor, as set forth in Article 9.8.3, after:

.1 Contractor submits the final Application For Payment and all submittals required in accordance with Article 9.3;

.2 Contractor submits all guarantees and warranties procured by Contractor from Subcontractors, all operating manuals for equipment installed in the Project, as-built documents, and all other submittals required by the Contract Documents;

.3 Contractor submits the Final Distribution of Contract Dollars in the form contained in the Exhibits; and

.4 University's Representative issues the final Certificate For Payment.

At its sole discretion, after Final Completion, University may waive the requirement that Contractor submit a final Application For Payment before making final payment and/or release of retention to Contractor.

9.8.3 Final payment shall be paid not more than 10 days after University's Representative issues the final Certificate For Payment. Retention shall be released to Contractor 35 days after the filing of the Notice of Completion.

9.8.4 Acceptance of final payment by Contractor shall constitute a waiver of all claims, except claims for retention and claims previously made in writing and identified by Contractor as unsettled at the time of the final Application For Payment.

ARTICLE 10
PROTECTION OF PERSONS AND PROPERTY

10.1 SAFETY PRECAUTIONS AND PROGRAMS

10.1.1 Contractor shall be solely responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the performance of the Contract.

10.2 SAFETY OF PERSONS AND PROPERTY

10.2.1 Contractor shall take adequate precautions for safety of and shall provide adequate protection to prevent damage, injury, or loss to the following:

.1 Employees involved in the Work and other persons who may be affected thereby.

.2 The Work in place and materials and equipment to be incorporated therein, whether in storage on or off the Project site, under care, custody, or control of Contractor or Subcontractors.

.3 Other property at the Project site and adjoining property.

10.2.2 Contractor shall erect and maintain, as required by existing conditions and performance of the Work, adequate safeguards for safety and protection, including providing adequate lighting and ventilation, posting danger signs and other warnings against hazards, promulgating safety regulations, and notifying owners and users of adjacent sites and utilities.

10.2.3 When use or storage of explosives, other hazardous materials, equipment, or unusual methods are necessary for execution of the Work, Contractor shall exercise the utmost care and carry on such activities only under the supervision of properly qualified personnel.

10.2.4 Contractor shall designate a responsible member of Contractor's organization at the Project site whose duty shall be the prevention of accidents. That person shall be the Superintendent, unless otherwise designated by Contractor in writing to University and University's Representative.

10.2.5 Contractor shall not load or permit any part of the Work or the Project site to be loaded so as to endanger the safety of persons or property.

10.3 EMERGENCIES

10.3.1 In an emergency affecting the safety of persons or property, Contractor shall act to prevent or minimize damage, injury, or loss. Contractor shall promptly notify University's Representative, which notice may be oral followed by written confirmation, of the occurrence of such an emergency and Contractor's action.

ARTICLE 11
INSURANCE AND BONDS

11.1 CONTRACTOR'S INSURANCE

11.1.1 Contractor shall, at its expense, purchase and maintain in full force and effect such insurance as will protect itself and University from claims, such as for bodily injury, wrongful death, and property damage, which may arise out of or result from the Work required by the Contract Documents, whether such Work is done by Contractor, by any Subcontractor, by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable. The amounts of such insurance and any additional insurance requirements are specified in the Supplementary Conditions. See Article 3.21 regarding the scope and extent of Contractor's liability for and repair of damaged Work.

11.1.2 The following policies and coverages shall be furnished by Contractor:

.1 COMMERCIAL GENERAL LIABILITY INSURANCE subject to terms no less broad than the Insurance Services Office's (ISO) form CG 0001 (2004 or later edition), or a substitute form providing coverage at least as broad as the ISO form specified, covering all Work done by or on behalf of Contractor and providing insurance for bodily injury, wrongful death, personal injury, property damage, and contractual liability. There shall be no limitations or exclusions of coverage beyond those contained in the standard ISO form CG 0001 (2004 or later edition). Except with respect to bodily injury and property damage included within the products and completed operations hazards, the aggregate limit shall apply separately to Work required of Contractor by these Contract Documents. Contractor shall continue to maintain Products/Completed Operations liability insurance coverage for a minimum completed operations period of 10 year(s) or the applicable Statute of Repose as provided by the law of the jurisdiction where the project is located as shown in the policy(ies), whichever is less. All terms and conditions of such coverage shall be maintained during this completed operations period, including the required minimum coverage limits and the requirement to provide the University with coverage as an additional insured for completed operations as specified under this Article 11.1 and the Supplementary Conditions.

.2 BUSINESS AUTOMOBILE LIABILITY INSURANCE subject to terms no less broad than the Insurance Services Office's (ISO) form CA 0001 (1990 or later edition), or a substitute form providing coverage at least as broad as the ISO form specified, covering owned, hired, leased, and non-owned automobiles used by or on behalf of Insured, and providing liability insurance for bodily injury and property damage arising from the use or operation of such auto(s) with a minimum combined single limit of not less than $1,000,000 per accident. The minimum limits required may be satisfied by combination of primary and umbrella/excess policies. The Commercial Automobile Liability Insurance shall be provided by Contractor for all on site and off site Work.

.3 WORKERS' COMPENSATION AND EMPLOYER'S LIABILITY INSURANCE as required by Federal and State of California law. Contractor shall also require all of its Subcontractors to maintain this insurance coverage.

11.1.3 The coverages required under this Article 11 shall not in any way limit the liability of Contractor.

11.1.4 Contractor's Certificates of Insurance, executed by a duly authorized representative of each broker of record or each insurer as evidence of the insurance required by these Contract Documents and on the form contained in the Exhibits, shall be submitted by Contractor to University prior to the commencement of Work by the Contractor. The Certificates of Insurance shall provide for no cancellation or modification of coverage without prior written notice to University, in accordance with policy provisions.

11.1.5 In the event Contractor does not comply with these insurance requirements, University may, at its option, provide insurance coverage to protect University; and the cost of such insurance shall be paid by Contractor and may be deducted from the Contract Sum.

11.1.6 Contractor's insurance as required by Article 11.1.2, shall, by endorsement to the policies, include the following:

.1 The Regents of the University of California, The University of California, University, and each of their Representatives, consultants, officers, agents, employees, and each of their Representative's consultants, regardless of whether or not identified in the Contract Documents or to the Contractor in writing, will be included as additional insureds on the Contractor's General Liability insurance for and relating to the Work to be performed by the Contractor and Subcontractors. Additional Insured provision or endorsement shall be at least as broad as the CG 20 07 04 in combination with the CG 20 37 07 04 (or earlier versions of CG 20 10 and CG 20 37 or Form B - CG 20 10 11 85 by itself), as published by Insurance Services Offices (ISO) and shall be included with Certificates of Insurance. The additional insured requirement shall not apply to Worker's Compensation and Employer's Liability insurance.

Further, the amount of insurance available to the University shall be for the full amount of the loss up to the available policy limits and shall not be limited to any minimum requirements stated in the Contract Documents.

.2 University, University's consultants, University's Representative, and University's Representative's consultants will not by reason of their inclusion as insureds incur liability to the insurance carriers for payment of premiums for such insurance.

.3 Coverage provided is primary and is not in excess of or contributing with any insurance or self-insurance maintained by University, University's consultants, University's Representative, and University's Representative's consultants. This provision, however, shall only apply as per the stipulations of Article 11.1.6.1.

11.1.7 The form and substance of all insurance policies required to be obtained by Contractor shall be subject to approval by University. All policies required by Articles 11.1.2.1, 11.1.2.2, and 11.1.2.3 shall be issued by companies with ratings and financial classifications as specified in the Supplementary Conditions.

11.1.8 Contractor shall, by mutual agreement with University, furnish any additional insurance as may be required by University. Contractor shall provide Certificates of Insurance evidencing such additional insurance.

11.1.9 The Certificate of Insurance shall show (1) all companies affording coverage and (2) the name of the insured exactly in the manner as shown on the Bid Form. The name of the insured must be the name under which the entity is licensed by the Contractors State License Board.

11.1.10 If insurance company refuses to use the Certificate of Insurance form as contained in the Exhibits, it must provide a Certificate of Insurance evidencing compliance with this Article including those provisions noted under DESCRIPTION OF OPERATIONS/LOCATIONS/VEHICLES section of the Certificate of Insurance Exhibit by including an endorsement to its Certificate of Insurance form covering those noted provisions exactly as they appear on the Certificate of Insurance Exhibit.

11.1.11 At the request of University, Contractor shall submit to University copies of the policies obtained by Contractor.

11.2 BUILDER'S RISK PROPERTY INSURANCE

11.2.1 If and only if the Contract Sum exceeds $300,000 at the time of award, University will provide its standard builder's risk property insurance, subject to the deductibles, terms and conditions, exclusions, and limitations as contained in the provisions of the policy. A copy of the University's standard builder's risk property insurance policy is available at the University's Facility office. In addition, a summary of the provisions of the policy is included as an Exhibit to the Contract. Contractor agrees that the University's provision of its standard builder's risk property insurance policy meets the University's obligation to provide builder's risk property insurance under the Contract and, in the event of a conflict between the provisions of the policy and any summary or description of the provisions contained herein or otherwise, the provisions of the policy shall control and shall be conclusively presumed to fulfill the University's obligation to provide such insurance. The proceeds under such insurance policies taken out by University insuring the Work and materials will be payable to University and Contractor as their respective interests, from time to time, may appear. Contractor

shall be responsible for the deductible amount in the event of a loss. In addition, nothing in this Article 11.2 shall be construed to relieve Contractor of full responsibility for loss of or damage to materials not incorporated in the Work, and for Contractor's tools and equipment used to perform the Work, whether on the Project site or elsewhere, or to relieve Contractor of its responsibilities referred to under this Article 11. Materials incorporated in the Work, as used in this Article 11.2, shall mean materials furnished while in transit to, stored at, or in permanent place at the Project site.

11.2.2 Insurance policies referred to under this Article 11.2 shall:

.1 Include a provision that the policies are primary and do not participate with nor are excess over any other valid collectible insurance carried by Contractor.

.2 Include a waiver of subrogation against Contractor, its Subcontractors, its agents, and employees.

11.2.3 Builder's risk insurance coverage under this Article 11.2 will expire on the date of Final Completion recited in a Notice of Completion filed pursuant to Article 9.8.1. Should a Notice of Completion be filed more than 10 days after the date of Final Completion, the date of Final Completion recited in the Notice of Completion will govern.

11.3 PERFORMANCE BOND AND PAYMENT BOND

11.3.1 Contractor shall furnish bonds covering the faithful performance of the Contract (Performance Bond) and payment of obligations arising thereunder (Payment Bond) on the forms contained in Exhibits 3 and 2.

11.3.2 The Payment Bond and Performance Bond shall each be in the amount of the Contract Sum.

11.3.3 The Payment Bond and Performance Bond shall be in effect on the date the Contract is signed by University.

11.3.4 Contractor shall promptly furnish such additional security as may be required by University to protect its interests and those interests of persons or firms supplying labor or materials to the Work. Contractor shall furnish supplemental Payment and Performance Bonds each in the amount of the current Contract Sum at the request of the University.

11.3.5 Surety companies used by Contractor shall be, on the date the Contract is signed by University, an admitted surety insurer (as defined in the California Code of Civil Procedure Section 995.120).

11.3.6 The premiums for the Payment Bond and Performance Bond shall be paid by Contractor.

ARTICLE 12
UNCOVERING AND CORRECTION OF WORK

12.1 UNCOVERING OF WORK

12.1.1 If a portion of the Work is covered contrary to University's Representative's request or direction, or contrary to the requirements of the Contract Documents, it must, if required in writing by University's Representative, be uncovered for University's Representative's observation and be replaced at Contractor's expense without adjustment of the Contract Time or the Contract Sum.

12.1.2 If a portion of the Work has been covered, which is not required by the Contract Documents to be observed or inspected prior to its being covered and which University's Representative has not specifically requested to observe prior to its being covered, University's Representative may request to see such Work and it shall be uncovered and replaced by Contractor. If such Work is in accordance with the Contract Documents, the costs of uncovering and replacing the Work shall be added to the Contract Sum by Change Order; and if the uncovering and replacing of the Work extends the Contract Time, an appropriate adjustment of the Contract Time shall be made by Change Order. If such Work is not in accordance with the Contract Documents, Contractor shall pay such costs and shall not be entitled to an adjustment of the Contract Time or the Contract Sum.

12.2 CORRECTION OF DEFECTIVE WORK AND GUARANTEE TO REPAIR PERIOD

12.2.1 The term "Guarantee To Repair Period" means a period of 1 year, unless a longer period of time is specified, commencing as follows:

.1 For any Work not described as incomplete in the Certificate of Substantial Completion, on the date of Substantial Completion.
.2 For space beneficially occupied or for separate systems fully utilized prior to Substantial Completion pursuant to Article 9.6, from the first date of such Beneficial Occupancy or actual use, as established in a Certificate of Beneficial Occupancy.
.3 For all Work other than .1 or .2 above, from the date of Final Completion.

12.2.2 Contractor shall (1) correct Defective Work that becomes apparent during the progress of the Work or during the Guarantee To Repair Period and (2) replace, repair, or restore to University's satisfaction any other parts of the Work and any other real or personal property which is damaged or destroyed as a result of Defective Work or the correction of Defective Work. Contractor shall promptly commence such correction, replacement, repair, or restoration upon notice from University's Representative or University, but in no case later than 10 days after receipt of such notice; and Contractor shall diligently and continuously prosecute such correction to completion. Contractor shall bear all costs of such correction, replacement, repair, or restoration, and all losses resulting from such Defective Work, including additional testing, inspection, and compensation for University's Representative's services and expenses. Contractor shall perform corrective Work at such times that are acceptable to University and in such a manner as to avoid, to the extent practicable, disruption to University's activities.

12.2.3 If immediate correction of Defective Work is required for life safety or the protection of property and is performed by University or Separate Contractors, Contractor shall pay to University all reasonable costs of correcting such Defective Work. Contractor shall replace, repair, or restore to University's satisfaction any other parts of the Work and any other real or personal property which is damaged or destroyed as a result of such Defective Work or the correction of such Defective Work.

12.2.4 Contractor shall remove from the Project site portions of the Work and materials which are not in accordance with the Contract Documents and which are neither corrected by Contractor nor accepted by University.

12.2.5 If Contractor fails to commence correction of Defective Work within 10 days after notice from University or University's Representative or fails to diligently prosecute such correction to completion, University may correct the Defective Work in accordance with Article 2.4; and, in addition, University may remove the Defective Work and store salvageable materials and equipment at Contractor's expense.

12.2.6 If Contractor fails to pay the costs of such removal and storage as required by Articles 12.2.4 and 12.2.5 within 10 days after written demand, University may, without prejudice to other remedies, sell such materials at auction or at private sale, or otherwise dispose of such material. Contractor shall be entitled to the proceeds of such sale, if any, in excess of the costs and damages for which Contractor is liable to University, including compensation for University's Representative's services and expenses. If such proceeds of sale do not cover costs and damages for which Contractor is liable to University, the Contract Sum shall be reduced by such deficiency. If there are no remaining payments due Contractor or the remaining payments are insufficient to cover such deficiency, Contractor shall promptly pay the difference to University.

12.2.7 Contractor's obligations under this Article 12 are in addition to and not in limitation of its warranty under Article 3.4 or any other obligation of Contractor under the Contract Documents. Enforcement of Contractor's express warranties and guarantees to repair contained in the Contract Documents shall be in addition to and not in limitation of any other rights or remedies University may have under the Contract Documents or at law or in equity for Defective Work. Nothing contained in this Article 12 shall be construed to establish a period of limitation with respect to other obligations of Contractor under the Contract Documents. Establishment of the Guarantee To Repair Period relates only to the specific obligation of Contractor to correct the Work and in no way limits either Contractor's liability for Defective Work or the time within which proceedings may be commenced to enforce Contractor's obligations under the Contract Documents.

ARTICLE 13
TERMINATION OR SUSPENSION OF THE CONTRACT

13.1 TERMINATION BY CONTRACTOR

13.1.1 Subject to Article 13.1.2, Contractor shall have the right to terminate the Contract only upon the occurrence of one of the following:

.1 Provided that University has not commenced reasonable action to remove any order of a court within the 90 day period, the Work is stopped for 90 consecutive days, through no act or fault of Contractor, any Subcontractor, or any employee or agent of Contractor or any Subcontractor, due to an issuance of an order of a court or other public authority having jurisdiction or due to an act of government, such as a declaration of a national emergency making material unavailable.

.2 University fails to perform any material obligation under the Contract and fails to cure such default within 30 days, or University has not commenced to cure such default within 30 days where such cure will require a reasonable period beyond 30 days and diligently prosecutes the same to completion, after receipt of notice from Contractor stating the nature of such default(s).

.3 Repeated suspensions by University, other than such suspensions as are agreed to by Contractor under Article 13.3, which constitute in the aggregate more than 20% of the Contract Time.

13.1.2 Upon the occurrence of one of the events listed in Article 13.1.1, Contractor may, upon 10 days additional notice to University and University's Representative, and provided that the condition giving rise to Contractor's right to terminate is continuing, terminate the Contract.

13.1.3 Upon termination by Contractor, University will pay to Contractor the sum determined by Article 13.4.4. Such payment will be the sole and exclusive remedy to which Contractor is entitled in the event of termination of the Contract by Contractor pursuant to Article 13.1; and Contractor will be entitled to no other compensation or damages and expressly waives the same.

13.2 TERMINATION BY UNIVERSITY FOR CAUSE

13.2.1 University will have the right to terminate the Contract for cause at any time after the occurrence of any of the following events:

.1 Contractor becomes insolvent or files for relief under the bankruptcy laws of the United States.
.2 Contractor makes a general assignment for the benefit of its creditors or fails to pay its debts as the same become due.
.3 A receiver is appointed to take charge of Contractor's property.
.4 The commencement or completion of any Work activity on the critical path is more than 30 days behind the date set forth in the Contract Schedule for such Work activity, as a resultof an Unexcusable Delay. For a Contract with a Contract Time of less than 300 days, the 30-day period shall be reduced to the number of days commensurate with 10% of the Contract Time.
.5 Contractor abandons the Work.

13.2.2 Upon the occurrence of any of the following events, University will have the right to terminate the Contract for cause if Contractor fails to promptly commence to cure such default and diligently prosecute such cure within 5 days after notice from University, or within such longer period of time as is reasonably necessary to complete such cure:

.1 Contractor persistently or repeatedly refuses or fails to supply skilled supervisory personnel, an adequate number of properly skilled workers, proper materials, or necessary equipment to prosecute the Work in accordance with the Contract Documents.
.2 Contractor fails to make prompt payment of amounts properly due Subcontractors

after receiving payment from University.

.3 Contractor disregards Applicable Code Requirements.

.4 Contractor persistently or materially fails to execute the Work in accordance with the Contract Documents.

.5 Contractor is in default of any other material obligation under the Contract Documents.

.6 Contractor persistently or materially fails to comply with applicable safety requirements.

13.2.3 Upon any of the occurrences referred to in Articles 13.2.1 and 13.2.2, University may, at its election and by notice to Contractor, terminate the Contract and take possession of the Project site and all materials, supplies, equipment, tools, and construction equipment and machinery thereon owned by Contractor; accept the assignment of any or all of the subcontracts; and then complete the Work by any method University may deem expedient. If requested by University, Contractor shall remove any part or all of Contractor's materials, supplies, equipment, tools, and construction equipment and machinery from the Project site within 7 days of such request; and if Contractor fails to do so, University may remove or store, and after 90 days sell, any of the same at Contractor's expense.

13.2.4 If the Contract is terminated by University as provided in this Article 13.2, Contractor shall not be entitled to receive any further payment until the expiration of 35 days after Final Completion and acceptance of all Work by University.

13.2.5 If the unpaid balance of the Contract Sum exceeds the cost of completing the Work, including all additional costs and expenses made necessary thereby, including costs for University staff time, plus all losses sustained, including any liquidated damages provided under the Contract Documents, such excess shall be paid to Contractor. If such costs, expenses, losses, and liquidated damages exceed the unpaid balance of the Contract Sum, Contractor shall pay such excess to University.

13.2.6 No termination or action taken by University after termination shall prejudice any other rights or remedies of University provided by law or by the Contract Documents upon such termination; and University may proceed against Contractor to recover all losses suffered by University.

13.3 SUSPENSION BY UNIVERSITY FOR CONVENIENCE

13.3.1 University may, at any time and from time to time, without cause, order Contractor, in writing, to suspend, delay, or interrupt the Work in whole or in part for such period of time, up to 90 days, as University may determine, with such period of suspension to be computed from the date of delivery of the written order. Such order shall be specifically identified as a “Suspension Order” under this Article 13.3. The Work may be stopped for such further period as the parties may agree. Upon receipt of a Suspension Order, Contractor shall, at University's expense, comply with its terms and take all reasonable steps to minimize costs allocable to the Work covered by the Suspension Order during the period of Work stoppage. Within 90 days after the issuance of the Suspension Order, or such extension to that period as is agreed upon by Contractor and University, University shall either cancel the Suspension Order or delete the Work covered by such Suspension Order by issuing a Change Order.

13.3.2 If a Suspension Order is canceled or expires, Contractor shall continue with the Work. A Change Order will be issued to cover any adjustments of the Contract Sum or the Contract Time necessarily caused by such suspension. Any Claim by Contractor for an adjustment of the Contract Sum or the Contract Time shall be made within 21 days after the end of the Work suspension. Contractor agrees that submission of its claim within said 21 days is an express condition precedent to its right to Arbitrate or Litigate such a claim.

13.3.3 The provisions of this Article 13.3 shall not apply if a Suspension Order is not issued by University. A Suspension Order shall not be required to stop the Work as permitted or required under any other provision of the Contract Documents.

13.4 TERMINATION BY UNIVERSITY FOR CONVENIENCE

13.4.1 University may, at its option, terminate this Contract, in whole or from time to time in part, at any time by giving notice to Contractor. Upon such termination, Contractor agrees to waive any claims for damages, including loss of anticipated profits, on account thereof; and, as the sole right and remedy of Contractor, University shall pay Contractor in accordance with Article 13.4.4.

13.4.2 Upon receipt of notice of termination under this Article 13.4, Contractor shall, unless the notice directs otherwise, do the following:

.1 Immediately discontinue the Work to the extent specified in the notice.
.2 Place no further orders or subcontracts for materials, equipment, services, or facilities, except as may be necessary for completion of such portion of the Work as is not discontinued.
.3 Promptly cancel, on the most favorable terms reasonably possible, all subcontracts to the extent they relate to the performance of the discontinued portion of the Work.
.4 Thereafter do only such Work as may be necessary to preserve and protect Work already in progress and to protect materials, plants, and equipment on the Project site or in transit thereto.

13.4.3 Upon such termination, the obligations of the Contract shall continue as to portions of the Work already performed and, subject to Contractor's obligations under Article 13.4.2, as to bona fide obligations assumed by Contractor prior to the date of termination.

13.4.4 Upon such termination, University shall pay to Contractor the sum of the following:

.1 The amount of the Contract Sum allocable to the portion of the Work properly performed by Contractor as of the date of termination, less sums previously paid to Contractor.
.2 Plus an amount equal to the lesser of $50,000 or 5% of the difference between the Contract Sum and the amount of the Contract Sum allocable to the portion of the Work properly performed by Contractor as of the date of termination.
.3 Plus previously unpaid costs of any items delivered to the Project site which were fabricated for subsequent incorporation in the Work.
.4 Plus any proven losses with respect to materials and equipment directly resulting from such termination.
.5 Plus reasonable demobilization costs.
.6 Plus reasonable costs of preparing a statement of the aforesaid costs, expenses, and losses in connection with such termination.

The above payment shall be the sole and exclusive remedy to which Contractor is entitled in the event of termination of the Contract by University pursuant to Article 13.4; and Contractor will be entitled to no other compensation or damages and expressly waives same.

ARTICLE 14
STATUTORY AND OTHER REQUIREMENTS

14.1 PATIENT HEALTH INFORMATION

Contractor acknowledges that its employees, agents, subcontractors, consultants and others acting on its behalf may come into contact with Patient Health Information ("PHI") while performing work at the Project Site. This contact is most likely rare and brief (e.g. walking through a clinic where patient files may be visible, overhearing conversations between physicians while working or touring a hospital, noticing a relative or acquaintance receiving treatment in a University facility, etc.). Contractor shall immediately notify University Representative of any such contact. Any and all forms of PHI should not be examined closer, copied, photographed, recorded in any manner, distributed or shared. Contractor will adopt procedures to ensure that its employees, agents and subcontractors refrain from such activity. If Contractor, its employees, agents or subcontractors do further examine, copy, photograph, record in any manner, distribute or share this information, Contractor will report such actions immediately to the University Representative. Contractor will immediately take all steps necessary to stop any such actions and will ensure that no further violations of this contractual responsibility will occur. Contractor will report to University Representative within five (5) days after Contractor gives University Representative notice of the event/action of the steps taken to prevent future occurrences.

14.2 NONDISCRIMINATION

14.2.1 For purposes of this Article 14.2, the term Subcontractor shall not include suppliers, manufacturers, or distributors.

14.2.2 Contractor shall comply and shall ensure that all Subcontractors comply with Section 12900 through 12996, of the State of California Government Code.

14.2.3 Contractor agrees as follows during the performance of the Work:

.1 Contractor shall provide equal treatment to, and shall not willfully discriminate against or allow harassment of any employee or applicant for employment on the basis of: race; color; religion; sex; age; ancestry; national origin; sexual orientation; physical or mental disability; veteran's status; medical condition (as defined in Section 12926 of the State of California Government Code and including cancer-related medical conditions and or genetic characteristics); genetic information (as defined in the Genetic Information Nondiscrimination Act of 2008 and including family medical history); marital status; gender identity, pregnancy, or citizenship (within the limits imposed by law or University's policy) or service in the uniformed services (as defined by the Uniformed Services Employment and Reemployment Rights Act of 1994). Contractor will also take affirmative action to ensure that any such employee or applicant for employment is not discriminated against on any of the bases identified above. Such equal treatment shall apply, but not be limited to the following: employment; upgrade; demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The contractor also agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth the provisions of this nondiscrimination clause. The Contractor will, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that qualified applicants will receive consideration for employment without regard to: race; color; religion; sex; age; ancestry; national origin; sexual orientation; physical or mental disability; veteran's status; medical condition (as defined in Section 12926 of the State of California Government Code and including cancer-related medical conditions and or genetic characteristics); genetic information (as defined in the Genetic Information Nondiscrimination Act of 2008 and including family medical history); marital status; gender identity, pregnancy, or citizenship (within the limits imposed by law or University's policy) or service in the uniformed services (as defined by the Uniformed Services Employment and Reemployment Rights Act of 1994). For purposes of this provision: (1) "Pregnancy" includes pregnancy, childbirth, and medical conditions related to pregnancy and childbirth; and (2) "Service in the uniformed services" includes membership, application for membership, performance of service, application for service, or obligation for service in the uniformed services.

.2 Contractor and all Subcontractors will permit access to their records of employment, employment advertisements, application forms, and other pertinent data and records by University or any appropriate agency of the State of California designated by University for the purposes of investigation to ascertain compliance with this Article 14.2. The outcome of the investigation may result in the following:

.1 A finding of willful violation of the provisions of this Contract or of the Fair Employment Practices Act may be regarded by University as (1) a basis for determining that Contractor is not a “responsible bidder” as to future contracts for which such Contractor may submit bids or (2) a basis for refusing to accept or consider the bids of Contractor for future contracts.

.2 University may deem a finding of willful violation of the Fair Employment Practices Act to have occurred upon receipt of written notice from the Fair Employment Practices Commission that it has (1) investigated and determined that Contractor has violated the Fair Employment Practices Act and (2) issued an order under the State of California Government Code Section 12970 or obtained an injunction under Government Code Section 12973.

.3 Upon receipt of such written notice from the Fair Employment Practices Commission, University may notify Contractor that, unless it demonstrates to the satisfaction of University within a stated period that the violation has been

corrected, Contractor's bids on future projects will not be considered.

.4 Contractor agrees that, should University determine that Contractor has not complied with this Article 14.2, Contractor shall forfeit to University, as a penalty, for each day or portion thereof, for each person who was denied employment as a result of such non-compliance, the penalties provided in Article 14.3 for violation of prevailing wage rates. Such penalty amounts may be recovered from Contractor; and University may deduct any such penalty amounts from the Contract Sum.

.5 Nothing contained in this Article 14.2 shall be construed in any manner so as to prevent University from pursuing any other remedies that may be available at law.

.6 Contractor shall meet the following standards for compliance and provide University with satisfactory evidence of such compliance upon University's request, which shall be evaluated in each case by University:

.1 Contractor shall notify its Superintendent and other supervisory personnel of the nondiscrimination requirements of the Contract Documents and their responsibilities thereto.

.2 Contractor shall notify all sources of employee referrals (including unions, employment agencies, and the State of California Department of Employment) of the nondiscrimination requirements of the Contract Documents by sending to such sources and by posting the Notice of Equal Employment Opportunity (EEO).

.3 Contractor or its representative shall, through all unions with whom it may have agreements, develop agreements that (1) define responsibilities for nondiscrimination in hiring, referrals, upgrading, and training and (2) implement an affirmative nondiscrimination program, in terms of the unions' specific areas of skill and geography, such that qualified minority women, nonminority women, and minority men shall be available and given an equal opportunity for employment.

.4 Contractor shall notify University of opposition to the nondiscrimination requirements of the Contract Documents by individuals, firms, or organizations during the term of the Contract.

.7 Contractor shall include the provisions of the foregoing Articles 14.2.3.2.1 through 14.2.3.2.6 in all subcontracts with Subcontractors, so that such provisions will be binding upon each such Subcontractor.

14.3 PREVAILING WAGE RATES

14.3.1 For purposes of this Article 14.3, the term Subcontractor shall not include suppliers, manufacturers, or distributors.

14.3.2 Contractor shall comply and shall ensure that all Subcontractors comply with prevailing wage law pursuant to the State of California Labor Code, including but not limited to Section 1720 et seq. of the State of California Labor Code. Compliance with these sections is required by this Contract. The Work under this Contract is subject to compliance monitoring and enforcement by the State of California Department of Industrial Relations.

14.3.3 The State of California Department of Industrial Relations has ascertained the general prevailing per diem wage rates in the locality in which the Work is to be performed for each craft, classification, or type of worker required to perform the Work. A copy of the general prevailing per diem wage rates will be on file at University's principal facility office and will be made available to any interested party upon request. Contractor shall post a copy of the general prevailing per diem wage rates as well as job site notices as prescribed by regulation at the job site. By this reference, such schedule is made part of the Contract Documents. Contractor shall pay not less than the prevailing wage rates, as specified in the schedule and any amendments thereto, to all workers employed by Contractor in the execution of the Work. Contractor shall cause all subcontracts to include the provision that all Subcontractors shall pay not less than the prevailing rates to all workers employed by such Subcontractors in the execution of the Work. Contractor shall forfeit to University, as a penalty, not more than $200 for each calendar day or portion thereof for each worker that is paid less than the prevailing rates as determined by the Director of Industrial Relations for the work or craft in which the worker is employed for any portion of the Work done by Contractor or any Subcontractor. The amount of this penalty shall be

determined pursuant to applicable law. Such forfeiture amounts may be deducted from the Contract Sum or sought directly from the surety under its Performance Bond if there are insufficient funds remaining in the Contract Sum. Contractor shall also pay to any worker who was paid less than the prevailing wage rate for the work or craft for which the worker was employed for any portion of the Work, for each day, or portion thereof, for which the worker was paid less than the specified prevailing per diem wage rate, an amount equal to the difference between the specified prevailing per diem wage rate and the amount which was paid to the worker. Review of any civil wage and penalty assessment shall be made pursuant to section 1742 of the California Labor Code.

14.4 PAYROLL RECORDS

14.4.1 For purposes of this Article 14.4, the term Subcontractor shall not include suppliers, manufacturers, or distributors.

14.4.2 Contractor and all Subcontractors shall keep an accurate payroll record, showing the name, address, social security number, job classification, straight time and overtime hours worked each day and week, and the actual per diem wages paid to each journeyworker, apprentice, worker, or other employee employed in connection with the Work. All payroll records shall be certified as being true and correct by Contractor or Subcontractors keeping such records; and the payroll records shall be available for inspection at all reasonable hours at the principal office of Contractor on the following basis:

.1 A certified copy of an employee's payroll record shall be made available for inspection or furnished to such employee or the employee's authorized representative on request.

.2 A certified copy of all payroll records shall be made available for inspection upon request to University, the State of California Division of Labor Standards Enforcement, and the Division of Apprenticeship Standards of the State of California Division of Industrial Relations.

.3 A certified copy of all payroll records shall be made available upon request by the public for inspection or copies thereof made; provided, however, that the request by the public shall be made to either University, the Division of Apprenticeship Standards, or the Division of Labor Standards Enforcement. The public shall not be given access to such records at the principal offices of Contractor or Subcontractors. Any copy of the records made available for inspection as copies and furnished upon request to the public or any public agency by University shall be marked or obliterated in such a manner as to prevent disclosure of an individual's name, address, and social security number. The name and address of Contractor awarded the Contract or performing the Contract shall not be marked or obliterated.

14.4.3 Contractor shall file a certified copy of the payroll records with the entity that requested the records within 10 days after receipt of a written request. Contractor shall inform University of the location of such payroll records for the Project, including the street address, city, and county; and Contractor shall, within 5 working days, provide notice of change of location of such records. In the event of noncompliance with the requirements of this Article 14.4 or with the State of California Labor Code Section 1776, Contractor shall have 10 days in which to comply following receipt of notice specifying in what respects Contractor must comply. Should noncompliance still be evident after the 10 day period, Contractor shall forfeit to University, as a penalty, $100 for each day, or portion thereof, for each worker, until strict compliance is accomplished. Such forfeiture amounts may be deducted from the Contract Sum.

14.5 APPRENTICES

14.5.1 For purposes of this Article 14.5, the term Subcontractor shall not include suppliers, manufacturers, and distributors.

14.5.2 Only apprentices, as defined in the State of California Labor Code Section 3077, who are in training under apprenticeship standards and written apprentice agreements under Chapter 4, Division 3, of the State of California Labor Code, are eligible to be employed by Contractor and Subcontractors as apprentices. The employment and training of each apprentice shall be in accordance with the provisions of the apprenticeship standards and written apprentice agreements under which the apprentice is training and in accordance with prevailing wage law pursuant to the Labor Code, including but not limited to Section 1777.5. The Contractor

bears responsibility for compliance with this section for all apprenticeable occupations.

14.5.3 Every apprentice shall be paid the standard wage to apprentices, under the regulations of the craft or trade at which the apprentice is employed, and shall be employed only at the Work in the craft or trade to which the apprentice is indentured.

14.5.4 When Contractor or Subcontractors employ workers in any apprenticeship craft or trade on the Work, Contractor or Subcontractors shall 1) send contract award information to the applicable joint apprenticeship committee that can supply apprentices to the site of the public work and 2) apply to the joint apprenticeship committee, which administers the apprenticeship standards of the craft or trade in the area of the Project site, for a certificate approving Contractor or Subcontractors under the apprenticeship standards for the employment and training of apprentices in the area of the Project site. The committee will issue a certificate fixing the number of apprentices or the ratio of apprentices to journeypersons who shall be employed in the craft or trade on the Work. The ratio will not exceed that stipulated in the apprenticeship standards under which the joint apprenticeship committee operates; but in no case shall the ratio be less than 1 hour of apprentice work for every 5 hours of journeyperson work, except as permitted by law. Contractor or Subcontractors shall, upon the issuance of the approval certificate in each such craft or trade, employ the number of apprentices or the ratio of apprentices to journeypersons fixed in the certificate issued by the joint apprenticeship committee or present an exemption certificate issued by the Division of Apprenticeship Standards.

14.5.5 “Apprenticeship craft or trade,” as used in this Article 14.5, shall mean a craft or trade determined as an apprenticeship occupation in accordance with rules and regulations prescribed by the Apprenticeship Council.

14.5.6 If Contractor or Subcontractors employ journeyworkers or apprentices in any apprenticeship craft or trade in the area of the Project site, and there exists a fund for assisting to allay the cost of the apprenticeship program in the trade or craft, to which fund or funds other contractors in the area of the Project site are contributing, Contractor and Subcontractors shall contribute to the fund or funds in each craft or trade in which they employ journeyworkers or apprentices on the Work in the same amount or upon the same basis and in the same manner done by the other contractors. Contractor may include the amount of such contributions in computing its bid for the Contract; but if Contractor fails to do so, it shall not be entitled to any additional compensation therefor from University.

14.5.7 In the event Contractor willfully fails to comply with this Article 14.5, it will be considered in violation of the requirements of the Contract.

14.5.8 Nothing contained herein shall be considered or interpreted as prohibiting or preventing the hiring by Contractor or Subcontractors of journeyworker trainees who may receive on-the-job training to enable them to achieve journeyworker status in any craft or trade under standards other than those set forth for apprentices.

14.6 WORK DAY

14.6.1 Contractor shall not permit any worker to labor more than 8 hours during any 1 day or more than 40 hours during any 1 calendar week, except as permitted by law and in such cases only upon such conditions as are provided by law. Contractor shall forfeit to University, as a penalty, $25 for each worker employed in the execution of this Contract by Contractor, or any Subcontractor, for each day during which such worker is required or permitted to work more than 8 hours in any 1 day and 40 hours in any 1 calendar week in violation of the terms of this Article 14.6 or in violation of the provisions of any law of the State of California. Such forfeiture amounts may be deducted from the Contract Sum. Contractor and each Subcontractor shall keep, or cause to be kept, an accurate record showing the actual hours worked each day and each calendar week by each worker employed on the Project, which record shall be kept open at all reasonable hours to the inspection of University, its officers and agents, and to the inspection of the appropriate enforcement agency of the State of California.

ARTICLE 15
MISCELLANEOUS PROVISIONS

15.1 GOVERNING LAW

15.1.1 The Contract shall be governed by the law of the State of California.

15.2 SUCCESSORS AND ASSIGNS

15.2.1 University and Contractor respectively bind themselves and their successors, permitted assigns, and legal representatives to the other party and to the successors, permitted assigns, and legal representatives of such other party in respect to covenants, agreements, and obligations contained in the Contract Documents. Neither party to the Contract shall assign the Contract, in whole or in part, without prior written consent of the other party. Notwithstanding any such assignment, each of the original contracting parties shall remain legally responsible for all of its obligations under the Contract.

15.3 RIGHTS AND REMEDIES

15.3.1 All University's rights and remedies under the Contract Documents will be cumulative and in addition to and not in limitation of all other rights and remedies of University under the Contract Documents or otherwise available at law or in equity.

15.3.2 No action or failure to act by University or University's Representative will constitute a waiver of a right afforded them under the Contract, nor will such action or failure to act constitute approval of or acquiescence in a condition or breach thereunder, except as may be specifically agreed in writing. No waiver by University or University's Representative of any condition, breach or default will constitute a waiver of any other condition, breach or default; nor will any such waiver constitute a continuing waiver.

15.3.3 No provision contained in the Contract Documents shall create or give to third parties any claim or right of action against University, University's Representative, or Contractor.

15.4 SURVIVAL

15.4.1 The provisions of the Contract which by their nature survive termination of the Contract or Final Completion, including all warranties, indemnities, payment obligations, and University's right to audit Contractor's books and records, shall remain in full force and effect after Final Completion or any termination of the Contract.

15.5 COMPLETE AGREEMENT

15.5.1 The Contract Documents constitute the full and complete understanding of the parties and supersede any previous agreements or understandings, oral or written, with respect to the subject matter hereof. The Contract may be modified only by a written instrument signed by both parties or as provided in Article 7.

15.6 SEVERABILITY OF PROVISIONS

15.6.1 If any one or more of the provisions contained in the Contract Documents should be invalid, illegal, or unenforceable in any respect, the validity, legality, and enforceability of the remaining provisions contained herein shall not in any way be affected or impaired thereby.

15.7 UNIVERSITY'S RIGHT TO AUDIT

15.7.1 University and entities and agencies designated by University will have access to and the right to audit and the right to copy at University's cost all of Contractor's books, records, contracts, correspondence, instructions, drawings, receipts, vouchers, purchase orders, and memoranda relating to the Work. Contractor shall preserve all such records and other items during the performance of the Contract and for a period of at

least 3 years after Final Completion.

15.8 METHODS OF DELIVERY FOR SPECIFIED DOCUMENTS

15.8.1 The following documents must be delivered in a manner specified in Article 15.8.2:

.1 Contractor Notices of election to litigate or arbitrate;
.2 Written demand for an informal conference to meet and confer pursuant to Article 4.5;
.3 University's written statement identifying remaining disputes following informal conference pursuant to Article 4.6;
.4 Written demand for non-binding mediation pursuant to Article 4.6;
.5 Contractor claims pursuant to Article 4.3;
.6 Contractor notices of conditions pursuant to Articles 3.17, 3.18, or 3.19;
.7 University's notices of Contractor's failure to perform and/or correct defective work pursuant to Articles 4.1.6, 12.2 and 13.2.3;
.8 University's notice to stop work pursuant to Article 2.3.1:
.9 Notices of termination or suspension pursuant to Article 13.

15.8.2 Delivery methods for documents specified in Article 15.8.1:

.1 By personal delivery.
.2 Sent by facsimile copy where receipt is confirmed.
.3 Sent by Express Mail, or another method of delivery providing for overnight delivery where receipt is confirmed.
.4 Sent by registered or certified mail, postage prepaid, return receipt requested.

15.8.3 The documents identified in Article 15.8.1 shall only be effective if delivered in the manner specified in Article 15.8.2. Subject to the forgoing, such documents shall be deemed given and received upon actual receipt in the case of all except registered or certified mail; and in the case of registered or certified mail, on the date shown on the return receipt or the date delivery during normal business hours was attempted. Delivery of the specified documents shall be made at the respective street addresses set forth in the Agreement. Such street addresses may be changed by notice given in accordance with this Article 15.8.

15.9 TIME OF THE ESSENCE

15.9.1 Time limits stated in the Contract Documents are of the essence of the Contract.

15.10 MUTUAL DUTY TO MITIGATE

15.10.1 University and Contractor shall use all reasonable and economically practicable efforts to mitigate delays and damages to the Project and to one another with respect to the Project, regardless of the cause of such delay or damage.

15.11 UC FAIR WAGE

Contractor shall pay all persons providing construction services and/or any labor on site, including any University location, no less than the UC Fair Wage (defined as $13 per hour as of 10/1/15, $14 per hour as of 10/1/16, and $15 per hour as of 10/1/17) and shall comply with all applicable federal, state and local working condition requirements.

SUPPLEMENTARY CONDITIONS

1. MODIFICATION OF GENERAL CONDITIONS, ARTICLE 11 – INSURANCE AND BONDS

Contractor shall furnish and maintain insurance in the amounts below.

The insurance required by 11.1.2.1 and 11.1.2.2 shall be (i) issued by companies with a Best rating of A- or better, and a financial classification of VIII or better (or an equivalent rating by Standard & Poor or Moody's) or (ii) guaranteed, under terms consented to by the University (such consent to not be unreasonably withheld), by companies with a Best rating of A- or better, and a financial classification of VIII or better (or an equivalent rating by Standard & Poor or Moody's). Such insurance shall be written for not less than the following:

		Minimum Requirement
11.1.2.1	Commercial General Liability Insurance-Limits of Liability	
	Each Occurrence-Combined Single Limit for Bodily Injury and Property	$1,000,000
	Products-Completed Operations Aggregate	$1,000,000
	Personal and Advertising Injury	$1,000,000
	General Aggregate	$2,000,000
11.1.2.2	Business Automobile Liability Insurance-Limits of Liability Each Accident-Combined Single Limit for Bodily Injury and Property Damage	$1,000,000

Insurance required by Paragraph 11.1.2.3 shall be issued by companies (i) that have a Best rating of B+ or better, and a financial classification of VIII or better (or an equivalent rating by Standard & Poor or Moody's); or (ii) that are acceptable to the University. Such insurance shall be written for not less than the following:

		Minimum Requirement
11.1.2.3	WORKER'S COMPENSATION AND EMPLOYER'S LIABILITY –	
	Worker's Compensation:	(as required by Federal and State of California law)
	Employer's Liability:	
	Each Employee	$1,000,000
	Each Accident	$1,000,000
	Policy Limit	$1,000,000

2. MODIFICATION OF ARTICLE 8 – CONTRACT TIME

Rainy weather in excess of the following number of days will be granted a Contract Time extension pursuant to Article 8.4 of the General Conditions:

0 Days

3. MODIFICATION OF GENERAL CONDITIONS ARTICLE 15 – MISCELLANEOUS PROVISIONS

This Agreement may be executed in two or more counterparts, each of which shall be deemed an original but all of which together shall constitute one and the same Agreement. The counterparts of this Agreement may be executed via a University approved digital signature process and shall have the same force and effect as the use of a manual signature. The University reserves the right to reject any digital signature that cannot be positively verified by the University system as an authentic digital signature.

EXHIBITS

TABLE OF CONTENTS

UCR Planning, Design & Construction

Project Name: West Lothian Air Handler Replacement
Project Number: 956394
Contract Number: 956394-LF-2019-105

APPLICATION FOR PAYMENT

Application No. _____ Period From: _____ To: _____

Application Date: _____ Contract Date: _____

To **University**: THE REGENTS OF THE UNIVERSITY OF CALIFORNIA,
University of California, Riverside, and University's Representative

From Contractor: _____

Address: _____

_____

CHANGE ORDER SUMMARY:		Additions	Deductions
Change Orders approved in previous months:	Total:		
Change Orders approved this month:			
Number:	Date Approved:		
	Total:	$-	$-

NET CHANGE BY CHANGE ORDERS: $-

Application is made for payment under the Contract as shown below and in Schedule 1 attached hereto:

1.	ORIGINAL CONTRACT SUM	
2.	NET CHANGE BY CHANGE ORDERS	$-
3.	CONTRACT SUM TO DATE (Line 1 ± Line 2)	$-
4.	TOTAL AMOUNT COMPLETED TO DATE (Column E on Schedule 1)	
5.	RETENTION: _____ % of Completed Work (Column H on Schedule 1)*	
	a. Current Value of Securities Deposited in Escrow	
	b. Current Value of Retention Deposited in Escrow	
	c. Retention Held by University	
	Current Retention Value (a + b + c) $-	
6.	TOTAL EARNED LESS RETENTION (Line 4 less Line 5)	$-
7.	TOTAL AMOUNT PREVIOUSLY PAID	
8.	CURRENT PAYMENT DUE (Line 6 less Line 7)	$-
9.	BALANCE TO FINISH, PLUS RETENTION (Line 3 less Line 6)	$-

*Pursuant to Article 9.2.2 of the General Conditions.

The undersigned Contractor hereby represents and warrants to University that all Work, for which Certificates For Payment have previously been issued and payment received from University, is free and clear of all claims, stop notices, security interests, and encumbrances in favor of Contractor, any Subcontractor, and any other persons or firms entitled to make claims by reason of having provided labor, materials, or equipment related to the Work.

The following Schedules are attached and incorporated herein, and made a part of this Application For Payment:

Schedule 1 Cost Breakdown Schedule
Schedule 2 Certification of Current Market Value of Securities in Escrow in Lieu of Retention
Schedule 3 List of Subcontractors
Schedule 4 Declaration of Releases of Claims

Contractor: _____

By: _____
(Signature & Date)

_____
(Print Name & Title)

DECLARATION

I, _____, hereby declare that I am the
(Print Name)

_____ of Contractor submitting this Application For
(Title)

Payment; that I am duly authorized to execute and deliver this Application For Payment on behalf of Contractor; and that all information set forth in this Application For Payment and all Schedules attached hereto are true, accurate, and complete as of its date.

I declare, under penalty of perjury, that the foregoing is true and correct and that this declaration was subscribed at _____, _____,
(City) (County)

State of _____ on _____.
(Date)

_____
(Signature & Date)

_____
(Print Name & Title)

UCR Architects & Engineers

Project Name: West Lothian Air Handler Replacement

Project Number: 956394

Contract Number: 956394-LF-2019-105

SCHEDULE 1
COST BREAKDOWN
TO
APPLICATION FOR PAYMENT

Application No. _____ Period From: _____ To: _____

Application Date: _____ Contract Date: _____

A Item No.	B Description of Work Activity or Other Item	C Scheduled Value	D % Complete to Date	E Total Amount Completed to Date (C x D)	F Total Amount Completed on Prior Application For Payment	G Amount of this Application (E - F)	H Retention (5% x E)
				-		-	-
				-		-	-
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				-		-	-
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				$-	$-	$-	$-

Project Name: West Lothian Air Handler Replacement

Project Number: 956394

Contract Number: 956394-LF-2019-105

SCHEDULE 2
CERTIFICATION OF CURRENT MARKET VALUE OF SECURITIES IN ESCROW IN LIEU OF RETENTION TO APPLICATION FOR PAYMENT

Application No. _____ Period From: _____ To: _____

Application Date: _____ Contract Date: _____

As of _____ (not earlier than 5 days prior to the date of the Application For Payment
(Date)
of which this Certification is a part), the aggregate market value of securities on deposit in Escrow Account No. _____ with _____
(Escrow Agent)

is _____ Dollars ($ _____).

_____ _____
(Escrow Agent) (Contractor)

By: _____ By: _____
(Sign & Date) (Sign & Date)

_____ _____
(Print Name & Title) (Print Name & Title)

NOTE: Notary acknowledgment for Contractor and Escrow Agent must be attached.

UCR Architects & Engineers

Project Name: West Lothian Air Handler Replacement
Project Number: 956394
Contract Number: 956394-LF-2019-105

SCHEDULE 3
LIST OF SUBCONTRACTORS
TO
APPLICATION FOR PAYMENT

Application No. _____ Period From: _____ To: _____

Application Date: _____ Contract Date: _____

Subcontractors listed below are all Subcontractors furnishing labor, services, or materials for the period referred to in the Application For Payment referenced above, of which this Schedule 3 is a part:

Name of Subcontractor	Subcontracted Work Activity	Date Work Activity Completed

_____
(Contractor)

By: _____
(Sign & Date)

_____
(Print Name & Title)

UCR Architects & Engineers

Project Name: West Lothian Air Handler Replacement
Project Number: 956394
Contract Number: 956394-LF-2019-105

SCHEDULE 4
DECLARATION OF RELEASE OF CLAIMS
TO
APPLICATION FOR PAYMENT

Application No. _____ Period From: _____ To: _____

Application Date: _____ Contract Date: _____

Contractor hereby certifies that attached hereto are releases and waivers of claims and stop notices from all Subcontractors furnishing labor, services, or materials covered by the Certificate For Payment for the preceding Application for Payment No. _____, except for those listed below:

Name of Subcontractor	Subcontracted Work Activity	Date Work Activity Completed

_____
(Contractor)

By: _____
(Sign & Date)

_____
(Print Name & Title)

UCR | Planning, Design & Construction

ACORD®

CERTIFICATE OF LIABILITY INSURANCE

(for non-UCIP Construction Projects and Consultant/Design Contracts)

DATE (MM/DD/YYYY)

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

IMPORTANT: If the certificate holder is an ADDITIONAL INSURED, the policy(ies) must be endorsed. If SUBROGATION IS WAIVED, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

PRODUCER	CONTACT NAME:	
	PHONE (A/C, No, Ext):	FAX (A/C, No):
	E-MAIL ADDRESS:	

INSURED	INSURER(S) AFFORDING COVERAGE	NAIC #
	INSURER A :	
	INSURER B :	
	INSURER C :	
	INSURER D :	
	INSURER E :	
	INSURER F :	

COVERAGES **CERTIFICATE NUMBER:** **REVISION NUMBER:**

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR LTR	TYPE OF INSURANCE	ADDL INSR	SUBR WVD	POLICY NUMBER	POLICY EFF (MM/DD/YYYY)	POLICY EXP (MM/DD/YYYY)	LIMITS
	GENERAL LIABILITY ☐ COMMERCIAL GENERAL LIABILITY ☐ CLAIMS-MADE ☐ OCCUR GEN'L AGGREGATE LIMIT APPLIES PER: ☐ POLICY ☐ PRO-JECT ☐ LOC						
	AUTOMOBILE LIABILITY ☐ ANY AUTO ☐ ALL OWNED AUTOS ☐ SCHEDULED AUTOS ☐ HIRED AUTOS ☐ NON-OWNED AUTOS						
	☐ **UMBRELLA LIAB** ☐ OCCUR ☐ **EXCESS LIAB** ☐ CLAIMS-MADE ☐ DED ☐ RETENTION $						
	WORKERS COMPENSATION AND EMPLOYERS' LIABILITY ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED? Y / N ☐ **(Mandatory in NH)** If yes, describe under DESCRIPTION OF OPERATIONS below	**N/A**					☐ WC STATU-TORY LIMITS ☐ OTH-ER
	PROFESSIONAL LIABILITY ☐ OCCUR ☐ CLAIMS-MADE						

Special Provisions:

1. The Regents of the University of California, The University of California, University, and each of their Representatives, consultants, officers, agents, employees, and each of their Representative's consultants, are included as additional insureds on the general liability policy as required by contract and pursuant to additional insured endorsement CG2010 (11/85) or a combination of both CG 2010 (10/01 or 07/04) and CG 2037 (10/01 or 07/04) but only in connection with West Lothian Air Handler Replacement, Project No. 956394, Contract No. 396394-LF-2019-105.
2. The General Liability coverage contains a Severability of Interest provision and shall be primary insurance as respects The Regents of the University of California, its officers, agents and employees. Any insurance or self-insurance maintained by The Regents of the University of California shall be excess of and non-contributory with this insurance.

CERTIFICATE HOLDER: The Regents of the University of California

Forward to: UCR CAPITAL PROGRAMS PLANNING, DESIGN & CONSTRUCTION, ATTN: CONTRACTS 1223 UNIVERSITY AVENUE, SUITE 240 RIVERSIDE, CA 92507	**SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS.** ***AUTHORIZED REPRESENTATIVE***

CERTIFICATE OF SUBSTANTIAL COMPLETION

Contractor: _____ Date of Issuance: _____

The Work has been reviewed and the date of Substantial Completion is hereby established as of the date of issuance above.

A Certificate of Occupancy has been issued by the University's Building Official **Robert K. Williams**, **Director of Inspection & Quality Assurance Certified Building Official** on **Date**.

A punch list of items to be completed or corrected is included herein. The failure to include any items on such list does not alter the responsibility of Contractor to complete all of the Work in accordance with the Contract Documents.

In accordance with the Contract Documents, Contractor is notified as follows:

1. Without limitation of Contractor's obligation to fully complete the Work within the Contract Time, Contractor shall complete or correct the Work on the list of items ("Punch List") attached hereto within days from the date of Substantial Completion.

2. University will be responsible for **INSERT "NONE" OR STATE ANY UNIVERSITY RESPONSIBILITIES AFTER SUBSTANTIAL COMPLETION: security, maintenance, utilities (e.g. water, sewer, electrical, gas, etc.)**

3. Contractor shall be responsible for all Contract requirements except items or responsibilities of University set forth in Paragraph 2 above.

4. List of items to be completed or corrected: **INSERT "NONE" or "SEE ATTACHMENT: LIST OF ITEMS TO BE COMPLETED OR CORRECTED."**

UNIVERSITY'S REPRESENTATIVE

(Signature & Date)
John Franklin
Senior Project Manager
Planning, Design & Construction
(Print Name & Title)

UNIVERSITY:
By: The Regents of the University of California
University of California, Riverside

(Signature & Date)
Blythe R. Wilson, Architect
Director of Project Management
Planning, Design & Construction
(Print Name & Title)

cc: Office of Risk Management

PUNCH LIST OF ITEMS TO BE COMPLETED OR CORRECTED

ATTACHMENT TO CERTIFICATE OF SUBSTANTIAL COMPLETION ISSUED

Contractor:

UCR | Planning, Design & Construction

Project Name: West Lothian Air Handler Replacement
Project Number: 956394
Contract Number: 956394-LF-2019-105

CHANGE ORDER

Contract Date: _____

Change Order No.: _____
Date Issued: _____

To Contractor: _____
Attn: _____
Address: _____

DESCRIPTION OF CHANGE: (Reference attachments)	Contract Sum Adjustment	Contract Time Adjustment
1.		
2.		
☐ **Description of Change continued on Page 2. Subtotal from Page 2:**	**$0.00**	**0**

Adjustment of Contract Sum:		Adjustment of Contract Time:		
Original Contract Sum:		Original Contract Time:	0	(Days)
Prior Adjustments:		Prior Adjustments:	0	(Days)
Contract Sum before this Change:	**$-**	Contract Time before this Change:	**0**	(Days)
Adjustment for this Change:	**$-**	Adjustment for this Change:	**0**	(Days)
Revised Contract Sum:	**$-**	Revised Contract Time:	**0**	(Days)
		Start Date:		
		Original Final Completion Date:	##########	
		Revised Final Completion Date:	##########	

Contractor waives any claim for further adjustments of the Contract Sum and the Contract Time related to the above described change in the Work.

Accepted:
By: Contractor

_____
(Signature & Date)

_____
(Print Name & Title)

Recommended:
By: University's Representative

_____
(Signature & Date)
John Franklin
Senior Project Manager
Planning, Design & Construction
(Print Name & Title)

Funds Sufficient:
By: Financial Administrative Officer

_____
(Signature & Date)
Susan McFadden
Senior Financial Analyst
Planning, Design & Construction
(Print Name & Title)

Approved:
University: The Regents of the University of California

_____
(Signature & Date)
Blythe R. Wilson, Architect
Director of Project Management
Planning, Design & Construction
(Print Name & Title)

Account No.: _____ Activity Code: _____
Fund: _____ Function: _____
Cost Center: _____ Project Code: _____

UCR | Planning, Design & Construction

Project Name: West Lothian Air Handler Replacement
Project Number: 956394
Contract Number: 956394-LF-2019-105

CHANGE ORDER

Contract Date: _____ Change Order No.: _____

	DESCRIPTION OF CHANGE - CONTINUED	Contract Sum Adjustment	Contract Time Adjustment
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
	Subtotals:	**$0.00**	**0**

CHANGE ORDER REQUEST

Date: _____ Change Order Request (COR) No. _____

Scope of Change:

Instructions:

1. Complete this form by providing (a) all information required above, (b) the amount and justification based upon the Contract Schedule for any proposed adjustment of Contract Time, (c) the proposed adjustment of Contract Sum, (d) the attached "Cost Proposal Summary," and (e) the attached form entitled, "Supporting Documentation for the Cost Proposal Summary."

2. Attach the form entitled "Supporting Documentation for the Cost Proposal Summary" for Contractor and each Subcontractor involved in the Extra Work. Each such form shall be completed and signed by Contractor or Subcontractor actually performing the Work Activity identified on the form. Attach supporting data to each such form to substantiate the individually listed costs. The costs provided on these forms shall be used to substantiate additional costs shown on the Cost Proposal Summary.

3. The Contractor Fee shall be computed on the Cost of Extra Work of Contractor and each Subcontractor involved in the Extra Work; and shall constitute full compensation for all costs and expenses related to the subject change and not listed in the "Supporting Documentation for the Cost Proposal Summary," including overhead and profit.

4. Refer to Article 7.3 of the General Conditions for the method of computing the Contractor Fee.

Adjustment of the Contract Time (Include justification based upon the Contract Schedule): _____ (Days)
Refer to Article 8 of the General Conditions.

Adjustment of the Contract Sum (Total from Line 18, Col. 4 of Cost Proposal Summary): $ _____
Refer to Article 7 of the General Conditions.

Submitted: CONTRACTOR **Received: UNIVERSITY'S REPRESENTATIVE**

_____
(Company Name)

_____
(Signature & Date)

_____
(Print Name & Title)

_____
(Signature & Date)

John Franklin
Senior Project manager
Planning, Design & Construction
(Print Name & Title)

cc: Executive Director, Architects & Engineers, Capital Programs

COST PROPOSAL SUMMARY

Contractor: _____ COR No. _____

		(1) Contractor	(2) 1st Tier Subs	(3) 2nd & Lower Tier Subs	(4) Total
ACTUAL COSTS	1. Straight Time Wages/Salaries-Labor				-
	2. Fringe Benefits and Payroll Taxes-Labor				-
	3. Overtime Wages/Salaries-Labor				-
	4. Fringe Benefits & Payroll Taxes-Overtime				-
	5. Materials & Cnsumable Items				-
	6. Sales Taxes (On Line 5)				-
	7. Rental Charges				-
	8. Royalties				-
	9. Permits				-
	10. Total Direct Expense (Sum of Lines 1-9)	**$-**	**$-**	**$-**	**$-**
	11. Insurance & Bonds (up to 2% of Line 10)	-	-	-	-
CONTRACTOR FEE	12. Sub-Sub (15% of Line 10, Col. 3)			-	-
	13. Subcontractor (5% of Line 10, Col. 3)		-		-
	14. Subcontractor (15% of Line 10, Col. 2)		-		-
	15. Contractor (5% of Line 10, Col. 2 & 3)	-			-
	16. Contractor (15% of Line 10, Col. 1)	-			-
	17. Contractor Fee (Sum of Lines 12-16)	$-	$-	$-	$-
TOTAL	18. Sum of Lines 10, 11, & 17	**$-**	**$-**	**$-**	**$-**

Actual Costs are taken from Line 12 of the attached forms entitled, “Supporting Documentation For the Cost Proposal Summary” for Contractor and each Subcontractor involved in the Extra Work.

SUPPORTING DOCUMENTATION FOR THE COST PROPOSAL SUMMARY

Supporting Documentation From: _____ COR No. _____
(Contractor/Subcontractor Name)

Work Activity: _____

COST ITEM	DESCRIPTION	COST[1]
ACTUAL COSTS	1. Straight Time Wages/Salaries-Labor	
	2. Fringe Benefits & Payroll Taxes-Labor: ___% of Line 1	
	3. Overtime Wages/Salaries-Labor (Attach University's Representative's written authorization.)	
	4. Fringe Benefits & Payroll Taxes-Overtime: ___% of Line 3	
	5. Materials & Consumable Items	
	6. Sales Taxes: ___% of Line 5	
	7. Rental Charges (Attach CalTrans' Schedule.)	
	8. Royalties	
	9. Permits	
	10. Total Direct Expense (Sum of Lines 1-9)	**$-**
	11. Insurance & Bonds ___% of Line 10 (up to 2% of Line 10)	-
TOTAL	12. Sum of Lines 10 & 11	**$-**

Prepared By:[2]

_____
(Company Name)

_____
(Signature & Date)

_____
(Print Name & Title)

CONTRACTOR:[3]

_____
(Company Name)

_____
(Signature & Date)

_____
(Print Name & Title)

Notes:

(1) This form shall be prepared and signed by Contractor or Subcontractor actually performing the Work Activity indicated above.
(2) If this form is signed by a Subcontractor, it shall be reviewed and signed by Contractor certifying the accuracy of the information.

CLAIM CERTIFICATION - GENERAL CONTRACTOR

Pursuant to Article 4.3.3 of the General Conditions, I certify as follows:

1. The Claim to which this certification is attached is made in good faith.

2. Amounts claimed for costs, expenses and damages incurred by Contractor are accurate and complete. Supporting data for amounts incurred by Contractor is accurate and complete. Any such supporting data, including any such new amounts, submitted after the execution of this certification, will be accurate and complete.

3. To the best of my knowledge and belief, amounts claimed, and supporting data submitted by Contractor on behalf of any and all subcontractors or suppliers, of all tiers, or any person or entity under Contractor, are accurate and complete. Contractor will not submit, after the date of execution of this certification, any such supporting data, including any such new amounts that, to the best of my knowledge and belief, is not accurate and complete.

4. The amount requested accurately reflects the adjustment of the Contract Sum for which the Contractor believes the University is liable.

5. Attached hereto is a certification that has been executed by each Subcontractor claiming not less than 5% of the total monetary amount sought by the claim to which this certification is attached.

6. I am duly authorized to certify the Claim on behalf of the Contractor.

I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct and that this declaration was executed at _____ (Name of City if within a City, otherwise, Name of County),

in the State of _____ (Name of State), on _____ (Date).

_____
(Name of Contractor)

By: _____
(Signature)

_____
(Print Name & Title)

CLAIM CERTIFICATION - SUBCONTRACTOR

Pursuant to Article 4.3.3 of the General Conditions, I certify as follows:

1. The portion of the Claim made on behalf of the Subcontractor to which this certification is attached is made in good faith.

2. Amounts claimed for costs, expenses and damages incurred by the Subcontractor are accurate and complete. Supporting data for amounts incurred by the Subcontractor is accurate and complete. Any such supporting data, including any such new amounts, submitted to Contractor after the execution of this certification, will be accurate and complete.

3. To the best of my knowledge and belief, amounts claimed, and supporting data submitted to Contractor by the Subcontractor on behalf of any and all subcontractors or suppliers to Subcontractor, of all tiers, or any person or entity under Subcontractor, are accurate and complete. Subcontractor will not submit, after the date of execution of this certification, any such supporting data, including any such new amounts that, to the best of my knowledge and belief, is not accurate and complete.

4. The amount requested accurately reflects the amount for which the Subcontractor believes the University is liable to Contractor.

5. I am duly authorized to certify the Claim on behalf of the Subcontractor.

I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct and that this declaration was executed at _____ ,
(Name of City if within a City, otherwise, Name of County)

in the State of _____ , on _____ .
(Name of State) (Date)

_____
(Name of Subcontractor)

By: _____
(Signature)

_____
(Print Name & Title)

CONDITIONAL WAIVER AND RELEASE ON FINAL PAYMENT

NOTICE:
THIS DOCUMENT WAIVES THE CLAIMANT'S LIEN, STOP PAYMENT NOTICE, AND PAYMENT BOND RIGHTS EFFECTIVE ON RECEIPT OF PAYMENT. A PERSON SHOULD NOT RELY ON THIS DOCUMENT UNLESS SATISFIED THAT THE CLAIMANT HAS RECEIVED PAYMENT.

Identifying Information:

Name of Claimant: _____

Name of Customer: _____

Job Location: **West Lothian Air Handler Replacement, Project No. 956394**

University of California, Riverside, City of Riverside, County of Riverside

Owner: **The Regents of the University of California**

Conditional Waiver and Release:

This document waives and releases lien, stop payment notice, and payment bond rights the claimant has for labor and service provided, and equipment and material delivered, to the customer on this job. Rights based upon labor or service provided, or equipment or material delivered, pursuant to a written change order that has been fully executed by the parties prior to the date that this document is signed by the claimant, are waived and released by this document, unless listed as an Exception below. This document is effective only on the claimant's receipt of payment from the financial institution on which the following check is

Maker of Check: _____

Amount of Check: $ _____

Check Payable to: _____

Exceptions:

This document does not affect any of the following: Disputed claims for extras in the amount of:

$ _____ .

Signature:

Claimant's Signature & Date: _____

Claimant's Name & Title: _____

Prime Contractor's Application for Payment # _____

CONDITIONAL WAIVER AND RELEASE ON PROGRESS PAYMENT

NOTICE:
THIS DOCUMENT WAIVES THE CLAIMANT'S LIEN, STOP PAYMENT NOTICE, AND PAYMENT BOND RIGHTS EFFECTIVE ON RECEIPT OF PAYMENT. A PERSON SHOULD NOT RELY ON THIS DOCUMENT UNLESS SATISFIED THAT THE CLAIMANT HAS RECEIVED PAYMENT.

Identifying Information:

Name of Claimant: _____

Name of Customer: _____

Job Location: **West Lothian Air Handler Replacement, Project No. 956394**
University of California, Riverside, City of Riverside, County of Riverside

Owner: **The Regents of the University of California**

Through Date: _____

Conditional Waiver and Release:

This document waives and releases lien, stop payment notice, and payment bond rights the claimant has for labor and service provided, and equipment and material delivered, to the customer on this job through the Through Date of this document. Rights based upon labor or service provided, or equipment or material delivered, pursuant to a written change order that has been fully executed by the parties prior to the date that this document is signed by the claimant, are waived and released by this document, unless listed as an Exception below. This document is effective only on the claimant's receipt of payment from the financial institution on which the following check is drawn:

Maker of Check: _____

Amount of Check: $ _____

Check Payable to: _____

Exceptions:

This document does not affect any of the following:

(1) Retentions.
(2) Extras for which the claimant has not received payment.
(3) The following progress payments for which the claimant has previously given a conditional waiver and release but has not received payment:

Date(s) of Waiver and Release: _____

Amount(s) of Unpaid Progress Payment(s): $ _____

(4) Contract rights, including (A) a right based on rescission, abandonment, or breach of contract, and (B) the right to recover compensation for work not compensated by the payment.

Signature:

Claimant's Signature & Date: _____

Claimant's Name & Title: _____

Prime Contractor's Application for Payment # _____

RETURN THIS AGREEMENT SIGNED BY CONTRACTOR AND ESCROW AGENT TO:
UNIVERSITY OF CALIFORNIA, RIVERSIDE
Planning, Design & Construction
1223 University Ave, Suite 240
Riverside, CA 92507
USE THIS ADDRESS FOR ALL CORRESPONDENCE

Escrow Account No.: _____

ESCROW AGREEMENT FOR DEPOSIT OF SECURITIES IN LIEU OF RETENTION AND DEPOSIT OF RETENTION

This Escrow Agreement is made as of _____ (Date), and entered into by and between THE REGENTS OF THE UNIVERSITY OF CALIFORNIA, hereinafter called "University," and

_____,

whose address is _____,

hereinafter called "Contractor," and _____,

a state or federally chartered bank in the state of California, whose address is

_____,

hereinafter called "Escrow Agent."

For consideration hereinafter set forth, University, Contractor, and Escrow Agent agree as follows:

(1) Contractor has the option to deposit securities with Escrow Agent as a substitute for retention required to be withheld by University pursuant to the Contract Documents, hereinafter referred to as "Contract," entered into between University and Contractor for the Project titled

West Lothian Air Handler Replacement,

Project Number **956394**, in the amount of $ _____,

dated _____. Alternatively, on written request of Contractor, University shall deposit retention directly with Escrow Agent. Contractor and its surety shall be at risk for failure of the Escrow Agent selected. When Contractor deposits the securities as a substitute for retention, Escrow Agent shall notify University within 5 days after the deposit. At all times, Contractor shall have on deposit securities the market value of which is at least equal to the cash amount then required to be withheld as retention under the terms of the Contract. Securities shall be held in the name of The Regents of the University of California, Riverside; and Contractor shall be designated as the beneficial owner.

(2) Escrow Agent shall review the market value of securities deposited in escrow under this Escrow Agreement as often as conditions of the securities market warrant, but in no case less than once per month. Escrow Agent shall promptly notify University and Contractor of the market value of the deposited securities if such market value is less than the total amount of retention required to be withheld under the terms of the Contract. Contractor shall promptly deposit additional securities so that the current market value of the total of all deposited securities shall be at least equal to the total required amount of retention. Escrow Agent shall,

within 5 days after University's request, provide a statement to University of the current market value of all securities deposited under this Escrow Agreement as of a date not earlier than 5 days prior to such request. The provisions of this Paragraph 2 shall not apply to securities consisting of monetary deposits as allowed by Paragraph 7 held by a bank as Escrow Agent, provided the bank provides monthly statements reflecting the status of the monetary deposits held by the bank to University and Contractor.

(3) Contractor shall not use any or all of the securities deposited in lieu of retention under this Escrow Agreement for any other obligations, including deposits in lieu of retention for other contracts. Contractor represents, covenants and warrants that all deposited securities shall be lien free when tendered to the Escrow Agents and shall remain lien free during their retention by the Escrow Agent.

(4) University shall make progress payments to Contractor for those funds which otherwise would be withheld from progress payments pursuant to the Contract provision, provided that Escrow Agent holds securities in the form and amount specified herein.

(5) Prior to Contractor's submission of each Application For Payment, Escrow Agent shall issue a current statement of (a) the value of the securities currently being deposited in lieu of retention and (b) the current value of all securities being held in escrow pursuant to this Escrow Agreement. Such statement shall be no more than 5 days old at the time of submission, shall be notarized or have a guarantee of signature, and shall be submitted to Contractor with a copy to University under separate cover. Contractor shall attach such original statement to each Application For Payment. The provisions of this Paragraph 5 shall not apply to securities consisting of monetary deposits as allowed by Paragraph 7 held by a bank as Escrow Agent, provided the bank provides monthly statements reflecting the status of the monetary deposits held by the bank to University and Contractor.

(6) If, at the request of Contractor, University deposits retention directly with Escrow Agent, Escrow Agent shall hold such retention for the benefit of Contractor until such time as the escrow created under the Contract is terminated. All terms and conditions of this Escrow Agreement and the rights and responsibilities of the parties shall be equally applicable and binding when University deposits retention directly with Escrow Agent.

(7) University will allow Contractor to deposit the following securities in lieu of retention and direct the investment of the retention deposits into any of the following which at the time of payment are legal investments under the laws of the State of California:

a. Direct obligations of the United States of America (including obligations issued or held in book-entry form on the books of the Department of the Treasury of the United States of America or any Federal Reserve Bank), or obligations the timely payment of the principal of and interest on which are fully guaranteed by the United States of America, or tax-exempt obligations which are rated in the highest rating category of a nationally recognized bond rating agency.

b. Obligations, debentures, notes or other evidence of indebtedness issued or guaranteed by any of the following: Banks for Cooperatives, Federal Intermediate Credit Banks, Federal Home Loan Bank System, Export-Import Bank of the United States, Federal Financing Bank, Federal Land Banks, Federal Farm Credits, Government National Mortgage Association, Farmer's Home Administration, Federal Home Loan Mortgage Corporation, or Federal Housing Administration.

c. Bonds of the State of California or those for which the faith and credit of the State of California are pledged for the payment of principal and interest.

d. Interest-bearing bankers acceptances and demand or time deposits (including certificates of deposit) in banks, provided such deposits are either (1) secured at all times, in the manner and to the extent provided by law, by collateral security described in clauses a or b of this Paragraph 7 continuously having a market value at least equal to the amount so invested so long as such underlying obligations or securities are in the possession of the Securities Investors Protection Corporation, (2) in banks having a combined capital and surplus of at least One Hundred Million Dollars, or (3) fully insured by the Federal Deposit Insurance Corporation.

e. Taxable government money market portfolios restricted to obligations with maturities of one (1) year or less, issued or guaranteed as to payment of principal and interest by the full faith and credit of the United States of America.

f. Commercial paper rated in the highest rating category of a nationally recognized rating agency, and issued by corporations organized and operating within the United States of America and having total assets in excess of Five Hundred Million Dollars.

(8) Contractor shall be responsible for paying all fees, costs, and expenses incurred by Escrow Agent in administering the escrow account. These expenses and payment terms shall be determined by Contractor and Escrow Agent. All fees, costs, and expenses of this Escrow Agreement and any transactions carried out hereunder shall be billed by Escrow Agent to Contractor. In the event that any fees, costs, or expenses shall remain unpaid in excess of 30 days from the date due, Escrow Agent may withhold such unpaid amount from any income distributable to Contractor, but shall not withhold such unpaid amount from any income distributable to University.

(9) Interest earned on the securities or the money market accounts held in escrow and all interest earned on the interest shall be for the sole account of Contractor and shall be held in escrow. Interest may be withdrawn by Contractor from time to time, without notice to University, only to the extent that the total amount held in escrow meets or exceeds the required amount of retention.

(10) Except as provided in Paragraph 9, Contractor shall have the right to withdraw all or any part of the escrow account only by written notice to Escrow Agent accompanied by written authorization from University to Escrow Agent stating that University consents to the withdrawal of the amount sought to be withdrawn by Contractor. University shall not be obligated to consent to any withdrawal to the extent of stop notice claims which cannot be satisfied from other funds then due and payable to Contractor.

(11) University shall have the right to draw upon the securities, any interest earned on the securities, and any interest earned on the interest in the event of default by Contractor. Upon 7 days written notice to Escrow Agent from University, with a copy to Contractor, Escrow Agent shall immediately convert the securities, any interest earned on the securities, and all interest earned on the interest to cash and shall distribute the cash as instructed by University. Escrow Agent shall have no duty to determine whether a default has occurred and may rely solely upon the written notice of such default from University.

(12) Upon receipt of written notification from University certifying that final payment is due under the Contract, Escrow Agent shall release to Contractor the amount, if any, by which the value of all securities and interest on deposit less escrow fees and charges of the escrow account exceeds 125% of all stop notice claims on file. Escrow Agent shall pay the remaining amount to University or as directed by University. The escrow shall be closed immediately upon disbursement of all monies and securities on deposit and payment of fees and charges.

(13) Escrow Agent shall rely upon the written notifications from University and Contractor pursuant to this Escrow Agreement; and University and Contractor shall hold Escrow Agent harmless from Escrow Agent's release, conversion, and disbursement of the securities and interest as set forth herein.

(14) Escrow Agent shall have the right to terminate this Escrow Agreement upon 30 days notice to all parties hereunder. Upon receipt of such notice, University and Contractor shall appoint a successor Escrow Agent in writing and deliver written notice of such appointment to Escrow Agent. Thereupon, Escrow Agent shall deliver all assets in its custody to such successor Escrow Agent and all responsibility of Escrow Agent under this Escrow Agreement shall terminate; provided, however, if Contractor and University fail to appoint a successor Escrow Agent on or before the end of the 30 day notice period, then Escrow Agent is authorized and instructed to return all assets, documents, and other items in its custody to University and this Escrow Agreement shall be terminated without further instruction.

(15) The duties and responsibilities of Escrow Agent shall be limited to those expressly set forth in this Escrow Agreement; provided, however, that, with Escrow Agent's written consent, the duties and responsibilities in this Escrow Agreement may be amended at any time or times by an instrument in writing signed by all parties.

(16) Whenever Contractor tenders securities to be deposited in lieu of retention, an authorized representative of the Contractor shall declare under penalty of perjury that the securities are lien free and shall remain lien free during their retention by the Escrow Agent. The declaration shall be in the following form:

"The undersigned, on behalf of _____ whose address is
(Name of Contractor)

_____ ,
(Street Address, City, State & Zip Code)

represents, covenants and warrants that the securities tendered herewith are lien free and shall remain lien free during their retention by the Escrow Agent.

I, _____ , hereby declare that I am the
(Name)

_____ of _____ ,
(Title) (Name of Contractor)

that I am duly authorized to make this representation, and that I declare under perjury under the laws of the State of California that the foregoing is true and correct."

_____ _____
(Signature) (Date)

(17) The names of the persons authorized to give written notice or to receive written notice on behalf of University and on behalf of Contractor in connection with this Escrow Agreement, and exemplars of their respective signatures, are as set forth below. Such names may be changed by written notice to the other parties.

On behalf of University:

1. _____
(Signature)

Blythe R. Wilson, Architect
Director of Project Management
Planning, Design & Construction
(Print Name & Title)

951.827.1485
(Telephone Number)

2. _____
(Signature)

Bobbi McCracken
Associate Vice Chancellor and Controller
Business and Financial Services
(Print Name & Title)

951.827.3303
(Telephone Number)

On behalf of Contractor:

1. _____
(Signature)

_____
(Print Name & Title)

_____
(Telephone Number)

2. _____
(Signature)

_____
(Print Name & Title)

_____
(Telephone Number)

Contractor, Escrow Agent, and University hereby agree to the covenants contained herein.

IN WITNESS WHEREOF, Contractor, Escrow Agent, and University have executed this Escrow Agreement, the day and year first written above.

University:

By: _____
(Signature)

Blythe R. Wilson, Architect
Director of Project Management
Planning, Design & Construction
(Print Name & Title)

951.827.1485
(Telephone Number)

By: _____
(Signature)

Bobbi McCracken
Associate Vice Chancellor and Controller
Business and Financial Services
(Print Name & Title)

951.827.3303
(Telephone Number)

Contractor:

By: _____
(Signature)

_____
(Print Name & Title)

_____
(Telephone Number)

By: _____
(Signature)

_____
(Print Name & Title)

_____
(Telephone Number)

Escrow Agent:

By: _____
(Signature)

_____
(Print Name & Title)

_____
(Telephone Number)

FIELD ORDER

Contract Date: _____ Field Order No. _____

To Contractor: _____

Attn: _____
Address: _____
_____

	Description of Work	Estimated Adjustment, Contract Sum	Estimated Adjustment, Contract Time
1.			
2.			
3.			

By University's Representative:

_____
(Signature & Date)
John Franklin
Senior Project Manager
Planning, Design & Construction
(Print Name & Title)

NOTE: If the work described above constitutes a change, this Field Order will be superseded by a Change Order that will include the scope of the change in the Work and any actual adjustments of the Contract Sum and the Contract Time.

cc: Director of Project Management, Planning, Design & Construction

UCR | Planning, Design & Construction

West Lothian Air Handler Replacement
Project Number: 956394
Contract Number: 956394-LF-2019-105

FINAL DISTRIBUTION OF CONTRACT DOLLARS

Completed By: _____ (Signature) _____ (Printed Name) _____ (Title) Date: _____

Provide the following information for each contracting party including the prime Contractor and each subcontractor regardless of tier.* Attach additional sheets if necessary.

Sheet No. _____ of _____

1	2	3	4	5	6					7a	7b	7c
Full Name of Business	Street Address City, State & Zip Code	Telephone # & Fax #	Contact Name	Type of Owner-ship	Business Categories (Check all that apply [X])					Portion of the Work	Amount $	Percent %
					SBE	DVBE	DBE	WBE	N/A			
Prime:												
Sub:												
Sub:												
Sub:												

Total Contract Amount: $ _____

Column 5 – Type of	Column 6 – Business Categories	Subtotals	
C = Corporation	SBE = Small Business Enterprise		
JV = Joint Venture	DVBE = Disabled Veteran Business Enterprise		
P = Partnership	DBE = Disadvantaged Business Enterprise		
SP = Sole Proprietorship	WBE = Women-Owned Business Enterprise		
O = Other	N/A = Not Applicable		

*Regardless of tier, a completed Self-Certification form must be submitted for the prime Contractor and each subcontractor shown on this Exhibit.

**If a prime Contractor, refer to the Report of Subcontractor Information for license and other information.

FINAL INSPECTION ACCEPTANCE

Contract Date: _____ Final Inspection Date: _____

To Contractor: _____

Attn: _____

Address: _____

_____

The above Project was inspected and accepted as of the above Final Inspection Date. No outstanding work remains to be performed. All required submittals have been received. All training has been performed pursuant to the Contract.

The following Change Orders for time and/or money ONLY remain unexecuted:

Upon receipt of this executed document for Final Inspection Acceptance, Contracts Administration will file a Notice of Completion with the county recorder's office. This action terminates the construction contract for this Project.

By: Inspector

(Signature & Date)

Cathie Crouch
Senior Construction Inspector
Planning, Design & Construction

(Print Name & Title)

By: Design Professional

N/A

(Signature & Date)

N/A

(Print Name & Title)

By: University's Representative

(Signature & Date)

John Franklin
Senior Project manager
Planning, Design & Construction

(Print Name & Title)

By: University's Responsible Administrator

(Signature & Date)

Blythe R. Wilson, Architect
Director of Project Management
Planning, Design & Construction

(Print Name & Title)

Bond No. _____

PAYMENT BOND

KNOW ALL PERSONS BY THESE PRESENTS:

THAT WHEREAS, The Regents of the University of California ("The Regents") has awarded to _____ as Principal a contract dated the _____ day of _____, 20 _____, (the "Contract") for the work described as follows:

Project Name:
Project No. , Contract No.

AND WHEREAS, the Principal is required to furnish a bond in connection with the Contract, to secure the payment of claims of laborers, mechanics, material suppliers, and other persons as provided by law;

NOW, THEREFORE, we, the undersigned Principal and _____ as Surety, are held and firmly bound unto The Regents in the sum of _____ Dollars ($ _____), for which payment well and truly to be made we bind ourselves, our heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that if Principal, or its heirs, executors, administrators, successors, or assigns approved by The Regents, or its subcontractors shall fail to pay any of the persons named in State of California Civil Code Section 9100, or amounts due under the State of California Unemployment Insurance Code with respect to work or labor performed under the Contract, or for any amounts required to be deducted, withheld, and paid over to the State of California Employment Development Department from the wages of employees of Principal and subcontractors pursuant to Section 13020 of the State of California Unemployment Insurance Code with respect to such work and labor, that Surety will pay for the same in an amount not exceeding the sum specified in this bond, otherwise the above obligation shall become and be null and void.

This bond shall inure to the benefit of any of the persons named in State of California Civil Code Section 9100 as to give a right of action to such persons or their assigns in any suit brought upon this bond.

Surety, for value received, hereby expressly agrees that no extension of time, change, modification, alteration, or addition to the undertakings, covenants, terms, conditions, and agreements of the Contract, or to the work to be performed thereunder, shall in any way affect the obligation of this bond; and it does hereby waive notice of any such extension of time, change, modification, alteration, or addition to the undertakings, covenants, terms, conditions, and agreements of the Contract, or to the work to be performed thereunder.

Surety's obligations hereunder are independent of the obligations of any other surety for the payment of claims of laborers, mechanics, material suppliers, and other persons in connection with the Contract; and suit may be brought against Surety and such other sureties, jointly and severally, or against any one or more of them, or against less than all of them without impairing The Regents' rights against the other.

In the event suit is brought upon this bond, the parties not prevailing in such suit shall pay reasonable attorneys' fees and costs incurred by the prevailing parties in such suit.

Correspondence or claims relating to this bond shall be sent to Surety at the address set forth below.

IN WITNESS WHEREOF, we have hereunto set our hands and seals this _____ day of _____ , 20 ____ .

PRINCIPAL:

_____
(Name of Company)

By: _____
(Signature)

_____
(Print Name)

_____
(Title)

SURETY:

_____
(Name of Company)

By: _____
(Signature)

_____
(Print Name)

_____
(Title)

Address for Notices:

_____
(Street Address)

_____
(City, State & Zip Code)

NOTE: Notary acknowledgement for Surety and Surety's Power of Attorney must be attached.

Bond No. _____

PERFORMANCE BOND

KNOW ALL PERSONS BY THESE PRESENTS:

THAT WHEREAS, The Regents of the University of California ("The Regents") has awarded to _____ as Principal a contract dated the _____ day of _____ , 20 _____ , (the "Contract"), which Contract is by this reference made a part hereof, for the work described as follows:

Project Name:
Project No. , Contract No.

AND WHEREAS, Principal is required to furnish a bond in connection with the Contract, guaranteeing the faithful performance thereof;

NOW, THEREFORE, we, the undersigned Principal and _____ as Surety are held and firmly bound unto The Regents in the sum of _____ Dollars ($ _____), to be paid to The Regents or its successors and assigns; for which payment, well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that if Principal, or its heirs, executors, administrators, successors, or assigns approved by The Regents, shall promptly and faithfully perform the covenants, conditions, and agreements of the Contract during the original term and any extensions thereof as may be granted by The Regents, with or without notice to Surety, and during the period of any guarantees or warranties required under the Contract, and shall also promptly and faithfully perform all the covenants, conditions, and agreements of any alteration of the Contract made as therein provided, notice of which alterations to Surety being hereby waived, on Principal's part to be kept and performed at the time and in the manner therein specified, and in all respects according to their true intent and meaning, and shall indemnify, defend, protect, and hold harmless The Regents as stipulated in the Contract, then this obligation shall become and be null and void; otherwise it shall be and remain in full force and effect.

No extension of time, change, alteration, modification, or addition to the Contract, or of the work required thereunder, shall release or exonerate Surety on this bond or in any way affect the obligation of this bond; and Surety does hereby waive notice of any such extension of time, change, alteration, modification, or addition.

Whenever Principal shall be and declared by The Regents to be in default under the Contract, Surety shall promptly remedy the default, or shall promptly:

1. Undertake through its agents or independent contractors, reasonably acceptable to The Regents, to complete the Contract in accordance with its terms and conditions and to pay and perform all obligations of Principal under the Contract, including without limitation, all obligations with respect to warranties, guarantees, and the payment of liquidated damages, or, at Surety's election, or, if required by The Regents,

2. Obtain a bid or bids for completing the Contract in accordance with its terms and conditions, and, upon determination by The Regents of the lowest responsible bidder, arrange for a contract between such bidder and The Regents and make available as work progresses (even though there should be a default or a succession of defaults under the contract or contracts of completion arranged under this paragraph) sufficient funds to pay the cost of completion less the balance of the Contract Sum, and to pay and perform all obligations of Principal under the Contract, including, without limitation, all obligations with respect to warranties, guarantees, and the payment of liquidated damages; but, in any event, Surety's total obligations hereunder shall not exceed the amount set forth in the third paragraph hereof. The term "balance of the Contract Sum," as used in this paragraph, shall mean the total amount payable by The Regents to the Principal under the Contract and any amendments thereto, less the amount paid by The Regents to Principal.

Surety's obligations hereunder are independent of the obligations of any other surety for the performance of the Contract, and suit may be brought against Surety and such other sureties, jointly and severally, or against any one or more of them, or against less than all of them without impairing The Regents' rights against the others.

No right of action shall accrue on this bond to or for the use of any person or corporation other than The Regents or its successors or assigns.

Surety may join in any arbitration proceedings brought under the Contract and shall be bound by any arbitration award.

In the event suit is brought upon this bond by The Regents, Surety shall pay reasonable attorney's fees and costs incurred by The Regents in such suit.

Correspondence or claims relating to this bond shall be sent to Surety at the address set forth below.

IN WITNESS WHEREOF, we have hereunto set our hands this _____ day of _____ , 20 ____ .

PRINCIPAL:	**SURETY:**
_____ (Name of Company)	_____ (Name of Company)
By: _____ (Signature)	By: _____ (Signature)
_____ (Print Name)	_____ (Print Name)
_____ (Title)	_____ (Title)
	Address for Notices:
	_____ (Street Address)
	_____ (City, State & Zip Code)

NOTE: Notary acknowledgement for Surety and Surety's Power of Attorney must be attached.

UCR Planning, Design & Construction

West Lothian Air Handler Replacement
Project Number: 956394
Contract Number: 956394-LF-2019-105

REPORT OF SUBCONTRACTOR/SUBCONSULTANT INFORMATION

(NOTE: THIS EXHIBIT IS NOT TO BE SUBMITTED WITH BID)

Completed By: _____ (Signature) _____ (Print Name) _____ (Title) Date: _____

Provide the following information for each contracting party including the prime Contractor and each subcontractor regardless of tier*. Sheet No. ____ of ____

Attach additional sheets if necessary.

1	2	3	4	5	6					7a	7b	8	
Full Name of Business	Street Address City, State & Zip Code	Telephone # & Fax #	Contact Name	Type of Owner-ship	Business Categories* (Check all that apply [X])					Portion of the Work	Amount $	License Information**	
					SBE	DVBE	DBE	WBE	N/A			License Classification	License #
Prime:													
Sub:													
Sub:													
Sub:													

Column 5 – Type of Ownership	Column 6 – Business Categories
C = Corporation	SBE = Small Business Enterprise
JV = Joint Venture	DVBE = Disabled Veteran Business Enterprise
P = Partnership	DBE = Disadvantaged Business Enterprise
SP = Sole Proprietorship	WBE = Women-Owned Business Enterprise
O = Other	N/A = Not Applicable

*Regardless of tier, a completed Self-Certification form must be submitted for the prime Contractor and each subcontractor shown on this Exhibit.
**List only those license classifications and numbers relevant to this Project.

SELECTION OF RETENTION OPTIONS

I (we): _____
(Contractor)

SELECT OPTION 1 _____ Initial and date here for OPTION 1

University will withhold retention.

OR SELECT OPTION 2 _____ Initial and date here for OPTION 2

herewith elect to substitute securities in the form of:

_____
(Type of Security)

in lieu of retention being withheld by University for the above-referenced project.

OR SELECT OPTION 3 _____ Initial and date here for OPTION 3

herewith elect to have retention on the above-referenced project paid directly into the Escrow Account.

_____
(Type of Security to be Purchased)

An Escrow Account will be opened with: _____
(Name of state or federally chartered bank in California)

whose address is: _____
(Street)

_____
(City, County)

_____
(State, Zip Code)

On Behalf of Contractor*:	On Behalf of University: Acknowledged and Approved
By: _____ (Signature)	By: _____ (Signature)
_____ (Print Name & Title)	Blythe R. Wilson, Architect Director of Project Management Planning, Design & Construction (Print Name & Title)

* Signature shall be by the authorized party who signs the Escrow Agreement for Deposit of Securities in Lieu of Retention and Deposit of Retention ("Escrow Agreement").

Note: If a completed and signed Escrow Agreement is not submitted with this form, University will not allow deposit of securities in lieu of retention.

SELF-CERTIFICATION

For the contractor and each subcontractor, the following must be completed.

Indicate all Business category(ies) that apply by initialing next to the applicable category(ies):

_____ (Initial, if applicable) **Small Business Enterprise (SBE)** - an independently owned and operated concern certified, or certifiable, as small business by the Federal Small Business Administration (SBA). (Size standards by Standard Industrial Classification codes required by the Federal Acquisition Regulations, Section 19.102, may be found at http://www.sba.gov/content/table-small-business-size-standards.) The eligibility requirements for California contracting purposes is on the Department of General Services website at http://www.dgs.ca.gov/pd/Programs/OSDS/SBEligibilityBenefits.aspx. The University may rely on written representation by the vendors regarding their status.

_____ (Initial, if applicable) **Disabled Veteran Business Enterprise (DVBE)** - a business that is at least 51% owned by one or more disabled veterans or, in the case of any publicly owned business, at least 51% of the stock of which is owned by such individuals and whose management and daily business operations are controlled by one or more of such individuals. A Disabled Veteran is a veteran of the military, naval, or air service of the United States with a service connected disability who is a resident of the State of California. To qualify as a veteran with a service connected disability, the person must be currently declared by the United States Veterans Administration to be 10% or more disabled as a result of service in the armed forces.

_____ (Initial, if applicable) **Disadvantaged Business Enterprise (DBE)** - a business concern that is at least 51% owned by one or more socially and economically disadvantaged individuals or, in the case of any publicly owned business, at least 51% of the stock of which is owned by such individuals and whose management and daily business operations are controlled by one or more of such individuals. Socially disadvantaged individuals are those who have been subjected to racial or ethnic prejudice or cultural bias because of their identity as members of a group without regard to their individual qualities. Economically disadvantaged individuals are those socially disadvantaged individuals whose ability to compete in the free private enterprise system has been impaired due to diminished capital and credit opportunities as compared to others in the same business area who are not socially disadvantaged. Business owners who certify that they are members of named groups (Black Americans, Hispanic Americans, Native Americans, Asian-Pacific Americans, Asian-Indian Americans) are to be considered socially and economically disadvantaged.

_____ (Initial, if applicable) **Women-Owned Business Enterprise (WBE**) - a business that is at least 51% owned by a woman or women who also control and operate it. "Control" in this context means exercising the power to make policy decisions. "Operate" in this context means being actively involved in the day-to-day management.

_____ (Initial, if applicable) **None of the above categories apply.**

I hereby certify under penalty of perjury under the laws of the State of California that I have read this certification and know the contents thereof, and that the business category indicated above reflects the true and correct status of the business in accordance with Federal Small Business Administration criteria and Federal Acquisition Regulations, FAR 19 pertaining to small, disadvantaged, women-owned, and disabled veteran business enterprises. I understand that falsely certifying the status of this business, obstructing, impeding or otherwise inhibiting any University of California official who is attempting to verify the information on this form may result in suspension from participation in University of California business contracts for a period up to five (5) years and the imposition of any civil penalties allowed by law.

INFORMATION FURNISHED BY: _____
(Print Name of Owner and/or Principal)

_____
(Name of Business or Firm)

a _____
(Insert type of business e.g. corporation, sole proprietorship, partnership, etc.)

By: _____ _____
(Print Name) (Title)

_____ _____
(Signature) (Date)

PRIVACY NOTICE

The State of California Information Practices Act of 1977 (effective July 1, 1978) requires the University of California to provide the following information to individuals who are asked to supply personal information about themselves. Information furnished on the Self-Certification form may, in some cases, identify personal information of an individual.

- The University of California, Riverside, is requesting the information contained in this form and the accompanying Report of Subcontractor Information.
- The Small Business Outreach Program Manager at the University of California, Riverside, is responsible for maintaining the requested information. The contact information for the Small Business Outreach Program Manager may be found at: http://www.ucop.edu/procurement-services/_files/sbdmgr.xlsx.
- The maintenance of information is authorized in part by Public Contract Code section 10500.5.
- Furnishing the information requested on this form is mandatory. If SBE, DBE, WBE and/or DVBE status is applicable, furnishing such information is mandatory.
- Failure to provide the information may be a violation of bidding procedures and/or breach of the contract and the University may pursue any and all remedies permitted by the provisions of the Contract Documents.
- The information on this form is collected for monitoring and reporting purposes in accordance with state law and University policy.
- The individual may access information contained in this form and related forms by contacting the Small Business Outreach Program Manager(s).

SUBMITTAL SCHEDULE

Contract Date: _____

Subcontractor: _____

Specification Section: _____

Work Activity: _____

Event	Scheduled Completion Date	Actual Completion Date	Calendar Days Required to Complete
1. Received by Contractor and Time for Checking			
2. First Delivered to University's Representative and Time for Checking			
3. Return to Contractor			
4. Corrections Completed and Time for Corrections			
5. Next Delivered (1st Resubmission) to University's Representative and Time for Checking			
6. Return to Contractor			
7. Approval for Job Information			
8. Approval for Fabrication and Time for Fabrication			
9. Fabrication Completed			
10. Shipping Date and Time In Route			
11. Delivery to Job			

*Contractor must revise Submittal Schedule to reflect number of resubmissions.

SUBSTITUTION OF SUBCONTRACTOR - INDEMNITY AGREEMENT and CONSENT

WHEREAS, on **Date**, **The Regents of the University of California** (University) and _____ (Contractor)
(Full Company Name & Address of Prime Contractor)
entered into an Agreement (Contract Number **956394-LF-2019-105**) for the construction of **West Lothian Air handler Replacement, Project No. 956394**, University of California, Riverside (Project); and

WHEREAS, Contractor's Bid, which was accepted by University for said Project, listed **Name of Listed Sub** as Subcontractor for the **work activity** work called for by the Bidding Documents and Contract Documents; and

WHEREAS, Contractor has represented and does hereby represent to University that **Name of Listed Sub** has **reasons for substitution**;

In consideration of the consent of University to the substitution of:

_____ , for
*(Full Company Name & Address of **Substitute** Subcontractor)*

Name of Listed Sub , as
*(Full Company Name of **Listed** Subcontractor)*

Subcontractor to provide the **work activity** work called for in the Bidding Documents and Contract Documents for the Project, Contractor does hereby agree to indemnify the University and hold it harmless from any and all claims, expenses, losses or liabilities arising out of said substitution of subcontractor or said consent thereto, and to defend at Contractor's expense any and all claims, protests, suits, actions or other proceedings in connection therewith; provided, however, that the University shall be given prompt notice of all such proceedings and it shall be entitled, if it so desires, to participate in the response to or defense of any such proceedings. If any such proceedings causes or results in a delay in the completion of said Project, the loss to the University for such delay shall be deemed to be the amount determined by applying the liquidated damages provisions of said Agreement for the period of such delay.

IN WITNESS WHEREOF, this Indemnity Agreement has been executed on _____ ,
(Date)

at _____ , California.
(Location: City & County)

CONTRACTOR:

By: _____
(Signature)

_____
(Typed or Printed Name & Title)

CONSENT TO SUBSTITUTION OF SUBCONTRACTOR

In consideration of the indemnification of University by Contractor, above, University agrees and does hereby consent to the substitution of:

_____ , for
*(Full Company Name & Address of **Substitute** Subcontractor)*

Name of Listed Sub , as
*(Full Company Name of **Listed** Subcontractor)*

Subcontractor to provide the **work activity** work called for in the Bidding Documents and Contract Documents for the above named Project.

IN WITNESS WHEREOF, University and Contractor have executed this Consent to Substitution of Subcontractor as of the above date.

CONTRACTOR:

By: _____
(Signature)

_____
(Typed or Printed Name & Title)

UNIVERSITY:

By: _____
(Signature)

_____
(Typed or Printed Name & Title)

THE REGENTS OF THE UNIVERSITY OF CALIFORNIA
Master Builder's Risk Program
Coverage Summary

This document summarizes the Builder's Risk policy and is not intended to reflect all the terms, conditions, or exclusions of such policy as of the effective date of coverage. This document is not an insurance policy and does not amend, alter or extend the coverage afforded by the listed policy. The insurance afforded by the policy is subject to all the terms, exclusions and conditions of such policy.

Some Projects may be excluded and/or must be underwritten separately any may be subject to different rates, deductibles, and terms and conditions. (See page 13) Therefore, this document should be used as a guideline only.

INSURANCE COMPANY: Allianz Global Risks U.S. Insurance Company

BEST'S RATING: A+

NAMED INSURED: The Regents of the University of California

INSURING AGREEMENT

This Policy, subject to the Limit of Liability and the terms, conditions, and limitations contained herein or endorsed hereon, insures against all risks of direct physical loss of or direct physical damage to Insured Property while at the construction site, stored off-site, or in the course of transit within the Territorial Limits specified in the Schedule during the Period of Insurance of each Insured Project.

LIMITS OF LIABILITY

SCHEDULE OF LIMITS

This Company shall not be liable for more than the Limit of Liability as stated on the Certificate of Insurance in any one Occurrence for any one Insured Project, subject to the following limits and sublimits:

MASTER POLICY LIMITS

$150,000,000 per project, per occurrence
$ 25,000,000 per project, Joisted Masonry

NOTE: *This Limit of Liability will correspond with the Total Estimated Construction Cost as indicated on the original Builder's Risk Insurance Application. If the construction costs should increase, the Limit of Liability can be subsequently increased once prior notice has been given by the University's Representative to Aon Risk Insurance Services West, Inc..*

SUBLIMITS:

1. $5,000,000 for **Wood Frame Construction**

2. $100,000 for **Pollution Cleanup Expenses**

3. 15% of the declared estimated Total Project Value, subject to a maximum of $25,000,000 for **Demolition and Increased Cost of Construction**

4. 25% of the adjusted property damage loss, subject to a maximum of $2,500,000 for **Expediting Expense/Extra Expense**

5. 10% of the declared estimated Total Project Value, subject to a maximum of $10,000,000 for **Insured Property while Stored Off-site**

6. 10% of the declared estimated Total Project Value, subject to a maximum of $10,000,000 for **Insured Property while in the Course of Inland Transit**

7. 25% of the declared estimated Total Project Value, subject to a maximum of $25,000,000 for **Debris Removal**

8. $500,000 for **Plans, Blueprints and Specifications**

9. $500,000 for **Trees, Grass, Shrubbery, Seed and Plants**

10. 33% of the declared estimated Total Project Value subject to a maximum of $50,000,000 for **Water Damage**. (Each Insured Project is also subject to a $50,000,000 Annual Aggregate for Water Damage.)

11. 15% of the adjusted property damage loss, subject to a maximum of $10,000,000 for **Green/LEED Rating System**

12. 10% of the adjusted property damage loss, subject to a maximum of $50,000 for **Mold/Fungi**

13. 5% of the declared estimated Total Project Value, subject to a maximum of $10,000,000 for additional **Architects, Engineering and Professional Fees**

14. $100,000 for **Claims Preparation Expenses**

15. $500,000 for **Fire Department Service Charges**

TERMS AND CONDITIONS

NAMED INSURED

The Regents of the University of California and all affiliated and subsidiary companies, corporations, ventures, partnerships or other organizations, all owned, controlled or managed by the Named Insured and all as now exist or may hereafter be constituted or acquired.

ADDITIONAL INSUREDS

General Contractors and subcontractors of every tier to the extent required by any contract or subcontract for an Insured Project, and then only as their respective interests may appear, any individual(s) or entity(ies) specified in such contract or subcontract, are recognized as Additional Insureds hereunder. As respects architects, engineers, manufacturers and suppliers, the foregoing is limited to their site activities only.

ATTACHMENT/TERMINATION

Insurance hereunder applies to all projects specifically declared under the Master Policy in a Quarterly Report Endorsement or in a Project Declaration Endorsement, where the project is scheduled to begin during the term of the Master Policy. The Master Policy term commences on September 1, 2011 at 12:01AM and ends on September 1, 2014 at 12:01AM.

Coverage for each Insured Project declared under the Master Policy will go into effect and continue in full force and effect during the Certificate Period specified in the project's Certificate of Insurance.

NOTIFICATION OF COVERAGE/TERMINATION: *The Certificate Period will correspond with the Estimated Dates of Commencement and Completion of Work as indicated on the original Builder's Risk Insurance Application. If construction is not completed on time and coverage beyond the Estimated Date of Completion of Work is required, prior notification must be given by the University Representative to Aon Insurance Services West, Inc.*

DEDUCTIBLES

$25,000 for **All Other Perils** for Projects **over** $2,500,000 at the time of the loss
except Water Damage
$10,000 for **All Other Perils** for Projects **under** $2,500,000 at the time of the loss
except Water Damage
$100,000 for **Water Damage** for **all** projects

NOTE: *The contractor shall be responsible for the deductibles.*

EXCLUSIONS

PROPERTY EXCLUDED

This Policy does not insure:

1. Land, but this exclusion does not apply to excavation and grading as long as the cost of the excavation and grading is included in the Limit of Liability as stated in the Certificate of Insurance.

2. Contractor's plant and equipment, machinery, tools, or property of similar nature not destined to become a permanent part of the Insured Project but this exclusion shall not apply to formwork, fences, shoring, falsework and temporary buildings as long as the value of these items are included in the estimated Limit of Liability as stated in the Certificate of Insurance.

3. Automobiles or other vehicles, watercraft or aircraft.

4. Water.

5. Accounts, bills, currency, deeds, securities, books, records, manuscripts, other similar papers, or data processing media.

6. Existing buildings or structures or any other existing property.

7. Owner supplied material, equipment, machinery and supplies, unless the value of such is included in the Limit of Liability as stated in the Certificate of Insurance.

8. Transmission and/or distribution lines; including wires, cables, poles, towers and all equipment attached thereto beyond 1,000 feet from the perimeter of the project site.

9. Partially or completely excavated or open trench, pipeline or workface, at any one time beyond 1,000 feet in length.

EXCLUDED CAUSES OF LOSS

1. Loss or damage caused by, or resulting from, wear and tear, moth, vermin, termites or other insects, inherent vice, latent defect, gradual deterioration, wet or dry rot and rust, corrosion, erosion or normal settling, shrinkage, and/or expansion of buildings and/or foundations.

2. Any loss of use or occupancy or consequential loss of any nature howsoever caused.

3. Liquidated damages and/or penalties for delay or detention in connection with guarantees of performance or efficiency.

4. Hostile or warlike action.

5. Nuclear reaction, nuclear radiation, or radioactive contamination.

6. Any cost or expenses incurred to test for, monitor, or assess the existence, concentration or effects of Fungi.

7. Loss or damage caused by or resulting from infidelity or dishonesty on the part of the Insured and/or any employee of the Insured; inventory shortage or unexplained disappearance.

8. Loss or damage caused by or resulting from frost, falling ice, or freezing, unless resulting directly from damage caused by fire, lightning, explosion, windstorm, riot, riot attending a strike, civil commotion, aircraft, vehicles, or smoke.

9. Loss or damage caused by or resulting from the enforcement of any ordinance or law, or any order of governmental or municipal authority; by suspension, lapse, termination and/or cancellation of any license, lease, or permit, or any injunction or process of any court, unless otherwise endorsed herein.

10. Loss or damage caused by, resulting form, contributed to or made worse by actual, alleged, or threatened release, discharge, escape or dispersal of Contaminants and/or Pollutants.

11. Loss or damage to Insured Property while aboard any aircraft or watercraft.

12. The cost of making good faulty or defective workmanship, material, construction, designs, plans and/or specifications unless direct physical loss or direct physical damage not otherwise excluded under this policy ensues and then this Policy will cover such ensuing loss or damage only.

13. Loss, damage, corruption, destruction, distortion, interruption, disruption, erasure, deletion, alteration, loss of use, reduction in functionality, loss of access to, denial of access to or breakdown of Electronic Data from any cause whatsoever.

14. Loss or damage to Used Equipment caused by mechanical and/or electrical breakdown.

15. Loss or damage directly or indirectly caused by, resulting from, contributed to, or aggravated by Land Movement.

16. Loss or damage directly or indirectly caused by, resulting from, contributed to, or aggravated by Flood.

17. Loss or damage covered under any guarantee or warranty, expressed or implied, by any manufacturer or supplier whether or not such manufacturer or supplier is an Insured under this policy.

18. Terrorism.

19. Loss or damage arising out of the performance of the professional activities of any consulting engineer, architect, or designer, or any person employed by them or any others whose acts they are legally liable for whether or not named as an Insured under this Policy.

SELECTED EXTENSIONS OF COVERAGE

1. EXPEDITING/EXTRA EXPENSES

Subject to the stated sublimit, this Policy is extended to cover extra charges for overtime, night work, work on public holidays, the extra cost of rental construction equipment, express freight, including air freight all incurred solely:

A. to facilitate the repair or replacement of the Insured Property which has sustained physical loss or physical damage from a peril insured, or;

B. which are necessary to return the work on the Insured Property to the same schedule actually being observed immediately prior to the sustaining of physical loss or physical damage from a peril insured.

This Policy does not cover charges incurred to expedite work on parts of the Insured Property which have not sustained physical loss or physical damage.

2. DEMOLITION AND INCREASED COST OF CONSTRUCTION

A. Subject to the stated sublimit, in the event of direct physical loss and/or direct physical damage by perils insured under this Policy, the Company shall also pay:

(i) The increased cost to repair, replace or re-erect the Insured Property caused by the enforcement of any building, zoning or land use ordinance or law in force at the time of loss. If the Insured Property is replaced, it must be intended for similar occupancy of the current Insured Property, unless otherwise required by zoning or land use ordinance or law.

(ii) The cost to demolish and clear the construction site of undamaged parts of the Insured Property caused by the enforcement of any building, zoning or land use law in force at the time of the loss.

B. In no event, however, shall the Company be liable for costs associated with the enforcement of any ordinance or law which requires any Insured or others to test for, monitor, clean up, remove, contain, treat, detoxify, or neutralize, or in any way respond to or assess the discharge, dispersal, release or escape of smoke, vapors, soot, fumes, acids, alkali, toxic chemicals, liquids or gasses, waste materials or other irritants, any Contaminants and/or Pollutants.

C. The Company shall not pay for the increased cost of construction until the Insured Property is actually repaired, replaced, or re-erected at the same construction site or elsewhere and as soon as reasonably possible after the loss or damage, not to exceed thirty (30) months.

D. In no event, however, shall the Company pay more:

(i) If the Insured Property is repaired, replaced or re-erected at the same construction site than the amount the insured actually spends to:

a) Demolish and clear the construction site; and

b) Repair, replace or re-erect the Insured Property but not for more than property of like height, floor area and style at the same construction site.

(ii) If the Insured Property is not repaired, replaced, or re-erected at the same construction site than:

a) The amount the Insured actually spends to demolish and clear the construction site; and

b) The cost to replace, at the same construction site, the damaged or destroyed Insured Property with other property;

1) of like kind and quality;

2) of like height, floor area and style; and

3) used for the same purpose.

(iii) Than the stated sublimit of Demolition and Increased Cost of Construction.

3. FIRE DEPARTMENT SERVICE CHARGES

Subject to the stated sublimit, when property insured is destroyed or damaged by a peril insured, this Policy shall also pay for the cost of fire department service charges for which the Insured is liable, provided they are assumed by contract or written agreement prior to a loss or they are required by a local ordinance.

4. PLANS, BLUEPRINTS, AND SPECIFICATIONS

Subject to the stated sublimit, in the event of direct physical loss or direct physical damage to plans, blueprints or specifications by perils insured under this policy, this insurance shall also pay the costs of mechanical reproduction from originals stored off-site for plans, blueprints or specifications.

5. TREES, GRASS, SHRUBBERY, SEED AND PLANTS

Subject to the stated sublimit, this policy is extended to insure direct physical loss or direct physical damage to trees, grass, shrubbery, seed and plants caused by or resulting from fire, lightning, windstorm, hail, explosion, smoke, collision by aircraft or vehicle, riot, riot attending a strike or civil commotion, vandalism or malicious mischief.

6. DEBRIS REMOVAL

Subject to the stated sublimit, in the event of direct physical loss or physical damage to Insured Property by perils insured under this policy, this insurance shall also pay the cost of removal of material and debris being a part of the Insured Property located at the construction site and the cost to demolish and clear the construction site of undamaged parts caused by the enforcement of any building, zoning or land use law in force at the time of the loss.

This Policy also covers cost or expense to:

A. Extract Contaminants and/or Pollutants from the debris; or
B. Extract Contaminants and/or Pollutants from land and/or water; or
C. Remove, restore, or replace land and/or water made necessary due to the presence of Contaminants and/or Pollutants; or
D. Remove or transport any property, material, or debris to a site for storage or decontamination required because the property, material, or debris is affected by Contaminants and/or Pollutants, whether or not such removal, transport, or decontamination is required by law or regulation.
E. This sub-clause (Items A - D above), is subject to a sublimit for **Pollution Cleanup Expenses**.

It is a condition precedent to recovery under this clause, that the Company shall have paid, or agreed to pay for direct physical loss or direct physical damage to the Insured Property and that the Insured shall give written notice to the Company of intent to claim for cost of removal of debris or the cost of cleanup no later than (12) twelve months after the date the original physical loss or physical damage occurred.

7. ARCHITECT, ENGINEERING AND PROFESSIONAL FEES

Subject to the stated sublimit, Architect, Engineering and Professional Fees shall mean the additional architectural and engineering expenses, excluding any costs for redesign or betterment, or owner's consultant service expenses, or owner's legal, appraisal, title and/or inspection fees incurred to facilitate repair or replacement of the Insured Property which has sustained physical loss or physical damage from an insured peril.

8. GREEN/LEED

Subject to the stated sublimit, in the event of a direct physical loss or direct physical damage not otherwise excluded in the policy to Insured Property by perils insured under the policy the Insurer shall also pay the reasonable additional cost, if any, incurred by the Insured to repair or replace such damaged or destroyed Insured Property in a manner and with products or materials of otherwise equivalent quality and function that meet the requirements of the LEED Rating System.

Coverage under this extension applies only if the Insured Project has been registered with the US Green Building Council during the Period of Insurance specified on the Certificate of Builder's Risk Insurance and prior to any loss, and only to the initial and intended building certification level that has been registered with the US Green Building Council, in accordance with the criteria outlined in order to comply with the requirements of the LEED Rating System existing at the time of the loss or damage to the Insured Project, which upon completion will undergo the process of being certified by the US Green Building Council.

The following exclusions and limitations apply to this coverage extension:

No coverage is provided under this extension:

A. If no such products or materials exist at the time of the loss or damage; or
B. If the Insured does not repair or replace the damaged or destroyed Insured Property.

In no event will the policy pay more than the lesser of the:

A. The cost to repair; or
B. The cost to replace;

the damaged Insured Property in a manner and with products or materials of otherwise equivalent quality and function that meet the requirements of the LEED Rating System existing at the time of the loss or damage.

No coverage is provided under this extension of coverage for any of the following items:

A. Re-registering the Insured project with the US Green Building Council.
B. Failure to meet the registered LEED Building Rating certification level.
C. Land and land values.
D. Any additional cost incurred to comply with any law or ordinance.
E. Personal property of others in the Insured's care, custody or control.
F. Raw materials, stock-in-process and finished goods.
G. Motor vehicles.
H. Property located outside the Territorial Limits of the policy.

9. CLAIMS PREPARATIONS EXPENSE

Subject to the stated sublimit, this policy is extended to include reasonable expenses incurred by the Insured, or by the Insured's representatives for preparing the details of a claim resulting from a loss which would be payable under this policy. However, the Company shall not liable for expenses incurred by the Insured in utilizing or retaining the services of attorneys, insurance agents or brokers; or any subsidiary, related or associated entities either partially or wholly owned by an attorney or public adjuster.

10. MOLD/FUNGI

Subject to the stated sublimit, in the event of direct physical loss or direct physical damage to Insured Property by perils insured under the policy, the insurance shall also pay, subject to the Limit of Liability and the terms, conditions, and limitations of this policy, the cost to clean up or remove Mold/Fungi from Insured Property located at the construction site.

Not withstanding any terms or conditions, this policy does not insure any cost or expense incurred to test for, monitor, or assess the existence, concentration or effects of Mold/Fungi.

SELECTED GENERAL CONDITIONS

1. REQUIREMENTS IN CASE OF LOSS

In the event of loss or damage to Insured Property the Insured shall:

A. Give immediate notice to the insurance company;

B. Protect the Insured Property from further loss or damage;

C. Within ninety (90) days from the date of discovery of the loss or damage, the Named Insured shall render a statement to the Insurer signed and sworn to by the Named Insured stating the knowledge and belief of the Insured as to the time and cause of the loss or damage and the interest of the Insured and all others in the Insured Property;

D. Exhibit to any person designated by the Insurer all that remains of the Insured Property.

E. Coordinate and cooperate with investigation and/or inspection of property and provide documentation as requested by the insurance adjuster. Do NOT destroy or salvage damaged property unless authorized to do so by the insurance adjuster.

F. Submit to examinations under oath by any person named by the Insurer and produce for examination all writings, books of account, bills, invoices and other vouchers, or certified copies thereof if originals be lost, at such reasonable time and place as may be designated by the Insurer or its representative, and permit extracts and copies thereof to be made. No such examination under oath or examination of books or documents shall be deemed to be a waiver of any defense which the Insurer might otherwise have with respect to any loss or claim; but all such examinations and acts shall be deemed to have been made or done without prejudice to the Company's liability.

G. Subject to the Limit of Liability and the terms, conditions, and limitations of the policy, all adjusted losses shall be paid or made good to the Named Insured within sixty (60) days after presentation and acceptance of the satisfactory proof of interest and loss to the Insurer. No amount shall be paid on an adjusted loss or made good if the Insured has collected the same from others.

2. VALUATION

Subject to the Limit of Liability, sublimits or Aggregate Limit of Liability, the Insurer shall not be liable beyond the cost to repair, replace, or re-erect the Insured Property at the time and place of loss, with materials of like kind and quality, less the cost of betterment, salvage, or other recovery including contractors reasonable profit and overhead in the proportion as that included in the original contract documents, or 15% profit and overhead, whichever is lesser. If the Insured Property is not replaced, then the loss shall be settled on the Actual Cash Value basis with proper deduction for depreciation, salvage or other recovery and exclusive of profit and overhead.

3. PROTECTION OF PROPERTY

In the case of direct physical loss or direct physical damage to Insured Property by perils insured under the policy, it shall be lawful and necessary for the Insured, his or their factors, servants, or assigns, to sue, labor, and travel for in and about the defense, safeguard, and recovery of the Insured Property, or any part thereof, without prejudice to this insurance, nor shall the acts of the Insured or Insurer, in recovering, saving, and preserving the Insured Property in case of loss be considered a waiver or an acceptance of abandonment. The expenses so incurred shall be borne by the Insured and the Insurer proportionately to the extent of their respective interests.

4. OTHER INSURANCE

This Policy shall not provide coverage to the extent of any other insurance, whether prior or subsequent hereto in date, and by whomsoever effected, directly or indirectly covering the same property against the same peril; and the Company shall be liable for direct physical loss or direct physical damage only for the excess value beyond the amount due from such other insurance, subject to the applicable Deductible.

5. INSUREDS' REPRESENTATIVE

The first Named Insured shall be the sole and irrevocable agent of each and every Insured for the purpose of:

A. Payment of premium;
B. Giving or receiving notice of cancellation;
C. Requesting amendments to this policy and accepting amendments to the policy made by the Insurer.

6. LOSS PAYABLE

Loss, if any, shall be payable to the first Named Insured and/or its assigned designee**.**

7. PARTIAL OCCUPANCY OR USE

Notwithstanding anything to the contrary elsewhere in the policy, the Owner and/or tenants may occupy or use any completed or partially completed portion of the Insured Property, provided that the Insured warrants that all fire protection shall be in service and fully operational during such occupancy or use.

SELECTED DEFINITIONS

The following terms have been defined in the Master Policy and will be applied in the interpretation of certain wording used herein or within the Master Policy.

1. FLOOD:

Flood shall mean the rising, overflowing or breaking of boundaries of rivers, lakes, streams, ponds or similar natural or man-made bodies of water, or from waves, tidal waves, tidal waters, wave wash, or spray from any of the foregoing, surface waters, rain accumulation run off, all whether driven by wind or not.

2. CONTAMINANTS OR POLLUTANTS:

Contaminants and/or Pollutants shall mean any material which after its release or discharge can cause or threaten damage to human health and/or human welfare, or causes or threatens damage, deterioration, loss of value, marketability and/or loss of use to Insured Property; including, but not limited to, bacteria, virus, or hazardous substances as listed in the Federal Water Pollution Control Act, Clean Air Act, Resource Conservation and Recovery Act of 1976, and/or Toxic Substances Control Act, or as designated by the U.S. Environmental Protection Agency.

3. LAND MOVEMENT:

Land Movement shall mean all land movement however caused, whether by natural event or man-made including but not limited to, earthquake, volcanic eruption, tsunami, subsidence, landslide, mudflow, or rockfall.

4. OCCURRENCE:

Occurrence shall mean any one loss, disaster, or casualty, or series of losses, disasters, or casualties arising out of one event. With respect to the perils of Water Damage, Flood, Land Movement, or riots, one event shall be construed to be all losses arising during a continuous period of seventy-two (72) hours.

The Insured may choose the time from which any such seventy-two (72) hour period shall be deemed to have commenced, provided it shall not be earlier than the time of the first loss sustained by the Insured during the Occurrence.

5. WATER DAMAGE:

All water damage excluding flood, however caused, whether by natural event or man-made, including but not limited to interior water damage, damage due to water from pipe breakage or sprinkler leakage, damage from rainfall and/or resulting runoff; all whether wind driven or not.

PROJECTS EXCLUDED AND/OR MUST BE UNDERWRITTEN SEPARATELY. THESE PROJECTS MAY BE SUBJECT TO DIFFERENT RATES, DEDUCTIBLES, AND TERMS AND CONDITIONS.

(A) Construction Cost exceeds:

- $150 Million regardless of Construction Type
- $5 Million for Wood Frame
- $25 Million for Joisted Masonry
- $50 Million for Structural Renovations

(B) Project involves:

- Construction occurring outside of the State of California
- Co-Generation Facility
- Stadium or arena
- Bridge
- Tunnel
- Excavations greater than 1,000 feet in length or 40 feet in depth
- Transmission and/or distribution lines extending greater than 1,000 feet in length from the perimeter project site including cable, telecom, wires, poles, towers, and electrical
- Directional Drilling
- Gas Turbine
- Power Plants
- Standalone Projects for Water or Sewer Pipelines, Cut and Cover, Open Trench, Utility Relocations, Central Utility Plants, Waste Water, or Water Treatment Facilities. Standalone projects means when the scope of work is not included in the estimated Construction Cost of a building project

(C) Project requires coverage for:

- Land Movement (e.g. Earthquake)
- Flood
- Terrorism
- Delay in Completion

UNCONDITIONAL WAIVER AND RELEASE ON FINAL PAYMENT

NOTICE TO CLAIMANT:
THIS DOCUMENT WAIVES AND RELEASES LIEN, STOP PAYMENT NOTICE, AND PAYMENT BOND RIGHTS UNCONDITIONALLY AND STATES THAT YOU HAVE BEEN PAID FOR GIVING UP THOSE RIGHTS. THIS DOCUMENT IS ENFORCEABLE AGAINST YOU IF YOU SIGN IT, EVEN IF YOU HAVE NOT BEEN PAID. IF YOU HAVE NOT BEEN PAID, USE A CONDITIONAL WAIVER AND RELEASE FORM.

Identifying Information:

Name of Claimant: _____

Name of Customer: _____

Job Location: **West Lothian Air Handler Replacement, Project No. 956394**
University of California, Riverside, City of Riverside, County of Riverside

Owner: **The Regents of the University of California**

Unconditional Waiver and Release:

This document waives and releases lien, stop payment notice, and payment bond rights the claimant has for all labor and service provided, and equipment and material delivered, to the customer on this job. Rights based upon labor or service provided, or equipment or material delivered, pursuant to a written change order that has been fully executed by the parties prior to the date that this document is signed by the claimant, are waived and released by this document, unless listed as an Exception below. The claimant has been paid in full.

Exceptions:

This document does not affect the following: Disputed claims for extras in the amount of:

$ _____ .

Signature:

Claimant's Signature & Date: _____

Claimant's Name & Title: _____

Prime Contractor's Application for Payment # _____

UNCONDITIONAL WAIVER AND RELEASE ON PROGRESS PAYMENT

NOTICE TO CLAIMANT:
UNCONDITIONAL WAIVER AND RELEASE ON PROGRESS PAYMENT NOTICE TO CLAIMANT: THIS DOCUMENT WAIVES AND RELEASES LIEN, STOP PAYMENT NOTICE, AND PAYMENT BOND RIGHTS UNCONDITIONALLY AND STATES THAT YOU HAVE BEEN PAID FOR GIVING UP THOSE RIGHTS. THIS DOCUMENT IS ENFORCEABLE AGAINST YOU IF YOU SIGN IT, EVEN IF YOU HAVE NOT BEEN PAID. IF YOU HAVE NOT BEEN PAID, USE A CONDITIONAL WAIVER AND RELEASE FORM.

Identifying Information:

Name of Claimant: _____

Name of Customer: _____

Job Location: **West Lothian Air Handler Replacement, Project No. 956394**
University of California, Riverside, City of Riverside, County of Riverside

Owner: **The Regents of the University of California**

Through Date: _____

Unconditional Waiver and Release:

This document waives and releases lien, stop payment notice, and payment bond rights the claimant has for labor and service provided, and equipment and material delivered, to the customer on this job through the Through Date of this document. Rights based upon labor or service provided, or equipment or material delivered, pursuant to a written change order that has been fully executed by the parties prior to the date that this document is signed by the claimant, are waived and released by this document, unless listed as an Exception below. The claimant has received the following progress payment: $ _____

Exceptions:

This document does not affect any of the following:

(1) Retentions.
(2) Extras for which the claimant has not received payment.
(3) Contract rights, including (A) a right based on rescission, abandonment, or breach of contract, and (B) the right to recover compensation for work not compensated by the payment.

Signature:

Claimant's Signature & Date: _____

Claimant's Name & Title: _____

Prime Contractor's Application for Payment # _____

SPECIFICATIONS

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Division 01 – General Requirements

Initial Issue	Revision	Section #	Title
		01 7329	**Cutting and Patching**
		01 7400	**Cleaning and Waste Management**
		01 7700	**Contract Closeout**
		01 7839	**As-Built Documents**

DIVISION 3 - CONCRETE
3 3000 Cast in Place Concrete

DIVISION 5 – STRUCTURAL STEEL
05 1200 Structural Steel Framing

DIVISION 23 - HEATING VENTILATING AND AIR CONDITIONING
23 0500 Common Work Results For HVAC
23 0510 Variable Frequency Drives
23 0511 Welding Pressure Piping
23 0513 Motors For HVAC
23 0519 Thermometers And Gages For HVAC
23 0529 Hangers And Supports For HVAC
23 0553 Identification For HVAC
23 0593 Testing, Adjusting, And Balancing For HVAC
23 0700 HVAC Insulation
23 0800 Commissioning Of HVAC
23 0900 Instrumentation And Controls
23 2110 Hydronic Distribution
23 2113 Hydronic Piping And Valves
23 3113 Metal Ducts
23 3300 Air Duct Accessories
23 7513 Custom Air-handling Units

DIVISION 26 - ELECTRICAL
26 0500 Common Work Results For Electrical
26 0519 Low-voltage Electrical Power Conductors And Cables
26 0526 Grounding And Bonding For Electrical Systems
26 0529 Hangers And Supports For Electrical Systems
26 0533 Raceway And Boxes For Electrical Systems
26 0553 Identification For Electrical Systems
26 2816 Enclosed Switches And Circuit Breakers

END OF SPECIFICATIONS
TABLE OF CONTENTS

SECTION 01 1100
SUMMARY OF WORK

PART 1 – GENERAL

1.1. SUMMARY

A. Section includes:

1. Work Covered by Contract Documents
2. Work Sequence
3. Work by University
4. University Furnished Products

B. In case any Sections contain conflicting requirements, refer to General Conditions, Paragraph 4.1.8.

1.2. WORK COVERED BY CONTRACT DOCUMENTS

A. The University of California, Riverside (UCR) intends to procure the services of a General Contractor (Contractor) to replace two existing air handler units located at the West Lothian Mechanical Room with two like kind units.

B. The Contract Time to complete the Work of this Contract is specified in the Supplemental Instructions to Bidders.

C. Project Location: Lothian Hall, 900 University Ave., Riverside California 92521

D. The University has specified that the requirements and procedures for compliance with certain U.S. Green Building Council's (USGBC) LEED (Leadership in Energy and Environment Design) New Construction (NC) Version 3 (v3) prerequisites and credits will be used to target the Project to obtain the goal of LEED Gold certification. See Section 01 8113 "Sustainability Design Requirements" for additional information.

1.3. WORK SEQUENCE

A. Contractor to provide work sequence and Project schedule to University for review and approval.

1.4. WORK BY UNIVERSITY – Not Used

1.5. UNIVERSITY FURNISHED PRODUCTS – Not Used

PART 2 – PRODUCTS – Not Used

PART 3 – EXECUTION – Not Used

END OF SECTION

SECTION 01 1400
WORK RESTRICTIONS

PART 1 – GENERAL

1.1. SUMMARY

A. Section includes:

1. Access to Site
2. Coordination with Occupants
3. Use of Site
4. Scheduling of Work and Work Hours
5. Neighbor Complaint Hotline
6. Site Decorum

1.2. ACCESS TO SITE

A. Special Requirements

1. Existing Site Conditions and Restrictions:
   a. Maintain access and code required exiting to and from surrounding buildings during construction.
2. Contractor shall be responsible for safely securing the work areas, with at a minimum, trench plates, fencing, signage, safety lighting, traffic and pedestrian coordinators.
3. Trench plates shall be provided and safely secured at all roadway, parking lots, and walkways.
4. Trenches shall be protected from vehicles by utilizing trench plates, and from pedestrians by utilizing fully installed galvanized fencing. Excavations and holes shall be protected by utilizing fully installed galvanized fencing, safety lighting, and other methods to safely secure the site. Establishment of the work area in any space requiring the University's vacating shall not commence before notification to University's Representative. Refer to Section 01 1400 - CONTRACTOR'S USE OF THE PROJECT SITE, Notifications.
5. Individual work areas shall not be established until Contractor has labor, materials and equipment ready to commence and complete the Work in that area.
6. Work shall not commence in any area until barriers and other protections are in place.

B. Use of Public Thoroughfares and University Roads

1. Contractor shall make its own investigation of the condition of available public thoroughfares and University roads, and of the clearances, restrictions, bridge load limits, and other limitations affecting transportation and ingress and egress at the Project site.

2. Where materials are transported in the prosecution of the Work, do not load vehicles beyond the capacity recommended by manufacturer of the vehicles or prescribed by any applicable state or local law or regulation.

3. Use only established roads on the campus; provided, however, that such temporary haul roads as may be required in the work shall be constructed and maintained by Contractor, subject to the approval of University's Representative. Refer to Section 01 3540 Environmental Mitigation for description of the approved haul route to and from the campus.

4. Provide protection against damage whenever it is necessary to cross existing

sidewalks, curbs, and gutters in entering upon the University roads and public thoroughfares. Repair and make good immediately at the expense of Contractor all damages thereto, including damage to existing utilities and paving, arising from the operations under the Contract.

5. Truck staging is not allowed on campus or on any residential street surrounding the campus.

C. See also Section 01 5500, Vehicular Access and Parking.

1.3. COORDINATION WITH OCCUPANTS

A. The University reserves the right to occupy and to place and install equipment in completed areas of the Work prior to Notice of Completion, provided such occupancy does not interfere with completion of the Work and subject to the General Conditions. Such placing of equipment and partial occupancy shall not constitute acceptance of the total Work.

1. Partial occupancy of the Work may occur upon University's approval, in which case the University's Representative will prepare a Certificate of Beneficial Occupancy for each specific portion of the Work to be occupied prior to Final Completion of the entire Work.
2. Refer to Article 9.6 of the General Conditions.

1.4. USE OF SITE

A. Confine operations to areas within contract limits indicated. Do not disturb portions of the site beyond the areas in which the Work is indicated.

1. Driveways and Entrances: Keep driveways and entrances serving adjacent buildings clear and available to the University, and its employees, students, faculty, visitors, and emergency vehicles at all times. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for use of these areas.
2. Contractor's use of the Project site for the work, staging, deliveries, and storage is restricted to the project limits on the Drawings, or as directed by the University's Representative.
3. All material for construction operations shall be brought in and the work conducted so as to avoid any interference with existing University facilities or their normal operations.
4. Noise from job equipment shall be kept to a minimum by use of adequate mufflers and other appropriate means.
5. Delivery of Materials: Arrange for delivery of materials and equipment to minimize length of on-site storage prior to installation. Delivery route shall be from South Campus Circle Drive to Big Springs Road to the project site, or as designated by the University's Representative.
6. The Contractor shall take appropriate steps throughout the term of the project to prevent airborne dust due to work under this contract. Water shall be applied wherever practical to settle and hold dust to a minimum, particularly during excavation and moving of materials. No chemical palliatives shall be used.

1.5. SCHEDULING OF WORK AND WORK HOURS

A. Work outside of regular work hours, ***7:00 a.m. to 3:30 p.m.,*** "overtime", required to accomplish work of this contract, such as utility shutdowns, shall be included in the contract sum.

OR:

A. Restrict Construction Hours: All contractors, and overseen by the General Contractor, shall ensure that all construction contracts will limit exterior construction activities to occurring between 7:00 a.m. and 7:00 p.m. Monday through Friday, and 8 a.m. and 5 p.m. on Saturday. Construction will not be allowed on Sunday or federal holidays.

B. Overtime work requests must be submitted to the University's Representative three working days before the work is to commence.

1. Acceptable overtime hours are no earlier than 7:00 a.m. and no later than 7:00 p.m., Monday through Friday; and from 8:00 a.m. to 5:00 p.m. on Saturday. Work will not be allowed on Sunday and Holidays.
2. Work at other times may be permitted if it takes place within the enclosed building and the University's Representative determines that it is unlikely to affect University personnel, students, operations and the surrounding neighborhood.
3. Additional overtime operating hours may be approved at the University's Representative sole discretion and only without change to the contract sum.
4. Contractor shall pay all the inspectors (in-house inspectors and University's testing laboratory inspectors) and University's Representative's costs if the overtime request is approved by University's Representative.

1.6. NEIGHBOR COMPLAINT HOTLINE

A. Contractor to provide a phone number monitored 24 hours a day for the public to use to lodge complaints about construction activities that may harm or degrade their quality of life. Refer to Section 01 5000 “Construction Controls and Temporary Facilities” for more detailed specifications.

B. Neighbor Complaint Hotline Phone Number: Contractor shall provide signage described elsewhere in this section with the telephone number for the off-campus neighbors to use to notify the contractor and University about construction related issues affecting their persons and properties such as, but not limited to excessive noise, dust and construction vehicle traffic along Valencia Hill Drive which is not allowed under any circumstances.

1. The contractor shall contact a security service which shall provide an answering service for any calls, 24 hours a day and relay the call to a list of designated construction personnel on site for response. The contactor can contact Knight Security at (760) 745-3604 which provided service for the Phase 1 portion of the project for terms and conditions but is not obligated to use this firm and can choose to any service of a similar type.

1.7. SITE DECORUM

A. Contractor shall control the conduct of its employees (including subcontractor's employees) so as to prevent unwanted interaction initiated by Contractor's employees with University of California Riverside (UCR) students, UCR staff, UCR Faculty or other individuals (except those associated with the Project), adjacent to the Project site. Without limitation, unwanted interaction by Contractor employees would include whistling at or initiating conversations with passersby. In the event that any Contractor employee initiates such unwanted interaction, or utilized profanity, Contractor shall, either upon request of University's Representative or on its own initiative, replace said employee with another of equivalent technical skill, at no additional cost to the University. No radios, other than two-way communication type, will be allowed on the Project site. No smoking is allowed in any University Building.

B. Contractor shall control the conduct of its employees (including subcontractor's employees) to prevent unwanted interaction initiated by Contractor's employees with UCR students, staff, Faculty or other individuals, adjacent to the Project site. Unwanted interaction by Contractor employees includes whistling at, or initiating conversations with, passersby. If any contractor employee initiates such unwanted interaction, or utilizes profanity, Contractor shall, upon request of University's Representative or on its own initiative, replace said employee with another of equivalent technical skill, at no additional cost to University. No radios, other than two-way communication type, will be allowed on the Project site. No smoking is allowed in any existing University Building or University Building under Construction.

PART 2 – PRODUCTS (Not Applicable)

PART 3 – EXECUTION (Not Applicable)

END OF SECTION

MATERIAL/PRODUCT SUBSTITUTION REQUEST FORM

Date: _____ Material/Product Substitution Request No. _____

TO:	University's Representative	**FROM:**	

A. We hereby submit for your consideration the following product instead of the specified item:

1. Section: _____ Sub-Article: _____
2. Specified Item: _____
3. Proposed Substitution: (Mfg., Type, Model, etc. Attach a separate sheet if necessary.)

B. Complete all of the following:

1. Does this Substitution offer The Regents a cost credit (including costs for changes by other trades)? ☐ Yes ☐ No
   If "Yes," state how much and attach an itemized breakdown of all costs: $ _____
2. Does this Substitution offer earlier delivery or less construction time? ☐ Yes ☐ No
   If "Yes," state the effect on the Contract Time: (Attach a separate sheet if necessary.)
3. Does this substitution affect any dimensions, layout, or details of other trades as shown on the drawings? ☐ Yes ☐ No
   If "Yes," explain in the space below: (Attach a separate sheet if necessary.)
4. Describe the specific differences between this Substitution and the specified item in the space below: (Attach a separate sheet if necessary.)

C. Attach the following items as applicable: (Check if attached.)

1. Manufacturer's technical data. ☐
2. Laboratory test or performance results. ☐
3. Drawings and wiring diagrams of the proposed product. ☐
4. Drawings and description of changes required by other trades. ☐
5. Samples. ☐
6. Manufacturer's guarantee and maintenance instructions. ☐
7. Documentation of code compliance for all specific uses. ☐

D. The undersigned agrees to pay for all additional review, design, testing, changes in the contract documents, and construction as a result of the acceptance of this substitution, at no cost to The Regents.

E. Submitted by Contractor: _____
(Signed)

_____
(Printed Name & Title)

UNIVERSITY'S REPRESENTATIVE'S USE ONLY:

☐Accepted ☐Revise and Resubmit ☐Rejected ☐See attachment dated _____

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SECTION 01 2500
PRODUCT OPTIONS AND SUBSTITUTIONS

PART 1 – GENERAL

1.1. SUMMARY

A. This Section includes:

1. General Provisions
2. Special Requirements for Other Than First-Named Product, Material or Equipment
3. Special Requirements for Substitutions
4. Material/Product Substitution Request Form

1.2. GENERAL PROVISIONS

A. This subsection includes the general provisions regarding specification of products, material and equipment by brand or trade name.

B. Products, material or equipment specified by both brand or trade name and model number are approved for use, provided that Contractor complies with all Contract requirements. Specification of a product, material or equipment by brand or trade name and model number is not a representation or warranty that the product, material or equipment can be used without modification, to meet the requirements of the plans and specifications; Contractor shall, at its sole cost, modify such products, material, or equipment so that they comply with all requirements of the plans and specifications.

C. The **first-named** product, material or equipment specified by brand or trade name and model number is the **basis for the Project design** and the use of any item other than the first-named one may require modifications of that design. If Contractor uses any product, material or equipment other than the first-named one, Contractor shall, at its sole cost:

1. Make all revisions and modifications to the design and construction of the Work necessitated by the use of the product, material or equipment.
2. Be responsible for all costs of any changes resulting from the use of the product, material or equipment including without limitation, costs or changes which affect other parts of the Work, the work of Separate Contractors, or any other property or operations of the University.

D. When a product, material or equipment specified by brand or trade name is followed by the words "**or equal**," a **substitution** may be permitted if the substitution is equal to or superior to the first-named product, material or equipment in quality, utility and appearance and if the substitution complies with all other requirements of the plans and specifications.

E. A product, material or equipment specified by brand or trade name followed by the words "**or equal, no known equal**," signifies that University does not have sufficient knowledge to specify a product, material or equipment, other than the one specified by brand or trade name, that is suitable for use on the Project. The use of the words "no known equal" is not intended to discourage substitution requests in accordance with the requirements specified herein.

F. When catalog numbers and specific brands or trade names not followed by the designation "or equal" are used in conjunction with a product, material or equipment required by the specifications, **substitutions will NOT be allowed** and the named product, material or equipment must be used.

G. Specification of a product, material or equipment by brand or trade name and model number is not a representation or warranty that the product, material or equipment is available; Contractor should confirm, prior to submitting its Bid, the availability of any product, material or equipment specified by brand or trade name and model number.

1.3. SPECIAL REQUIREMENTS FOR OTHER THAN FIRST-NAMED PRODUCT, MATERIAL OR EQUIPMENT

A. This subsection includes special requirements for named products, material and equipment, other than the first-named product, material or equipment, specified by both brand or trade name and model number.

B. In addition to complying with all other submittal requirements of the Contract, **submit within 70 days after the date of commencement specified in the Notice to Proceed**, for review and approval by the University's Representative, Contractor prepared specifications and drawings, including design and engineering calculations, prepared by an appropriate licensed professional, depicting all revisions and modifications to the design and construction of the Work necessitated by the use of the product, material or equipment**. If no revisions or modifications are necessary, submit within 70 days after the date of commencement specified in the Notice to Proceed**, a written representation that no revisions or modifications to the design or construction of the Work are necessitated by the use of the product, material or equipment. Contractor shall utilize the first-named product, material or equipment if Contractor fails to make the appropriate required submittal pursuant to this paragraph within the 70-day period.

C. A product, material or equipment, other than the first-named product, material or equipment, specified by both brand or trade name and model number may be used if no revisions or modifications to the design or construction of the Work are necessitated by the use of the product, material or equipment. If such revisions or modifications are necessary, the product, material or equipment may be used only if the revisions or modifications are approved in writing by the University's Representative. Contractor has the burden of demonstrating, through the procedures specified herein, that any such revisions or modifications will not be detrimental to the quality, utility or appearance of the Project or any portion of the Project. The University's Representative may refuse to approve any such proposed revisions or modifications where, in the reasonable opinion of the University's Representative, Contractor has failed to demonstrate, through the procedures specified herein, that the revisions or modifications are not detrimental to the quality, utility or appearance of the Project or any portion of the Project.

1.4. SPECIAL REQUIREMENTS FOR SUBSTITUTIONS

A. In addition to complying with all other submittal requirements of the Contract, submit written data demonstrating that the proposed substitution is equal to or superior to the first-named product, material or equipment in quality, utility, appearance, environmental performance criteria, and otherwise complies with all requirements of the plans and specifications, including:

1. Complete technical data including drawings, performance specifications, samples, and test reports of the article proposed for substitution.
2. Statement by Contractor that the proposed substitution is in full compliance with the requirements of the Contract Documents and Applicable Code Requirements.
3. List of Subcontractors, if any, that may be affected by the substitution.
4. Contractor prepared specifications and drawings, including design and engineering calculations, prepared by an appropriately licensed professional, depicting all revisions and modifications to the design and construction of the Work necessitated by the use of the substitution. If no revisions or modifications are necessary, submit a written representation that no revisions or modifications to the design or construction of the Work are necessitated by the use of the product, material or equipment.

B. Requests for substitutions will only be considered if Contractor completes and submits Material/Product Substitution Request Form and the above supporting data.

C. At the request of and within the timeframes specified by the University's Representative:

1. Submit samples as deemed necessary by the University's Representative to evaluate the proposed substitution.
2. Submit proposed substitution to tests deemed necessary by the University's Representative to evaluate the proposed substitution. Such tests shall be made by an independent Testing Laboratory and at the sole expense of Contractor, after review and approval of the test procedures by University's Representative. If re-testing is deemed necessary by the University's Representative to evaluate the proposed substitution, such re-testing shall be made by an independent Testing Laboratory at the sole expense of the Contractor.
3. Provide any additional information deemed necessary by the University's Representative to evaluate the proposed substitution.

D. If University's Representative, in reviewing a proposed substitution, requires revisions or corrections to be made to previously accepted shop drawings and supplemental supporting data to be resubmitted, Contractor shall do so within the time period specified by the University's Representative. A proposed substitution may be rejected if Contractor fails to submit such revisions, corrections, or supplemental supporting data within the specified time period.

E. Except for products, material or equipment designated in the Bidding Documents for evaluation of substitutions prior to award, **requests for substitution, including the data required by Paragraph 1.4.A., must be submitted to the University's Representative not later than 35 days after the date of commencement specified in the Notice to Proceed**. No requests for substitutions of products, material or equipment subject to the 35-day deadline shall be considered unless the request and supporting data is submitted on or before the deadline, except those deemed, in University's Representative's sole opinion, to be necessary because (i) previously specified or approved manufactured products, material or equipment are no longer manufactured, (ii) of University initiated change orders, or (iii) it is in the best interest of University to accept such substitution.

F. If a product, material or equipment is designated in the Bidding Documents for evaluation of substitutions prior to award, then a request for substitution of the product, material or equipment, including the data required by Paragraph 1.4.A., must be submitted by the deadline specified in the Bidding Documents. Because of time constraints, only one submittal will be allowed for each such substitution request. Requests for substitutions of products, material or equipment designated for evaluation prior to award may not be made after the deadline specified in the Bidding Documents, and such requests be shall not be considered unless the request and supporting data is submitted on or before the deadline specified in the Bidding Documents. Notwithstanding the forgoing, the University may consider, after award of the Contract, requests for substitution of a product, material or equipment designated for evaluation prior to award where, in University's Representative's sole opinion, a substitution is necessary because (i) previously specified or approved manufactured products, material or equipment are no longer manufactured, (ii) of University initiated change orders, or (iii) it is in the best interest of University to accept such substitution.

G. In reviewing the supporting data submitted for substitutions, University's Representative will use, for purposes of comparison, all the characteristics of the specified material or equipment as they appear in the manufacturer's published data even though all the characteristics may not have been particularly mentioned in the Specifications. If more than 2 submissions of supporting data are required, the cost of reviewing the additional supporting data shall be at Contractor's expense.

H. Contractor has the burden of demonstrating, through the procedures specified herein, that its proposed substitution is equal to or superior to the first-named product, material or equipment in quality, utility and appearance and complies with all other requirements of the plans and specifications. If revisions or modifications to the design or construction of the work are necessitated by the use of the substitution, Contractor also has the burden of demonstrating, through the procedures specified herein, that the use of the substitution will not be detrimental to the quality, utility or appearance of the Project or any portion of the Project.

I. The University's Representative may refuse to approve any requested substitution where, in the reasonable opinion of the University's Representative, Contractor has failed to demonstrate, through the procedures specified herein, that the proposed substitution is equal to, or superior to, the first-named product, material or equipment, in quality, utility and appearance and that the proposed substitution complies with all other requirements of the plans and specifications.

J. University's Representative may reject any substitution not proposed in the manner and within the time limits prescribed herein.

K. Substitutions are not allowed unless approved in writing by the University's Representative. Any such approval shall not relieve Contractor from the requirements of the Contract Documents.

L. The 35-day and 70-day submittal periods do not excuse Contractor from completing the Work within the Contract Time or excuse Contractor from paying liquidated damages if Final Completion is delayed.

M. If revisions or modifications to the design or construction of the Work are necessitated by the use of a substitution, the substitution may be used only if the revisions and modifications are approved in writing by the University's Representative. The University's Representative may refuse to approve any such proposed revisions or modifications where, in the reasonable opinion of the University's Representative, Contractor has failed to demonstrate, through the procedures specified herein, that the revisions or modifications are not detrimental to the quality, utility and appearance of the Project or any portion of the Project.

N. If a substitution request is finally rejected by the University's Representative, Contractor shall furnish and install:

1. The first-named product, material or equipment; or
2. A product, material, or equipment, other than the first-named product, material or equipment, specified by both brand or trade name and model number, provided Contractor complies with the submittal requirements (including deadlines) of this specification section 01 2500.

PART 2 – PRODUCTS (Not Applicable)

PART 3 – EXECUTION (Not Applicable)

END OF SECTION

(MATERIAL/PRODUCT SUBSTITUTION REQUEST FORM ON FOLLOWING PAGE)

SECTION 01 2613
REQUESTS FOR INFORMATION & INSTRUCTIONS (RFI) PROCEDURES

PART 1 – GENERAL

1.1. SUMMARY

A. This Section contains the procedures to be followed by Contractor upon discovery of any apparent conflicts, omissions, or errors in the Contract Documents or upon having any question concerning interpretation.

1.2. PROCEDURES

A. Notification by Contractor:

1. Submit all requests for clarification or additional information in writing to Design Professional and University's Representative concurrently using the **Request for Information (RFI) form attached to this Section**.

   a. All RFI's, and any attachments thereto, must be submitted in PDF format with Optical Character Recognition (OCR) Text.

   b. For any RFI for which Contractor has indicated a Cost Impact or Work/Time Impact, Contractor must also send a copy of the RFI to University's Responsible Administrator at Blythe.Wilson@ucr.edu .

2. Limit each RFI to one subject and number RFI's sequentially. For each resubmission, follow the RFI number with suffix "R" sequentially numbered as necessary. For example, the first RFI would be "1." The second RFI would be "2." The first resubmittal of RFI "2" would be "2R1."

3. Submit a RFI if one of the following conditions occurs:

   a. Contractor discovers an unforeseen condition or circumstance that is not described in the Contract Documents.

   b. Contractor discovers an apparent conflict or discrepancy between portions of the Contract Documents that appears to be inconsistent or is not reasonably inferred from the intent of the Contract Documents.

   c. Contractor discovers what appears to be an omission from the Contract Documents that cannot be reasonably inferred from the intent of the Contract Documents.

4. Contractor shall not submit a RFI:

   a. As a request for substitution.

   b. As a submittal.

   c. Under the pretense of a Contract Documents discrepancy or omission without thorough review of the Contract Documents.

   d. In a manner that suggests that specific portions of the Contract Documents are assumed to be excluded or by taking an isolated portion of the Contract Documents in part rather than whole.

   e. In an untimely manner without proper coordination and scheduling of Work of related trades.

f. As a request for approval of Contractor's means and methods.

5. If Contractor submits a RFI contrary to 1.2. A.4. above, Contractor shall pay the cost of any review, which cost shall be deducted from the Contract Sum.

6. Contractor shall submit a RFI immediately upon discovery. Contractor shall submit RFI's within a reasonable time frame so as not to delay the Contract Schedule while allowing the full response time described below.

B. Response Time:

1. Design Professional shall send its RFI response to University's Representative within a reasonable time so that University's Representative can send a final RFI response to Contractor within the time frames in 1.2. B.2. below.

2. University's Representative, or his/her designee, whose decision will be final and conclusive, shall resolve such questions and issue instructions or issue approval of instructions or information from Design Professional, to Contractor within a reasonable time frame. In most cases, RFI's will receive a response within **7 days for architectural issues and within 14 days for issues that require review and response from Design Professional's consultants.** In some cases, the response time may be lengthened for complex issues or shortened for emergencies as approved by University's Representative in writing. If in the opinion of University's Representative more than **14 days** is required to prepare a response to a RFI, Contractor will be notified in writing.

3. Should Contractor proceed with the Work affected before receipt of a response from University's Representative within the response time described above, any portion of the Work which is not done in accordance with University's Representative's interpretations, clarifications, instructions, or decisions is subject to removal or replacement and Contractor shall be responsible for all resultant losses.

4. Failure to Agree: In the event of failure to agree as to the scope of the Contract requirements, Contractor shall follow procedures set forth in Article 4 of the General Conditions.

PART 2 – PRODUCTS (Not Applicable)

PART 3 – EXECUTION (Not Applicable)

END OF SECTION

REQUEST FOR INFORMATION

DATE: mm/dd/yy **RFI #:** _____

TO:		**FROM:**	
Cc:			

Subject/Title:

☐ Electrical

☐Architectural ☐ Civil ☐ Mechanical ☐ Plumbing ☐ Structural ☐Fire Protection ☐ Landscape ☐ Other: _____

Reason(s) for RFI:

☐ Clarification/Interpretation	☐ Conflict in CD's
☐ Coordination Issue	☐ Information Not Shown on CD's
☐ Cost Impact: _____	☐ Safety
	☐ Work/Time Impact: _____

Issue/Question:
(Reference Attachments)

Specification #: _____ Paragraph #: _____ Sheet #: _____ Detail #: _____
Other Reference: _____ Schedule Activity: _____

Proposed Solution:
(Reference Attachments)

Signed by Contractor: _____ **Response Required by Date:** mm/dd/yy

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RESPONSE TO CONTRACTOR:

From Design Professional:
(Reference Attachments)

Date Received RFI: mm/dd/yy **Response Date:** mm/dd/yy **Signed:** _____

From University's Rep.:
(Reference Attachments)

Date Received RFI: mm/dd/yy **Response Date:** mm/dd/yy **Signed:** _____

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SECTION 01 3113
COORDINATION

PART 1 – GENERAL

1.1. SUMMARY

A. This Section includes administrative and supervisory requirements necessary for coordinating construction operations including, but not necessarily limited to, the following:

1. Administrative Requirements
2. Facilities Services Coordination and Service Continuity

1.2. ADMINISTRATIVE REQUIREMENTS

A. Coordinate construction operations including, but not limited to, the following:

1. Coordinate the Work and do not delegate responsibility for coordination to any Subcontractor.
2. Anticipate the interrelationship of all Subcontractors and their relationship with the Work.
3. Resolve differences or disputes between Subcontractors and their relationship with the Work.
4. Coordinate the Work of Subcontractors so that portions of the Work are performed in a manner that minimizes interference with the progress of the Work.
5. Do not obstruct spaces and installations that are required to be clear by Applicable Code Requirements.
6. Do not cover any piping, wiring, ducts, or other installations until they have been inspected and approved and required certificates of inspection issued.
7. Remove and replace all Work, which does not comply with the Contract Documents. Repair or replace any other Work or property damaged by these operations with no adjustment of Contract Sum.

B. Coordinate construction operations included in various Sections of these Specifications to assure efficient and orderly installation of each part of the Work. Coordinate construction operations included under different Sections that depend on each other for proper installation, connection, and operation. Coordinate all portions of the Work requiring careful coordination in order to fit in space available. Before commencing such portions of the Work, prepare supplementary Drawings for review by University's Representative and Design Professional. Non-conformance of this task will result in the delay of applications for payment and the contractor responsibility for any remedial works requested by University Representative.

1. Schedule construction operations in the sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components to assure maximum accessibility for required maintenance, service, and repair.
3. Make provisions to accommodate items scheduled for later installation, including, but not limited to, coordination of furnishing and placing embedded items, sleeves, and block-outs with formwork and reinforcing steel for cast-in-place concrete.
4. Resolve conflicts and coordinate access to, and utilization of, spaces available for construction activities on the site and within structures, and delivery, storage, and installation of materials and equipment.
5. Implement a quality assurance program designed to ensure completion of the Work in accordance with requirements of the Contract Documents.

C. Where necessary, prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and attendance at meetings.

1. Prepare similar memoranda for the University and separate contractors where coordination of their work is required.

D. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and assure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of schedules.
2. Installation and removal of temporary facilities.
3. Delivery and processing of submittals.
4. Progress meetings.
5. Project closeout activities.
6. Obtaining required permits and approvals from authorities having jurisdiction.
7. Utility company approvals and installations.

E. Conservation: Coordinate construction operations to assure that operations are carried out with consideration given to conservation of energy, water, and materials.

1. Salvage materials and equipment involved in performance of, but not actually incorporated in, the Work.

F. Clean and protect construction in progress and adjoining materials in place, during handling and installation. Apply protective covering where required to assure protection from damage or deterioration at Substantial Completion.

G. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to assure operability without damaging effects.

1.3. FACILITIES SERVICES COORDINATION AND SERVICE CONTINUITY

A. Maintain continuous services to all existing facilities during the period of construction except for the following conditions:

1. Perform Work that involves "shut-down" of existing facilities at such times as will cause the least inconvenience to the University activities, performing at night, on Saturdays, Sundays, holidays and at the discretion of University's Representative. Furnish University's Representative written notice of exact date and time of "shut-down" at least **thirty (30) working days** in advance, unless a longer period is specified or shown on the Drawings. On jobs with short performance time, Contractor shall verify with University's Representative the number of days required in advance for shut-down.

2. The University's preference would be for the contractor to try to coordinate the high voltage utility shut down simultaneously with the Student Recreation Center's shut down to avoid unnecessary inconvenience to the campus. However this preference is not a mandatory requirement if it doesn't fit in with the contractor's schedule.

3. The Contractor's bid shall include the cost of overtime necessary for the Work. No extra payment will be allowed for overtime to meet this requirement or the Contract Schedule.

B. Service Continuity:

1. Within the areas of the Work, investigate and uncover all drainage lines, sewers, electrical ducts, and other piping in use or forming continuations or utility systems required for other buildings or improvements upon the campus, and maintain such services in operation during performance of the Work of the Contract.

C. Notify University's Representative at least 30 days in advance of all utility shutdowns including date, time and expected duration.

PART 2 – PRODUCTS (Not Applicable)

PART 3 – EXECUTION (Not Applicable)

END OF SECTION

SECTION 01 3119
PROJECT MEETINGS

PART 1 – GENERAL

1.1. SUMMARY

A. This Section includes administrative and procedural requirements for the following project meetings:

1. Pre-Construction Meeting
2. Pre-Installation Meetings
3. Progress Meetings
4. Billing Meetings
5. 11-Month Warranty Meeting

1.2. PRE-CONSTRUCTION MEETING

A. The University's Representative will schedule a pre-construction conference before starting construction, at a time convenient to the University and the University's Representative, but no later than 10 days after execution of the Agreement. The conference will be held at the Project Site or another convenient location. The meeting will review responsibilities and personnel assignments.

1. Distribute written notice of agenda, meeting time, and location a minimum of five calendar days in advance.

B. Attendees: The University's Representative and authorized representatives of the Architect, and its consultants; the Contractor and its superintendent; major subcontractors; manufacturers; suppliers; Contractor's designated safety manager; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with the Project and authorized to conclude matters relating to the Work.

C. Agenda: Items of significance that could affect progress, including the following:

1. Tentative construction schedule.
2. Critical work sequencing.
3. Designation of responsible personnel.
4. Procedures for processing field decisions and Change Orders.
5. Procedures for processing Applications for Payment.
6. Distribution of Contract Documents.
7. Submittal of Shop Drawings, Product Data, and Samples.
8. Preparation of record documents.
9. Use of the premises.
10. Parking availability.
11. Office, work, and storage areas.
12. Equipment deliveries and priorities.
13. Safety procedures, including emergency notification procedures.
14. First Aid.
15. Security.
16. Housekeeping.
17. Working hours.
18. Sustainability requirements, including Contractor staffing.

1.3. PRE-INSTALLATION MEETINGS

A. The Contractor shall conduct a pre-installation conference at the Project Site before each construction activity that requires coordination with other construction, and as required by other sections of the specifications.

1. The Contractor shall distribute written notice of agenda, meeting time, and location a minimum of five calendar days in advance.

B. Attendees: The Installer and representatives of manufacturers and fabricators involved in or affected by the installation, and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise the University's Representative of scheduled meeting dates.

1. Review the progress of other construction activities and preparations for the particular activity under consideration at each pre-installation conference, including requirements for the following:

a. Contract Documents
b. Options
c. Related Change Orders
d. Purchases
e. Deliveries
f. Shop Drawings, Product Data, and quality-control samples
g. Possible conflicts
h. Compatibility problems
i. Time schedules
j. Weather limitations.
k. Manufacturer's recommendations
l. Warranty requirements
m. Compatibility of materials
n. Acceptability of substrates
o. Temporary facilities
p. Space and access limitations
q. Governing regulations
r. Safety
s. Inspecting and testing requirements
t. Required performance results
u. Recording requirements
v. Protection.

2. Record significant discussions and agreements and disagreements of each conference, and the approved schedule. Promptly distribute the record of the meeting to everyone concerned, including the University and the University's Representative.

3. Do not proceed with the installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of Work and reconvene the conference at the earliest feasible date.

1.4. PROGRESS MEETINGS

A. The Contractor shall conduct progress meetings at the Project Site at regular intervals. Notify the University's Representative and the Design Professional of scheduled meeting dates. Coordinate dates of meetings with preparation of the payment request. Document meetings with meeting minutes to be distributed to the University's Representative, the Design Professional and all other attendees.

B. Attendees: In addition to representatives of the University and the Architect, each subcontractor, supplier, or other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with the Project and authorized to conclude matters relating to the Work.

C. Agenda: Review and correct or approve minutes of the previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to the status of the Project.

1. Contractor's Construction Schedule: Review progress since the last meeting. Determine where each activity is in relation to the Contractor's Construction Schedule, whether on time or ahead or behind schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to insure that current and subsequent activities will be completed within the Contract Time.

2. Review the present and future needs of each entity present, including the following:

a. Interface requirements
b. Time
c. Sequences
d. Status of submittals
e. Status of RFI's
f. Deliveries
g. Off-site fabrication problems
h. Access
i. Site utilization
j. Temporary facilities and services
k. Hours of work
l. Contractor's Safety Program (including any special hazards and risks)
m. Housekeeping
n. Quality and work standards
o. Contractor's two week "look ahead" schedule and issues
p. Change Orders
q. Documentation of information for payment requests
r. Sustainability review, including tracking and status.

D. Schedule Updating: Revise the Contractor's Construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue the revised schedule concurrently with the report of each meeting.

1.5. BILLING MEETINGS

A. Attend a meeting monthly 7 days prior to submittal of the Application for Payment, at a location acceptable to University's Representative.

B. Attendees:

1. University's Representative.
2. Design Professional and Consultants, as appropriate.
3. Contractor's Project Manager.
4. Superintendent.
5. Others as directed by University's Representative.

C. Agenda:

1. Determination of current schedule progress.
2. Review of work completed based on the cost loaded schedule to be billed in the Application for Payment.

D. Schedule Updating: Revise the Contract Schedule prior to the meeting based on information determined at prior progress meetings. Review schedule revisions and prepare a final revised schedule for submission 10 days prior to the application for payment.

1.6. 11-MONTH WARRANTY MEETING

A. Attend a meeting eleven months following the date of Notice of Completion.

B. Attendees:

1. University's Representative
2. Design Professional and Consultants, as appropriate
3. Contractor's Project Manager
4. Subcontractors, as appropriate
5. Others as directed by Responsible Administrator.

C. Agenda: Review of guarantees, bonds, service and maintenance contracts for materials and equipment.

PART 2 – PRODUCTS (Not Applicable)

PART 3 – EXECUTION (Not Applicable)

END OF SECTION

SECTION 01 3200
DOCUMENT CONTROL

PART 1 – GENERAL

1.1. SUMMARY

A. This Section includes the requirements for Contractor provided electronic document control system(s):

1. General Requirements
2. Submittals
3. Software
4. System Maintenance

1.2. GENERAL REQUIREMENTS

A. Contractor shall provide a web accessible system for electronic document control designed for use during pre-construction and construction to manage documents including RFIs and submittals.

B. Contractor shall provide an electronic document control system(s) that is accessible via a web browser (including IE version 7.7) from any geographical location.

C. Contractor shall provide access to University's Representative, University's Inspector of Record, Design Professional, and at least 7 other individuals identified by University's Representative.

D. The electronic document control system must use the University numbering system specified in the applicable Specification Section.

E. Hours of Operation: The electronic document control system shall be available 24 hours a day, 7 days a week except for short periods of planned system maintenance.

1.3. SUBMITTALS

A. Contractor shall submit a narrative description and outline of the proposed electronic document control system for review and approval by University's Representative.

B. Contractor shall submit an example of the electronic log for both RFIs and Submittals for review and approval by University's Representative.

C. Contractor shall establish a commercially available web based RFI and submittal processing system capable of posting RFI's and submittals with the following capabilities:

1. Password secured access with varying levels of "write" or action capability, with multiple user defined stamps for action taken.
2. Accessible from any computer with Internet access, whether in the office or the field.
3. Notification of submittal status based on user profile.
4. Automatic Transmittal generation when submittal is released.
5. Extensive and user friendly mark-up tools and capability.
6. Ability to hide mark-up comments based on user profile.
7. Status of submittal and responsible party.
8. Download in PDF format based on user profile.
9. Tracking of resubmittal process, including University designated numbering system.

PART 2 – PRODUCTS

2.1. SOFTWARE

A. Primavera, Prolog or equal is acceptable as the electronic document control system used for RFIs and submittals.

2.2. SYSTEM MAINTENANCE

A. University shall be notified at least 48 hours in advance of planned system maintenance of the electronic document control system(s). Planned system maintenance should be scheduled not to interfere with construction activities whenever possible. The system uptime shall be at least 95% based on a rolling monthly average.

B. Contractor is responsible for installation, maintenance, and backup activities of the electronic document control system(s).

PART 3 – EXECUTION (Not Applicable)

1.1. UPDATES

A. Every two (2) weeks, Contractor shall export or otherwise generate electronic logs of all RFIs and submittals that can be imported into the University's enterprise system. The format of the electronic logs shall be a spreadsheet in MS-Excel format of all the structured data from each RFI or submittals. The exported or otherwise generated log for RFIs shall be separate from the log for submittals. Samples shall be included in the log of submittals.

B. Contractor shall also allow, at any time, the University's Representative or designee, to download electronic copies of such RFI and submittal documents in a format that is searchable such as printed PDFs. Scanned PDFs are not acceptable except in the case of drawings.

C. At least 7 days before the date scheduled for Final Inspection, Contractor shall provide University's Representative a complete electronic copy of all electronic files from the electronic document control system for the project.

1. The electronic files shall be executable on CD or DVD.

2. Each disc shall be fully labeled with the project name, contract number, date, and the sequence number of the disc in the set. Files may be submitted compressed, but the decompression utility used (executable preferred) should be fully described with directions included on the transmittal as well as in digital form.

END OF SECTION

SECTION 01 3216
SCHEDULES

PART 1 – GENERAL

1.1. SUMMARY

A. This Section includes administrative and procedural requirements for the Critical Path Method (CPM) of scheduling and reporting progress of the Work:

1. Preliminary Contract Schedule
2. Contract Schedule
3. Summary Schedule
4. Narrative Report
5. Variance Report
6. Cash Flow Curve
7. Manpower Curve
8. Look-Ahead Schedule
9. Final As-Built Schedule
10. Responsibility for Completion
11. Adjustment of Time for Completion

B. Refer to the Agreement, General Conditions, and Notice to Proceed for definitions and specific dates of Contract Time.

1. Contractor shall develop a network plan and schedule for the Project demonstrating complete fulfillment of all contract requirements, shall keep the network plans up-to-date and in accordance with the requirements of this Section and shall utilize the CPM in planning, coordination, performing and reporting the Work under this Contract, including all activities of subcontractors, equipment vendors, and suppliers and in assisting University's Representative in monitoring the progress of the Work.

2. The Precedence Diagramming Method (PDM) shall be utilized in preparing the CPM Schedule network diagrams utilizing Primavera Scheduling Software (P6 or the latest version for Windows, MS Project (latest version for Windows), or equal which is 100% importable into Primavera.

3. Contractor shall use Primavera Scheduling Software as a computerized critical path scheduling system for producing computer generated reports with the following minimum information:

a. Activity identification code keyed to summary and Contract Schedule activities.
b. Activity description.
c. Status date and remaining duration.
d. Activity percentage complete.
e. Activity duration.
f. Early start/finish and late start/finish.
g. Total float.
h. Free float.
i. The predecessor and successor activities for each individual activity.
j. A comparison between the current updated Contract Schedule and the Baseline Schedule.
k. Designation of the planned work day/work week for each activity.
l. A critical item list of activities with ten (10) working days or less total float.
m. Scheduled and actual manpower loading for each activity.
n. Scheduled and actual progress payment for each activity.

C. Definitions:

1. Critical Path activities are defined as Work activities that, if delayed or extended, will cause a critical delay as defined in Article 8 of the General Conditions. All other Work activities are defined as non-critical Work activities and are considered to have float.

2. Float is defined as the time that a non-critical Work activity can be delayed or extended without causing a critical delay as defined in Article 8 of the General Conditions. Neither Contractor nor University shall have an exclusive right to the use of float. Float is a shared resource available to Contractor and University.

a. Float for any Work Activity shall be calculated as the difference in days between the Latest Finish and its Earliest Finish. Any such calculated float that results in a negative number is considered Negative Float.

D. Submittals:

1. Preliminary Contract Schedule
2. Contract Schedule
3. Summary Schedule
4. Narrative Report
5. Variance Report
6. Cash Flow Curve
7. Manpower Curve
8. Look-Ahead Schedule
9. Final As-Built Schedule

1.2. PRELIMINARY CONTRACT SCHEDULE

A. Submittal

1. Submit the Preliminary Contract Schedule to University's Representative within the time specified in the Instructions to Bidders and Supplementary Instructions to Bidders.

2. Submit to University's Representative **1 hardcopy**, **1 electronic copy** in PDF, and **1 electronic copy** in the computerized critical path scheduling system software per 1.1.A.2. above approved by University's Representative.

3. Use the form of a bar chart, GANT chart, or other system approved by University's Representative showing the Work from the construction start date through the final completion date, with the work activities involved and other information relative to the progress of the Work, in a continuous flow from left to right.

4. Show sufficient detail to demonstrate adequate planning for the Work and to show a practical plan to complete the Work within the Contract Time, and suitable for monitoring progress of the Work.

B. Approval

1. Within **5 days** after receipt of the Contract Schedule, University's Representative will notify Contractor of its acceptance or return with comments for resubmittal.

C. Activities and Milestones

1. Identify all Work activities which constitute the Critical Path.

2. Include submittals and lead times.

3. Identify the milestone for completion of the Project. At a minimum, identify the following milestones:

   Commencement Date
   Substantial Completion
   Final Completion

4. Identify all holidays and non-working days. Contractor shall perform no work that requires the University's observation or inspection on the following University holidays and campus closure days:

   a. Regular University Holidays and Campus Closure Days:

      New Year's Day
      Martin Luther King, Jr. Day (3rd Monday in January)
      Presidents' Day (3rd Monday in February)
      Cesar Chavez Day (Last Friday in March)
      Memorial Day (Last Monday in May)
      Independence Day (July 4)
      Labor Day (1st Monday in September)
      Veterans' Day (November 11)
      Thanksgiving Day (4th Thursday in November)
      Friday following Thanksgiving Day
      Christmas Eve
      Christmas Day
      Campus Closure: business days between Christmas Day and New Year's Eve
      New Year's Eve

      Exception: A University Holiday that falls on a Saturday is observed on the preceding Friday, and a University Holiday that falls on a Sunday is observed on the following Monday, unless an alternate day to observe the University Holiday is designated by the University.

   b. Other Campus Closure Days: N/A

1.3. CONTRACT SCHEDULE

A. Submittal

1. Submit the Contract Schedule, or updated Contract Schedule as applicable, within **7 days** prior to submitting an Application For Payment.

   a. The initial Contract Schedule submitted to and approved by University's Representative shall be known as the Baseline Schedule, and shall be used by Contractor to execute the Work of the Contract, including planning, organizing and directing the Work, and reporting its progress until subsequently updated.

   b. In no event shall Contractor submit an updated Contract Schedule less than monthly.

   c. If the commencement or completion of any Work activity on the critical path is more than 30 days behind the date set forth in the Contract Schedule for such Work activity, at University's Representative's sole discretion, University's Representative may require Contractor to submit an updated Contract Schedule at a more frequent interval without additional cost to the University.

      If the Contract Time is less than 300 days, and if the commencement or completion of any Work activity on the critical path is more than 10% of the Contract Time behind the date set forth in the Contract Schedule for such Work activity, at University's Representative's sole discretion, University's Representative may require Contractor

to submit an updated Contract Schedule at a more frequent interval without additional cost to the University.

2. Submit to University's Representative **1 hardcopy**, **1 electronic copy** in PDF, and **1 electronic copy** in the computerized critical path scheduling system software per 1.1.A.2. above approved by University's Representative.

3. Submit the Contract Schedule or updated Contract Schedule in the same form as required in 1.2.A. above.

4. The presentation of each Work activity on the Contract Schedule or updated Contract Schedule shall include a brief description of the Work activity, the duration of the Work activity in days, and a responsibility code identifying the organization or trades performing the Work activity.

5. The Contract Schedule or updated Contract Schedule shall be a computerized, detailed, task level CPM diagram in PDM format. A clear delineation of construction activities shall be shown. This schedule shall be manpower and cost loaded and not extending beyond the Contract Time.

6. The work activities comprising the Contract Schedule shall be of sufficient detail to ensure adequate planning and execution of the Work to provide an appropriate basis for monitoring and evaluating the progress of the Work. A work activity is defined as an activity which requires time and resource (manpower, equipment, and/or material) to complete in a continuous operation. No activity shall be less than 1 day, no more than 14 days duration for any onsite operation.

7. Failure by Contractor to include any element of the Work required for the performance of this Contract and completion of the Project shall not excuse Contractor from completing all work required within the Contract Time, regardless of University's Representative's acceptance of the Contract Schedule or any updated Contract Schedule.

8. No more than 30% of the total number or activities shown shall be critical or near critical. Near critical is defined as float less than 10 days.

9. These schedules shall indicate the sequence and interdependency of work activities and shall be coordinated with all submittal, review and approval requirements.

10. Each approved Change Order and Field Order shall be listed and plotted as a separate and independent activity. Schedule components shall be organized into logical groupings by location, responsibility, Specification Section, etc.

B. Approval

1. Within **5 days** after receipt of the Contract Schedule or updated Contract Schedule, University's Representative will notify Contractor of its acceptance or return with comments for resubmittal.

   a. Contractor shall participate in a review of the proposed Contract Schedule or updated Contract Schedule by University's Representative when requested.

   b. Contractor shall resubmit any revisions within **3 days**.

2. The accepted Contract Schedule or updated Contract Schedule shall be the Contract Schedule of record for the period it is current and shall be the basis for payment during that period. Contractor shall perform the Work in accordance with the Contract Schedule or updated Contract Schedule as accepted.

3. No Application For Payment will be processed nor shall any progress payment become due for work performed until the Contract Schedule or updated Contract Schedule is accepted by University's Representative. University's Representative's acceptance of the Contract Schedule or updated Contract Schedule is a condition precedent to University making any progress payment for work performed.

4. Updating

   a. Contractor shall meet with University's Representative at least **once per month**, or as directed by University's Representative, to review the latest approved Contract Schedule for actual progress made to date, activities started and completed to date, and the percentage of work completed to date on each activity started but not completed, and to incorporate in the Contract Schedule all changes in the progress, sequences, and scope of Work activities.

      (1) The updated Contract Schedule shall accurately represent the as-built condition of all completed and in-progress Work activities as of the date of the updated Contract Schedule.

      (2) The updated Contract Schedule shall incorporate all changes mutually agreed upon by Contractor and University during preceding periodic reviews and all changes resulting from Change Orders and Field Orders.

      (3) Contractor shall document the effect on the updated Contract Schedule whenever float has been used.

C. Activities and Milestones

1. Identify all Work activities which constitute the critical path.

2. Identify all Work activities in correct sequence for the completion of the Work. Work activities shall include the following:

   a. Major Contractor-furnished equipment, materials, and building elements, and scheduled activities requiring submittals or University's prior approval.

   b. Show dates for the submission, review, and approval of each submittal. Dates shall be shown for the procurement, fabrication, delivery, and installation of major equipment, materials, and building elements, and for scheduled activities designated by University.

   c. System test dates.

   d. Scheduled overtime Work if required by Contract Documents.

   e. Dates of Contractor requests for designated working spaces, storage areas, access, and other facilities to be provided by University.

   f. Dates of Contractor requests for approvals and decisions from University on designated items.

   g. Dates of Contractor requests for University-furnished equipment.

   h. Dates of Contractor requests for University-furnished utilities.

   i. Connection and relocation of existing utilities.

   j. Connecting to or penetrating existing structures.

   k. Inspections and testing.

l. Commissioning Sequence and activities for all building systems.

3. Include the milestones per 1.2.C.

4. Include all holidays and non-working days per 1.2.C.

1.4. SUMMARY SCHEDULE

A. All activities in the Contract Schedule shall be grouped to enable "rollup" of the activities in the form of a Summary Schedule which shall be submitted along with the updated Contract Schedule within **7 days** prior to submitting Contractor's next Application For Payment. A clear delineation of construction activities shall be shown on the summary schedule. The summary schedule shall be manpower and cost loaded.

B. Review and approval by University's Representative of the Summary Schedule is a condition precedent to University making any progress payments for work performed.

1.5. NARRATIVE REPORT

A. With each updated Contract Schedule, Contractor shall provide an accompanying Narrative Report within **7 days** prior to submitting its next Application For Payment.

B. The Narrative Report shall describe the progress achieved over the past period since the prior update, the progress anticipated during the upcoming period, critical activities, delays encountered during the prior period, delays anticipated during the upcoming period, and an audit of the Contract Time. The narrative shall also discuss the status of major project milestones. The audit shall show current days allowed by Contract, days used through the end of the period, days remaining, percent of time used to date, and percent complete as measured by a cost loaded schedule, and days ahead of or behind schedule. In the event that the Contractor was delayed by any occurrence during the prior period, the narrative report shall include a listing of all delays that affected the critical path and shall clearly explain the impact the claimed delay(s) had on the critical path and shall include an accounting of days lost or gained.

C. In the event the monthly update shows the Contractor to be behind schedule (negative float), the narrative shall include a description of actions needed to bring the project back on schedule.

D. Review and approval by University's Representative of the Narrative Report is a condition precedent to University making any progress payments for work performed.

1.6. VARIANCE REPORT

A. A variance report shall be submitted along with the updated Contract Schedule within **7 days** prior to submitting Contractor's next Application For Payment.

B. The variance report shall compare the approved Baseline Schedule and the latest updated Contract Schedule. The report shall include a description of all activities completed during the preceding period (last approved updated Contract Schedule), a description of progress made and planned for activities listed as started but not completed on the updated Contract Schedule, and shall report noncritical activities which have been delayed 10 or more days and critical (8 days or less total float) activities that have incurred any delay. The format of this report shall include:

1. Activity code and description.
2. Baseline scheduled early start/finish dates.
3. Current anticipated early start/finish dates.
4. Days remaining to complete the activity.
5. Percentage complete of the activity.
6. Total float of the activity.

C. Review and approval by University's Representative of the Variance Report is a condition precedent to University making any progress payments for work performed.

1.7. CASH FLOW CURVE

A. Contractor shall submit its Cash Flow Curve of expected progress payments over the time of the Project along with its Contract Schedule within **7 days** prior to submitting its first Application For Payment. The curve shall be plotted against the Contract Schedule using the Cost Breakdown approved by University's Representative.

B. Contractor shall furnish costs for each Work activity that cumulatively equal the total Contract Sum. Mobilization costs may be shown separately; however, other costs, such as profit and bonds, shall be pro-rated throughout all activities.

C. Contractor shall update the Cash Flow Curve with actuals from the approved progress payments and forecasted progress payments and submit it to University's Representative along with Contractor's updated Contract Schedule per 1.3. The total of approved progress payments and forecasted progress payments shall equal the Contract Sum plus approved Change Orders. The updated curve shall be plotted against the Baseline Schedule and updated Contract Schedule.

D. Review and approval by University's Representative of the Cash Flow Curve is a condition precedent to University making any progress payments for work performed.

1.8. MANPOWER CURVE

A. Contractor shall submit a Manpower Curve of the labor requirements per calendar week over the time of the Project along with its Contract Schedule within **7 days** prior to submitting its first Application For Payment. The curve shall be plotted against the Baseline Schedule. The curve shall show the number of persons in each craft for each week.

B. Contractor shall update the Manpower Curve with actual labor employed and forecasted labor requirements necessary to complete the Project within the Contract Time, and shall submit it to University's Representative along with Contractor's updated Contract Schedule per 1.3. The updated curve shall be plotted against the Baseline Schedule and updated Contract Schedule.

C. Review and approval by University's Representative of the Manpower Curve is a condition precedent to University making any progress payments for work performed.

1.9. LOOK-AHEAD SCHEDULE

A. The Look-Ahead Schedule is a schedule derived from the Contract Schedule or updated Contract Schedule that indicates in detail all activities scheduled for work for the next 2 weeks and all activities scheduled to occur during the next 4 weeks.

B. Submit in 11" x 17" Gantt chart format. Provide as many copies as requested by University's Representative.

C. The Look-Ahead Schedule shall be generated from the then current Preliminary Contract Schedule, Contract Schedule, or updated Contract Schedule.

1.10. FINAL AS-BUILT SCHEDULE

A. A combined 2-week Look-Ahead Schedule with a 2-week As-Built Schedule for previous two weeks shall be submitted by Contractor for review and approval as often as requested by the University's Representative, at no additional cost.

B. As a condition precedent to final acceptance of the Project, Contractor shall submit a final As-Built Schedule and all final reports which accurately reflect the manner in which the Project

was constructed and includes actual start and completion dates for all work activities on the last updated Contract Schedule.

C. As a condition precedent to the release of retention, the last update of the Contract Schedule submitted shall be identified by the Contractor as the "As Built Schedule". The As-Built Schedule shall be submitted when all activities are 100 percent complete. The As-Built Schedule shall reflect the exact manner in which the Project was actually constructed (including start and completion dates, activities, sequences, and logic) and shall include a statement signed by the Contractor that the As Built Schedule accurately reflects the actual sequence and timing of the construction of the Project.

1.11. RESPONSIBILITY FOR COMPLETION

A. Delays of any non-critical Work activity shall not be the basis for an extension of Contract Time until the delays consume the float associated with that non-critical Work activity and cause the Work activity to become critical.

B. Contractor shall not sequester float through strategies including extending activity duration estimates to consume available float, using preferential logic, using extensive or insufficient crew/resource loading, use of float suppression techniques, special lead/lag logic restraints or imposed dates. Use of float time disclosed or implied by the use of alternate float suppression techniques shall be shared for the benefit of both the University and contractor.

C. It is acknowledged that University generated time savings (critical path submittal reviews returned in less time than allowed by the Contract Documents, approval of substitution requests which result in a savings of time for contractor) create shared float. Accordingly, University caused delays may be offset by University generated time savings.

D. Contractor agrees that whenever it becomes apparent from the current updated Contract Schedule that the Contract completion date will not be met, it will take some or all of the following actions, with prior approval of University's Representative, at no additional cost.

1. Increase construction manpower in such quantities and crafts as will eliminate, in the judgment of University's Representative, any delay.

2. Increase the number of working hours per shift, shifts per working day, working days per week, or the amount of construction equipment, or any combination of the foregoing, sufficiently to eliminate, in the judgment of University's Representative, any delay. This paragraph shall not be construed to permit Contractor to violate the work hour restrictions specified in the Contract Documents.

3. Reschedule activities to achieve maximum practical concurrent completion activities within the requirements of the specifications.

1.12. ADJUSTMENT OF TIME FOR COMPLETION

A. Contractor shall submit a detailed time impact analysis of the Contract Schedule to support an adjustment of the Contract Time for delay under Article 8 of the General Conditions or an adjustment of the Contract Sum for delay under Article 7 of the General Conditions.

B. Each time impact analysis shall provide information justifying the request and stating the extent of the adjustment requested for each specific change or alleged delay. Each time impact analysis shall be in form and content acceptable to University's Representative, and shall include, but not be limited to the following:

1. A fragmentary CPM type network (Fragnet) illustrating how Contractor proposes to incorporate the change or alleged delay into the current updated Contract Schedule.

2. Identification of activities in the current updated Contract Schedule which are proposed to be amended due to the change or alleged delay, together with engineering estimates and other appropriate data justifying the proposal.

C. The time impact analysis shall be determined on the basis of the date when the change was issued, or the date when the alleged delay began. The status of completion of the Work and time impact analysis shall include event time computations for all affected activities.

D. Contractor shall provide time impact analysis at no additional cost to demonstrate the time impact upon the Contract Time.

E. If University's Representative finds, after review of the time impact analysis, that Contractor is entitled to any extension of time, the Contract Time will be adjusted per the General Conditions, and Contractor shall revise the updated Contract Schedule accordingly.

PART 2 – PRODUCTS (Not Applicable)

PART 3 – EXECUTION (Not Applicable)

END OF SECTION

SECTION 01 3280
ELECTRONIC DATA TRANSFER

PART 1 – GENERAL

1.1. SUMMARY

A. Section includes Terms and Conditions for the transfer of Electronic Data to Contractor for use in preparation of Submittals, Record Documents, coordination drawings, and related documents to be produced by Contractor and submitted to University:

1. **CONTRACTOR'S ACCEPTANCE OF ELECTRONIC DATA IN ANY FORM SHALL CONSTITUTE ACCEPTANCE OF THE TERMS AND CONDITIONS OF THIS SECTION, INCLUDING PAYMENT OF INDICATED FEES.**

B. The University and the Contractor acknowledge that established administrative procedures for management of construction Projects anticipate paper documentation and methods for the exchange of such documents. To the extent the administrative and procedural requirements of the Contract Documents are predicated on established practices the University and the Contractor agree to accept reasonable modifications to certain procedural requirements to facilitate electronic exchange of information and the use of digital media.

C. Submittals: Only a material original stamped and signed by the University's Representative shall be acceptable as an official record of the processed submittal. When directed, quantities of document submittals specified in the Contract Documents may be adjusted as permitted to facilitate utilization of electronic transfer of information.

1.2. TERMS AND CONDITIONS

A. In consideration of Contractor's request to the University to deliver certain Electronic Data for use on the Project, Contractor agrees to the following:

1. Electronic Data includes but is not limited to, computer-aided design (CAD) files including native file formats (DWG) and drawing exchange formats (DXF), and files produced by word processing, spread sheet, scheduling, data base and other software programs. The Electronic Data may be provided in an original format produced by Design Professional or other University consultant, or an alternate, "translated" format as requested by other parties to this Agreement.

2. The means by which the Electronic Data is transferred may include but are not limited to, electronic mail, File Transfer Protocol (FTP) sites, project websites, and disk copies transmitted between the parties to this Agreement. Contractor acknowledges that Electronic Data transferred in any manner or translated from the system and format used by Design Professional or other University consultant, to an alternate system or format is subject to errors that may affect the accuracy and reliability of the data and that the data may be altered, whether inadvertently or otherwise. Accordingly, the University and Design Professional make no warranty, express or implied, as to the accuracy of the information transferred. The Electronic Data are not the Bidding Documents and differences may exist between these electronic files and corresponding hard-copy Bidding Documents. University reserves the right to retain hard copy originals in addition to electronic copies of the Electronic Data transferred, which originals shall be referred to and shall govern.

3. As consideration to University for the transfer of the Electronic Data, Contractor agrees that the University, University's Design Professional, and University's agents and consultants shall not be liable for and hereby waives all claims and agrees to indemnify and hold University harmless from all liabilities, losses, damages or expenses (including attorneys' fees) arising out of, or connected with: (1) the transfer of Electronic Data by any means; (2) the use, modification or misuse by parties other than University

and Design Professional of the Electronic Data; (3) the limited life expectancy and decline of accuracy or readability of the Electronic Data due to storage; (4) any use of the Electronic Data by any third parties receiving the data from other parties to this Agreement; or (5) the incompatibility of software or hardware used by University and Design Professional and the other parties participating in the Work.

4. The Electronic Data provided under the terms of this Agreement are the proprietary information of University. All Electronic Data shall be treated as confidential and shall not be disclosed to or shared with others without express, written consent from the University's.

5. The University shall issue the most current information available, but does not undertake the responsibility for providing updated information as the Project proceeds. Contractor may make a specific written request for such updated information as Contractor deems necessary, which University will then provide subject to the Terms and Conditions hereof.

PART 2 – PRODUCTS (Not Applicable)

PART 3 – EXECUTION (Not Applicable)

END OF SECTION

SUBMITTAL SCHEDULE									
Section	Shop Dwgs	Prod. Data/List	Samples Mock-ups	Extend. Guarantee	Op/Maint. Manuals	Tests	Extra Mat'l	Certs.	Other
01 1100									
01 1400									
01 2500									
01 2613									
01 3113									
01 3119									
01 3200									
01 3300									
01 3543									
01 3546									
01 4100									
01 4200									
01 4300									
01 4500									
01 4516									
01 5300									
01 5400									
01 5500									
01 5600									
01 5639									
01 6000									
01 7100									
01 7329									
01 7400									
01 7700									
01 7839									
02 105									
05 120									
05 920									
06 100									
07 1416									
23 0010									
23 0513									
23 0529									
23 0548									
23 0593									
23 0713									

SUBMITTAL SCHEDULE									
Section	Shop Dwgs	Prod. Data/List	Samples Mock-ups	Extend. Guarantee	Op/Maint. Manuals	Tests	Extra Mat'l	Certs.	Other
23 0719									
23 0802									
23 2113									
23 2114									
23 3100									
23 3300									
23 7313									
26 0010									
26 0519									
26 0526									
26 0529									
26 0533									
26 0534									
26 2726									
26 2813									
26 2816									

NOTE: Should a discrepancy arise between this schedule's requirements and individual requirements, the most stringent requirement shall prevail.

END OF SECTION

SECTION 01 3300
SUBMITTALS

PART 1 – GENERAL

1.1. SUMMARY

A. Section includes:

1. Certificates
2. Shop Drawings, Product Data, and Samples
3. LEED Documentation
4. Refrigerant Management Documentation
5. Contractor Certification Form
6. Subcontractor Certification Form
7. Submittal Schedule

B. Definitions:

1. Mockups are full-size assemblies for review of construction, coordination, testing, or operation, appearance, and finish by which the Work will be judged; they are not Samples.

2. The terms “Shop Drawings” and Product Data” are defined in Article 3.12 of the General Conditions.

3. As used herein, the term “manufactured” applies to standard units usually mass-produced. The term “fabricated” means items specifically assembled or made out of selected materials to meet individual design requirements. Shop drawings shall establish the actual detail of all manufactured or fabricated items, indicate proper relation to adjoining Work, and amplify design details of mechanical and electrical equipment in proper relation to physical spaces in the structure.

4. The terms "Shop Drawings" and "Product Data" are defined in Article 3.12 of the General Conditions.

C. Manufacturers’ Instructions: Where any item of Work is required by the Contract Documents to be furnished, installed, or performed in accordance with a specified product manufacturer's instruction, Contractor shall procure and distribute the necessary copies of such instructions to University's Representative and all other concerned parties, and Contractor shall furnish, install, or perform the Work in strict accordance therewith.

OR

Manufacturer’s Instructions: Where it is required in the specifications that materials, products, processes, equipment or the like to be installed or applied in accordance with manufacturer's instructions, directions or specification, or words to this effect, it shall be construed to mean that said application or installation shall be in strict accordance with printed instructions furnished by the manufacturer of the material concerned for use under conditions similar to those at the job site. Three (3) copies of such instructions shall be furnished to the University's Representative and his/her approval thereof obtained before work is begun.

D. The University's Representative or its Design Professional reserves the right to review and request the removal or redesign of manufacturers' trade marks and names on items of materials and equipment which will be exposed to view in the completed Work. Such removal or redesign shall be at no increase in Contract Sum.

E. Materials and equipment, for which Underwriters' Laboratories, Inc. standards have been established and their label service is available, shall bear the appropriate UL label.

1.2. CERTIFICATES

A. Certifications of Review and Coordination: Within 10 days of Notice to Proceed, submit completed Contractor Certification of Review and Coordination and all Subcontractor Certifications of Review and Coordination.

B. Certifications of Review and Coordination: As required by the General Conditions, perform a thorough review of the Contract Documents prior to commencing the Work. If there are no exceptions, write 'NO EXCEPTIONS" in the space provided.

1. Complete a copy of the Contractor Certification of Review and Coordination Form following this Section.
2. Require all subcontractors to perform a thorough review of the Contract Documents and complete a copy of the Subcontractor Certification of Review and Coordination Form following this Section.
3. Review all completed Forms and resolve conflicting comments, if any, among the various parties so as to present a clear, concise view of items noted.
4. Submitting the required certifications does not relieve the Contractor from responsibility to continue to immediately report new discrepancies, errors, omissions, conflicts, code violations, and improper use of materials discovered in the Contract Documents during the course of construction.
5. Applications for Payment will not be processed by the University's Representative until all certificates have been received.

1.3. SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

A. Shop drawings, product data, and samples, other than in connection with proposed substitutions, shall be submitted to University’s Representative only when specifically required; and University’s Representative will not review any other such submittals. Product data and samples for proposed substitutions shall be submitted to University’s Representative in accordance with Section 01 2500. Contractor shall be responsible for obtaining such copies of shop drawings, product data, and samples as it may require for its own use. Submittals Not Required: No shop drawings of supplemental data are required unless specifically requested by the University or specified herein. No shop drawings shall be submitted unless specifically requested.

1. Submittal Schedule:

a. Refer to Specific Specification Sections for the list of submittals required under each section and indicate the required submittals on the attached Submittal Schedule for review by University’s Design Professional. A schedule of submission of shop drawings, product data, and samples by Contractor (“Submittal Schedule”), and their processing and return by the University’s Design Professional shall be agreed upon by both parties in order that the items covered by these submittals will be available when needed by the construction process and so that each party can plan its workload in an orderly manner. Submit Submittal Schedule no later than 30 days after Award of Contract.
b. Contractor shall prepare the Submittal Schedule in the form as attached or similar form acceptable to the University’s Representative, and coordinate it with the Contract Schedule. No submittals will be processed before the Submittal Schedule has been submitted to and accepted by University’s Representative, except in such cases where the processing of submittals is required to maintain job progress before the acceptance of the Submittal Schedule.
c. In preparing the Submittal Schedule, Contractor must first determine from the Contract Schedule the date a particular item is needed for the Work. Working backwards, Contractor will establish the number of days required for fabrication, shipment, placement, and similar activities to determine the date required for the first submittal.

d. Allow 14-28 day duration for the University's Design Professional's initial review of submittals depending on the submittal/shop drawing and specification section. Allow 7 days for Design Professional to re-review revised or unapproved submittal/shop drawings.
e. Contractor to indicate whether the submittal is a "Full" or "Partial" submittal on the schedule and on the submittal.

2. Material List: Provide complete material list of products proposed for use. Submit Material Safety Data Sheets (MSDS) for Owner's use. Neither the University Representative nor its Design Professional will review MSDS.

3. Contractor's Review:

a. Contractor Review: The shop drawings and supplemental data, when called for, shall be submitted as the instruments of the Contractor, even though they may have been prepared by a subcontractor, supplier, dealer, manufacturer, or by any other person, firm or organization. Prior to submission, the Contractor shall undertake his/her own review and stamp with his/her acceptance those shop drawings and supplemental data he/she is requested to submit to the University's Architect/Design Professional for his/her review. By accepting and submitting shop drawings and supplemental data, the Contractor represents that the Contractor has determined and verified all field measurements, the physical construction, the quality of materials, the applicability of catalog numbers, and similar data, or will do so, and that the Contractor has checked and coordinated each shop drawing with the requirements of the work and of the Contract Documents. Conflicts with other trades shall be resolved by the Contractor in the shop drawings, if possible, but in any event prior to the actual construction. Drawings submitted in response to a request of the University's Architect shall show rearrangements, if any, made necessary by the use of materials or equipment other than those specified. Review, mark-up as appropriate, and stamp show drawings, product data, and samples prior to submission. Submittals shall clearly show that they have been reviewed and approved by Contractor for conformance with the requirements of the Contract Documents and for coordination with other Sections.
b. Submittals not stamped and signed by Contractor will be returned without review.
c. Determine and verify:
(1) Field measurements.
(2) Field construction criteria.
(3) Catalog numbers and similar data.
(4) Conformance with Contract Documents.
d. Coordinate each submittal with requirements of the Work and of the Contract Documents.
e. Notify University's Representative and it's Design Professional in writing, at time of submission, of any changes in the submittals from requirements of the Contract Documents. Contractor is responsible to correct the deficiencies from the requirements of the contract documents when any changes are not made in writing to the University Representative or its Design Professional at the time of submission. The approval of submittals will be deemed null and void.
f. Begin no fabrication or Work which requires submittals until the return of the University's Design Professional's final reviewed submittals.

4. Coordination Drawings: Prepare coordination drawings where careful coordination is needed for installation of products and materials fabricated by separate entities as specified in Section 01 3300. Prepare coordination drawings where limited space availability necessitates maximum utilization of space for efficient installation of different components.

    a. Show the relationship of components shown on separate Shop Drawings.
    b. Indicate required installation sequences.
    c. Comply with requirements contained in this Section.

5. BIM Procedures:

    a. Contractor shall establish procedures for coordinating work using BIM methods and protocols.

    b. Format and Development: Prepare coordination drawings according to the following requirements:

        (1) Prepare BIM files for the project based on original hard copy documents as received from the University.
        (2) Prepare all files using BIM software program, version, and operating system as approved by University.
        (3) Prepare BIM Execution Plan establishing BIM protocols for project, including standards, responsibilities of Contractor and sub-contractors, schedules, clash detection, and quality control.
        (4) Designate a specific staff person as Contractor's BIM Coordinator.
        (5) Submit or post coordination drawing files using format same as file preparation format or Portable Data File (PDF) format.

    c. Clash Detection:

        (1) Using BIM procedures perform clash detection as part of preparation of coordination drawings.
        (2) Include clash detection protocol in the BIM execution plan.
        (3) BIM Coordinator will review and assemble the various design and trade models, create clash reports and conduct coordination meetings with University's Representative as defined by the BIM execution plan.
        (4) Run Parameters: Clash detection, at minimum, shall be set to report any hard clashes within a 1 /4 inch tolerance. Clearance tolerances shall be used to account for additional material applied to modeled elements, such as fire proofing or required clearances.
        (5) At a minimum, review Clash Detection documents on a weekly basis. Identify conflicts requiring document modifications and review with University's Representative.
        (6) Update model elements based on field verification of dimensions and orientation.

    d. Following resolution of conflicts and clash detection, prepare coordination drawings for review as follows:

        (1) Comply with shop drawing requirements for sheet size and submittal methods specified in Section 01 3300 "Submittals".
        (2) Refer to Specifications in Divisions 2-33 technical specification sections for specific Coordination Drawing requirements.
        (3) Provide composite coordination drawings for equipment and system installations in mechanical and electrical rooms and spaces where two or more entities will provide the work.
        (4) Provide composite coordination drawings showing planned locations of core cuts, sleeves, and other penetrations intended for placement in

concrete decks, slabs, and structural components. Indicate intended use such as openings for conduit, piping, ducts, and utility services.

(5) Provide composite coordination drawings showing planned locations of fire and sound rated wall penetrations, including dampers. Indicate intended use such as openings for conduit, piping, ducts, and utility services.

(6) Prepare above-ceiling coordination drawings showing all above-ceiling work including structural members and required clearances and dimensions.

e. At the end of the project as part of the close out submittals the Contractor shall provide an “as-built” BIM model to be given to the University in addition to the hard copy as built drawings.

6. Submission Requirements:

a. Make submittals promptly in accordance with the Specifications and in such sequence as to cause no delay in the Work.

(1) Coordination: Coordinate preparation and processing of submittals with performance of construction activities. Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay.

(a) Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals and related activities that require sequential activity.

(b) Coordinate transmittal of different types of submittals for related elements of the work so processing will not be delayed by the need to review submittals concurrently for coordination.

(c) The University's Representative reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

(2) Processing: Allow sufficient review time so that installation will not be delayed as a result of the time required to process submittals, including time for resubmittals.

(a) Allow sufficient time from receipt by University's Representative, for initial review and comment. Allow additional time if processing must be delayed to permit coordination with subsequent submittals. The University's Representative will promptly advise the Contractor when a submittal being processing must be delayed for coordination.

(b) If an intermediate submittal is necessary, process the same as the initial submittal.

(c) Allow additional time for reprocessing each submittal.

(d) No extension of Contract Time will be authorized because of failure to transmit submittals to the University's Representative sufficiently in advance of the Work to permit processing.

b. Number of Submittals Required: Refer to Specification Section 01 3500 “Document Control” for distribution of Shop Drawings and Product Data submittals. After each submittal has been reviewed by the Design Professional and returned to the Contractor. The Contractor shall make (two) 2 hard copies of all approved submittals and shall submit the hard copies to the University’s Representative for project record filing.

(1) Samples: Contractor to submit a minimum of (five) 5 physical samples each of products and or samples for Design Professional’s review and approval. After review and approval one sample will be retained by the architect, two (2) for

the contractor and its subcontractor and two (2) for the University's Representative.

(2) Shop drawings and supplemental data, where called for, shall be prepared and submitted as per General Conditions. Final corrected copies of schedules and shop drawings or supplemental data to University's Design Professional for review shall be such as to provide one (1) for University's Architect's files, two (2) for the University and two (2) to the Contractor's job files and for distribution by the Contractor to subcontractors or vendors. Exceptions shall be as noted in Specifications sections.

c. Submittals shall contain:

(1) Identification data number assigned by the Contractor, consisting of the specification section number followed with the number 001 and continuing in sequence.

(a) Resubmittals: Add a letter to the previous identification, for instance 01 3400/005/R1 would be a first resubmittal.
(b) Use a separate number for each product, assembly, or system. Similar or related items may be grouped only if compatible with review process as approved.

(2) Date of submission and dates of any previous submissions.
(3) Project name and number, and contract identification.
(4) Names of Contractor, Subcontractor, Supplier and Manufacturer.
(5) Identification of item, with Specification Section number and article/paragraph references.
(6) Field dimensions, clearly identified as such.
(7) Relation to adjacent or critical features of the Work or materials.
(8) Reference standards, such as ASTM or Federal Specification numbers.
(9) Identification of changes from requirements of the Contract Documents.
(10) Identification of revisions on resubmittals.
(11) An 8-inch x 3 inch blank space for review stamps, as necessary.
(12) Contractor's stamp, initialed or signed, certifying to the review of the submittal; verification of materials and field measurements and conditions; and compliance of the information within the submittal with requirements of the Work and of the Contract Documents.

d. Interpretation of Terms:

(1) "As directed", "as required", "as permitted", "acceptable", "satisfactory", means by or to the University's Architect. The term "equal" means "equal in the opinion of the University's Architect after submittal data is reviewed". The term "favorable review" means that the submittals for material list, shop drawings, material substitutions, schedules, etc., will be reviewed by the University's Architect and copies returned to the Contractor marked as "Review Completed", "No Exceptions Taken" or "Make Corrections Noted" in which case no further submittals are needed.
(2) Submittals returned marked "Resubmit", "Amend and Resubmit" or "Rejected - Resubmit" shall be corrected to comply with project requirements and shall be resubmitted for review

7. Resubmission Requirements:

a. Shop Drawings and Product Data:

(1) Revise shop drawings or product data, and resubmit as specified for the initial submittal, only if required by University's Design Professional.
(2) Identify any changes which have been made other than those requested.

(3) Note any departures from the Contract Documents or changes in previously reviewed submittals which were not commented upon by University's Design Professional.

b. Samples: Submit new samples as required for initial submittal.

c. University's Design Professional's Review: The University's Design Professional will review shop drawings and supplemental data submitted by the Contractor only for general design conformance with the concept of the Project and compliance with the information given in the Contract Documents. Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of Contractor as required by the Contract Documents.

8. Distribution:

a. Reproduce and distribute copies of Submittals including Shop Drawings and Product Data, which carry the University's Design Professional's review stamp, to the following locations:
(3) Contractor's Project site file.
(4) Record documents file maintained by Contractor.
(5) Separate Contractors.
(6) Subcontractors.
(7) Supplier or manufacturer.
(8) Other involved parties as directed by University's Representative.

9. Design Professional's or Design Professional's designee's or University Representative's Review will be under the following conditions.

a. Review of submittals is only for general conformance with the design concept of the Project and general compliance with the information given in the Contract Documents. Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instruction for installation for performance or equipment or systems, all of which remain the responsibility of contractor as required by the Contract Documents.

b. The review does not affect the Contractor's responsibility to perform all Contract requirements with no change in Contract Sum or Contract Time. Any actions shown are subject to the requirements of the Drawings, Specifications and other Contract Documents. The Contractor is responsible to confirm and correlate dimensions at the site, for information that pertains to the fabrication processes, for the means, methods, techniques, procedures, sequences and quantities necessary to complete the Contract and for coordination of the work of all trades and satisfactory performance of his work. The review is undertaken solely to satisfy Consultant's obligations, if any to the University and shall not give rise to any claim by the Contractor or other parties against the University's Representative, his/her Consultants or University.

B. Shop Drawings

1. Present information required on shop drawings in a clear and thorough manner. Identify details by reference to drawings and detail, schedule, or room numbers shown and specified.

2. Shop drawings shall be original drawings by the Contractor. Direct reproductions of the Contract Drawings will not be acceptable as shop drawings.

3. Shop Drawings Delineation: The Shop Drawings shall be drawn to scale and shall be completely dimensioned, giving the plan together with such sections as are necessary to clearly show construction detail.

4. Responsibility: These Shop Drawings and all supporting data, catalogs, etc., shall be prepared by the Contractor or his/her suppliers, but shall be submitted as the instruments of the Contractor. Therefore, the Contractor shall review and approve the drawings of his/her suppliers as well as his/her own drawings before submitting them to the University's Representative. In particular, the Contractor shall ascertain that the drawings meet all requirements of the Drawings and Specifications and also conform to the structural and space conditions. Each Shop Drawing submitted for review shall bear a stamp certifying that it has been reviewed and approved by the Contractor in accordance with the Contract Documents. If such Shop Drawings show variations from Contract Documents, whether because of standard shop practice or other reasons, the Contractor shall make special mention thereof in his/her letter of transmittal. The Contractor shall be fully responsible for observing the need for and making any changes in the arrangement of piping, connections, wiring, manner of installation, etc., which may be required by the equipment he/she proposes to supply both as pertains to his/her own work and any work affected under other parts, heading or divisions of Drawings and Specifications.

5. Identification: Shop Drawings shall be entitled with the name of the project on each sheet and shall otherwise be identified by listing the particular division, section, article or reference of the work pertaining. Submit different items on separate sheets. All submittals shall be numbered sequentially.

6. Manner: Furnish for University's Design Professional's approval separate sheets of submittal of each specialty item in the following manner:

    a. Catalog cuts shall be photocopied or reproduced in some other acceptable manner and submitted on one (1) side only of an 8-1/2" x 11" sheet, noting only the items in question, together with the descriptive (specification) data complete. Once the Design Professional has reviewed the submittal provide two (2) hard copies of each approved, stamped shop drawing and other supporting data to the on-site University's Representative.
    b. Each sheet shall be identified with the division, section, article or reference in the Contract Documents which covers the item submitted for approval.
    c. Each sheet shall be identified with the project name, the University's Representative and the project's Design Professional.
    d. Each sheet shall bear the Contractor's stamp and signature of approval.

7. All shop drawings shall be drawn accurately suitable for duplicate copying by black line, blue line printing processes or photocopy.

8. Supplemental Data: Supplemental data shall include information as noted in the specification paragraphs requiring them, or as requested by the University.

9. Review Required: Shop drawings, if requested, must be submitted to and favorably reviewed by the University's Architect/Design Professional before being used by the Contractor on the job.

C. Product Data

1. Clearly mark each copy to identify pertinent Products or models.

2. Show performance data consisting of capabilities, rpm, kw pressure drops, design and operating pressures, temperatures, performance curves, noise level curves, power characteristics and consumption; conforming as closely as possible to the test methods referenced in the plan and specifications.

3. Show dimensions, weights and clearances required.

4. Show wiring or piping diagrams and controls.

5. Modify the standard schematic drawings and other diagrams to delete information, which is not applicable to the Work.

6. Supplement standard information to provide information specifically applicable to the Work.

D. Samples

1. Office samples shall be of sufficient size and quality to clearly illustrate the following:
    a. Functional characteristics of the products, with integrally related parts and attachment devices.
    b. Full ranges of color, texture, and pattern.
    c. Provide a minimum of5 samples plus any additional number for Contractor needs.
2. Samples herein referred to shall include all materials, equipment, surface textures, colors, fabrics, etc., as required by Drawings and Specifications or as requested by the University's Design Representative. They shall be submitted as required by the Specifications or requested by the University's Representative or its Design Professional.
3. Submittal: Samples, properly identified and described, shall be submitted as noted herein, or as may be required by the University's Representative. They shall be submitted and resubmitted until approved. No approval of a sample shall be taken in itself to change or modify any contract requirement. Finishes, materials, or workmanship in the completed building shall match the approved samples.
4. Manner: Contractor shall forward all samples under cover letter in five (5) copies, including a complete listing of such samples designated for use on the project, with complete identification on each sample by project name, ultimate destination of material, manufacturer, brand, lot, style, model, etc., Contract Document reference as well as the names of the Contractor, Supplier, Project, Design Professional and University's Representative. All submittals shall be numbered sequentially.
5. Return: Samples of value will be returned to the Contractor for use in the project after review, analysis, comparison and/or testing as may be required by the University's Architect.
6. Test Sample: Test samples, as the University's Representative designates, will be selected from the materials or equipment delivered by the Contractor for use in the work. If any test sample fails to meet the specification requirements, all previous approvals will be withdrawn and such materials or equipment which fail the testing shall be subject to removal and replacement by the Contractor with materials or equipment meeting the specification requirements.

E. Mockups

1. Provide mock-ups as described in Specification Section 01 4339 and on the following drawings:
2. Material List: Provide complete material list of products proposed for use. Submit Material Safety Data Sheets (MSDS) for Owner’s use. Neither the University Representative nor its Design Professional will review MSDS.
3. Contractor’s Review: Review, mark-up as appropriate, and stamp show drawings, product data, and samples prior to submission. Submittals shall clearly show that they have been reviewed and approved by Contractor for conformance with the requirements of the Contract Documents and for coordination with other Sections.

1.4. LEED DOCUMENTATION

A. Sustainable Design and LEED submittals are in addition to other submittals. If submittal item is identical to that submitted to comply with other requirements, submit duplicate electronic copies as a separate submittal to verify compliance. Any discrepancies shall be referred to the Universities Representative for clarification.

B. LEED documentation submittals shall be prepared and submitted using the LEED-Online credit website.

C. Refer to Section 01 8113 “Sustainability Design Requirements” item 1.5 Submittals; for the complete listing of all LEED documentation and submittals required for the project.

1.5. REFRIGERANT MANAGEMENT DOCUMENTATION

A. UCR has instituted a requirement to comply with end-of-year refrigerant inventory for reporting to UCOP and with the South Coast Air Quality Management District’s policies to account for the use of refrigerant gas delivery, recovery and charging installed with new HVAC and any other equipment using gas refrigerant on UCR projects.

B. To provide accurate accounting for the reporting of the refrigerant charge in a mechanical system and/or equipment, the actual quantity must be known in order to document gas lost from leaks etc. when repairs are done.

C. HVAC and other equipment utilizing gas refrigerant that are delivered to the site intact with the factory charge quantity listed on the nameplate or in literature submitted for the design professional’s review, can sometimes be charged in the field according to various indications. Therefore the contractor who delivers and installs any system and/or equipment which uses refrigerant shall provide startup reports that list the exact quantity of gas charged into each system and submit these reports to the University’s Representative who will provide to UCR EH&S.

PART 2 – PRODUCTS (Not Applicable)

PART 3 – EXECUTION (Not Applicable)

END OF SECTION

CONTRACTOR CERTIFICATION

COMPLETE THIS CERTIFICATE, INCLUDING SIGNATURE BY PERSON DIRECTLY RESPONSIBLE FOR WORK ON THIS PROJECT. REVIEW EACH SUBCONTRACTOR CERTIFICATION FOR COMPLETENESS AND COORDINATION WITH COMMENTS MADE ON THIS CERTIFICATE AND OTHER SUBCONTRACTOR CERTIFICATES. SUBMIT THIS CERTIFICATE AND ALL SUBCONTRACTOR CERTIFICATES TO THE UNVERSITY'S REPRESENTATIVE WITHIN 10 DAYS OF RECEIVING NOTICE TO PROCEED**.**

1. As required by the General Conditions of the Contract for Construction, the undersigned certifies that a thorough review has been made of all of the Contract Documents, including, but not limited to the Agreement, General and Supplementary conditions, Drawings, specifications, and Addenda (if any) for the Work. The undersigned also acknowledges each subcontractor has been required to perform a similar thorough review and that Contractor and subcontractors have related and coordinated requirements of individual units of Work to requirements for the entire Work.

2. The undersigned acknowledges his/her obligation to identify below discrepancies, errors, omissions, conflicts, code violations, and improper use of materials discovered in the Contract Documents. Except as noted below and on subcontractor certificates, the undersigned certifies, to the best of his/her knowledge, information, and belief that the Work can be completed in a workmanlike manner without extensive modifications or additional expense.

EXCEPTIONS:_____
_____
_____
_____

NAME, ADDRESS, TELEPHONE OF
CONTRACTOR:_____
_____
_____
_____

AUTHORIZED
SIGNATURE:_____ DATE:_____

NAME (PRINTED CLEARLY OR TYPED):_____

TITLE:_____

END OF CONTRACTOR CERTIFICATION

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INTENTIONALLY

SUBCONTRACTOR CERTIFICATION

COMPLETE THIS CERTIFICATE, INCLUDING SIGNATURE BY PERSON DIRECTLY RESPONSIBLE FOR WORK ON THIS PROJECT, AND SUBMIT TO THE GENERAL CONTRACTOR WITHIN 5 DAYS OF RECEIVING NOTICE TO PROCEED FROM GENERAL CONTRACTOR.

1. As required by the General Conditions of the Contract FOR construction, the undersigned certifies that a thorough review has been made of all of the Contract Documents, including, but not limited to the Agreement, General and Supplementary Conditions, Drawings, Specifications, and Addenda (if any) for the Work. The undersigned also certifies that Contractor and subcontractor have related and coordinated requirements for the entire Work.

2. The undersigned acknowledges his/her obligation to identify below discrepancies, errors, omissions, conflicts, code violations, and improper use of materials discovered in the Contract Documents. Except as noted below, the undersigned certifies, to the best of his/her knowledge, information, and belief that no such discrepancies, errors, omissions, conflicts, code violations, or improper use of materials occur in the Contract Documents.

3. Except as noted below, the undersigned has no objection to, or reservation about, the materials to be furnished or the conditions under which they will be installed, and is satisfied that contractual responsibilities for units of Work for which undersigned is responsible can be completed in a workmanlike manner without extensive modifications or additional expense.

EXCEPTIONS:_____
_____
_____

UNITS OF WORK FOR WHICH UNDERSIGNED IS RESPONSIBLE:
_____
_____

NAME, ADDRESS, TELEPHONE OF
SUBCONTRACTOR:_____
_____
_____
_____

AUTHORIZED
SIGNATURE: _____DATE_____

NAME (PRINTED CLEARLY OR TYPED) _____

TITLE: _____

END OF SUBCONTRACTOR CERTIFICATION

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INTENTIONALLY

SECTION 01 3543
ENVIRONMENTAL PROCEDURES

PART 1 – GENERAL

1.1. SUMMARY

A. This Section includes:

1. Hazardous Materials Procedures
2. Toxic Materials Procedures
3. University of California – Approved TSDFs (Attached to end of Section.)

B. Submittals:

1. Submit Material Safety Data Sheets (MSDS) for all materials, whether existing or incorporated into the work, which are identified as potentially hazardous but not required to be abated.

1.2. HAZARDOUS MATERIALS PROCEDURES

A. Except as otherwise specified, in the event Contractor encounters on the Project site material reasonably believed to be asbestos, polychlorinated biphenyl (PCB), or other hazardous materials which have not been rendered harmless, Contractor shall immediately stop Work in the area affected and report the condition to University and University's Representative in writing. The Work in the affected area shall not thereafter be resumed except by written agreement of University and Contractor if in fact the material is asbestos, PCB, or other hazardous materials and has not been rendered harmless. The Work in the affected area shall be resumed in the absence of asbestos, PCB, or other hazardous materials, or when such materials have been rendered harmless.

B. If material has been encountered on site and the Contractor has reported the condition to the University's Representative, then the University Representative shall contact UCR Environmental Health and Safety office (EH&S) and **Ambient Environmental**, the University's hazardous material consultant to conduct an on-site assessment of the material and if it is found to be hazardous then **Ambient Environmental** shall prepare a plan to remove it off site and dispose of it at a University of California approved Treatment, Storage, and Disposal Facility (TSDF). See the list of University of California – Approved TSDFs attached to the end of this Section.

1.3. TOXIC MATERIALS PROCEDURES – Not Used

PART 2 – PRODUCTS (Not Applicable)

PART 3 – EXECUTION (Not Applicable)

END OF SECTION

University of California - Approved TSDFs

This document is a list of permitted treatment, storage, and disposal facilities (TSDFs) that have been deemed acceptable for use in managing hazardous waste generated by the University of California (UC) or at UC facilities. Neither UC nor any of its employees makes any warranty, express or implied, as to the merchantability or fitness for a particular purpose of the goods or services provided by the TSDFs listed above. Except as stated above, reference to the TSDFs in this document does not necessarily constitute or imply its endorsement or recommendation by UC and UC expresses no opinion as to any TSDF that does not appear in this document. This document shall not be used for advertising or product endorsement purposes or for any other use not expressly authorized in writing by UC.

TSDF name	Street	City	State	Zip	phone	EPA ID
Altamont Landfill	10840 Altamont Pass Road	Livermore	CA	94550	(925) 455-7306	CAD981382732
AERC INC (MTI)	30677 Huntwood Avenue	Hayward	CA	94544	(510) 429-1129	CAD982411993
Azusa Land Reclamation Co.	1201 W. Gladstone	Azusa	CA	91702	(626) 334-0719	CAD009007626
Bethlehem Apparatus	890 Front Street	Hellertown	PA	18055	(610) 838-7034	PAD002390961
Chemical Waste Management (CWM) - Kettleman Hills	35251 Old Skyline Road	Kettleman	CA	93239	(559) 386-9711	CAT000646117
Chemical Waste Management (CWM) - TWI	7 Mobile Drive	Sauget	IL	62201	(618)271-2804	ILD098642424
Chem-Nuclear Systems, Inc (Barnwell)	140 Stoneridge Drive	Columbia	SC	29210	(803) 758-1826	SCD048372429
Clean Harbors (Aragonite), LOC Inc.	P.O. Box 22890	Aragonite	UT	84122	(801) 323-8100	UTD981552177
Clean Harbors (Chicago)	11800 S. Stony Island Ave.	Chicago	IL	60617	(800)678-4844	ILD000608471
Clean Harbors (Deer park), Inc	2027 Battleground Road	Deer Park	TX	77536	(713) 930-2300	TXD055141378
Clean Harbors (Kimball, Incinerator Facility)	2247 S. Highway 71	Kimball	NE	69145	(308)235-4012	NED981723513
Clean Harbors (Lokern)	2500 West Lokern Rd.	Buttonwillow	CA	93206	(805) 762-6200	CAD980675276
Clean Harbors (Los Angeles), Inc.	5756 Alba Street	Los Angeles	CA	90058	(213) 585-5063	CAD050806850
Clean Harbors (Phoenix)	1340 West Lincoln Street	Phoenix	AZ	85007	(602)258-6155	AZD049318009
Clean Harbors (Sacramento)	6000 - 88th Street	Sacramento	CA	95828	(916) 386-4999	CAD000084517
Clean Harbors (San Jose)	1040 Commercial St. Suite 109	San Jose	CA	95112	(408) 453-6046	CAD059494310
Clean Harbors (Spring Grove Resources Recovery)	4829 Spring Grove Ave.	Cincinnati	OH	45232	(513)681-5738	OHD000816629
Crosby & Overton, Inc.	1630 W 17th Street	Long Beach	CA	98013	(562) 432-5445	CAD028409019
DeMenno/Kerdoon	22000 N. Alameda Street	Compton	CA	90222	(310)537-7100	CAT080013352
Diversified Scientific Services (DSSI)	P.O. Box 863	Kinston	TN	37831	(615) 376-0084	TND982109142
Duratek	1560 Bear Creek Road	Oak Ridge	TN	37831	(423) 481-0222	TND982157570
ENSCO	309 American Circle	El Dorado	AR	71730	(870) 862-0272	ARD069748192
ENSCO West	1737 East Denni Street	Wilmington	CA	90744	(310) 835-9997	CAD044429835
Envirocare of Utah, Inc	US I-80, Exit 49	Clive	UT	84029	(801) 532-1330	UTD982598898
Environmental Management & Controls (EMC)	3106 South Faith Home Road	Turlock	CA	95380	(209)-667-1102	Radioactive Material License # 3546-5(
Envirosafe	hwy 78 Missile Base Road	Grand View	ID	82624	(208)834-2275	IDD073114654
Heritage Environmental Services, Inc	7901 West Morris Street	Indianapolis	IN	46231	(317) 243-0811	IND093219012
Heritage Environmental Services, LLC	5122 East Story Road	Coolidge	AZ	85228	(520)723-4167	AZD081705402
Heritage Landfill	4370 W.CR 1275N	Roachdale	IN	46172	(317)243-0811	IND980503890
Kinsbursky Brothers Incorporated	1314 Lemon Street	Anaheim	CA	92801	(714)738-8516	CAD088504881
Mercury Waste Solutions, Inc.	21211 Durand Avenue	Union Grove	WI	53182	414-878-2599	WIR 000 000 356
Merry X-Ray	131 South Maple #1	S. San Fran	CA	94080	(650)6742-6630	CAL000512065
ONYX (formerly AETS)	1125 Hensley Street	Richmond	CA	94801	(510) 233-8001	CAT080014079
Onyx (formerly CWM OSCO)	1704 W. First Street	Azusa	CA	91702	(626) 815-2215	CAD008302903
Onyx (Superior Special Services, Inc.)	5736 West Jefferson	Phoenix	AZ	85043	(602) 233-2955	AZD983473539
Perma-Fix (Quadrex)	1940 NW 67th Street	Gainesville	FL	32653	(405) 468-2000	FLD980711071
Philip Environmental (Burlington)	20245 - 77th Avenue, south	Kent	WA	98032	(206) 872-8030	WAD991281767
Philip Environmental (Georgetown)	734 Lucile Street	Seattle	WA	98108	(206) 762-3362	WAD000812909
Philip Environmental (Rho-Chem)	425 Isis Avenue	Inglewood	CA	90301	(213) 776-6233	CAD008364432
Photo Waste Recycling Co., Inc.	2980 Kerner Boulevard	San Rafael	CA	94901	(415)459-8807	CAD981429673
Photo Waste Recycling Co., Inc.	12898 Bradley Avenue, Suite B	Sylmar	CA	91342	(818)362-0668	CAD000121946
Ramos Environmental Services Inc.	1515 South River Road	W. Sacramento	CA	95691	(916)-371-5747	CAD044003556
Romic Environmental Technologies Corp	2081 Bay Road	East Palo Alto	CA	94303	(650)-324-1638	CAD009452657
Romic Environmental Technologies Corp (Southwest)	6760 West Allison Road	Chandler	AZ	85226	(602) 796-1040	AZD009015389
Ross Environmental Services	36790 Giles Road	Grafton	OH	44044	(440) 748-5800	OHD 048415665
Stericycle, Inc. (Formerly BFI)	4135 West Swift Avenue	Fresno	CA	93722	(559)275-0991	None
Stericycle, Inc. (Formerly BFI)	90 North 1100 West	North Salt Lake	UT	84054	(801) 295-1555	UTD988078150
Systech Environmental Corp.	South Cement Road	Fedonia	KS	66736	(316) 378-4451	KSD980633259
SET Environmental INC. (Treatment One)	5743 Chestwood	Houston	TX	77087	(713)645-8710	TXD055735388
U.S. Filter Recovery Services (Norris Environmental)	5375 South Boyle Ave.	Los Angeles	CA	90058	(213) 277-1500	CAD097030993
Von Roll America (WTI)	1250 Saint George Street	East Liverpool	OH	43920	(800) 403-4888	OHD980613541
Waste Control Speciaists (WCS)	1710 West Broadway	Andrews	TX	79714	(713) 944-5900	TXD988088464
Pacific Resource Recovery Services		Big Bear	CA			CAD008252405

Yellow Highlight indicates TSDF pending approval.

SECTION 01 3546
INDOOR AIR QUALITY (IAQ) PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. This Section includes, without limitation, the following:

1. IAQ Submittals
2. Quality Assurance
3. IAQ Management During Construction
4. Sequence of Finish Installation

B. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Indoor Air Quality Procedures include:

1. IAQ Management Plan During Construction:
   a. Prepare plan to comply with the requirements for LEED EQ 3.1 as specified in Section 01 8113, “Sustainable Design Requirements” and in this Section.
   b. Procedures to prevent indoor air quality problems resulting from the construction/renovation process in order to help sustain the comfort and well-being of construction workers and building occupants.

2. Sequence of Finish Installation: Scheduling/sequencing requirements and procedures necessary to optimize Indoor Air Quality (IAQ) levels for the completed Project.

B. Related Work Specified in Other Sections:

1. Section 01 8113, "Sustainable Design Requirements (for LEED Certification)" for additional requirements.
2. Section 01 5000, "Construction Facilities and Temporary Controls" for environmental-protection measures during construction and location of waste containers at Project site.
3. Section 01 7419, "Construction Waste Management" for handling requirements of construction waste.
4. Application Sections for indoor air sampling prior to occupancy. (Sections to be identified)

1.3 IAQ SUBMITTALS

A. IAQ Construction Management Plan. Submit 5 copies of plan within 30 days of date established for commencement of the Work.

1. Include a schedule of all IAQ-related construction activities in the IAQ Construction Management Plan submittal.
2. Update plan as required during the construction process to reflect Project conditions.

B. Meeting Minutes: Submit minutes from Contractor meetings related to the execution and verification of the IAQ Construction Management Plan.

C. Project Photographs: Submit to document IAQ measures implemented.

D. Product Data: Submit cut sheets of filtration media proposed for use.

E. LEED Submittal: LEED letter template for Credit EQ 3.1, signed by Contractor, with copy of plan and a statement that requirements for the credit have been met.

1.4 QUALITY ASSURANCE

A. Comply with the requirements of LEED Credit EQ 3.1, “Construction IAQ Management Plan During Construction.”

B. Contractor’s Plan shall meet or exceed the recommended design approaches of SMACNA’s “IAQ Guidelines for Occupied Buildings Under Construction,” (1995 Edition, Chapter 3).

C. IAQ Management Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1. Review methods and procedures related to IAQ management during construction.
2. Review IAQ management requirements for each trade.

PART 2 - PRODUCTS

PART 3 - EXECUTION

3.1 IAQ MANAGEMENT DURING CONSTRUCTION

A. General: Contractor’s IAQ Construction Management Plan shall include procedures to prevent indoor air quality problems resulting from the construction/renovation process in order to help sustain the comfort and well-being of construction workers and building occupants.

1. Prepare and submit an Indoor Air Quality (IAQ) Management Plan to comply with the requirements for LEED EQ 3.1, as specified in Section 01 81 13, “Sustainable Design Requirements” and in this Section.
2. Contractor’s detailed plan shall be based on the particular characteristics of the Project, and include the items listed in this Section as a minimum.
3. The IAQ Management Plan shall highlight the five requirements of the Sheet Metal and Air Conditioning National Design/Builders Association (SMACNA), “IAQ Guidelines for Occupied Buildings Under Construction,” 1995, Chapter 3 and shall embody the principles and practices set forth hereinafter.
4. Subcontractors and their employees shall be provided instruction and training in the IAQ Management Plan.

B. Plan Implementation:

1. Implement waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
2. Comply with Section 01 5000 for operation, termination, and removal requirements.

C. Monitoring of IAQ Plan:

1. Hold weekly Contractor Site Co-ordination Meetings with the superintendents of all trade contractors. Review the appropriate components of the IAQ Construction Management Plan as a regular action topic at these meetings, and update the Plan as required. Document the implementation of the Plan in the meeting minutes. As a recording format, use SMACNA IAQ Guidelines Appendix C (Planning Checklist) and Appendix D (Inspection Checklist) as a guide.
2. Take a specific series of record photographs at the appropriate stages to document adherence with the IAQ requirements. Submit at least 18 photographs (six photos taken on three different occasions during construction) along with identification of the SMACNA approach featured by each photo, in order to show consistent adherence to the LEED Credit requirements.

D. HVAC Protection:

1. Store HVAC equipment in a clean, dry location. Until HVAC equipment (ducting, registers, air handler VAV boxes components, fans, and motors) has been installed, it shall be kept covered and secured with plastic film or in a location where it will not be exposed to moisture, dust, or other contaminants.
2. Seal off all louvers and air intake/discharge points to prevent construction dust and debris from entering.
3. Seal off all ductwork openings and air outlets with plastic sheeting to protect the duct system from dust and debris. Do not re-open until the end of activities that produce dust or pollution, such as drywall sanding, concrete cutting, masonry work, wood sawing, and so forth.
4. Seal all HVAC inlets and outlets. Use of the HVAC system shall be avoided during construction until drywall construction is complete. Temporary ventilation may be installed to remove contaminants. All air inlets and outlets shall be sealed securely with tape during construction. These include, but not limited to, outside air inlets, grilles, diffusers, supply ducts, return ducts, ceiling plenums, VAV (variable-air volume) plenum intakes, exhaust ducts, and window ventilator or air conditioning units. Openings shall be sealed with plastic film and tape that can be removed cleanly.
5. Seal HVAC components during installation. For ducting runs that require several days to install, sections shall be sealed off as they are completed. Seals shall be removed prior to continuing the ducting run. Other components of the HVAC system shall be subjected to the same requirements to protect them from contamination.
6. Use temporary filtration media. If the HVAC system is to be used while construction work is being done, temporary filtration media shall be installed on all intakes. Such filtration media shall have a minimum filtration efficiency (Minimum Efficiency Reporting Value-MERV per ASHRAE 52.2) of 8 or higher. For air intakes into parts of a building that are very sensitive to dust contamination, such as computer rooms, filtration media with a MERV rating of 13 or higher is required. New filtration with a MERV rating of 13 or higher shall be installed after construction.
7. If, for some unforeseen reason, there should arise a circumstance wherein the return air system is required to be used during the construction phase, install temporary MERV 8 filters or higher (as determined by ASHRAE Standard 52.2-1999) at each return air opening and provide frequent inspection and maintenance. If inspections by University Representatives reveal that the ductwork has become contaminated due to inadequate protection, the ductwork shall be cleaned professionally prior to the first phase of occupancy, using procedures established in ACR 2005 published by the National Air Duct Cleaners Association.
8. Under no circumstances shall air be returned from a construction area and then re-circulated through the permanent supply ductwork, unless and until the level of construction in the relevant area involves final finishes and trim and the construction has reached a point of complete building dry-in with no sanding and is free from dust, debris, and contaminants.
9. Do not use fan rooms to store construction or waste materials, and keep them clean and neat.

10. Inspect filters regularly. When the HVAC system is being used during construction and temporary filters are installed, filters shall be inspected weekly and replaced as needed.
11. Avoid contaminated air entry into enclosed parts of the building. When outdoor construction activities generate dust, combustion emissions, or other contaminants, operable windows and outside air supplies to enclosed portions of the building shall be closed.

E. Source Control:

1. Limit construction traffic and motor idling in the vicinity of air intake louvers when the HVAC systems are activated. Restrict motor vehicles to the loading dock area, well-removed from air intakes, preventing emissions from being drawn into the building.
2. Use electric or natural gas alternatives for gasoline and diesel equipment where possible and practical.
3. Cycle equipment off when not being used or needed.
4. Avoid the use of materials and products with high VOC and/or particulate levels. Use products and installation methods with low VOCs such as paints, sealers, sealants, filler materials, insulation, adhesives, caulking and cleaners. Comply with the requirements in other specification sections.
5. Keep containers of wet products closed as much as possible. Cover and seal waste materials which can release odor or dust.
6. Protect all materials, especially absorbent materials such as insulated ductwork, against moisture during delivery to and storage at the job site. Store materials inside the structure in a dry and clean environment pending installation. Building materials shall be kept dry to avoid the introduction of moisture into the building interior.
7. Avoid the use of moisture-damaged materials. Any porous materials that have been wetted shall be dried thoroughly before installation. Any porous materials that have been damaged, remained wet longer than 48 hours, or show signs of visible mold shall be discarded.
8. Ensure that the construction process will not result in moisture intrusion. In the event of rain or groundwater gaining entry to the building interior during construction, notify the University.
9. Avoid tracking pollutants into work areas.
    a. Once the framing and mechanical system installation starts, access to the building interior shall be controlled to minimize the tracking in of contaminants.
    b. Material deliveries and construction waste removal shall be routed via the most direct route to the building exterior of the building rather than through the space.
    c. Provide rough track-off grates or matting at the entryway to remove moisture and contaminants from workers shoes.
    d. Prevent the ingress of rodents and pests.
    e. Use procedures to ensure that there is no smoking inside the building.

F. Pathway Interruption:

1. Use dust curtains or temporary enclosures to prevent dust from migrating to other areas when applicable. During construction, isolate areas of work to prevent contamination of clean or occupied areas.
2. Keep pollutant sources as far away as possible from ductwork and areas occupied by workers when feasible.
3. Isolate work areas and/or create pressure differentials to prevent the migration of contaminants.
4. Use portable fan systems to exhaust contaminated air directly to the outside of the building, and discharge the air in a means to prevent it from re-entering.

G. Housekeeping:

1. Minimize accumulation of dust and other contaminants. Construction practices shall be used that minimize the production of dust and other contaminants from construction activities. Use integral dust-collection systems on drywall sanders, cut-off saws, and

routers. Confine dust-generation activities to areas where clean-up can be carried out easily and contaminants will not be tracked to other areas.

2. Suppress Dirt. Wetting agents or sweeping compounds shall be used to deep dust from becoming airborne.
3. Clean up dust. Wet clothes, damp mops, wet scrubbers, and vacuum cleaners with high-efficiency particulate (HEPA) filters shall be used to clean up dust generated by construction activities.
   a. Cleaning frequency shall be increased when dust accumulation is noted.
   b. Institute cleaning activities of building areas on a daily basis, and of HVAC equipment as required.
4. Keep all coils, air filters, dampers, fans, and ductwork clean during installation, and clean them as required prior to performing the testing, adjusting and balancing of the systems.
5. Clean up spills. All spills and excess applications of solvent-containing products should be cleaned up using approved methods as soon as practicable. Water spills shall be mopped up promptly.
6. Keep work area dry. Avoid accumulations of water inside the building, and promptly remove any that may occur.
   a. Especially protect porous materials such as insulation and ceiling tiles from exposure to moisture.
   b. The entire area shall be kept as dry as practicable by promptly repairing any leaks that allow rainwater entry and mopping up any water accumulation.
   c. Use dehumidification if necessary for prompt drying of wetted spaces. Unvented combustion (e.g., propane of diesel “salamander” space heaters) shall not be used.
7. Seal containers containing volatile liquids. Containers of fuel, paints, finishes, and solvents shall be kept tightly sealed and preferably stored outside of the building when not in use.

H. Scheduling:

1. Comply with the scheduling requirements of Article, "Sequence of Finish Installation" of this Section.
   a. Schedule the installation of porous materials only after closing in building.
   b. Porous materials, such as insulation, fireproofing, and drywall shall not be installed in a building open to the weather.
   c. To avoid potential contamination of porous or absorbent materials such as ceiling tiles, install furnishings after interior finishes (drywall, paint, and floor finishing) have cured.
2. Phased Completion: Implement IAQ control measures in each tenant area until construction in that area is complete. Do not allow contaminants from an area under construction to enter the HVAC ductwork systems or to migrate to completed areas.
3. Filters:
   a. Install new MERV 13 filters at the central fan system, immediately prior to the first phase of building occupancy.
   b. Install new MERV 13 filters at fan systems serving limited areas immediately prior to occupancy for each respective area.

I. Ventilation:

1. Provide adequate ventilation during curing period. To aid in curing of interior finishes and other products used during construction and to remove pollutants after drywall installation is complete, provide adequate ventilation with 100% outside air, and proper filtration. In humid periods or when very high-moisture materials are present, supplementary dehumidification may be required during this curing period.
2. Flush-Out: Comply with the requirements of LEED credit EA 3.2.

3.2 SEQUENCE OF FINISH INSTALLATION

A. Sequence of Finish Installation: Project schedule shall address construction scheduling/sequencing requirements and procedures necessary to optimize Indoor Air Quality (IAQ) levels for the completed Project.

1. Scheduling: Contractor's Project Schedule for finish applications should allow for:
   a. Dissipation of high emissions from finishes that off-gas perceptible quantities of deleterious material during curing.
   b. Separation of off-gassing effects from the installation of adsorptive materials that would act as a "sink" for storage and subsequent release of these unwanted substances into building spaces and mechanical systems after project occupancy.

2. When Contractor's "Project Schedule" requires less than optimal sequencing of finish installation, related to IAQ, provide supplemental filtered "fresh air" ventilation of work areas during construction and restrict / control the use of permanent building mechanical systems prior to Owner acceptance of building to prevent contamination of systems by construction wastes and other deleterious substances.

B. Finish Types:

1. Type 1 Finishes: Materials and finishes which have a potential for short-term levels of off-gassing from chemicals inherent in their manufacturing process, or which are applied in a form requiring vehicles or carriers for spreading which release a high level of particulate matter in the process of installation and/or curing. Type 1 Finishes include, but are not limited to the following:
   a. Composite wood products, specifically including particleboard from which millwork, wood paneling, doors or furniture may be fabricated.
   b. Adhesives, sealants, and glazing compounds, specifically those with petrochemical vehicles or carriers.
   c. Wood preservatives, finishes, and paint.
   d. Control and/or expansion joint fillers.
   e. All hard finishes requiring adhesive installation.
   f. Gypsum board and associated finish processes.
   g. Sealants and associated filler materials.

2. Type 2 Finishes: "Fuzzy" materials and finishes which are woven, fibrous, or porous in nature and tend to adsorb chemicals off-gassed by Type 1 finishes or may be adversely affected by particulates. These materials become "sinks" for deleterious substances which may be released much later, or collectors of contaminants that may promote subsequent bacterial growth. Type 2 Finishes include, but are not limited to the following:
   a. Carpet and padding.
   b. Fabric wallcovering.
   c. Insulation exposed to the airstream.
   d. Acoustic ceiling materials.
   e. Fabric covered acoustic wall panels.
   f. Upholstered furnishings.

3. Materials that can be categorized as both Type 1 and Type 2 materials shall be considered to be Type 1 materials.

C. Optimal Order of Installation: Apply all Type 1 interior finishes throughout the entire controlled air zone of each enclosed building or building segment and allow such finishes to completely cure according to intervals and times stated in respective finish manufacturer's printed instructions before commencing installation of any Type 2 materials in the same area.

1. Do not store any Type 2 materials in areas where installation or curing of Type 1 materials is in progress.

D. Materials Test Data - Required For Substitutions Only:

1. All manufacturers/producers of materials listed below that are proposed for substitution on this Project are required to provide test data for their materials which show permanent, in-place Indoor Air Quality performance in accordance with requirements of this Specification.
2. Material Safety Data Sheets: Review all MSDS's of materials to be submitted for testing as well as MSDS's for other products where specifically requested in this Project Manual and identify those classified as "Prohibited Materials".
3. Prohibited Materials:
   a. Any building materials or products that emit pollutants included on the International Agency for Research on Cancer (IARC) "List of Chemical Carcinogens", the "Carcinogen List" of the National Toxicology Program, and the "Reproductive Toxin List" of the "Catalog of Teratogenic Agents" must have approval in writing from the Owner's Representative before that building material or product may be used on this Project.
   b. Carcinogens: Use of materials emitting carcinogens will not be permitted unless a suitable substitute is not available. Do not proceed with procurement of any carcinogen emitting product or material without prior review and written approval of the University's Representative.

END OF SECTION

SECTION 01 4100
REGULATORY REQUIREMENTS

PART 1 – GENERAL

1.1. SUMMARY

A. Section includes:

1. Applicable Codes, Regulations, and Authorities
2. Regulatory Notifications
3. Permit Requirements, Notifications, and Certificates
4. Fees

B. References in the Specifications to "code" or to "building code," not otherwise identified, shall mean the foregoing specified codes, together with the additions, changes, amendments, and interpretations adopted by the enforcing agency and in effect on the date of these Contract Documents. Nothing on the Drawings or in the Specifications shall be interpreted as requiring or permitting work that is contrary to these rules, regulations, and codes.

C. Where other regulatory requirements are referenced in these Specifications, the affected work shall meet or exceed the applicable requirements of such references.

D. Nothing stated in this Section of the Specifications or other Sections of the Specifications, the other Contract Documents or shown on the Drawings shall be construed as allowing Work that is not in strict compliance with all applicable Federal, State, regional, and local statutes, laws, regulations, rules, ordinances, codes and standards.

E. Regulatory requirements referred to shall have full force and effect as though printed in these Specifications.

F. Discrepancies between these codes/rules/etc. and the Contract Documents shall be brought to the attention of the University's Representative for resolution. Unless otherwise directed by the University's Representative, if a conflict exists between referenced regulatory requirements and the Contract Documents, comply with the one establishing the more stringent requirements.

1.2. APPLICABLE CODES, REGULATIONS, AND AUTHORITIES

A. All applicable federal, state, and local laws and the rules and regulations of governing utility districts and the various other authorities having jurisdiction over the construction and completion of the Project, including the latest rules and regulations of the state fire marshal, OSHA, and the California Labor Code, shall apply to the Contract throughout, and they shall be deemed to be included in the Contract the same as though printed in these Specifications.

B. Codes and regulations that apply to this Project include, but are not limited to, the following including additions, changes, and interpretations adopted by the enforcing agency in effect as of the date of these Contract Documents.

1. California Code of Regulations (CCR):

a. Title 8, Industrial Relations
b. Title 17, Public Health
c. Title 19, Public Safety
d. Title 20, Public Utilities and Energy
e. Title 21, Public Works
f. Title 22, Environmental Health

g. Title 24: Building Standards Code
   (1) Part 2, California Building Code
   (2) Part 3, California Electric Code
   (3) Part 4, California Mechanical Code
   (4) Part 5, California Plumbing Code
   (5) Part 6, California Energy Code
   (6) Part 7, California Elevator Safety Construction Code
   (7) Part 9, California Fire Code
   (8) Part 11, California Green Building Standards Code
   (9) Part 12, California State Reference Standards

2. In addition to the above, work shall comply with the following:

   a. California Environmental Quality Act (CEQA).
   b. California Health and Safety Code.
   c. California Occupational Safety and Health Act Standards (Cal-OSHA).
   d. California Department of Transportation (Caltrans): Standard Specifications, latest edition.
   e. National Fire Protection Association (NFPA): Standards 13, 24, 72, and 80.
   f. Americans with Disabilities Act - Title II (ADA).
   g. Federal Occupational Safety and Health Act (OSHA).
   h. Federal Environmental Protection Agency – Clean Air Act.
   i. Storm Water Pollution Prevention Act.

3. All work shall meet or exceed code and regulatory requirements.

C. Copies of Regulations: Obtain copies of the following regulations and retain at the Project site to be available for reference by parties who have a reasonable need:

1. California Code of Regulations, Title 8, 9 and 19
2 California Code of Regulations, Title 24, including:
   a. Part 1, California Administrative Code
   b. Part 2, California Building Code, Volumes 1 and 2
   c. Part 3, California Electrical Code
   d. Part 4, California Mechanical Code
   e. Part 5, California Plumbing Code
   f. Part 6, California Energy Code
   g. Part 7, California Elevator Safety Construction Code
   h. Part 9, California Fire Code
   i. Part 11, California Green Building Standards Code
   i. Part 12, California Referenced Building Standards Code
2. California Health and Safety Code regulations as referenced in the specifications.
1. CAL/OSHA Construction Safety Orders.
2. City of Riverside “Department of Public Works Standards and Specifications.
3. ~~National Electrical Code.~~ Covered by Part 3
4. National Fire Protection Association standards as referenced within the specifications
5. State of California, Department of Transportation, Division of Highways, “Materials Specifications.” [should keep this in]
6. State of California, Department of Transportation, Division of Highways, “Standard Specifications.” [should keep this in]
7. ~~State of California, Office of State Fire Marshal~~ Covered by Title 19 and Part 9
8. California Industrial Accident Commission, Safety Bulletins .
~~9.~~ ~~Uniform Building Code~~
~~10.~~ ~~Uniform Mechanical Code~~
~~11.~~ ~~Uniform Plumbing Code~~
12. Standard Specifications for Public Works, (Greenbook), with local agency amendments.

D. 2010 ADA Accessibility Standards for Accessible Design

1.3. REGULATORY NOTIFICATIONS

A. Submit all required notifications to Federal, State of California, State in which disposal facility is located if not in California, regional, and local agencies with regulatory responsibilities associated with the Work activities that are included in the Contract. All notifications shall be served in writing, in the form required by the agency requiring notification, and in a timely manner so as not to negatively impact the Project schedule. Serve notifications at least 10 business days in advance (or earlier if required by agency) of activity requiring notice. The Contractor shall serve all required notifications in writing to all governmental and quasi-government agencies having notification requirements pertaining to any portion of the Work included in the Project.

B. Contractor shall file a Notice of Intent for coverage under State General Construction Activity Storm water Permit National Pollutant Discharge Eliminate System (NPDES). Contractor shall comply with applicable permit requirements including the project Storm Water Pollution Prevention Plan.

1.4. PERMIT REQUIREMENTS, NOTIFICATIONS, AND CERTIFICATES

A. Permits, Licenses, and Certificates: For the University's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgment, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

B. Underground Service Alert (USA) Notifications: Prior to commencing clearing, excavation and trenching, coordinate with Underground Service Alert of Southern California for field verification and marking of utilities within the limits of Project site. Contractor shall be responsible for outlining limits of excavation with white chalk paint prior to coordination with USA. Coordination shall require 2 business days advance notification prior to start of excavation work. Provide USA notification permit number to the University's Representative prior to starting site Work.

C. In no event, shall the Contractor install materials that contain asbestos, PCB, lead or other known hazardous materials unless prior approval is obtained from the University.

D. Regulated Carcinogens by Title 8 California Code of Regulations (CCR), Subchapter 7, Group 16 (Control of Hazardous Substances), Article 110 (Regulated Carcinogens).

1. Products containing chemicals regulated as carcinogens by the State of California are not allowed for use on University projects.

2. Case-by-case exceptions may be considered for products containing the following Cal/OSHA recognized carcinogens:

Methylene Chloride, 5202
Cadmium, 1532, 5207
Inorganic Arsenic, 5214
Formaldehyde, 5217
Benzene, 5218

3. Case-by-case exceptions may only be made when suitable alternative products are not available. Such exceptions are subject to written approval by the University's Representative.

4. Exceptions require that the Contractor shall have an established carcinogen program as required by Cal/OSHA (§5203. Carcinogen Report of Use Requirements) and shall submit to University's Representative, a copy of the Cal/OSHA Confirmation of Report for Cal/OSHA carcinogens.

5. When exceptions are granted, the Contractor is responsible for providing to the University's Representative a copy of the semi-annual Confirmation of Report received from Cal/OSHA or, in lieu of that, a copy of the Contractor's semi-annual report as submitted to Cal/OSHA at periods not to exceed 6 months, or at project closeout, whichever occurs first.

E. Fire Department and Additional Notifications, Manifests, and Requirements: As required by University and coordinated by Contractor with the University's Representative.

1.5. FEES – Not Used

PART 2 – PRODUCTS (Not Applicable)

PART 3 – EXECUTION (Not Applicable)

END OF SECTION

SECTION 01 4200
REFERENCES

PART 1 – GENERAL

1.1. SUMMARY

A. Section includes:

1. Specification Format and Content Explanation
2. Definitions
3. Reference Standards
4. Abbreviations and Acronyms

1.2. SPECIFICATION FORMAT AND CONTENT EXPLANATION

A. Specification Format: These Specifications are organized into Divisions and Sections based on the 49-division format and CSI/CSC's "Master Format" numbering system.

B. Specification Content: These Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be interpolated as the sense requires. Singular words shall be interpreted as plural and plural words interpreted as singular where applicable as the context of the Contract Documents indicates.
2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by the Contractor. At certain locations in the Text, subjective language is used for clarity to describe responsibilities that must be fulfilled indirectly by the Contractor or by others when so noted.

    a. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon is used within a sentence or phrase.

1.3. DEFINITIONS

A. "Indicated": The term "indicated refers to graphic representations, notes, or schedules on the Drawings; or to other paragraphs or schedules in the Specifications and similar requirements in the Contract Documents. Terms such as "shown," "noted," "scheduled," "detailed" and "specified" are used to help the user locate the reference. Location is not limited.

B. "Directed": Terms such as "directed," "requested," "authorized," "selected," "approved," "required," and "permitted" mean directed by the University's Representative or University, requested by the University's Representative or University, and similar phrases.

C. "Approved": The term "approved," when used in conjunction with the University Representative's action on the Contractor's submittals, applications, and requests, is limited to the University Representative's duties and responsibilities as stated in the Conditions of the Contract.

D. "Regulations," "building code," "code": The terms "regulations," "building code", and "code" include laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.

E. "Furnish": The term "furnish" means to supply and deliver to the Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

F. "Install": The term "install" describes operations at the Project site including the actual unloading, temporary storage, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing protecting, cleaning, and similar operations.

G. "Provide": The term "provide" means to furnish and install, complete in place, operating, tested, approved, and ready for the intended use.

H. "Installer": An installer is the Contractor or another entity engaged by the Contractor, either as an employee, subcontractor, or contractor of lower tier, to perform a particular construction activity, including installation, erection, application, or similar operations. Installers are required to be experienced in the operations they are engaged to perform.

1. Unless specified otherwise in other Sections, the term "experienced," when used with the term "installer," means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with the special requirements indicated; and having complied with requirements of authorities having jurisdiction.
2. Trades: Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespersons of the corresponding generic name.

I. "Project site" is the space available to the Contractor for performing construction activities, either exclusively or in conjunction with others performing other work as part of the Project. The extent of the Project site is shown on the Drawings and may or may not be identical with the description of the land on which the Project is to be built.

J. "Testing Agencies": A testing agency is an independent entity engaged to perform specific inspections or tests, either at the Project site or elsewhere, and to report on and, if required, to interpret results of those inspections or tests.

K. "Similar": The term "similar" means in the general sense and not necessarily identical.

L. See also the Instructions to Bidders and General Conditions.

1.4. REFERENCE STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

1. Requirements for packaging, packing, marking, and preparation for shipment or delivery included in referenced federal specifications are not mandatory for products provided for this Work.

B. Publication Dates: Comply with the standards in effect as of the date of the Contract Documents except where a specific publication date or issue is included with the reference in other Sections of these Specifications.

1. When a named or proposed product complies with a referenced standard of different publication date or issue than required by these Specifications, submit the product as a substitute under provisions of Division 1 Section "Substitutes." Provide a detailed written summary of changes in product or workmanship quality and performance as a result of the product complying with a different version of a standard from the version referenced.

C. Conflicting Requirements: Where compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different but apparently equal to the University's Representative for a decision before proceeding.

1. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicate numeric values are minimum or maximum, as appropriate, for the context of the requirements. Refer uncertainties to the University's Representative for a decision before proceeding.
2. Where a product is specified by both brand name and reference to 1 or more standards, provide that product only if it actually complies with the required standards. Listing of a product by brand or trade name in these Specifications is not a warranty that the product complies with the standards which may also be listed. If a named product does not comply with 1 or more of the required standards and no alternative product is listed which does comply, submit a substitute product under provisions of Division 1 Section "Substitutes" which complies with the required standards.

D. Copies of Standards: Each entity engaged in construction on the Project must be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, the Contractor shall obtain copies directly from the publication source and make them available on request.

1.5. ABBREVIATIONS AND ACRONYMS

A. Trade Abbreviations and Association Names: Trade association names and titles of general standards are frequently abbreviated. The following abbreviations and acronyms, as referenced in the Contract Documents, mean the associated names. Names and addresses are subject to change and are believed, but not assured, to be accurate and up-to-date as the date of the Contract Documents.

B. Federal Government Agencies: Names and titles of Federal Government standards- or specification-producing agencies are often abbreviated. The following abbreviations and acronyms referenced in the Contract Documents indicate names of standards-or specification-producing agencies of the Federal Government. Names and addresses are subject to change and are believed, but are not assured, to be accurate and up-to-date as of the date of the Contract Documents.

C. The following are commonly used abbreviations which may appear in the Project Manual. Refer to Construction Specifications Institute Document TD-2-4 "Abbreviations" for explanation of other abbreviations.

C	degree Centigrade
Co.	Company
Corp.	Corporation
F	degree Fahrenheit
ft.	foot (feet)
ga.	gage or gauge
gal.	gallon(s)
in.	inch(es)
Inc.	Incorporated

HVAC	Heating, Ventilating and Air Conditioning
lb(s).	pound(s)
o.c.	on center
psi	pounds per square inch
psf	pounds per square foot
sq.	square
yd.	yard(s)

PART 2 – PRODUCTS (Not Applicable)

PART 3 – EXECUTION (Not Applicable)

END OF SECTION

SECTION 01 4300
INSPECTION OF WORK

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes, without limitation, the following:

1. Access to the Work
2. Testing and Approval
3. University's Inspectors
4. Inspection Requests
5. Inspection Request Form
6. Nonconforming Work Notice

B. The University will provide a Project Inspector or Inspector of Record (IOR) for this project. Contractor shall not cover any work requiring inspection until the IOR has inspected and approved the subject work. For uncovering of work, refer to General Conditions, Article 12.

1.2 ACCESS TO THE WORK

A In addition to the requirements of the General Conditions, University, University's Representative and their representatives shall at all times have access to the Work wherever it is in preparation or progress and Contractor shall provide safe and proper facilities for such access and for inspection. The inspection and written acceptance of material and workmanship, unless otherwise stated in these Specifications, shall be final except as provided in Article 12.2 of the General Conditions.

1.3 TESTING AND APPROVAL

A. In addition to the requirements of the General Conditions, if any law, ordinance or public authority or the Specifications or University's Representative's instructions require any work to be specially tested or approved (including use of ionizing radiation for radiography), Contractor shall give University's Representative timely notice of its readiness for inspection, and if the inspection is by another authority, other than University's Representative, of the date fixed for such inspection.

B. Re-examination of questioned work may be ordered by University's Representative.

1.4 UNIVERSITY'S INSPECTORS

A. The IOR shall report to University's Representative. The IOR shall observe construction in progress and shall have the following responsibilities and limitations on authority.

1. Act under the direction of University's Representative.

2. Observe installation and work in progress as a basis for determining conformance of the work, materials and equipment with the Contract Documents. IOR will report any discrepancies observed to University's Representative and Contractor. Only University's Representative has the final authority to make approvals or rejections.

3. Only University's Representative shall interpret the requirements of the Contract Documents. If any item is ambiguous, University's Representative shall make a written interpretation. If Contractor requests changes or modifications to the Contract Documents, University's Representative shall make a written determination on the requested changes or modifications.

4. Prepare and submit an inspection report to University's Representative for each

inspection performed.

5. Review application for payments.

6. Assist University's Representative in reviewing the test and inspection results of testing laboratories.

7. The IOR is not authorized to permit deviations from the requirements of the Contract Documents unless such deviation has been approved by University's Representative in writing.

8. The IOR shall not supervise, coordinate, or direct the Work. The IOR has no responsibility or control over Contractor's construction means, methods, techniques, sequences, procedures, or coordination of any portions of the Work, or over any safety programs in connection with the Project.

B. The failure of University, University's Representative and its representatives and consultants, or University's IOR to observe or inspect the Work, or to detect deficiencies in the Work, or to inform Contractor of any deficiencies which may be discovered, shall not relieve Contractor, its subcontractors regardless of tier, or suppliers from their responsibility for construction means, methods, techniques, sequences and procedures, construction safety, nor from their responsibilities to carry out the work in accordance with the Contract Documents and to detect and correct defective work as defined in the General Conditions.

1.5 INSPECTION REQUESTS

A. Contractor shall request inspection of completed portions of the Work through University's Representative. Contractor shall submit a request for inspection using University's Inspection Request Form attached to the end of this Section.

1. Contractor shall submit an Inspection Request **at least 3 working days prior** to the time the work will be ready for inspection.

2. For work to be inspected by a third party testing laboratory, whether Contractor's or University's, Contractor shall submit an Inspection Request **at least 3 working days prior** to the time the work will be ready for inspection.

3. For work not in conformance with the Contract Documents, the IOR shall submit to the Contractor a Nonconforming Work Notice.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

2.1 Refer to the Inspection Request Form attached at the end of this Section.

2.2 Refer to the Nonconforming Work Notice form attached at the end of this Section.

END OF SECTION

NONCONFORMING WORK NOTICE
NUMBER: _____
DATE: _____

TO: **FROM:**

SPEC. SEC. REF.:_____ PARA:_____ DWG REF:_____ DETAIL:_____

DESCRIPTION OF DEFECTIVE CONDITION (IOR):_____

_____

_____

_____

_____

REPORTED BY (IOR): _____

CORRECTIVE ACTION SHOULD BE TAKEN AS SOON AS POSSIBLE AND COORDINATED WITH THE INSPECTOR OF RECORD (IOR). IF FURTHER INFORMATION IS NEEDED, ADVISE THE UNIVERSITY'S REPRESENTATIVE IMMEDIATELY.

DESCRIPTION OF CORRECTIVE ACTION TAKEN (CONTRACTOR): _____

_____

_____

_____

_____

_____

ACCEPTED BY (CONTRACTOR):_____ **DATE:**_____

UCR USE ONLY

ACCEPTANCE OF CORRECTED DEFECTIVE CONDITION (IOR): _____

_____

_____

_____

ACCEPTED BY (IOR):_____ **DATE:**_____

COPIES: ☐ UNIVERSITY ☐ CONSULTANT ☐ CONTRACTOR

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INTENTIONALLY

INSPECTION REQUEST

INSPECTION REQUEST INSTRUCTIONS USING CFORMS

1. *Log into http://ucr.cforms.net
2. Complete Automated Inspection Request Form
3. Select your Permit # from the drop down menu and request the inspection you are in need of
4. An e-mail will be sent to the IOR for that project, advising them that you are requesting inspection
5. Once that inspection is conducted, the IOR will input the disposition into CForms (approved, disapproved, corrections, etc.) and may add photos, documents, etc.
6. Results of the inspection is known immediately by those assigned to the project via email. Inspectors can also upload photos and other documents and attach them to the inspection file in CForms
7. Completed "As-Built" plans of project shall be provided to Inspector of Record (IOR) prior to final inspection signature
8. Once the work is completed, request a final inspection and a final inspection will be conducted. If approved, the permit will be signed as approved and complete.

*Access to CForms must be granted by Inspection Group prior to accessing CForms.

SECTION 01 4500
QUALITY CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for quality-control services, without limitation, the following:

1. Contractor's Responsibilities
2. Tests and Inspections
3. Test Reports
4. Geotechnical Engineer and Other Inspection and Testing
5. Repair and Protection

B. Quality-control services include inspections, tests, and related actions, including reports performed by Contractor, by independent agencies, and by governing authorities. They do not include contract enforcement activities performed by University's Representative.

C. Inspection and testing services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with Contract Document requirements.

D. Requirements of this Section relate to customized fabrication and installation procedures, not production of standard products.

1. Specific quality-control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
2. Specified inspections, tests, and related actions do not limit Contractor's quality-control procedures that facilitate compliance with Contract Document requirements.
3. Requirements for Contractor to provide quality-control services, required by University's Representative, are not limited by provisions of this Section.

E. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 1 Section "Cutting and Patching" specifies requirements for repair and restoration of construction disturbed by inspection and testing activities.

1.2 DEFINITIONS

A. The term "University's Testing Laboratory" means a testing laboratory retained and paid for by the University for the purpose of performing the testing services required by the Contract Documents except where specifically noted to be done by contractor, reviewing material and product reports, and performing other services as determined by University's Representative.

B. The term "Contractor's Testing Laboratory" means a testing laboratory retained and paid for by Contractor to perform the testing services which are required by the Contract Documents to be performed by Contractor. Contractor's Testing Laboratory shall be an organization other than University's Testing Laboratory and shall be acceptable to University's Representative. It may be a commercial testing organization or the testing laboratory of a trade association. Contractor's Testing Laboratory shall have performed testing of the type specified for at least five (5) years and shall maintain a separate General and Professional Liability Insurance, (Errors and Omissions,) in amount not less than one million dollars ($1,000,000) each.

C. Tests, inspections, and acceptances of portions of the Work required by the Contract Documents or by Applicable Code Requirements shall be made at the appropriate times. Contractor shall give University's Representative timely notice of when and where tests and inspections are to be made and/or required regardless whose Testing Laboratory will perform the tests and inspections.

D. If such procedures for testing, inspection, or acceptance reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, Contractor shall bear all costs made necessary by such failure including those of repeated procedures and compensation for University's Representative's services and expenses.

E. If University's Representative is to observe tests, inspections, or make acceptances required by the Contract Documents, University's Representative will do so promptly upon 3 days advance written notice and, where practicable, at the normal place of testing.

F. Tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

1.3 CONTRACTOR'S RESPONSIBILITIES

A. Secure and deliver to Contractor’s Testing Laboratory adequate quantities of representative samples of materials proposed for use as specified.

B. Submit to University's Testing Laboratory the preliminary design mixes proposed to be used for concrete and other materials which require review by University's Testing Laboratory.

C. Submit copies of product test reports as specified.

D. Furnish incidental labor and facilities, as required:

1. To provide University's Testing Laboratory access to the Work to be tested.
2. To obtain and handle samples at the Project site or at the source of the product to be tested.
3. To facilitate inspections and tests.
4. For storage and curing of test samples.

E. Provide written notice to University's Representative sufficiently in advance (a minimum of 3 days) of operations to allow for University's Testing Laboratory assignment of personnel and scheduling of tests.

F. When tests or inspections are not performed after such notice, Contractor shall reimburse University for University's Testing Laboratory personnel and travel expenses incurred.

1.4 TESTS AND INSPECTIONS

A. Certain portions of the Work will be tested, inspected, or both, at various stages. Nothing in any prior acceptance or satisfactory test result shall govern, if at any subsequent time the Work, or portion thereof, is found not to conform to the requirements of the Contract Documents.

B. If initial tests or inspections made by University's Testing Laboratory’s Geotechnical Engineer reveal that any portion of the Work does not comply with Contract Documents, or if University's Representative determines that any portion of the Work requires additional testing or inspection, additional tests and inspections shall be made as directed.

C. If such additional tests or inspections establish that such portion of the Work fails to comply with the Contract Documents, all costs of such additional tests and inspections, and all other costs resulting from such failure, including compensation for University's

Representative and University Representative's Consultants shall be deducted from the Contract Sum.

D. Fixtures, equipment, materials, and other items removed, demolished, abandoned, or capped and left in place, shall be tested to verify that there is no damage caused after the items have been covered by construction.

1.5 TEST REPORTS

A. University's Testing Laboratory and Contractor's Testing Laboratory shall submit five (5) copies of all reports to University's Representative, indicating observations and results of tests and indicating compliance or non-compliance with the Contract Documents.

1.6 GEOTECHNICAL ENGINEER AND OTHER INSPECTION AND TESTING

A. The University shall retain and pay the expenses of a Geotechnical Engineer and materials testing, inspection and observation services consultant (“TIO Consultant”) to perform inspection, testing, and observation functions specified by the University. Geotechnical Engineer and such other TIO Consultant shall communicate only with University and University's Representative. University's Representative shall then give notice to Contractor, with a copy to the University, of any action required of Contractor.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 REPAIR AND PROTECTION

A. General: Upon completion of inspection, testing, sample taking and similar services, repair damaged construction and restore substrates and finishes. Comply with Contract Document requirements for Division 1 Section "Cutting and Patching."

B. Protect construction exposed by or for quality-control service activities, and protect repaired construction.

C. Repair and protection is Contractor's responsibility, regardless of the assignment of responsibility for inspection, testing, or similar services.

END OF SECTION

SECTION 01 4516
CONTRACTOR'S QUALITY CONTROL PROGRAM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. This Section includes, without limitation, the following:

1. Quality Control Program
2. Submittals
3. Qualifications of Quality Control Manager
4. Reporting Procedures
5. Implementation

B. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section describes the requirements for implementation of a Quality Control Program by the Contractor to assure performance of the Work in conformance with the provisions of the Contract Documents.

B. Related Work Specified Elsewhere:

1. Testing and Inspection Services of Quality Control are specified in Section 01 4500, "Quality Control."

1.3 QUALITY CONTROL PROGRAM

A. The Contractor shall prepare and submit within thirty (30) days after the issuance of Notice to Proceed, the Quality Control Program (QCP) they intend to implement for the Work for approval by the University. This Program shall be tailored to the specific requirements of the Work and shall become an active part of the construction procedures. The Quality Control Program shall include the procedures, instructions, reports and forms to be used throughout the performance of the Work. The University reserves the right to review and reject all or part of the Quality Control Program as proposed by the Contractor. The Contractor shall revise and resubmit as appropriate until satisfactory to the University. The basic objectives of the Quality Control Program are as follows:

1. To ensure that all Work adheres strictly to all provisions of the Contract Documents and governing agencies.
2. To produce good quality workmanship.
3. To prevent deficiencies through pre-construction quality control coordination.
4. To detect and correct deficiencies in a timely manner.
5. To provide an auditable record of all tests, inspections, procedures, non-compliance and corrections, and any other pertinent data as required by the University.

B. The Contractor shall notify the University in writing of any proposed change to their Quality Control system and changes shall not be permitted if they would, in the opinion of the University, result in nonconformance with the Contract requirements.

C. The Contractor may select either an outside "agency" or in-house personnel to administer the program. In either case, the Quality Control staff on-site shall be responsible only for Quality Control and the Quality Control Manager shall report directly to the Contractor's highest ranking Corporate Officer involved in the Work. Quality Control staff members shall interface with the University, its Inspectors and Consultants, as required and appropriate.

1.4 SUBMITTALS

A. The Quality Control Program submittal shall include, as a minimum, the following:

1. The Quality Control organization chart, beginning with the Quality Control Manager, shall include Quality Control personnel as may be necessary to accomplish complete and adequate inspection of the Work.
2. Names and qualifications of personnel and firms selected to implement the Quality Control Program on-site and off-site.
3. Authority and responsibility of the Quality Control Staff.
4. Methods of Quality Control inspection including subcontractor's work and describing name of qualified testing laboratory to be used, if applicable.
5. Documents to be used to record inspections and tests, including those specified in the Contract.
6. Formats for documentation and reports.
7. Model agenda for Quality Control Meetings
8. A letter signed by the Responsible Managing Officer of the Contractor's firm outlining the authority of the Quality Control Manager to include, among other things, the authority as described herein. Clerical personnel sufficient to accomplish timely submittal of Quality Control Reports and other required documentation shall be provided.

1.5 QUALIFICATION OF QUALITY CONTROL MANAGER

A. The minimum qualifications required of the Quality Control Manager are as follows:

1. Has recent construction experience in projects of similar size and nature.
2. Has ten (10) years' experience performing construction-related work on Type I or II buildings.
3. Has seven (7) years' experience performing Quality Control services on Type I or II multi story projects. At least 3 years must be on projects in California.

OR

4. Has recent construction experience in projects of similar size and nature.
5. Possess current certification issued by State of California OSHPD Class A level or DSA Class 1 level.
6. Has seven (7) years' experience performing Quality Control work or inspection services on multi story Type I or II projects. At least 3 years must be on projects in California.

OR

7. Possess an undergraduate degree in architecture, civil engineering or construction management.
8. Has five years (5) performing Quality Control services or inspection experience on Type I or II multi story buildings. At least 3 years must be on projects in California.
9. Possess at least four special inspector current certifications issued by ICC.

B. Responsibilities and Duties of the Quality Control Staff:

1. The Quality Control Manager shall have the authority to stop work, reject work, order work removed, initiate remedial work, propose solutions, and reject material not in compliance with the Contract Documents.
2. Responsibilities of the Quality Control Manager shall include, but are not limited to the following:
   a. Present on-site during all working hours and assigned "full time" to this Project. Contractor shall designate alternate individual(s) to assume responsibilities in the temporary absence of the Quality Control Manager or when overtime work is being performed.
   b. Have complete familiarity with the Drawings and Specifications.
   c. Establish and implement Quality Control Programs for the Contractor and with the various Subcontractors and monitor their conformance.
   d. Present samples, mock-ups and test panels to be used as standards of quality for review by the University and their Consultants.
   e. Inspect existing conditions prior to the start of new work segments.

f. Perform in-progress and follow-up inspections on each work segment to ensure compliance with the Contract Documents. Accompany the University and their Consultants on such inspections.
g. Coordinate required tests, inspections, and demonstrations with the University's IOR inspectors, consultants and any other authority having jurisdiction.
h. Inspect all materials and equipment arriving at the job site to ensure conformance to the provisions of the Contract Documents. Prepare and submit to the University written reports as required by the Contract Documents.
i. Identify, report and reject defective Work or Work not in conformance with the Contract Documents. Monitor the repair or reconstruction of rejected Work.
j. Develop checklists to be used for the inspection of each Division of the Work.
k. Retain specialists or outside firms for inspection of Work in areas where additional technical knowledge is required (mechanical, electrical, electronics, controls, communications, security, welding, structural, security hardware, etc.).
l. Schedule additional site visits where appropriate.
m. Verify and report that all materials and equipment manufactured off-site are in conformance with the Contract Documents.
n. Prior to the start of each Division, Section and/or major item of Work required by the Contract Documents, conduct a preconstruction Quality Control meeting with responsible field and office representative and the University and their Consultants. Provide the University and their Consultants minutes of these meetings within forty-eight (48) hours.
o. Work closely with the University to ensure optimum Quality Control. Attend Project meetings as required by the University.

1.6 REPORTING PROCEDURES

A. As a minimum, develop forms, logs and reporting procedures consisting of the following:

1. A Quality Control meeting shall be held at least monthly between the University, Consultants and the Quality Control Manager during which only Quality related topics will be reviewed.
2. A monthly written report published at month end providing an overview of Quality Control activities, problems found and/or solved, status of remedial work, status of mock-ups, anticipated problems and planned activities for the coming month, etc.
3. Deficiency reports: Plan of action by the Contractor for correcting any known contract deficiencies including delay in scheduled progress.
4. Weekly reports (including reports from Contractor and Subcontractors) to the University describing:
   a. Equipment and material received.
   b. Tests and inspections performed with submittal information.
   c. Deficiencies noted and/or corrected.
   d. Quality Control concerns and problems.
   e. Record keeping (as required).

1.7 IMPLEMENTATION

A. The Contractor's Quality Control program shall be adequate to cover all operations, including both on-site and off-site and will be keyed to the proposed sequence of work and shall include as a minimum at least three (3) phases of inspection for all definable items or segments of work, as follows:

1. Preparatory inspection shall be performed prior to beginning any work on any definable segment of the Work and shall include a review of Contract requirements; verification that all materials and/or equipment have been tested, submitted, and accepted; verification that provisions have been made to provide required control testing; examination of the work area to ascertain that all preliminary work has been completed; and a physical examination of materials and equipment to assure that they conform to accepted shop drawings or submittal data and that all material and/or equipment are available. As a part of this preparatory work, Contractor's Quality Control organization will review and verify that all

documents, including but not limited to; shop drawings, submittal data, method of Quality Control, product data sheets, test reports, affidavits, certification and manufacturer's instructions have been submitted and accepted by the University as required herein. Each submittal to the University shall bear the date and the signature of the Contractor's Quality Control Manager indicating that he has reviewed the submittal and certified it to be in compliance with Drawings and Specifications or showing the required changes.

2. Initial Inspection: To be performed as soon as a representative segment of the particular item of work has been accomplished and to include examination of the quality or workmanship and a review of control testing for compliance with Contract requirements, exclusion of defective or damaged materials, omissions, and dimensional requirements.
3. Follow-up Inspection: To be performed daily or as frequently as necessary to ensure continuing compliance with Contract requirements, including control testing, until completion.
4. The Contractor shall maintain daily current records with information as described above, in an appropriate format of all inspections and tests that the required inspection or tests have been performed. These records must cover both conforming and defective items and must include a statement that all supplies and materials, incorporated in the Work, are in full compliance with the terms of the Contract. Two legible copies must be furnished to the University. The report will cover all work performed or completed subsequent to the previous report.

END OF SECTION

SECTION 01 5300
TEMPORARY CONSTRUCTION

PART 1 – GENERAL

1.1. SUMMARY

A. Section includes:

1. Temporary Stairs, Scaffold, and Runways
2. Trenching and Shoring
3. Temporary Bridges
4. Temporary Decking
5. Temporary Overpasses
6. Temporary Ramps
7. Temporary Runarounds

1.2. TEMPORARY STAIRS, SCAFFOLD, AND RUNWAYS

A. Provide all scaffolds, stairs, hoist plant, runways, platforms, and similar temporary construction as may be necessary for the performance of the Contract. Such facilities shall be of the type and arrangement as required for their specific use, substantially constructed throughout and strongly supported, well secured and complying with all applicable rules and regulations of the Industrial Accident Commission of the State of California and all applicable laws and ordinances. Refer to Section 01 41002, Regulatory Requirements.

B. Arrange for construction equipment access to areas which may be partly blocked by existing obstructions.

1.3. TRENCHING AND SHORING

A. All Work shall be in full accordance, but not necessarily limited to the following codes and regulations: Titles 8, 19, 21, 22 and 24, State of California, California Code of Regulations (CCR), California Occupational Safety and Health Administration (OSHA).

B. Protection. Pursuant to Labor Code Sections 6705 and 6707, Contractor shall include in its base bid all costs incident to the provision of adequate sheeting, shoring, bracing or equivalent method for the protection of Life and Limb which shall conform to the applicable Federal and State Safety Orders.

C. Before beginning excavation five feet or more in depth, Contractor shall submit to University's Representative a detailed plan showing the design or shoring, bracing, sloping, or other provisions to be made for worker protection from the hazards of caving ground during the excavation. The proposed plan shall comply with the State of California Construction Safety Orders, Title 8 and Title 24 of the California Code of Regulations (CCR). If the detailed plan varies from such shoring system standards, it shall be prepared by a registered civil or structural engineer registered in the State of California, University's Representative's determination of the matter shall be final and conclusive on Contractor. The cost of required engineering services shall be borne by Contractor and shall be deemed to have been included in the amount bid for the Work as stated in the Agreement.

D. Neither the review nor approval of any plan showing the design of shoring, bracing, sloping, or other provisions for worker protection, shall relieve Contractor from its obligation to comply with Construction Safety Orders Standards and Title 24 CCR for the design and construction of such protective Work, and Contractor shall indemnify University and University's Representative from any and all claims, liability, costs, action and causes of action arising out of or related to the failure of such protective systems. Contractor shall

defend University, its officers, employees, and agents and University's Representative in any litigation of proceeding brought with respect to the failure of such protective systems.

E. Comply with State of California Construction Safety Orders, Article 6 - Excavations, Trenches, Earthwork - whether or not the excavation, trench, or earthwork is five feet or more in depth.

1.4. TEMPORARY BRIDGES

1.5. TEMPORARY DECKING

1.6. TEMPORARY OVERPASSES

1.7. TEMPORARY RAMPS

1.8. TEMPORARY RUNAROUNDS

PART 2 – PRODUCTS (Not Applicable)

PART 3 – EXECUTION (Not Applicable)

END OF SECTION

SECTION 01 5400
CONSTRUCTION AIDS

PART 1 – GENERAL

1.1. SUMMARY – Not Used

1.2. TEMPORARY ELEVATORS – Not Used

1.3. TEMPORARY LIFTS AND HOISTS

A. Provide facilities for hoisting materials and employees. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

1.4. TEMPORARY CRANES

1.5. TEMPORARY SWING STAGING

PART 2 – PRODUCTS (Not Applicable)

PART 3 – EXECUTION (Not Applicable)

END OF SECTION

SECTION 01 5500
VEHICULAR ACCESS AND PARKING

PART 1 – GENERAL

1.1. SUMMARY

A. Section includes:

1. Temporary Access Roads
2. Haul Routes
3. Temporary Parking Areas
4. Temporary Roads
5. Traffic Control
6. Staging Areas

B. Submittals:

1. Submittals shall be submitted in accordance with Section 01 3300, "Submittals."
   a. Submit Traffic Control Plan for Project Construction prior to the start of construction activities for approval by University's Representative.
   b. Submit Pedestrian Access Plan for Project Construction prior to the start of construction activities for approval by University's Representative.

1.2. TEMPORARY ACCESS ROADS

1.3. HAUL ROUTES

1.4. TEMPORARY PARKING AREAS

A. Parking: Limited parking for workers employed on the Work may be provided on the Project Site to the extent that space for that purpose is available without interference with activities of University or activities related to performance of the Work. Refer to Section 01 3540 "Environmental Mitigation".

1. All vehicles are required to display a parking permit while parked on campus. Transportation and Parking Services will sell parking permits to contractors, their employees and sub-contractors in parking lots where spaces are currently available for purchase. 2014-15 monthly permit rates are $40/Gold, $47/Blue and $64/Red. All rates are subject to change. Monthly permits are available at the Parking Service Building located at 683 Linden Street. Daily permits can be purchased in the Parking Service Building, at information kiosks at campus entrances, and in posted visitor parking lots. Parking permits are lot specific. All vehicles entering the campus are required to adhere to the University's parking policies and the California Vehicle Code. .
2. Contractor may use available space within its Project Site fence limits for parking without a permit.

1.5. TEMPORARY ROADS

1.6. TRAFFIC CONTROL

A. Prior to the start of construction activities, determine the routing of construction vehicles and the measures necessary to control traffic during construction. Provide measures including, but not limited to, the following:

1. Contractor is responsible for controlling construction traffic on and adjacent to the site, including public right-of-ways. Comply with requirements of authorities having jurisdiction for traffic controls in public right-of-ways.
    a. Provide necessary measures including, but not limited to, flag personnel, barricades, sufficient lights, reflectors, warning signals, warning signs indicating closures, directional, and detour instructions.
2. Route construction equipment, trucks, and similar vehicles through the campus to Big Springs Road and existing public streets to and from the site as approved by the University's Representative and as specified in Section 01 3540 Environmental Mitigation.
3. Schedule deliveries to minimize disruption of University traffic and duration of on-site storage.

B. Traffic Control Plan for Project Construction.

1. Contractor and all subcontractors shall ensure that the construction site and access road speed limits are established and enforced during the Contract Time until Substantial Completion. Post and enforce traffic speed limits of 15 miles per hour or less on all unpaved roads.

2. Contractor and all subcontractors shall comply with the Traffic Control Plan for project construction prepared by Contractor and approved by University's Representative prior to the commencement of construction activities.

3. To the extent reasonable, Contractor and all subcontractors shall maintain at least one unobstructed lane in both directions on campus roadways. At any time only a single lane is available, Contractor and all subcontractors shall provide a temporary traffic signal, signal carriers (i.e., flag persons), or other appropriate traffic controls, as approved by University's Representative, to allow travel in both directions. If construction activities require the complete closure of a roadway segment, contractor and all subcontractors shall provide appropriate signage indicating alternative routes as approved by University's Representative.

4. To maintain adequate access for emergency vehicles when construction activities would result in roadway closures, Contractor shall give 14-days notice to the University's Representative, so that the University's Representative can consult with the UCPD, EH&S, and Riverside Fire Dept. as appropriate to disclose closures and identify alternative travel routes.

5. The hauling and disposal of any excess clean soil excavated from or already stockpiled on the site will be the responsibility of the contractor to transport and stockpile it at the UCR Ag Ops area located near Lot 13 as directed by the University Representative. Refer to Section 31 2000 Earth Moving for additional information regarding the collection and disposal of unsatisfactory material and debris.

6. All construction traffic will access the Project Site from the west and through the campus. Construction traffic will avoid using Valencia Hill Drive, Watkins Drive and Big Springs Road. There are two existing, posted construction traffic warning signs at the corner of Watkins Drive and Valencia Hill Drive which shall remain in place and maintained by the Contractor for the duration of the Project and will be the Contractor's responsibility to remove and dispose of the signs at the completion of the Work.

C. Pedestrian Access Plan for Project Construction.

1. Contractor and all subcontractors shall comply with the Pedestrian Access Plan for project construction prepared by the Contractor and approved by University's Representative, prior to the commencement of construction activities.

1.7. STAGING AREAS

PART 2 – PRODUCTS (Not Applicable)

PART 3 – EXECUTION (Not Applicable)

END OF SECTION

SECTION 01 5600
TEMPORARY BARRIERS AND ENCLOSURES

PART 1 – GENERAL

1.1. SUMMARY

A. This Section includes:

1. General Cleaning and Protection
2. Temporary Fire Protection
3. Temporary Barricades, Warning Signs, Signals and Lights
4. Temporary Fencing
5. Temporary Protective Walkways

1.2. GENERAL CLEANING AND PROTECTION

A. Clean and protect construction in progress and adjoining materials in place, during handling and installation. Apply protective covering where required to assure protection from damage or deterioration at Substantial Completion.

B. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to assure operability without damaging effects.

C. Limiting Exposures: Supervise construction operations to assure that no part of the construction completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period. Where applicable, such exposures include, but are not limited to, the following:

1. Excessive static or dynamic loading.
2. Excessive internal or external pressures.
3. Excessively high or low temperatures.
4. Thermal shock.
5. Excessively high or low humidity.
6. Air contamination or pollution.
7. Water or ice.
8. Solvents.
9. Chemicals.
10. Light.
11. Radiation.
12. Puncture.
13. Abrasion.
14. Heavy traffic.
15. Soiling, staining, and corrosion.
16. Bacteria.
17. Rodent and insect infestation.
18. Combustion.
19. Electrical current.
20. High-speed operation.
21. Improper lubrication.
22. Unusual wear or other misuse.
23. Contact between incompatible materials.
24. Destructive testing.
25. Misalignment.
26. Excessive weathering.

27. Unprotected storage.
28. Improper shipping or handling.
29. Theft.
30. Vandalism.

1.3. TEMPORARY FIRE PROTECTION

A. Except for use of permanent fire protection as soon as available, do not change over from use of temporary security and protection facilities to permanent facilities until Substantial Completion, or longer, as requested by the University's Representative.

B. Temporary Fire Protection: Until fire-protection needs are supplied by permanent facilities, install and maintain temporary fire-protection facilities of the types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 10 "Standard for Portable Fire Extinguishers,"NFPA 241 "Standard for Safeguarding Construction, Alterations, and Demolition Operations," and requirements of the University.

1. Locate fire extinguishers where convenient and effective for their intended purpose.
2. Store combustible materials in containers in fire-safe locations.
3. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire-protection facilities, stairways, and other access routes for fighting fires. Prohibit smoking in all buildings and anywhere on site.
4. Provide supervision of welding operations, combustion-type temporary heating units, and similar sources of fire ignition.

1.4. TEMPORARY BARRICADES, WARNING SIGNS, SIGNALS AND LIGHTS

A. Comply with standards and code requirements for erection of structurally adequate barricades. Paint with appropriate colors, graphics, and warning signs to inform personnel and the public of the hazard being protected against. Where appropriate and needed, provide lighting, including flashing red or amber lights.
1. Enclose excavations and openings with proper barricades.
2. Clearly identify hazards on and adjacent to the Project site. Maintain clearly visible and, if applicable, audible identification on a continuous 24-hour-per-day basis.
3. Illuminate barricades, warning signs, obstructions, and other hazards at night. Provide adequate light for clear visibility from sunset to sunrise.
4. Where appropriate, provide audible warning signals.

1.5. TEMPORARY FENCING – Not Used

1.6. TEMPORARY PROTECTIVE WALKWAYS – Not Used

PART 2 – PRODUCTS (Not Applicable)

PART 3 – EXECUTION (Not Applicable)

END OF SECTION

SECTION 01 5700
TEMPORARY CONTROLS

PART 1 – GENERAL

1.1. SUMMARY

A. This Section Includes:

1. Control of Construction Water
2. Dust Control, Air Pollution, and Odor Control
3. Noise Control
4. Temporary Erosion and Sediment Control (SWPPP)
5. Temporary Environmental Controls
6. Temporary Pest Control
7. Biological Resources
8. Cultural Resources
9. Aesthetics
10. Air Quality

1.2. CONTROL OF CONSTRUCTION WATER

A. Provide impermeable floor coverings and suitable dams to prevent damage by water used for the Work. Immediately clean up and remove all surplus water and water spilled in non-working areas. Do not allow water to overflow gutters, flood streets or parking lots.

1.3. DUST CONTROL, AIR POLLUTION, AND ODOR CONTROL

A. The Contractor shall employ measures to prevent the creation of dust, air pollution and odors.

1. Unpaved areas where vehicles are operated shall be periodically wetted down or given an equivalent form of treatment as defined in South Coast Air Quality Management District (SCAQMD) Rule 403 to eliminate dust formation.

2. All volatile liquids including fuels or solvents shall be stored in closed containers.

3. No open burning of debris, lumber or other scrap will be permitted.

4. Equipment shall be maintained in a manner to reduce gaseous emission.

5. Low sulfur fuel shall be used for construction equipment.

6. Stockpiles of excavated materials shall be covered with material approved by University's Representative.

7. Contractor shall provide street sweeping whenever silt from construction site is carried over to adjacent streets.

B. Provide measures, including regular watering, necessary to minimize air-borne dust.

1. Exposed surfaces should be watered twice daily.
2. Stockpiles of excavated materials should be covered.
3. A berm shall be erected on the downslope of the project site to prevent silt-laden water from running off site.
4. Trucks carrying excavated materials from the site shall be covered and shall have their tires and undercarriages washed prior to exiting the site as required to remove material that may fall or blow off later.

5. Paving of exposed dirt surfaces should be done as quickly as is reasonably possible.
6. Streets affected by fugitive dust shall be swept regularly.
7. The Contractor shall assign a person to be responsible for monitoring dust levels, reviewing conditions with the University's Representative, and suggesting appropriate additional control measures when required.
8. Uncovered soil shall be bound by grass or similar ground cover as soon as is reasonably possible.
9. Excavation should not be conducted when surface winds exceed 11 miles per hour.
10. Unnecessary idling of construction vehicles and equipment shall be avoided.

C. All contractors, and overseen by the General Contractor, shall implement dust control measures consistent with South Coast Air management District (SCAQMD) Rule 403 – Fugitive Dust during the construction phases on the project development.

1. Apply water and/or non-toxic chemical soil stabilizers according to manufacturer's specifications to all inactive construction areas (previously graded areas that have been inactive for 10 or more days).

2. Replace ground cover in disturbed areas as quickly as possible.

3. Enclose, cover, water twice daily, or apply approved chemical soil binders to exposed piles with 5 percent or greater silt content.

4. Water active grading sites at least twice daily.

5. Suspend all excavating and grading operations when wind speeds (as instantaneous gusts) exceed over 25 mile per hour over a 30-minute period.

6. All trucks hauling dirt, sand, soil, or other loose material are to be covered or should maintain at least two feet of freeboard (i.e., minimum vertical distance between top of the load and top of the trailer) in accordance with section23114 of the California Vehicle Code.

7. Sweep streets at the end of the day if visible soil material is carried over to adjacent roads.

8. Install wheel washers where vehicles enter and exit unpaved roads onto paved roads, or wash off trucks and any equipment leaving project site for each trip.

9. Apply water three times daily of chemical soil stabilizers according to manufacturer's specifications to all unpaved parking or staging areas or unpaved road surfaces.

1.4. NOISE CONTROL

A. Noise control shall be maintained by the contractor in all areas of construction, guarding against any undue noise which may impair proper use of existing facilities. Activities with the highest noise potential shall be scheduled for the times when background ambient noise levels are highest (i.e., during peak commute hours). Contractor shall use noise suppressed equipment available and/or shall muffle/control noise on equipment to the maximum extent possible. Noisy construction-related operations (e.g. mixing concrete) shall be accomplished on-site to the extent feasible. Those noisy, construction-related operations shall be performed on those areas of the site furthest from noise sensitive receptors i.e. residence halls, off-site community, etc."

OR

Noise control shall be maintained by the contractor in all areas of construction, guarding against any undue noise, which may impair proper use of existing facilities. Contractor shall use noise

suppressed equipment available and control noise on equipment to the maximum extent possible.

B. The following noise control procedures shall be employed:

1. Maximum Noise: The Contractor shall use equipment and methods during the course of this work that are least disruptive to adjacent offices or residences. Noise levels for trenchers, graders, trucks and pile drivers shall not exceed 90 dBA at 50 feet as measured under the noisiest operating conditions. For all other equipment, noise levels shall not exceed 85 dBA at 50 feet.

   OR

   Noise control shall be maintained by the contractor in all areas of construction, guarding against any undue noise, which may impair proper use of existing facilities. Contractor shall use noise suppressed equipment available and control noise on equipment to the maximum extent possible.

2. Equipment: Jack hammers shall be equipped with exhaust mufflers and steel muffling sleeves. All diesel equipment shall have exhaust muffled. Air compressors shall be of a quiet type such as a "whisperized" compressor.

   OR

   Equipment: Jack hammers shall be equipped with exhaust mufflers and steel muffling sleeves. All diesel equipment shall have exhaust muffled. Air compressors shall be of a quiet type such as a "whisperized" compressor. Require contractors to use the quietest among alternative equipment or to muffle/control noise from available equipment to the maximum extent possible.

   AND/OR

   Require Mufflers and Other Noise Attenuators on Project Construction Equipment: All contractors, and overseen by the General Contractor, shall ensure that noise-producing construction equipment and vehicles using internal combustion engines will be equipped with mufflers; air-inlet silencers where appropriate; and any other shrouds, shields, or other noise-reducing features in good operating condition that meet or exceed original factory specification. Mobile or fixed “package” equipment (e.g., arc-welders, air compressors) will be equipped with shrouds and noise-control features that are readily available for that type of equipment. Stationary construction equipment, material and vehicle staging shall be placed to direct noise away from sensitive receptors.

   AND OR

   Require Use of Electrically Powered Equipment: All contractors, and overseen by the General Contractor, shall ensure that work use electrically powered equipment instead of pneumatic or internal combustion–powered equipment, where feasible.

3. Operations: Machines shall not be left idling. Electric power shall be used in lieu of internal combustion engine power wherever possible. Equipment shall be maintained to reduce noise from vibration, faulty mufflers, or other sources.

   OR

   Operations: Machines shall not be left idling. Electric power shall be used in lieu of internal combustion engine power wherever possible. Equipment shall be maintained to reduce noise from vibration, faulty mufflers, or other sources.

4. Scheduling: Noisy operations shall be scheduled so as to minimize the disturbance and duration to adjacent neighborhoods and nearby student Housing complexes.

OR

Scheduling: Noisy operations shall be scheduled so as to minimum their disturbance to occupied adjacent areas and duration at any given location. Schedule activities with highest noise potential for times when background ambient noise levels are highest.

5. Location: Consider noise sensitive areas around the site when planning locations of operations which cause higher levels of noise, and perform those tasks in less sensitive areas when possible. Schedule work that will generate vibrations, uncontrolled dust , noise levels in excess of 65 dBA, interior- 85 dBA, exterior and potentially hazardous conditions for time periods that are the least disruptive to the University and the surrounding residential neighborhood.

6. Use of High Vibration Construction Equipment near Lothian Residence Hall

   a. All contractors, and overseen by the General Contractor, shall schedule construction activity entailing use of high-vibration generating equipment within 75 feet of Residence Halls during periods when students are not in residence, to the extent feasible.

Prohibit Noise-producing Signals: All contractors, and overseen by the General Contractor, shall prohibit the use of noise-producing signals, including horns, whistles, alarms, and bells, except for safety purposes only. Public address or music systems will also be prohibited.

1.5. TEMPORARY EROSION AND SEDIMENT CONTROL

A. Exposed earth surfaces shall be watered to minimize dust generation as necessary according to weather conditions.

B. During winter construction, an erosion and sediment-transport control plan incorporating standard erosion control practices shall be implemented prior to the first day of earth moving activities.

1. Erosion control shall include retaining sediments within project site by the use of catch basins; using interceptor ditches and benches to prevent gullying of slopes; and preparing and implementing erosion control plans.

C. Storm Water Pollution Prevention Plan (SWPPP):

1. This project has an active SWPPP permit and the university has retained a SWPPP management consultant for this project. The contractor shall take over the contract of the SWPPP consultant for the SWPPP management of the project for the duration of the schedule until substantial completion. Contact David Beckwith, President, David Beckwith & Associates at (714) 349-7007. The details of the SWPPP for Glen Mor 2 and its implementation can be viewed online at the California State Water Resources Board's SMARTS website (type "University of California, Riverside").

2. Refer to Section 01 2100 Allowances for the description of the SWPPP allowance.

3. For additional information see Section 31 1000 "Site Clearing".

4. Protection Against Inclement Weather: Brace, secure, and cover all parts of the Work to prevent damage by inclement weather. Refer to Section 3.9 Storm Water Control for SWPPP information.

5. Protect the Work from damage due to nuisance water such as rainwater, surface runoff,

and irrigation water. Comply with requirements of the University's Representative regarding routing and disposal of nuisance water.

D. Storm Water Control

1. This project already has an open SWPPP permit on file. Refer to Section 01 1400 “Contractor’s Use of the Project Site” for more detailed SWPPP information.

a. Provide engineering, drawings, etc., to meet the requirements.

2. Erect berm and other appropriate measures to prevent water from running off site and staging area.

3. Erect berm and other appropriate measures to prevent water from entering the site and staging area.

4. Temporary Storm Water Pollution Control: Provide earthen embankments and similar barriers in and around excavations and subgrade construction, sufficient to prevent flooding by runoff of storm water from heavy rains.

1.6. TEMPORARY ENVIRONMENTAL CONTROLS

A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations, and minimize the possibility that air, waterways, and subsoil might be contaminated or polluted or that other undesirable effects might result. Avoid use of tools and equipment that produce levels of harmful noise. Restrict use of noise-making tools and equipment to hours that will minimize complaints from persons or firms near the site.

B. See also Section 01 3543, Environmental Procedures.

1.7. TEMPORARY PEST CONTROL – Not Used

1.8. BIOLOGICAL RESOURCES

A. Pre-Construction Surveys for Burrowing Owls will be conducted (by University representatives) **not more than 30 days prior to ground disturbance and/or construction related activities.** No ground disturbance and/or construction related activities shall begin until survey complete and any avoidance measures identified and implemented.

B. Pre-Construction Nesting Bird Surveys will be conducted (by University representatives) **within a maximum of 7 days prior to initiation of ground disturbance activities** when vegetation removal will occur between February 15 and September 15. No ground disturbance activities shall occur until survey complete and any avoidance measures identified and implemented.

1. Prior to initiation of ground disturbance activities, disturbance limits adjacent to or within the Arroyo shall be clearly staked by University representatives, including disturbance limits associated with Arroyo improvements. Access to the Arroyo shall be limited to existing roads and shall be fenced to ensure unnecessary encroachment to the Arroyo does not occur.

C. Minimize Temporary Impacts

1. Biological Resources to be avoided during construction, include identified California Dept. of Fish and Game (CDFG) jurisdictional streambeds and riparian habitats, and shall be

avoided if practicable. No impacts on the Arroyo shall occur outside of staked disturbance limits.

2. At a minimum, the following areas shall be avoided:

   a. Riparian vegetation adjacent to the path/culvert removal.

   b. Riparian vegetation located at the northwest side of the south abutment temporary work area for Bridge 2.

   c. CDFG jurisdictional streambed located on the south side of the bank re-contouring area.

   d. The mature cottonwood tree near the Valencia Hill culvert extension work limit.

      (1) The following measures will be implemented to minimize disturbance to the cottonwood tree at the Valencia Hill culvert work area:

      (2) Establishment and demarcation of a tree protection zone. This should be accomplished under the guidance of an International Society of Arboriculture (ISA) certified arborist and employ a protective barrier consisting of 3-foot- high orange construction fencing. The preferred protection zone shall encompass a buffer of 5 feet beyond the drip line, or 15 feet from trunks, whichever is greater. Where the proposed improvements extend into the preferred protection zone, placement of the protective barrier shall minimize encroachment into the preferred protection zone to the maximum extent practical.

      (3) Pruning of tree roots, limbs and canopy prior to start of construction, under the guidance of an ISA certified arborist and in accordance with ISA pruning standards (for instance, cuts made clean and to the bark collar of the closest joint on the branch). Pruning should occur during the dormant period (approximately November to March).

      (4) Construction of the Valencia Hill culvert extension shall be monitored by an ISA certified arborist. The arborist may require implementation of best management practices to minimize disturbance within the work limits, including but not limited to padding of vehicles, minimizing soil removal or addition, and use of protective matting.

      (5) Upon completion of construction, the tree shall be evaluated by an ISA certified arborist. Evaluations shall occur quarterly for one full year to monitor for signs of failure (including canopy dieback, reduced size or number of leaves, premature fall color). If in the opinion of the arborist, the tree is not showing signs of failure, it shall be determined that the avoidance measures have been successful and no further action shall be required.

      (6) If post-construction monitoring indicates the tree has failed, the measures provided for below shall be implemented to replace the lost functions and values:

      (7) In the event the mature cottonwood tree at the Valencia Hill culvert extension is determined to have failed the re-vegetation plan shall include the following measures to replace the lost functions and values:

(8) Replacement planting of three coast live oaks on the upper bank within the removed canopy area. Replacement trees shall be at least 6 inch caliper and 10 feet in height.

(9) Replacement planting of Fremont's cottonwood (15 gallon minimum) along the stream channel within the area immediately downstream of the extended culvert. The total number of replacement trees (live oak and cottonwood) shall provide a minimum 1:1 replacement ratio based on the 85-inch diameter at breast height (DBH) measurement of the existing cottonwood tree. It is expected compliance with this measure would require planting of approximately 25 to 30 cottonwood trees.

e. To reduce disturbance of Natural and Naturalistic Open Space areas:

(1) Unnecessary driving in sensitive or otherwise undisturbed areas shall be avoided. New roads or construction access roads would not be created where adequate access already exists.

(2) Removal of native shrub or brush shall be avoided, except where necessary.

(3) Drainages shall be avoided, except where required for construction. Limit activity to crossing drainages rather than using the lengths of drainage courses for access.

(4) Excess fill or construction waste shall not be dumped in washes.

(5) Vehicles or other equipment shall not be parked in washes or other drainages.

(6) Overwatering shall be avoided in washes and other drainages.

(7) Wildlife including species such as fox, coyote, snakes, etc. shall not be harassed. Harassment includes shooting, throwing rocks, etc.

D. Worker Education Program

1. All contractors, and overseen by the General Contractor, shall participate in a worker education program for all construction personnel prior to personnel initiating ground disturbance activities, which will include a discussion of the importance of the Arroyo and areas within the Arroyo to be avoided (including parking and staging of equipment), a discussion of native wildlife with the potential to occur, and education on not harassing native wildlife.

E. Biological Monitoring During Construction

1. All contractors, and overseen by the General Contractor, shall cooperate with and follow required direction from the qualified biologist who shall monitor the project for compliance with best management practices.

F. Exotic species

1. Any exotic species removed shall be properly handled to prevent sprouting or re-growth. Construction equipment shall be cleaned of mud or other debris that may contain invasive plants and/or seeds and inspected to reduce the potential of spreading noxious weeds before mobilizing to the work of construction. Cleaning of any equipment shall occur at least 300 feet from the Arroyo area and before leaving the work area during the course of construction.

1.9. CULTURAL RESOURCES

A. Protection and Recovery of Buried Artifacts

1. If an archaeological resource is discovered during construction, all soil-disturbing work within 100 feet of the find shall cease and the University Representative shall be notified and shall contact a qualified archaeologist within 24 hours of discovery to inspect the site. If a resource within the project area of potential effect is determined to qualify as a unique archaeological resource (as defined by CEQA), the University shall devote adequate time and funding to salvage the material. Any archaeologically important artifacts recovered during monitoring shall be cleaned, catalogued, and analyzed, with the results presented in a report of finding that meets professional standards.

2. In the event of the discovery of a burial, human bone, or suspected human bone, all excavation or grading in the vicinity of the find shall halt immediately and the area of the find shall be protected and the University immediately shall notify the Riverside County Coroner of the find and comply with the provisions of P.R.C. Section 5097 with respect to Native American involvement, burial treatment, and re-burial, if necessary.

1.10. AESTHETICS

A. Strict adherence to the approved Detailed Planting Plans to Maintain Existing View Corridors.

1.11. AIR QUALITY

A. All construction vehicles and equipment containing an internal combustion engine and operating on the project site shall meet EPA-certified Tier 2 emission standards or higher. Contractor shall maintain on-going verification records of equipment certification as new equipment is delivered to the site for University Representatives to review for compliance.

B. Low NOx diesel fuel and construction equipment shall be used to the extent that is readily available at the time of construction. Contractor shall maintain on-going, updated records for University Representatives to review for compliance.

C. The following Air Quality reduction procedures shall be implemented throughout the construction process:

a. Compliance with all SCAQMD rules and regulations.

b. Maintenance programs to assure vehicles remain in good operating condition.

c. Avoid unnecessary idling of construction vehicles and equipment.

d. Use of alternative fuel vehicles.

e. Provision of electrical power to site to eliminate the need for on-site generators.

D. All off-road equipment operating on project site, as well as on-road heavy-duty vehicles (including hauling and material delivery trucks) traveling to and from the project site will be fitted with an oxides catalyst. Contractor shall maintain on-going verification records of equipment

certification as equipment is delivered to the site for University Representatives to review for compliance.

E. Limited on-campus parking outside the project site boundaries will be made available for construction workers. The University will provide contractors' workers with limited, free, on-campus parking in a designated portion of Lot 13 across Big Springs Rd from the project site.

1. Confine parking to the construction site or specifically designated areas of Lot 13. Vehicles parked elsewhere are subject to Campus parking fees or fines. Campus parking permits are available through Parking Services of **$56.00** per month (check with Parking Services for daily and weekly rates) per vehicle. Rate is subject to change.
2. Contractor may use available space within its Project fence limits for parking without a permit.
3. Provide 3 parking spaces within the staging area for University's Representative and its Consultants use.

PART 2 – PRODUCTS (Not Applicable)

PART 3 – EXECUTION (Not Applicable)

END OF SECTION

SECTION 01 6000
PRODUCT REQUIREMENTS

PART 1 – GENERAL

1.1. SUMMARY

A. This Section includes administrative and procedural requirements governing the Contractor's selection of products for use in the Project:

1. Quality Assurance
2. Product Delivery, Storage, and Handling
3. Product Selection
4. Product Installation

B. Definitions: The Definitions used in this Article are not intended to change the meaning of other terms used in the Contract Documents, such as "specialties," "systems," "structure," "finishes," "accessories," and similar terms. Such terms are self-explanatory and have well-recognized meanings in the construction industry.

1. “Products” are items purchased for incorporation in the Work, whether purchased for the Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

   a. "Named Products" are items identified by the manufacturer's product name, including make or model number or other designation, shown or listed in the manufacturer's published product literature that is current as of the date of the Contract Documents.
   b. "Foreign Products," as distinguished from "domestic products," are items substantially manufactured (50 percent or more of value) outside the United States and its possessions. Products produced or supplied by entities substantially owned (more than 50 percent) by persons who are not citizens of, nor living within, the United States and its possessions are also considered to be foreign products.

2. “Materials” are products substantially shaped, cut, worked, mixed, finished, refined or otherwise fabricated, processed, or installed to form a part of the Work.

3. “Equipment” is a product with operational parts, whether motorized or manually operated, that requires service connections, such as wiring or piping.

1.2. QUALITY ASSURANCE

A. Source Limitations: To the fullest extent possible, provide products of the same kind from a single source.

B. Compatibility of Options: When the Contractor is given the option of selecting between 2 or more products for use on the Project, the product selected shall be compatible with products previously selected, even if previously selected products were also options.

1. Each prime contractor is responsible for providing products and construction methods that are compatible with products and construction methods of other prime or separate contractors.

2. If a dispute arises between prime contractors over concurrently selectable, but incompatible products, the University's Representative will determine which products shall be retained and which are incompatible and must be replaced.

C. Foreign Product Limitations: Except under one or more of the following conditions, provide domestic products, not foreign products, for inclusion in the Work:

1. No available domestic product complies with the Contract Documents.

2. Domestic products that comply with the Contract Documents are available only at prices or terms substantially higher than foreign products that comply with the Contract Documents.

D. Nameplates: Except for required labels and operating data, do not attach or imprint manufacturer's or producer's nameplates or trademarks on exposed surfaces of products that will be exposed to view in occupied spaces or on the exterior.

1. Labels: Locate required product labels and stamps on concealed surfaces or, where required for observation after installation, on accessible surfaces that are not conspicuous.

2. Equipment Nameplates: Provide a permanent nameplate on each item of service-connected or power-operated equipment. Locate on an easily accessible surface that is inconspicuous in occupied spaces. The nameplate shall contain the following information and other essential operating data:

a. Name of product and manufacturer.
b. Model and serial number.
c. Capacity.
d. Speed.
e. Ratings.

3. UL Label: Provide products bearing appropriate UL label as indicated.

1.3. PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 01 5200, Paragraph 1.5.

PART 2 – PRODUCTS

2.1. PRODUCT SELECTION

A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, new at the time of installation, except where salvaged materials are indicated.

1. Provide products complete with accessories, trim, finish, safety guards, and other devices and details needed for a complete installation and the intended use and effect.

2. Standard Products: Where available, provide standard products of types that have been produced and used successfully in similar situations on other projects.

B. Product Selection Procedures: The Contract Documents and governing regulations govern product selection. Procedures governing product selection include the following:

1. Nonproprietary Specifications: When Specifications list products or manufacturers that are available and may be incorporated in the Work, but do not restrict the Contractor to use of these products only, the Contractor may propose any available product that complies with Contract requirements. Comply with Contract Document provisions concerning "substitutions" to obtain approval for use of an unnamed product.

2. Compliance with Standards, Codes, and Regulations: Where Specifications only require compliance with an imposed code, standard, or regulation, select a product that complies with the standards, codes, or regulations specified.

3. Visual Matching: Where Specifications require matching an established Sample, the University Representative's decision will be final on whether a proposed product matches satisfactorily.

   a. Where no product available within the specified category matches satisfactorily and complies with other specified requirements, comply with provisions of the Contract Documents concerning "substitutions" for selection of a matching product in another product category.

4. Visual Selection: Where specified product requirements include the phrase "...as selected from manufacturer's standard colors, patterns, textures..." or a similar phrase, select a product and manufacturer that complies with other specified requirements. The University's Representative will select the color, pattern, and texture from the product line selected.

PART 3 – EXECUTION

3.1 PRODUCT INSTALLATION

A. Comply with manufacturer's instructions and recommendations for installation of products in the applications indicated. Anchor each product securely in place, accurately located and aligned with other Work.

1. Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

END OF SECTION

SECTION 01 7100
EXAMINATION AND PREPARATION

PART 1 – GENERAL

1.1. SUMMARY

A. This Section includes:

1. Mobilization
2. Acceptance of Conditions
3. Construction Layout
4. Construction Surveying
5. Protection of Adjacent Construction
6. Non-Destructive Concrete Examination

1.2. MOBILIZATION – Not Used

1.3. ACCEPTANCE OF CONDITIONS

1. Prior to commencing the Work, the Contractor and University's Representative shall tour together the Project site (and areas immediately surrounding the site) to examine and record damage to existing buildings and improvements constructed under a prior contract. As such the Contractor accepts the work constructed on site “as–is” and must finish what is installed into a complete and functional system.

2. This record shall serve as a basis for determination of subsequent damage due to Contractor's operations and shall be signed by all parties making the tour. Any cracks, sags, or damage to the adjacent buildings, improvements and landscaping elements not noted in the original survey, but subsequently discovered, shall be reported to University's Representative within 15 days from Notice to Proceed.

3. The Contractor shall prepare a report of the survey, including:

   a. DVD recording of existing conditions.
   b. 8" x 10" glossy photographs of significant features requested by University's Representative.
   c. Key plan with references to video/photographs

4. The Contractor and University Representative shall periodically monitor conditions of existing buildings and installations for signs of movement, settlement, or other damage related to construction.

5. Contractor is solely responsible for repairing damage to existing construction and finishes and for replacing damaged components, which cannot be repaired.

6. Contractor is solely responsible for maintaining and watering existing landscaping within the Project site and for replacing landscaping elements, which are damaged or destroyed during the course of the Work.

1.4. CONSTRUCTION LAYOUT

1.5. CONSTRUCTION SURVEYING

1.6. PROTECTION OF ADJACENT CONSTRUCTION

1.7. NON-DESTRUCTIVE CONCRETE EXAMINATION

PART 2 – PRODUCTS (Not Applicable)

PART 3 – EXECUTION (Not Applicable)

END OF SECTION

SECTION 01 7329
CUTTING AND PATCHING

PART 1 – GENERAL

1.1. SUMMARY

A. This Section includes general administrative and procedural requirements for cutting and patching, including without limitation, the following:

1. Submittals
2. Quality Assurance
3. Warranty
4. Materials
5. Inspection
6. Preparation
7. Performance
8. Cleaning

B. Requirements of this Section apply to mechanical and electrical installations. Refer to Specification Divisions 20-28 for other requirements and limitations applicable to cutting and patching mechanical and electrical installations.

C. Refer to other applicable Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.

D. Cutting and Patching, in addition to requirements of the General Conditions, includes removing, altering, and repairing portions of the Work as required to accomplish the following:

1. Make several parts fit properly.
2. Uncover work to provide for installation of ill-timed work.
3. Remove and replace defective work.
4. Remove samples of installed work as specified or requested by the University's Representative for testing.
5. Install new construction penetrations of or connections to existing construction.

1.2. SUBMITTALS

A. Cutting and Patching Proposal: Submit written notice to the University's Representative requesting permission to proceed with cutting which could affect structural safety of the project 10 days in advance of starting cutting. Request approval to proceed. Include the following information, as applicable, in the proposal:

1. Describe the extent of cutting and patching required. Show how it will be performed and indicate why it cannot be avoided.
2. Describe anticipated results in terms of changes to existing construction. Include changes to structural elements and operating components as well as changes in the building's appearance and other significant visual elements.
3. List products to be used and firms or entities that will perform Work.
4. Indicate dates when cutting and patching will be performed.
5. Utilities: List utilities that cutting and patching procedures will disturb or affect. List utilities that will be relocated and those that will be temporarily out-of-service. All utility shut downs shall be kept to a minimum. Contractor shall coordinate for all shut downs to occur during weekend hours without change to the contract sum. Identify date, time and expected duration (no more than 8 hours duration) of all utility shutdowns. There will be no shut downs for sewer services, must do bypass.

6. Approval by the University's Representative to proceed with cutting and patching does not waive the University's Representative right to later require complete removal and replacement of unsatisfactory work.

B. Changed Conditions Notice: Submit written recommendations to the University's Representative should conditions of work or schedule indicate change of materials or methods, including the following:

1. Conditions indicating change.
2. Recommendations for alternative materials and methods.
3. Information required for substitution.

1.3. QUALITY ASSURANCE

A. Requirements for Structural Work:

1. Obtain approval of the cutting and patching proposal before cutting and patching structural elements including, but not limited to, the following:

a. Foundation construction.
b. Structural concrete.
c. Miscellaneous structural metals.
d. Piping and equipment.

B. Operational Limitations: Do not cut and patch operating elements or related components in a manner that would result in reducing their capacity to perform as intended. Do not cut and patch operating elements or related components in a manner that would result in increased maintenance or decreased operational life or safety.

1. Obtain approval of the cutting and patching proposal before cutting and patching the following operating elements or safety related systems

a. Primary operational systems and equipment.
b. Fire protection systems.
c. Communication systems.
d. Electrical wiring systems.
e. Security systems

C. Visual Requirements: Do not cut and patch construction in a manner that would result in visual evidence of cutting and patching. Remove and replace construction cut and patch in a visually unsatisfactory manner.

1.4. WARRANTY

A. Existing Warranties: Replace, patch, and repair material and surfaces cut or damaged by methods and with materials in such a manner as not to void any warranties required or existing.

PART 2 – PRODUCTS

2.1. MATERIALS

A. Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible if identical materials are unavailable or cannot be used. Use materials whose installed performance will equal or surpass that of existing materials.

PART 3 – EXECUTION

3.1 INSPECTION

A. Examine surfaces to be cut and patched and conditions under which cutting and patching is to be performed before cutting. If unsafe or unsatisfactory conditions are encountered, take corrective action and notify University's Representative before proceeding.

1. Before proceeding, meet at the Project Site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.
2. Provide drawings and calculations signed by a licensed California Structural Engineer for shoring, bracing and support to maintain structural integrity.
3. Protect other portions of the Project.
4. Protect Project from the element.

3.2 PREPARATION

A. Temporary Support: Provide temporary support of work to be cut.

B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of the Project that might be exposed during cutting and patching operations.

C. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

D. Avoid cutting existing pipe, conduit, or ductwork serving the building but scheduled to be removed or relocated until provisions have been made to bypass them.

3.3 PERFORMANCE

A. General: Employ skilled workmen to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time and complete without delay.

1. Cut existing construction to provide for installation of other components or performance of other construction activities and the subsequent fitting and patching required to restore surfaces to their original condition.

B. Cutting: Cut existing construction using methods least likely to damage elements retained or adjoining construction. Where possible, review proposed procedures with the original Installer; comply with the original Installer's recommendations.

1. In general, where cutting, use hand or small power tools designed for sawing or grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces.
3. Cut through concrete and masonry using a cutting machine, such as a Carborundum saw or a diamond-core drill.
4. Comply with requirements applicable Division 2 Sections where cutting and patching requires excavating and backfilling.
5. Where services are required to be removed, relocated, or abandoned, by-pass utility services, such as pipe or conduit, before cutting. Cut-off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal the remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after by-passing and cutting.

C. Patching: Patch with durable seams that are as invisible as possible. Comply with specified tolerances.

1. Where feasible, inspect and test patched areas to demonstrate integrity of the installation.
2. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
3. Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.

3.4 CLEANING

A. Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar items. Thoroughly clean piping, conduit, and similar features before applying paint or other finishing materials. Restore damaged pipe covering to its original condition.

END OF SECTION

SECTION 01 7400
CLEANING AND WASTE MANAGEMENT

PART 1 – GENERAL

1.1. SUMMARY

A. This Section includes:

1. Progress Cleaning and Site Maintenance
2. Construction Waste Management and Disposal
3. Final Cleaning
4. Contractor C&D Waste Monitoring Form and Green Waste Monitoring Form, copies of which are attached at the end of this Section.

B. Cleaning Agents: Use cleaning materials and agents recommended by the manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

C. Environmental Requirements: Conduct cleaning and waste-disposal operations in compliance with local laws and ordinances. Comply fully with federal and local environmental and antipollution regulations.

1. Do not dispose of volatile wastes, such as mineral spirits, oil, or paint thinner, in streams, storm or sanitary drains.
2. Burning or burying of debris, rubbish, or other waste material on the premises is not permitted.
3. Comply with requirements of Southern California Air Quality Management District in effect at the time of construction.
4. Comply with governing regulations and safety standards for cleaning operations. Remove waste materials from the site and dispose of lawfully.

D. Submittal: Prior to requesting inspection for Substantial Completion and Final Completion, submit written certification to the University's Representative that final cleaning has been performed in accordance with the Contract Documents.

1.2. PROGRESS CLEANING AND SITE MAINTENANCE

A. Collection and Disposal of Waste: Contractor shall furnish all labor, equipment, containers, transportation, materials, supplies and related expenses to provide the University with comprehensive waste collection and waste recycling services for the Project. Contractor shall collect waste from construction areas and elsewhere daily. Comply with requirements of NFPA 241 for removal of combustible waste material and debris. Enforce requirements strictly. Do not hold materials more than 7 days during normal weather or 3 days when the temperature is expected to rise above 80 degrees F (27 degrees C). Handle hazardous, dangerous, or unsanitary waste materials separately from other waste by containerizing properly.

1. Do not burn waste materials. Do not bury debris or excess materials on the University's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems or streams. Remove waste materials from the site and dispose of lawfully.

2. Where extra materials of value remain after completion of associated Work, they become the University's property. Dispose of these materials as directed by the University's Representative.

3. Provide on-site containers for collection of waste materials, debris, and rubbish, and empty at least weekly. Maintain containers in such condition so as to ensure

they are clean and sanitary, to prevent odor and insect infestation, and ensure no unsightly presentation. Perform maintenance on the containers as required to ensure proper function for the intended purpose.

4. Handle waste materials in a controlled manner. Do not drop or throw materials from heights.

5. Remove combustible debris from the building daily and store in covered, non-combustible containers located not less than 40 feet from any building.

B. Cleaning During Construction Period: Comply with regulations of the University and safety standards for cleaning.

1. Schedule cleaning operations so that dust and other contaminants resulting from cleaning operations will not settle on wet paint, or other coatings or finishes during their cure period.

2. Comply with manufacturer's instructions for cleaning the surfaces and parts of finishes and equipment. Use only those cleaning materials and procedures recommended by the manufacturer of the item to be cleaned.

3. Provide cleaning during construction as necessary to ensure operations can proceed on schedule and that finish materials can be installed properly and viewed for determination of aesthetic characteristics.

1.3. CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

A. The University has established that this Project shall generate the least amount of waste possible and that processes that ensure the generation of as little waste as possible shall be employed to enable the University to meet a minimum 95% percent diversion of construction and demolition (C&D) waste (including green waste) from the landfill.

B. Contractor shall be responsible for monitoring and maintaining a written log using the C&D Waste Monitoring Form and Green Waste Monitoring Form, copies of which are attached at the end of this Section, to report when actual container deliveries and waste pickups occur, the types of C&D waste material included, weight of each type (in Tons) diverted or landfilled and total percentage of waste diverted from landfill, and any other data required to be reported on the respective forms. Contractor shall submit completed forms with the required data to University's Representative, or designee, **with each Application for Payment**. Such written information shall be used as backup to support payment of Contractor's scheduled value for Division 1, General Requirements.

C. C&D waste is a combination of concrete, lumber, plaster, cardboard, glass, various metals, paper, PVC, ABS, HDPE, PP, PDPE, PET, white foam, paint buckets, carpet, green waste, and dirt.

1. C&D waste accepted for recycling:

a. Card Board.
b. Mixed metals.
c. PVC Pipe.
d. ABS Pipe.
e. H.D.P.E. Pipe.
f. Carpet.
g. Carpet Pad.
h. Mixed Plastics.
i. Glass.
j. Bottles & Cans – CRV.
k. H.D.P.E Plastics.
l. H.D.P.E Pipe.

m. Foam – White.
n. Paper – Mixed.
o. Plastic Buckets – Paint (empty) & Landscapers.
p. Drywall.
q. Wood.
r. Particle Board.
s. Green Waste:
   (1) Green Waste refers to waste resulting from removal of vegetation; it is a combination of brush, branches, leaves, flowers, shrubs and small trees and other items listed on the Green Waste Monitoring Form.
   (2) Green Waste accepted for recycling and/or compost:
      (a) Grass Clippings.
      (b) Trees – Tree trunks shall be cut into 4' and 10" pieces.
      (c) Branches – Branches shall be cut into 4' and 10" pieces.
      (d) Tree Trimmings – All other material other than trunks, branches, and leaves.
      (e) Wood.
      (f) Mulch.
      (g) Brush.
      (h) Leaves.
      (i) Flowers.
      (j) Shrubs.
      (k) Palm Fronds.
t. Inert Material – Soil, Asphalt, Brick, Concrete

1.4. FINAL CLEANING

A. This Section includes the administrative and procedural requirements for final cleaning at Substantial Completion and Final Inspection.

B. Provide final-cleaning operations when indicated. Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit of Work to the condition expected from a commercial cleaning and maintenance program. Comply with manufacturer's instructions.

C. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for the entire Project or a portion of the Project.

1. Clean the Project Site, yard and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and foreign substances.

2. Sweep paved areas broom clean. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.

3. Remove petrochemical spills, stains, and other foreign deposits.

4. Remove tools, construction equipment, machinery, and surplus material from the site.

5. Remove snow and ice, if any, to provide safe access to the building.

6. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.

7. Remove debris and surface dust from limited access spaces, including trenches, equipment vaults, manholes and similar spaces.

8. Broom clean concrete floors in unoccupied spaces.

9. Remove labels that are not permanent labels.

10. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.

    a. Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.

11. Wipe surfaces of electrical equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.

12. Remove grease, dust, dirt, stains, and other marks from surfaces exposed-to-view.

13. Leave the Project clean.

D. Pest Control: Engage an experienced, licensed exterminator to make a final inspection and rid the Project of rodents, insects, and other pests. Comply with regulations of local authorities.

E. Removal of Protection: Remove temporary protection and facilities installed during construction to protect previously completed installations during the remainder of the construction period.

F. Where extra materials of value remain after completion of associated Work, they become the University's property. Dispose of these materials as directed by the University's Representative at no additional cost to the University.

PART 2 – PRODUCTS (Not Applicable)

PART 3 – EXECUTION (Not Applicable)

END OF SECTION

Contractor C&D Waste Monitoring Form

Project Name & No.:

Contractor:

Prepared by:

Date/Time of Pick up	Size of Bin	R/L[1]	Bin Makeup: Recycled or Landfill Materials (Provide quantity of each in Tons.)											
			Concrete	Metals	Wood	Glass	Clay/Brick	Paper	Gypsum	Paint	Insulation	Green Waste[2]	Dirt[2]	Other
Column Totals:														
Total C&D Waste to Landfill:														
% of C&D Waste Recycled:														

[1] Indicate whether R=Recycled or L=Landfill.

[2] For waste diversion numbers, Green Waste and dirt are not included. Complete Green Waste Monitoring Form.

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Contractor Green Waste Monitoring Form

Project Name & No.:

Contractor:

Prepared by:

Date/Time of Pick up	Size of Bin	R/L[1]	Bin Makeup: Recycled or Landfill Materials (Provide quantity of each in Tons.)											
			Grass Clippings	Small Tree	Tree Trunks	Branches	Tree Trimmings	Wood	Mulch	Brush	Leaves	Flowers	Shrubs	Palm Fronds
Column Totals:														
Total Green Waste to Landfill:														
% of Green Waste Recycled:														

[1] Indicate whether R=Recycled or L=Landfill.

SECTION 01 7700
CONTRACT CLOSEOUT

PART 1 – GENERAL

1.1. SUMMARY

A. This Section includes administrative and procedural requirements for contract closeout including, but not limited to, the following:

1. Substantial Completion
2. Final Inspection Acceptance
3. Closeout Procedures
4. Instruction and Evaluation of University's Personnel
5. Training Tools and Materials
6. Qualifications of Instructors
7. Operation and Maintenance Manuals and Instructions
8. Spare Parts and Extra Stock Materials
9. Warranties

B. Closeout requirements for specific construction activities are included in the appropriate Sections in Divisions 2 through 33.

1.2. SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting inspection for certification of Substantial Completion, complete the following. List exceptions in the request.

1. In the Application for Payment that coincides with, or first follows, the date Substantial Completion is claimed, show 100 percent completion for the portion of the Work claimed as substantially complete.
   a. Include supporting documentation for completion as indicated in these Contract Documents and a statement showing an accounting of changes to the Contract Sum.
   b. If 100 percent completion cannot be shown, include a list of incomplete items, the value of incomplete construction, and reasons the Work is not complete.
2. Advise the University of pending insurance changeover requirements.
3. Submit specific warranties, workmanship bonds, maintenance and service agreements, final certifications, and similar documents.
4. Obtain and submit releases enabling the University unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
5. Submit record drawings, operation and maintenance manuals, final project photographs, damage or settlement surveys, property surveys, and similar final record information.
6. Deliver tools, spare parts, extra stock, and similar items.
7. Make final changeover of permanent locks and transmit keys and key schedule to the University. Advise the University's personnel of changeover in security provisions.
8. Complete startup testing of systems and instruction of the University's operation and maintenance personnel. Discontinue and remove temporary facilities from the site, along with mockups, construction tools, and similar elements.
9. Complete final cleanup requirements, including touchup painting.
10. Touch up and otherwise repair and restore marred, exposed finishes.
11. Adjust and balance all systems and adjust all valves.
12. Check fluid and gas carrying pipe systems, roofs, flashings, gutters, and downspouts for leaks. Repair or replace as necessary.

13. Lubricate all moving parts of machinery and equipment as recommended by the manufacturers of the machinery and equipment.
14. Submit certification required in Section 01 7400 for "Final Cleaning."

B. Inspection Procedures: On receipt of a request for inspection, the University's Representative will either proceed with inspection or advise the Contractor of incomplete or incorrect work. The University's Representative will prepare the Punchlist following inspection or advise the Contractor of what must be completed or corrected before the certificate will be issued.

1. The University's Representative will repeat inspection when requested and assured that the Work is substantially complete.
2. Results of the completed inspection will form the basis of requirements for final acceptance.
3. Allow 3 weeks for the University's Representative to prepare the list of items to be corrected.

1.3. FINAL INSPECTION ACCEPTANCE

A. Preliminary Procedures: Before requesting final inspection for certification of final acceptance and final payment, complete the following. List exceptions in the request.

1. Submit the final payment request with releases and supporting documentation not previously submitted and accepted. Include insurance certificates for products and completed operations where required.
2. Submit an updated final statement, accounting for final additional changes to the Contract Sum.
3. Submit a certified copy of the University Representative's final inspection list of items to be completed or corrected, endorsed and dated by the University's Representative. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance and shall be endorsed and dated by the University's Representative.
4. Submit final meter readings for utilities, a measured record of stored fuel, and similar data as of the date of Substantial Completion or when the University took possession of and assumed responsibility for corresponding elements of the Work.
5. Submit consent of surety to final payment.
6. Submit a final liquidated damages settlement statement.
7. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
8. Completed Punchlist.

B. Reinspection Procedure: The University's Representative will reinspect the Work upon receipt of notice that the Work, including inspection list items from earlier inspections, has been completed, except for items whose completion is delayed under circumstances acceptable to the University's Representative.

1. Upon completion of reinspection, the University's Representative will prepare a certificate of final acceptance. If the Work is incomplete, the University's Representative will advise the Contractor of Work that is incomplete or of obligations that have not been fulfilled but are required for final acceptance.
2. If necessary, reinspection will be repeated and related costs of University's Representative and University Representative's Consultants will be deducted from final retention payment.

PART 2 – PRODUCTS (Not Applicable)

PART 3 – EXECUTION

3.1 CLOSEOUT PROCEDURES

A. Operation and Maintenance Instructions: Arrange for each Installer of equipment that requires regular maintenance to meet with the University's personnel to provide instruction in proper operation and maintenance. Provide instruction by manufacturer's representatives if installers are not experienced in operation and maintenance procedures. Include a detailed review of the following items:

1. Operation and Maintenance manuals.
2. As-Built documents.
3. Spare parts and materials.
4. Tools.
5. Lubricants.
6. Fuels.
7. Identification systems.
8. Control sequences.
9. Hazards.
10. Cleaning.
11. Warranties and bonds.
12. Maintenance agreements and similar continuing commitments.

B. As part of instruction for operating equipment, demonstrate the following procedures:

1. Startup.
2. Shutdown.
3. Emergency operations.
4. Noise and vibration adjustments.
5. Safety procedures.
6. Economy and efficiency adjustments.
7. Effective energy utilization.

3.2 INSTRUCTION AND EVALUATION OF UNIVERSITY'S PERSONNEL

A. Perform hands-on demonstrations and instruction for University's designated personnel in the operation, adjustment and maintenance of products, equipment, and systems, as required and at agreed upon times.

B. Instruction Before Final Inspection: Before Final Inspection, and after work under this contract is completed, tested and prior to acceptance by the University; and not less than five (5) days after submittal of the Operation and Maintenance Data, operate all the systems for a period of three (3) 8-hour periods during which time a qualified factory trained representative familiar with the items installed shall instruct and supervise the University's Personnel in the operation and maintenance of the equipment and systems. This instruction period is in addition and subsequent to any period of operation, testing and adjustment called for elsewhere in these specifications.

C. Instruction by Manufacturer's Representatives: Any instructions from manufacturer's representatives required under other sections of this specification shall be conducted during this period. This instruction period shall be conducted after completion of all piping and equipment labeling required by the Contract.

D. Time of Instructions: Make all arrangements and notices for operation and instruction periods though the University's Representative.

E. Seasonal Operation: For equipment requiring seasonal operation, perform demonstrations and instructions for each required season and at agreed upon times.

F. Evaluation: During and after demonstrations and instructions for University's designated personnel, evaluate their ability to perform the necessary maintenance and operation functions required to properly operate and maintain each piece of equipment. Make sure that at the end of the training session, the University's designated personnel are reasonably proficient in the operations and maintenance of products, systems, and equipment.

3.3 TRAINING TOOLS AND MATERIALS

A. Use operation and maintenance manuals as basis for instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance. For all systems requiring operation and maintenance training from factory representative, written authorization from the University is required. All systems of more than one manufacturer, a factory representative from each will be required.

B. Prepare and insert additional data in Operation and Maintenance Manual when need for such data becomes apparent during instruction.

3.4 QUALIFICATIONS OF INSTRUCTORS

A. Instructions for the University's Personnel. For instruction of the University's operating and maintenance personnel, use experienced instructors thoroughly trained and experienced in the operation and maintenance of the building equipment or system involved.

3.5 OPERATION AND MAINTENANCE MANUALS AND INSTRUCTIONS

A. Assemble and furnish a minimum of 3 complete sets (unless otherwise indicated in a specific section) of all mechanical and electrical systems data, except that noted to be mounted in frames, in three-ring loose-leaf binders, complete with index, with indexed dividers permanently attached and exterior labels on cover and back of binders.

B. Data Required:
1. Manufacturers' Manuals: Provide complete installation, operation, maintenance, and service manuals and printed instructions and parts lists for all materials and equipment, where such printed matter is regularly available from the manufacturer. This includes but is not limited to such service manuals as may be sold by the manufacturer covering the operation and maintenance of items, and complete replacement parts lists sufficiently detailed for parts replacement ordering to manufacturer. Bound publications need not be assembled in binders.
2. Equipment Nameplate Data: A typewritten list of all mechanical and electrical equipment showing all equipment nameplate data exactly. Identify equipment by means of names, symbols, and numbers used in the Contract Documents.
3. System Operating Instructions: Typewritten instructions covering operation of the entire system as installed (not duplicating manufacturers' instructions for operating individual components). Include schematic flow and control diagrams as appropriate and show, locate, or list system valves, control-elements, and equipment components using identification symbols and numbers. List rooms, area of equipment served, and show proper settings for valves, controls, and switches.
4. System Maintenance Instructions: Typewritten instructions covering routine maintenance of systems. List each item of equipment requiring inspection, lubrication, or service and briefly describe such maintenance, including types of lubricants and frequency of service. It is not intended that these instructions duplicate manufacturers' detailed instructions. Give name, address, and phone number of nearest firm authorized or qualified to service equipment or provide parts.
5. Warranty, Bonds, and Service Contracts: Provide a copy of each warranty, bond, and service contract issued. These should be accompanied by a sheet which outlines procedures to take in the event of failure and the circumstances which might affect the validity of warranties or bonds.
6. Wall Mounted Data: Frame one set of typewritten system instructions and diagrams as required under Paragraphs 3. and 4. above, covered with plexiglass and mount in locations as directed by the University's Representative.

3.6 SPARE PARTS AND EXTRA STOCK MATERIALS

3.7 WARRANTIES

A. General Provisions:

1. This subsection includes administrative and procedural requirements for warranties required by the Contract Documents, including manufacturers' standard warranties on products and special warranties.

   a. Refer to the General Conditions for terms of the Contractor's period for correction of the Work.

   b. Refer to Divisions 2 through 33 for specific requirements for warranties on products and installations specified to be warranted.

   c. Certifications and other commitments and agreements for continuing services to University are specified elsewhere in the Contract Documents.

2. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products. Manufacturer's disclaimers and limitations on product warranties do not relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor.

3. Effective Date: Warranties shall begin on the date of Final Acceptance unless specifically designated differently or a different date is mutually agreed upon in writing by the parties involved.

4. General Conditions require all items to be under warranty for a period of one (1) year from date of final completion (Notice of Completion) unless otherwise indicated. Warranties for more than one year required by individual Sections require a written warranty by Contractor and Subcontractor. Refer to individual Section of the Specifications to verify if longer warranties are required.

B. Definitions:

1. Standard product warranties are preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the University.

2. Special warranties are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for the University.

C. Warranty Requirements

1. Related Damages and Losses: When correcting failed or damaged warranted construction, remove and replace construction that has been damaged as a result of such failure or must be removed and replaced to provide access for correction of warranted construction.

2. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.

3. Replacement Cost: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of the Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding

defective Work regardless of whether the Regents have benefited from use of the Work through a portion of its anticipated useful service life.

4. Regents' Recourse: Expressed warranties made to the Regents are in addition to implied warranties and shall not limit the duties, obligations, rights, and remedies otherwise available under the law. Expressed warranty periods shall not be interpreted as limitations on the time in which the Regents can enforce such other duties, obligations, rights, or remedies.

    a. Rejection of Warranties: The Regents reserve the right to reject warranties and to limit selection to products with warranties not in conflict with requirements of the Contract Documents.

    b. The Regents reserve the right to reuse to accept Work for the Project where a special guarantee, certification, or similar commitment is required on such Work or part of the Work, until evidence is presented so that entities required to countersign such commitments are willing to do so.

5. Where the Contract Documents require a special warranty, or similar commitment on the Work or part of the Work, the University reserves the right to refuse to accept the Work, until the Contractor presents evidence that entities required to countersign such commitments are willing to do so.

6. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on standard product warranties shall not relieve the Contractor of the Contractor's warranty on the Work that incorporates the products, and shall also not relieve suppliers, manufacturers, and subcontractors required to counter-sign special warranties with the Contractor.

D. Warranty Submittals

1. Submit written warranties to the University's Representative prior to the date certified for Substantial Completion. If the University Representative's Certificate of Substantial Completion designates a commencement date for warranties other than the date of Substantial Completion, or a designated portion of the Work, submit written warranties upon request of the University's Representative.

    a. When a designated portion of the Work is completed and occupied or used by the University, by separate agreement with the Contractor during the construction period, submit properly executed warranties to the University's Representative within 10 days of completion of that designated portion of the Work.

2. Forms for special warranties are included at the end of this Section. Prepare a written document utilizing the appropriate form, ready for execution by the Contractor, or by the Contractor, subcontractor, supplier, or manufacturer. Submit a draft to the University, through the University's Representative, for approval prior to final execution.

    a. Refer to Divisions 2 through 33 for specific content requirements and particular requirements for submitting special warranties.

3. Form of Submittal: At Final Completion compile 3 copies of each required warranty, in the form included at the end of this Section, properly executed by the Contractor, or by the Contractor, subcontractor, supplier, or manufacturer. Organize the warranty documents into an orderly sequence based on the table of contents of the Project Manual.

4. Assemble required guarantees, bonds, and service and maintenance contracts.

5. Number of original signed copies required: Three (3) sets, each on 8-1/2 inch x 11 inch sheets, 3-hole punched in 3-ring binders. Fold larger sheets to fit into binders. Submit in commercial quality, 3-ring binders, with durable, cleanable plastic covers. Each set of binders shall include:

a. Cover: Identify each binder on the cover with typed or printed title, "WARRANTIES", University's Project Name and Number, Name of General Contractor, and binder number, such as "Set 1, Volume 1 of 2", etc.

b. Table of Contents: in a spreadsheet/table format, neatly typed and in orderly sequence by CSI number, based on Specifications Table of Contents in the Bidding-Contract Documents, with the following information:
   (1) CSI Number.
   (2) Name of Product or Work item.
   (3) Brief Scope Description.
   (4) Firm name, address, telephone number, and name of principal with email address.
   (5) Date of beginning of guarantee, bond, or service and maintenance contract.
   (6) Duration and expiration date of warranty or service and maintenance contract.

c. When warranted, construction requires operation and maintenance manuals, provide additional copies of each required warranty, as necessary, for inclusion in each required manual.

d. Except when a special warranty is required by the provisions of a specific Section of these Specifications, or a standard warranty is not offered as a matter of record by the manufacturer of a specified product, submit the manufacturer's standard warranty for each product incorporated in the Work.

e. When a manufacturer does not offer a standard warranty, provide a written form listing the product and indicating "Standard Product Warranty Not Available."

6. Special Warranty Forms: Attached at the end of this Section.

END OF SECTION

SPECIAL WARRANTY FORM

When required in Sections of the Specifications, Special Warranties shall be in the following form and written on Contractor's own letterhead:

"Warrant _____
(portion of work warranted)

Project:_____

Address:_____

Date: _____

We, the undersigned hereby warrant to the Regents of the University of California ("Regents") that the portion of the work identified, which we have installed in the above-named Project has been performed in accordance with the Contract Documents and that the work, as installed, will fulfill the requirements of the warranty included in this Specification. We agree to repair or replace any or all of our work, together with any other work which may be damaged or displaced by so doing, that may prove to be defective in its workmanship, materials, operation, or failure to conform to Contract provisions and requirements within a period of year(s) from date of Substantial Completion of the stipulated below for the above-named Project, without any expense whatever to the said Regents, ordinary wear and tear and unusual abuse or neglect excepted. In the event of our failure to comply with the above-mentioned conditions within ten (10) calendar days after being notified in writing by the Regents, we collectively or separately do hereby authorize the Regents to proceed to have said defects repaired and made good at our expense, including all collection cost and reasonable attorney fees, and we will honor and pay the costs and charges therefore upon demand."

WARRANTY PERIOD: _____ STARTING: _____ TERMINATING _____

Name of General Contractor	Name of Subcontractor
_____	_____
_____ Signature of General Contractor	_____ Signature of Subcontractor
_____ Address	_____ Address
_____ Phone Number	_____ Phone Number
_____ State License Number	_____ State License Number
_____ Name of Manufacturer	_____ Manufacturer Phone Number
_____ Signature of Manufacturer	

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GUARANTEE

Project Name: _____ Date:_____

Project Location: _____

Project Number: _____

GUARANTEE FOR_____ _____ (the "Contract"), between
The (Specification SECTION and Contract No.)

The Regents of the University of California ("University") and

_____
("Contractor")

_____
(Name of Contractor or Subcontractor)

hereby guarantees to University that the portion of the Work described as follows:

_____
_____
_____
_____,

which it has provided for the above referenced Project, is of good quality; free from defects; free from any liens, claims, and security interests; and has been completed in accordance with Specification SECTION and the other requirements of the Contract.

The undersigned further agrees that, if at any time within _____ months after the date of the guarantee the undersigned receives notice from University that the aforesaid portion of the Work is unsatisfactory, faulty, deficient, incomplete, or not in conformance with the requirements of the Contract, the undersigned will, within 10 days after receipt of such notice, correct, repair, or replace such portion of the Work, together with any other parts of the Work and any other property which is damaged or destroyed as a result of such defective portion of the Work or the correction, repair, or replacement thereof; and that it shall diligently and continuously prosecute such correction, repair, or replacement to completion.

In the event the undersigned fails to commence such correction, repair, or replacement within 10 days after such notice, or to diligently and continuously prosecute the same to completion, the undersigned, collectively and separately, do hereby authorize University to undertake such correction, repair, or replacement at the expense of the undersigned; and Contractor will pay to University promptly upon demand all costs and expenses incurred by University in connection therewith.

SUBCONTRACTOR

Signed: _____ Title: _____
Typed Name:_____
Name of Firm: _____
Contractor License Classification and Number: _____
Address: _____
Telephone Number: _____

CONTRACTOR

Signed: _____ Title: _____
Typed Name: _____
Name of Firm: _____

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SECTION 01 7839
AS-BUILT DOCUMENTS

PART 1 – GENERAL

1.1. SUMMARY

A. This Section includes administrative and procedural requirements for As-Built Documents, including without limitation, the following:

1. As-Built Drawings
2. As-Built Specifications
3. As-Built Product Data
4. As-Built Sample Submittal
5. Miscellaneous As-Built Submittals
6. Recording

B. As-Built Documents required include the following:

1. Marked-up copies of Drawings.
2. Marked-up copies of Shop Drawings.
3. Newly prepared drawings.
4. Marked-up copies of Specifications, Addenda, and Change Orders.
5. Marked-up Product Data submittals.
6. Samples.
7. Field records for variable and concealed conditions.
8. Record information on Work that is recorded only schematically.
9. Operation and Maintenance Data submittals.
10. Miscellaneous submittals.

C. Maintenance of Documents and Samples: Store As-Built Documents and Samples in the field office apart from the Contract Documents used for construction. Do not use As-Built Documents for construction purposes. Maintain As-Built Documents in good order, legible condition, and in a clean, dry, secure, fire-safe location. Make As-Built Documents and Samples available at all times for the University's Representative's inspections.

1. Maintain 1 set of all As-Built Documents at the Project site for the entire duration of construction.
2. Clearly label each document or item "AS-BUILT DRAWING," "AS-BUILT SAMPLE," "AS-BUILT SPECIFICATION," or similarly as appropriate and applicable.

D. Do not conceal Work requiring verification for As-Built Documents until such information has been verified and recorded.

1.2. AS-BUILT DRAWINGS

A. Markup Procedure: During construction, maintain a clean, undamaged set of blue- or black-line white prints of Contract Drawings and Shop Drawings for As-Built Document purposes.

1. Mark these Drawings to show the actual installation where the installation varies from the installation shown originally. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later. Items required to be marked include, but are not limited to, the following:

a. Dimensional changes to the Drawings.
b. Revisions to details shown on the Drawings.
c. Depths of foundations below the first floor. Indicate foundation elevations relative to first floor elevation.
d. Horizontal locations and vertical depths of underground utilities and appurtenances, including both site utilities and those under buildings and structures, referenced to permanent surface improvements.
e. Revisions to routing of piping and conduits.
f. Revisions to electrical circuitry.
g. Changes made by change order or field order.
h. Changes made following the University Representative's written orders and pertinent graphic and written responses to RFI's.
i. Details not on original Contract Drawings.

2. Mark As-Built prints of Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. Where Shop Drawings are marked, show cross-reference on Contract Drawings location.

3. Mark As-Built sets with red erasable colored pencil. Use other colors to distinguish between changes for different categories of the Work at the same location.

4. Mark important additional information that was either shown schematically or omitted from original Drawings. Mark new information that is important to the University but was not shown on Contract Drawings or Shop Drawings.

5. Note field order numbers, alternate numbers, change order numbers, RFI numbers, ASI numbers, and similar identification.

6. Identify and date each drawing; include the printed designation "AS-BUILT DRAWING" in a prominent location on each drawing

B. Responsibility for Markup: The individual or entity who obtained As-Built data, whether the individual or entity is the installer, subcontractor, or similar entity, shall prepare the markup on As-Built drawings.

1. Accurately information in an understandable drawing technique.

2. Record data as soon as possible after obtaining it, but within 24 hours maximum. Record and check the markup prior to enclosing concealed installations.

3. At time of Substantial Completion, submit As-Built drawings to the University's Representative for the University's records. Organize into sets and bind and label sets for the University's continued use. Bind each set with durable-paper cover sheets. Include appropriate identification, including titles, dates, and other information on the cover sheets.

C. Newly Prepared As-Built Drawings: Prepare new drawings instead of following procedures specified for preparing As-Built drawings where new drawings are required, and the University's Representative determines that neither original Contract Drawings nor Shop Drawings are suitable to show the actual installation.

D. Consult with the University's Representative for the proper scale and scope of detailing and notations required to record the actual physical installation and its relation to other construction. When completed and accepted, integrate newly prepared Drawings with procedures specified for organizing, copying, binding and submittal of As-Built drawings.

1.3. AS-BUILT SPECIFICATIONS

A. During the construction period, maintain 3 copies of the Specifications, including addenda and modifications issued, for As-Built Document purposes.

1. Mark the Specifications to indicate the actual installation where the installation varies from that indicated in Specifications and modifications issued. Note related project record drawing information, where applicable. Give particular attention to substitutions, selection of product options, and information on concealed installations that would be difficult to identify or measure and record later.

a. In each Specification Section where products, materials, or units of equipment are specified or scheduled, mark the copy with the proprietary name and model number of the product furnished.

b. Record the name of the manufacturer, supplier, installer, and other information necessary to provide a record of selections made and to document coordination with As-Built Product Data submittals and maintenance manuals.

c. Note related As-Built Product Data, where applicable. For each principal product specified, indicate whether As-Built Product Data has been submitted in maintenance manual instead of submitted as As-Built Product Data.

d. Use pen and black ink so marks will reproduce clearly.

2. Upon completion of markup, submit As-Built Specifications to the University's Representative for the University's records.

1.4. AS-BUILT PRODUCT DATA

A. During the construction period, maintain one copy of each Product Data submittal for As-Built Document purposes.

1. Mark Product Data to indicate the actual product installation where the installation varies substantially from that indicated in Product Data submitted. Include significant changes in the product delivered to the site and changes in manufacturer's instructions and recommendations for installation.

2. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.

3. Note related change orders and markup of As-Built Drawings, where applicable.

4. Upon completion of markup, submit a complete set of As-Built Product Data to the University's Representative for the University's records.

5. Where As-Built Product Data is required as part of maintenance manuals, submit marked-up Product Data as an insert in the manual instead of submittal as As-Built Product Data.

1.5. AS-BUILT SAMPLE SUBMITTAL

A. Immediately prior to date of Substantial Completion meet with the University's Representative and the University's personnel at the site to determine which of the Samples maintained during the construction period shall be transmitted to the University for record purposes. Comply with the University Representative's instructions for packaging, identification marking, and delivery to the University's Sample storage space. Dispose of other Samples in a manner specified for disposing surplus and waste materials.

1.6. MISCELLANEOUS AS-BUILT SUBMITTALS

A. Refer to other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Immediately prior to Substantial Completion, complete miscellaneous As-Built records and place in good order, properly identified and bound or filed, ready for use and reference. Submit to the University's Representative for the University's records.

1. Categories of requirements resulting in miscellaneous As-Built Documents include, but are not limited to, the following:

a. Field records on excavations and foundations.
b. Field records on underground construction and similar work.
c. Survey showing locations and elevations of underground lines.
d. Invert elevations of drainage piping.
e. Surveys establishing building lines and levels.
f. Authorized measurements utilizing unit prices or allowances.
g. Records of plant treatment.
h. Ambient and substrate condition tests.
i. Certifications received in lieu of labels on bulk products.
j. Batch mixing and bulk delivery records.
k. Testing and qualification of tradesmen.
l. Documented qualification of installation firms.
m. Load and performance testing.
n. Inspections and certifications by governing authorities.
o. Leakage and water-penetration tests.
p. Final inspection and correction procedures.
q. Field test reports.

PART 2 – PRODUCTS (Not Applicable)

PART 3 – EXECUTION (Not Applicable)

3.1 RECORDING

A. Post changes and modifications to the As-Built Documents as they occur. Do not wait until the end of the Project. The University's Representative and IOR will periodically review As-Built Documents to determine compliance with this requirement.

B. Current updated As-Built Documents shall be made available to the University's Representative and IOR for review at the time of submitting applications for payment.

C. Per the General Conditions, the University has the right to withhold payment until As-Built Documents are completed and current to date as of the latest application for payment

END OF SECTION

SECTION 03 3000

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 SUMMARY

A. Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
   1. Slabs-on-grade.

1.02 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Design Mixtures: For each concrete mixture, prepared by and stamped or under the supervision of a qualified California registered professional engineer. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

   1. Indicate amounts of mixing water to be withheld for later addition at Project site.

C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

D. Samples: For waterstops and vapor retarder.

E. Welding certificates.

F. Qualification Data: For manufacturer and [**testing agency**].

G. Material Test Reports: For the following, from a qualified testing agency acceptable to University's Representative, indicating compliance with requirements:

   1. Cementitious materials.
   2. Steel reinforcement and accessories.
   3. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.

H. Material Certificates: For each of the following, signed by manufacturers:

   1. Admixtures.

2. Form materials and form-release agents.
3. Fiber reinforcement.
4. Waterstops.
5. Curing compounds.
6. Floor and slab treatments.
7. Bonding agents.
8. Adhesives.
9. Vapor retarders.
10. Semirigid joint filler.
11. Joint-filler strips.
12. Repair materials.

I. Floor surface flatness and levelness measurements to determine compliance with specified tolerances.

J. Field quality-control test reports.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

B. Testing Agency Qualifications: An independent agency, acceptable to University's Representative, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

C. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.

D. Welding: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code--Reinforcing Steel."

E. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301, "Specification for Structural Concrete," [**Sections 1 through 5.**][**Sections 1 through 5 and Section 7, "Lightweight Concrete."**]
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
3. ACI 347, "Guide to Formwork for Concrete."

F. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

G. Mockups: Cast concrete [**slab-on-grade**] [**and**] [**formed-surface**] panels to demonstrate typical joints, surface finish, texture, tolerances, and standard of workmanship.

H. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:

   a. Contractor's superintendent.
   b. Independent testing agency responsible for concrete design mixtures and field quality control.
   c. Ready-mix concrete manufacturer.
   d. Concrete and reinforcing steel subcontractors.
   e. University's Representative.
   f. Waterproofing manufacturer's representative.
   g. Flooring product manufacturer's representative for every type of floor covering to be used on the project.

2. Review shall include the following as applicable to the project:

   a. Special inspection and testing and inspecting agency procedures for field quality control.
   b. Concrete finishes and finishing.
   c. Hot-weather concreting procedures.
   d. Curing procedures.
   e. Construction contraction and isolation joints, and joint-filler strips.
   f. Semirigid joint fillers.
   g. Forms and form removal limitations.
   h. Shoring and reshoring procedures.
   i. Vapor-retarder installation.
   j. Anchor rod and anchorage device installation tolerances.
   k. Steel reinforcement installation.
   l. Floor and slab flatness and levelness measurement.
   m. Concrete repair procedures.
   n. Concrete protection.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement if coated steel is used.

B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Products: Subject to compliance with requirements, provide one of the products specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
3. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section "Product Requirements", Part 2 "Product Substitutions" Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.02 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish full size forms or in sizes indicated on shop drawings.

1. Plywood, metal, or other approved panel materials unless a specific finish is required.
2. Exterior-grade plywood panels ¾-inch thick, suitable for concrete forms, complying with DOC PS 1, and as follows:

    a. High-density overlay, Class 1 or better for glossy finish.
    b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed for matte finish.
    c. Structural 1, B-B or better; mill oiled and edge sealed for exterior textured finish.
    d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed for exterior textured finish.

3. Steel forms shall be true, clean and smooth for concrete surfaces and shall be designed to allow easy removal without damaging placed concrete. Blocking for adjoining units shall be provided to prevent form deflection during placement and compaction.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation. Use only one type of form for similar features throughout a project.

D. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.

E. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads may be used for expansive soils or block outs only.

F. Chamfer Strips: Smooth rigid PVC, wood, or hard rubber strips, 3/4 by 3/4 inch chamfer or 3/4 inch radius.

G. Rustication Strips: PVC, wood, or rubber strips, kerfed for ease of form removal.

H. Form-Release Agent: Commercially formulated film-type form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

I. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal. Ties fabricated at Project site are not acceptable.

1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
2. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.
3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.
4. At fire rated conditions, the total tie shall be carefully removed from the concrete. The tie void shall be filled with non-shrink grout and a lead plug placed at exposed conditions.

2.03 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed for non-welded applications.

B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed when reinforcement is welded or Structural Engineer requires added ductility.

C. Galvanized Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed bars, ASTM A 767/A 767M, Class I zinc coated after fabrication and bending or ASTM A 706/A 706M if welded.

D. Epoxy-Coated Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed bars, ASTM A 775/A 775M , epoxy coated, with less than 2 percent damaged coating in each 12-inch bar length.

E. Stainless-Steel Reinforcing Bars: ASTM A 955/A 955M, Grade 60, Type [**304**] [**316L**], deformed.

F. Steel Bar Mats: ASTM A 184/A 184M, fabricated from [**ASTM A 615/A 615M, Grade 60**] [**ASTM A 706/A 706M**], deformed bars, assembled with clips.

G. Plain-Steel Wire: ASTM A 82, galvanized.

H. Deformed-Steel Wire: ASTM A 496.

I. Epoxy-Coated Wire: ASTM A 884/A 884M, Class A, Type 1 coated, deformed-steel wire, with less than 2 percent damaged coating in each 12-inch wire length.

J. Plain-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets.

K. Deformed-Steel Welded Wire Reinforcement: ASTM A 497, flat sheet.

L. Galvanized-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from galvanized steel wire into flat sheets.

M. Epoxy-Coated Welded Wire Reinforcement: ASTM A 884/A 884M, Class A coated, Type 1, deformed steel.

2.04 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut bars true to length with ends square and free of burrs.

B. Epoxy-Coated Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, ASTM A 775/A 775M epoxy coated.

C. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM A 775/A 775M.

D. Zinc Repair Material: ASTM A 780, zinc-based solder, paint containing zinc dust, or sprayed zinc.

E. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
3. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.

2.05 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout similar locations on the Project:

1. Portland Cement: ASTM C 150, Type II, except if soil conditions have a high sodium content then use Type V, gray unless white is required for exposed locations. Supplement with the following:

a. Fly Ash: ASTM C 618, Class [**C**] [**F**].
b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

2. Blended Hydraulic Cement: ASTM C 595, Type [**IS, portland blast-furnace slag**] [**IP, portland-pozzolan**] [**I (PM), pozzolan-modified portland**] [**I (SM), slag-modified portland**] cement.

B. Normal-Weight Aggregates: ASTM C 33, Class 1N coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.

1. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Lightweight Aggregate: ASTM C 330, 1/2-inch nominal maximum aggregate size.

D. Water: ASTM C 94/C 94M and potable.

2.06 ADMIXTURES

A. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

B. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C 494/C 494M, Type C.

1. Products:

a. Boral Material Technologies, Inc.; Boral BCN.
b. Euclid Chemical Company (The); Eucon CIA.
c. Grace Construction Products, W. R. Grace & Co.; DCI.
d. Master Builders, Inc.; Rheocrete CNI.
e. Sika Corporation; Sika CNI.
f. Or equal.

C. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.

1. Products:

    a. Axim Concrete Technologies; Catexol 1000CI.
    b. Boral Material Technologies, Inc.; Boral BCN2.
    c. Cortec Corporation; MCI [**2000**] [**2005NS**].
    d. Grace Construction Products, W. R. Grace & Co.; DCI-S.
    e. Master Builders, Inc.; Rheocrete 222+.
    f. Sika Corporation; FerroGard-901.
    g. Or equal.

D. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.

1. Manufacturers:

    a. Conspec Marketing & Manufacturing Co., Inc.; a Dayton Superior Company.
    b. Davis Colors.
    c. Scofield, L. M. Company.
    d. Or equal

2. Color: Match University Representative's sample or is not available as selected by University's Representative from manufacturer's full range.

2.07 FIBER REINFORCEMENT

A. Carbon-Steel Fiber: ASTM A 820, deformed, minimum of [**1.5 inches**] [**2 inches**] [**2.4 inches**] <**Insert dimension**> long, and aspect ratio of [**35 to 40**] [**45 to 50**] [**60 to 65**] <**Insert ratio**>.

1. Products:

    a. Bekaert Corporation; Dramix.
    b. Fibercon International, Inc.; Fibercon.
    c. SI Concrete Systems; Zorex.
    d. Or equal.

2. Fiber: Type[**1, cold-drawn wire**] [**or**] [**2, cut sheet**].

B. Synthetic Fiber: [**Monofilament**] [**or**] [**fibrillated**] polypropylene fibers engineered and designed for use in concrete pavement, complying with ASTM C 1116, Type III, [**1/2 to 1-1/2 inches**] <**Insert dimensions**> long.

1. Products:

    a. Monofilament Fibers:

        1) Axim Concrete Technologies; Fibrasol IIP.
        2) Euclid Chemical Company (The); Fiberstrand 100.
        3) FORTA Corporation; Forta Mono.

4) Grace Construction Products, W. R. Grace & Co.; Grace MicroFiber.
5) Metalcrete Industries; Polystrand 1000.
6) SI Concrete Systems; Fibermix Stealth.
7) Or equal.

b. Fibrillated Fibers:

1) Axim Concrete Technologies; Fibrasol F.
2) Euclid Chemical Company (The); Fiberstrand F.
3) FORTA Corporation; Forta.
4) Grace Construction Products, W. R. Grace & Co.; Grace Fibers.
5) SI Concrete Systems; Fibermesh.
6) Or equal.

2.08 WATER STOPS

A. Flexible Rubber Waterstops: CE CRD-C 513,[**with factory-installed metal eyelets,**] for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.

1. Manufacturers:

a. Greenstreak.
b. Progress Unlimited, Inc.
c. Williams Products, Inc.
d. Or equal.

2. Profile: [**Flat, dumbbell with center bulb**] [**Flat, dumbbell without center bulb**] [**Ribbed with center bulb**] [**Ribbed without center bulb**] [**As indicated**] <**Insert profile**>.
3. Dimensions: [**4 inches by 3/16 inch thick**] [**6 inches by 3/8 inch thick**] [**9 inches by 3/8 inch thick**] <**Insert dimensions**>; nontapered.

B. Chemically Resistant Flexible Waterstops: Thermoplastic elastomer rubber waterstops[**with factory-installed metal eyelets**], for embedding in concrete to prevent passage of fluids through joints; resistant to oils, solvents, and chemicals. Factory fabricate corners, intersections, and directional changes.

1. Products:

a. JP Specialties, Inc.; Earth Shield TPE-Rubber.
b. Vinylex Corp.; PetroStop.
c. WESTEC Barrier Technologies, Inc.; 600 Series TPE-R.
d. Or equal.

2. Profile: [**Flat, dumbbell with center bulb**] [**Flat, dumbbell without center bulb**] [**Ribbed with center bulb**] [**Ribbed without center bulb**] [**As indicated**] <**Insert profile**>.

3. Dimensions: [**4 inches by 3/16 inch thick**] [**6 inches by 3/16 inch thick**] [**6 inches by 3/8 inch thick**] [**9 inches by 3/16 inch thick**] [**9 inches by 3/8 inch thick**] <**Insert dimensions**>; nontapered.

C. Flexible PVC Waterstops: CE CRD-C 572,[**with factory-installed metal eyelets,**] for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.

1. Manufacturers:

a. Bometals, Inc.
b. Greenstreak.
c. Meadows, W. R., Inc.
d. Murphy, Paul Plastics Co.
e. Progress Unlimited, Inc.
f. Tamms Industries, Inc.
g. Vinylex Corp.
h. Or equal.

2. Profile: [**Flat, dumbbell with center bulb**] [**Flat, dumbbell without center bulb**] [**Ribbed with center bulb**] [**Ribbed without center bulb**] [**As indicated**] <**Insert profile**>.
3. Dimensions: [**4 inches by 3/16 inch thick**] [**6 inches by 3/8 inch thick**] [**9 inches by 3/8 inch thick**] <**Insert dimensions**>; nontapered.

D. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch.

1. Products:

a. Colloid Environmental Technologies Company; Volclay Waterstop-RX.
b. Concrete Sealants Inc.; Conseal CS-231.
c. Greenstreak; Swellstop.
d. Henry Company, Sealants Division; Hydro-Flex.
e. JP Specialties, Inc.; Earthshield Type 20.
f. Progress Unlimited, Inc.; Superstop.
g. TCMiraDRI; Mirastop.
h. Or equal.

E. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free hydrophilic polymer modified chloroprene rubber, for adhesive bonding to concrete, 3/8 by 3/4 inch.

1. Products:

a. Deneef Construction Chemicals; Swellseal.
b. Greenstreak; Hydrotite.
c. Mitsubishi International Corporation; Adeka Ultra Seal.
d. Progress Unlimited, Inc.; Superstop.

e. Or equal.

2.09 VAPOR RETARDERS

A. Plastic Vapor Retarder: ASTM E 1745, Class A. Include manufacturer's recommended adhesive or pressure-sensitive tape, minimum 3-inches wide and manufacture's boot system for sealing pipe and conduit penetrations.

1. Products:

a. W. R. Meadows; Perminator 15 mil.
b. Stego Industries, LLC; Stego Wrap 15 mil Class A.
c. Reef Industries, Inc.; Griffolyn 15 mil Green.
d. Or equal.

B. Fine-Graded Granular Material: Clean manufactured or natural sand; ASTM C 33 for fine aggregates.

2.10 FLOOR AND SLAB TREATMENTS

A. Slip-Resistive Emery Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive, crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials with 100 percent passing [**3/8-inch**] [**No. 4**] [**No. 8**] <**Insert size or gradation**> sieve.

1. Products:

a. Anti-Hydro International, Inc.; Emery.
b. Dayton Superior Corporation; Emery Non-Slip.
c. Emeri-Crete, Inc.; Emeri-Topcrete.
d. Lambert Corporation; EMAG-20.
e. L&M Construction Chemicals, Inc.; Grip It.
f. Metalcrete Industries; Metco Anti-Skid Aggregate.
g. Or equal.

B. Slip-Resistive Aluminum Granule Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of not less than 95 percent fused aluminum-oxide granules.

1. Products:

a. Anti-Hydro International, Inc.; A-H Alox.
b. L&M Construction Chemicals, Inc.; Grip It AO.
c. Sonneborn, Div. of ChemRex; Frictex NS.
d. Or equal.

C. Emery Dry-Shake Floor Hardener: [**Pigmented**] [**Unpigmented**], factory-packaged, dry combination of portland cement, graded emery aggregate, and plasticizing admixture; with emery aggregate consisting of no less than 60 percent of total aggregate content.

1. Color: As selected by University's Representative from manufacturer's full range.

D. Metallic Dry-Shake Floor Hardener: [**Pigmented**] [**Unpigmented**], factory-packaged, dry combination of portland cement, graded metallic aggregate, rust inhibitors, and plasticizing admixture; with metallic aggregate consisting of no less than 65 percent of total aggregate content.

1. Color: As selected by University's Representative from manufacturer's full range.

E. Unpigmented Mineral Dry-Shake Floor Hardener: Factory-packaged dry combination of portland cement, graded quartz aggregate, and plasticizing admixture.

1. Products:

a. Burke by Edoco; NonMetallic Floor Hardener.
b. ChemMasters; Concolor.
c. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; Conshake 500.
d. Dayton Superior Corporation; Quartz Tuff.
e. Euclid Chemical Company (The); Surflex.
f. L&M Construction Chemicals, Inc.; Quartzplate FF.
g. MBT Protection and Repair, Div. of ChemRex; Maximent.
h. Scofield, L. M. Company; Lithochrome Color Hardener.
i. Symons Corporation, a Dayton Superior Company; Hard Top.
j. Or equal.

F. Pigmented Mineral Dry-Shake Floor Hardener: Factory-packaged, dry combination of portland cement, graded quartz aggregate, color pigments, and plasticizing admixture. Use color pigments that are finely ground, nonfading mineral oxides interground with cement.

1. Products:

a. Burke by Edoco; NonMetallic Floor Hardener-Color.
b. ChemMasters; Concolor.
c. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; Conshake 600 Colortone.
d. Dayton Superior Corporation; Quartz Tuff.
e. Euclid Chemical Company (The); Surflex.
f. L&M Construction Chemicals, Inc.; Quartz Plate FF.
g. MBT Protection and Repair, Div. of ChemRex; Mastercron.
h. Scofield, L. M. Company; Lithochrome Color Hardener.
i. Symons Corporation, a Dayton Superior Company; Color Hardener.
j. Or equal.

2. Color: As selected by University's Representative from manufacturer's full range.

G. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; colorless; that penetrates, hardens, and densifies concrete surfaces.

1. Products:

    a. Burke by Edoco; Titan Hard.
    b. ChemMasters; Chemisil Plus.
    c. ChemTec International; ChemTec One.
    d. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; Intraseal.
    e. Curecrete Distribution Inc.; Ashford Formula.
    f. Dayton Superior Corporation; Day-Chem Sure Hard.
    g. Euclid Chemical Company (The); Euco Diamond Hard.
    h. Meadows, W. R., Inc.; Liqui-Hard.
    i. Nox-Crete Products Group, Kinsman Corporation; Duranox.
    j. Symons Corporation, a Dayton Superior Company; Buff Hard.
    k. US Mix Products Company; US Spec Industraseal.
    l. Or equal.

2.11 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

1. Products:

    a. Axim Concrete Technologies; Cimfilm.
    b. Burke by Edoco; BurkeFilm.
    c. ChemMasters; Spray-Film.
    d. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; Aquafilm.
    e. Dayton Superior Corporation; Sure Film.
    f. Euclid Chemical Company (The); Eucobar.
    g. L&M Construction Chemicals, Inc.; E-Con.
    h. MBT Protection and Repair, Div. of ChemRex; Confilm.
    i. Meadows, W. R., Inc.; Sealtight Evapre.
    j. Nox-Crete Products Group, Kinsman Corporation; Monofilm.
    k. Sika Corporation, Inc.; SikaFilm.
    l. Symons Corporation, a Dayton Superior Company; Finishing Aid.
    m. Unitex; Pro-Film.
    n. US Mix Products Company; US Spec Monofilm ER.
    o. Or equal.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

1. Products:

    a. Anti-Hydro International, Inc.; AH Curing Compound #2 DR WB.
    b. Burke by Edoco; Aqua Resin Cure.
    c. ChemMasters; Safe-Cure Clear.
    d. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; W.B. Resin Cure.
    e. Dayton Superior Corporation; Day Chem Rez Cure (J-11-W).
    f. Euclid Chemical Company (The); Kurez DR VOX.
    g. Kaufman Products, Inc.; Thinfilm 420.
    h. Lambert Corporation; Aqua Kure-Clear.
    i. L&M Construction Chemicals, Inc.; L&M Cure R.
    j. Meadows, W. R., Inc.; 1100 Clear.
    k. Nox-Crete Products Group, Kinsman Corporation; Resin Cure E.
    l. Symons Corporation, a Dayton Superior Company; Resi-Chem Clear Cure.
    m. Tamms Industries, Inc.; Horncure WB 30.
    n. Unitex; Hydro Cure 309.
    o. US Mix Products Company; US Spec Maxcure Resin Clear.
    p. Vexcon Chemicals, Inc.; Certi-Vex Enviocure 100.
    q. Or equal.

F. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, nondissipating[**, certified by curing compound manufacturer to not interfere with bonding of floor covering**].

1. Products:

    a. Anti-Hydro International, Inc.; AH Clear Cure WB.
    b. Burke by Edoco; Spartan Cote WB II.
    c. ChemMasters; Safe-Cure & Seal 20.
    d. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; Cure and Seal WB.
    e. Dayton Superior Corporation; Safe Cure and Seal (J-18).
    f. Euclid Chemical Company (The); Aqua Cure VOX.
    g. Kaufman Products, Inc.; Cure & Seal 309 Emulsion.
    h. Lambert Corporation; Glazecote Sealer-20.
    i. L&M Construction Chemicals, Inc.; Dress & Seal WB.
    j. Meadows, W. R., Inc.; Vocomp-20.
    k. Metalcrete Industries; Metcure.
    l. Nox-Crete Products Group, Kinsman Corporation; Cure & Seal 150E.
    m. Symons Corporation, a Dayton Superior Company; Cure & Seal 18 Percent E.
    n. Tamms Industries, Inc.; Clearseal WB 150.
    o. Unitex; Hydro Seal.
    p. US Mix Products Company; US Spec Hydrasheen 15 percent
    q. Vexcon Chemicals, Inc.; Starseal 309.
    r. Or equal.

G. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, 18 to 25 percent solids, nondissipating[**, certified by curing compound manufacturer to not interfere with bonding of floor covering**].

1. Products:

a. Burke by Edoco; Spartan Cote WB II 20 Percent.
b. ChemMasters; Safe-Cure Clear.
c. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; High Seal.
d. Dayton Superior Corporation; Safe Cure and Seal (J-19).
e. Euclid Chemical Company (The); Diamond Clear VOX.
f. Kaufman Products, Inc.; SureCure Emulsion.
g. Lambert Corporation; Glazecote Sealer-20.
h. L&M Construction Chemicals, Inc.; Dress & Seal WB.
i. MBT Protection and Repair, Div. of ChemRex; MasterKure-N-Seal VOC.
j. Meadows, W. R., Inc.; Vocomp-20.
k. Metalcrete Industries; Metcure 0800.
l. Nox-Crete Products Group, Kinsman Corporation; Cure & Seal 200E.
m. Sonneborn, Div. of ChemRex; Kure-N-Seal.
n. Symons Corporation, a Dayton Superior Company; Cure & Seal 18 Percent E.
o. Tamms Industries, Inc.; Clearseal WB STD.
p. Unitex; Hydro Seal 18.
q. US Mix Products Company; US Spec Radiance UV-25
r. Vexcon Chemicals, Inc.; Starseal 0800.
s. Or equal.

H. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

1. Products:

a. Burke by Edoco; Cureseal 1315 WB.
b. ChemMasters; Polyseal WB.
c. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; Sealcure 1315 WB.
d. Euclid Chemical Company (The); Super Diamond Clear VOX.
e. Kaufman Products, Inc.; Sure Cure 25 Emulsion.
f. Lambert Corporation; UV Safe Seal.
g. L&M Construction Chemicals, Inc.; Lumiseal WB Plus.
h. Meadows, W. R., Inc.; Vocomp-30.
i. Metalcrete Industries; Metcure 30.
j. Symons Corporation, a Dayton Superior Company; Cure & Seal 31 Percent E.
k. Tamms Industries, Inc.; LusterSeal WB 300.
l. Unitex; Hydro Seal 25.
m. US Mix Products Company; US Spec Radiance UV-25.
n. Vexcon Chemicals, Inc.; Vexcon Starseal 1315.
o. Or equal.

2.12 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.

B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, [**epoxy resin with a Type A shore durometer hardness of 80**] [**aromatic polyurea with a Type A shore durometer hardness range of 90 to 95**] per ASTM D 2240.

C. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:

1. Types I and II, when non-load bearing and IV and V, when load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

E. Reglets: Fabricate reglets of not less than 0.0217-inch-thick, galvanized steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

F. Dovetail Anchor Slots: Hot-dip galvanized steel sheet, not less than 0.0336 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.13 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than [**4100 psi**] <**Insert strength**> at 28 days when tested according to ASTM C 109/C 109M.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.

4. Compressive Strength: Not less than [**5000 psi**] <**Insert strength**> at 28 days when tested according to ASTM C 109/C 109M.

2.14 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Fly Ash: 25 percent.
2. Combined Fly Ash and Pozzolan: 25 percent.
3. Ground Granulated Blast-Furnace Slag: 50 percent.
4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
5. Silica Fume: 10 percent.
6. Combined Fly Ash, Pozzolans, and Silica Fume: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
7. Combined Fly Ash or Pozzolans, Ground Granulated Blast-Furnace Slag, and Silica Fume: 50 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.

C. Limit water-soluble, chloride-ion content in hardened concrete to [**0.06**] [**0.15**] [**0.30**] [**1.00**] percent by weight of cement.

D. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

E. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.15 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi at 28 days.
2. Minimum Cementitious Materials Content: 520 lb/cu. yd.
3. Slump Limit: [**4 inches**] [**5 inches**], plus or minus 1 inch.

4. Air Content: [**5-1/2**] <**Insert number**> percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.
5. Air Content: [**6**] <**Insert number**> percent, plus or minus 1.5 percent at point of delivery for [**1-inch**] [**3/4-inch**] nominal maximum aggregate size.
6. Air Content: Do not allow air content of troweled finished floors to exceed 3 percent.
7. Maximum Water-Cementitious Materials Ratio: 0.50.
8. Steel-Fiber Reinforcement: Add to concrete mixture, according to manufacturer's written instructions, at a rate of [**50 lb/cu. yd.**] <**Insert weight**>.
9. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than [**1.0 lb/cu. yd.**] [**1.5 lb/cu. yd.**] <**Insert dosage**>.

2.16 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.17 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M [**and ASTM C 1116**], and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd.
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.01 FORMWORK

A. Forms shall be used for all concrete, except for sides of footings where neat excavations are possible.

B. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

C. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

D. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:

1. Class A, 1/8 inch for smooth-formed finished surfaces.
2. Class B, 1/4 inch for rough-formed finished surfaces.

E. Construct forms tight enough to prevent loss of concrete mortar.

F. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install keyways, reglets, recesses, and the like, for easy removal.
2. Do not use rust-stained steel form-facing material.
3. Form panels shall be erected with long axis perpendicular to length of framing.
4. Form facings shall butt together.
5. Voids in joints shall be filled with sealant and tooled smooth with surface.

G. Side forms of beams and girders shall be formed so that removal will not disturb bottom forms or shoring.

H. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

I. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

J. Chamfer or radius exterior corners and edges of permanently exposed concrete.

K. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

L. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

M. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment. The formwork assembly shall be torqued to a specific pressure and tightened accordingly and sequentially during the concrete pour.

N. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

O. Form Ties

1. Formwork tie plugs shall be minimum ¼" thick lead plugs ½" from the face, at exposed conditions. At non-exposed conditions the plug holes shall be grouted with non-shrink grout to a flush condition.

2. At fire rated conditions, the total tie shall be carefully removed from the concrete. The tie void shall be filled with non-shrink grout and the lead plug placed at exposed conditions.
3. The plastic form tie system shall have a ± ¼" compressible gasket at the end where the tie is connected to the formwork.
4. Locate form ties the will be exposed in a symmetrical pattern, lined up both vertical and horizontally unless another design pattern is desired. Form ties shall typically be placed at least 4-inches from the edge of the panels.

3.02 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
3. Install dovetail anchor slots in concrete structures as indicated.

3.03 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete, if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces.

D. Wood forms used for exposed concrete shall only be reused when permitted by the University's Representative and provided the material is maintained to prevent voids.

3.04 SHORES AND RESHORES

A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.

1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.

C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.05 VAPOR RETARDERS

A. Plastic Vapor Retarders: Provide at slab on grade areas within a building enclosure. Place, protect, and repair vapor retarders according to ASTM E 1643 and manufacturer's written instructions.

1. Lap joints 6 inches and seal with manufacturer's recommended tape.
2. Seal every penetrating utility, column, and perimeter wall system providing a continuous barrier to moisture penetration or permutation.
3. Provide a minimum of 3-inches of sand below vapor retarder and 2-inches above.

3.06 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

1. Weld reinforcing bars according to AWS D1.4, where indicated.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

F. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M. Use epoxy-coated steel wire ties to fasten epoxy-coated steel reinforcement.

G. Zinc-Coated Reinforcement: Repair cut and damaged zinc coatings with zinc repair material according to ASTM A 780. Use galvanized steel wire ties to fasten zinc-coated steel reinforcement.

H. Samples of reinforcing steel shall be taken at the place of distribution, and shall be taken from bundles as delivered from the mill. Samples shall include no fewer than 2 pieces each, 18 inches long of each size and kind of reinforcing steel used.

3.07 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by University's Representative.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
2. Form keyed joints shall not be used in walls and floors and between walls and slabs or footings.
3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
5. Space vertical joints in walls [**as indicated**] not to exc. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks. Joints shall be saw cut when the concrete is hard enough to have no tracks or damage, no more than 12 hours after concrete is placed.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.

2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Division 7 Section "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.08 WATERSTOPS

A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.

B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.

3.09 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by University's Representative.

C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

D. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.

2. Maintain reinforcement in position on chairs during concrete placement.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.
5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not disturb slab surfaces before starting finishing operations.

E. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use calcium chloride, salt, or other materials containing chemical accelerators unless approved in mixture designs.

F. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.10 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete such as waterproofing.

C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete scheduled for painting:

1. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When

grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.

D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless allowed otherwise by the University's Representative.

3.11 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in 1 direction.

1. Apply scratch finish to surfaces to receive mortar setting beds for bonded cementitious floor finishes.

C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
2. Finish surfaces to the following tolerances, according to ASTM E 1155, for a randomly trafficked floor surface:

    a. Specified overall values of flatness, F(F) 20; and of levelness, F(L) 15; with minimum local values of flatness, F(F) 15; and of levelness, F(L) 12.
    b. Specified overall values of flatness, F(F) 25; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 20; and of levelness, F(L) 15.
    c. Specified overall values of flatness, F(F) 35; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 2.
    d. Specified overall values of flatness, F(F) 30; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 25; and of levelness, F(L) 15.

3. Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-foot-long straightedge resting on 2 high spots and placed anywhere on the surface does not exceed 1/8 inch.

E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.

1. Comply with flatness and levelness tolerances for trowel finished floor surfaces.

F. Broom Finish: Normally not used, coordinate use with University's Representative before application.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.

G. Slip-Resistive Finish: Before final floating, apply slip-resistive [**aggregate**] [**aluminum granule**] finish to concrete stair treads, platforms, and ramps. Apply according to manufacturer's written instructions and as follows:

1. Uniformly spread [**25 lb/100 sq. ft.**] <**Insert rate**> of dampened slip-resistive [**aggregate**] [**aluminum granules**] over surface in 1 or 2 applications. Tamp aggregate flush with surface, but do not force below surface.
2. After broadcasting and tamping, apply float finish.
3. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive [**aggregate**] [**aluminum granules**].

H. Dry-Shake Floor Hardener Finish: After initial floating, apply dry-shake floor hardener to surfaces according to manufacturer's written instructions and as follows:

1. Uniformly apply dry-shake floor hardener at a rate of [**100 lb/100 sq. ft.**] <**Insert rate**> unless greater amount is recommended by manufacturer.
2. Uniformly distribute approximately two-thirds of dry-shake floor hardener over surface by hand or with mechanical spreader, and embed by power floating. Follow power floating with a second dry-shake floor hardener application, uniformly distributing remainder of material, and embed by power floating.
3. After final floating, apply a trowel finish. Cure concrete with curing compound recommended by dry-shake floor hardener manufacturer and apply immediately after final finishing.

3.12 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Embedded Items: Embedded items in slabs shall be hand-finished within 24 inches around the item so that the embedded item is flush with the slab surface without a noticeable rise or drop in elevation.

C. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

D. Equipment Bases and Foundations: Provide machine and equipment bases and foundations. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

E. Steel Pan Stairs where used: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories. Screed, tamp, and trowel-finish concrete surfaces.

3.13 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing. Protect concrete surfaces from traffic and vandalism until sufficiently cured.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

    a. Water.
    b. Continuous water-fog spray.
    c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

    a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.

b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project..

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

   a. After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.14 LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.

1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
2. Do not apply to concrete that is less than [**three**] [**seven**] [**14**] [**28**] days' old.
3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.

B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

3.15 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least [**one**] [**six**] month(s). Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.16 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by University's Representative. Remove and replace concrete that cannot be repaired and patched to University Representative's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension in solid concrete, but not less than 1 inch in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at mockup or inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by University's Representative.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to University Representative's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to University Representative's approval.

3.17 FIELD QUALITY CONTROL

A. Testing and Inspecting: University will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Inspections may include although not limited to the following:

1. Steel reinforcement placement.
2. Steel reinforcement welding.
3. Headed bolts and studs.
4. Verification of use of required design mixture.
5. Concrete placement, including conveying and depositing.
6. Curing procedures and maintenance of curing temperature.
7. Verification of concrete strength before removal of shores and forms from beams and slabs.

C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain at least one composite sample for each 150 cu. yd. or fraction thereof of each concrete mixture placed each day.

    a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.

3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; [**ASTM C 173/C 173M, volumetric method, for structural lightweight concrete;**]one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
5. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
6. Compression Test Specimens: ASTM C 31/C 31M.

    a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
    b. Cast and field cure [**two**] <**Insert number**> sets of two standard cylinder specimens for each composite sample.

7. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.

    a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
    b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

8. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
9. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
10. Test results shall be reported in writing to University's Representative, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
11. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by University's Representative but will not be used as sole basis for approval or rejection of concrete.
12. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by University's Representative. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by University's Representative.

13. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
14. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

D. Measure floor and slab flatness and levelness according to ASTM E 1155 within 24 hours of finishing. Report results within 72 hours to the University's Representative.

1. To establish the installation's compliance with the specified floor tolerances, floor tolerance compliance tests shall be performed by a testing agency employed by the contractor, and defective areas identified.
2. For suspended cast-in-place slabs, test for acceptance shall be conducted before forms and shoring have been removed, so that the effects of deflection and shrinkage on the tolerance data can be minimized.
3. As a practical matter, measurements for suspended slab construction should usually be made within a few hours of slab placement, before the slab begins to be used for staging materials.
4. Remedial measures shall be required:

    a. If the composite value of the entire floor installation measures less than either of the specified overall F numbers, or
    b. If any individual section measures less than either of the specified Minimum Local F_F/F_L numbers.

5. Sectional boundaries are typically set at the column and half column lines on suspended slabs or at the construction joints for slabs on ground. They shall not be farther apart than one-half bay.

END OF SECTION

SECTION 05 1200

STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes the following:

1. Structural steel.
2. Grout.

1.02 DEFINITIONS

A. Structural Steel: Elements of structural-steel frame, as classified by AISC's "Code of Standard Practice for Steel Buildings and Bridges," that support design loads.

1.03 PERFORMANCE REQUIREMENTS

A. Connections: Provide details of[**simple shear**] connections required by the Contract Documents to be selected or completed by structural-steel fabricator to withstand [**ASD-service**] [**LRFD**] loads indicated and comply with other information and restrictions indicated.

1. Select and complete connections using [**schematic details indicated**] [**and**] [**AISC's "Manual of Steel Construction, Load and Resistance Factor Design," Volume 2, Part 9**] [**AISC's "Manual of Steel Construction, Allowable Stress Design," Part 4**] <**Insert source**>.
2. Engineering Responsibility: Fabricator's responsibilities include using a qualified professional engineer to prepare structural analysis data for structural-steel connections.

B. Construction: Type [**PR, partially**] [**FR, fully**] restrained.

C. Construction: Type [**1, rigid frame**] [**2, simple framing**] [**3, semirigid framing**].

1.04 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.

5. For structural-steel connections indicated to comply with design loads, include structural analysis data signed and sealed by the qualified California licensed professional engineer responsible for their preparation.
6. Do not proceed with fabrication of steel until University's Representative reviews shop drawings. University review of shop drawings will be for general concept and design and character of details, not for accuracy of dimensions. A maximum submission of 60 structural steel shop drawings will be reviewed in any 15-working day period. Larger submittals will require additional review time.
7. Direct copies of the Contract Documents will not be accepted as a submission.

C. Welding certificates.

D. Qualification Data: For [**Installer**] [**fabricator**] [**professional engineer**] [**testing agency**].

E. Mill Test Reports: Signed by manufacturers certifying that the following products comply with requirements:

1. Structural steel including chemical and physical properties.
2. Bolts, nuts, and washers including mechanical properties and chemical analysis.
3. Direct-tension indicators.
4. Tension-control, high-strength bolt-nut-washer assemblies.
5. Shear stud connectors.
6. Shop primers.
7. Nonshrink grout.
8. **<Insert product.>**

F. Source quality-control test reports.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category [**CASE**] [**CSE**].

B. Fabricator Qualifications: A qualified fabricator who participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category [**Cbd**] [**Sbd**].

C. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement [**P1**] [**P2**] [**P3**] or SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."

D. Welding: Qualify procedures and personnel according to:

1. AWS D1.1, "Structural Welding Code--Steel."
2. CCR Titles 8 and 24.

E. Comply with applicable provisions of the following specifications and documents:

1. AISC's "Code of Standard Practice for Steel Buildings and Bridges."
2. AISC's "Seismic Provisions for Structural Steel Buildings" and "Supplement No. 2."

3. AISC's "[**Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design**] [**Load and Resistance Factor Design Specification for Structural Steel Buildings**]."
4. AISC's "Specification for the Design of Steel Hollow Structural Sections."
5. AISC's "[**Specification for Allowable Stress Design of Single-Angle Members**] [**Specification for Load and Resistance Factor Design of Single-Angle Members**]."
6. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

F. Mockups: Build mockups of architecturally exposed structural steel to set quality standards for fabrication and installation.

1. Coordinate finish painting requirements with Division 09 painting Sections.
2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

G. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from erosion and deterioration.

1. Store fasteners in a protected place. Clean and relubricate bolts and nuts that become dry or rusty before use.
2. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.07 COORDINATION

A. Furnish anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 2 - PRODUCTS

2.01 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: [**ASTM A 992/A 992M**] [**ASTM A 572/A 572M, Grade 50**] .

B. Channels, Angles[**, M**] [**, S**]-Shapes: [**ASTM A 36/A 36M**] [**ASTM A 572/A 572M, Grade 50**] [**ASTM A 529/A 529M, Grade 50**] [**ASTM A 913/A 913M, Grade 50**].

C. Plate and Bar: [**ASTM A 36/A 36M**] [**ASTM A 572/A 572M, Grade 50**] [**ASTM A 529/A 529M, Grade 50**].

D. Corrosion-Resisting Structural Steel: ASTM A 588/A 588M, Grade 50.

E. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade [**B**] [**C**], structural tubing.

F. Corrosion-Resisting Cold-Formed Hollow Structural Sections: ASTM A 847, structural tubing.

G. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.

1. Weight Class: [**Standard**] [**Extra strong**] [**Double-extra strong**].
2. Finish: [**Black**] [**Galvanized**] [**Black, except where indicated to be galvanized**].

H. Medium-Strength Steel Castings: ASTM A 27/A 27M, Grade 65-35, carbon steel.

I. High-Strength Steel Castings: ASTM A 148/A 148M,Grade 80-50, carbon or alloy steel.

J. Welding Electrodes: Comply with AWS requirements.

2.02 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy hex steel structural bolts; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.

1. Finish: [**Hot-dip zinc coating, ASTM A 153/A 153M, Class C**] [**Mechanically deposited zinc coating, ASTM B 695, Class 50**].
2. Direct-Tension Indicators: ASTM F 959, Type 325 compressible-washer type.

a. Finish: [**Mechanically deposited zinc coating, ASTM B 695, Class 50**] [**Mechanically deposited zinc coating, ASTM B 695, Class 50, baked epoxy coated**].

B. High-Strength Bolts, Nuts, and Washers: ASTM A 490, Type 1, heavy hex steel structural bolts[**or tension-control, bolt-nut-washer assemblies with splined ends**]; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers, plain.

1. Direct-Tension Indicators: ASTM F 959, Type 490, compressible-washer type, plain.

C. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, [**heavy hex**] [**round**] head steel structural bolts with splined ends; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.

1. Finish: Mechanically deposited zinc coating, ASTM B 695, Class 50.

D. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B.

E. Unheaded Anchor Rods: [**ASTM F 1554, Grade 36**] [**ASTM F 1554, Grade 55, weldable**] [**ASTM A 354**] [**ASTM A 449**] [**ASTM A 572/A 572M, Grade 50**] [**ASTM A 36/A 36M**] [**ASTM A 307, Grade A**].

1. Configuration: [**Straight**] [**Hooked**].
2. Nuts: ASTM A 563 [**heavy**]hex carbon steel.

3. Plate Washers: ASTM A 36/A 36M carbon steel.
4. Washers: ASTM F 436 hardened carbon steel.
5. Finish: [**Plain**] [**Hot-dip zinc coating, ASTM A 153/A 153M, Class C**] [**Mechanically deposited zinc coating, ASTM B 695, Class 50**].

F. Headed Anchor Rods: [**ASTM F 1554, Grade 36**] [**ASTM F 1554, Grade 55, weldable**] [**ASTM A 354**] [**ASTM A 449**] [**ASTM A 307, Grade A**], straight.

1. Nuts: ASTM A 563 [**heavy**]hex carbon steel.
2. Plate Washers: ASTM A 36/A 36M carbon steel.
3. Washers: ASTM F 436 hardened carbon steel.
4. Finish: [**Plain**] [**Hot-dip zinc coating, ASTM A 153/A 153M, Class C**] [**Mechanically deposited zinc coating, ASTM B 695, Class 50**].

G. Threaded Rods: [**ASTM A 193/A 193M**] [**ASTM A 354**] [**ASTM A 449**] [**A 572/A 572M, Grade 50**] [**ASTM A 36/A 36M**] [**ASTM A 307, Grade A**].

1. Nuts: ASTM A 563 [**heavy**]hex carbon steel.
2. Washers: [**ASTM F 436 hardened**] [**ASTM A 36/A 36M**] carbon steel.
3. Finish: [**Plain**] [**Hot-dip zinc coating, ASTM A 153/A 153M, Class C**] [**Mechanically deposited zinc coating, ASTM B 695, Class 50**].

H. [**Clevises**] [**Turnbuckles**]: ASTM A 108, Grade 1035, cold-finished carbon steel.

I. Eye Bolts and Nuts: ASTM A 108, Grade 1030, cold-finished carbon steel.

J. Sleeve Nuts: ASTM A 108, Grade 1018, cold-finished carbon steel.

2.03 PRIMER

A. Primer: SSPC-Paint 25, Type [**I**] [**II**], iron oxide, zinc oxide, raw linseed oil, and alkyd.

B. Primer: SSPC-Paint 25 BCS, Type [**I**] [**II**], iron oxide, zinc oxide, raw linseed oil, and alkyd.

C. Primer: SSPC-Paint 23, latex primer.

D. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer.

E. Galvanizing Repair Paint: [**MPI#18, MPI#19, or SSPC-Paint 20**] [**ASTM A 780**].

2.04 GROUT

A. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404, Size No. 2. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

B. Metallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time.

C. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.05 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC's "[**Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design**] [**Load and Resistance Factor Design Specification for Structural Steel Buildings**]."

1. Camber structural-steel members where indicated.
2. Identify high-strength structural steel according to ASTM A 6/ A 6M and maintain markings until structural steel has been erected.
3. Mark and match-mark materials for field assembly.
4. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
5. Provide for attachment of work to structural steel.

B. Thermal Cutting: Thermal cutting is subject to approval from University's Representative. Perform thermal cutting, when so approved, by machine to greatest extent possible.

1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.

C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to [**SSPC-SP 1, "Solvent Cleaning**] [**SSPC-SP 2, "Hand Tool Cleaning**] [**SSPC-SP 3, "Power Tool Cleaning**]."

F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.

G. Steel Wall-Opening Framing: Select true and straight members for fabricating steel wall-opening framing to be attached to structural steel. Straighten as required to provide uniform, square, and true members in completed wall framing.

H. Welded Door Frames: Build up welded door frames attached to structural steel. Weld exposed joints continuously and grind smooth. Plug-weld fixed steel bar stops to frames. Secure removable stops to frames with countersunk, cross-recessed head machine screws, uniformly spaced not more than 10 inches o.c., unless otherwise indicated.

I. Holes: Provide holes required for securing other work to structural steel and for passage of other work through steel framing members.

1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
2. Base-Plate Holes: Cut, drill, or punch holes perpendicular to steel surfaces.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.06 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: [**Snug tightened**] [**Pretensioned**] [**Slip critical**].

B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.

1. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
2. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.
3. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances.[**Prevent weld show-through on exposed steel surfaces.**]

    a. Grind butt welds flush.
    b. Grind or fill exposed fillet welds to smooth profile. Dress exposed welds.

2.07 SHOP PRIMING

A. Shop prime steel surfaces except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
2. Surfaces to be field welded.
3. Surfaces to be high-strength bolted with slip-critical connections.
4. Surfaces to receive sprayed fire-resistive materials.
5. Galvanized surfaces.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:

1. SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a dry film thickness of not less than 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
2. Apply two coats of shop paint to inaccessible surfaces after assembly or erection. Change color of second coat to distinguish it from first.

D. Painting: Apply a 1-coat, nonasphaltic primer complying with SSPC-PS Guide 7.00, "Painting System Guide 7.00: Guide for Selecting One-Coat Shop Painting Systems," to provide a dry film thickness of not less than 1.5 mils.

2.08 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/ A 123M.

1. Fill vent holes and grind smooth after galvanizing.
2. Galvanize [**lintels**] [**shelf angles**] attached to structural-steel frame and located in exterior walls.

2.09 SOURCE QUALITY CONTROL

A. University will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.

1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

C. Bolted Connections: Shop-bolted connections will be[**tested and**] inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Welded Connections: In addition to visual inspection, shop-welded connections will be tested and inspected according to AWS D1.1 and the following inspection procedures, at testing agency's option:

1. Liquid Penetrant Inspection: ASTM E 165.
2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
3. Ultrasonic Inspection: ASTM E 164.
4. Radiographic Inspection: ASTM E 94.

E. In addition to visual inspection, shop-welded shear connectors will be tested and inspected according to requirements in AWS D1.1 for stud welding and as follows:

1. Bend tests will be performed if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
2. Tests will be conducted on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments, with steel erector present, for compliance with requirements.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place, unless otherwise indicated.

1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.03 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "[**Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design**] [**Load and Resistance Factor Design Specification for Structural Steel Buildings**]."

B. Base[**and Bearing**] Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting base[**and bearing**] plates. Clean bottom surface of base[**and bearing**] plates.

1. Set base[**and bearing**] plates for structural members on wedges, shims, or setting nuts as required.
2. Weld plate washers to top of base plate.
3. [**Snug-tighten**] [**Pretension**] anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of base[**or bearing**] plate before packing with grout.
4. Promptly pack grout solidly between bearing surfaces and base[**or bearing**] plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure.[**Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.**]

C. Maintain erection tolerances of structural steel[**and architecturally exposed structural steel**] within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

D. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.

2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

E. Splice members only where indicated.

F. Remove erection bolts on welded, architecturally exposed structural steel; fill holes with plug welds; and grind smooth at exposed surfaces.

G. Do not use thermal cutting during erection[**unless approved by University's Representative. Finish thermally cut sections within smoothness limits in AWS D1.1**].

H. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

I. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.

3.04 FIELD CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: [**Snug tightened**] [**Pretensioned**] [**Slip critical**].
2. Orient bolt heads in same direction on architecturally exposed structural steel.

B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.

1. Comply with AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "[**Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design**] [**Load and Resistance Factor Design Specification for Structural Steel Buildings**]" for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.
2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.
4. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances.[**Prevent weld show-through on exposed steel surfaces.**]

    a. Grind butt welds flush.
    b. Grind or fill exposed fillet welds to smooth profile. Dress exposed welds.

3.05 FIELD QUALITY CONTROL

A. Testing Agency: University may engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections if applicable.

B. Bolted Connections: Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Welded Connections: Field welds will be visually inspected according to AWS D1.1.

1. In addition to visual inspection, field welds will be tested according to AWS D1.1 and the following inspection procedures, at testing agency's option:

a. Liquid Penetrant Inspection: ASTM E 165.
b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
c. Ultrasonic Inspection: ASTM E 164.
d. Radiographic Inspection: ASTM E 94.

D. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1 for stud welding and as follows:

1. Perform bend tests if visual inspections reveal either a less-than- continuous 360-degree flash or welding repairs to any shear connector.
2. Conduct tests on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1.

E. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

3.06 REPAIRS AND PROTECTION

A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists and accessories[**, bearing plates,**] and abutting structural steel.

1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.

C. Touchup Painting: Cleaning and touchup painting are specified in Division 09 Section “High-Performance Coatings”.

END OF SECTION

SECTION 23 0500

COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Transition fittings.
3. Dielectric fittings.
4. Mechanical demolition.
5. Equipment installation requirements common to equipment sections.
6. Painting and finishing.
7. Concrete bases.
8. Supports and anchorages.

1.02 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.

2. NBR: Acrylonitrile-butadiene rubber.

1.03 SUBMITTALS

A. Product Data: For the following if proposed to be used on this project:

1. Transition fittings.

2. Dielectric fittings.

B. Welding certificates: Certificates shall be applicable for materials to be joined at the job-site.

1.04 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel" and ASME Section VIII.

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."

2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

D. Groove-less clamps, cut groove pipe and fittings, reducing couplings, mechanical tees or saddle fittings are prohibited.

E. Structural Seismic Performance: Refer to Division 23 Section “Vibration and Seismic Controls for HVAC.”

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

1.06 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for mechanical items requiring access that are concealed behind finished surfaces. Coordinate to avoid access panels at hard lid ceiling if possible. Access panel shall be located in accessible area for maintenance convenience and safety and limit disturbance to the public.

D. Coordinate with other sections of the specifications for the applicability of materials specified in this section. Not every product or material listed may be used.

E. Coordinate requirements of this section with actual work to be performed. This section is general in scope for basic materials and methods, some of which may not actually apply to this project.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

1. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.02 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.03 JOINING MATERIALS

A. Refer to individual Division 23 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: Bolts shall be United States Customary System bolts and nuts (e.g. ¾”). Metric bolts and nuts are prohibited. Bolts and nuts shall be SAE Grade 5 hot-dip galvanized steel or stainless steel with heavy hex nuts. For underground or where used with non-ferrous flanges, provide stainless steel. .

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.04 TRANSITION FITTINGS

A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

1. Manufacturers:

a. Cascade Waterworks Mfg. Co.
b. Dresser Industries, Inc.; DMD Div.
c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
d. JCM Industries.
e. Smith-Blair, Inc.
f. Viking Johnson.
g. Or equal.

2. Aboveground Pressure Piping: Pipe fitting.

2.05 DIELECTRIC FITTINGS

A. Description: Kit of parts for isolating pipes of dissimilar metals.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Are prohibited. Provide 6" long brass nipple with brass unions, or brass union and bronze ball valve on ends of nipple.

D. Dielectric-Flange Kits: Isolating gasket kit and stainless steel bolts for a complete assembly for field installation assembly. Include full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and stainless steel backing washers.

1. Manufacturers:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Central Plastics Company.
d. Pipeline Seal and Insulator, Inc.
e. Or equal.

E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

1. Manufacturers:

a. Calpico, Inc.
b. Lochinvar Corp.
c. Or equal.

F. Dielectric Nipples: hot-dip galvanized steel nipple with inert and noncorrosive, thermoplastic lining; plain, or threaded ends, and 300-psig minimum working pressure at 225 deg F.

1. Manufacturers:

a. Perfection Corp.
b. Precision Plumbing Products, Inc.
c. Sioux Chief Manufacturing Co., Inc.
d. Or equal.

PART 3 - EXECUTION

3.01 MECHANICAL DEMOLITION

A. Refer to Division 01 Cutting and Patching for general demolition requirements and procedures.

B. Disconnect, demolish, and remove mechanical systems, equipment, and components indicated to be removed.

1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.

2. Piping to Be Abandoned in Place: Prohibited. Remove completely.
3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
4. Ducts to Be Abandoned in Place: Prohibited. Remove completely.
5. Equipment to Be Removed: Disconnect and cap services and remove equipment.
6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to University's Representative.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.02 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing and replacement.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends in straight runs.

I. Install fittings or custom bends for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Mounting hardware, including nuts, bolts and washers for outdoor applications and below grade applications must be of stainless steel materials.

M. Verify final equipment locations for roughing-in.

N. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

O. Install valves in readily accessible locations, avoiding hard-lid ceilings where possible. Provide access panels for valve access and coordinate access panel locations with other disciplines.

3.03 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Oxyacetylene torch welding and cutting of structural steel or bolt holes is prohibited.

E. Install main and branch piping using specified fittings.

F. “T-drill”, “welded nozzles”, or “Side-Tap” or similar fitting substitution style connections are prohibited.

G. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

H. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

I. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.

2. Damaged Threads: Pipe or pipe fittings with threads that are corroded or damaged are prohibited. Pipe sections that have cracked or open welds are prohibited.

J. Welded Joints: See Section 23 0511 “Welding Pressure Piping.”

K. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.04 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install shut-off valves at final connection to each piece of equipment.

2. Install unions, in piping NPS 2½ and smaller, adjacent to each valve and at final connection to each piece of equipment.
3. Install flanges, in piping NPS 3 and larger, adjacent to each valve and at final connection to each piece of equipment.
4. Wet Piping Systems: Install brass union, ball valve and minimum 6-inch long brass nipple fitting or dielectric flanges to connect piping materials of dissimilar metals.

3.05 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Grease fittings shall be installed in accessible locations. Extended lube lines are prohibited.

D. Install equipment to allow right of way for piping installed at required slope.

3.06 PAINTING

A. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.07 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to CBC.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit, vibration isolator, or seismic restraint. Provide 1 inch chamfer or half-inch radius round over at corners.

2. Install dowel rods to connect concrete base to concrete floor. Install dowel rods on 18-inch centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded. Minimum embedment shall comply with seismic engineer’s calculations.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement.

3.08 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

B. Field Welding: Comply with AWS D1.1.

3.09 SHEET METAL

A. Exposed edges shall be completely deburred and smooth or folded over (hemmed)

B. Eliminate sharp corners through rounding, folding over, trimming, or other acceptable means.

C. Sheet metal ducting shall not “oil can” or visibly deflect in service. Add additional reinforcement(s) as needed to eliminate these issues if observed.

END OF SECTION

SECTION 23 0510

VARIABLE FREQUENCY DRIVES

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes solid-state, Pulse Width Modulated (PWM) and Vector Control, VFDs for speed control of three-phase, squirrel-cage induction motors for plumbing and HVAC equipment.

1.02 DEFINITIONS

A. PWM: Pulse-width modulated.

B. VFD: Variable frequency drive (may be referred to as “VSD” or “variable speed drive”, in other sections).

1.03 SUBMITTALS

A. Product Data: For each type of VFD, provide dimensions; mounting arrangements; location for conduit entries; shipping and operating weights; and manufacturer's technical data on features, performance, electrical ratings, characteristics, installation instructions and finishes.

B. Shop Drawings: For each VFD.

1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:

    a. Each installed unit's type and details.
    b. Nameplate legends.
    c. Short-circuit current ratings of integrated unit.
    d. VFD UL listing for series rating of over-current protective devices in combination controllers.

2. Wiring Diagrams: Power, signal, and control wiring for VFD. Provide schematic wiring diagram for each type of VFD.

C. Coordination Drawings: Floor plans showing dimensioned layout, required working clearances, and required area above and around VFDs where pipe and ducts are prohibited. Show VFD layout and relationships between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.

D. Qualification Data: For testing agency and manufacturer.

E. Manufacturer's field service report.

F. Operation and Maintenance Data: For VFDs, installed devices, and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01, include the following:

1. Routine maintenance requirements for VFDs and installed components.
2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Maintain, within 100 miles of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.

B. Source Limitations: Obtain VFDs of a single type through one source from a single manufacturer for every VFD required for the project.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC, Article 100, by a testing agency acceptable to University's Representative, and marked for intended use.

D. Design: VFDs shall meet requirements of IEC 801-2, IEC 801-4, IEC 255-4 and shall be shall be UL listed.

E. Product Selection for Restricted Space: Coordinate maximum dimensions for VFDs, minimum clearances between VFDs, and adjacent surfaces and other items. Comply with manufacturer's recommended clearances.

F. Comply with CEC.

G. VFDs and by-pass, if applicable, shall be manufactured and tested in the United States of America.

H. VFD Manufacturer shall perform the following:

1. Control power test.
2. No Load test.
3. Partial Load test, at 10 Hz.
4. Full Load test (full amperage).
5. Voltage detection testing.
6. Calibration test.

I. Structural Seismic Performance: Refer to Division 23 Section "Vibration and Seismic Controls for HVAC."

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store VFDs indoors in clean, dry space with uniform temperature to prevent condensation. Protect VFDs from exposure to dirt, fumes, water, corrosive substances, and physical damage.

B. If stored in areas subject to weather, cover VFDs to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable

materials from inside controllers; install electric heating of sufficient wattage to prevent condensation.

1.06 COORDINATION

A. Coordinate layout and installation of VFDs with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate features of VFDs, installed units, and accessory devices with pilot devices and control circuits to which they connect.

C. Coordinate features, accessories, and functions of each VFD and each installed unit with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.

D. Coordinate with rooftop custom air handling unit manufacturer to provide an electrical compartment that the NEMA 12 enclosed drive can be installed within in lieu of separate NEMA 3R enclosure.

E. Coordinate with Division 26 on location of VFDs and disconnect switch. Coordinate flexible electrical connections, and travel requirements, on spring/rubber isolated equipment such as fans, pumps, and other equipment. Avoid unnecessary duplication of a disconnect switch since lockable integral disconnect with fuses shall be provided with VFDs. Separate non-fused lockable disconnect is only required if VFD is not in line of sight of motor.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

1. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.02 VARIABLE FREQUENCY CONTROLLERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ABB Power Distribution, Inc.; ABB Control, Inc. Subsidiary.
2. Or equal.

B. Description: NEMA ICS 2, FWR, IGBT, PWM, PW rating of 1600 volts, VFD; listed and labeled as a complete unit and arranged to provide variable frequency of a NEMA MG 1, Design B, 3-phase, premium -efficiency induction motor by adjusting output voltage and frequency. Drives 60 HP and larger shall use direct torque control technology.

C. Configuration

1. For parts interchangeability purposes, VFDs shall have the same customer interface and control logic board, including digital display, keypad and control connections; regardless of horsepower rating. VFDs from 2 HP to 400 HP shall have the same operator interface and keypad. The keypad is to be used for local control (start/stop, hand, off, auto, forward/reverse, and speed adjust), for setting parameters, and for stepping through the displays and menus.
2. The VFD shall give the user the option of either (1) displaying a fault, or (2) running at a programmable preset speed if the input reference (4-20mA or 2-10V) is lost; as selected by the user.
3. The VFD's shall utilize digital display in English. The digital display shall be a 30-character (2 line x 16 characters/line,) LCD display. The screen shall be backlit to provide easy viewing in any light condition. The contrast should be adjustable to optimize viewing at any angle.
4. The Drive shall have local-remote for speed control and manual-auto for start-up. When in "Local", the VFD will be started, and the speed will be controlled from the speed up or speed down keypads. When in "Off", the VFD will be stopped. When in "Auto", the VFD will start via an external contact closure, and its speed will be controlled via an external speed reference.
5. The VFD shall be capable of starting into a rotating load (forward or reverse) and accelerate or decelerate to set point without safety tripping or component damage (flying start). Coast to stop before restart is not required.
6. VFD's to have the following adjustments:

    a. Three (3) programmable critical frequency lockout ranges to prevent the VFD from continuously operating at an unstable speed.
    b. PID Set point controller shall be standard in the drive, allowing a pressure or flow signal to be connected to the VFD, using the microprocessor in the VFD for the closed loop control; thus eliminating the need for external controllers.
    c. Two (2) programmable analog inputs shall accept a current or voltage signal for speed reference and actual signals for PID controller. Analog inputs shall include a filter, programmable from 0.01 to 10 seconds to remove any oscillation in the input signal. The minimum and maximum values (gain and offset) shall be adjustable within the range of 0-20 mA and 0-10 volts.
    d. Two independently adjustable acceleration and deceleration ramps. These ramp times shall be adjustable from 1 to 1800 seconds.

D. Design and Rating: Match load type such as fans, blowers, compressors and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.

E. Output Rating: 3-phase; 0 to 120 Hz, with voltage proportional to frequency throughout voltage range.

F. Unit Operating Requirements:

1. Input ac tolerance of 200V +/-10% at 48-63 Hz for nominal 208V systems, and 460V +/- 10% at 48-63 Hz for nominal 480 V systems.
2. Capable of driving full load, under the following conditions, without derating:

    a. Ambient Temperature: 0 to 40 deg C.

b. Humidity: Less than 95 percent (non-condensing).

3. Minimum Efficiency: 98 percent at 60 Hz, full load.
4. Minimum Displacement Primary-Side Power Factor: 98 percent.
5. Overload Capability: 1.1 times the base load current for 60 seconds; 2.0 times the base load current for 3 seconds.
6. Starting Torque: 150 percent of rated torque.
7. Speed Regulation: Plus or minus 1 percent.
8. Isolated control interface to allow controller to follow control signal over an 11:1 speed range.

G. Self-Protection and Reliability Features:

1. The drive shall employ two current limit circuits to provide trip free operation:

   a. The Rapid Current Regulation limit shall be adjustable from 50% to 180% of the VFDs variable torque current rating. If the motor current exceeds the current limit setting, the drive shall stop, and decrease the output frequency until the motor current is reduced below the current limit level, at which time the output frequency shall accelerate (at the rate set by the acceleration time) to the set frequency. The rapid current regulation shall allow up to 200% current to be drawn for a short period of time before the current is reduced to the slow current regulation limit.
   b. The Slow Current Regulation limit circuit shall be adjustable from 50% to 350% of the VFDs variable torque current rating. This current regulation operates similarly to the rapid current regulation, except at a slower rate. This adjustment shall be made via the keypad, and shall be displayed in actual amps, and not as percent of full load.

2. The overload rating of the drive shall be 110% of its variable torque current rating for 1 minute every 10 minutes, and 115% of its variable torque current rating for 2 seconds every 10 seconds.

   a. The VFD shall have a 100,000 Amp short circuit rating protection without the need of semi-conductor fuses.
   b. The Customer terminal strip shall be isolated from the line and ground.

3. The drive shall have the inherent capability of protecting the motor connected to it, by stopping the motor when the motor temperature reaches the warning level of 95% of the nominal value, and displaying “MOTOR TEMP” fault in plain English. The Drive shall calculate the motor temperature based on the Motor Load Curve. The Motor Load Curve shall be defined by zero speed zero load and break point parameters. 100% of the Motor Load Curve shall be based on the Full Load Amperage inputted in the drive at startup time. The load curve should be based on 104 degrees F ambient temperature and cooling time during rest to be four times the cooling time of when the motor is running. The Motor Load Curve shall be adjustable. The Motor Theorem time shall also be adjustable from 20 to 10000 seconds, to prevent undesirable trips. Motor thermal protection shall be accomplished without the need for external temperature sensors.

4. The VFD shall have the following protection circuits. In the case of a protective trip, the drive shall stop, and announce the fault condition in complete words.

    a. Over current trip limit: 3.5 x In instantaneous of the VFD's variable torque rating
    b. Over voltage trip limit: 1.35 x Vr (rated voltage)
    c. Under voltage trip limit: .65 x Vn
    d. Over temperature (heat sink): + 203 degrees F
    e. Auxiliary voltage: ground fault protected
    f. Ground Fault: Protected
    g. Short circuit: Protected
    h. Microprocessor fault: Protected
    i. Motor stall protection: Protected
    j. Motor over-temperature protection (I2t): Protected
    k. Loss of reference: Protected
    l. Input power loss of phase: Protected

5. Input transient protection by means of surge suppressors.
6. Snubber networks to protect against malfunction due to system voltage transients.
7. Under- and overvoltage trips; inverter overtemperature, overload, and overcurrent trips.
8. Motor Overload Relay: Adjustable and capable of NEMA 250, Class 20 performance.
9. Notch filter to prevent operation of the controller-motor-load combination at a natural frequency of the combination.
10. Instantaneous line-to-line and line-to-ground overcurrent trips.
11. Loss-of-phase protection.
12. Reverse-phase protection.
13. Short-circuit protection.
14. Motor overtemperature fault.

H. Multiple-Motor Capability: Controller suitable for service to multiple motors and having a separate overload relay and protection for each controlled motor. Overload relay shall shut off controller and motors served by it when overload relay is tripped.

I. Automatic Reset and Restart: To attempt restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Bidirectional autospeed search shall be capable of starting into rotating loads spinning in either direction and returning motor to set speed in proper direction, without damage to controller, motor, or load. (The number of restart attempts and trail duration period shall be programmable.)

J. Torque Boost: Automatically vary starting and continuous torque to at least 1.5 times the minimum torque to insure high-starting torque and increased torque at slow speeds.

K. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled fan-ventilated motors at slow speeds.

L. VFD Compliance to IEEE 519: Compliance will be determined after the drive manufacturer completes a full harmonic analysis. Electrical drawings must be made available to

manufacturer for review. If additional filters or reactors are required manufacturer shall comply.

M. VFD Output Filtering: VFD Output filtering shall be considered for long VFD to motor line lengths (over 100 feet). Consideration for filtering shall be given during IEEE 519 analysis. If required, manufacturer shall comply.

N. Panel-Mounted Operator Station: Start-stop and speed control are functions of system key pad.

O. Indicating Devices: VFD keypad and display shall indicate the following controller parameters:

1. Output frequency (Hz).
2. Motor speed (rpm).
3. Motor status (running, stop, fault).
4. Motor current (amperes).
5. Motor torque (percent).
6. Fault or alarming status (code).
7. PID feedback signal (percent).
8. DC-link voltage (VDC).
9. Set-point frequency (Hz).
10. Motor output voltage (V).

P. Control Signal Interface: Provide VFD with the following:

1. Electric Input Signal Interface: A minimum of 2 analog inputs (0 to 10 V or 0/4-20 mA) and 6 programmable digital inputs.
2. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the BMS or other control systems:

    a. 0 to 10-V dc.
    b. 0-20 or 4-20 mA.
    c. Potentiometer using up/down digital inputs.
    d. Fixed frequencies using digital inputs.
    e. RS485.
    f. Keypad display for local hand operation.

3. Analog Input Filter:

    a. Analog inputs shall have a programmable filter to remove any oscillation of the reference signal. The filter shall be adjustable from .01 to 10 seconds. The analog input should be able to be inverted, so that minimum reference corresponds to maximum speed, and maximum reference corresponds to minimum speed. The minimum and maximum values (gain and offset) shall be adjustable within the range of 0-20 mA and –10 volts. The active analog input shall have loss of reference protection, if selected.

4. Output Signal Interface:

a. A minimum of 1 analog output signal (0/4-20 mA), which can be programmed to any of the following:

1) Output frequency (Hz).
2) Output current (load).
3) DC-link voltage (VDC).
4) Motor torque (percent).
5) Motor speed (rpm).
6) Set-point frequency (Hz).

5. Remote Indication Interface: A minimum of 2 dry circuit relay outputs (120-V ac, 1 A) for remote indication of the following:

a. Motor running.
b. Set-point speed reached.
c. Fault and warning indication (overtemperature or overcurrent).
d. PID high or low speed limits reached.

Q. VFD Serial Communications with Siemens or Johnson Controls systems:

1. The VFD shall have an RS-485 port as standard.
2. To communicate with Siemens FLN and Johnson Metasys DDC control systems, the variable frequency drive must, as a minimum, be able to accomplish functions of: run-stop control, speed set adjustment, proportional/integral gain adjustments, RPM feedback, kilowatt-hour feedback, drive and motor temperature feedback, and warning/fault diagnostics across the serial port. Serial communication shall be accomplished through an EE-Prom integral to the VFD. Communication gateways or hard wiring for each individual point shall not be required. The VFD manufacturer's serial communication protocol, software and product must be officially approved and endorsed by the DDC control company, and a letter from the DDC control manufacturer shall be furnished upon request.

R. Manual Bypass: Arrange magnetic contactor to safely transfer motor between controller output and bypass controller circuit when motor is at zero speed. Controller-off-bypass selector switch sets mode, and indicator lights give indication of mode selected. Unit shall be capable of stable operation (starting, stopping, and running), with motor completely disconnected from controller (no load).

S. Isolating Switch: Non-load-break switch arranged to isolate VFD and permit safe troubleshooting and testing, both energized and de-energized, while motor is operating in bypass mode.

T. Bypass Controller: NEMA ICS 2, full-voltage, nonreversing enclosed controller with across-the-line starting capability in manual-bypass mode. Provide motor overload protection under both modes of operation with control logic that allows common start-stop capability in either mode.

U. Bypass Requirement: Manual bypass, isolation switch, and controller shall only be provided if the drive does not have redundant or standby fans or pumps. Non-critical equipment (e.g. heating water pump serving non-critical areas) do not need a bypass.

V. Integral Disconnecting Means: NEMA KS 1, fusible switch with lockable handle.

2.03 ENCLOSURES

A. Indoor units: VFD enclosure shall be NEMA 12 with NEMA 12 keypad.

B. Outdoor units: Install NEMA 12 VFD with NEMA 12 keypad within a NEMA 3R ventilated enclosure. Outdoor weatherproof enclosure shall have the keypad mounted on the face of the door and covered with a hinged sunshield. NEMA 3R enclosure shall be stainless steel construction with hinged door and clasp.

C. Air handling units can be constructed with a weatherproof electrical compartment for VFD installation. Provide ventilation using manually controllable air handling unit air.

2.04 ACCESSORIES

A. If IEEE 519 analysis indicates requirement Manufacturer shall comply: Provide a 3% impedance input Line Reactor for lower harmonic distortion on the power line and improved displacement power factor. The line reactor shall be integral to the drive and the drive performance shall be based on the drive including the integral line reactor as a standard feature. The line reactor shall be 1-1/2% on each of the positive and negative legs on the input side of the DC Bus Link.

B. Devices shall be factory installed in controller enclosure.

C. Historical Logging Information and Displays:

1. Total run time.
2. Fault log, maintaining last four faults.

D. Current-Sensing, Phase-Failure Relays for Bypass Controller: Solid-state sensing circuit with isolated output contacts for hard-wired connection; arranged to operate on phase failure, phase reversal, current unbalance of from 30 to 40 percent, or loss of supply voltage; with adjustable response delay.

2.05 PROHIBITED FEATURES

A. The following design and/or construction features are prohibited. Drives submitted with these features will be rejected:

1. Drive efficiencies of less than 97% at full rating.
2. Phase Control Rectifiers (Thyristors) or other such devices causing line notching.
3. VV1, six-step, and current source drives.
4. Drives requiring external fusing.
5. Function and/or fault indications that are in code or require reference to an operating manual or any methods not using direct reading English words.
6. SCR'S GTO'S and Darlington transistors.

2.06 FACTORY FINISHES

A. Manufacturer's standard finish suitable for area of installation. Field painting of units is prohibited.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas, surfaces, and substrates to receive VFDs for compliance with requirements, installation tolerances, and other conditions affecting performance.

B. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFD installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 APPLICATIONS

A. Select features of each VFD to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; and duty cycle of motor, drive, and load.

B. Select rating of controllers to suit motor controlled.

3.03 INSTALLATION

A. Install VFD mounting to walls or metal channel racks in accordance with manufacturer's installation instructions.

B. Comply with mounting and anchoring requirements specified in Division 23 Section "Vibration and Seismic Controls for HVAC Systems."

C. Controller Fuses: Install fuses in each fusible switch.

3.04 IDENTIFICATION

A. Identify VFDs, components, and control wiring according to Division 23 Section "Identification for HVAC".

B. Operating Instructions: Frame printed operating instructions for VFDs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of VFD units.

3.05 CONTROL WIRING INSTALLATION

A. Install wiring between VFDs and remote devices according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

B. Bundle, train, and support wiring in enclosures.

C. Connect hand-off-automatic switch and other automatic-control devices where available.

1. Connect selector switches with control circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.06 CONNECTIONS

A. Conduit installation requirements are specified in other Division 26 Sections. Drawings indicate general arrangement of conduit, fittings, and specialties.

B. Ground equipment.

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

3.07 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each VFD element, bus component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

B. Testing: Perform the following field quality-control testing:

1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Sections 7.5, 7.6, and 7.16. Certify compliance with test parameters.
2. VFD Failure analysis: VFD manufacturer shall have an analysis laboratory to evaluate the failure of any component. The failure analysis lab shall allow the manufacturer to perform complete electrical testing, x-ray of components, and decap or delaminate of components and analyze failures within the components.
3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

C. VFD Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, and perform testing and adjusting of VFDs.

D. Test Reports: Prepare a written report to record the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

3.08 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements in Division 26 Sections.

C. Complete installation and startup checks according to manufacturer's written instructions.

3.09 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges.

3.10 CLEANING

A. Clean VFDs internally, on completion of installation, according to manufacturer's written instructions. Vacuum dirt and debris; Using compressed air to assist in cleaning is prohibited.

3.11 DEMONSTRATION

A. Engage a factory-authorized service representative to train University's maintenance personnel to adjust, operate, and maintain VFDs. Refer to Division 01.

END OF SECTION

SECTION 23 0511

WELDING PRESSURE PIPING

PART 1 - GENERAL

1.01 SUMMARY

A. Section applies to welding of steel piping provided under Division 23 except for high temperature water piping on campus.

B. Related Sections:

1. Section 23 2400 "High Temperature Water Systems" for welding ASME B31.1 piping systems.

1.02 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only:

1. ANSI Z49.1 - Safety in Welding and Cutting.
2. ASME-01 - Boiler and Pressure Vessel Code; Section I, Power Boilers.
3. ASME-04 - Boiler and Pressure Vessel Code; Section II, Material Specifications, Part C - Specifications for Welding Rods, Electrodes and Filler Metals.
4. ASME-14 - Boiler and Pressure Vessel Code; Section V, Nondestructive Examination.
5. ASME-17 - Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications.
6. ASME B31.3 - Process Piping.
7. ASME B31.9 - Building Services Piping
8. ASNT-01 - Recommended Practice SNT-TC-1A.
9. ASNT-02 - Question and Answer Book A (Supplement to Recommended Practice SNT-TC-1A).
10. ASNT-03 - Question and Answer Book B: Magnetic Particle Method; Levels I, II, III (Supplement to Recommended Practice SNT-TC-1A).
11. ASNT-04 - Question and Answer Book C: Ultrasonic Testing Method; Levels I, II, III (Supplement to Recommended Practice SNT-TC-1A.
12. ASNT-05 - Question and Answer Book D: Liquid Penetrant Testing Method; Levels I, II, III (Supplement to Recommended Practice (SNT-TC-1A).
13. AWS A2.4 – Symbols for Welding, Brazing and Nondestructive Examination

1.03 SUBMITTALS

A. Certificates: Welding Certificates applicable to the material being joined.

B. Pressure Piping: Detail drawings showing location, length, and type of welds; and indicating postweld heat treatment and NDE as required.

C. Qualifications: Welder and welding operator performance qualification certificates. Welding inspectors and NDE personnel certificates. Qualifications of testing laboratory or the Contractor's quality assurance organization.

D. Welding Operations: Detailed procedures that define methods of compliance to contract drawings and specifications. Inspection and material procurement records. System and material testing and certification records. Written records and drawings indicating location of welds made by each welder or welding operator.

1.04 DEFINITIONS

A. Definitions shall be in accordance with AWS A3.0.

1.05 GENERAL REQUIREMENTS

A. Section covers the welding of pressure piping systems. Procedures shall be developed for welding metals included in the work. Welding shall not be started until welding procedures, welders, and welding operators have been qualified. An approved testing laboratory shall perform qualification testing. Maintain current records of the test results obtained in the welding procedure, welding operator, welder performance qualifications, and nondestructive examination (NDE) procedures readily available at the site for examination. The procedures for making transition welds between different materials or between plates or pipes of different wall thicknesses shall be qualified. ASME B31.9 requirements for branch connections may be used in lieu of detailed designs. Unless otherwise specified, the choice of welding process shall be the responsibility of the Contractor.

1.06 PERFORMANCE

A. Provide quality joint preparation, welding, and examination. Materials used in the welding operations shall be clearly identified and recorded. The inspection and testing defined in this specification are minimum requirements. Additional inspection and testing shall be the responsibility of the Contractor when he deems it necessary to achieve the quality required.

1.07 QUALIFICATIONS

A. Certification

1. Each welder shall have passed a qualification test within the past 12 months. The test shall be in accordance with the ASME Boiler and Pressure Vessel Code, Section IX, “Welding Qualifications,” ASME Section VIII.
2. The test report shall certify that the welder is qualified to weld the material to be used at the job site.
3. Submit copies of each welder’s qualification test report for approval prior to commencing the work. No welder shall be used on the project until so certified.

B. Welding Procedures Qualification: Record in detail and qualify the Welding Procedure Specifications for every welding procedure proposed. Qualification for each welding procedure shall conform to the requirements of ASME B31.9 and to this specification. The welding procedures shall specify end preparation for butt welds including cleaning,

alignment, and root openings. Preheat, interpass temperature control, and postheat treatment of welds shall be as required or specified. The type of backing rings or consumable inserts, if used, shall be described and if they are to be removed. Welding procedures shall be identified individually and shall be referenced on the detail drawings.

C. Welder and Welding Operator Performance: Each welder and welding operator assigned to work shall be qualified in accordance with ASME B31.9.

D. Identification: Each welder or welding operator shall be assigned an identifying number, letters or symbol that shall be used to identify their welds.

E. Inspector Certification: Welding inspectors shall be qualified in accordance with AWS QC1.

F. NDE Personnel: NDE personnel shall be certified, and a written procedure for the control and administration of NDE personnel training, examination and certification shall be established. The procedures shall be based on appropriate specific and general guidelines of training and experience recommended by ASNT-01.

1.08 DELIVERY, STORAGE AND HANDLING

A. Filler metals, electrodes, fluxes, and other welding materials shall be delivered to the site in manufacturers' original packages and stored in a dry space until used.

B. Material Control: Materials shall be stored in a controlled access and clean, dry area that is weathertight and is maintained at a temperature recommended by the manufacturer. The materials shall not be in contact with the floor and shall be stored on wooden pallets or cribbing.

1.09 SYMBOLS

A. Symbols shall be in accordance with AWS A2.4.

1.10 SAFETY

A. Safety precautions shall conform to ANSI Z49.1.

PART 2 - PRODUCTS

2.01 WELDING MATERIALS

A. Welding materials shall comply with ASME-04. Welding equipment, electrodes, welding wire, and fluxes shall be capable of producing satisfactory welds when used by a qualified welder or welding operator using qualified welding procedures.

PART 3 - EXECUTION

3.01 WELDING

A. Do not deviate from applicable codes, approved procedures and approved shop drawings. Materials or components with welds made off the site will not be accepted if the welding does not conform to the requirements of this specification unless otherwise specified.

Assign each welder or welding operator an identifying number, letter, or symbol that shall be used to identify his welds. Each welder or welding operator shall apply his mark adjacent to his weld using an approved rubber stamp or felt-tipped marker with permanent, weatherproof ink or other approved methods that do not deform the metal. For seam welds, place identification marks adjacent to the welds at 3 foot intervals. Confine identification by die stamps or electric etchers to the weld reinforcing crown, preferably in the finished crater.

3.02 WELDING OPERATORS

A. Perform welding in accordance with qualified procedures using qualified welders and welding operators.

3.03 WELDING PROCEDURES

A. Welding procedure:

1. Electric metallic arc process shall be used for welding. End preparations shall conform to ANSI and ASTM Standards. Welding shall be per ASME standards. Cutting by oxyacetylene torch shall be in accordance with ASME B31.9.
2. Use only one welder for each joint.
3. Branch pipe shall be welded to mains with thread-o-let, weld-o-let, sock-o-let or other manufactured fittings.
4. Weld slip-on flanges on both front and backsides.
5. Thermometer and test wells shall be threaded and installed with thread-o-let fittings.

3.04 SUPPORTS

A. Welding of hangers, supports, and plates to structural members shall conform to AWS D1.1.

3.05 EXAMINATIONS, INSPECTIONS AND TESTS

A. Visual and nondestructive examinations shall be included in the contract to detect surface and internal discontinuities in completed welds. Employ the services of a qualified commercial inspection or testing laboratory or technical consultant approved by the University. Visually examine welds. Liquid penetrant, Magnetic particle, or Ultrasonic examination shall be required as indicated or in accordance with other sections where detailed requirements are specified. When examination and testing indicates defects in a weld joint, a qualified welder shall repair the weld in accordance with the paragraph entitled "Corrections and Repairs" of this section.

B. Visually examine welds as follows:

1. Before welding -- for compliance with requirements for joint preparation, placement of backing rings or consumable inserts, alignment and fit-up, and cleanliness.
2. During welding -- for conformance to the qualified welding procedure.
3. After welding -- for cracks, contour and finish, bead reinforcement, undercutting, overlap, and size of fillet welds.

C. NDE shall be in accordance with written procedures. Procedures for radiographic tests and methods shall conform to ASME BPVC SEC V. The approved procedure shall be demonstrated to the satisfaction of the University's Representative. In addition to the information required in ASME BPVC SEC V, the written procedures shall include:

1. Timing of the nondestructive examination in relation to the welding operations.
2. Safety precautions.

D. Tests by the University

1. University may elect to perform tests that may include destructive tests. When destructive tests are made, qualified welders or welding operators shall make repairs using welding procedures which will develop the full strength of the members cut. Welding shall be subject to examination and tests in the mill, shop, and field. Destructive tests shall be limited to five percent of total welds on project. If any test finds a defective weld additional tests may be required.

3.06 ACCEPTANCE STANDARDS

A. Visual: The following indications are unacceptable:

1. Surface of welds shall be sufficiently free from coarse ripples, grooves, overlaps, abrupt ridges, and valleys.
2. Cracks
3. Undercut on surface that is greater than 1/32-inch deep.
4. Weld reinforcement greater than 5/32 inch.
5. Lack of fusion on surface.
6. Incomplete penetration (applies only when inside surface is readily accessible).
7. Convexity of fillet weld surface greater than 10 percent of longest leg plus 0.03 inch.
8. Concavity in groove welds.
9. Concavity in fillet welds greater than 1/16 inch.
10. Fillet weld size less than indicated or greater than 1-1/4 times the minimum indicated fillet leg length.

B. Magnetic Particle Examination: The following relevant indications are unacceptable:

1. Any cracks and linear indications.
2. Rounded indications with dimensions greater than 3/16 inch.
3. Four or more rounded indications in a line separated by 1/16 inch or less edge-to-edge.
4. Ten or more rounded indications in any 6 square inches of surface with the major dimension of this area not to exceed 6y inches with the area taken in the most unfavorable location relative to the indications being evaluated.

C. Liquid Penetrant Examination: Indications whose major dimensions are greater than 1/16 inch shall be considered relevant. The following relevant indications are unacceptable:

1. Any cracks or linear indications.

2. Rounded indications with dimensions greater than 3/16 inch.
3. Four or more rounded indications in a line separated by 1/16 inch or less edge-to-edge.
4. Ten or more rounded indications in any 6 square inches of surface with the major dimension of this area not to exceed 6 inches with the area taken in the most unfavorable location relative to the indications being evaluated.

D. Ultrasonic Examination: Linear-type discontinuities are unacceptable if the amplitude exceeds the reference level and discontinuities have lengths which exceed the following:

1. 1/4 inch for t up to 3/4 inch.
2. 1/3 inch for t from 3/4 to 2-1/4 inch.
3. 3/4 inch for t over 2-1/4 inch.
4. Where t is the thickness of the weld being examined; if the weld joints two members having different thicknesses at the weld, t is the thinner of these two thicknesses. Where discontinuities are interpreted to be cracks, lack of fusion, and incomplete penetration, they are unacceptable regardless of length.

E. The University reserves the right to perform any in-process inspection to ensure that the welds meet the requirements of ASME B31.9.

3.07 CORRECTIONS AND REPAIRS

A. Defects shall be removed and repaired as specified in ASME B31.9 unless otherwise specified. Disqualifying defects discovered between weld passes shall be repaired before additional weld material is deposited. Wherever a defect is removed, and repair by welding is not required, the affected area shall be blended into the surrounding surface, eliminating sharp notches, crevices or corners. After defect removal is complete and before rewelding, the area shall be examined by the same test method which first revealed the defect to ensure that the defect has been eliminated. After rewelding, the repaired area shall be reexamined by the same test method originally used for that area. Any indication of a defect shall be regarded as a defect unless reevaluation by NDE or by surface conditioning shows that no disqualifying defects are present. The use of any foreign material to mask, fill in, seal, or disguise welding defects will not be permitted.

END OF SECTION

SECTION 23 0513

MOTORS FOR HVAC

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on AC power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.02 QUALITY ASSURANCE

A. Bearings: Bearing loads and bearing life shall be determined using AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings, and AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

B. Comply with NEMA MG 1 unless otherwise indicated.

C. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

D. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

E. Motor Efficiency: Motors one horsepower and larger shall exceed current NEMA Premium Efficiency standards.

F. Structural Seismic Performance: Refer to Division 23 Section "Vibration and Seismic Controls for HVAC."

1.03 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
    a. Motors operating on nominal 208-volt systems shall be selected for operation at 200-volts.
    b. Motors labeled for 208-230/460 volts are prohibited on 208-volt systems.
    c. Motors less than ½ HP shall be 120 volt, 1 phase. Motors ½ HP and larger shall be 3 phase.
4. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.
5. Ambient and environmental conditions of installation location.

6. Matched to the VFD inverter mode and by-pass “across-the-line starting” mode.
7. Matched to the driven equipment by coordination, review, and approval by the manufacturer. Motor applications shall be reviewed and analyzed by the manufacturer for proper bearing selections:

    a. Verify proper size and type bearings are selected to match the particular motor application ensuring that specified motor bearing life is met.

1.04 SUBMITTALS

A. Product Data: For each motor, provide operating weights; and manufacturer's technical data on specified features, performance, electrical ratings, and characteristics. Motor performance; percent efficiency, power factor, torque, RPM, power (W) and current vs. percent of rated power output (Horsepower) curves.

B. Operation and maintenance manual for the motor and installed devices.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified:

1. U.S. Motors.
2. General Electric.
3. Siemens Motors.
4. Baldor - Reliance.
5. Westinghouse.
6. Or equal.

B. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.02 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.03 POLYPHASE MOTORS ONE-HALF AND THREE-FOURTH HORSEPOWER

A. Efficiency: Meeting or exceeding DOE 10 CFR Part 431, Energy Conservation Standards for Small Electric Motors.

B. Bearings: Sealed.

C. Service Factor: 1.25.

D. Use: Minimize use of motors in this size range by combining loads.

2.04 POLYPHASE MOTORS ONE HORSEPOWER AND LARGER

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: NEMA Premium (applicable to various motor speed selections).

C. Comply with IEEE 841, with 1.15 minimum service factor (applicable to all motors).

D. Enclosure: Totally enclosed fan-cooled (TEFC), cast-iron (may use steel mounting base on 140-T frame series). IEC Protection: IP-44.

E. VFD Compatibility: "Inverter Ready" per NEMA Standard MG1, Part 31.4.4.2.

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
2. Insulation: Class F or H insulation, with Class B temperature rise, non-hygroscopic.
3. Shaft Grounding Kit to reduce current flow through bearings, which has damaged many motors on campus.

F. Variable torque Ratio: 10:1 minimum.

G. Rotor Balance Requirement: 0.08 Inches per second maximum vibration.

H. Bearings: Shielded antifriction bearings suitable for application specific radial and thrust loading.

1. The manufacturer's analysis, and selection, shall ensure bearings will have an L_{10} life of not less than 130,000 hours for direct-drive and not less than 40,000 hours for belt-drive.
2. Bearing styles and types matching special loading requirements. Over-sized bearings as required.
3. Ensure motor bearings conform to requirements for Variable Frequency Drive applications.

I. Mounting Feet: Cast-iron precision machined flatness for accurate motor base mounting alignment per NEMA MG1.

1. Foot-to-foot flatness from mounting hole to mounting hole shall not exceed 0.005 inches.

J. Conduit Boxes: Shall be over-sized NEMA, gasketed, repositionable box for field conduit routing adjustment, with grounding connection.

K. Lifting Lugs: For frame sizes 215 and above, permanent lifting provisions, such as eye bolts, shall be provided.

L. Service Factor: 1.15.

2.05 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Outdoor Applications: For outdoor applications provide "rain-proof" motors with options listed below Outdoor motor features listed below offer better environmental enclosure protection, and are in "addition to the required features" of protected indoor motors:

1. IEC Ingress Protection Rating: IP-54.
2. Epoxy paint on enclosure and rotor.
3. Shaft slingers.
4. Stainless steel nameplate and hardware.

B. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

C. Motors Used with Variable Frequency Controllers:

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
5. Shaft Grounding Kit to reduce current flow through bearings, which has damaged many motors on campus

2.06 SHAFT GROUNDING RINGS

A. Manufacturers:

1. Electro Static Technology Inc. - Aegis SGR product line.
2. Inpro/Seal, a division of Waukesha Bearings Corporation - CDR product line.
3. Or equal.

B. Provide shaft grounding rings (SGRs) on 3-phase motors 1/2 hp or larger intended for used with variable-frequency drives (VFDs). The SGRs may be furnished by the motor manufacturer as an integral part of the motor, furnished factory-installed by the equipment manufacturer, or furnished for field installation by the equipment installer.

C. Description: Circumferential micro-fiber ring with metal frame, designed to conduct VFD induced bearing currents from the motor shaft to ground. Provides protection recommended in NEMA MG 1. Provide with mounting kit including bolts and bracket, or conductive epoxy to adhere to motor casing, to ensure ground connection from the SGR to the motor frame.

D. Provide SGRs on at least one end of the motor.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas to receive field-installed motors for compliance with requirements, installation tolerances, maintenance clearances and other conditions affecting performance.

B. Examine roughing-in of conduit systems to verify actual locations of conduit connections before motor installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 MOTOR INSTALLATION

A. Anchor each motor assembly to base, adjustable rails, or other support, arranged and sized according to manufacturer's written instructions. Attach by bolting. Level and align motor with base. Align motors, bases, shafts, pulleys and belts with driven equipment, or couplers. Tension belts according to manufacturer's written instructions.

B. Comply with mounting and anchoring requirements specified in Division 23 Section "Vibration and Seismic Controls for HVAC."

C. Connect motor leads to power source using rings and bolts or split bolts as needed. Insulation of connected motor leads shall be of the highest quality and designed to withstand the same temperature as the internal windings. Ordinary electrical tape is not generally suitable for this service and shall not be used as the only means of insulation. Wire nuts are prohibited.

D. Motor power leads shall be marked at the source and at the connection box on the motor.

3.03 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Run each motor with its controller. Demonstrate correct rotation, alignment, and speed at motor design load.
2. Test interlocks and control features for proper operation.
3. Verify that current in each phase is within nameplate rating.

B. Testing: University's Representative may engage a qualified testing agency to perform the following field quality-control testing:

1. Perform each electrical test and visual and mechanical inspections stated in NETA ATS, Section 7.15.1 and certify compliance with test parameters.

C. After the University's testing agency is finished, correct any malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and the University shall retest.

3.04 CLEANING

A. After completing equipment installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean motors, on completion of installation, according to manufacturer's written instructions.

END OF SECTION

SECTION 23 0519

THERMOMETERS AND GAUGES FOR HVAC

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes thermometers and gauges for HVAC systems and:

1. Thermowells.
2. Test plugs.

1.02 DEFINITIONS

A. CR: Chlorosulfonated polyethylene synthetic rubber.

B. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Schedule: For thermometers, pressure gauges, thermowell and test plugs indicating manufacturer's number, scale range, and location for each.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
2. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.02 DIAL THERMOMETERS

A. Manufacturers

1. Ashcroft Commercial Inc.
2. Marsh Bellofram
3. Trerice, H. O. Co.
4. Weiss Instruments, Inc.
5. Weksler Instruments Inc.
6. 3D Instruments
7. Or equal.

B. Bimetallic-Actuated

1. Description: Adjustable angle, Direct-mounting, bimetallic-actuated dial thermometers complying with ASME B40.200.
2. Case: Highly polished, hermetically sealed, stainless steel, 2½ to5-inch diameter as directed.
3. Element: Bimetal coil.
4. Dial: Satin-faced, or highly polished, non-reflective aluminum with permanently etched scale markings.
5. Pointer: Black metal.
6. Window: Double strength Glass.
7. Ring: Stainless steel.
8. Connector: Adjustable angle, NPS ½ with ASME B1.1 screw threads.
9. Stem: stainless steel, for thermo-well installation and of length to suit installation.
10. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.
11. Units: Scale shall be degrees Fahrenheit, unless otherwise indicated, suitable for the media operating temperatures.

2.03 THERMOWELLS

A. Manufacturers:

1. Ashcroft Commercial Inc.
2. Marsh Bellofram.
3. Trerice, H. O. Co.
4. Weiss Instruments, Inc.
5. 3D Instruments
6. Or equal.

B. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping.
3. Pressure Rating: Not less than piping system design pressure.
4. Material: stainless steel.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS ½, NPS ¾, or NPS 1, ASME B1.20.1 pipe threads.
7. Internal Threads: ½, ¾, and 1 inch, with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Extend one-third to two-thirds of pipe diameter into fluid. See Campus Standard Details for thermal well installations in various pipe sizes and types. .
10. Lagging Extension: Extension for Insulated Piping: 2 inches nominal and not less than thickness of insulation.
11. Bushings: are prohibited.

C. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.04 PRESSURE GAUGES

A. Manufacturers:

1. Ashcroft Commercial Inc.
2. Marsh Bellofram.
3. Trerice, H. O. Co.
4. Weiss Instruments, Inc.
5. 3D Instruments.
6. Or equal.

B. Direct-Mounting, Dial-Type Pressure Gauges: Indicating-dial type complying with ASME B40.100.

1. Case: Liquid-fillable type, 2½-4-½-inch diameter Grade-A phosphor Bronze or stainless steel.
2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
3. Pressure Connection: Brass, or stainless steel, NPS ¼, or ½, bottom-outlet type unless back-outlet type is indicated.
4. Movement: Mechanical, direct drive or with link to pressure element and connection to pointer.
5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
6. Pointer: Black metal.
7. Window: Glass.
8. Ring: Stainless steel.
9. Accuracy: Grade A, plus or minus 1 percent of middle half scale.
10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure.
11. Range for Fluids under Pressure: Two times operating pressure.
12. Scale: Scale shall be psig, inches mercury vacuum, combination of those two depending on the application.
13. Units: Psi only. Dual unit gauges (e.g. kPa and psi) are prohibited.

C. Pressure-Gauge Fittings:

1. Valves: NPS ¼ or ½ bronze or stainless-steel threaded ball type or forged steel globe valve as specified in Hydronic Piping and Valves or High Temperature Piping Systems.
2. Syphons: NPS ¼ or ½ coil of brass tubing or stainless steel with threaded ends.
3. Snubbers: ASME B40.100, NPS ¼ or ½.

2.05 TEST PLUGS

A. Manufacturers:

1. Peterson Equipment Co., Inc.
2. Sisco Manufacturing Co.
3. IMI Hydronic Engineering (Flow Design), Inc.
4. Or equal.

B. Description: Corrosion-resistant brass or stainless-steel body with minimum two core inserts and gasketed and threaded cap with cap retainer, with extended stem beyond insulation for units to be installed in insulated piping.

C. Thread Size: NPS ½, ASME B1.20.1 pipe thread.

D. Minimum Pressure and Temperature Rating: 500 psig at 200°F.

E. Core Inserts: Two chlorosulfonated (CR) polyethylene synthetic and EPDM (Nordel) self-sealing rubber, valves gasketed orifice, suitable for inserting a 1/8" OD probe assembly.

1. Insert material for air, water (except for water heated by high temperature water), oil, or gas service at 20 to 200 °F shall be CR.
2. Insert material for air or high temperature water heated hot water service at 30 to plus 275 °F shall be EPDM.
3. If test plug requires probes longer than 1-inch, provide to the University three probes of the required length for the installed test plug.

PART 3 - EXECUTION

3.01 THERMOMETER APPLICATIONS

A. Install bimetallic-actuated dial thermometers in the following locations:

1. Inlet and outlet of each hydronic zone.
2. Inlet and outlet of each hydronic steam generator.
3. Inlet and outlet of each hydronic coil in air-handling units and built-up central systems.
4. Inlet and outlet of each hydronic heat exchanger.

B. Subject to listed standard ranges from the approved manufacturer, provide the following temperature ranges for thermometers:

1. Heating Hot Water: 30 to 240 °F, with 2-degree scale divisions.
2. Condenser Water: 0 to 160 °F, with 2-degree scale divisions.
3. Chilled Water: 0 to 100 °F, with 2-degree scale divisions.
4. Steam and Condensate: 50 to 500 °F, with 5-degree scale divisions.

3.02 GAUGE APPLICATIONS

A. Install dry-case-type pressure gauges for inlet and discharge of each pressure-reducing valve.

B. Install dry-case-type pressure gauges at chilled- and condenser-water inlets and outlets of chillers.

C. Install liquid-filled-case-type pressure gauges at suction and discharge of each pump.

D. Subject to listed standard ranges from the approved manufacturer, provide the following pressure ranges for the gauges:

1. Heating Hot Water Piping: 0 to 200 psi.
2. Condenser Water Piping: 0 to 100 psi.
3. Chilled Water Piping: 0 to 200 psi.
4. Steam Piping: 0 to 200 psi.

3.03 INSTALLATIONS

A. Install direct-mounting thermometers and adjust vertical and tilted positions.

B. Install thermowells with socket extending a minimum of 2 inches into fluid or to the center of pipe and in vertical position in piping tees where thermometers are indicated. Comply with Campus Standard detail.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounting pressure gauges in piping tees with pressure gauge located on pipe at most readable position.

F. Install remote-mounting pressure gauges on panel. Provide root valve at the main piping and needle valve at the remote panel.

G. Install ball valve for each pressure gauge for fluids (except steam). Provide pressure snubber for pulsing applications. These are not common.

H. Install ½-inch forged steel globe valve and syphon fitting in piping for each pressure gauge for steam see campus standard detail. Note that connection to the main piping will be 1-inch not ½-inch.

I. Install test plugs in tees in piping.

J. Install sight flow indicators, in accessible positions for easy viewing, in piping systems.

K. Assemble and install connections, tubing, and accessories between flow-measuring elements as prescribed by manufacturer's written instructions.

L. Install permanent indicators on walls or brackets in accessible and readable positions.

M. Install connection fittings for attachment to portable indicators in accessible locations.

3.04 CONNECTIONS

A. Install meters and gauges adjacent to machines and equipment to allow service and maintenance for meters, gauges, machines, and equipment.

3.05 ADJUSTING

A. Calibrate meters according to manufacturer's written instructions, after installation.

B. Adjust faces of meters and gauges to proper angle for best visibility.

3.06 CLEANING

A. Clean windows of meters, and gauges, and factory-finished surfaces. Replace cracked and broken windows, and repair scratched and marred surfaces with manufacturer’s touch-up paint.

END OF SECTION

SECTION 23 0529

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes the following hangers and supports for mechanical system piping and equipment:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Pipe positioning systems.
7. Equipment supports.

1.02 DEFINITIONS

A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.

1.03 PERFORMANCE REQUIREMENTS

A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Design seismic-restraint hangers and supports shop drawing for piping and equipment in accordance with CBC.

D. Seismic-Restraint Loading: (to be confirmed for each building)

1. Site Class as Defined in the CBC: D.

2. Assigned Seismic Use Group or Building Category as Defined in the CBC: II.

   a. Component Importance Factor: 1.0.
   b. Component Response Modification Factor: 2.5.
   c. Component Amplification Factor: 2.5.

3. Design Spectral Response Acceleration at Short Periods (0.2 Second): 1.057 g.
4. Design Spectral Response Acceleration at 1.0-Second Period: 0.579 g.

1.04 SUBMITTALS

A. Product Data: For the following:

1. Steel pipe hangers and supports.

2. Thermal-hanger shield inserts.
3. Pipe positioning systems.

B. Shop Drawings: Signed and sealed by a qualified California registered professional engineer. Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers. Include Product Data for components.
2. Metal framing systems. Include Product Data for components.
3. Equipment supports.

C. Welding certificates.

1.05 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code--Steel."
2. AWS D1.2, "Structural Welding Code--Aluminum."
3. AWS D1.3, "Structural Welding Code--Sheet Steel."
4. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
5. ASME Boiler and Pressure Vessel Code: Section IX.

B. Seismic Engineering: Seismic bracing and support design, mounting hardware and equipment, support systems, restraint systems, anchorage systems, and installation shall conform to the CBC. Submit calculations, plans, and documents stamped by a qualified California registered engineer.

C. Structural Review: Seismic engineering submittal documents, seismic loads, anchorage and support loads, and vertical loads applied to building structures and structural components shall be reviewed, analyzed, and approved by the project structural engineer of record.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
2. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.02 STEEL PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

B. Manufacturers:

1. B-Line Systems, Inc.; a division of Cooper Industries.

2. ERICO/Michigan Hanger Co.
3. Grinnell Corp.
4. Tolco Inc.
5. Superstrut.
6. Or equal.

C. Galvanized, Metallic Coatings: Pregalvanized or hot dip galvanized.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.03 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.04 METAL FRAMING SYSTEMS

A. Description: MFMA-4, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. Manufacturers:

1. Allied Tube & Conduit.
2. Cooper B-Line, Inc.
3. Flex-Strut Inc.
4. GS Metals Corp.
5. Thomas & Betts Corporation.
6. Unistrut Corporation; Atkore International, Ltd.
7. Wesanco, Inc.
8. Or equal.

C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.05 THERMAL-HANGER SHIELD INSERTS

A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.

B. Manufacturers:

1. Carpenter & Paterson, Inc.
2. Clement Support Services.
3. ERICO International Corporation.
4. National Pipe Hanger Corporation.
5. PHS Industries, Inc.
6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
7. Piping Technology & Products, Inc.
8. Rilco Manufacturing Co., Inc.

9. Value Engineered Products, Inc.
10. Or equal

C. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100 psig minimum compressive strength and vapor barrier.

D. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass with 100 psig minimum compressive strength.

E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.06 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: are prohibited except when executed in accordance with Division 01.

B. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated, except exterior or corrosive environments shall be stainless steel, for use in hardened Portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Manufacturers:

a. B-Line Systems, Inc.; a division of Cooper Industries.
b. Hilti, Inc.
c. ITW Ramset/Red Head.
d. Simpson Strong-Tie Company.
e. Or equal.

2.07 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.08 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.01 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use padded hangers for piping that is subject to scratching.

F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
6. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
7. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
8. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.
9. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.

G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.

H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape. Provide with retaining bracket.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of wooden beams only.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.

2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

    a. Horizontal (MSS Type 54): Mounted horizontally.
    b. Vertical (MSS Type 55): Mounted vertically.
    c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

N. Use mechanical-expansion anchor attachments if concrete insert is not available in concrete construction.

3.02 HANGER AND SUPPORT INSTALLATION

A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Flexible connection located in horizontal piping shall be supported within 2 feet of each connector.

C. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

E. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

F. Fastener System Installation:

1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

G. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

I. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

J. Install lateral bracing with pipe hangers and supports to prevent swaying.

K. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

L. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.

N. Insulated Piping: Comply with the following:

1. Attach clamps and spacers to piping.

a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.

c. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
b. NPS 4: 12 inches long and 0.06 inch thick.
c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

5. Pipes NPS 8 and Larger: Include wood inserts.
6. Insert Material: Length at least as long as protective shield.
7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

O. Hangers shall not be in direct contact with the pipe.

3.03 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.04 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.05 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.06 PAINTING

A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 23 0553

IDENTIFICATION FOR HVAC

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes the following mechanical identification materials and their installation:

1. Equipment nameplates.
2. Equipment markers.
3. Equipment signs.
4. Access panel and door markers.
5. Pipe markers.
6. Duct markers.
7. Damper tags.
8. Stencils.
9. Valve tags.
10. Valve schedules/chart.
11. Warning tags.
12. Thermostats referencing terminal boxes.
13. Control devices and instruments

1.02 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Valve Numbering Scheme. Provide hard-copy and electronic spreadsheet of valve schedule covering valve tags. Coordinate numbering scheme prior to submittal with any existing valve numbering in an existing building.

D. Valve Plans and Schedules: For each piping system. Furnish extra copies (in addition to mounted copies) in maintenance manuals.

E. Air-Side Equipment Schedule: Provide hard copy and electronic spreadsheet of air-side equipment schedule covering damper, terminal boxes, instrumentation, etc. Coordinate numbering scheme prior to submittal.

F. System Drawings: For each piping system for each air system (exhaust included). Furnish system one-line plan drawings indicating valves, dampers, instruments, control devices, smoke detectors, and equipment addressed in this section. Furnish electronic spread sheet for each system. Coordinate numbering scheme prior to submittal.

G. Equipment Location Plans: For each system. Furnish plans showing equipment, equipment identification numbers/tags, and description.

1.03 QUALITY ASSURANCE

A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

B. NFPA Compliance: Comply with requirements of NFPA-99 for piping and equipment labeling and identification.

1.04 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with location of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.01 MATERIALS

A. For fixture descriptions in other Part 2 articles where the subparagraph titles "Products," and "Manufacturers" introduce a list of manufacturers and their products or manufacturers only, the following requirements apply for product selection:

1. Products: Subject to compliance with requirements, provide one of the products specified in other Part 2 articles.
2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified in other Part 2 articles.
3. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.02 EQUIPMENT IDENTIFICATION DEVICES

A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.

1. Data:
    a. Manufacturer, product name, model number, and serial number.
    b. Capacity, operating and power characteristics, and essential data.
    c. Labels of tested compliances.
2. Location: Accessible and visible.
3. Fasteners: As required to mount on equipment.

B. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent epoxy adhesive or rivets.

1. Terminology: Match schedules as closely as possible.
2. Data:

a. Name and plan number.
b. Equipment service.
c. Design capacity.
d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.

3. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.

C. Equipment Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, white surface, black phenolic core, with black melamine subcore. Fabricate in sizes required for message. Provide holes for mechanical fastening.

1. Data: Instructions for operation of equipment and for safety procedures.
2. Engraving: Manufacturer's standard letter style, of sizes and with terms to match equipment identification.
3. Thickness: 1/8 inch.
4. Provide signs on equipment that is automatically started to comply with CAL-OSHA requirements.
5. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

D. Access Panel and Door Markers: 1/16-inch- thick, engraved laminated plastic, with abbreviated terms and numbers corresponding to identification. Provide 1/8-inch center hole for attachment.

1. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

2.03 PIPING IDENTIFICATION DEVICES

A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.

1. Colors: Comply with ASME A13.1, unless otherwise approved.
2. Lettering: Use piping system terms and abbreviations as approved by the University's Representative.
3. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers extending 360 degrees around pipe at each location.
4. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.
5. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.

B. Pretensioned Pipe Markers: Precoiled semirigid plastic formed to cover full circumference of pipe and to attach to pipe without adhesive.

C. Shaped Pipe Markers: Preformed semirigid plastic formed to partially cover circumference of pipe and to attach to pipe with mechanical fasteners that do not penetrate insulation vapor barrier.

D. Self-Adhesive Pipe Markers: Plastic with pressure-sensitive, permanent-type, self-adhesive back.

E. Plastic Tape: Continuously printed, vinyl tape at least 3 mils thick with pressure-sensitive, permanent-type, self-adhesive back.

1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches: 3/4 inch minimum.
2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 inches minimum.

2.04 DUCT IDENTIFICATION DEVICES

A. Duct Markers: Engraved, color-coded laminated plastic. Include direction and quantity of airflow and duct service (such as supply, return, and exhaust). Include contact-type, permanent epoxy adhesive. As an option, stencil may be used.

B. Automatic or Motorized Control Damper Tags: Same as valve tags.

2.05 STENCILS

A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches for ducts; and minimum letter height of 3/4 inch for access panel and door markers, equipment markers, equipment signs, and similar operational instructions.

1. Stencil Material: Aluminum.
2. Stencil Paint: Use for pipe marking, exterior, gloss, acrylic enamel black. Paint may be in pressurized spray-can form.
3. Identification Paint: Use for contrasting background, exterior, acrylic enamel in colors according to ASME A13.1.

2.06 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers, with numbering scheme approved by the University. Provide 5/32-inch hole for fastener.

1. Material: 0.040-inch- thick brass minimum 2” in diameter.
2. Valve-Tag Fasteners: Stainless steel chain, or S-hook.

2.07 VALVE PLANS

A. Valve Plans: For each piping system, on standard-size or 11”x17” bond paper. Provide a plan per floor showing the location, valve number, control device number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-Plan and Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve plan and schedule. Include mounting screws.
2. Frame: Extruded aluminum.
3. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

B. For added equipment update existing valve plan. Use sequential numbering beginning with last number used on previous plan. Duplicate numbers are prohibited.

2.08 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags; of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches minimum.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.
4. Color: Yellow background with black lettering.

2.09 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Brady Corporation.
2. Seton Identification Products.
3. R&R Identification Co.
4. Or equal.

PART 3 - EXECUTION

3.01 APPLICATIONS, GENERAL

A. Products specified are for applications referenced in other Division 23 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.02 EQUIPMENT IDENTIFICATION

A. Install and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible.

B. Install equipment markers with permanent adhesive on or near each major item of mechanical equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated.

1. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
2. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
3. Locate markers where accessible and visible. Include markers for the following general categories of equipment:

a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
b. Meters, gages, thermometers, and similar units.
c. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.
d. Pumps, compressors, chillers, condensers, and similar motor-driven units.
e. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
f. Fans, blowers, primary balancing dampers, and mixing boxes.
g. HVAC custom, central-station and zone-type air handling units.
h. Tanks and pressure vessels.
i. Strainers, filters, humidifiers, water-treatment systems, and similar equipment.

C. Install equipment signs with screws or permanent adhesive on or near each major item of mechanical equipment. Locate signs where accessible and visible.

1. Identify mechanical equipment with equipment markers in the following color codes:

a. Green: For cooling equipment and components.
b. Yellow: For heating equipment and components.
c. Green and Yellow: For combination cooling and heating equipment and components.
d. Brown: For energy-reclamation equipment and components.

2. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
3. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
4. Include signs for the following general categories of equipment:

a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
b. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.
c. Pumps, compressors, chillers, condensers, and similar motor-driven units.
d. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
e. Fans, blowers, primary balancing dampers, and mixing boxes.
f. Packaged HVAC central-station and zone-type units.
g. Tanks and pressure vessels.
h. Strainers, filters, humidifiers, water-treatment systems, and similar equipment.

D. Install access panel markers with screws on equipment access panels.

3.03 PIPING IDENTIFICATION

A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.

1. Pipes with OD, Including Insulation, Less Than 6 Inches: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, 1-1/2 inches wide, lapped at least 1-1/2 inches at both ends of pipe marker, and covering full circumference of pipe.
2. Pipes with OD, Including Insulation, 6 Inches and Larger: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, at least 1-1/2 inches wide, lapped at least 3 inches at both ends of pipe marker, and covering full circumference of pipe.
3. Do not use pipe markers and tapes for bare pipes conveying fluids at temperatures of 125 deg F or higher.

B. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior nonconcealed locations as follows:

1. Near each valve and control device.
2. At each branch of a tee.
3. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
4. Near penetrations through walls, floors, ceilings, and nonaccessible enclosures.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 25 feet along each run. Located on each side of wall penetrations.

C. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, on each piping system.

1. Identification Paint: Use for contrasting background.
2. Stencil Paint: Use for pipe marking.

3.04 DUCT IDENTIFICATION

A. Install duct markers with permanent adhesive or stencil on air ducts in the following color codes:

1. Blue: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
2. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

B. Stenciled Duct Label Option: Stenciled labels, showing service and flow direction, may be provided instead of plastic-laminated duct labels, at Installer's option, if lettering larger than 1 inch high is needed for proper identification because of distance from normal location of required identification.

C. Locate markers near points where ducts enter into concealed spaces and at maximum intervals of 50 feet (maximum intervals of 25 feet for exhaust ductwork) in each space where ducts are exposed or concealed by removable ceiling system.

D. Duct markers shall include air system type, and air system number.

3.05 VALVE-TAG INSTALLATION

A. Install tags on valves (every type) and control devices in piping systems, except check valves; shutoff valves within factory-fabricated equipment units. List tagged valves in a valve schedule that shall continue existing valve schedule. Install tags on valves such that they will not interfere with the valve operation and maintenance. Do not hang tags on valve hand wheels.

B. Valve-Tag Application Schedule:

1. Information:

   a. Service.
   b. Floor.
   c. Valve number.
   d. Area served.
   e. Normal position.
   f. Duty.
   g. Type (if not obvious).

2. Valve-Tag Size and Shape: 2 inches, round.

3.06 VALVE-PLAN INSTALLATION

A. Mount copy of valve plan on wall in accessible location in each major equipment room. Turn over original to University's Representative.

3.07 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

3.08 ADJUSTING

A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.09 CLEANING

A. Clean faces of mechanical identification devices and glass frames of valve schedules.

END OF SECTION

SECTION 23 0593

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes TAB to produce design objectives for the following new and existing systems affected by the Work of this project:

1. Balancing Air systems
2. Balancing Hydronic piping systems
3. Testing, Adjusting and Balancing HVAC equipment quantitative-performance settings
4. Vibration tests
5. Sound tests
6. Verifying that automatic control devices are functioning properly.
7. Reporting results of activities and procedures specified in this Section

1.02 DEFINITIONS

A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.

B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to indicated quantities.

C. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.

D. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.

E. NC: Noise criteria

F. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.

G. RC: Room criteria

H. Report Forms: Test data sheets for recording test data in logical order

I. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.

J. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.

K. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

L. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.

M. TAB: Testing, adjusting, and balancing.

N. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

O. Test: A procedure to determine quantitative performance of systems or equipment

P. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures

1.03 SUBMITTALS

A. Qualification Data: Within 20 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed or as directed by University's Representative, submit the Contract Documents review report as specified in Part 3.

C. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

D. System Readiness Checklists: Within 30 days of Contractor's Notice to Proceed, submit system readiness checklists as specified in "Preparation" Article.

E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.

F. Certified TAB reports

G. Within 30 days of Contractor's Notice to Proceed, submit instrument calibration reports for instruments proposed to be used which shall include the following:

1. Instrument type and make
2. Serial number
3. Application
4. Dates of calibration

1.04 QUALITY ASSURANCE

A. TAB Firm Qualifications: Engage a TAB firm certified by either AABC or NEBB. Submit proof of a minimum of five years of experience in work similar to that required by the Project.

B. TAB Conference: Meet with University's Representative on approval of TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives, HVAC controls installers, and other support personnel. Provide seven days' advance notice of scheduled meeting time and location.

1. Agenda Items: Include at least the following:

    a. Submittal distribution requirements
    b. The Construction Documents examination report.
    c. TAB plan
    d. Work schedule and Project-site access requirements
    e. Coordination and cooperation of trades and subcontractors
    f. Coordination of documentation and communication flow

C. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.

D. TAB Report Forms: Use standard forms from AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems." or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems." If data required by the specification is not on standard forms, modify those forms or use a non-standard form or provide supplement form to provide the specified items.

E. Instrumentation Type, Quantity, and Accuracy: As described in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems and NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."

F. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by instrument manufacturer. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.

1.05 PROJECT CONDITIONS

A. Full University Occupancy: University will occupy the site and existing building during entire TAB period. Cooperate with University during TAB operations to minimize conflicts with University's operations.

1.06 COORDINATION

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.

B. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

C. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.07 WARRANTY

A. National Project Performance Guarantee: Provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:

1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
2. Systems are balanced to optimum performance capabilities within design and installation limits.

B. Special Guarantee: Provide a guarantee on NEBB forms stating that NEBB will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee shall include the following provisions:

1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
2. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine the Construction Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

1. Construction Documents are defined in the General and Supplementary Conditions of Contract.
2. Verify provision of balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.

B. Examine approved submittal data of HVAC systems and equipment.

C. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

D. Examine equipment performance data including fan and pump curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

2. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems--Duct Design." Compare results with the design data and installed conditions.

E. Examine system and equipment installations verifying they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.

F. Examine system and equipment test reports.

G. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

H. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

I. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

J. Examine terminal units, such as variable-air-volume boxes, to verify that they are accessible and their controls are connected and functioning.

K. Examine strainers. Verify that startup screens have been replaced by permanent screens with indicated perforations.

L. Examine existing strainers for clean screens and proper perforations.

M. Examine control valves for proper installation for their intended function of throttling, diverting or mixing fluid flows.

N. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

O. Examine existing or new system pumps to ensure absence of entrained air in the suction piping.

P. Examine equipment for installation and for properly operating safety interlocks and controls.

Q. Examine automatic temperature system components to verify the following:

1. Dampers, valves, and other controlled devices are operated by the intended controller.
2. Dampers and valves are in the position indicated by the controller.
3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in mixing boxes, and variable-air-volume terminals.

4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, heat sources, and cold walls.
6. Sensors are located to sense only the intended conditions.
7. Sequence of operation for control modes.
8. Controller set points are set at indicated values.
9. Interlocked systems are operating.
10. Changeover from heating to cooling mode occurs according to indicated values.

R. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.02 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Ensure that gauges and test equipment are recently calibrated. Use pressure gauges accurate to ±0.1% of full scale. Where measuring differential pressures, a direct-reading differential gauge may be used.

C. Complete system readiness checks and prepare system readiness reports. Verify the following:

1. Permanent electrical power wiring is complete
2. Hydronic systems are filled, clean, and free of air
3. Automatic temperature-control systems are operational
4. Equipment and duct access doors are securely closed
5. Balance, smoke, and fire dampers are open
6. Fan isolation and control dampers are in correct position for the controls sequence and operate correctly and closed completely when commanded to close
7. Isolating and balancing valves are open and control valves are operational
8. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided
9. Windows and doors can be closed so indicated conditions for system operations can be met

3.03 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.

1. Measure and record the operating speed, airflow, and static pressure of each fan.
2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
3. Check the refrigerant charge.
4. Check the condition of filters.
5. Check the condition of coils.
6. Check the operation of the drain pan and condensate-drain trap.
7. Check bearings and other lubricated parts for proper lubrication.

8. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.

B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:

1. New filters are installed.
2. Coils are clean and fins combed.
3. Drain pans are clean.
4. Fans are clean.
5. Bearings and other parts are properly lubricated.
6. Deficiencies noted in the preconstruction report are corrected.

C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.

1. Compare the indicated airflow of the renovated work to the measured fan airflows, and determine the new fan speed and the face velocity of filters and coils.
2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
3. If calculations increase or decrease the airflow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
4. Balance each air outlet.

3.04 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.

B. Use factory provided or field installed test ports. Cutting, drilling or otherwise penetrating of equipment with previously installed test ports is prohibited and if test port are not used may require complete new air handling unit doors or ductwork to be installed as directed by University's Representative. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project. Provide stainless steel test ports for stainless steel ductwork and plenums. Install test ports that comply with requirements in Section 23 3300 "Air Duct Accessories."

C. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.05 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct airflow measurements.

E. Check airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and function.

K. Check for proper sealing of air-handling unit components.

L. Check for proper sealing of air duct system.

3.06 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

    a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
    b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
    c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
    d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

2. Measure fan static pressures to determine actual static pressure as follows:

    a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
    b. Measure static pressure directly at the fan outlet or through the flexible connection.

c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
4. Measure static pressures entering and leaving other devices such as sound traps, isolation and control dampers, heat recovery equipment, and air washers, under final balanced conditions.
5. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
6. Obtain approval from University's Representative before any adjustment of fan speed higher or lower than indicated speed. If a higher speed is needed, evaluate the system effects to determine and eliminate the cause of the increased resistance. System effect is a phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Increasing the fan speed shall not be the solution. If the University approves, make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.

1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.

a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Remeasure each submain and branch duct after volume dampers have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure terminal outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.07 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:

1. Open manual valves for maximum flow.
2. Check expansion tank liquid level.
3. Check makeup-water-station pressure gage for 10 psig pressure at the highest point of the hydronic system.
4. Check flow-control valves for specified sequence of operation and set at indicated flow.
5. Set system controls so automatic valves are wide open to heat exchangers.
6. Check pump-motor load. If motor is overloaded, limit maximum load with variable speed drive so motor nameplate rating is not exceeded. If drive is not present consult with University’s Representative.
7. Check air vents for a forceful liquid flow exiting from vents when manually operated.

D. Although balance of the high temperature water system is not required, ensure that the HTW control valves open fully and close tightly. Verify that the valve position corresponds to the control signal in 20% increments from fully closed to fully open (i.e. 0%, 20%, 40%, 60%, 80%, and 100%). Coordinate testing of the HTW controls with the University’s Representative.

3.08 PROCEDURES FOR HYDRONIC SYSTEMS

A. Measure pressure at pumps. Use the following procedure for centrifugal pumps:

1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve.
3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.

B. Automatic flow limiting valves are not automatic balancing valves. If the pressure differential reading across the valve is within the operating control range (e.g. 1-14 psi) than the correct flow should be provided. Include one psi to account for system aging and a safety factor. For a 1-14 psi differential control range, provide 2 psi measured across the flow limiter when the control valve is fully open. Ensure that the most remote valve has sufficient pressure.

C. For air handling units with multiple coils, manual balancing valves shall be balanced. Adjust to provide design quantities. Use calibrated fitting and pressure gages to determine flow rates. Balance with automatic control valve fully open.

3.09 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. The following procedure shall be used for a heating water system with a variable speed pump.

1. Verify that the manual shut-off valves are fully open.
2. Verify that the piping system is clear and that the strainers are clean.
3. Verify that each coil has an automatic flow limiting valve or pressure independent control valve installed and that the flow arrow is pointed in the correct direction. Each valve shall have two factory tags connected to it. One tag shall be permanently affixed to the valve body and the other shall be hung from the pressure taps so that it is visible outside the insulation. The tag shall have the name of the air handler or system served printed on it (e.g. BRENAH01, NSVAV037, HOBAH01C, etc.) Record each valve's tag information in the TAB report.
4. Override the controls to open the heating control valves to full flow. The automatic flow limiting valves will limit flow to each coil to the maximum required coil rate (gpm). Valves are accurate to within ±5% over 95% of the pressure differential control range.
5. Test is to determine the minimum differential pressure set point for the variable frequency drive (VFD). Turn the heating pump on and ramp it up to the speed needed to maintain the differential pressure 1 psi above the minimum control range at the automatic flow limiting or pressure independent valve with the highest-pressure drop requirement, normally the longest run. The differential is to be measured at the factory supplied taps on each valve. Select a gage that has a range appropriate for the system pressure. Recognize that the differentials measured are low and that a small error in actual reading can still add up to a large differential error. A direct reading differential gage may be used.
6. Check the remaining automatic limiting valves to verify that they are within their control pressure range.
7. Record the differential pressure at the differential pressure transmitter that will be used as the input for the pump speed control. Verify that the transmitter is reading the same differential and that the VFD controlling the pump is receiving the correct signal either directly or from the Building Automation System. The pressure reading shall become the VFD set point and recorded in the TAB report.

B. Record final measurements for hydronic equipment performance data sheets. Include entering and leaving water temperatures for heating and cooling coils, and for converters. Include entering and leaving dry bulb air temperatures (and wet bulb for cooling coils) for

air handling units and reheat coils. Make air and water temperature measurements at the same time.

3.10 PROCEDURES FOR HEAT-TRANSFER COILS

A. Water Coils: Measure the following data for each coil:

1. Entering- and leaving-water temperature
2. Water flow rate
3. Water pressure drop for major (more than 20 gpm) equipment coils, excluding unitary equipment such as reheat coils, unit heaters, and fan-coil units
4. Dry-bulb temperature of entering and leaving air
5. Wet-bulb temperature of entering and leaving air for cooling coils
6. Airflow
7. Air pressure drop

B. Steam Coils: Measure the following data for each coil:

1. Dry-bulb temperature of entering and leaving air
2. Airflow
3. Air pressure drop
4. Inlet steam pressure

C. Refrigerant Coils: Measure the following data for each coil:

1. Dry-bulb temperature of entering and leaving air
2. Wet-bulb temperature of entering and leaving air
3. Airflow
4. Air pressure drop
5. Refrigerant suction pressure and temperature

3.11 PROCEDURES FOR TEMPERATURE MEASUREMENTS

A. During TAB, report the need for adjustment in temperature regulation within the automatic temperature-control system.

B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of two successive eight-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.

C. Measure outside-air, wet- and dry-bulb temperatures.

3.12 PROCEDURES FOR VIBRATION MEASUREMENTS

A. Use a vibration meter meeting the following criteria:

1. Solid-state circuitry with a piezoelectric accelerometer
2. Velocity range of 0.1 to 10 inches per second
3. Displacement range of 1 to 100 mils
4. Frequency range of at least 0 to 1000 Hz
5. Capable of filtering unwanted frequencies

B. Calibrate the vibration meter before each day of testing.

1. Use a calibrator provided with the vibration meter.
2. Follow vibration meter and calibrator manufacturer's calibration procedures.

C. Perform vibration measurements when other building and outdoor vibration sources are at a minimum level and will not influence measurements of equipment being tested.

1. Turn off equipment in the building that might interfere with testing.
2. Clear the space of people.

D. Perform vibration measurements after air and water balancing and equipment testing is complete.

E. Clean equipment surfaces in contact with the vibration transducer.

F. Position the vibration transducer according to manufacturer's written instructions and to avoid interference with the operation of the equipment being tested.

G. Measure and record vibration on rotating equipment over 1 hp.

H. Measure and record equipment vibration, bearing vibration, equipment base vibration, and building structure vibration. Record velocity and displacement readings in the horizontal, vertical, and axial planes.

1. Pumps:

a. Pump Bearing: Drive end and opposite end
b. Motor Bearing: Drive end and opposite end
c. Pump Base: Top and side
d. Building: Floor
e. Piping: To and from the pump after flexible connections

2. Fans and HVAC Equipment with Fans:

a. Fan Bearing: Drive end and opposite end.
b. Motor Bearing: Drive end and opposite end.
c. Equipment Casing: Top and side
d. Equipment Base: Top and side
e. Building: Floor
f. Ductwork: To and from equipment after flexible connections
g. Piping: To and from equipment after flexible connections

3. HVAC Equipment with Compressors:

a. Compressor Bearing: Drive end and opposite end
b. Motor Bearing: Drive end and opposite end
c. Equipment Casing: Top and side
d. Equipment Base: Top and side
e. Building: Floor
f. Piping: To and from equipment after flexible connections

I. For equipment with vibration isolation, take floor measurements with the vibration isolation blocked solid to the floor and with the vibration isolation floating. Calculate and report the differences.

J. Inspect, measure, and record vibration isolation.

1. Verify that vibration isolation is installed in the required locations.
2. Verify that installation is level and plumb.
3. Verify that isolators are properly anchored.
4. For spring isolators, measure the compressed spring height, the spring OD, and the travel-to-solid distance.
5. Measure the operating clearance between each inertia base and the floor or concrete base below. Verify that there is unobstructed clearance between the bottom of the inertia base and the floor.

3.13 PROCEDURES FOR SOUND-LEVEL MEASUREMENTS

A. Perform sound-pressure-level measurements with an octave-band analyzer complying with ANSI S1.4 for Type 1 sound-level meters and ANSI S1.11 for octave-band filters. Comply with requirements in ANSI S1.13, unless otherwise indicated.

B. Calibrate sound meters before each day of testing. Use a calibrator provided with the sound meter complying with ANSI S1.40 and that has NIST certification.

C. Use a microphone that is suitable for the type of sound levels measured. For areas where air velocities exceed 100 fpm, use a windscreen on the microphone.

D. Perform sound-level testing after air and water balancing and equipment testing are complete.

E. Close windows and doors to the space.

F. Perform measurements when the space is not occupied and when the occupant noise level from other spaces in the building and outside are at a minimum.

G. Clear the space of temporary sound sources so unrelated disturbances will not be measured. Position testing personnel during measurements to achieve a direct line-of-sight between the sound source and the sound-level meter.

H. Take sound measurements at a height approximately 48 inches above the floor and at least 36 inches from a wall, column, and other large surface capable of altering the measurements.

I. Take sound measurements using the dB(A) filter and in each of the 8 unweighted octave bands in the frequency range of 63 to 8000 Hz.

J. Take sound measurements with the HVAC systems off to establish the background sound levels and take sound measurements with the HVAC systems operating. Calculate the difference between measurements. Apply a correction factor depending on the difference and adjust measurements.

K. Perform sound testing at two locations on Project for each of the following space types. For each space type tested, select a measurement location that has the greatest sound level. If

testing multiple locations for each space type, select at least one location that is near and at least one location that is remote from the predominant sound source.

1. Each space with a noise criterion of RC or NC 25 or lower
2. Each space with an indicated noise criterion of RC or NC 35 and lower that is adjacent to a mechanical equipment room or roof mounted equipment
3. Inside each mechanical equipment room
4. Two additional areas as designated by the University

3.14 TEMPERATURE-CONTROL VERIFICATION

A. Verify that controllers are calibrated and commissioned.

B. Check transmitter and controller locations and note conditions that would adversely affect control functions.

C. Record controller settings and note variances between set points and actual measurements.

D. Check the operation of limiting controllers (i.e., high- and low-temperature controllers).

E. Check free travel and proper operation of control devices such as damper and valve operators.

F. Check the sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water flow measurements. Note the speed of response to input changes.

G. Check the interaction of electrically operated switch transducers.

H. Check the interaction of interlock and lockout systems.

I. Check main control supply-air pressure and observe compressor and dryer operations.

J. Record voltages of power supply and controller output. Determine whether the system operates on a grounded or non-grounded power supply.

K. Note operation of electric actuators using spring return for proper fail-safe operations.

3.15 TOLERANCES

A. Set HVAC system airflow and water flow rates within the following design rate tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: 0 to plus 10 percent
2. Individual room air outlets and inlets, and air flow rates: minus 5 percent to plus 10 percent. Total room shall be ±5 percent
3. Heating-Water Flow Rate: Minus 2 to plus 5 percent
4. Heating Hot Water Coils: Minus 2 to plus 5 percent
5. Chilled-Water Flow Rate: Minus 2 to plus 5 percent
6. Minimum Outside Air: 0 to plus 10 percent
7. Air Terminal Units (Max): Minus 5 percent to plus 5 percent
8. Air Terminal Units (Min): 0 to plus 10 percent
9. Pressure Independent Airflow Valves (Min and Max): 0 to plus 10 percent

10. Chilled Water Coils: minus 2 to plus 5 percent
11. Other Equipment Water Flow Rate: 0 to plus 10 percent

B. Maintaining pressure relationships and coil capacities as designed shall have priority over the tolerances specified above.

3.16 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.17 FINAL REPORT

A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.

1. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.
3. Certify validity and accuracy of field data.

B. Final Report Contents: In addition to certified field report data, include the following:

1. Fan curves
2. Manufacturers' test data
3. Field test reports prepared by system and equipment installers
4. Simplified system diagrams
5. Other information relative to equipment performance, but do not include Shop Drawings and Product Data

C. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:

1. Title page
2. Name and address of TAB firm
3. Project name
4. Project location
5. Architect's name and address
6. Engineer's name and address
7. Contractor's name and address
8. Report date
9. Signature of TAB firm who certifies the report

10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report
11. Summary of contents including the following:

    a. Indicated versus final performance
    b. Notable characteristics of systems
    c. Description of system operation sequence if it varies from the Contract Documents

12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer, type size, and fittings.
14. Notes to explain why certain final data in the body of reports varies from indicated values.
15. Test conditions for fans and pump performance forms including the following:

    a. Settings for outside-, return-, and exhaust-air dampers
    b. Conditions of filters
    c. Cooling coil, wet- and dry-bulb conditions
    d. Face and bypass damper settings at coils
    e. Fan drive settings including settings and percentage of maximum pitch diameter
    f. Inlet vane settings for variable-air-volume systems
    g. Settings for supply-air, static-pressure controller
    h. Other system operating conditions that affect performance

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outside, supply, return, and exhaust airflows
2. Water and steam flow rates
3. Duct, outlet, and inlet sizes
4. Pipe and valve sizes and locations
5. Terminal units
6. Balancing stations
7. Position of balancing devices

E. Air-Handling Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data: Include the following:

    a. Unit identification
    b. Location
    c. Make and type
    d. Model number and unit size
    e. Manufacturer's serial number
    f. Unit arrangement and class
    g. Discharge arrangement
    h. Sheave make, size in inches, and bore
    i. Sheave dimensions, center-to-center, and amount of adjustments in inches
    j. Number of belts, make, and size

k. Number of filters, type, and size

2. Motor Data:

a. Follow “Procedures for Motors” specified herein.
b. Sheave make, size in inches, and bore
c. Sheave dimensions, center-to-center, and amount of adjustments in inches

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm
b. Total system static pressure in inches water gauge
c. Fan rpm.
d. Discharge static pressure in inches water gauge
e. Filter static-pressure differential in inches water gauge
f. Sound attenuator static-pressure differential in inches water gauge
g. Preheat coil static-pressure differential in inches water gauge
h. Cooling coil static-pressure differential in inches water gauge
i. Heating coil static-pressure differential in inches water gauge
j. Outside airflow in cfm.
k. Return airflow in cfm.
l. Damper position(s).

F. Apparatus-Coil Test Reports:

1. Coil Data:

a. System identification.
b. Location.
c. Coil type.
d. Number of rows.
e. Fin spacing in fins per inch
f. Make and model number.
g. Face area in square feet
h. Tube size in NPS.
i. Tube and fin materials.
j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

a. Airflow rate in cfm.
b. Average face velocity in fpm.
c. Air pressure drop in inches water gauge
d. Outside-air, wet- and dry-bulb temperatures in °F
e. Return-air, wet- and dry-bulb temperatures in °F
f. Entering-air, wet- and dry-bulb temperatures in °F
g. Leaving-air, wet- and dry-bulb temperatures in °F
h. Water flow rate in gpm.
i. Water pressure differential psi
j. Entering-water temperature in °F

k. Leaving-water temperature in °F
l. Refrigerant expansion valve and refrigerant types.
m. Refrigerant suction pressure in psig
n. Refrigerant suction temperature in °F
o. Inlet steam pressure in psig

G. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

a. System identification
b. Location
c. Make and type
d. Model number and size
e. Manufacturer's serial number
f. Arrangement and class
g. Sheave make, size in inches, and bore
h. Sheave dimensions, center-to-center, and amount of adjustments in inches

2. Motor Data:

a. Follow “Procedures for Motors” specified herein.
b. Sheave make, size in inches, and bore
c. Sheave dimensions, center-to-center, and amount of adjustments in inches
d. Number of belts, make, and size

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm
b. Total system static pressure in inches water gauge
c. Fan rpm
d. Discharge static pressure in inches water gauge
e. Suction static pressure in inches water gauge

H. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:

a. System and air-handling unit or exhaust fan number
b. Location and zone
c. Traverse air temperature in °F
d. Duct static pressure in inches water gauge
e. Duct size in inches
f. Duct area in square feet
g. Length of straight duct before traverse in feet and inches.
h. Indicated airflow rate in cfm
i. Indicated velocity in fpm
j. Actual airflow rate in cfm
k. Actual average velocity in fpm

l. Barometric pressure in inches of mercury
m. Duct mounted sound attenuator static-pressure differential in inches water gauge and velocity in fpm

I. Air-Terminal-Device Reports:

1. Unit Data:

a. System and air-handling unit identification
b. Location and zone
c. Test apparatus used
d. Area served
e. Air-terminal-device make
f. Air-terminal-device number from system diagram
g. Air-terminal-device type and model number
h. Air-terminal-device size
i. Air-terminal-device effective area in square feet

2. Test Data (Indicated and Actual Values):

a. Airflow rate in cfm
b. Air velocity in fpm
c. Preliminary airflow rate as needed in cfm
d. Preliminary velocity as needed in fpm
e. Final airflow rate in cfm
f. Final velocity in fpm
g. Space temperature in °F

J. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data:

a. System and air-handling unit identification
b. Location and zone
c. Room or riser served
d. Coil make and size
e. Flowmeter type

2. Test Data (Indicated and Actual Values):

a. Airflow rate in cfm
b. Entering-water temperature in °F
c. Leaving-water temperature in °F
d. Water pressure drop in psi
e. Entering-air temperature in °F
f. Leaving-air temperature in °F

K. Compressor and Condenser Reports: For refrigerant side of unitary systems, stand-alone refrigerant compressors, air-cooled condensing units, or water-cooled condensing units, include the following:

1. Unit Data:

   a. Unit identification
   b. Location
   c. Unit make and model number
   d. Compressor make
   e. Compressor model and serial numbers
   f. Refrigerant weight in pounds
   g. Low ambient temperature cutoff in °F

2. Test Data (Indicated and Actual Values):

   a. Inlet-duct static pressure in inches water gauge
   b. Outlet-duct static pressure in inches water gauge
   c. Entering-air, dry-bulb temperature in °F
   d. Leaving-air, dry-bulb temperature in °F
   e. Condenser entering-water temperature in °F
   f. Condenser leaving-water temperature in °F
   g. Condenser-water temperature differential in °F
   h. Condenser entering-water pressure psig
   i. Condenser leaving-water pressure psig
   j. Condenser-water pressure differential psi
   k. Control settings
   l. Unloader set points
   m. Low-pressure-cutout set point in psig
   n. High-pressure-cutout set point in psig
   o. Suction pressure in psig
   p. Suction temperature in °F
   q. Condenser refrigerant pressure in psig
   r. Condenser refrigerant temperature in °F
   s. Oil pressure in psig
   t. Oil temperature in °F
   u. Voltage at each connection
   v. Amperage for each phase
   w. Kilowatt input
   x. Crankcase heater kilowatt
   y. Number of fans
   z. Condenser fan rpm
   aa. Condenser fan airflow rate in cfm
   bb. Condenser fan motor make, frame size, rpm, and horsepower
   cc. Condenser fan motor voltage at each connection
   dd. Condenser fan motor amperage for each phase.

L. Vibration Measurement Reports:

1. Date and time of test
2. Vibration meter manufacturer, model number, and serial number
3. Equipment designation, location, equipment, speed, motor speed, and motor horsepower
4. Diagram of equipment showing the vibration measurement locations
5. Measurement readings for each measurement location
6. Calculate isolator efficiency using measurements taken
7. Description of predominant vibration source

M. Sound Measurement Reports: Record sound measurements on octave band and dB(A) test forms and on an NC or RC chart indicating the decibel level measured in each frequency band for both "background" and "HVAC system operating" readings. Record each tested location on a separate NC or RC chart. Record the following on the forms:

1. Date and time of test
2. Sound meter manufacturer, model number, and serial number
3. Space location within the building including floor level and room number
4. Diagram or color photograph of the space showing the measurement location
5. Time weighting of measurements, either fast or slow
6. Description of the measured sound: steady, transient, or tonal
7. Description of predominant sound source

N. Instrument Calibration Reports:

1. Report Data:

   a. Instrument type and make
   b. Serial number
   c. Application
   d. Dates of use
   e. Dates of calibration

3.18 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the Final Report.
2. Randomly check the following for each system:

   a. Measure airflow of at least 10 percent of air outlets.
   b. Measure water flow of at least 5 percent of terminals.
   c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
   d. Measure sound levels at two locations.
   e. Measure space pressure of at least 10 percent of locations.
   f. Verify that balancing devices are marked with final balance position.
   g. Note deviations to the Contract Documents in the Final Report.

B. Final Inspection:

1. After initial inspection is complete and evidence by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by University's Representative.
2. TAB firm test and balance engineer shall conduct the inspection in the presence of University's Representative.
3. University Representative shall randomly select measurements documented in the final report to be rechecked. The rechecking shall be limited to either 10 percent of the total measurements recorded, or the extent of measurements that can be accomplished in a normal 8-hour business day.
4. If the rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
6. TAB firm shall recheck measurements and make adjustments. Revise the final report and balancing device settings to include changes and resubmit the final report.
7. Request a second final inspection. If the second final inspection also fails, University shall contract the services of another TAB firm to complete the testing and balancing in accordance with the Contract Documents and deduct the cost of the services from the final payment.

END OF SECTION

SECTION 23 0700

HVAC INSULATION

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes new piping and ductwork and equipment insulation that is not factory insulated and repair of existing insulation damaged by the Work of this contract:

1. Insulation Materials:

    a. Cellular glass.
    b. Flexible elastomeric.
    c. Mineral fiber.

2. Adhesives.
3. Mastics.
4. Sealants.
5. Factory-applied jackets.
6. Field-applied fabric-reinforcing mesh.
7. Field-applied jackets.
8. Tapes.
9. Securements.
10. Corner angles.

1.02 DEFINITIONS

A. The term “piping” includes piping, fittings, valves, controls, specialties, accessories; in other words everything except the equipment connected to the piping.

B. “Aboveground” includes piping above ground or within personnel or utility tunnels that are tall enough for walking.

C. “Underground” includes piping direct buried in the ground and within utility trench.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any). Clearly mark the materials being provided and its intended use of each product or the submittal will be rejected.

B. Submittal:

1. Product Data: For adhesives and sealants, including printed statement of VOC content.

C. Shop Drawings:

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.

2. Detail insulation application at pipe expansion joints for each type of insulation.
3. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
4. Detail removable insulation at piping specialties, equipment connections, nameplates, service plugs, HTW pipe anchors, guides, expansion joints, and HTW supports, and access panels.
5. Detail application of field-applied jackets.
6. Detail application at linkages of control devices.
7. Detail field application for each equipment type.

D. Qualification Data: For qualified Installer.

E. Material Test Reports: From a qualified testing agency acceptable to Campus Fire Marshal indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

F. Field quality-control reports if requested by the University's Representative.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface Burning Characteristics: For insulation and related materials, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to Campus Fire Marshal. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

C. Mockups shall be Type 1: An in-place review of items, materials and systems prior to execution, with approval by University's Representative. It is not the intent to modify materials or installation but to verify quality control expectations of the Contractor. The mockups shall include materials, finishes, and construction details to complete the finished appearance. The exact location shall be verified with the Contractor's sequencing and the University's Representative.

1. Piping Mockups:

a. One of each type chilled water 90-degree elbow.
b. One chilled water NPS 2-½ or larger valve.
c. One chilled water drain and strainer and how removable portion of insulation shall be constructed.
d. One chilled water pressure temperature tap.
e. One chilled water mechanical coupling, if existing.

2. Ductwork Mockups:

    a. None unless installing special or alternate insulation, build in place mockups for each type of insulation and finish to demonstrate quality of insulation application and finishes. Build mockups using same materials as for the completed Work.

3. Equipment Mockups:

    a. One in place chilled-water pump, if applicable to the project.
    b. One in place tank or vessel, if applicable to the project.

4. For each mockup, fabricate cutaway sections or shop drawing to allow observation of application details for insulation materials, adhesives, mastics, attachments, and jackets.
5. Notify University's Representative seven days in advance of dates and times when mockups will be constructed.
6. Obtain University's Representative's approval of mockups before starting insulation application.
7. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless University's Representative specifically approves such deviations in writing.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

B. Insulation shall be delivered to the job site in original, unopened manufacturer's containers.

C. Insulation shall be stored in a dry location and kept dry throughout construction.

1.06 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC."

B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.07 SCHEDULING

A. Schedule insulation application after pressure testing systems. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.01 INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

B. Prohibited: Products containing asbestos, lead, mercury, or mercury compounds.

C. Prohibited insulation materials: Calcium silicate, phenolic, or polyisocyanurate insulation.

D. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

E. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

F. Definition of "Or Equal": Where products are specified by manufacturers' name and accompanied by the term "or equal", comply with provisions in Division 01. Specific procedures must be followed before use of an unnamed product or manufacturer.

G. Mineral Wool: Inorganic mineral fiber made from Basalt, or high-recycled content mineral fiber insulation. Comply with ASTM C547 with or without factory applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Industrial Insulation Group, LLC
    b. Roxul
    c. Thermafiber
    d. Or Equal

H. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Nominal density is 7.5 lbs/cu. ft. or more. Thermal conductivity (k-value) at 75 deg F is maximum 0.29 Btu-inch/hr-ft^2-°F

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Cell-U-Foam Corporation; Ultra-CUF.
    b. Pittsburgh Corning Corporation; Foamglas. .
    c. Or equal.

2. Block Insulation: ASTM C 552, Type I, Grade 1.
3. Special-Shaped Insulation: ASTM C 552, Type III.
4. Board Insulation: ASTM C 552, Type IV.
5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II.
6. Preformed Pipe Insulation with Factory-Applied ASJ or ASJ-SSL: Comply with ASTM C 552, Type II.
7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

I. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Aeroflex USA Inc.; Aerocel.
    b. Armacell LLC; AP Armaflex.
    c. K-Flex USA; Insul-sheet.
    d. Or equal.

J. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. CertainTeed Corp.; Duct Wrap.
    b. Johns Manville; Microlite.
    c. Knauf Insulation; Duct Wrap.
    d. Manson Insulation Inc.; Alley Wrap.
    e. Owens Corning; All-Service Duct Wrap.
    f. Or equal.

K. High-Temperature (greater than 250 deg F), Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type V, without factory-applied jacket.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Johns Manville; HTB 23 Spin-Glas.
    b. Owens Corning; High Temperature Flexible Batt Insulations.
    c. Or equal.

L. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. For equipment applications, provide insulation without factory-applied jacket if needed for building up thicknesses of insulation otherwise provide with factory-applied ASJ or with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. CertainTeed Corp.; Commercial Board.
    b. Fibrex Insulations Inc.; FBX.
    c. Industrial Insulation Group, LLC
    d. Johns Manville; 800 Series Spin-Glas.
    e. Knauf Insulation; Insulation Board.
    f. Manson Insulation Inc.; AK Board.
    g. Owens Corning; Fiberglas 700 Series.
    h. Roxul
    i. Thermafiber
    j. Or equal.

M. High-Temperature (greater than 250 deg F), Inorganic mineral fiber made from Basalt, or high-recycled content mineral fiber insulation. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type III, without factory-applied jacket.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Fibrex Insulations Inc.; FBX.
   b. Industrial Insulation Group, LLC
   c. Johns Manville; 1000 Series Spin-Glas.
   d. Owens Corning; High Temperature Industrial Board Insulations.
   e. Rock Wool Manufacturing Company; Delta Board.
   f. Roxul Inc.; Roxul RW.
   g. Thermafiber; Thermafiber Industrial Felt.
   h. Or equal.

N. Mineral-Fiber, Preformed Pipe Insulation (rated for up to 850 deg F):

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Fibrex Insulations Inc.; Coreplus 1200.
   b. Industrial Insulation Group, LLC
   c. Johns Manville; Micro-Lok.
   d. Knauf Insulation; 1000 Pipe Insulation.
   e. Manson Insulation Inc.; Alley-K.
   f. Owens Corning; Fiberglas Pipe Insulation.
   g. Or equal.

2. Type I, less than 850 deg F Materials: Mineral fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
3. Type II, up to but less than 1200 deg F Materials: Mineral fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type II, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

O. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semi rigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following]:

   a. CertainTeed Corp.; CrimpWrap.
   b. Industrial Insulation Group, LLC
   c. Johns Manville; MicroFlex.
   d. Knauf Insulation; Pipe and Tank Insulation.

e. Manson Insulation Inc.; AK Flex.
f. Owens Corning; Fiberglas Pipe and Tank Insulation.
g. Or equal.

2.02 THERMAL BLANKETS:

A. Thermal blankets: custom fit pre-engineered insulation system, flexible and removable after installation to allow reinstallation and access to valves, pumps, flanges, equipment, and other hard to insulate items.

1. Insulation Material: ASTM C 1086, encapsulated 11 lb/cu. ft. fiberglass needled mat, Type E fiber
2. Inner and Outer Jacket: Minimum 16.5 oz./sq. yd. PTFE Teflon impregnated fiberglass.
3. Blanket Construction: Double sewn lock stitch with a minimum of 7 stitches per inch. Raw jacket edges shall have a PTFE Teflon fiberglass cloth binding with Teflon coated fiberglass thread stitching.
4. Quilting: Stainless steel tufts or pins placed at random locations no greater than 16" inches apart, with stainless steel speed washers for securing the insulation in place.
5. Fasteners: 12 or 14 gauge Type 304 Stainless Steel lacing pins shall be provided. The lacing pins will be held in place with 1-inch diameter, 14 gauge, type 304 stainless steel speed washers.
6. I.D. Tags: Stainless steel with embossed lettering.
7. Insulation thickness: to comply with insulation schedule in Part 3.
8. Thermal blankets installed outdoors shall be installed in a manner that rain and dew will not collect on blankets or seep inside of blanket. Provide removable aluminum jackets water shields or rain guards if necessary.
9. Custom Manufacturers:

a. Orange County Thermal Industries, Inc.
b. Sound Waves Insulations, Inc., Santa Ana
c. Thermal Energy Products, Inc.
d. Or equal.

2.03 FIRE-RATED INSULATION SYSTEMS

A. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 1 or 2-hour fire rating as required by the installation and by a NRTL acceptable to Campus Fire Marshal.

1. Products: Subject to compliance with requirements, provide one of the following:

a. CertainTeed Corp.; FlameChek.
b. Industrial Insulation Group, LLC
c. Johns Manville; Firetemp Wrap.
d. Nelson Firestop Products; Nelson FSB Flameshield Blanket.
e. Thermal Ceramics; FireMaster Duct Wrap.
f. 3M; Fire Barrier Wrap Products.
g. Unifrax Corporation; FyreWrap.
h. Or equal.

2.04 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated. Adhesives shall contain no flammable solvents if that option is available.

B. Cellular-Glass Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 200 deg F.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Design Polymerics
   b. Foster Products Corporation
   c. Or equal.

2. For indoor applications use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Aeroflex USA Inc.; Aeroseal.
   b. Armacell LCC; 520 BLV Adhesive.
   c. Foster Products Corporation, H. B. Fuller Company; 85-75.
   d. RBX Corporation; Rubatex Contact Adhesive.
   e. Or equal.

2. For indoor applications use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Design Polymerics DP 2590-CA
   b. ITW TACC, Division of Illinois Tool Works; SP80, T1080
   c. Marathon Industries, Inc.
   d. Or equal.

2. For indoor applications use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Design Polymerics DD2590-CA.
   b. ITW TACC, Division of Illinois Tool Works; SP80, T1080
   c. Marathon Industries, Inc.

d. Or equal.

2. For indoor applications use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Dow Chemical Company (The); 739, Dow Silicone.
b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
c. P.I.C. Plastics, Inc.; Welding Adhesive.
d. Speedline Corporation; Speedline Vinyl Adhesive.
e. Or equal.

2. For indoor applications use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.05 MASTICS

A. Materials shall water based and be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 40 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-35.
b. Design Polymerics 3040 with zero VOC's.
c. Foster Products Corporation, H. B. Fuller Company; 30-90.
d. ITW TACC, Division of Illinois Tool Works; CB-50.
e. Marathon Industries, Inc.; 590.
f. Mon-Eco Industries, Inc.; 55-40.
g. Vimasco Corporation; 749.
h. Or equal.

2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-10.
b. Foster Products Corporation, H. B. Fuller Company; 35-00.
c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
d. Marathon Industries, Inc.; 550.
e. Mon-Eco Industries, Inc.; 55-50.
f. Vimasco Corporation; WC-1/WC-5.
g. Or equal.

2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

D. High Temperature Water Mastic: asphalt cutback

1. Products:

a. Pittsburgh Corning Corp.: Pittcote 300.
b. Or equal.

2.06 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-76.
b. Foster Products Corporation, H. B. Fuller Company; 30-45.
c. Marathon Industries, Inc.; 405.
d. Mon-Eco Industries, Inc.; 44-05.
e. Pittsburgh Corning Corporation; Pittseal 444.
f. Vimasco Corporation; 750.
g. Or equal.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 100 to plus 300 deg F.
5. Color: White or gray.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-76-8.
b. Foster Products Corporation, H. B. Fuller Company; 95-44.
c. Marathon Industries, Inc.; 405.
d. Mon-Eco Industries, Inc.; 44-05.
e. Vimasco Corporation; 750.

f. Or equal.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.
6. For indoor applications use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. ASJ Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-76.
b. Or equal.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.
6. For indoor applications and use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.07 FACTORY-APPLIED JACKETS

A. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.08 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Fabric for Pipe Insulation: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch for covering pipe and pipe fittings.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Vimasco Corporation; Elastafab 894.
b. Or equal.

B. Woven Glass-Fiber Fabric for Duct and Equipment Insulation: Approximately 6 oz./sq. yd. with a thread count of 5 strands by 5 strands/sq. inch for covering equipment.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; Chil-Glas No. 5.
b. Or equal.

C. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch, in a Leno weave, for duct, equipment, and pipe.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Foster Products Corporation, H. B. Fuller Company; Mast-A-Fab.
b. Vimasco Corporation; Elastafab 894.
c. Or equal.

2.09 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Johns Manville; Zeston.
b. P.I.C. Plastics, Inc.; FG Series.
c. Proto PVC Corporation; LoSmoke.
d. Speedline Corporation; SmokeSafe.
e. Or equal.

2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White.
4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, and mechanical joints.
b. Factory fabricate tank heads and tank side panels.

D. Metal Jacket:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; Metal Jacketing Systems.
b. PABCO Metals Corporation; Surefit.
c. RPR Products, Inc.; Insul-Mate.
d. Or equal.

2. Aluminum Jacket: Comply with ASTM B209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.

a. Sheet and roll stock ready for shop or field sizing.
b. Finish and thickness are indicated in field-applied jacket schedules.

c. Moisture Barrier for Indoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and 40 pound kraft paper.
e. Factory-Fabricated Fitting Covers:

1) Aluminum, minimum 0.016 inch thick, smooth or stucco embossed finish.
2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
3) Tee covers.
4) Flange and union covers.
5) End caps.
6) Beveled collars.
7) Valve covers.
8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

E. Underground Direct-Buried Jacket: minimum 140-mil thickness membrane consisting of two-layers of 70-mil thick self-sealing, modified bituminous membrane for protecting cellular glass insulation systems designed for an outer surface temperature below 170°F. Jacketing consists of a polymer modified bituminous compound reinforced with a woven glass fabric and a 1-mil (0.03 mm) aluminum top film and release paper backing. Jacketing may also be factory-applied on the insulation.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Pittsburgh Corning Corporation; Pittwrap SS.
b. Polyguard; Insulrap No Torch 125.
c. Or equal.

F. Self-Adhesive Outdoor Jacket: minimum 70-mil thick self-sealing, modified bituminous membrane for protecting cellular glass insulation systems designed for an outer surface temperature below 170°F. Jacketing consists of a polymer modified bituminous compound reinforced with a woven glass fabric and a 1-mil (0.03 mm) aluminum top film and release paper backing. Jacketing may also be factory-applied on the insulation.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Pittsburgh Corning Corporation; Pittwrap SS.
b. Polyguard; Insulrap No Torch 125.
c. Or equal.

2.10 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136. Product performance is based on products manufactured by Venture Tape; there are slight variations among manufacturers listed.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
b. Compac Corp.; 104 and 105.
c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
e. Or equal.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
b. Compac Corp.; 110 and 111.
c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
e. Or equal.

2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
b. Compac Corp.; 130.
c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
d. Venture Tape; 1506 CW NS.
e. Or equal.

2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
    b. Compac Corp.; 120.
    c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
    d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
    e. Or equal.

2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

2.11 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Childers Products; Bands.
    b. PABCO Metals Corporation; Bands.
    c. RPR Products, Inc.; Bands.
    d. Or equal.

2. Stainless Steel: ASTM A167 or ASTM A240/A 240M, Type 304 or Type 316; 0.015 inch thick, ¾ inch wide with wing seal.
3. Aluminum: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, ¾ inch wide with wing seal.
4. Springs: For larger than 84-inch diameter tank applications. Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated with integral 1½-inch galvanized carbon-steel washer.

    a. Products: Subject to compliance with requirements, provide one of the following:

        1) AGM Industries, Inc.; CWP-1.
        2) GEMCO; Cupped Head Weld Pin.
        3) Midwest Fasteners, Inc.; Cupped Head.
        4) Nelson Stud Welding; CHP.
        5) Or equal.

2. Self-Sticking-Base Insulation Hangers for Equipment: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, and securely in

position indicated when self-locking washer is in place. Self-sticking-base is prohibited for use with ductwork insulation. Comply with the following requirements:

a. Products: Subject to compliance with requirements, provide one of the following:

1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.
2) GEMCO; Press and Peel.
3) Midwest Fasteners, Inc.; Self Stick.
4) Or equal.

b. Baseplate: Galvanized carbon-steel sheet, 0.015 inch thick by 2 inches square.
c. Spindle: Low carbon steel, fully annealed, 0.105-inch-diameter (12 gage) shank, length to suit depth of insulation indicated.
d. Adhesive-backed base with a peel-off protective cover.

3. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-½ inches in diameter.

a. Products: Subject to compliance with requirements, provide one of the following:

1) AGM Industries, Inc.; RC-150.
2) GEMCO; R-150.
3) Midwest Fasteners, Inc.; WA-150.
4) Nelson Stud Welding; Speed Clips.
5) Or equal.

b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

C. Staples: Outward-clinching insulation staples, nominal ¾-inch- wide, stainless steel or Monel.

D. Wire: 0.062-inch soft-annealed, stainless steel or 0.062-inch soft-annealed Monel®.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. C & F Wire.
b. Childers Products.
c. PABCO Metals Corporation.
d. RPR Products, Inc.
e. Or equal.

2.12 CORNER ANGLES

A. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.

B. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A167 or ASTM A240/A240M, Type 304 or Type 316.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

1. Verify that systems and equipment to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

1. Stainless Steel: Coat 300 series stainless steel with epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

B. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.03 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation in accordance with the manufacturer's installation instructions. Any conflicts or differences shall be brought to the attention of the University's Representative for review and approval before any work proceeds.

B. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.

C. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.

D. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

E. Install insulation with longitudinal seams at top and bottom of horizontal runs.

F. Install multiple layers of insulation with longitudinal and end seams staggered.

G. Welding brackets, clips, or other attachment devices to piping, fittings, and specialties is prohibited.

H. Keep insulation materials dry during application and finishing.

I. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

J. Install insulation with least number of joints practical. Do not use two or more scrap pieces where a full-length section will fit.

K. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

L. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses. Their function is not to mask poor-fitting insulation.

M. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches on center.
3. Overlap jacket longitudinal seams at least 1-½ inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches on center.

    a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.

N. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

O. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

P. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

Q. Existing pipe insulation damaged or affected by the work of this contract shall be repaired to comply with these specifications except that materials and thicknesses may match existing unless otherwise directed by the University's Representative.

3.04 GENERAL PIPE INSULATION INSTALLATION

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Requirements in this article generally apply to insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

C. Preformed fittings shall be provided for elbows, tees, flanges, etc. or Thermal Blankets may be provided.

D. Batt insulation stuffed into metal or PVC fitting covers is prohibited..

E. Insulation Installation on Fittings, Couplings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, couplings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with

insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.

6. Insulate couplings, flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions may be used if indoors and located with a concealed space. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

F. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

G. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with aluminum bands unless not material in not compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is allowed, finish exposed surfaces with a metal jacket.

3.05 CELLULAR-GLASS INSULATION INSTALLATION

A. Cutting of cellular-glass shall be outdoors or in a well ventilated space if indoors in a sealed building.

B. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6 inches on center.
4. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
5. For insulation in utility trench, provide bands at 12 inches on center to the exterior of the field instated jacketing.

C. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

D. Insulation Installation on Pipe Couplings, Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

E. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.06 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

A. Seal longitudinal seams and end joints with manufacturers recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturers recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered or preformed sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.07 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches on center.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.

4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

E. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 90 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to surfaces of fittings and transitions.
3. Install cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

    a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches on center.
    b. On duct sides with dimensions larger than 18 inches, place pins 16 inches on center each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    c. Pins and adhesive may be omitted from top surface of horizontal, rectangular ducts and plenums.
    d. Do not over compress insulation during installation.
    e. Impale insulation over pins and attach speed washers.
    f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with ½-inch outward-clinching

staples, 1 inch on center. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.

5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches on center.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Do not compress insulation beyond 25% of its' nominal thickness.
8. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches on center.

F. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 90 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to surfaces of fittings and transitions.
3. Install cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches on center.
b. On duct sides with dimensions larger than 18 inches, space pins 16 inches on center each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
c. Pins and adhesive may be omitted from top surface of horizontal, rectangular ducts and plenums.
d. Do not over compress insulation during installation.
e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with ½-inch outward-clinching

staples, 1 inch on center. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches on center.

3.08 THERMAL BLANKET INSTALLATION

A. Apply removable and reusable insulating thermal blankets on systems operating at greater than 180°F, and other water systems as follows:

1. Valves.
2. Strainers.
3. Pumps.
4. Regulators.
5. Flow meters.
6. Flow control, balancing, and instrumentation devices.
7. Steam Trap assemblies (except the trap, itself, which shall be uninsulated)
8. Service connection piping at locations that require maintenance, i.e. tube pull and heat exchanger head removal.
9. HTW anchors, guides, expansion joints and pipe supports.

B. Blanket Overlap: Install blanket with a minimum 2 inches overlap of adjacent insulation, as existing insulation with a minimum of 2 inches overlap. Where blanket cannot overlap existing oversized insulation, blanket shall butt up to existing insulation with a friction closing seam. Open gaps are prohibited. Blanket diameters which are 2 inches larger than existing insulation must be capped to eliminate open air void.

C. Any one piece will not exceed 40 lbs. in weight.

3.09 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.

4. Install jacket with 1½-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturers recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

C. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with aluminum bands 12 inches on center and at end joints.

D. For vertical tanks and vessels greater than 48 inches in diameter, provide either nominal 1¼ or 2½ inch-deep, corrugated sheets or 4-by-1-inch box rib sheets for improved durability.

3.10 FINISHES

A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

3.11 FIELD QUALITY CONTROL

A. Perform tests and inspections when requested and in the presence of University's Representative. The University will test and inspect if there is a concern with the installer's workmanship.

B. Tests and Inspections:

1. Inspect ductwork, randomly selected by University's Representative, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location for each 5,000 cfm duct system.
2. Inspect field-insulated equipment, randomly selected by University's Representative, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
3. Inspect pipe, fittings, strainers, and valves, randomly selected by University's Representative, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, for each pipe service defined in the "Piping Insulation Schedule, General" Article.

C. Insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.12 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation: are listed in the Article "Duct and Plenum Insulation Schedule."

B. Ducts with duct liner within the duct shall still require exterior duct insulation.

C. Sound attenuators or duct silencers if installed in an insulated duct system shall also require exterior duct insulation.

D. Install duct insulation with a vapor barrier.

E. Indoor-Exposed duct and plenum insulation schedule requirement for rigid board applies to insulation below 7-foot from finished floor or service/maintenance walkway. The rigid board protects the insulation from being damaged. Full pieces of insulation shall be used to exceed the height requirement.

F. Provide professional appearance in exposed locations for blanket and board insulation. Board shall continue to suitable point to change to blanket insulation, e.g. elbow, tee, etc. Secure blanket insulation in exposed locations shall using tape. Exposed wire is prohibited.

G. Items Not Insulated:

1. Factory-insulated flexible ducts.
2. Factory-insulated plenums and casings.
3. Flexible connectors.
4. Vibration-control devices.
5. Factory-insulated access panels and doors.

3.13 DUCT AND PLENUM INSULATION SCHEDULE

DUCT OR PLENUM LOCATION	TYPE	NOMINAL THICKNESS/ MINIMUM R-VALUE (HR-FT^2-°F/BTU) @ 75°F			DENSITY (LBS/ FT^3)
		SUPPLY	RETURN	OUTSIDE AIR	
Mechanical, Machine, Electric & Utility Rooms (unconditioned space)	Board	2" / 8	2" / 8	1" / 4.2	3

3.14 EQUIPMENT INSULATION SCHEDULE, GENERAL

A. Insulation materials and thicknesses are identified in following Article based on the equipment temperature service. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.

B. Insulate indoor and outdoor equipment in paragraphs below that are not factory insulated or if the factory installed insulation that does not meet or exceed the specified thermal requirements.

C. Provide removable thermal blanket insulation covers on un-insulated parts of boilers, heaters, heat exchangers, tanks, etc.

D. Insulate the following indoor or outdoor equipment:

1. Chilled-water equipment, heat exchangers, centrifugal pump housings, compression tank, air separator and any other cold surface.
2. Heating hot-water or high temperature water centrifugal pump housings expansion/compression tanks air separators.
3. Heat exchangers.
4. Steam generators.
5. Any other equipment not listed or not factory insulated in compliance with California Energy Code.

E. Omit insulation if equipment service is above 200°F from the following:

1. Vibration-control devices.
2. Testing agency labels and stamps, except for HTW provide removal insulation cover.

3.15 EQUIPMENT INSULATION SCHEDULE

A.

EQUIPMENT SERVICE temperature	THICKNESS	INSULATION TYPE	VAPOR BARRIER	MINIMUM INSTALLED R-VALUE
35°F to 75°F, interior (chilled-water)	2" ,	Cellular Glass or elastomeric	Yes	7.1
100 to 200°F, interior (heating water)	2"	Mineral fiber board or cellular glass	No	5.6

3.16 PIPING INSULATION SCHEDULE, GENERAL

A. Application schedules identify piping system and indicate pipe size ranges and material, thickness, and jacket requirements.

3.17 INDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Service: Chilled-water supply and return.

1. Operating Temperature: 35 to 75 deg F.
2. Insulation Material: Cellular glass or flexible elastomeric.
3. Insulation Thickness:

    a. Nominal pipe size (NPS) up to 2 diameter: 2 inches.
    b. Nominal pipe size (NPS) 2½ to 12: 2½ inches.

4. Vapor Retarder Required: Yes.

B. Service: Heating water supply and return.

1. Operating Temperature: 100 to 200 deg F.
2. Insulation Material: Preformed Mineral fiber.
3. Insulation Thickness:

    a. Nominal pipe size (NPS) ¾ to 2 main lines: 1½ inch.
    b. Nominal pipe size (NPS) 2½ to 6 pipes: 2 inches

4. Vapor Retarder Required: No.

C. Service: Vents from condensate blow down tank, condensate receiver and steam relief valves.

1. Operating Temperature: 450 deg F or lower.
2. Insulation Material: Preformed Mineral fiber.
3. Insulation Thickness: Apply the insulation thicknesses as listed for steam condensate.
4. Vapor Retarder Required: No.

3.18 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. Ducts and Plenums, Concealed: None.

C. Ducts and Plenums, Exposed: factory applied jacket.

D. Equipment, Concealed: None.

E. Equipment, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches: Aluminum, Corrugated or Stucco Embossed: 0.016 inch.

F. Equipment, Exposed, Larger than 48 Inches in Diameter or with Flat Surfaces Larger than 72 Inches: Aluminum stucco embossed or corrugated: 0.024 inch.

G. Piping, Concealed: None.

H. Piping, Exposed from finished floor or walkway to 10 feet above:

1. Aluminum, Stucco Embossed: 0.020 inch.
2. Smooth aluminum for elbows and fittings is acceptable if not available in stucco embossed.

I. For HTW piping applications 0.024 inch thick aluminum, stucco embossed with smooth segmented elbows.

END OF SECTION

SECTION 23 0800

COMMISSIONING OF HVAC

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes commissioning process requirements for the following HVAC&R systems, assemblies, and equipment:
   1. Cooling generation systems, including chilled-water systems.
   2. Distribution systems, including air distribution (heating and cooling) systems, heating water distribution systems, chilled-water distribution systems & air-handling units.
   3. Vibration and sound systems, including, vibration isolation devices, and seismic restraints.
   4. Controls and instrumentation, including energy monitoring and control system.
   5. Systems testing and balancing verification, including heating-water piping systems, chilled-water piping systems, and supply-air systems.

1.02 DEFINITIONS

A. BAS: Building automation system.

B. DDC: Direct digital controls.

C. HVAC&R: Heating, Ventilating, Air Conditioning, and Refrigeration.

D. "Systems," "Subsystems," "Equipment," and "Components": Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

E. TAB: Testing, adjusting, and balancing.

1.03 INFORMATIONAL SUBMITTALS

A. Qualification Data: For HVAC&R Testing Technician.

B. Construction Checklists: See related Sections for technical requirements for the following construction checklists:

   1. Vibration and seismic controls for HVAC&R piping and equipment.
   2. Instrumentation and control for HVAC&R.
   3. Heating-water piping and accessories.
   4. Cooling-water piping and accessories.
   5. Metal ducts and accessories.
   6. Fans.
   7. Particulate air filtration.

8. Air-handling units.

1.04 QUALITY ASSURANCE

A. HVAC&R Testing Technician Qualifications: Technicians to perform HVAC&R construction checklist verification tests, construction checklist verification test demonstrations, commissioning tests, and commissioning test demonstrations shall have the following minimum qualifications:

1. Journey-level or equivalent skill level. Vocational School four-year program graduate or an Associate's degree in mechanical systems, air conditioning, or similar field. Degree may be offset by three years' experience in servicing mechanical systems in the HVAC industry. Generally, required knowledge includes HVAC&R systems, electrical concepts, building operations, and application and use of tools and instrumentation to measure performance of HVAC&R equipment, assemblies, and systems.
2. Minimum three years experience installing, servicing, and operating systems manufactured by approved manufacturer.
3. One of the following:
   a. National Environmental Balancing Bureau (NEBB) Certified Testing, Adjusting, and Balancing Technician.
   b. Associated Air Balance Council (AABC) Certified Test and Balance Technician.
   c. Owner retains the right to waive NEBB or AABC Certification.

B. Testing Equipment and Instrumentation Quality and Calibration: For test equipment and instrumentation required to perform HVAC&R commissioning work, perform the following:

1. Submit test equipment and instrumentation list. For each equipment or instrument, identify the following:
   a. Equipment/instrument identification number.
   b. Planned commissioning application or use.
   c. Manufacturer, make, model, and serial number.
   d. Calibration history, including certificates from agencies that calibrate the equipment and instrumentation.

2. Test equipment and instrumentation shall meet the following criteria:
   a. Capable of testing and measuring performance within the specified acceptance criteria.
   b. Be calibrated at the manufacturer's recommended intervals with current calibration tags permanently affixed to the instrument being used.
   c. Be maintained in good repair and operating condition throughout the duration of use on this Project.
   d. Be recalibrated/repaired if dropped or damaged in any way since last calibrated.

C. Proprietary Test Instrumentation and Tools:

1. Equipment Manufacturer's Proprietary Instrumentation and Tools: For installed equipment included in the commissioning process, test instrumentation and tools

manufactured or prescribed by equipment manufacturer to service, calibrate, adjust, repair, or otherwise work on its equipment or required as a condition of equipment warranty, perform the following:

a. Submit proprietary instrumentation and tools list. For each instrument or tool, identify the following:

   1) Instrument or tool identification number.
   2) Equipment schedule designation of equipment for which the instrument or tool is required.
   3) Manufacturer, make, model, and serial number.
   4) Calibration history, including certificates from agencies that calibrate the instrument or tool, where appropriate.

b. Include a separate list of proprietary test instrumentation and tools in the operation and maintenance manuals.

c. HVAC&R proprietary test instrumentation and tools become the property of Owner at the time of Substantial Completion.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.01 GENERAL TESTING REQUIREMENTS

A. Certify that HVAC&R systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents and approved Shop Drawings and submittals.

B. Certify that HVAC&R instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents and approved Shop Drawings and submittals, and that pretest set points have been recorded.

C. Certify that TAB procedures have been completed and that TAB reports have been submitted, discrepancies corrected, and corrective work approved.

D. Set systems, subsystems, and equipment into operating mode to be tested according to approved test procedures (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

E. Measure capacities and effectiveness of systems, assemblies, subsystems, equipment, and components, including operational and control functions to verify compliance with acceptance criteria.

F. Test systems, assemblies, subsystems, equipment, and components operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and response according to acceptance criteria.

G. Construction Checklists: Prepare and submit detailed construction checklists for HVAC&R systems, subsystems, equipment, and components.

1. Contributors to the development of construction checklists shall include, but are not limited to, the following:
   a. HVAC&R systems and equipment installers.
   b. TAB technicians.
   c. HVAC&R instrumentation and controls installers.

H. Perform tests using design conditions, whenever possible.

1. Simulated conditions may, with approval of Architect, be imposed using an artificial load when it is impractical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by Commissioning Coordinator and document simulated conditions and methods of simulation. After tests, return configurations and settings to normal operating conditions.
2. Commissioning test procedures may direct that set points be altered when simulating conditions is impractical.
3. Commissioning test procedures may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are impractical.

I. If tests cannot be completed because of a deficiency outside the scope of the HVAC&R system, document the deficiency and report it to Owner. After deficiencies are resolved, reschedule tests.

J. If seasonal testing is specified, complete appropriate initial performance tests and documentation and schedule seasonal tests.

K. Coordinate schedule with, and perform the following activities at the direction of, Commissioning Coordinator.

L. Comply with construction checklist requirements, including material verification, installation checks, start-up, and performance tests requirements specified in Sections specifying HVAC systems and equipment.

M. Provide technicians, instrumentation, tools, and equipment to complete and document the following:

1. Performance tests.
2. Demonstration of a sample of performance tests.
3. Commissioning tests.
4. Commissioning test demonstrations.

3.02 TAB COMMISSIONING TESTS

A. TAB Verification:

1. Prerequisites: Completion of "Examination" Article requirements and correction of deficiencies, as specified in Section 23 0593 "Testing, Adjusting, and Balancing for HVAC."

2. Completion of "Preparation" Article requirements for preparation of a TAB plan that includes strategies and step-by-step procedures, and system-readiness checks and reports, as specified in Section 23 0593 "Testing, Adjusting, and Balancing for HVAC."
3. Scope: HVAC&R air systems and hydronic piping systems.
4. Purpose: Differential flow relationships intended to maintain air pressurization differentials between the various areas of Project.
5. Conditions of the Test:
   a. Commissioning Test Demonstration Sampling Rate: As specified in "Inspections" Article in Section 23 0593 "Testing, Adjusting, and Balancing for HVAC."
   b. Systems operating in full heating.
   c. Systems operating in full cooling mode.

6. Acceptance Criteria:
   a. Under all conditions, rechecked measurements comply with "Inspections" Article in Section 23 0593 "Testing, Adjusting, and Balancing for HVAC."
   b. Additionally, no rechecked measurement shall differ from measurements documented in the final report by more than two times the tolerances allowed.
   c. Under all conditions, where the Contract Documents indicate a differential in airflow between supply and exhaust and/or return in a space, the differential relationship shall be maintained.

3.03 HEATING CONTROL SYSTEM COMMISSIONING TESTS

A. Heating-Water Supply Temperature Control:

1. Prerequisites: Installation verification of the following:
   a. Startup of heating coils.
   b. TAB of heating-water flow and pressure.
   c. Input Device: Heating-water supply temperature; thermistor temperature sensor or resistance temperature sensor.
   d. Output Device: Pressure Independent Control valve.
   e. Display the following at the operator's workstation:

      1) Heating-water supply temperature.
      2) Control-valve position.

2. Scope: Heating-water system.
3. Purpose: Control of heating-water supply temperature at heating coil.
4. Conditions of the Test:
   a. Minimum heating-water flow.
   b. Midrange Heating-Water Flow: [50 to 60] percent of maximum.
   c. Maximum heating-water flow.

5. Acceptance Criteria: Under all conditions, heating-water supply temperature is within plus or minus 2.0 deg F of set point.

B. Heating-Water Supply Temperature Reset:

1. Prerequisites: Installation verification of the following:
   a. TAB of heating-water flow and pressure.
   b. Input Device: Heating-water supply temperature; thermistor temperature sensor or resistance temperature sensor.
   c. Input Device: Outdoor-air temperature; [electric, outdoor-air-reset controller] [outdoor-air sensor].
   d. Output Device: Pressure Independent Control Valve.
   e. Display the following at the operator's workstation:

      1) Outdoor-air temperature.
      2) Heating-water supply temperature.
      3) Heating-water supply temperature set point.
      4) Control-valve position.

2. Scope: Heating-water system.
3. Purpose: Control of heating-water supply temperature at heating-water supply temperature input device <**Insert device designation**> in response to variable outdoor-air temperature input; outdoor-air sensor.
4. Conditions of the Test: Outdoor-air temperature input value may be overridden for this test.
   a. Low Temperature: Outdoor-air temperature between minus 30 and 0 deg F.
   b. Midrange Temperature: Outdoor-air temperature between 30 and 45 deg F.
   c. High Temperature: Outdoor-air temperature above 65 deg F.

3.04 AIR-HANDLING SYSTEM COMMISSIONING TESTS

A. Supply Fan(s) Variable-Volume Control:

1. Prerequisites: Installation verification of the following:
   a. Volume Control Input Device: Static-pressure transmitter sensing supply-duct static pressure referenced to conditioned-space static pressure.
   b. Volume Control Output Device: DDC system analog output to digital-to-pneumatic transducer to modulating damper actuator. Set inlet guide vanes to minimum position when fan is stopped.
   c. Volume Control Output Device: Receiver controller motor speed controller. Set variable-speed drive to minimum speed when fan is stopped.
   d. High-Pressure Input Device: Static-pressure transmitter sensing supply-duct static pressure referenced to static pressure outside the duct.
   e. High-Pressure Output Device: [Receiver controller] [DDC system binary output] to [alarm panel] [motor starter].
   f. Display the following at the operator's workstation:

      1) Supply-fan-discharge static-pressure indication.
      2) Supply-fan-discharge static-pressure set point.
      3) Supply-fan airflow rate.
      4) Supply-fan speed.

2. Scope: Variable-air-volume supply fan units and associated controls.
3. Purpose:

a. Supply-air discharge static pressure control.
b. Response to excess supply-air discharge static pressure condition.

4. Conditions of the Test:
   a. Minimum supply-air flow.
   b. Midrange Supply-Air Flow: [50 to 60] percent of maximum.
   c. Maximum supply-air flow.
   d. Excess supply-air discharge static pressure.

5. Acceptance Criteria:
   a. At all supply-air flow rates, and during changes in supply-air flow, discharge air static pressure is at set point plus or minus 2 percent.
   b. Fan stops and an alarm is initiated at the operator's workstation when supply-air discharge static pressure is at the excess static pressure plus or minus 2 percent.

END OF SECTION

SECTION 23 0900

INSTRUMENTATION AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. This Building Management System (BMS) integrates building management controls and energy management, and shall be an Alerton, Schneider Electric, or Honeywell system.

B. The control contractor shall have integrator experience in Southern California for at least (10) years and have a minimum of (15) factory certified technicians on staff prior to the bid. The contractor must furnish all labor, materials, equipment, and service necessary for a complete and operating system, utilizing Direct Digital Controls as shown on the drawings and as described herein. Drawings are diagrammatic only.

C. The BMS shall be capable of total integration of the facility infrastructure systems with user access by a standard Web Browser over the Internet. This shall include HVAC control, electrical, gas and water metering, energy management, alarm monitoring, security and personnel access control, fire-life safety monitoring, and all trending, reporting and maintenance management functions related to normal building operations all as indicated on the drawings or elsewhere in this specification.

D. Provide the detail design of the system, furnish and install hardware, start-up and commissioning of the system and then warrant the completed system including equipment, appurtenances, and existing campus system modifications.

E. Provide a Building Management System (BMS) incorporating Direct Digital Control (DDC) Energy Management, monitoring and control of HVAC equipment and room control. The BMS shall be fully integrated to provide the end users with full control, monitoring and management functions based on a common computer operating system and operating procedures.

F. The building HVAC control system will be comprised of microprocessor based plant controllers and intelligent room controllers interfacing directly with sensors, actuators, HVAC equipment, chillers, boilers, room climate control, lighting systems, and electrical systems.

G. Furnish a totally native BACnet-based system, based on a distributed control system in accordance with this specification. All building controllers, application controllers, and all input/output devices shall communicate using the protocols and network standards as defined by ANSI/ASHRAE Standard 135–2001, BACnet. In other words, all controllers, including unitary controllers, shall be native BACnet devices. The control system shall be the Alerton Ascent line or equal.

H. The BMS shall be listed by the Underwriters Laboratories Inc. (ULI) for use in energy management, (PAZX), critical process (QVAX), security (APOU), and the primary control and monitoring device for smoke control (UUKL) and fire alarm systems (UOJZ). In addition to the above listings, the BMS shall have the ability to integrate all open communications protocol standards including BACnet, LonMark, ODBC, OPC, AdvanceDDE and Modbus. The BMS shall have the ability to simultaneously allow open integration and control of stand-alone systems, HVAC, fire, security, lighting, asset tracking and monitoring CCTV and digital video systems.

I. Complete temperature control system to be DDC with electronic sensors and electric/electronic actuation of valves and dampers.

J. The system shall include all interconnecting wiring and conduit as required for an operational system as specified. Wiring shall be installed as per local codes or Division 16 whichever is more stringent, and a letter indicating method of code compliance which shall be furnished with first shop drawing submittal.

1. Line voltage wiring shall utilize methods and materials complying with the requirements of the Electrical Specifications, local building code, and NEC.

2. Low voltage wiring shall use methods and materials complying with the requirements of the Electrical Specifications, local building code and NEC.

K. Where interface between a device such as a variable frequency drive and the building management system is required and the manufacturer's interface card does not provide the required points or information then the required points shall be hard wired from the device to the required destination. The required points shall be landed, and all control logic for those points shall be implemented at no additional cost to the campus. The intent shown on the construction document for those required points shall be implemented to the satisfaction of the campus.

1.2 QUALITY ASSURANCE DURING CONSTRUCTION

A. The acceptable manufacturers are listed below, provided they meet the specification criterion (See 1.2 B, C) included below as part of this project:

i. Alerton/Niagara by Climatec Branch Irvine
ii. Schneider Electric by Schneider Electric Branch
iii. Honeywell by Honeywell Branch

No exceptions, substitutions and equals

B. Proposed BMS shall utilize GUI that resides on a Tridium-based platform. All installation, programming, and other associated work must be completed by a local certified Tridium dealer with at least fifteen (15) past project experiences. Local Tridium provider shall have no less than seven (7) local Tridium-certified technicians that regularly install and service Tridium based GUIs. Project references

and technician Tridium certifications shall be provided upon request.

C. Prior to receiving approval to proceed on this project the contractor must provide and demonstrate the following:

2. A copy of Southern California Tridium dealership license.
3. Five (5) customer references in Los Angeles County with an installed lab control system.
4. Presence in Los Angeles County HVAC controls market of at least fifteen (15) years.
5. Reference Information must include the following:
   i. Customer name
   ii. Address
   iii. Contact name
   iv. Contact phone number
   v. System description
   vi. Statement of BACnet compliance

D. Contractor performing work as part of this specification shall be fully responsible for all building automation system warranties in all buildings whether existing or in construction at the OWNER.

E. The control contractor must perform all engineering, programming, & project management in house. Subcontracting or brokering of these responsibilities is not allowed of the control contractor.

F. The Installation Contractor shall be responsible for the complete installation, including the initial data input, system debugging, and initial calibration of system components.

G. A full-time Project Manager with a minimum of ten (10) years experience with facilities of this size project and complexity shall be assigned to manage both the engineering/design and system installation/start-up phases of the projects. Close coordination and approval from and with the Design Professional is required.

H. Control system shall be engineered, programmed, and supported completely by representative's local office that must be within 20 miles of project site. The control contractor shall be independent and not part of a Mechanical Contractor's control division.

I. The Building Control System Contractor shall submit a list of projects with contact names as part of his submittal package. The contractor shall possess valid California State Class C-10 or C20 license.

J. Owner reserves the right to immediately disqualify contractors and products that do not meet the specific requirements as outlined in this specification.

1.3 SUBMITTALS

A. Submit complete coordination system documentation including, but not limited to:

1. Equipment location and conduit routing drawings.
2. Point-to-point wiring diagrams.
3. Descriptive literature and specification sheets for hardware and equipment.
4. Operating and maintenance instructions on hardware and equipment.
5. I/O (input/output device) point assignments.
6. Complete schedule and legend listing sensors, readers, etc., indicating its location, make and model number, I/O assignment, etc. Room numbers shall be actual, final building room numbers.
7. Database and software modification documentation indicating sequences of operation, listing of control program additions, flow charts of control program additions, and proposed floor maps with symbols to be programmed into the existing campus central EMS database.
8. Procedures and documents to be used for training, check-out, and commissioning.

1.4 FUNCTION

A. Design and install an integrated building control system including necessary hardware and software to perform the functions intended.

B. The system shall provide the following functions:

1. Monitor control and alarm points for alarm and status.
2. Log selected events to the host system database.
3. Upload and download data to the central server database server.
4. Display alarms on the host system terminal including a location plan.
5. Local programming of the system using a portable computer.
6. The building management control decisions shall be made locally by the building controller automatically without the need for any operator intervention. Whenever an alarm or other exceptional situation occurs, the controller shall automatically transmit event data to the central campus BMS server via a dedicated connection while simultaneously alerting any remote alarm monitoring station, executing preprogrammed output commands as established by the system design submittals.
7. The BMS shall perform data acquisition of facility point conditions and shall be capable of uploading transactions and/or events to the existing campus central database system and include the date, time, location, and nature of the event.

    a. The BMS shall utilize distributed control architecture to ensure minimum down time in the event of a single or multiple component failure. The BMS shall be capable of identifying the failed component(s) and bring it to the attention of the existing campus central server operator.

b. The BMS shall possess a modular architecture that permits 25% expansion of the system through the addition of expansion boards and memory to a building terminal controller and adding more building control panels, sensors, and readers.

1.5 WARRANTY

A. All components, system software, and parts supplied by the building control system contractor shall be guaranteed against defects in materials and workmanship for three (3) years from acceptance date. This includes work done on the campus central server.

B. Labor to repair, reprogram, or replace components shall be furnished by the building control system contractor at no charge during the warranty period. All corrective software modifications made during warranty periods shall be updated on all user documentation and on user and manufacturer archived software disks. The Contractor shall respond to the Owners request for warranty service within 24 hours during normal business hours.

PART 2 - NETWORKS

2.1 LOCAL AREA NETWORK

A. The Local Area Network (LAN) shall be a 100 Megabits/sec (Minimum) Ethernet network supporting LON, BACnet, and XML for maximum flexibility for integration of building data with enterprise information systems and providing support for multiple Network Area Controllers (NACs), user workstations and, if specified, a local server.

B. Local area network minimum physical and media access requirements:

1. Ethernet; IEEE standard 802.3
2. Cable; 100 Base-T, UTP-8 wire, Category 5
3. Minimum throughput; 100 Mbps.

2.2 REMOTE ACCESS

A. For Local Area Network installations, provide access to the LAN from a remote location, via the Internet. The Owner shall provide a connection to the Internet to enable this access via high speed cable modem, asynchronous digital subscriber line (ADSL) modem, ISDN line, T1 Line or via the customer's Intranet to a corporate server providing access to an Internet Service Provider (ISP). Customer agrees to pay monthly access charges for connection and ISP.

PART 3 - PRODUCTS

3.1 BUILDING MANAGEMENT SYSTEM AND COMPONENTS DESCRIPTION

A. The Building Management System (BMS) shall be comprised of a network of interoperable, stand-alone digital controllers, a computer system, graphical user interface software, printers, network devices and other devices as specified herein.

1. Building Management System to be provided shall perform the following general functions:

    a. Building management and control
    b. Monitoring and control of controllers, remote devices and programmable logic controllers including sensors, actuators, environmental delivery systems (chillers, boilers, room climate control, lighting systems, electrical systems etc.)
    c. Operator interface to allow general supervision of room controls
    d. Data collection and historization
    e. Alarm management
    f. Trending
    g. Report generation
    h. Customer Dashboarding
    i. Network integration

2. Data exchange and integration with a diverse range of other computing and facilities systems using industry standard techniques.

3. System shall employ all standard features and functions as described in Section 1 to monitor and control building equipment. At a minimum, the following data shall be accessible:

    a. Space temperature
    b. Space temperature set point
    c. Occupancy status
    d. Operating mode
    e. Window status
    f. Valve positions
    g. Air volume flow
    h. Percent terminal load
    i. Time schedules
    j. Zero energy bands
    k. Room name
    l. Terminal type e.g. fan coil

4. In the event of a power failure or disconnection from the network, the controllers shall continue to be fully operational with full time program capability.

B. Web Browser Clients:

1. The system shall be capable of supporting an unlimited number of clients using a standard Web browser such as Internet Explorer™, Mozilla FireFox™ or Chrome. Systems requiring additional software (to enable a standard Web browser) to be resident on the client machine, or manufacture-specific browsers shall not be acceptable. Must be based on HTML5. Systems requiring Plug-ins or Java are not acceptable.
2. The Web browser software shall run on any operating system and system configuration that is supported by the Web browser. Systems that require specific machine requirements in terms of processor speed, memory, etc., in order to allow the Web browser to function with the BMS, shall not be acceptable.
3. The Web browser shall provide the same view of the system, in terms of graphics, schedules, calendars, logs, etc., and provide the same interface methodology as is provided by the Graphical User Interface Systems that require different views or that require different means of interacting with objects such as schedules, or logs, shall not be permitted.
4. The Web browser client shall support at a minimum, the following functions:
    a. User log-on identification and password shall be required. If an unauthorized user attempts access, a blank web page shall be displayed. Security using Java authentication and encryption techniques to prevent unauthorized access shall be implemented.
    b. Graphical screens developed for the GUI shall be the same screens used for the Web browser client. Any animated graphical objects supported by the GUI shall be supported by the Web browser interface.
    c. HTML programming shall not be required to display system graphics or data on a Web page. HTML editing of the Web page shall be allowed if the user desires a specific look or format.
    d. Storage of the graphical screens shall be in the Tridium Vykon AX Supervisor without requiring any graphics to be stored on the client machine. Systems that require graphics storage on each client are not acceptable.
    e. Real-time values displayed on a Web page shall update automatically without requiring a manual “refresh” of the Web page.

f. Users shall have administrator-defined access privileges. Depending on the access privileges assigned, the user shall be able to perform the following:

1. Modify common application objects, such as schedules, calendars, and set points in a graphical manner.

a Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.

b Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.

2. Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.

3. View logs and charts

4. View and acknowledge alarms

5. Setup and execute SQL queries on log and archive information

g. The system shall provide the capability to specify a user's (as determined by the log-on user identification) home page. Provide the ability to limit a specific user to just their defined home page. From the home page, links to other views, or pages in the system shall be possible, if allowed by the system administrator.

h. Graphic screens on the Web Browser client shall support hypertext links to other locations on the Internet or on Intranet sites, by specifying the Uniform Resource Locator (URL) for the desired link.

C. On-line Help:

1. Provide a context sensitive, on-line help system to assist the operator in operation and editing of the system. On-line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext. All system documentation and help files shall be in HTML format.

D. Security:

1. The installed system shall provide secure password access to all features, functions and data contained in the overall BMS.

2. Each operator shall be required to log on to the system with a user name and password in order to view, edit, add, or delete data.

3. System security shall be selectable for each operator. The system administrator shall have the ability to set passwords and security levels for all other operators. Each operator password shall be able to restrict the operators' access for viewing and/or changing each system application, full screen editor, and object.

4. User log-on and log-off attempts shall be recorded.

5. All system security data shall be stored in an encrypted format.

6. System shall protect itself from unauthorized use by automatically logging off five minutes following the last keystroke or mouse activity.

E. System Diagnostics:

1. The system shall automatically monitor the operation of all workstations, printers, modems, network connections, building management panels, and controllers. The failure of any device shall be annunciated to the operator.

2. Provide fully licensed software with no recurring fees for programming of controllers.

F. Alarm Console:

1. The system shall automatically monitor the operation of all workstations, printers, modems, network connections, building management panels, and controllers. The failure of any device shall be annunciated to the operator.

2. When the Alarm Console is enabled, a separate alarm notification window will supersede all other windows on the desktop and shall not be capable of being minimized or closed by the operator. This window will notify the operator of new alarms and un-acknowledged alarms. Alarm notification windows or banners that can be minimized or closed by the operator shall not be acceptable.

G. User Interface / Displays

1. Navigation tree for building, equipment and system diagnostic centric display organization shall be available from data display view. Tree navigation contents shall be customizable on a per-user and per-group basis.

2. Each display may be protected from viewing unless operator credentials have the appropriate access level. An access level may be assigned to each display and system object. The menu label shall not appear on the graphic if the operator does not have the appropriate security level.

3. Ability to link to content outside of the EMCS system. Such content shall include, but is not limited to launching external files in their native applications (for example, a Microsoft Word document, PDF, Video or URL).

4. Graphic items with custom geometry that offer both color gradient shading and variable opacity in scale to system variables and range setpoints (OmniGraphics). Ability to Automatically resize to display (OmniZoom).

5. Clear & custom geometry navigation buttons to provide intuitive navigation to system display or external URLs.

6. Graphic files in JPG, PNG, and GIF file types.

7. Viewing of 1,024 system data points in a single screen.

8. Customizable mouse-over information of graphic items.

9. Right click capability to directly access system functionality, such as Schedule, Trendlogs and Alarms associated with a display object selected.

H. Remote Connectivity

1. System shall have ability to monitor & control system from mobile devices on all platforms utilizing HTML5.
2. Systems requiring plug in, java or flash are not acceptable.

Software - Programming:

I. Software – Programming

1. Shall be graphical with drag & drop icons for inputs / outputs and ability to link function blocks.
2. Program shall be downloadable from controllers.
3. Shall be Self documenting.
4. Have ability to view process in real-time.

J. Energy Dashboards

1. Shall use a Tridium or equivalent software platform to display information on both internally and externally facing dashboards.

2. Internally Facing Dashboards

   a. Where indicated on the plans, the following dashboard requirements must be applied.

   b. These dashboards shall provide detailed operational information focused towards daily operational, managerial and commissioning users.

      1. Dashboards shall incorporate:

         a Executive Dashboards – these dashboards shall provide a high level roll up of all utilities throughout the building and provide comparisons to the engineered energy models for the building. The energy models shall be provided by the owner and able to be integrated into these dashboards by the dashboard provider.

         b Utilities shall include, but not limited to, electric, water, natural gas and renewables like solar.

         c Dashboards shall be provide for data granularity at the same level as systems and metering within the building allows. Things like breakdown of energy consumption of lighting, HVAC and plug loads for example.

         d Users shall be able to select their specific time ranges of how they would like to see the data. At a minimum the user shall be allowed to select – today, yesterday, this week, last week, this month, last month, year to date and last 12 months. Additionally users may also select custom date ranges.

         e The dashboard shall also incorporate an "energy efficiency performance" screen, where by the dashboard shall roll up the energy use index (EUI) for the entire site; normalizing all utilities into kBTU/Ft2/Year.

      2. Energy Use Dashboards – these dashboards shall allow the user to look at energy data (electric, gas, water or renewables) on a very granular level.

         a Dashboards shall incorporate demand and consumption of each of these utilities.

         b Each meter that is connected shall be able to be looked at individually by selecting specific and predefined date ranges.

         c Predefined metrics on the dashboard shall derive relevant information from the data being requested during the specified time range.

      3. Virtual Electric Meter – This displays energy usage in a meter-style display. The meter has the ability to show kWh, kW, power factor, and kVAR.

      4. Comfort Dashboards - allows users to plot an area's cooling and heating setpoints, and verify that the controlled space temperature is

operating within the deadband of the two setpoints and that setpoints are within owner's requirements.

a Dashboards shall incorporate the selection of major air distribution systems, select specific zones as well as date range.

b Predefined metrics on the dashboard shall derive relevant information from the data being requested during the specified time range. This shall include a list of zones that are out of specification for example. The intent is to assist building operators to easily identify areas or zones to focus efforts.

5. Reporting – the system shall provide for a means of creating ad-hoc reports and exportation of data into flat file formats like CSV. Additionally the system shall allow users to export the on screen views into PDF and save these files for distribution.

3. Externally Facing Environment (kiosk)

a. This kiosk shall be located in the lobby of the building and shall reside on a 36" touch screen monitor. The intent is for the public and employees interact with the system and better understand how the building is performing and showcase the commitment to energy efficiency and sustainability by the owner.

b. These dashboards shall be intended to provide high level information focusing on energy use, sustainability, education and change management.

c. The following dashboard screens shall be incorporated –

1. Home Dashboard

a Describe what the dashboard is intended to do as well as how to navigate.

b Incorporate weather information as well as totalized utility data for the current day.

2. Energy Performance Dashboard

a One page per each utility (totalized)

b Incorporate demand and consumption

c Provide breakdown summaries, as data granularity allows, such as total HVAC, lighting, plug load or by area or floor.

3. Sustainability Page

a Provide carbon equivalents to energy consumption for the time period selected. Carbon equivalents shall include, but not limited to, #cars off road, #trees, lbs. of Co2 from atmosphere or #house powered for a year.

b Provide for metric to allow for totalized performance of a period, where user can see how the building's carbon footprint differed between time periods.

4. Owner Commitment

a Create dashboards to describe the owner's commitment to energy efficiency and sustainability. Owner shall provide this information for publishing.

b Highlight and describe sustainability features of the building's construction.

5. Green Tips / Change Management –

a These dashboard pages shall outline 5-10 green tips on things building occupants can do to reduce energy costs. These shall include things like, but not limited to, turning lights off, making thermostat changes, turning off office equipment when not used, etc.

K. Quality

1. Dashboard provider must have proven experience in development of the types of dashboards described in this specification. You must have at least three (3) certified technical resources on staff to provide development and support of this project.
2. Dashboard provider must have has at least five (5) years of experience in development of these environments. In submittal phase, provider must submit at least three (3) examples of similar projects.
3. Dashboard provider must be within 100 mile radius of the project location in order to provide quick and effective support of these systems.

L. Training, Warranty and Service

1. Provide a one (1) year warranty of materials, software and workmanship. Including all software upgrades during warranty period.
2. Provide eight (8) hours of operator training prior to turn over to building operators.
3. During warranty period, provide all software upgrades as well as monthly check up on data collection of the systems. Include not less than two (2) hours of remote connection and system verification during the warranty period.

3.2 HARDWARE

A. New central server will be located in the maintenance and operations office.

B. It shall be possible to provide access to all Network Area Controllers via a single connection to the server. In this configuration, each Network Area Controller can be

accessed from a remote Graphical User Interface (GUI) or from a standard Web browser by connecting to the server.

C. The server shall provide the following functions, at a minimum:
   1. Global Data Access: The server shall provide complete access to distributed data defined anywhere in the system.
   2. Distributed Control: The server shall provide the ability to execute global control strategies based on control and data objects in any NAC in the network, local or remote.

D. The server shall include a master clock service for its subsystems and provide time synchronization for all Network Area Controllers (NAC).

E. The server shall accept time synchronization messages from trusted precision Atomic Clock Internet sites and update its master clock based on this data.

F. The server shall provide scheduling for all Network Area Controllers and their underlying field control devices.

G. The server shall provide demand limiting that operates across all Network Area Controllers. The server must be capable of multiple demand programs for sites with multiple meters and or multiple sources of energy. Each demand program shall be capable of supporting separate demand shed lists for effective demand control.

H. The server shall implement the BACnet Command Prioritization scheme (16 levels) for safe and effective contention resolution of all commands issued to Network Area Controllers. Systems not employing this prioritization shall not be accepted.

I. Each Network Area Controller supported by the server shall have the ability to archive its log data, alarm data and database to the server, automatically. Archiving options shall be user-defined including archive time and archive frequency.

J. The server shall provide central alarm management for all Network Area Controllers supported by the server. Alarm management shall include:
   1. Routing of alarms to display, printer, email and pagers
   2. View and acknowledge alarms
   3. Query alarm logs based on user-defined parameters

K. The server shall provide central management of log data for all Network Area Controllers supported by the server. Log data shall include process logs, runtime and event counter logs, audit logs and error logs. Log data management shall include:
   1. Viewing and printing log data
   2. Exporting log data to other software applications
   3. Query log data based on user-defined parameters

L. Connection to the BMS network shall be via an Ethernet network interface card, 100 Mbps.

M. Graphics:

1. Provide custom dynamic graphics for systems and controlled devices installed in this project.
2. Provide standardized intelligent dynamic graphics for application specific controllers that will automatically modify itself based on system components installed.

N. High Performance Global Controller
   1. Shall Utilize full duplex communications (simultaneous bi-directional)
   2. Utilize dual network cards
   3. Have inherent ability to run a minimum of six (6) separate instances of DDC code.
   4. Have inherent ability to support up to six (6) separate sub networks with a mix & match of protocols.
   5. Utilize onboard supervised Hand-Off-Auto switches
   6. Utilize onboard analog potentiometers with true positions monitored in software

O. The NAC shall provide the interface between the LAN or WAN and the field control devices, and provide global supervisory control functions over the control devices connected to the NAC. It shall be capable of executing application control programs to provide:
   1. Calendar functions
   2. Scheduling
   3. Trending
   4. Alarm monitoring and routing
   5. Time synchronization
   6. Network Management functions for all controllers

P. The Network Area Controller must provide the following hardware features as a minimum:
   1. Two (2) Ethernet Ports – 100/1000 Mbps
   2. One RS-232 port
   3. One RS-485 port
   4. Battery Backup
   5. Flash memory for long term data backup (If battery backup or flash memory is not supplied, the controller must contain a hard disk with at least 1 gigabyte storage capacity)
   6. The NAC must be capable of operation over a temperature range of 32 to 122°F
   7. The NAC must be capable of withstanding storage temperatures of between 0 and 158°F

8. The NAC must be capable of operation over a humidity range of 5 to 95% RH, non-condensing

Q. The NAC shall provide multiple user access to the system and support for ODBC or SQL. A database resident on the NAC shall be an ODBC-compliant database or must provide an ODBC data access mechanism to read and write data stored within it.

R. The NAC shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 32 simultaneous users.

S. Event Alarm & Notification Actions:

1. The NAC shall provide alarm recognition, storage; routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers.
2. The NAC shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via dial-up telephone connection, or wide-area network.
3. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but limited to:
   a. To alarm
   b. Return to normal
   c. To fault
4. Provide for the creation of a minimum of eight of alarm classes for the purpose of routing types and or classes of alarms, i.e.: security, HVAC, Fire, etc.
5. Provide timed (schedule) routing of alarms by class, object, group, or node.
6. Provide alarm generation from binary object “runtime” and /or event counts for equipment maintenance. The user shall be able to reset runtime or event count values with appropriate password control.
7. Control equipment and network failures shall be treated as alarms and annunciated.
8. Alarms shall be annunciated in any of the following manners as defined by the user:
   a. Screen message text
   b. Email of the complete alarm message to multiple recipients. Provide the ability to route and email alarms based on:
      1. Day of week
      2. Time of day
      3. Recipient
   c. Pagers via paging services that initiate a page on receipt of email message
   d. Graphic with flashing alarm object(s)

e. Printed message, routed directly to a dedicated alarm printer

9. The following shall be recorded by the NAC for each alarm (at a minimum):
   a. Time and date
   b. Location (building, floor, zone, office number, etc.)
   c. Equipment (air handler #, access way, etc.)
   d. Acknowledge time, date, and user who issued acknowledgement.
   e. Number of occurrences since last acknowledgement.
10. Alarm actions may be initiated by user defined programmable objects created for that purpose.
11. Defined users shall be given proper access to acknowledge any alarm, or specific types or classes of alarms defined by the user.
12. A log of all alarms shall be maintained by the NAC and/or a server (if configured in the system) and shall be available for review by the user.
13. Provide a "query" feature to allow review of specific alarms by user defined parameters.
14. A separate log for system alerts (controller failures, network failures, etc.) shall be provided and available for review by the user.
15. An Error Log to record invalid property changes or commands shall be provided and available for review by the user.

T. Data Collection & Storage:
   1. The NAC shall have the ability to collect data for any property of any object and store this data for future use.
   2. The data collection shall be performed by log objects, resident in the NAC that shall have, at a minimum, the following configurable properties:
      a. Designating the log as interval or deviation.
      b. For interval logs, the object shall be configured for time of day, day of week and the sample collection interval.
      c. For deviation logs, the object shall be configured for the deviation of a variable to a fixed value. This value, when reached, will initiate logging of the object.
      d. For all logs, provide the ability to set the maximum number of data stores for the log and to set whether the log will stop collecting when full, or rollover the data on a first-in, first-out basis.
      e. Each log shall have the ability to have its data cleared on a time-based event or by a user-defined event or action.
   3. All log data shall be stored in a relational database in the NAC and the data shall be accessed from a server (if the system is so configured) or a standard Web browser.

4. All log data, when accessed from a server, shall be capable of being manipulated using standard SQL statements.
5. All log data shall be available to the user in the following data formats:
    a. HTML5
    b. XML
    c. Plain Text
    d. Comma or tab separated values
6. Systems that do not provide log data in HTML and XML formats at a minimum shall not be acceptable.
7. The NAC shall have the ability to archive its log data either locally (to itself), or remotely to a server or other NAC on the network. Provide the ability to configure the following archiving properties, at a minimum:
    a. Archive on time of day
    b. Archive on user-defined number of data stores in the log (buffer size)
    c. Archive when log has reached its user-defined capacity of data stores
    d. Provide ability to clear logs once archived

U. Audit Log:

1. Provide and maintain an Audit Log that tracks all activities performed on the NAC. Provide the ability to specify a buffer size for the log and the ability to archive log based on time or when the log has reached its user-defined buffer size. Provide the ability to archive the log locally (to the NAC), to another NAC on the network, or to a server. For each log entry, provide the following data:
    a. Time and date
    b. User ID
    c. Change or activity: i.e., Change setpoint, add or delete objects, commands, etc.

V. Database Backup & Storage:

1. The NAC shall have the ability to automatically backup its database. The database shall be backed up based on a user-defined time interval.
2. Copies of the current database and, at the most recently saved database shall be stored in the NAC. The age of the most recently saved database is dependent on the user-defined database save interval.
3. The NAC database shall be stored, at a minimum, in XML format to allow for user viewing and editing, if desired. Other formats are acceptable as well, as long as XML format is supported.

W. Graphical User Interface Software

1. Operating System**:**

   a. The GUI shall run on Microsoft Windows 8 running on a 64 bit PC.

2. The GUI shall employ browser-like functionality for ease of navigation. It shall include a tree view (similar to Windows Explorer) for quick viewing of, and access to, the hierarchical structure of the database. In addition, menu-pull downs, and toolbars shall employ buttons, commands and navigation to permit the operator to perform tasks with a minimum knowledge of the HVAC Control System and basic computing skills. These shall include, but are not limited to, forward/backward buttons, home button, and a context sensitive locator line (similar to a URL line), that displays the location and the selected object identification.

3. Real-Time Displays. The GUI, shall at a minimum, support the following graphical features and functions:

   a. Graphic screens shall be developed using any drawing package capable of generating a GIF, BMP, or JPG file format. Use of proprietary graphic file formats shall not be acceptable. In addition to, or in lieu of a graphic background, the GUI shall support the use of scanned pictures.

   b. Graphic screens shall have the capability to contain objects for text, real-time values, animation, color spectrum objects, logs, graphs, HTML or XML document links, schedule objects, hyperlinks to other URL's, and links to other graphic screens.

   c. Graphics shall support layering and each graphic object shall be configurable for assignment to a layer. A minimum of six layers shall be supported.

   d. Modifying common application objects, such as schedules, calendars, and set points shall be accomplished in a graphical manner.

      1. Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.

      2. Holidays shall be set by using a graphical calendar without requiring any keyboard entry from the operator.

   e. Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.

   f. Adjustments to analog objects, such as set points, shall be done by right-clicking the selected object and using a graphical slider to adjust the value. No entry of text shall be required.

4. System Configuration. At a minimum, the GUI shall permit the operator to perform the following tasks, with proper password access:

   1. Create, delete or modify control strategies.

2. Add/delete objects to the system.
3. Tune control loops through the adjustment of control loop parameters.
4. Enable or disable control strategies.
5. Generate hard copy records or control strategies on a printer.
6. Select points to be alarmed and define the alarm state.
7. Select points to be trended over a period of time and initiate the recording of values automatically.

3.3 SYSTEM PROGRAMMING

A. The Graphical User Interface software (GUI) shall provide the ability to perform system programming and graphic display engineering as part of a complete software package. Access to the programming functions and features of the GUI shall be through password access as assigned by the system administrator.

B. A library of control, application, and graphic objects shall be provided to enable the creation of all applications and user interface screens. Applications are to be created by selecting the desired control objects from the library, dragging or pasting them on the screen, and linking them together using a built in graphical connection tool. Completed applications may be stored in the library for future use. Graphical User Interface screens shall be created in the same fashion. Data for the user displays is obtained by graphically linking the user display objects to the application objects to provide "real-time" data updates. Any real-time data value or object property may be connected to display its current value on a user display. Systems requiring separate software tools or processes to create applications and user interface displays shall not be acceptable.

C. Programming Methods:

1. Provide the capability to copy objects from the supplied libraries, or from a user-defined library to the user's application. Objects shall be linked by a graphical linking scheme by dragging a link from one object to another. Object links will support one-to-one, many-to-one, or one-to-many relationships. Linked objects shall maintain their connections to other objects regardless of where they are positioned on the page and shall show link identification for links to objects on other pages for easy identification. Links will vary in color depending on the type of link; i.e., internal, external, hardware, etc.
2. Configuration of each object will be done through the object's property sheet using fill-in the blank fields, list boxes, and selection buttons. Use of custom programming, scripting language, or a manufacturer-specific procedural language for configuration will not be accepted.
3. All programming shall be graphical and utilize a non proprietary tool like Microsoft Visio. Text based programming is not acceptable.
4. The software shall provide the ability to view the logic in a monitor mode. When on-line, the monitor mode shall provide the ability to view the logic in real time for easy diagnosis of the logic execution. When off-line (debug), the monitor

mode shall allow the user to set values to inputs and monitor the logic for diagnosing execution before it is applied to the system.

5. All programming shall be done in real-time. Systems requiring the uploading, editing, and downloading of database objects shall not be allowed.

6. The system shall support object duplication within a customer's database. An application, once configured, can be copied and pasted for easy re-use and duplication. All links, other than to the hardware, shall be maintained during duplication.

D. Scheduling:

1. Provide the capability to schedule each object or group of objects in the controller system. Controllers shall have a minimum of 20 schedules. Each schedule shall consist of the following:

   a. Daily schedule: Provide daily schedules that are the basic building blocks for any of the following time schedules. Using daily schedules, user shall enter the switching times with the desired set points and switching conditions for the data-points. When preparing a daily schedule and assigning the name, there is initially no specific relationship to a particular day in the week. The modular structure of the time schedule shall make it possible for the user to establish various different daily schedules, keep them in a library, and include them in the weekly schedule. User shall be free to extend the list of daily schedules to meet his/her special requirements. The repeated use of the same daily schedule shall also be possible (for example, the same daily schedule can apply from Monday to Friday in the weekly schedule). Changes in a daily schedule shall be immediately effective in the weekly and annual schedules, as well as in the special day list.
   b. Weekly schedule: Provide a separate weekly schedule that shall be generated for each time schedule. Weekly schedule defines which daily schedule is to be used for which weekday. A daily schedule is assigned to each day of the week (Monday to Sunday). It shall also be possible to assign the same daily schedule to several weekdays. Weekly schedule, as defined, shall automatically be copied for each week in the annual schedule. If a change is made to a weekday in a weekly schedule, this change shall affect the weekday in every week of the year. If a daily schedule is entered directly in the annual schedule, this daily schedule shall have priority over the daily schedule from the weekly schedule. Definition of a weekly schedule forms the basis of the annual schedule.
   c. Annual schedule: Provide an annual schedule that is structured like a calendar and consists of successive weekly schedules. It provides an overview of which daily schedules are valid on which calendar days. If the daily schedule in a weekly schedule does not apply on a particular calendar date, another daily schedule can be entered for it directly in the annual schedule. Annual schedule starts on the current day. Each day, the time frame shifts one day. Days added at the end shall automatically be assigned

the daily schedule from the weekly schedule. Entries in the annual schedule shall therefore be made only if a daily schedule differing from the one selected is to be used. An undefined daily schedule to be inserted in the annual schedule can be defined in the daily schedule.

d. Holiday schedule: Provide one holiday day list that shall exist per time schedule. List shall make a number of holidays and special days available to which a daily schedule can be assigned. This daily schedule will then apply to this holiday or special day every year. The date of floating holidays shall be calculated automatically by the controller. If no daily schedule is entered on certain holidays, the special day list is not taken into account on this day. Provide capability for 24 holidays and special days.

E. Digital alarms: Each digital object shall be set to alarm based on the operator-specified state. Provide the capability to automatically and manually disable alarming.

F. Analog alarms: Provide analog objects with two maximum limits (limit max 1 and limit max 2), and two minimum limits (limit min 1 and limit min 2).

G. Totalizer alarms: Each totalizer object shall be set to alarm based on a pulse input signal interval that, if exceeded, triggers an alarm signal. Alarm signal text shall be permanently programmed and needs no input from the user.

H. Alarms shall be selectable as critical or non-critical. Critical alarms shall be transmitted as high priority.

I. System alarms: Operating errors that occur in a control unit or during communication with other controllers shall be recognized and displayed by the computer module. These alarm signals can relate, for example, to a defective module, the need to change the buffer battery (data protection), or the presence of one digital output module too many (maximum 10). These alarm signal texts are preprogrammed. They are always critical alarms.

J. Demand limiting:

1. Demand-limiting program shall monitor building power consumption from signals generated by a pulse generator (provided by others) mounted at the building power meter or from a watt transducer or current transformer attached to the building feeder lines.
2. Demand-limiting program shall predict the probable power demand such that action can be taken to prevent exceeding the demand limit. When demand prediction exceeds demand limit, action will be taken to reduce loads in a predetermined manner. When demand prediction indicates the demand limit will not be exceeded, action will be taken to restore loads in a predetermined manner.
3. Demand reduction shall be accomplished by the following means:

    a. Reset air-handling unit supply temperature set point up by 1 degree C (2 degrees F).

b. Reset space temperature set points up by 1 degree C (2 degrees F).
c. De-energize equipment based upon priority.

4. Demand-limiting parameters, frequency of calculations, time intervals, and other relevant variables shall be based on the means by which the local power company computes demand charges.
5. Provide demand-limiting prediction and control for any individual meter monitored by the system or for the total of any combination of meters.
6. Provide the means for an operator to make the following changes on-line:

   a. Addition and deletion of loads controlled.
   b. Changes in demand intervals.
   c. Changes in demand limit for meter(s).
   d. Maximum shutoff time for equipment.
   e. Minimum shutoff time for equipment.
   f. Select rotational or sequential shedding and restoring.
   g. Shed and restore priority.

7. Provide the following information and reports, to be available on an hourly, daily, and monthly basis:

   a. Total electric consumption
   b. Peak demand
   c. Date and time of peak demand
   d. Daily peak demand

K. Sequencing: Provide application software based upon the sequences of operation specified to properly sequence AHU's.

L. EPID control: An EPID (enhanced proportional-integral-derivative) algorithm with additional features shall be supplied. Algorithm shall calculate a time-varying analog value that is used to position an output or stage a series of outputs. Enhanced features shall include a built-in start-up ramp, direct-reverse action selection, integral recalculation to prevent windup below minimum and above maximum, and an auxiliary input for limit applications and integral reset. Controlled variable, set point, and PID gains shall be user-selectable.

M. Staggered start: This application shall prevent all controlled equipment from simultaneously restarting after a power outage. The order in which equipment or groups of equipment is started, along with the time delay between starts, shall be user-selectable.

N. Energy calculations:

1. Provide software to allow instantaneous power (e.g., kW) or flow rates (e.g., gpm) to be accumulated and converted to energy usage data.

2. Provide an algorithm that calculates a sliding window average (e.g., rolling average). Algorithm shall be flexible to allow window intervals to be user-specified (e.g., 15 minutes, 30 minutes, and 60 minutes).

3. Provide an algorithm that calculates a fixed window average. A digital input signal will define the start of the window period (e.g., signal from utility meter) to synchronize the fixed window average with that used by the utility.

O. Anti-short cycling: Digital output objects shall be protected from short cycling. This feature shall allow minimum on time and off time to be selected.

P. On and off control with differential: Provide an algorithm that allows a digital output to be cycled based on a controlled variable and set point. Algorithm shall be direct acting or reverse acting and incorporate an adjustable differential.

Q. Duty cycle: Provide software to switch HVAC systems on and off at variable intervals to save energy while maintaining room conditions. Program shall have adjustable internal parameters for room comfort range, maximum off times, minimum off times, and motor cycle times.

R. Economizer: Provide software that determines the most economical system operation for full and partial air conditioning systems. For a full air conditioning plant, it calculates the control signal for energy recovery on the basis of actual outdoor air enthalpy, return air enthalpy, and demand. In partial air conditioning systems, this control icon shall be used for heat recovery with temperature comparison. Economizer program shall make decisions based on the following information: Is the system a full or partial air conditioning system. A full system has temperature and humidity control. A partial system has temperature control only. Is there mixed air damper operation or heat and humidity recovery using a thermal wheel? Which has the higher energy cost: heating or cooling?

S. Enthalpy: Provide an algorithm that calculates enthalpy and humidity ratio based on temperature and relative humidity. Night purge: Provide a program that outputs an on and off value to start and stop ventilation and air conditioning systems to precondition rooms when cold outdoor air is available during non-working hours (usually, nighttime). To switch on the air conditioning as late as possible, this function shall permit room temperature to drop below room temperature set point during night cooling. Night purge shall achieve this action by resetting the room temperature set point downward. Minimum outdoor air temperature shall be limited to prevent damage from excessively cold outdoor air.

T. Optimum start and stop: Provide a software program that calculates optimized values for starting and stopping the heating plant. Optimized start-stop function shall consider the residual heat in a building to avoid unnecessary heating operation. Required room conditions are met at all times. Optimum start and stop program calculates required flow temperature with an integrated heating curve. Two techniques shall be available: optimization without room sensor or optimization with room sensor. Optimization without room sensor uses outdoor air temperature to determine optimum start (the preheat point). Optimization with room sensor uses room control and needs a time constant (time program) and dead time to calculate the preheat point.

U. Zero energy band: Provide a software program that determines set points to maintain a predetermined comfort band divided into heating, cooling, and zero energy bands. ZEB subdivides a predetermined comfort band into: Heating band zero energy band cooling band. Zero energy band represents a temperature range in which the room temperature may vary without a need for heating or cooling.

V. Run-time totalization: Provide software to totalize run times for all digital input objects. A high run-time alarm shall be assigned, if required, by the operator.

1. Data references like text descriptors, historical data, alarm buffer, engineering units, engineering characteristics etc. must be resident inside the building controller.
2. Provide at minimum 1000 BACnet ® Objects, of which a minimum 300 physical I/Os must be possible.

3.5 CUSTOM AIR HANDLING UNIT CONTROLLERS

A. General:
1. Basis of Design: Alerton VLX, native BACnet controller shall be used for these applications.
2. Expandable application controller shall be capable of providing control strategies for the system based on information from any or all connected inputs. The program that implements these strategies shall be completely flexible and user definable. Any systems utilizing factory pre-programmed global strategies that cannot be modified by field personnel on-site via simple download are not acceptable. Changing global strategies via firmware

changes is also unacceptable. Program execution of controller shall be a minimum of once per second.

3. Programming shall be object-oriented using control program blocks. Controller shall support a minimum of 500 Analog Values and 500 Binary Values. Each and every analog and binary value shall support standard BACnet priority arrays. Programming tool shall be provided with system and shall be the same tool that is used to program the Building Controller. All flowcharts shall be generated and automatically downloaded to controller. No re-entry of database information shall be necessary.
4. Provide means to graphically view inputs and outputs to each program block in real-time as program is executing. This function may be performed via the operator's terminal or field computer.
5. Controller shall have adequate data storage to ensure high performance and data reliability. Battery shall retain static RAM memory and real-time clock functions for a minimum of 1.5 years (cumulative). Battery shall be a field-replaceable (non-rechargeable) lithium type. Unused battery life shall be 10 years.
6. The onboard, battery-backed real time clock must support schedule operations and trend logs.
7. Global control algorithms and automated control functions should execute via 32-bit processor.
8. Controller shall include both on-board 10BASE-T/100BASE-TX Ethernet BACnet communication over twisted pair cable (UTP) and shall include BACnet IP communication. In addition, controller shall include BACnet PTP connection port.
9. The base unit of the controller shall host up to 8 expansion modules with various I/O combinations. These inputs and outputs shall include universal 12-bit inputs, binary triac outputs, and 8-bit switch selectable analog outputs (0-10V or 0-20 mA). Inputs shall support 3K and 10K thermistors, 0-5VDC, 0-10VDC, 4-20mA, dry contacts and pulse inputs directly.
10. All outputs must have onboard Hand-Off-Auto switches and a status indicator light. HOA switch position shall be monitored. Each analog output shall include a potentiometer for manually adjusting the output when the HOA switch is in the Hand position.
11. The position of each and every HOA switch shall be available system wide as a BACnet object. Expandable Central Plant Controller shall provide up to 176 discreet inputs/outputs per base unit.

B. BACnet Conformance:

1. AHU Controller shall as a minimum support Point-to-Point (PTP), MS/TP and Ethernet BACnet LAN types. It shall communicate directly via these BACnet LANs as a native BACnet device and shall support simultaneous routing functions between all supported LAN types. Building controller shall be a BACnet conformance class 3 device and support all BACnet services necessary to provide the following BACnet functional groups:
   a. Clock Functional Group
   b. Files Functional Group

c. Reinitialize Functional Group
d. Device Communications Functional Group
e. Event Initiation Functional Group

2. Please refer to section 22.2, BACnet Functional Groups, in the BACnet standard for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All necessary tools shall be supplied for working with proprietary information.
3. Standard BACnet object types supported shall include as a minimum: Analog Input, Binary Input, Analog Output, Binary Output, Analog Value, Binary Value, Device, File, Group, Event Enrollment, Notification Class, Program and Schedule object types. All necessary tools shall be supplied for working with proprietary information.
4. The Controller shall comply with Annex J of the BACnet specification for IP connections. This device shall use Ethernet to connect to the IP internetwork, while using the same Ethernet LAN for non-IP communications to other BACnet devices on the LAN. Must support interoperability on wide area networks (WANs) and campus area networks (CANs) and function as a BACnet Broadcast Management Device (BBMD).

C. Schedules: Each AHU controller shall support a minimum of 50 BACnet Schedule Objects.

D. Logging Capabilities:
1. Each controller shall support a minimum of 200 trend logs. Any object in the system (real or calculated) may be logged. Sample time interval shall be adjustable at the operator's workstation.
2. Controller shall periodically upload trended data to system server for long term archiving if desired.
3. Archived data stored in database format shall be available for use in third-party spreadsheet or database programs

E. Alarm Generation:
1. Alarms may be generated within the system for any object change of value or state either real or calculated. This includes things such as analog object value changes, binary object state changes, and various controller communication failures.
2. Alarm log shall be provided for alarm viewing. Log may be viewed on-site at the operator's terminal or off-site via remote communications
3. Controller must be able to handle up to 200 alarm setups stored as BACnet event enrollment objects – system destination and actions individually configurable.

3.6 INPUT AND OUTPUT INTERFACE

A. Hardwired inputs and outputs may tie into the system through general purpose, custom application, unitary controllers or distributed I/O devices.

B. Input points and output points shall be protected such that shorting of the point to itself, to another point, or to ground will cause no damage to controller. Input and output points shall be protected from voltage up to 24 V of any duration, such that contact with this voltage will cause no damage to controller. Inputs and outputs shall be arranged on interchangeable modules or circuit boards to allow the replacement of a damaged module or board without replacing the entire controller.

C. Digital inputs shall allow the monitoring of on and off signals from remote devices. Digital inputs shall provide a wetting current of at least 12 mA to be compatible with commonly available control devices, and shall be protected against the effects of contact bounce and noise. Digital inputs shall sense dry contact closure without external power other than that provided by the controller being applied.

D. Totalizer input points: This type of point shall conform to all requirements of digital input points, and also accept up to 15 pulses per second for pulse accumulation.

E. Analog inputs for GPCs shall be minimum 12-bit resolution and allow the monitoring of low-voltage (0 to 10 VDC), current (0 to 20 mA), negative temperature coefficient (NTC), and resistance to detector (RTD). Analog inputs shall be compatible with and field-configurable to commonly available sensing devices. To prevent thermal loading, RTDs and thermistors shall be scanned rather than have continuous power applied.

F. Inputs shall be electrically isolated from their associated field points.

G. Digital outputs shall provide for on and off operation, or a pulsed low-voltage signal for pulse width modulation control. Outputs shall be selectable for either normally open or normally closed operation.

H. Analog outputs shall be minimum 8-bit resolution and provide a modulating signal for the control of end devices. Outputs shall provide either a 0 to 10 VDC or a 4 to 20 mA signal as required to provide proper control of the output device. Analog outputs on general purpose or custom application controllers shall have status lights and a two-position Auto and Manual switch and manually adjustable potentiometer with feedback for manual operation. Analog outputs shall not exhibit a drift of greater than 0.4 percent of range per year.

I. Tri-State outputs: Provide tri-state outputs (two coordinated digital outputs) for control of three-point floating-type electronic actuators without feedback. Use of three-point floating devices shall be limited to zone control and terminal unit control applications (VAV terminal units, duct-mounted heating coils, zone dampers, radiation). Control algorithms shall run the zone actuator to one end of its stroke every 24 hours for verification of operator tracking.

J. System point capacity: System size shall be expandable to at least two times the number of hardware and software input and output points required for this project or 20,000 points, whichever is greater. Additional controllers (along with associated devices and wiring) shall be all that is necessary to achieve this capacity

requirement. Operator interfaces installed for this project shall not require any hardware additions or software revisions to expand the system.

K. Spare I/O Points: At each controller location, provide spare points equal to 15 percent of total I/O points at that location or 2 AI, 2 AO, 2 DO and 2 DI, whichever is greater.

3.7 POWER SUPPIES AND LINE FILTERING

A. Control transformers shall be UL and CSA Listed. Furnish Class 2 current-limiting type or furnish over-current protection in both primary and secondary circuits for Class 2 service per NEC requirements. Limit connected loads to 80 percent of rated capacity

1. DC power supply output shall match output current and voltage requirements. Unit shall be full-wave rectifier type with output ripple of 5.0 mV maximum peak-to-peak. Regulation shall be 1. 0 percent line and load combined, with 100-microsecond response time for 50 percent load changes. Unit shall have built-in over-voltage and over-current protection and shall be able to withstand a 150 percent current overload for at least three seconds without trip-out or failure.

    a. Unit shall operate between 32 degrees F and +120 degrees F. EM/RF shall meet FCC Class B and VDE 0871 for Class B and MIL-STD 810C for shock and vibration.
    b. Line voltage units shall be UL Recognized and CSA approved.

B. Power line filtering:

1. Provide transient voltage and surge suppression for all workstations and controllers, either internally or as an external component. Surge protection shall have the following at a minimum:

    a. Dielectric strength of 1,000 volts minimum
    b. Response time of 10 nanoseconds or less
    c. Transverse mode noise attenuation of 65 dB or greater
    d. Common mode noise attenuation of 150 dB or better at 40 Hz to 100 Hz

3.8 FIELD CONTROL DEVICES

A. Temperature Sensors:
1. All temperature sensors to be solid state electronic, factory-calibrated to within 0.5°F, totally interchangeable with housing appropriate for application.
2. Wall sensors to be installed as indicated on drawings. Mount 48 inches about finished floor.

3. Duct sensors to be installed such that the sensing element is in the main air stream.
4. Immersion sensors to be installed in wells provided by control contractor, but installed by mechanical contractor. Immersion wells shall be filled with thermal compound before installation of immersion sensors.
5. Outside air sensors shall be installed away from exhaust or relief vents, not in an outside air intake and in a location that is in the shade most of the day.

B. Intelligent Room Sensor with LCD Readout:
1. The intelligent room sensor shall be the Microset IV by Alerton, or equal.
2. Sensor shall contain a backlit LCD digital display and user function keys along with temperature sensor. Controller shall function as room control unit, and shall allow occupant to raise and lower setpoint, and activate terminal unit for override use—all within limits as programmed by building operator. Sensor shall also allow service technician access to hidden functions as described in sequence of operation.
3. The Intelligent Room Sensor shall simultaneously display room setpoint, room temperature, outside temperature, and fan status (if applicable) at each controller. This unit shall be programmable, allowing site developers the flexibility to configure the display to match their application. The site developer should be able to program the unit to display time-of-day, room humidity and outdoor humidity. Unit must have the capability to show temperatures in Fahrenheit or Centigrade.
4. Override time may be set and viewed in half-hour increments. Override time count down shall be automatic, but may be reset to zero by occupant from the sensor. Time remaining shall be displayed. Display shall show the word "OFF" in unoccupied mode unless a function button is pressed.
5. See sequence of operation for specific operation of LCD displays and function keys in field service mode and in normal occupant mode. Provide intelligent room sensors as specified in point list.
6. Field service mode shall be customizable to fit different applications. If intelligent room sensor is connected to terminal controller, terminal box shall be balanced and all air flow parameters shall be viewed and set from the intelligent room sensor with no computer or other field service tool needed.

C. RELAYS:

1. Control relays shall be UL Listed plug-in type. Contact rating, configuration, and coil voltage suitable for application. Honeywell R4228/8228.
2. Time delay relays shall be UL Listed solid-state plug-in type with adjustable time delay. Delay shall be adjustable ±200% (minimum) from set point shown on plans. Contact rating, configuration, and coil voltage suitable for application. Provide NEMA 1 enclosure when not installed in local control panel.

A. Voltage Transformers:

1. AC voltage transformers shall be UL and CSA recognized, 600 VAC rated, complete with built-in fuse protection.
2. Transformers shall be suitable for ambient temperatures of +40 to +130 degrees F and shall provide ±0.5 percent accuracy at 24 VAC and a 5 VA load.
3. Windings (except for terminals) shall be completely enclosed with metal or plastic material.
4. Transmitters
   a. Transmitter shall operate on 24 VAC. Transmitter shall not require an isolated power source.
   b. Operating temperature range for the transmitter shall be -20° F to 120° F. Protect transmitter from weather and water.
   c. Communication with host controls using one of the following interface options:

      1) Linear analog output signal: Field selectable, fuse protected and isolated, 0-10VDC and 4-20mA (4-wire)
      2) RS-485: Field selectable BACnet-MS/TP, ModBus-RTU

5. Measuring device shall be UL listed as an entire assembly.
6. Contractor shall review and approve placement and operating airflow rates for each measurement location indicated on the plans. A written report shall be submitted to the engineer if any measurement locations do not meet the manufacturer's placement requirements.

B. Local Control Panels:

1. Indoor control cabinets shall be fully enclosed NEMA 1 construction with hinged door or key-lock latch, and removable sub-panels. A single key shall be common to all field panels and sub-panels.
2. Interconnections between internal and face-mounted devices pre-wired with color-coded stranded conductors neatly installed in plastic troughs and/or tie-wrapped. Terminals for field connections shall be UL Listed for 600 volt service, individually identified per control/interlock drawings, with adequate clearance for field wiring. Control terminations for field connection shall be individually identified per control drawings.
3. Provide on and off power switch with over-current protection for control power sources to each local panel.
4. Build control panels in accordance with UL508A standards and label with separate UL label numbers.

C. Current Sensing Relay

1. Current Sensing Relays: Provide solid-state sensor, which operates when the current level sensed by the internal current transformer, exceeds the adjustable trip point. The internal circuits shall be totally powered by induction from the line being monitored. The relay shall have zero off state leakage in the solid-state output while switching both AC and DC circuits.

The monitored AC circuits shall be 1 to 150 amps. Veris, Model H908, or approved equal.

D. Flow Meters

1. Onicon Model FB-1210.

E. Network Connection Tool

1. Network connection tool shall allow technician to connect a laptop to any MS/TP network or at any MS/TP device and view and modify all information throughout the entire BACnet network. Laptop connection to tool shall be through Ethernet or PTP.

2. Provide quick connect to MS/TP LAN at each controller. Tool shall be able to adjust to all MS/TP baud rates specified in the BACnet standard.

3. Provide (1) Network Connection Tool for this project.

3.10 CONTROL VALVES

A. Manufacturers:

1. Honeywell
2. Belimo

B. Control Valves: Factory Fabricated, Of Type, Body Material, And Pressure Class Based On Maximum Pressure And Temperature Rating Of Piping System, Unless Otherwise Indicated.

C. Butterfly Valves: 200-Psig, 150-Psig (1034-Kpa) Maximum Pressure Differential, ASTM A 126 Cast-Iron Or ASTM A 536 Ductile-Iron Body And Bonnet, Extended Neck, Stainless-Steel Stem, Field-Replaceable EPDM Or Buna N Sleeve And Stem Seals.

1. Body Style: Lug.
2. Disc Type: Elastomer-coated ductile iron
3. Sizing: 1-psig maximum pressure drop at design flow rate.

D. Characterized Ball Type

1. Valves shall be specifically designed for modulating duty in control application with guaranteed average leak-free life span over 200,000 full stroke cycles.
2. Industrial quality with nickel plated forged brass bronze bodies and female NPT threads.
3. Blowout proof stem design, glass-reinforced Teflon thrust seal washer and stuffing box ring with minimum 600 psi rating (2-way valves) or 400 psi

rating (3-way valves). The stem packing shall consist of 2 lubricated O-rings designed for on-off, floating, or modulating service and requiring no maintenance.

4. Valves suitable for water or low-pressure steam shall incorporate an anti-condensation cap thermal break in stem design.
5. Ball: stainless steel
6. Stem: stainless steel
7. Port: Segmented design with characterizing disk held securely by a keyed ring

E. Plug-Type Globe

1. Valves shall have cage-type trim, providing seating and guiding surfaces for plug on top-and-bottom guided plugs.
2. Temperature Rating: 25ºF minimum, 250ºF maximum
3. Body

    a. Bronze, screwed for 1/2 inch to 2 inch
    b. Cast Iron, flanged for 2-1/2 inch and larger

4. Valve Trim: Bronze; Stem: Polished stainless steel
5. Packing: Spring Loaded Teflon or Synthetic Elastomer U-cups, self-adjusting
6. Plug: Brass, bronze or stainless steel, Seat: Brass
7. Disc: Replaceable Composition or Stainless Steel Filled PTFE
8. Ambient Operating Temperature Limits: -10 to 150ºF

F. Minimum Valve Assembly Pressure Ratings:

1. Chilled water: 125 psi at 60ºF
2. Hot water: 125 psi at 200ºF.

G. Valve Selection:

1. 2" and less: characterized ball valve.
2. 2-1/2" and greater: glob type

H. Valve Sizing:

1. Minimum pressure drop: equal to pressure drop of coil.
2. Maximum pressure drop:

    a. Hot water at coils: 2 psi
    b. Chilled water coils: 5 psi

3.11 ACTUATORS

A. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.

B. Manufacturers:

1. Honeywell

2. Belimo

C. Valves: Size for torque required for valve close off at maximum pump differential pressure.

D. Coupling: V-bolt and V-shaped, toothed cradle.

E. Overload Protection: Electronic overload or digital rotation-sensing circuitry.

F. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.

G. Power Requirements (non-Spring Return): 24 V ac.

H. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.

I. Proportional Signal: 2- to 10-V dc, and 2- to 10-V dc position feedback signal.

J. Temperature Rating: 40 to 104 deg F

K. Standard spring ranges are 2 to 5 psig, 3 to 10 psig, and 8 to 11 psig.

L. Not pulse actuated.

PART 4 EXECUTION

4.1 INSTALLATION

A. Provide conduit and wire from dedicated 120 VAC emergency power circuit if available.

B. Power supply wiring (120 VAC) shall be run in dedicated conduit. Power conduit shall be separated from control and signal conduits by a minimum of 3 inches.

C. EMS equipment shall be located such that it is accessible for service while maintaining clearances or walkways required around other equipment or obstacles.

D. Control elements located in outdoor installations shall be weatherproof.

E. Splices in shielded cables shall not be permitted. Terminations of shields and conductors shall be done in accordance with the manufacturer's instructions.

F. Cabling and wiring within panels shall be harnessed with tie wraps and secured in a neat and orderly fashion.

G. Cable runs shall be kept as short as possible, allowing extra length for making connections to termination points.

H. Each cable or individual conductor shall be labeled with a unique tag for quick identification during checkout, testing, and troubleshooting. each component shall be permanently labeled with the device name and at each terminal point per section.

4.2 EXAMINATION

A. Project plans shall be thoroughly examined for control device and equipment locations. Any discrepancies, conflicts, or omissions shall be reported to the Architect and Engineer for resolution before rough-in work is started.

B. Contractor shall inspect the site to verify that equipment may be installed as shown. Any discrepancies, conflicts, or omissions shall be reported to the Engineer for resolution before rough-in work is started.

C. Contractor shall examine the drawings and specifications for other parts of the work. If head room or space conditions appear inadequate—or if any discrepancies occur between the plans and contractor's work, and the plans and the work of others—contractor shall report these discrepancies to the Engineer and shall obtain written instructions for any changes necessary to accommodate the contractor's work with the work of others. Changes in the work covered by this Specification made necessary by the failure or neglect of contractor to report such discrepancies shall be made by—and at the expense of—this contractor.

4.3 PROTECTION

A. Contractor shall protect work and material from damage from its work or employees, and be liable for all damages thus caused.

B. Contractor shall be responsible for its work and equipment until finally inspected, tested, and accepted. Contractor shall protect material that is not immediately installed. Contractor shall close open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

4.4 COORDINATION

A. Site:

1. Where mechanical work will be installed in close proximity to, or will interfere with, work of other trades, contractor shall assist in working out space conditions to make a satisfactory adjustment. If contractor installs its work before coordinating with other trades, so as to cause any interference with work of other trades, contractor shall make necessary changes in its work to correct the condition without extra charge.

2. Coordinate and schedule work with all other work in same area, or with work that is dependent upon other work, to facilitate mutual progress.

B. Submittals: Refer to Submittals Article in Part 1 of this Specification for requirements.

C. Test and balance:

1. Contractor shall furnish all tools necessary to interface to the control system for test and balance purposes.
2. Contractor shall provide training in the use of these tools. This training will be planned for a minimum of four hours.
3. In addition, the contractor shall provide a qualified technician to assist in test and balance process, until the first 20 terminal units are balanced.
4. Tools used during the test and balance process will be returned at completion of the testing and balancing.

D. Coordination with controls specified in other sections or divisions: Other sections and divisions of this Specification include controls and control devices that are to be part of or interfaced to control system specified in this section. Controls shall be integrated into the system and coordinated by contractor as follows:

1. Communication media and equipment shall be provided as specified in Part 2: Communication of this Specification.
2. Each supplier of a control product is responsible for the configuration, programming, startup, and testing of that product to meet the sequences of operation described in this section.
3. Contractor shall coordinate and resolve any incompatibilities that arise between the control products provided under this section and those provided under other sections or divisions of this Specification.
4. Contractor is responsible for providing all controls as referenced in the related sections this work of contract documents.
5. Contractor is responsible for the interface of control products provided by multiple suppliers, as referenced in the related sections this work of contract documents.

4.5 GENERAL WORKMANSHIP

A. Install equipment, piping, and wiring raceway parallel to the building lines (i.e., horizontal, vertical, and parallel to walls) wherever possible.

B. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.

C. Install equipment in readily accessible locations as defined by Chapter 1, Article 100, Part A of the National Electric Code (NEC).

D. Verify wiring integrity to ensure continuity and freedom from shorts and grounds.

E. Equipment, installation, and wiring shall comply with acceptable industry specifications and standards for performance, reliability, and compatibility, and be executed in strict adherence to local codes and standard practices.

4.6 WIRING

A. Control and interlock wiring shall comply with national and local electrical codes and Division 16 of this specification. Where requirements of this section differ with those in Division 16, the requirements of this section shall take precedence.

B. NEC Class 1 (line voltage) wiring shall be UL Listed in approved raceway per NEC and Division 16 requirements.

C. Low-voltage wiring shall meet NEC Class 2 requirements. (Low-voltage power circuits shall be sub-fused when required to meet Class 2 current limit.)

D. Where NEC Class 2 (current limited) wires are in concealed and accessible locations, including ceiling return air plenums, approved cables not in the raceway may be used, provided cables are UL Listed for intended application. For example, plenums shall be UL Listed specifically for that purpose.

E. Wiring in mechanical, electrical, or service rooms—or where subject to mechanical damage—shall be installed in raceway at levels below 10ft.

F. Do not install Class 2 wiring in raceway containing Class 1 wiring. Boxes and panels containing high-voltage wiring and equipment may not be used for low-voltage wiring except for the purpose of interfacing the two.

G. Do not install wiring in raceway containing tubing.

H. Class 2 wiring to be installed in conduit.

I. Wire-to-device connections shall be made at a terminal block or terminal strip. Wire-to-wire connections shall be made at a terminal block or wire nut at junction box.

J. Wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.

K. Maximum allowable voltage for control wiring shall be 120v. If only higher voltages are available, the contractor shall provide step-down transformers.

L. Wiring shall be installed as continuous lengths, with no splices permitted between termination points.

M. Size of raceway and size and type of wire shall be the responsibility of contractor, in keeping with the manufacturer's recommendation and NEC requirements, except as noted elsewhere.

N. Include one pull string in each raceway 1 inch or larger.

O. Use coded conductors throughout with different colored conductors.

P. Conceal all raceways, except within mechanical, electrical, or service rooms. Install raceway to maintain a minimum clearance of 6inch from high-temperature equipment (e.g., steam pipes or flues).

Q. Secure raceways with raceway clamps fastened to structure and spaced according to code requirements. Raceways and pull boxes may not be hung on flexible duct strap or tie rods. Raceways may not be run on or attached to ductwork.

R. Install insulated bushings on all raceway ends and openings to enclosures. Seal top end of vertical raceways.

S. Contractor shall terminate control and interlock wiring, and maintain updated wiring diagrams with terminations identified at the job site.

T. Flexible metal raceways and liquid-tight, flexible metal raceways shall not exceed 3 ft in length and shall be supported at each end. Flexible metal raceway less than ½ in. electrical trade size shall not be used. In areas exposed to moisture—including chiller and boiler rooms—liquid-tight, flexible metal raceways shall be used.

U. All conduits on roof or exposed to weather to be rigid.

V. Raceway shall be rigidly installed, adequately supported, properly reamed at both ends and left clean and free of obstructions. Raceway sections shall be joined with couplings (per code). Terminations shall be made with fittings at boxes, and ends not terminating in boxes shall have bushings installed.

4.7 COMMUNICATION WIRING

A. Contractor shall adhere to items listed in Wiring Article in Part 3 of Specification.

B. Follow manufacturer's installation recommendations for communication cabling.

C. Do not install communication wiring in raceway and enclosures containing Class 1 or other Class 2 wiring.

D. Maximum pulling, tension, and bend radius for cable installation, as specified by the cable manufacturer, shall not be exceeded during the installation.

E. Contractor shall verify the integrity of the entire network following the cable installation. Use appropriate test measures for each particular cable.

F. When a cable enters or exits a building, a lightning arrestor shall be installed between the lines and ground. Lightning arrestor shall be installed according to the manufacturer's instructions.

G. Runs of communication wiring shall be unspliced lengths when that length is commercially available.

H. Label communication wiring to indicate origination and destination data.

4.8 FIELD QUALITY CONTROL

A. Work, materials, and equipment shall comply with rules and regulations of applicable local, state, and federal codes and ordinances as identified in Part 1 of this Specification.

B. Contractor shall continually monitor the field installation for code compliance and quality workmanship.

C. Contractor shall have work inspected by local or state authorities having jurisdiction over the work.

4.9 IDENTIFICATION OF HARDWARE AND WIRING

A. Wiring, cabling, and tubing within factory-fabricated panels shall be labeled within 2inch of termination with point address or termination number.

B. Label pneumatic tubing at each end within 2inch of termination with descriptive identifier.

C. Identify control panels with minimum 1/2inch letters on laminated plastic nameplates.

D. Manufacturers' name plates and UL or CSA labels are to be visible and legible after equipment is installed.

E. Identifiers shall match record documents.

F. Permanently label or code each point of field terminal strips to show instrument or item served.

G. Identify room sensors relating to air handling units and terminal air units with nameplates.

H. Label wiring and conduit, including wire within panels.

I. Electrical devices such as transformers and power supplies shall be labeled with supply voltage and power circuit number.

J. Terminal blocks shall be labeled to match the connected device.

K. Label panel-mounted devices to match as built drawings.

L. Wire and tubing labels shall be clearly indicated on the control drawings. Method of labeling shall be logical and intuitive.

M. Provide label on ceiling grid near each terminal air unit, and air and water pressure transducers in the ductwork and piping. Follow campus standard for type and appearance of label.

4.10 PROGRAMMING

A. Provide sufficient internal memory for the specified sequences of operation and trend logging. There shall be a minimum of 25 percent of available memory free for future use.

B. Point naming and point value: System point names and values shall be of sufficient size to allow flexibility in design, allowing easy operator interface without the use of a written point index or cryptic alphanumeric shorthand.

1. Point ID is used to designate the location of the point within the building, such as mechanical room, wing, or level, or the building itself in a multi-building environment. Point ID shall be a minimum of 40 characters in length.
2. Point descriptors shall be a minimum of 132 characters.
3. Point states shall be a minimum of 8 characters in length.
4. Point engineering units shall be a minimum of 6 characters in length.
5. Point values shall be a minimum of 15 characters in length with a variable decimal point.

C. Operator interface:

1. Standard graphics: Provide graphics for all mechanical systems and floor plans of the building. This includes each chilled water system, hot water system, fan coil unit, terminal equipment and all life safety devices. Point information on the graphic displays shall dynamically update. Show on each graphic all input and output points for the system. Also show relevant calculated points such as set points.
2. Show terminal equipment information on a graphic summary table. Provide dynamic information for each point shown.
3. Program graphic screens to show the location of, alarm points, and cameras. Set up these screens to provide automatic camera call up upon alarm.
4. Contractor shall provide labor necessary to install, initialize, start up, and troubleshoot all operator interface software and their functions as described in this section. This includes any operating system software, operator interface database, and any third-party software installation and integration required for successful operation of the operator interface

4.11 BUILDING CONTROL INSTALLATION SPECIFICS

A. Installation of sensors

1. Install sensors in accordance with the manufacturer's recommendations.
2. Mount sensors rigidly and adequately for the environment within which sensor operates.
3. Room temperature sensors shall be installed on concealed junction boxes properly supported. Wiring to the sensor shall not be required to be polarity sensitive. Design of sensor shall be modular, which allows for rough-in of wiring without presence of electronics or esthetic covering.
4. Wires attached to sensors shall be air sealed in their raceways or in the wall to stop air transmitted from other areas affecting sensor readings.

B. Flow switch installation

1. Use correct paddle for pipe diameter.
2. Adjust flow switch in accordance with manufacturer's instructions.

C. Actuators

1. Mount and link control damper actuators per manufacturer's instructions.

    a. Check operation of damper and actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
    b. Provide mounting hardware and linkages for actuator installation.

2. Electric and electronic actuators:

    a. Dampers: Actuators shall be direct-mounted on damper shaft or jackshaft unless shown as a linkage installation. Actuators shall be mounted following manufacturer's recommendations.
    b. Valves: Actuators shall be connected to valves with adapters approved by actuator manufacturer. Actuators and adapters shall be mounted following actuator manufacturer's recommendations.

4.12 CONTROL SYSTEM CHECKOUT AND TESTING

A. Startup testing: Testing listed in this Article shall be performed by contractor and make up part of the necessary verification of an operating control system. Testing shall be completed before the Owner's representative is notified of the system demonstration.

1. Contractor shall furnish all labor and test apparatus required to calibrate and prepare for service all instruments, controls, and accessory equipment furnished under this Specification.
2. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
3. Enable control systems and verify calibration of all input devices individually. Perform calibration procedures per manufacturers' recommendations.

4. Verify that digital output devices (relays, solenoid valves, two-position actuators and control valves, and magnetic starters) operate properly and that normal positions are correct.
5. Verify that analog output devices (I/Ps, actuators) are functional, that start and span are correct, and that direction and normal positions are correct. Contractor shall check all control valves and automatic dampers to ensure proper action and closure. Contractor shall make any necessary adjustments to valve stem and damper blade travel.
6. Verify that system operation adheres to the Sequences of Operation. Simulate and observe modes of operation by overriding and varying inputs and schedules. Tune all DDC loops and optimum start and stop routines.
7. Analog intelligent devices shall be tested for current address, sensitivity and user defined message
8. Verify activation of all waterflow switches.
9. Open initiating device circuits and verify that the trouble signal actuates.

4.13 CONTROL SYSTEM DEMONSTRATION AND ACCEPTANCE

A. Demonstration:

1. Prior to acceptance, control system shall undergo a series of performance tests to verify operation and compliance with this Specification. Tests shall occur after the contractor has completed the installation, started up the system, and performed its own tests.
2. Tests described in this section are to be performed in addition to tests that contractor performs as a necessary part of the installation, startup, and debugging process and as specified in the Control System Checkout and Testing Article in Part 3 of this Specification. Engineer will be present to observe and review these tests. Notify Engineer at least 10 days in advance of the start of the testing procedures.
3. Demonstration process shall follow that approved in Part 1: Submittals. Approved checklists and forms shall be completed for all systems as part of the demonstration.
4. Contractor shall provide at least two persons equipped with two-way communication, and shall demonstrate field operation of each control and sensing point for modes of operation including day, night, occupied, unoccupied, fire/smoke alarm, seasonal changeover, alarm, trouble, and power failure modes. Purpose is to demonstrate the calibration, response, and action of every point and system. Test equipment required to prove operation of system shall be provided and operated by contractor.
5. Complete a log showing the date, technician's initials, and any corrective action taken or needed for each control input and output checked.
6. Demonstrate compliance with Part 1: System Performance.
7. Demonstrate compliance with Sequences of Operation through all modes of operation.
8. Demonstrate the following items:

    a. Complete operation of the operator interface

b. DDC Loop response: Contractor shall supply trend data output in a graphical form showing the step response of each DDC loop. Test shall show the loop's response to a change in set point that represents a change of actuator position of at least 25 percent of its full range. Sampling rate of the trend shall be from 10 seconds to 3 minutes, depending on the speed of the loop. For each sample, the trend data shall show the set point, actuator position, and controlled variable values. Any loop that yields unreasonably under-damped or over-damped control shall require further tuning by contractor.
c. Demand limiting (if implemented): Contractor shall supply a trend data output showing the action of demand limiting algorithm. Data shall document action on a minute-by-minute basis over a 30-minute period. Included in the trend shall be building kW, demand limiting set point, and the status of sheddable equipment outputs.
d. Optimum start and stop (if implemented): Contractor shall supply a trend data output showing the capability of the algorithm. The hour-by-hour trends shall include output status of optimally started and stopped equipment, and area temperature sensor inputs.
e. Interface to the building fire alarm system (if implemented).
f. Operational logs for each system that indicate all set points, operating points, valve positions, mode, and equipment status shall be submitted to the Architect and Engineer. These logs shall cover three 48-hour periods and have a sample frequency of not more than 10 minutes. Provide logs in both printed and disk formats.
g. Devices supplied by others connected to the LonWorks™ system shall be checked out and commissioned by supplier, and verification of interface interoperability shall be conducted by contractor.

9. Tests that fail to demonstrate operation of the system shall be repeated at a later date. Contractor shall be responsible for necessary repairs or revisions to hardware or software to successfully complete tests.

B. Acceptance:

1. Tests described in this Specification shall have been performed to the satisfaction of the Engineer and Owner prior to acceptance of the control system as meeting the requirements of completion. Tests that cannot be performed due to circumstances beyond the control of contractor may be exempt from completion requirements if stated in writing by the Engineer. Tests shall then be performed as part of the warranty.
2. System shall not be accepted until all forms and checklists completed as part of the demonstration are submitted and approved as required in Part 1: Submittals.

4.14 CLEANING

A. Contractor shall clean up all debris resulting from its activities daily. Contractor shall remove all cartons, containers, and crates under its control as soon as their contents have been removed. Waste shall be collected and placed in a designated location.

B. At completion of work in any area, contractor shall clean all of its work and equipment, keeping it free from dust, dirt, and debris.

C. At the completion of work, equipment furnished under this Section shall be checked for paint damage, and any factory-finished paint that has been damaged shall be repaired to match the adjacent areas. Any cabinet or enclosure that has been deformed shall be replaced with new material and repainted to match the adjacent areas.

4.15 SYSTEM TESTING AND CHECKOUT

A. Prior to the acceptance test, perform the following tasks:

1. Check for electrical continuity, eliminating shorts and open circuits, and verify grounding.
2. Install, calibrate, adjust, debug and set system's initial operating parameters including the existing campus central server.
3. Check out systems to verify the provided engineering documentation and approved submittals have been followed.

B. The EMS must operate continuously for seven (2) days with no operational malfunctions or problems before setting an acceptance test date. Simulate different building control scenarios for worst-case condition and simulate other alarm conditions to test the response and handling of situations.

C. Prepare and submit an Acceptance Test Plan for approval. This test shall include verification of communications, control, and response from the existing campus central server to the building controller and finally to the sensor and controlled device to demonstrate the proper operation of control loops, conditional control and default sequences in accordance with the project documentation.

D. Obtain the approval of the OWNER's representative as to when the acceptance test will be performed.

E. Conduct the acceptance test in the presence of the designated representative for OWNER following the approved Acceptance Test Plan.

F. The OWNER's Representative shall check off and initial each successfully tested item. Demonstrate that the electromechanical systems are operating properly and that the system is providing the required control sequences, alarms, graphic displays, and report generations.

G. An ongoing punch list shall be maintained throughout the test of items. This list shall contain items that must be corrected prior to accepting the system for beneficial use and commencement of the warranty period.

H. Provide copy of database of objects, and any programming tools used during the setup of the system.

4.16 TRAINING

A. Furnish the services of competent instructor(s) who shall give a minimum of (4) hours onsite instruction and orientation to the OWNER's designated personnel in the adjustment, operation and maintenance, including pertinent safety requirements of the equipment, the affected systems, and the software provided. The training shall be customized to reflect the actual system installed rather than being a general training course. Each instructor shall be thoroughly familiar with all aspects of the subject matter they are to teach.

B. Provide the following minimum training services for at least (2) owners representatives.

C. Train designated staff of Owner's representative and Owner to enable them to:

1. Day-to-Day Operators:

    a. Proficiently operate the system
    b. Understand control system architecture and configuration
    c. Understand system components
    d. Understand system operation, including system control and optimizing routines (algorithms)
    e. Operate the workstation and peripherals
    f. Log on and off the system
    g. Access graphics, point reports, and logs
    h. Adjust and change system set points, time schedules, and holiday schedules
    i. Recognize malfunctions of the system by observation of the printed copy and graphical visual signals
    j. Understand system drawings and the Operation and Maintenance manual
    k. Understand the job layout and location of control components
    l. Access data from various network and control nodes.
    m. Operate portable operator's terminals

2. Advanced operators:

    a. Make and change graphics on the workstation
    b. Create, delete, and modify alarms, including annunciation and routing of these
    c. Create, delete, and modify point trend logs, and graph or print these both on an ad-hoc basis and at user-definable time intervals
    d. Create, delete, and modify reports
    e. Add, remove, and modify system physical points
    f. Create, modify, and delete programming
    g. Add panels when required
    h. Add operator interface stations
    i. Create, delete, and modify system displays—both graphical and otherwise
    j. Perform system field checkout procedures
    k. Perform controller unit operation and maintenance procedures

l. Perform workstation and peripheral operation and maintenance procedures
m. Perform system diagnostic procedures
n. Configure hardware including PC boards, switches, communication, and I/0 points
o. Maintain, calibrate, troubleshoot, diagnose, and repair hardware
p. Adjust, calibrate, and replace system components

3. System managers and administrators:

a. Maintain software and prepare backups
b. Interface with job-specific, third-party operator software
c. Add new users and understand password security procedures

D. These objectives will be divided into three logical groupings. Participants may attend one or more of these, depending on the level of knowledge required:

1. Day-to-day operators
2. Advanced operators
3. System managers and administrators

E. Provide course outline and materials as per Submittals Article in Part 1 of this Specification. Instructor(s) shall provide one copy of training material per student.

F. Instructor(s) shall be factory-trained experienced in presenting this material.

G. Classroom training shall be done using a network of working controllers representative of the installed hardware.

PART 5 POINTS LIST AND SEQUENCE OF OPERATION

Refer to Controls Drawings for control schematics, points list and sequence of operation.

END OF SECTION

SECTION 23 2110

HYDRONIC DISTRIBUTION

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes piping for hydronic distribution systems for chilled water piping outside the building 12 inches and less in diameter. Larger-bore piping and installations will require more detailed design and different materials. Piping includes pipes, fittings, valves, insulation, and specialties for the following:

1. Manufactured, preinsulated piping systems.

1.02 PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing chilled water piping systems with the following minimum working-pressure ratings:

1. Chilled-Water Piping: 175 psig**.**

1.03 DEFINITIONS

A. The following are industry abbreviations for plastic and rubber piping materials:

1. PVC: Polyvinyl chloride plastic.

B. Thermal Conductivity and Apparent Thermal Conductivity (k-Value): As defined in ASTM C 168. In this Section, these values are the result of the formula Btu x in./h x sq. ft. x deg F or W/m x K at the temperature differences specified. Values are expressed as Btu or W.

1. Example: Apparent Thermal Conductivity (k-Value): 0.26 or 0.037.

1.04 SUBMITTALS

A. Product Data: Include carrier piping, insulation type and k-value, jacket, end seals, and major components for each cased piping system.

B. Shop Drawings: Signed and sealed by a qualified professional engineer.

1. Show pipe sizes, locations, and elevations. Show piping in trench, conduit, and cased pipe with details showing clearances between piping, and show insulation thickness.
2. Thrust block calculations and soil bearing strength values shall be subject to the approval of the civil or structural engineer of record.

C. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from hydronic distribution piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.

D. Profile Drawings: Show system piping in elevation. Draw profiles at horizontal scale of not less than 1 inch equals 50 feet and at vertical scale of not less than 1 inch equals 5 feet.

E. Field Reports: Indicate and interpret test results for compliance with performance requirements.

1. Manufacturer's Installation Report: Manufacturer's field inspection report, approved and signed by authorized factory agent.

F. Warranties: Special warranties specified in this Section.

1.05 COORDINATION

A. Coordinate pipe-fitting pressure classes with products specified in related Sections to allow matching of flange bolt holes.

1.06 QUALITY ASSURANCE

A. Manufacturer's Approved Installation Methods: The entire installation shall conform to the requirements of the piping system manufacturer, including thrust block layout and design.

1.07 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by the University or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify University Representative no fewer than two weeks in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without the University's Representative written permission.

1.08 WARRANTY

A. General Warranty: The special warranty specified in this Article shall not deprive the University of other Rights the University may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Pre-Insulated Piping Systems:

a. Perma-Pipe, Inc. - Chil Guard
b. Rovanco Corp.
c. Thermal Pipe Systems, Inc. - Kool –Kore
d. JM Eagle – Blue Brute
e. Or equal.

B. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.02 INSULATED PIPING SYSTEM

A. PVC Pipe:

1. Pressure Rating Schedule: DR14 or class 305 or FM class 200**.**
2. Dimensioning Type: Iron Pipe size (IPS) per ASTM D 2241, or AWWA C900.
3. PVC Material Grade: Type 1, Grade 1, Classification 12454-B per ASTM D 1784.
4. Hydrostatic Design Stress Designation: PVC 1120 per ASTM D 1784.
5. Pipe Joining Method: ASTM D 2466, bell and spigot type with Styrene-Butadiene rubber gaskets.

B. Pipe Fittings:

1. Restrained mechanical joint type epoxy coated ductile iron conforming to ANSI/AWWA C110/A21.10 and furnished with Styrene-Butadiene rubber gaskets.

C. Piping Insulation System:

1. General: Terms used in this Article are defined in ASTM C 168.
2. Insulation Type: Polyurethane – 90% closed cell piping insulation:

   a. Thermal conductivity (K-valve): 0.14 at 75 deg F. mean temperature.
   b. Density: 2-3-lb/cu. Ft. average.

3. Jacket: High impact seamless PVC.

   a. Compressive strength: 40 psi.

4. End Seals: Seals shall be designed and factory fabricated to prevent the ingress of moisture into the system. Painted on end seals of any type is prohibited.
5. Pipe Joint Insulation System: Provide manufacturer's field-applied insulation and jacketing option on field joints. Piping joints shall be insulated to match factory-applied insulation R-value, and jacketed with heat-shrink type outer jacketing.

2.03 JOINING MATERIALS

A. Gasket Materials: ASME B16.21, nonmetallic, asbestos free, rubber, and suitable for system liquid.

B. Fasteners: 316L stainless steel with anti-gall coating.

2.04 VALVES

A. Valves shall be Class 150 pipe systems, and shall open by turning the stem counter clockwise. Gate valves shall be manufactured in accordance with AWWA Standard C509, resilient wedge. Valves 12" and smaller shall be designed for 200 psi water working pressure and 150 psi for valves 14" and larger. Valves shall have flanged or mechanical joint ends and shall have clear waterway equal to the full nominal diameter of the valve. Provide

with fusion-bonded epoxy coating on the interior and exterior of valve body meeting AWWA C550. Fasteners shall be stainless steel. See Division 23 Section "Hydronic Piping and Valves" for further details.

2.05 CORROSION-PROTECTION ENCASEMENT FOR PIPING

A. Encasement for Underground Metal Piping: ASTM A 674 or AWWA C105, PE film, minimum 0.008-inch thick, tube, tape, or sheet.

PART 3 - EXECUTION

3.01 FITTING AND JOINT CONSTRUCTION

A. Fitting, Joints: Prepare piping and fittings and join according to manufacturer's written instructions.

B. Provide epoxy coated ductile iron fittings with stainless steel fasteners.

C. Gasketed Joints: Join according to ASTM D 3139 with piping manufacturer approved lubricant.

3.02 PIPING INSTALLATION

A. General Locations and Arrangements: Drawings indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated, unless deviations to layout are approved on Coordination Drawings.

B. Install piping free of sags and bends.

C. Locate groups of pipes parallel to each other, spaced to permit valve servicing.

D. Install fittings for changes in direction and branch connections.

E. Clean and coat non-epoxy coated metal products to be installed underground prior to backfilling. Coat with coal tar epoxy, polymer or organic based coating. Let completely dry before installing PE wrap.

F. Encase fittings in polyethylene wrap and seal ends with suitable tape. For smaller-bore fittings, use of 10-mil pipe wrapping tape is allowed.

G. Provide manufacturer's optional end seals, field-installed insulation at joints and fittings, and field-installed heat-shrink wrap type jacketing. Outer jacketing shall be water-tight.

H. Install drains at low points inside the building consisting of tee fitting, 3/4-inch NPS ball valve, and 6-inch long minimum 3/4-inch NPS threaded nipple and cap.

I. Make horizontal reductions in pipe sizes using eccentric reducer fitting installed with level side up.

J. Install flanges according to manufacturer's written instructions.

K. Piping Connections: Make piping connections to existing steel distribution piping and building steel piping system with flanges. Extend PVC piping 12-inches maximum into

buildings, tunnels, trench, or in accessible vaults, and make flange connections in readily accessible and visible location. Installation shall follow the pre-insulated piping manufacturer's details.

3.03 FIELD QUALITY CONTROL

A. Provide manufacturer's field construction supervision and installation inspection services with complete written report. Obtain manufacturer's written installation approval prior to trench backfilling.

B. Prepare hydronic piping for testing according to ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Isolate equipment. Do not subject equipment to test pressure.
3. Fill system. Use ambient temperature water.
4. Install relief valve set at pressure no more than one-third higher than test pressure.
5. Use vents installed at high points to release trapped air while filling system.

C. Test hydronic piping as follows:

1. Subject piping system to hydrostatic test pressure at 1.5 times the design pressure for four hours. There shall be no decrease in pressure allowed over the four hour test.
2. After hydrostatic test pressure has been applied, examine piping, joints, and connections for leakage throughout the testing period. Eliminate leaks by tightening, repairing, or replacing components as appropriate, and repeat hydrostatic test until there are no leaks.
3. Prepare a written report of testing.

3.04 CLEANING

A. Inspect finish of exposed, hydronic piping, including outlets, valves, specialties, and devices, after installation is complete. Remove burrs, dirt, and debris. Repair damaged finishes including chips, scratches, and abrasions.

B. Clean and flush hydronic piping.

END OF SECTION

SECTION 23 2113

HYDRONIC PIPING AND VALVES

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes piping, special-duty valves, and hydronic specialties for hot-water heating, chilled-water cooling, process cooling loops, and condenser water systems; makeup water for these systems; blow down drain lines; and condensate drain piping.

1.02 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NRS: Nonrising stem.

D. OS&Y: Outside screw and yoke.

E. RS: Rising stem.

F. SWP: Steam working pressure.

G. WOG: Water oil and gas.

H. Bronze: An alloy consisting primarily of copper and tin.

I. Brass: An alloy consisting primarily of copper and zinc.

J. Red Brass: An alloy consisting of not less than 85% copper with the balance being zinc and minor constituents.

K. PTFE: Polytetrafluoroethylene commonly called by the trade name Teflon®

1.03 SUBMITTALS

A. Product Data: For each type of valve indicated. Include flow and pressure drop curves based on manufacturer's testing for valves, diverting fittings, manual calibrated balancing valves, and automatic flow-control valves. Material properties including percentage of zinc, copper, tin, and minor metals, where specified.

B. Shop Drawings: Detail fabrication of pipe anchors, hangers, special pipe support assemblies, alignment guides, expansion joints and loops, and their attachment to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

C. Welding Certificates: Copies of certificates for welding procedures and personnel.

D. Field Test Reports: Written reports of tests specified in Part 3 of this Section. Include the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Failed test results and corrective action taken to achieve requirements.

E. Maintenance Data: For hydronic specialties and special-duty valves to include in maintenance manuals specified in Division 01.

F. Piping, fittings, and accessories: For each type of materials indicated, including gaskets.

1.04 QUALITY ASSURANCE

A. Welding: Qualify processes and operators according to the ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

B. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, and weld ends.
3. Block check valves in either closed or open position.
4. Set valves open to minimize exposure of functional surfaces.

B. Use the following precautions during storage:

1. Maintain valve or fitting end protection.
2. Store valves and fittings indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves and fittings; rig sling to avoid damage to exposed parts. Do not use operating handles, handwheels, or stems as lifting or rigging points.

1.06 COORDINATION

A. Coordinate layout and installation of hydronic piping and suspension system components with other construction, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

B. Coordinate pipe fitting pressure classes with products specified in related Sections.

C. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into base.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Materials:
   a. Certified to ASTM 584-14 and ASTM B61
   b. Provide manufacturer's certifications showing material properties
   c. Bronze containing not less than 85% copper by weight.
   d. Brass shall be dezinctification resistant as shown by MFR test data approved by the University's representative.

2. Safety Valves:

   a. Conbraco Industries, Inc.
   b. ITT McDonnell & Miller Div.; ITT Fluid Technology Corp.
   c. Kunkle Valve Division.
   d. Spence Engineering Company, Inc.
   e. Or equal.

3. Pressure-Independent Flow Control Valves:

   a. Delta-P
   b. Or equal

B. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.02 PIPING MATERIALS

A. General: Refer to Part 3 "Piping Applications" Article for applications of pipe and fitting materials.

2.03 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.

B. Wrought-Copper Fittings: ASME B16.22.

C. Wrought-Copper Unions: ASME B16.22.

D. Solder Filler Metals: ASTM B32, 95-5 tin antimony.

E. Brazing Filler Metals: AWS A5.8, Classification BAg-1 (silver).

2.04 STEEL PIPE AND FITTINGS

A. Steel Pipe, NPS ¾ through NPS 1½: ASTM A53, Type S (seamless) Grade A, Schedule 40, black steel, plain ends.

B. Steel Pipe, NPS 2 through NPS 10: ASTM A53, Type S (seamless) and Type ERW (welded) Grade A or B, Schedule 40, black steel, plain ends.

C. Steel Pipe, NPS 12 and larger: ASTM A53, Type S and Type ERW (welded) Grade B, 0.375 inch wall thickness, black steel, plain ends.

D. Steel Pipe Nipples: ASTM A733 made of ASTM A53, Schedule 40, black steel; seamless.

E. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300.

F. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300.

G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

1. Material Group: 1.1.
2. End Connections: Butt welding.
3. Facings: Raised face.

H. Welding Materials: Comply with Section II, Part C, of the ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.

I. Gasket Material: Thickness, material, and type suitable for fluid to be handled; and design temperatures and pressures.

J. Use of groove-joint piping and fittings for hydronic piping system is prohibited.

2.05 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B1.20.1 for threads for threaded-end valves.
2. ASME B16.1 for flanges on iron valves.
3. ASME B16.5 for flanges on steel valves.
4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
5. ASME B16.18 for solder-joint connections.
6. ASME B31.1 for power piping valves.
7. ASME B31.9 for building services piping valves.

C. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are prohibited.

D. Refer to HVAC valve schedule articles for applications of valves.

E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. Valve Actuator Types:

1. Gear Actuator: For quarter-turn valves NPS 4 and larger.
2. Handlever: For quarter-turn valves smaller than NPS 4.

H. Valves in Insulated Piping:

1. Include 2-inch or longer stem extensions.
2. Extended operating handle of nonthermal-conductive material, and protective sleeves that allow operation of valves without breaking the vapor seals or disturbing insulation.
3. Memory stops that are fully adjustable after insulation is applied.

I. Drain Connections: MSS SP-45.

2.06 VALVES

A. Ball Valves: (Sizes NPS ½"– 2", typical)

1. Ball valves (½"-2"), shall be two-piece style, full port, bronze body (ASTM B62 or B584) with type 316 stainless steel ball & stem and PTFE (or RPTFE) seats and seals. Valves shall be rated for 600 WOG & 150 SWP (non-shock). Valves shall have adjustable packing glands and blow-out proof (internally retained) stems and shall comply with the latest edition of MSS-SP-110. Threaded end (FNPT) ball valves only;

use male adapters where required in soldered end applications. Supply valves with stem extensions which clear 2" of piping insulation when installed in insulated services.

a. Conbraco Industries, Inc; Apollo Division figure 77-140.
b. Milwaukee Valve figure BA400S.
c. Hammond Valve figure 8303A.
d. Nibco figure T-585-70-66.
e. Or equal.

B. AWWA, Cast-Iron Gate Valves for non-hot water applications:

1. Manufacturers:

a. American AVK
b. American Flow Control Div.
c. Clow Valve
d. Kennedy Valve M&H Valve Company
e. Mueller Company
f. United States Pipe and Foundry Company
g. Or equal.

2. Nonrising-Stem, Resilient-Seated Gate Valves: AWWA C509, gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze or stainless steel stem, and stem nut. All fasteners on valves for water applications below 70°F shall be stainless steel.

a. Minimum Working Pressure: 200 AWWA 250 psig.; UL FM 200 psig
b. Above Ground End Connections: Flanged or threaded for 3-inches and smaller only.
c. Below Ground End Connections: Mechanical Joint, Flanged, or threaded for 3-inches and smaller only.
d. Interior and Exterior Coating: Fusion Bonded Epoxy Complying with AWWA C550, epoxy.
e. Metal thickness shall meet AWWA C509 standards whether using gray or ductile iron. The wall thickness reduction allowable for AWWA C515 is prohibited.

C. Ductile Iron or Cast Steel Gate Valves for heating water applications:

1. Manufacturers:

a. Bonney Forge
b. Crane Valves.
c. Milwaukee Valve Company.
d. NIBCO Figure F-637
e. Powell Valves
f. Pima Valve, Inc.
g. Stockham Div.

h. Walworth Valves
i. Or equal.

2. Ductile Iron Gate Valves, General: MSS SP-128, Type I.

a. 150 psi saturated steam to 366°F, 250 psi non-shock cold working pressure, Outside screw and yoke, Bolted bonnet, Solid wedge, Iron body bronze mounted (IBBM), Class 150 raised face flanged end connections.
b. 150 psi saturated steam to 366°F, 250 psi non-shock cold working pressure, Outside screw and yoke, Bolted bonnet, Solid wedge, Stainless steel trim, Class 150 raised face flanged end connections

3. Cast Steel Gate Valves, General:

a. ASME Pressure Class 150 Outside screw and yoke, bolted bonnet, solid wedge, API#8 Trim (13% Cr to hard face)

D. Safety Valves: Diaphragm-operated, bronze body with stainless steel, PTFE, or rubber, wetted, internal working parts; shall suit system pressure and heat capacity and shall comply with the ASME Boiler and Pressure Vessel Code, Section IV.

E. Refer to Part 3 "Valve Applications" Article for applications of each valve.

F. Combination duty type valves (e.g. "Triple Duty") and fittings are prohibited.

G. Combination Assemblies: Individual threaded components, ball valves, pressure independent control valve, automatic flow limiting device if pressure independent control valve for some reason is not being installed, fitted with pressure and temperature test valves, strainer, flexible hoses, and designed for 300 psig at 250 deg F for duct or terminal mounted heating coils. See Campus Standard detail.

2.07 HYDRONIC SPECIALTIES

A. Manual Air Vent Bronze body ball valve with stainless steel ball; NPS ½.

B. Automatic Air Vent: Designed to vent automatically with float principle; bronze body and nonferrous internal parts; 150-psig working pressure; 240 deg F operating temperature; with NPS ¼ discharge connection and NPS ½ inlet connection. Provide only one automatic air vent in system at air separator.

C. Y-Pattern Strainers NPS 2 and smaller:

1. Strainers 2" and smaller for heating and air conditioning water service shall be based on Watts No. LF777, LFS777 or equal strainer by Armstrong or equal, 400 WOG bronze body, threaded, Y-pattern, 20-mesh stainless steel screen, with a full size drain connection and ball valve.

D. Low Pressure Drop Y-Pattern Strainers NPS 2 and larger:

1. Strainers 2" and larger for heating and air conditioning water service shall be The Metraflex Company®, Chicago, IL, model LPD or equal, ASTM A126-B cast-iron body, flanged, Y-pattern, type 304 stainless steel screen, with a drain connection and ball valve (as described elsewhere herein). Strainer shall be suitable for horizontal and vertical mounting.
2. Y Strainer shall be low pressure drop design with the following minimum C_V values:

    a. 2" pipe 120
    b. 2½" pipe 160
    c. 3" Pipe 236
    d. 4" Pipe 460
    e. 5" Pipe 600
    f. 6" Pipe 952
    g. 8" Pipe 1,580
    h. 10" Pipe 2,424
    i. 12" Pipe 3,200

3. Screen perforations shall be:

    a. For liquid service for sizes 2" – 3" perforation shall be 0.045"
    b. For liquid service for sizes 4" – 12" perforation shall be 0.125"

4. Strainer shall have a screen pitch of less than 30°.
5. Provide start-up strainer.
6. Screens shall be removable via an access cover sealed with O-ring.
7. Strainer shall be manufactured with 0.25" or 0.375" pressure differential ports, placed on each side of the screen.
8. Strainer shall be equipped with a dry well port.

    a. Port shall be 0.5" for pipe sizes 2" – 3"
    b. Port shall be 1" for pipe sizes 4" – 12".

9. Strainer connection shall be 125 lb. class flange.

2.08 CHAINWHEELS

A. Description: Valve actuation assembly with sprocket rim, chain guides, chain, or if chainwheel does not mount directly to the valve stem or gearbox shaft attachment brackets for mounting chain wheels directly to hand wheels.

1. Sprocket Rim with Chain Guides: Ductile iron or Aluminum, of type and size required for valve. Include zinc or epoxy coating for exterior use.
2. Chain: Hot-dip-galvanized steel for exterior use, brass or 304 Stainless steel, of size required to fit sprocket rim.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine valves and fittings interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open- to fully-closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.02 PIPING APPLICATIONS

A. Hot Water Heating and Chilled Water (above ground):

1. NPS 2 and smaller: Type L copper; with 95-5 soldered wrought copper fittings.
2. NPS 2½ and larger: Black steel pipe, ASTM A53, Type S (seamless) or Type ERW (welded); with standard weight ASTM A234 forged steel fittings for butt-weld connection.

3. NPS 2 and smaller: Use union connections.
4. NPS 2½ and larger: Use flange connections.
5. Dissimilar metals: Where piping is connected to equipment with different materials, such as ferrous to copper, use brass union, brass coupler, or brass pipe nipple to prevent electrolysis.
6. Valves: Provide shut-off duty isolation valves and strainers at new equipment.
7. Flexible Piping Connectors: Provide flexible piping connectors at each piece of equipment unless acoustic consultant determines such devices are not required to meet project sound and vibration performance requirements.

B. Condensate Drain Lines: Type L drawn-temper copper tubing with soldered joints.

3.03 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valves with specified WOG, SWP classes or CWP ratings are unavailable, the same types of valves with higher WOG, SWP classes or CWP ratings may be substituted.

B. Select valves with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends.
2. For Copper Tubing, NPS 2½ and Larger: Flanged ends.
3. For Steel Piping, NPS 2 and Smaller: Threaded ends.
4. For Steel Piping, NPS 2½ and Larger: Flanged ends.

3.04 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.
2. Lift Check Valves: With stem upright and plumb.

F. Install chainwheels on operators for gate valves NPS 4 and larger and more than 84 inches above floor. Extend chains to 36 inches above finished floor.

G. Install valve tags. Comply with requirements in Division 23 Section "Identification for HVAC" for valve tags and schedules.

3.05 VALVE APPLICATIONS

A. General-Duty Valve Applications for hydronic systems unless otherwise noted, use the following valve types:

Type	Minimum Size	Maximum Size	Valve Service:
Ball	¼”	4”	Shut-off and Throttling duty.
Gate, AWWA for 33 to 105°F service only	2½”	n/a	Shut-off duty.
Butterfly	14”	n/a	Shut-off and Control duty.
Gate, rising stem for hot water	2½”	n/a	Shut-off duty.
Swing check	¼”	n/a	Check valve
Ball Check for hot water	¾”	3”	Check valve.

B. Install main building shut-off valves for hydronic systems.

C. Install shutoff duty valves at each branch connection to supply mains, at supply connection to each piece of equipment, unless only one piece of equipment is connected in the branch line.

D. Install auto flow limiting valves in the return water line of each heating or cooling element. Provide reverse-return piping arrangement at split coils as shown on the University's standard coil piping diagram. Provide manual balancing valves if reverse-return piping is physically not possible.

E. See Division 23 Section "Instrumentation and Controls" for hydronic control valve requirements.

F. Install safety valves on hot-water generators and elsewhere as required by the ASME Boiler and Pressure Vessel Code. Install safety-valve discharge piping, without valves. Comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, for installation requirements. Discharge piping shall not be supported by and shall place no strain on the safety valve or valves. These are life-safety devices and every effort shall be made to ensure proper installation.

G. Water valves operating between 32 and 105°F and larger than 2" shall be AWWA C-509 epoxy-coated gate valves. Where the valves are insulated to prevent sweating (e.g. chilled water) the valves shall be non-rising stem. Other applications may be either rising stem or non-rising stem as required. Except where buried outside, the valves shall have hand wheels. Buried valves shall have 2-inch square operating nut.

3.06 PIPING INSTALLATIONS

A. Refer to Division 23 Section "Common Work Results for HVAC" for basic piping installation requirements.

B. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

C. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and 6-inch NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

D. Install piping level or at a uniform grade of 0.2 percent in direction of flow or a drain.

E. Reduce pipe sizes using eccentric reducer fitting installed with level side up- top flat.

F. Install branch connections to mains using tee fittings in main pipe, with the takeoff coming out the bottom of the main pipe. For up-feed risers, install the takeoff coming out the top of the main pipe.

G. Install strainers on supply side of each coil, control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 nipple and ball valve in blow down connection of strainers NPS 2 and larger. Match size of strainer blow off connection for strainers smaller than NPS 2.

H. Anchor piping for proper direction of expansion and contraction.

I. Underground piping shall only be used when approved by University.

J. Piping penetrations shall be carefully detailed. Insulation through penetrations shall be continuous.

K. Bushings and short nipples are prohibited.

L. Avoid pipe joints located over, or within 2 feet of electrical equipment. If it cannot be avoided provide with drip pans.

M. Use PTFE "Teflon" tape for tapered threaded pipe joints. Provide pipe and fittings of similar materials so dielectric fittings are not needed; i.e. only brass and bronze fittings with copper piping.

3.07 HANGERS AND SUPPORTS

A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports for HVAC."

B. Comply with requirements below for maximum spacing of supports.

C. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
2. Spring hangers to support vertical runs.

D. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

NPS	Maximum span (feet)	Minimum rod size (inches)
3/4	7'	¼"
1	7 '	¼"
1½	9'	3/8"
2	10'	3/8"
2½	11'	3/8"
3	12'	3/8"
4	14'	½"
6	17'	½"
8	19'	5/8"
10	20'	¾"
12	23'	7/8"
14	25'	1"
16	27'	1"
18	28'	1-1/4"
20	30'	1-1/4"
24	32'	1-1/4"

E. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:

NPS	Maximum span (feet)	Minimum rod (inches)
3/4	5 ‘	1/4 “
1	6 ‘	1/4 “
1½	8 ‘	3/8 “
2	8 ‘	3/8 “
2½	9 ‘	3/8 “
3	10 ‘	3/8 “

F. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.08 PIPE JOINT CONSTRUCTION

A. Refer to Division 23 Section "Common Work Results for HVAC" for joint construction requirements for soldered and brazed joints in copper tubing; threaded, welded, and flanged joints in steel piping.

3.09 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

B. Install one automatic air vent per system in mechanical equipment rooms only at air separator for system air venting.

3.10 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush system with clean water. Clean strainers.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium.
2. While filling system, use vents installed at high points of system to release trapped air. Use drains installed at low points for complete draining of liquid.

3. Check expansion tanks to determine that they are not air bound and that system is full of water.
4. Subject piping system to hydrostatic test at 150 PSI or 1.5 times the design pressure, whichever is greater, for four hours. There shall be no decrease in pressure over the four hour test period. Isolate equipment subject to damage from test pressure. Make no test against a service valve or meter. Isolate from the system existing piping and new or existing equipment that may be damaged by test pressure. Test only new piping unless instructed otherwise. Final connection between new and existing piping shall be tested at normal system operating pressures and monitored for leaks for three working days. Verify that stress due to pressure at bottom of vertical runs does not exceed either 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A of ASME B31.9, "Building Services Piping."
5. After hydrostatic test pressure has been applied, examine piping, joints, and connections for leakage throughout the testing period. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
6. Prepare written report of testing.

3.11 ADJUSTING

A. Perform these adjustments before operating the system:

1. Open valves to fully open position.
2. Check air vents at high points of system and bleed air completely (manual type).
3. Set temperature controls so all coils are calling for full flow.
4. Check and set operating temperatures of heating and chilled water systems to design requirements.

3.12 CLEANING

A. Flush hydronic piping systems with clean water if more than 40-feet of new piping is being installed. After cleaning and flushing hydronic piping systems, and after 48 hours of run time, remove disposable fine-mesh strainers in Y-strainers.

B. Clean new piping and existing effected by the contract's Work using University furnished chemicals. Provide University's Representative more than 72 hours' notice of when chemicals are needed. Provide gallons of water in system to be cleaned.

END OF SECTION

SECTION 23 3113

METAL DUCTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes metal ducts for supply, return, outside, and exhaust air-distribution systems in pressure classes from minus 2- to plus 10 inches w.g. Metal ducts include the following:

1. Rectangular ducts and fittings.
2. Single-wall, round, and flat-oval spiral-seam ducts and formed fittings.
3. Duct liner. Exposed fibrous glass duct liners are prohibited.

1.02 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

1. Duct system design shall be used to select size and type of air-moving and distribution equipment and other air system components. Design of the layout and configuration of duct system shall be approved in writing by the University's Representative.

B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

C. Structural Seismic Performance: Refer to Division 23 Section "Vibration and Seismic Controls for HVAC."

1.03 SUBMITTALS

A. Shop Drawings: CAD-generated. Show fabrication and installation details for metal ducts.

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Equipment service clearance and access panels and door swings.
3. Duct layout indicating sizes and pressure classes.
4. Elevations of top and bottom of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Duct accessories, including access doors and panels.
12. Hangers and supports, including methods for duct and building attachment, vibration isolation, and seismic restraints.

13. Fabrication details and materials may be a separate submittal from ductwork shop drawings.
14. Seismic bracing calculations, details, products, and plans.

B. Welding certificates.

C. Field quality-control test reports.

D. Submittals:

1. Product Data: Documentation indicating that duct systems comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."
2. Product Data: Documentation indicating that duct systems comply with ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."
3. Leakage Test Report: Documentation of work performed for compliance with ASHRAE/IESNA 90.1, Section 6.4.4.2.2 - "Duct Leakage Tests."
4. Duct-Cleaning Test Report: Documentation of work performed for compliance with ASHRAE 62.1, Section 7.2.4 - "Ventilation System Start-Up."
5. Product Data: For adhesives and sealants, including printed statement of VOC content.

E. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.
3. Seismic-restraint devices.
4. Ducts, fittings, hangers, dampers, supports, fasteners and any other sheet metal products used.

1.04 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel," for hangers and supports AWS D1.2, "Sheet Metal Welding Code," for duct joint and seam welding.

B. Seismic Engineering: Seismic bracing and support design, product installation, equipment, and systems shall conform to the CBC. Submit calculations, plans, and documents stamped by a qualified California registered engineer.

C. Structural Review: Seismic engineering submittal documents, seismic loads, anchorage loads, and vertical loads applied to the building structure shall be approved by the project structural engineer of record.

D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

E. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
2. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.02 SHEET METAL MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 coating designation. Ducts shall have mill-phosphatized finish for surfaces exposed to public view and that are specified to be painted.

C. Stainless Steel: ASTM A 480/A 480M, Type 316L unless otherwise indicated, and having a No. 2D finish for concealed ducts and No. 4 finish for ducts exposed to public view. Minimum 18 gage. Provide welded construction.

D. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.

E. Tie Rods: Tie rods inside ductwork are prohibited.

2.03 DUCT LINER

A. Fibrous-Glass Liner: Shall not be used without University's Representatives written approval. When approved liner shall comply with the following:

1. Manufacturers:

    a. Certain Teed Corp.; Insulation Group.

    b. Johns Manville International, Inc.

    c. Knauf Fiber Glass GmbH.

    d. Owens Corning.

    e. Or equal.

2. Materials: ASTM C 1071; surfaces exposed to airstream shall be coated to prevent erosion of glass fibers.

    a. Thickness: 1 inch.

b. Thermal Conductivity (k-Value): 0.26 at 75 deg F mean temperature.

c. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.

d. Liner Adhesive: Comply with ASTM C 916.

e. Interior surface shall be perforated galvanized sheets.

f. Mechanical Fasteners: Galvanized steel suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in duct.

1) Tensile Strength: Indefinitely sustain a 50-lb tensile, dead-load test perpendicular to duct wall.

2) Fastener Pin Length: As required for thickness of insulation and without projecting more than 1/8 inch into airstream.

3) Adhesive for Attaching Mechanical Fasteners: Comply with fire-hazard classification of duct liner system.

g. For indoor applications use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

3. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.

B. Flexible Elastomeric Duct Liner: Comply with NFPA 90A. Shall not be used without University's Representatives written approval.

1. Manufacturers:

a. Armacell

b. Aeroflex USA

c. K-flex USA

d. Or equal.

2. Materials: Flexible Polymeric Foam Sheet Insulation complying with ASTM C 1534, Type I,

a. Thickness: 1 inch.

b. Thermal Conductivity (k-Value): less than 0.25 at 75 deg F mean temperature.

c. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM C 411.

d. UL 181 for mold growth/humidity, air erosion and passes ASTM G 21 Fungal Resistance.

e. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A.

f. For indoor applications use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.04 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 4 inches.
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10 inches w.g., positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel.
10. For indoor applications use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10 inches wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel.

D. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.

6. For indoor applications use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1 inch w.g. and shall be rated for 10 inches w.g. static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.05 HANGERS AND SUPPORTS

A. Building Attachments: Drilled in fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Use drilled in concrete fasteners for standard-weight aggregate concretes or for slabs more than 5 inches thick.

B. Powder-Actuated Fasteners: are prohibited except when executed in accordance with Division 01.

C. Hanger Materials: Galvanized sheet steel or threaded steel rod.

1. Hangers Installed in Corrosive Atmospheres: Hot-dip galvanized, threaded rods or stainless steel.
2. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for steel sheet width and thickness and for steel rod diameters.

D. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

E. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Galvanized-steel or stainless steel shapes and plates.

2.06 RECTANGULAR DUCT FABRICATION

A. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" third edition and complying with requirements for metal thickness, reinforcing types and intervals, and joint types and intervals except as modified by this specification.

1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
2. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

B. Elbows shall be short radius with splitter or guide vanes are the standard method to be used on campus or if space permits, long radius elbows may be used, figure 4-2, type RE 1

and RE 3 in the SMACNA manual. Use short radius elbows with 1, 2, or 3 splitter or guide vanes. Construct splitter or guide vanes per SMACNA HVAC Systems Duct Design Manual.

1. Mitered elbows with or without turning vanes and other elbow types are prohibited.

C. Divided flow branches shall be per SMACNA manual figure 4-5, type 1 or type 4A or 4B only.

D. Branch connections per SMACNA manual figure 4-6; 45-degree entry shall only be used where airflow in branch is less than 25% of total airflow in main duct.

E. Offsets shall be SMACNA manual figure 4-7, type 3 only.

F. Provide bellmouth transitions for connections to air handling units and plenums.

G. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.

1. Manufacturers:

a. Ductmate Industries, Inc.

b. Nexus Inc.

c. Ward Industries, Inc.

d. Or equal.

H. Longitudinal Seams: Pittsburgh lock sealed with noncuring polymer sealant.

1. Button punch snap lock seams are prohibited.

I. Provide drive slip or equivalent flat seams for ducts exposed in the conditioned space or where necessary due to space limitations.

J. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 20 gauge (0.0359 inch thick) or less, with more than 10 sq. ft. of nonbraced panel area.
.

2.07 APPLICATION OF LINER IN RECTANGULAR DUCTS

A. Adhere a single layer of indicated thickness of duct liner with at least 100 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.

B. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.

C. Butt transverse joints without gaps and coat joint with adhesive.

D. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.

E. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and standard liner product dimensions make longitudinal joints necessary.

F. Apply adhesive coating on longitudinal seams.

G. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.

H. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:

1. Fan discharges.
2. Intervals of lined duct preceding unlined duct.
3. Upstream edges of transverse joints in ducts where air velocities are greater than 2500 fpm or where indicated.

I. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent. Use solid metal (nonperforated) inner ducts for material handling exhaust systems.

J. Terminate inner ducts with build outs attached to fire-damper sleeves, dampers, splitter vane assemblies, or other devices. Fabricated build outs (metal hat sections) or other build out means are optional; when used, secure build outs to duct walls with bolts, screws, rivets, or welds.

2.08 ROUND AND FLAT-OVAL DUCT AND FITTING FABRICATION

A. Diameter as applied to flat-oval ducts in this Article is the diameter of a round duct with a circumference equal to the perimeter of a given size of flat-oval duct.

B. Round, Spiral Lock-Seam Ducts: Fabricate supply ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

C. Flat-Oval, Spiral Lock-Seam Ducts: Fabricate supply ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible." Fabricate ducts larger than 72 inches in diameter with butt-welded longitudinal seams.

1. Manufacturers:

   a. McGill AirFlow Corporation.

   b. SEMCO Incorporated.

   c. Or equal.

D. Duct Joints:

1. Ducts up to 20 inches in Diameter: Interior, center-beaded slip coupling per SMACNA figure 3-1, RT-1, sealed before and after fastening, attached with sheet metal screws.
2. Three-piece, gasketed flanged joint consisting of two external flanges with sealant, SMACNA manual figure 3-1, RT-2 and 2A.
3. Round Ducts: Prefabricated connection system consisting of neoprene gasket dual flanges. Manufacture ducts according to connection system manufacturer's tolerances.

a. Manufacturers:

1) Ductmate Industries, model Spiralmate

2) Or equal.

4. Flat-Oval Ducts: Prefabricated connection system consisting of two flanges and one synthetic rubber gasket.

a. Manufacturers:

1) Ductmate Industries, Inc.

2) McGill AirFlow Corporation.

3) SEMCO Incorporated.

4) Or equal.

E. 90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," with metal thicknesses specified for longitudinal-seam straight ducts.

F. Diverging-Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting into branch tap entrance.

G. Fabricate elbows using die-formed, gored, segmented, or mitered construction. Ratio of centerline radius to duct diameter of elbows shall be 1½. Unless elbow construction type is indicated, fabricate elbows as follows:

1. Mitered-Elbow Number of Pieces: Welded construction complying with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," comply with table 3-1.
2. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from minus 2 to plus 2 inches w.g.:

a. Ducts 3 to 36 Inches in Diameter: 0.034 inch.

b. Ducts 37 to 50 Inches in Diameter: 0.040 inch.

c. Ducts 52 to 60 Inches in Diameter: 0.052 inch.

d. Ducts 62 to 84 Inches in Diameter: 0.064 inch.

3. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from 2- to 10 inches w.g.:

a. Ducts 3 to 26 Inches in Diameter: 0.034 inch.

b. Ducts 27 to 50 Inches in Diameter: 0.040 inch.

c. Ducts 52 to 60 Inches in Diameter: 0.052 inch.

d. Ducts 62 to 84 Inches in Diameter: 0.064 inch.

4. Flat-Oval Mitered Elbows: Welded construction with same metal thickness as longitudinal-seam flat-oval duct.
5. Round Elbows 8 inches and less in Diameter: Fabricate die-formed elbows for 45- and 90-degree elbows. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
6. Round Elbows 9 through 14 inches in Diameter: Fabricate gored elbows for 30, 45, 60, and 90 degrees. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction. Fabricate 90 degrees elbows with minimum of 5 pieces.
7. Round Elbows Larger than 14 inches in Diameter and Flat-Oval Elbows: Fabricate gored elbows.
8. Die-Formed Elbows for Sizes through 8 inches in Diameter and Pressures 0.040 inch thick with 2-piece welded construction.
9. Round Gored-Elbow Metal Thickness: Same as non-elbow fittings specified above.
10. Flat-Oval Elbow Metal Thickness: Same as longitudinal-seam flat-oval duct specified above.

PART 3 - EXECUTION

3.01 DUCT APPLICATIONS

A. Static-Pressure Classes: Unless approved by the University's Representative, construct ducts according to the following:

1. Supply Ducts(exterior installation: plus 6 inches water gauge (w.g.).

B. Ducts shall be galvanized steel.

C. Use round ducts to the maximum extent possible. As duct size increases, flat oval shall be considered. Rectangular ducts shall be limited to areas of space restriction with a maximum aspect ratio of 3:1. If due to a structural clearance constraint, duct aspect ratio can be increased and/or duct cross section reduced if upstream transition has included angles of 60 degrees or less and downstream transition has included angles of 30 degrees or less.

D. Except for connection of terminal discharge duct to air outlets, 90 degree taps shall not be used. Takeoff feeding terminals shall be conical branch; 45 wye conical branch; low loss tee; bell mouth, or branch with a loss coefficient equivalent to that for the conical branch. The slopes of transitions shall be approximately one to five, and no abrupt changes or offsets of any kind in the duct system shall be permitted.

3.02 DUCT INSTALLATION

A. Construct and install ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.

B. Install round and flat-oval ducts in lengths not less than 12 feet unless interrupted by fittings.

C. Install ducts with fewest possible joints.

D. Install fabricated fittings for changes in directions, size, and shape and for connections.

E. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12 inches, with a minimum of 3 screws in each coupling.

F. Install ducts vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs in ducts that would be over 12 feet in length.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 2 inch on each side, plus allowance for insulation thickness.

I. Coordinate layout with fire- and smoke-control dampers, lighting layouts, and similar finished work.

J. Seal joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.

K. Install ducts with hangers and braces designed to withstand, without damage to equipment, seismic force required by California building codes.

L. Prohibited: Painting interiors of metal ducts.

M. Protect duct openings from damage and prevent entrance of foreign materials.

N. Sealants shall not take the place of welding of metal ducts, where required.

3.03 SEAM AND JOINT SEALING

A. Seal duct seams and transverse and longitudinal joints regardless of pressure classification.

B. Seal ducts before external insulation is applied.

C. Provide airtight seal on seams around fan and coil housings with clear caulking compound.

D. Do not use permanent sealants on duct mounted equipment. Sealant at equipment, or other in-duct maintenance component, shall be sealed with a code approved sealant that may be easily removed and replaced upon repair and replacement of the device connected to the ductwork.

3.04 HANGING AND SUPPORTING

A. Attachment method, hanger device selection, loads, and spacing shall be coordinated and approved with the structural engineer.

B. Support horizontal ducts within 24 inches of each elbow and within 48 inches of each branch intersection.

C. Support vertical ducts at maximum intervals of 16 feet and at each floor.

D. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load. Wire and friction clamps are prohibited.

E. Install concrete inserts before placing concrete.

F. Install drilled in concrete anchors after concrete is placed and completely cured.

G. Powder-Actuated Fasteners: are prohibited except when executed in accordance with Division 01.

H. Ducts and equipment shall be supported high enough above roofing surfaces to allow roofing access for maintenance and repair. Install ducts and equipment at a minimum height as shown in Table 4-1 of SMACNA Architectural Sheet Metal Manual – 5th Edition.

I. Roof-mounted duct and equipment supports: Unless otherwise shown, use round column supports to tie-in to structure with lead jacks, lead flashing, and lead umbrellas with stainless steel draw band per Figure 4-17A, or Figure 4-17B, of SMACNA architectural Sheet Metal Manual – 6th Edition. Coordinate flashing, waterproofing, and structural connection methods with other disciplines.

3.05 CONNECTIONS

A. Make connections to equipment with flexible connectors according to Division 23 Section "Air Duct Accessories" unless equipment is internally isolated.

B. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

C. Make connections to grilles, registers or diffusers the same size as the flange outer perimeter or neck size of the grille, register, or diffuser.

3.06 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections according to SMACNA's "HVAC Air Duct Leakage Test Manual" and prepare test reports:

1. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
2. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.
3. Maximum Allowable Leakage: Comply with requirements for Leakage Class 3 for round and flat-oval ducts, Leakage Class 12 for rectangular ducts in pressure classes lower than and equal to 2 inches w.g. (both positive and negative pressures), and Leakage Class 6 for pressure classes from 2- to 10 inches w.g.
4. Remake leaking joints and retest until leakage is equal to or less than maximum allowable.

B. Supply ducts shall be sealed to minimize leakage. Ducts in concealed spaces such as chases or shafts and above wallboard ceilings shall be pressure-tested prior to concealment. Seams and joints of ducts shall be sealed with mastic or mastic plus tape or gasketing as appropriate to limit the air leakage.

C. Materials such as duct, stiffeners, gaskets, bolting, etc., intended as part of the final installation, which are damaged during testing shall be replaced.

D. Ductwork may be tested in sections. The section of the ductwork to be tested shall be prepared by blanking off duct outlets, etc.

E. Dampers in the tested ductwork shall be left in the open position. Testing shall be satisfactorily completed before insulation or enclosure of the ductwork and before terminal units are installed.

3.07 CLEANING NEW SYSTEMS

A. If the ductwork system is maintained in a clean state during the installation the following is not required. If in the opinion of the University's Representative the ductwork system becomes dirty during installation the following shall be complied with:

B. Mark position of dampers and air-directional mechanical devices before cleaning, and perform cleaning before air balancing.

C. Use service openings, as required, for physical and mechanical entry and for inspection.

1. Create other openings to comply with duct standards.
2. Disconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling sections to gain access during the cleaning process.

D. Vent vacuuming system to the outside. Include filtration to contain debris removed from HVAC systems, and locate exhaust down wind and away from air intakes and other points of entry into building.

E. Clean the following metal duct systems by removing surface contaminants and deposits:
1. Supply fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
2. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
3. Coils and related components.
4. Supply-air ducts, dampers, actuators, and turning vanes.

F. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.

G. Cleanliness Verification:

1. Visually inspect metal ducts for contaminants.
2. Where contaminants are discovered, re-clean and reinspect ducts.

3.08 CLEANING EXISTING SYSTEMS

A. Use service openings, as required, for physical and mechanical entry and for inspection.

1. Use existing service openings where possible.
2. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Division 23 Section "Air Duct Accessories" for access panels and doors.
3. Disconnect flexible ducts as needed for cleaning and inspection.
4. Remove and reinstall ceiling sections to gain access during the cleaning process.

B. Mark position of dampers and air-directional mechanical devices before cleaning, and restore to their marked position on completion.

C. Particulate Collection and Odor Control

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron size (or larger) particles.
2. When venting vacuuming system to the outside, use filtration to contain debris removed from HVAC system, and locate exhaust downwind away from air intakes and other points of entry into building.

D. Clean the following components by removing surface contaminants and deposits:

1. Air inlets (registers, and grilles).
2. Supply-air ducts, dampers, actuators, and turning vanes.

E. Mechanical Cleaning Methodology

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide operative drainage system for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

F. Duct System Cleanliness Tests:

1. Verify cleanliness after mechanical cleaning and before application of treatment, including biocidal agents and protective coatings.
2. Visually inspect duct system to ensure that no visible contaminants are present.
3. Where contaminants are discovered, re-clean and reinspect ducts.
4. Test sections of metal duct system, chosen randomly by University's Representative, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems." Comply with ASHRAE 62.1-2004, in which Section 7.2.4 - "Ventilation System Start-Up" requires that distribution systems be clean of dirt and debris.

    a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

5. Duct system will be considered defective if it does not pass tests and inspections.
6. Prepare test and inspection reports.

G. Gravimetric Analysis: At discretion and expense of the University, sections of metal duct system, chosen randomly by the University, may be tested for cleanliness according to NADCA vacuum test gravimetric analysis.

1. If analysis determines that levels of debris are equal to or lower than suitable levels, system shall have passed cleanliness verification.
2. If analysis determines that levels of debris exceed suitable levels, system cleanliness verification will have failed and metal duct system shall be re-cleaned and re-verified.

END OF SECTION

SECTION 23 3300

AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes the following:

1. Manual volume dampers.
2. Automatic balancing damper
3. Motorized control dampers.
4. Turning vanes (prohibited)
5. Duct-mounting access doors.
6. Flexible connectors.
7. Drawband connectors.
8. Duct accessory hardware.

1.02 SUBMITTALS

A. Product Data: For the duct accessories to be used on this project.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Manual-volume damper installations.
2. Motorized-control damper installations.
3. Wiring Diagrams: Power, signal, and control wiring.

C. Submittal shall include published leakage, pressure drop and maximum pressure data for a full range of damper sizes based on AMCA Standard 500 testing. Data from one size sample test is prohibited.

D. Submittal:

1. Product data: Documentation indicating that units comply with ASHRAE 62.1.

1.03 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with AMCA 500-D testing for damper rating.

C. Flexible ducts shall be listed by Underwriters Laboratories, Inc., complying with UL 181.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
2. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.02 SHEET METAL MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated.

B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 coating designation; exposed ducts shall have mill-phosphatized finish for paint adhesion.

C. Stainless Steel: ASTM A480/A480M, type 304, and having a No. 2 finish for concealed ducts and exposed ducts.

D. Extruded Aluminum: ASTM B221, alloy 6063, temper T5.

E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for stainless steel ducts.

F. Tie Rods are prohibited.

2.03 MANUAL VOLUME DAMPERS

A. Standard, Steel, Rectangular Manual Volume Balancing Dampers:

1. Manufacturers:

a. Air Balance Inc.
b. American Warming and Ventilating
c. McGill AirFlow LLC.
d. Nailor Industries Inc.
e. Pottorff
f. Ruskin Company.
g. Or equal.

2. Standard leakage rating.
3. Suitable for horizontal or vertical applications.
4. Frames:

a. Frame: Hat-shaped, 0.094 inch thick, galvanized sheet steel or 0.05 inch thick stainless steel.
b. Welded corners
c. Flanges for attaching to walls, flangeless frame for installing inside ducts, and flanged frames for installing in ducts

5. Blades:

a. Multiple or single blade.
b. Parallel- or opposed-blade design.
c. Stiffen damper blades for stability.
d. Galvanized or Stainless-steel, 0.064 inch thick.
e. Blade Axles: Galvanized steel or Stainless steel.

6. Bearings:

a. Oil-impregnated bronze, oil-impregnated stainless-steel sleeve, or ball bearing as specified for the project conditions
b. Dampers in ducts with pressure classes of 3 inches water gauge or greater shall have full-length axles. That is, the damper shafts shall be solid and pass completely through from one side to the other without any form of coupling. Both ends shall be supported by bearings.
c. Tie Bars and Brackets: Galvanized steel.

7. Jackshaft (jackshafts are rarely used on manual volume dampers consult with University's Representative):

a. Size: 1 inch diameter or larger
b. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
c. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

8. Damper Hardware:

a. Include center hole to suit damper operating-rod size.
b. Include elevated platform for insulated duct mounting.

B. Standard, Steel, Round Manual Volume Balancing Dampers

1. Manufacturers

a. Air Balance Inc.
b. American Warming and Ventilating
c. McGill AirFlow LLC.
d. Nailor Industries Inc.
e. Pottorff
f. Ruskin Company.
g. Or equal.

2. Standard leakage rating.
3. Suitable for installation at any angle
4. Blades

    a. Single blade or multi-blade
    b. Stiffen damper blades for stability.
    c. Galvanized or Stainless-steel, 0.064 inch thick.
    d. Blade Axles: Galvanized steel or Stainless steel.

5. Bearings:

    a. Oil-impregnated bronze, oil-impregnated stainless-steel sleeve, or ball bearing as specified for the project conditions
    b. Dampers in ducts with pressure classes of 3 inches water gauge or greater shall have full-length axles. That is, the damper shafts shall be solid and pass completely through from one side to the other without any form of coupling. Both ends shall be supported by bearings.
    c. Tie Bars and Brackets: Galvanized steel.

6. Damper Hardware:

    a. Include center hole to suit damper operating-rod size.
    b. Include elevated platform for insulated duct mounting.
    c. Provide locking quadrant or remote actuator by Young Regulator

C. Motorized Control Dampers may be used as manual volume dampers where the dual application is suitable.

2.04 AUTOMATIC BALANCING DAMPERS

A. Manufacturers:

1. Ruskin Model ABD
2. Or equal

B. Pressure independent, 4, 5 and 6 inch round, automatically balance airflow to set point ±10% at 0.5 inch water gauge differential across the damper.

C. Shall comply with UL2043.

D. Warranty: 5 years, minimum.

2.05 ACTUATED CONTROL DAMPERS

A. Low-Leakage Outside Air, Return and Exhaust or Relief Dampers:

1. Manufacturers:

    a. TAMCO Series 1000 SW Air-Foil Control Damper with Salt Water Resistance Option

b. Or equal.

2. Dampers shall be manufactured of aluminum or stainless steel. Carbon steel components are prohibited in the damper construction.
3. If damper is to be aluminum, aluminum parts shall be clear anodized to a minimum thickness of 0.7 mil.
4. There shall be two mechanically-fastened damper blade seals at each blade sealing point to assure maintenance of long-term leakage resistance. Blade seals shall be of extruded silicone.
5. Frame seals shall be of extruded silicone and factory tested to over 500,000 cycles to ensure durability.
6. Bearings shall be maintenance free. Metal-to-metal contact is prohibited.
7. Damper drive rod shall be mechanically maintained in drive blade, and shall incorporate hex flats to prevent slippage.
8. Leakage shall not exceed 3 cfm/ft^2 against 1" water gauge differential static pressure (AMCA Class 1A).
9. Dampers shall be made to size required without blanking off free area.
10. Dampers shall have opposed blade action or parallel blade action, depending on application.
11. Dampers shall be available in three mounting types: "Installed in Duct", "Extended Rear Flange", or "Flanged to Duct" as required for installation.
12. Intermediate or tubular steel structural support shall be provided by installer to resist applied pressure loads for dampers that consist of two or more sections in height or width.
13. Air handling units with 100% outside air intended for continuous operation do not require outside air dampers. Systems with standby units require fan isolation control dampers at the discharge sides of the units.

2.06 TURNING VANES

A. Turning vanes are prohibited. Provide short radius elbows with splitter vanes per SMACNA or long radius elbows.

2.07 DUCT-MOUNTING ACCESS DOORS

A. General Description: Fabricate doors airtight and suitable for duct pressure class. Include vision panel where indicated.

B. Access Door: Double wall, duct mounting, for round or rectangular ducts; fabricated of galvanized sheet metal, or stainless steel, closed cell neoprene gasket, closure knobs with zinc plated springs and bolts. Provide accessory safety chain.

1. Manufacturers:

a. Ductmate Industries, Inc.
b. Greenheck Fan Corporation.
c. Pottorff; a division of PCI Industries, Inc.
d. Ruskin Company.
e. Or equal.

2. Frame: None. Sandwich type configuration with outer door galvanized sheet steel, notched frame
3. Hinge: None
4. Gasket location: shall be interchangeable for positive and negative pressure applications, in accordance with manufacturer's guidelines.
5. Pressure Rating: Ultra low leakage for positive or negative 8 inches water gauge

C. Pressure Relief Access Door: Double wall and duct mounting; fabricated of galvanized sheet metal, or stainless steel, with insulation fill and thickness as indicated for duct pressure class. Include vision panel where indicated, latches, and retaining chain.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. American Warming and Ventilating
   b. Ductmate Industries, Inc.
   c. Greenheck Fan Corporation.
   d. McGill AirFlow LLC.
   e. Ruskin Company.
   f. Or equal.

2. Frame: Galvanized sheet steel, with bend-over tabs and neoprene gaskets.
3. Provide negative pressure and positive pressure relief doors design to open automatically to prevent exploding or imploding ductwork in the event dampers close or some other event may occur while the fan is still operating. The door shall automatically close and reset when the pressure is equalized or the system shuts down. Ruskin models PRD18, NRD18 or ADHP-3. Provide insulated doors in supply air systems, stainless steel construction for hazardous air exhaust systems and construction shall be appropriate for the pressure class.
4. Seal around frame attachment to duct and door to frame with neoprene rubber.
5. Insulation: 1 inch thick, fibrous-glass or polystyrene-foam board.

2.08 FLEXIBLE CONNECTORS

A. Manufacturers:

1. Duro Dyne Inc.
2. Ventfabrics, Inc.
3. Ward Industries, Inc.
4. Or equal.

B. General Description: Flame-retardant or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.

C. Metal-Edged Connectors: Factory fabricated with a fabric strip 5¾ inches wide attached to two strips of 2¾ inches wide, 0.028 inch thick, galvanized sheet steel.

D. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 22 ounces per square yard.

2. Tensile Strength: 475 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Zero to plus 200 °F

E. Outdoor System, Flexible Connector Fabric: Glass fabric insulated double coated with weatherproof, Hypalon synthetic rubber resistant to UV rays and ozone.

1. Minimum Weight: 23 ounces per square yard
2. Insulation: Fiberglass.
3. Tensile Strength: 250 lbf/inch in the warp and 275 lbf/inch in the filling.
4. Service Temperature: Zero to plus 240 °F

F. High-Temperature System, Flexible Connectors: Glass fabric coated with silicone rubber.

1. Minimum Weight: 16 ounces per square yard.
2. Tensile Strength: 200 lbf/inch in the warp and 185 lbf/inch in the filling.
3. Service Temperature: Zero to plus 500 °F

G. High-Corrosive-Environment System, Flexible Connectors: Glass fabric with Teflon chemical-resistant coating including gasoline grease and acetone, UL 214 listed.

1. Minimum Weight: 14 ounces per square yard.
2. Pressure Rating: 8 inch water gauge positive and 5 inches water gauge negative.
3. Tensile Strength: 300 lbf/inch in the warp and 275 lbf/inch in the filling.
4. Service Temperature: Zero to plus 500 °F

2.09 DRAWBAND CONNECTORS

A. Manufacturers:

1. Ductmate
2. Phoenix Controls Corp.
3. Or equal.

B. General Description: Formed galvanized steel cylindrical sleeve with internal gasket and external drawband bolts. Flame-retardant or noncombustible gaskets and adhesives complying with UL 181, Class 1.

1. Pressure Rating: 10 inches water gauge positive and 5 inches water gauge negative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 20 to plus 200 °F
4. Fume Hood or Corrosive Application: Chemically resistant gasket material. Galvanized metal shall not contact airstream.

2.10 DUCT ACCESSORY HARDWARE

A. Instrument Test Ports or Holes: Cast aluminum, cast zinc, or zinc-plated cast iron to suit duct material, including screw cap and rubber gasket. Size to allow insertion of Pitot tube and other testing instruments and of length to suit duct insulation thickness. Basis of design is VentLok 699, or VentLok 699-2 (where there is 2 inches of external insulation), or equal.

B. Adhesives: High strength, quick setting, waterproof, antimicrobial agent, and resistant to gasoline and grease, complying with UL 181 and approved for use inside of ducts.

C. Remote Damper Actuators: Manually operated Bowden Cable Design Model 270 series by Young Regulator or equal.

PART 3 - EXECUTION

3.01 APPLICATION AND INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards-- Metal and Flexible" for metal ducts.

B. Provide duct accessories and components of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel ducts, and stainless-steel accessories in stainless-steel ducts.

C. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

D. Provide manual volume dampers at points on supply systems where branches lead from larger ducts as required for air balancing. Provide balancing volume dampers at duct takeoff serving ceiling diffusers and registers. Install at a minimum of two duct widths from branch takeoff. Provide 12” long neon color flags hanging from damper handle for locating dampers. Flags shall remain after balancing unless ductwork is exposed.

E. Provide instrument test holes in ductwork at fan inlets and outlets and elsewhere as required by Testing, Adjusting and Balancing contractor for testing and balancing purposes. Factory install instrument test holes for air handling units.

F. When approved by the University’s representative in writing, install duct silencers rigidly to ducts and provide supports.

G. Install duct access doors to allow for inspecting, adjusting, and maintaining accessories and terminal units as follows:

1. Upstream side of duct coils.
2. Downstream from volume dampers, and equipment.
3. Adjacent to fire or smoke dampers, providing access to reset or reinstall fusible links.
4. To interior of ducts for cleaning; at base of risers or bottom of multi-story drops.
5. On sides of ducts where adequate clearance is available.
6. For access to backdraft dampers adjustable device and to visual see position of dampers.
7. Control devices requiring inspection.
8. Elsewhere as indicated.

H. Install access doors to maintain seal when under duct static pressure.

I. Install the following sizes for rectangular duct-mounting, rectangular access doors:

1. 8 by 5 inches for 6-inch duct size and smaller.
2. 12 by 6 inches for 8-inch to 10-inch duct sizes.
3. 12 by 8 inches for 11 to 13-inch duct sizes.
4. 12 by 12 inches for 14-inch to 24-inch duct sizes by maximum of 18 inches wide.
5. 20 by 12 inches for 14-inch to 24-inch duct sizes by 19 inches and wider.
6. 24 by 24 inches for larger duct sizes than listed above.

J. Install the following sizes for round duct-mounting, round access doors:

1. 8 inches in diameter for up to 12-inch diameter duct size.
2. 12 inches in diameter for 13-inch to 19 inch duct sizes.
3. 18 inches in diameter for 20-inch to 25 inch duct sizes.
4. 24 inches in diameter for larger duct sizes than listed above.

K. Label access doors according to Division 23 Section "Identification for HVAC."

L. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators. Units with internal fan isolation are prohibited to have a flexible connector.

M. For fans developing static pressures of 5 inches water gauge and higher, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

N. For air systems with fire or smoke dampers in the mains provide pressure relief dampers when fan static exceeds pressure class of ductwork.

O. Connect terminal units to hard metal supply ducts directly.

P. Connect flexible ducts to metal ducts with adhesive and band clamps. Flexible ducts with galvanized sheet metal collars shall be connected with duct sealant and sheet metal screws.

3.02 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.

B. Adjusting:

1. Adjust duct accessories for proper settings.
2. Final positioning of manual-volume dampers is specified in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

END OF SECTION

CUSTOM AIR-HANDLING UNITS GALVANIZED STEEL CASING

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes custom air-handling units with coils for indoor installations.

1.02 PERFORMANCE REQUIREMENTS

A. General Performance: Air handling units shall withstand 8-inches of water column or 1.5 times the fan total static pressure without failure due to defective manufacture, fabrication, installation, or other defects in construction. Air handling units shall remain watertight and airtight after installation.

B. Cooling coils: Comply with performance requirements specified, as determined by testing assemblies representing those indicated for this Project.

1. Maximum coil face velocity shall be 500 feet per minute at maximum design airflow.
2. Maximum coil fins spacing shall be ten fins per inch for coils mounted in 100% outside air units.
3. Minimum cooling coil water-temperature differential shall be 15°F with 42°F entering water.
4. Cooling coil selection shall examine operation at 20% load, 50% load, and 100% load to ensure that pressure loss, coil water side velocity, and performance are appropriate at load points. Greater pressure drop at full load may be acceptable if it means keeping the low-flow velocity above one foot per second (1 fps).

C. Heating coils: Comply with performance requirements specified, as determined by testing assemblies representing those indicated for this Project. Coil face velocity shall match cooling coil. Coil capacity for pre-heat coils shall be sized to raise outside air airflow from design outside air temperature or mixed air temperature to the highest design cooling coil supply air temperature, not including fan heat. Heating coils for single zone systems and double duct systems shall be selected to heat air to minimum of 95°F and provide the heating design load for the areas served.

D. Fan: Comply with performance requirements specified, as determined by testing assemblies representing those indicated for this Project.

1. Select fan operating point to the right hand side of peak static pressure point and near the peak of static efficiency.
2. Operation of the fan above 60 hertz is acceptable during the 90 to 100% maximum airflow range.
3. Fans shall be direct drive.

E. Comply with performance requirements specified, as determined by testing assemblies representing those indicated for this Project.

F. Surface Condensation: Air handling unit casing, including roof, doors, coil access panels, and flooring shall be properly insulated, designed, and sealed to prevent formation of condensation based on 39-degree Fahrenheit chilled water serving the unit. In the event that condensation does form on the exterior surfaces of the unit within two years of acceptance, the unit shall be rebuilt, or repaired to meet the requirements of the specifications without additional cost to the University.

1.03 SUBMITTALS

A. Product Data: For each type of air-handling unit indicated. Include the following:

1. Certified fan-performance curves with system operating conditions indicated, for present and future conditions. Include dirty filter loading in static pressure calculation.
2. Certified fan-sound power ratings.
3. Certified coil-performance ratings with system operating conditions indicated.
4. Motor ratings, electrical characteristics, efficiency and motor and fan accessories.
5. Material gages and finishes for base, panel walls, doors, floor, drain pan, hoods, and exterior hardware.
6. Filters with performance characteristics.
7. Dampers, including housings, linkages, and operators.
8. Itemized list of specified and unspecified internal AHU pressure losses at present and future conditions. Determine total fan static pressure, including external static pressure.
9. Silencers with acoustic performance characteristics.
10. Certified air handling unit sound power level ratings in each octave band, for radiated and transmission sound for the fan and at the air handler casing inlet and outlet connections.
11. Acoustic panel, and insulation sound and thermal performance characteristics.
12. Louver material, gage, finish, and pressure drop and moisture carry-over performance.
13. Connection data: flexible duct connectors, piping and power connection.
14. Provide detail of mounting, securing, and flashing of roof curb to roof structure. Indicate coordination requirements with roofing system.

B. Shop Drawings: Signed and sealed by a qualified and registered California professional engineer.

1. Certified plan and elevation drawings indicating dimensions, weights, configuration, equipment locations, doors, door swings, duct size and connection location, and maintenance access requirements.
2. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
3. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include bases, unit rails, restraints, isolators, snubbers, and base weights.
4. Wiring Diagrams: Power, signal, and control wiring.

C. Coordination Drawings: Submit with Shop Drawings. Show mechanical-room layout and relationships between components, maintenance access requirements, and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate and certify field measurements.

D. Manufacturer Seismic Qualification Certification: Submit certification that air-handling units, accessories, and components will withstand seismic forces defined in Division 23 Section "Mechanical Vibration and Seismic Controls for HVAC." Include the following:

1. Dimensioned Outline Drawings of Equipment Unit: identify center of gravity, locate, and describe mounting and anchorage provisions.
2. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. Field Quality-Control Test Reports: From manufacturer's representative.

F. Factory Test Results: From manufacturer's representative, if required by project documents, which will define the tests to be performed.

1.04 QUALITY ASSURANCE

A. Source Limitations: Obtain air-handling units through one source from a single manufacturer. Companies specified specialize in manufacturing of industrial quality, custom-design air handling units with minimum five years documented experience of the size and type to be provided on this project.

B. Product Options: Drawings and schedules indicate size, profiles, performance requirements, and dimensional requirements of air-handling units and are based on the specific system indicated.. Ensure that product meets project performance requirements and space allocation requirements, and that components are compatibly matched.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in California Electric Code, Article 100, by a testing agency acceptable to University, and marked for intended use.

D. Comply with California Electrical Code.

E. Galvanized steel sheets shall be hot dipped conforming to ASTM A653 and shall provide 0.90 ounces of zinc per square foot (G90).

F. Aluminum sheeting shall be aluminum alloy 3003-H14, conforming to ASTM B209, with thickness of 0.040" and hardness of Brinell 40.

G. Aluminum structural base shall be aluminum alloy 6061-T6, conforming to ASTM B308, with hardness of Brinell 73.

H. Aluminum extrusions for door frames, damper frames, and other frames shall be aluminum alloy 6063-T6, conforming to ASTM B221, with hardness of Brinell 73.

I. Unit shall have the approval of one of the following agencies: Underwriters' Laboratories (UL), Electrical Testing Laboratories (ETL) or Canadian Standards Association (CSA). The air handler shall bear an appropriate label certifying that the unit has been designed and manufactured in strict accordance with the UL1995 Standard for air handling equipment. If the manufacturer cannot provide an ETL or UL sticker on the air handler, it will be the sole responsibility of the contractor to arrange for local ETL or UL approval and labeling.

J. The Unit Electrical Panel(s) shall be built in strict accordance to NEC Standards.

K. AHU Controls Compliance: The air handling unit controls shall conform to UL 508 Industrial Controls Equipment.

L. National Fire Protection Association (NFPA): Air handling unit internal insulation, and supplementary materials, shall have a flame spread rating of less than 25 and smoke developed rating less than 50 complying with NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

M. Certification: Fans shall have sound and air rating based on testing performed in compliance with the latest version of AMCA bulletins 210, 211, and 300.

N. Factory Tests:

1. The units shall be fully assembled in the factory to ensure proper fit of each component prior to shipment.

O. Sound Testing: The unit manufacturer shall meet the scheduled sound power levels for casing inlet, outlet values, and casing radiated sound Unit manufacturer shall test one unit at an AMCA accredited Laboratory or perform the test in accordance to ISO 9614-2. A written report shall be provided showing the test results and the test methods used. No other testing procedure will be accepted.

P. Vibration Testing:

1. A Field balance test shall be performed on the fan assembly to certify that the fan meets the following vibration values:

<u>Direct Drive - Spring Isolation Assembly</u>

Rotational Speed up to and including	Vibration Amplitude Peak to Peak
2000 rpm	0.50 mils
2000 + rpm	0.25 mils

Vibration measurements shall be taken in three orthogonal directions: One taken parallel to shaft in the horizontal plane and two taken perpendicular to the shaft in the horizontal and vertical planes. The values will be checked with the levels being measured in mils peak to peak.

2. During balancing, the fan shall be imposed with an operating resistance equal to the design external static pressure.

3. A certificate of compliance signed by the manufacturers Quality Control Inspector shall be attached to each fan assembly at the factory and incorporated into the operating and maintenance manuals.

Q. Safety: AHU and components shall meet requirements of UL 1995 safety standard for "Heating and Cooling Equipment".

1.05 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate size and location of structural-steel support members.

C. Coordinate electrical, temperature controls, and fire alarm system connection requirements. Controls may be factory mounted in lieu of field installation and is preferred by the University. Controls contractor to check prior to shipment.

D. Coordinate and provide the University's equipment access requirements. Include clearance for inspection, repair, component replacement, and maintenance service access.

E. Coordinate with the electrical contractor to provide factory installed conduit openings in the air-handling unit casing.

1.06 DELIVERY, STORAGE AND HANDLING

A. Vacuum clean inside of the unit and wipe down with clean rags to remove dust, dirt and metal shaving prior to shipping. Seal exterior opening be shipment.

B. Deliver air-handling units and systems to project site on the UCI campus. Store units under cover and elevated above grade. Protect from weather and construction traffic and debris. Handle carefully to avoid damage to components, enclosures, and finish.

1.07 PROJECT CONDITIONS

A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, shipping bolts removed and fan has been test run under observation.

1.08 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters: One set of filters for each air-handling unit.
2. Gaskets: One set for an access door.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Scott Springfield
   2. Haakon Industries
   3. Energy Labs
   4. Temtrol
   5. United Metal Products
   6. Or, equal

B. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section “Product Options and Substitutions”. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.02 MANUFACTURED UNITS

A. Custom air-handling units shall be factory assembled and consist of fans, motor and drive assembly, coils, damper, plenums, filters, condensate pans, mixing dampers, control devices, sound attenuators, and accessories.

2.03 CABINET

A. Construction: Formed and reinforced double-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed and constructed with thermal breaks.

   1. Outside Casing: 16 gage G90 galvanized steel
   2. Inside Casing: 22 gage G90 galvanized steel with the following exception; 22 gage perforated galvanized liner at fan sections.
   ~~3.~~ Floor Plate: 20 gage G-90 galvanized steel under liner, 14 gage G-90 galvanized steel floor. Acceptable alternate material is 1/8” thick safety tread surface aluminum sheet.
   4. Panel Fasteners: Screws or bolts shall be galvanized, or stainless steel at maximum 9-inch on centers. If screws are used, screw tips shall not protrude into maintenance access space, presenting a safety hazard to maintenance personnel.
   5. Accessibility: Insulating panels shall be constructed to allow field removal of panels as required gaining adequate maintenance access path for replacement of internal components such as, fan assembly, coils, and attenuators. Access panels shall be provided for coil removal access. Welded panels are not acceptable.
   6. Rigidity: Reinforcement of the unit is required to limit deflection to 1/200 when static pressure is at 8-inches of water column, or 1.5 times the fan static pressure, whichever is greater.
   7. Structure: Structural members shall be insulated in the same fashion as the insulated panel in order to reduce sound transmission, and surface condensation. Through metal connections, or “bridges” shall be kept to an absolute minimum.

8. Base: Welded steel base of minimum 6 inches high structural tubes or channels around the entire perimeter, and welded structural angle-iron, beams, or channels beneath the fan sections and coils. Welded or bolted cross-members shall be provided for lateral stability, and fully self-supporting system for installation on concrete housekeeping pad. Acceptable structural base material alternates are: welded stainless steel construction. Center span deflection shall be less than L/240 when supported from each end without a center support. Formed metal bases not acceptable.
9. Casing Openings: If bottom duct connections are used as in a down-shot configuration, supply, return air openings in the AHU casing shall be through framed raised dams where the flooring water-proofing is raised continuous to the top of the dam. Dams must be raised to a height of 6-inches above the AHU access door threshold height to prevent possible flooding in the event of a damaged and leaking coil. If horizontally ducted connections are used, duct connections shall be minimum 6-inches above the AHU access door threshold.
10. Penetrations: Supply, return, and outside air penetrations shall be low-pressure drop design, or bell-mouth fittings passing through framed openings.
11. Through Penetrations: Conduit and piping penetrating the AHU casing shall be sealed airtight and watertight with an approved sealant. Ensure sealing of chilled water piping where it passes through casing wall.

B. Cabinet Insulation: Comply with CMC.

1. Materials: ASTM C 1071 with coated surface exposed to airstream to prevent erosion of glass fibers. Insulation may be foamed in place instead of fiberglass.
2. Thickness for wall and roof: 2 inches interior and 4 inches for exterior units.
3. Thermal Conductivity (k-Value): maximum of 0.24 Btu inch/ft^2 at 70 deg F mean temperature.
4. Density: 3 lbs/ft^3.
5. Fire-Hazard Classification: Maximum flame-spread index per ASTM E84 of 25 and smoke-developed index of 50, and flame propagation index of 50 when tested according to ASTM C 411.
6. Mechanical Fasteners: Prohibited. Insulation shall be supported inside the double wall unit.
7. Location and Application: Encased between outside and inside casing.

C. Access Doors: One door for each air handling unit section of same materials and finishes as cabinet, complete with hinges, latches, handles, and gaskets.

1. Door frames: Extruded aluminum with corrosion resistant finish, or 16-gage welded construction.
2. Doors: Double-wall, minimum 2-inch thick, 16 gage G-90 galvanized steel.
3. Gasket: Hollow closed-cell elastomeric gasket or seal.
4. Hinges: Adjustable heavy duty corrosion resistant capable of suspending a 100 pound weight placed on the latch end of the door without deflection.
5. Door Handle: Adjustable corrosion resistant alloy lever cam action handles on both sides of door.
6. Instrument Test Port: Access doors shall be equipped with Ventfabrics Model #699 or equal, screwed and gasketed instrument test port. Provide any additional test

ports if necessary to allow measurement of the pressure drop across any apparatus in the air handling unit.

7. Fan section Doors: Fan section access doors shall have tool operated safety latches and safety trip timed-delay, matched to fan coast-down period. Door shall be equipped with a minimum size 9-inch by 9-inch reinforced thermal pane safety inspection window. Fan access doors shall meet requirements of UL 1995, and Title 8 Cal-OSHA. Fan section door, or removable fan section panel shall be large enough to accommodate removal of fan wheel and motor.

D. Condensate Drain Pans: Formed sections of 16 gage 304 stainless-steel sheets complying with requirements in ASHRAE 62. Fabricate pans with slopes in two planes to collect condensate from cooling coils (including coil piping connections and return bends).

1. Double-Wall Construction: Fill space between walls with foam insulation and seal moisture tight.
2. Slope: Pan shall be sloped ¼" per foot.
3. Drain Connections: 304 stainless steel pipe to outside of unit.
4. Drain Outlet: Bottom, or recessed side outlet.
5. Dimensions: Extend pans downstream of coil edge 1/3 the height of the coil, minimum of 12-inches. Minimum depth shall be 2-inches deep.
6. Units with stacked coils shall have an intermediate stainless steel drain pan or drain trough to collect condensate from top coil. Provide insulation on bottom of intermediate drain pan.
7. Parts in contact with cooling coil shall be 316 stainless steel.
8. Anchorage: Condensate drain bracket, support, and fastener, material shall be 316 stainless steel.

E. Finish: Salt spray test passing ASTM B-117, D-2247, and D-3359. Paint exterior of the unit casing and doors. Interior of casing may also be painted except for stainless steel sheeted sections.

1. Indoor Units: Epoxy based primer with two finishing coats of acrylic urethane for a minimum of 1,000- hour salt spray test.
2. Outdoor Units: Dry Powder – baked polyester coated for a minimum of 1,000 hours salt spray resistance test.

F. Casing and Liner Joints: Seal air handling unit wall panels, floors, liners, and door joints for an airtight and watertight seal, encapsulating the insulation.

1. Sleeves and sealant shall be used on cabinet electrical and piping penetrations.
2. Cabinet shall conform to ASHRAE/ANSI Standard 111, Leakage Class 9.
3. Assembled unit shall have maximum leakage rate of 1% of total airflow at 10" of static pressure.
4. Flooring shall be of completely watertight construction with minimum 2-inch raised dams as necessary to contain any potential spills, with low spill point dumping into the mechanical room.
5. Gasket and sealant between panels.

G. Motor Rail: Include a structural I-beam over the motor and to the access door for removal of the motor from the unit with a chain hoist, where combined weight of motor and fan is greater than 75 lbs.

2.04 FAN SECTION

A. Fan-Section Construction: Direct-drive plenum fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and support structure and equipped with formed-steel channel base for integral mounting of fan, motor, and casing panels. Mount fan with vibration isolation. Fans and motors shall be selected based on future capacity, as defined by the project design.

B. Plenum Fan: Completely welded aluminum, direct drive, airfoil blades, taper lock or taper bushing to shaft.

1. Supports: Structural steel tube, steel angle- or channel-iron member supports for mounting and supporting fan wheel, motor, and accessories.
2. Performance Class: AMCA 99, Class II minimum.
3. Safety: Cal-OSHA approved inlet screen and safety devices.
4. AMCA Seal: Fan assembly shall be licensed to bear the AMCA Seal.
5. Inlet: Precision spun inlet cone.
6. Drive: Direct, with coupler.
7. Coatings: Powder-baked enamel, on ferrous wheels.
8. Arrangement: arrangement 8, or arrangement 4 where approved by the University

C. Fan Assemblies: Statically and dynamically balanced at the factory and designed for continuous operation at maximum rated fan speed and motor horsepower.

1. Fan assemblies of 20 HP and larger shall be dynamically balanced in the field after construction is complete.

D. Arrays: Fan arrays may be provided when furnished with Electronically Commutated Motors. Fan arrays shall be provided with a blank-off plate in case of a fan failure. Automatic fan array backflow preventer may be furnished when specifically design for fan array use. Mount blank-off plate inside fan section and clearly label it intended use. Failed fan wheel and motors shall be replaced without disturbing other operable fan modules.

E. Shafts: Statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and motor horsepower, with final alignment made after installation.

1. Turned, ground, and polished hot-rolled steel with keyway. Ship with a protective coating of lubricating oil.
2. Solid steel ground and polished. Shaft shall be rated to operate at 20% greater speed than the maximum AMCA Class speed of the fan.

F. Grease-Lubricated Shaft Bearings: Self-aligning, pillow-block-type, ball or roller bearings with adapter mount and two-piece, cast-iron housing. Spherical roller bearings on fan sizes 33-inch and larger.

1. Ball-Bearing Rating Life: ABMA 9, L_{10} of 200,000 hours.
2. Roller-Bearing Rating Life: ABMA 11, L_{10} of 200,000 hours.
3. Bearing Lube Fitting: Readily accessible without the use of extension tubes, or external piping and fittings.

G. Belt Drives: Belt-driven fans are not permitted.

H. Vibration Control: Install fans on welded structural steel base with restrained-spring vibration isolators having a minimum of 2-inch static deflection, selected in conformance with California Building Code seismic compliance for non-structural components, with thrust restraint. On fan sizes 54-inch and larger, 3-inch static deflection is required. Provide flexible connectors complying with NFPA 90A inside the unit.

I. Fan-Section Source Quality Control:

1. Sound Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Fans shall bear AMCA-certified sound ratings seal.
2. Factory test fan performance for flow rate, pressure, power, air density, rotation speed, efficiency, and casing leakage rate. Establish ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

2.05 MOTORS

A. General: Totally enclosed, fan-cooled, cast-iron frame, premium efficient and compatible for inverter duty service.

B. Torque Characteristics: Sufficient to accelerate driven loads satisfactorily.

C. Motor Sizes: large enough so driven loads will not require motor to operate in service factor range.

D. Overload Protection: Built-in, automatically resetting, thermal-overload protection.

E. Nameplate: Indicate ratings, characteristics, construction, special features, and full identification of manufacturer.

F. Disconnect Switch: Mounted in an accessible location inside air handling unit casing or within 10 feet of motor.

G. Where fan arrays are used, provide with electronically commutated motors (ECM). Use the ECM internal rectifiers to control fan speed instead of providing variable speed drives.

2.06 VARIABLE FREQUENCY DRIVE (VFD)

A. VFD shall be factory mounted with a NEMA 12 enclosure. VFD shall be rated for compatibility with motor, and factory wired with stranded copper in watertight flexible

conduit to motor. Drive and motor shall be mounted, wired, and tested at the factory. Provide ABB ACH 550 HVAC VFD.

2.07 COILS

A. Coil Sections: Design and construct to facilitate removal and replacement of coil for maintenance and to ensure full airflow through coils.

B. Water Coils: Continuous circuit coil fabricated according to ARI 410, counter flow design, closed-cell insulation on any chilled water piping within casing and casing wall.

1. Arrangement: Horizontally stacked coils, individually removable whether top, middle, or bottom without disturbing the remaining coils.
2. Piping Connections: Threaded or flanged, on same end.
3. Tubes: minimum 5/8-inch outside diameter Copper tubes, minimum 0.035-inch tube wall thickness, with 0.040-inch thick tube bends, and maximum 48-inch support spacing. Tubes must be of round and open cross-section, void of flow enhancement accessories.
4. Fins: Aluminum with flat fins and minimum thickness size of 0.0075-inches, and maximum 10 fins per inch.
5. Fin and Tube Joint: Mechanical bond copper fin to copper tube.
6. Headers: Seamless copper tube with brazed joints, prime coated, with minimum ½" copper or red brass vent and drain piping extensions to outside of the panel wall.
7. Heating Coil Frames: Minimum 14 gage G-90 galvanized-steel channel frame, with minimum ¾" flanges.
8. Cooling Coil Frames: Minimum 12 gage 304 stainless steel channel frame, with minimum ¾-inch flanges.
9. Ratings: Design tested and rated according to ASHRAE 33 and ARI 410.

    a. Working-Pressure Ratings: 200 psig, 325 deg F.

10. Source Quality Control: Test with 300 psig air underwater.
11. Air vent and drain lines shall be extended to outside of unit casing.

2.08 DAMPERS

A. General: Leakage rate, according to AMCA 500, "Laboratory Methods for Testing Dampers for Rating," shall not exceed 2 percent of air quantity at 2000-fpm face velocity through damper and 4-inch wg pressure differential.

B. Damper Operators: Electric specified in Division 23 Section "Instrumentation and Controls."

C. Low-Leakage Outside air, return and relief Dampers: Double-skin, airfoil-blade extruded aluminum dampers with compressible jamb seals and rubber, or extruded-vinyl blade edge seals, in opposed-blade arrangement with steel operating rods rotating in stainless-steel sleeve bearings bronze bushings or ball bearings, mounted in a extruded aluminum or 16-gage galvanized-steel frame, and with concealed square or hexagonal zinc plated operating

rods connected with a common linkage. Leakage rate shall not exceed 5 cfm/sq. ft. at 1-inch wg and 9 cfm/sq. ft. at 4-inch wg.

1. Outside-Air/Relief-Air: Stainless steel frame, damper, axle, and accessories.
2. Option bearings may be composed of a Celcon inner bearing fixed to a 7/16" aluminum hexagon blade pin, rotating within a polycarbonate outer bearing inserted in the frame, resulting in no metal-to-metal or metal-to-plastic contact.
3. Units with 100% outside air that are 24/7 operation do not require outside air damper.

D. Fan isolation dampers required for units installed in parallel shall be in accordance with Division 23 Section "Air Duct Accessories." Fan isolation damper shall be an industrial type that will close against pressure.

E. Blade Length: Maximum 48" blade length.

2.09 FILTER SECTION

A. Filters: Comply with NFPA 90A.

B. Filter Section: Provide filter holding frames arranged for flat orientation.

1. Holding Frame: Farr Filter Company or equal Type 8, 16-gage galvanized steel with welded corners. Complete with filter hold-down clips.
2. Frame Stiffener: 3/16-inch thick galvanized steel stiffeners are required at 4-foot intervals on filter frame configurations larger than 4-high by 3-wide.
3. Configuration: Flat face holding frame, provide only in 24-inch by 24-inch modules.
4. Blank-off: 16-gage galvanized steel sheet blank-off's at irregular shapes at filter bank perimeter as required. Permanently fasten and seal blank-off panels for an airtight seal.
5. Frame Seal: Seal between filter supports and at plenum housing to prevent day lighting for an airtight seal, with permanent frame mounted closed-cell foam gasket for sealing against filter.
6. Filter Gage: Dwyer 2000 series magnahelic, mounted for reading differential pressure across filter bank, 0-2-inch scale.
7. Filter media: Campus Standard is a low pressure drop filter ASHRAE 52.1 85% efficiency, ASHRAE 52.2 MERV 13, mini-pleat V-Bank design with minimum 193 square feet of media within a 24" x 24" x 12" rigid frame, 0.30" w.g. initial pressure drop at 2,000 cfm, UL 900 Class 1, use 24-inch by 24-inch sizes only.
8. Provide filter frame and racks of stainless steel construction for 100% outside air units. Screws, bolts, washers, nuts, springs or any other part shall be stainless steel.

2.10 LIGHTING

A. Vapor proof cast-aluminum marine LED light with guard for units less than 6-feet wide and 4-foot vapor proof strip LED light with lens for others with EMT runs inside of unit serving lights in each section of the unit. Locate solid-state timer switch on exterior adjacent to fan access door with independently fed lighting circuit – separate from unit power connection.

B. Light fixtures shall be located at the least likely location that they would be bumped or knocked by maintenance staff. That may include ceiling or wall and the location shall be reviewed by the University's Representative.

2.11 ELECTRICAL

A. Electrical work shall be in accordance with current California Electric Code.

B. Wiring inside unit sections shall be installed inside conduit. Conduit shall not run across floors or be installed to prevent normal maintenance access. Provide stranded copper wire in a watertight flexible conduit for final connection to motor.

C. VFD for fans shall be factory mounted. Provide single VFD for fan arrays with individual manual motor protectors (MMPs) per fan motor. Wiring inside units shall be factory installed.

2.12 ACCESSORIES:

A. Blank-off panels: 316 stainless steel sheet as required. Permanently fasten and seal blank-off panels for an airtight seal.

B. Lifting Lugs: Factory mounted and adequately sized lifting lugs for each component shipped.

C. Piping penetrations: Extend air lines to exterior of AHU cabinet and cap ½" brass female pipe threads.

2.13 OUTDOOR UNITS

A. Rooftop air handling units shall meet the requirements of this specification, shall be completely weatherproof, and shall meet the following requirements:

1. Curbs and rail isolation systems shall be completely flashed and protected from the weather.
2. Doors, access panels, and casings shall have weatherproof gaskets and seals.
3. Storm Louvers:

    a. Blades: drainable blade storm type with drain gutter in each blade, stainless steel, or 6063-T5 aluminum alloy. Air velocity at full economizer cycle shall not exceed 900 fpm, and shall not allow moisture carry-over.
    b. Downspouts: shall be provided in frame jambs and mullions.
    c. Frames: stainless steel.
    d. Screen: removable stainless steel bird screen.
    e. Supports: designed to withstand wind load of 20 lb per ft^2.
    f. Certification: certified and licensed to bear the AMCA Seal.
    g. Provide drain pan underneath outside air louver draining to roof.

4. Lighting, switches, convenience outlets, controls, wiring, cabling and instruments shall be suitable for outdoor applications in a coastal corrosive environment.

5. Electrical panels, control panels, and electrical devices shall meet the requirements of NEMA 4X stainless steel or alternative design such as built in ventilated cabinet sections as approved by the University.
6. Door handles, hinges, hardware, and accessories shall be 316 stainless steel.
7. Roof shall be sloped to drain, and shall not allow standing water. Roof system interconnecting two air handling units shall be equipped with flexible joint for independent movement of AHU's if externally isolated.
8. Moisture eliminators shall be provided at air intake section for 100% outside air intake units.
9. Access plenum section shall be equipped with flexible connectors to allow independent movement of AHU's.
10. Provide cover of filter gauge to keep unit out of sunlight.

END OF SECTION

SECTION 26 0500

COMMON WORK RESULTS FOR ELECTRICAL

1.01 SUMMARY

A. Section includes the following:
   1. Supporting devices for electrical components.
   2. Electrical demolition.
   3. Cutting and patching for electrical construction.

1.02 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC, Article 100, by a testing agency acceptable to the University, and marked for intended use.

B. Comply with CEC.

1.03 COORDINATION

A. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.

B. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
   2. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.02 SUPPORTING DEVICES

A. Material: Cold-formed steel, with corrosion-resistant coating acceptable to the University.

B. Metal Items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel.

C. Slotted-Steel Channel Supports: Flange edges turned toward web, and 9/16-inch-diameter slotted holes at a maximum of 2 inches o.c., in webs.

1. Channel Thickness: Selected to suit structural loading.
2. Fittings and Accessories: Products of the same manufacturer as channel supports.

D. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps or click-type hangers.

E. Pipe Sleeves: ASTM A 53, Type E, Grade A, Schedule 40, galvanized steel, plain ends.

F. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for non-armored electrical cables in riser conduits. Plugs have number and size of conductor gripping holes as required to suit individual risers. Body constructed of malleable-iron casting with hot-dip galvanized finish.

G. Expansion Anchors: Carbon-steel wedge or sleeve type.

H. Toggle Bolts: Steel springhead type.

I. Powder-Actuated Fasteners: are prohibited except when executed in accordance with Division 01.

2.03 TOUCHUP PAINT

A. For Equipment: Equipment manufacturer's paint selected to match installed equipment finish.

B. Galvanized Surfaces: Touch-up and repair per ASTM A780 “The Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.”

PART 3 - EXECUTION

3.01 ELECTRICAL EQUIPMENT INSTALLATION

A. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide the maximum possible headroom and in no case less than 84 inches.

B. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.

C. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.

D. Right of Way: Give to raceways and piping systems installed at a required slope.

3.02 WIRING INSTALLATION

A. Install splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than the unspliced conductors.

B. Install wiring at outlets of sufficient length to extend a minimum of 6 inches outside of the opening.

C. Connect outlet and component connections to wiring systems and to ground. Tighten electrical connectors and terminals, according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

3.03 ELECTRICAL SUPPORTING DEVICE APPLICATION

A. Damp Locations and Outdoors: Hot-dip galvanized materials, U-channel system components.

B. Dry Locations: Electro-plated steel materials.

C. Support Clamps for PVC Raceways: Click-type clamp system.

D. Selection of Supports: Comply with manufacturer's written instructions.

E. Strength of Supports: Adequate to carry present and future loads, times a safety factor of at least four; minimum of 200-lb design load.

3.04 SUPPORT INSTALLATION

A. Install support devices to securely and permanently fasten and support electrical components.

B. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assemblies and for securing hanger rods and conduits.

C. Support parallel runs of horizontal raceways together on trapeze or bracket-type hangers.

D. Size supports for multiple raceway installations, so capacity can be increased by 25 percent minimum in the future.

E. Support individual horizontal raceways with separate, pipe hangers or clamps.

F. Install 1/4-inch diameter or larger threaded steel hanger rods.

G. Arrange supports in vertical runs so the weight of raceways and enclosed conductors is carried entirely by raceway supports, with no weight load on raceway terminals.

H. Simultaneously install vertical conductor supports with conductors.

I. Separately support cast boxes that are threaded to raceways and used for fixture support. Support sheet-metal boxes directly from the building structure or by bar hangers. If bar hangers are used, attach bar to raceways on opposite sides of the box and support the raceway with an approved fastener not more than 24 inches from the box.

J. Install metal channel racks for mounting cabinets, panel boards; disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices unless components are mounted directly to structural elements of adequate strength.

K. Install sleeves for cable and raceway penetrations of concrete slabs and walls unless core-drilled holes are used. Install sleeves for cable and raceway penetrations of masonry and fire-rated gypsum walls and other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.

L. Securely fasten electrical items and their supports to the building structure, unless otherwise indicated. Perform fastening according to the following unless other fastening methods are indicated:
1. Wood: Fasten with wood screws or lag bolts.
2. Masonry: Toggle bolts on hollow masonry units and expansion bolts on solid masonry units.
3. New Concrete: Concrete inserts with machine screws and bolts.
4. Existing Concrete: Expansion bolts.
    a. Instead of expansion bolts, threaded studs driven by a powder charge and provided with lock washers may be used in existing concrete when executed in accordance with Division 01 requirements.
5. Steel: Welded threaded studs or spring-tension clamps on steel.
    a. Field Welding: Comply with AWS D1.1.
6. Welding to steel structure may be used only for threaded studs, not for conduits, pipe straps, or other items.
7. Light Steel: Sheet-metal screws.
8. Fasteners: Select so the load applied to each fastener does not exceed 25 percent of its proof-test load.

3.05 FIRESTOPPING

A. Apply firestopping to cable and raceway penetrations of fire-rated floor and wall assemblies to achieve fire-resistance rating of the assembly.

3.06 DEMOLITION

A. Protect existing electrical equipment and installations indicated to remain. If damaged or disturbed in the course of the Work, remove damaged portions and install new products of equal capacity, quality, and functionality.

B. Accessible Work: Remove exposed electrical equipment and installations, indicated to be demolished, in their entirety.

C. Abandoned Work: Cut and remove buried raceway and wiring. When approved by the University's Representative raceway can be abandoned in place a minimum of 4 inches below the surface of adjacent construction. Cap raceways and patch surface to match existing finish.

D. Remove demolished material from Project site.

E. Remove, store, clean, reinstall, reconnect, and make operational components indicated for relocation.

3.07 CUTTING AND PATCHING

A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.

B. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new fireproofing where existing fire stopping has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

3.08 FIELD QUALITY CONTROL

A. Inspect installed components for damage and faulty work, including the following:
1. Supporting devices for electrical components.
2. Electrical demolition.
3. Cutting and patching for electrical construction.
4. Touchup painting.

3.09 REFINISHING AND TOUCHUP PAINTING

A. Refinish and touch up paint.
1. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.
2. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.
3. Touch-up and repair per ASTM A780 "The Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings."
4. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.10 CLEANING AND PROTECTION

A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.

B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 26 0519

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.

1.02 SUBMITTALS

A. Product Data: For each type of product indicated.

1.03 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC , Article 100, by a testing agency acceptable to the University, and marked for intended use.

B. Comply with CEC.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.
2. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.02 CONDUCTORS AND CABLES

A. Manufacturers (Building Wire and Cable):

1. American Insulated Wire Corp.; a Leviton Company.
2. General Cable Corporation.
3. Southwire Company.
4. Or equal

B. Manufacturers (Control Cable):

1. Alpha.

2. Belden.
3. Or equal.

C. Manufacturers (MC cable):

1. AFC Cable Systems.
2. Southwire Company.
3. Or equal.

D. Refer to Part 3 "Conductor and Insulation Applications" Article for insulation type, cable construction, and ratings.

E. Conductor Material: Copper complying with ICEA S-95-658 / NEMA WC 70 Nonshielded 0-2 kV Cables.

F. Conductor Insulation Types: Type THW, THHN-THWN, XHHW, UF, USE, and SO complying with NEMA WC 70.

2.03 CONNECTORS AND SPLICES

A. Manufacturers:

1. AFC Cable Systems, Inc.
2. AMP Incorporated/Tyco International.
3. Hubbell/Anderson.
4. O-Z/Gedney; EGS Electrical Group LLC.
5. 3M Company; Electrical Products Division.
6. Or equal.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.01 CONDUCTOR AND INSULATION APPLICATIONS

A. Feeders Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.

B. Feeders Concealed in Concrete, below Slabs-on-Grade, and in Crawlspaces: Type THHN-THWN, single conductors in raceway.

C. Exposed Branch Circuits, including in Crawlspaces: Type THHN-THWN, single conductors in raceway.

D. Branch Circuits Concealed in Concrete and below Slabs-on-Grade: Type THHN-THWN, single conductors in raceway.

3.02 INSTALLATION

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not use oil, grease, graphite or similar substances. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means; including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway. Pulling of large conductors in raceways shall be done with an approved cable pulling machine. Other methods such as block and tackle to install conductors are prohibited.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.

E. Support cables according to Division 26 Section "Common Work Results for Electrical".

F. Seal around cables penetrating fire-rated elements**.** Provide separate sleeves and/or fire barriers for cable fire wall penetration, unless cable is UL listed for the application.

G. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical System. Color-coded conductor sleeves are not permitted.

H. Metal Clad (MC) Cable Installation Requirements: Not Allowed

3.03 CONNECTIONS

A. Provide steel cable connectors with insulated throat, OZ/Gedney AMC series or equal. Die cast or pressure cast fittings are prohibited.

B. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

C. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

D. Wiring at Outlets: Install wiring at outlets of sufficient length to extend a minimum of 6 inches outside of the opening.

END OF SECTION

SECTION 26 0526

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.

B. Grounding to water piping whether underground, or indoors is strictly prohibited.

1.02 SUBMITTALS

A. Product Data: None.

1.03 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1. Comply with UL 467.

B. Comply with CEC; for medium-voltage underground construction, comply with IEEE C2.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Grounding Conductors, Cables, Connectors:

a. Burndy Electrical.
b. Cooper Power Systems.
c. Copperweld Corp.
d. Erico Inc.
e. Hubbell.
f. O-Z/Gedney Co.
g. Thomas & Betts
h. Or equal.

B. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.02 GROUNDING CONDUCTORS

A. For insulated conductors, comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

B. Material: Copper.

C. Equipment Grounding Conductors: Insulated with green-colored insulation.

D. Grounding Electrode Conductors: Stranded cable.

E. Bare Copper Conductors: Comply with the following:

1. Solid Conductors: ASTM B 3.
2. Assembly of Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.

F. Copper Bonding Conductors: As follows:

1. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG copper conductor, 1/4 inch in diameter.
2. Bonding Conductor: No. 4 or No. 6 AWG, stranded copper conductor.
3. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
4. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

G. Grounding Bus: Bare, annealed copper bars of rectangular cross section, with insulators.

2.03 CONNECTOR PRODUCTS

A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.

B. Bolted Connectors: Bolted-pressure-type connectors, or compression type.

C. Welded Connectors: Exothermic-welded type, in kit form, and selected per manufacturer's written instructions.

PART 3 - EXECUTION

3.01 APPLICATION

A. Use only copper conductors for both insulated and bare grounding conductors.

B. In raceways, use insulated equipment grounding conductors.

C. Exothermic-Welded Connections: Use for connections to structural steel.

D. Equipment Grounding Conductor Terminations: Use bolted pressure clamps.

E. Grounding Bus: Install as indicated.

1. Use insulated spacer; space 1 inch from wall and support from wall 6 inches above finished floor, unless otherwise indicated.
2. At doors, route the bus up to the top of the door frame, across the top of the doorway, and down to the specified height above the floor.

3.02 EQUIPMENT GROUNDING CONDUCTORS

A. Comply with CEC , Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by CEC are indicated.

B. Install equipment grounding conductors in feeders and circuits.

C. Install insulated equipment grounding conductor with circuit conductors for the following items, in addition to those required by NEC:

1. Feeders and branch circuits.
2. Receptacle circuits.
3. Single-phase motor and appliance branch circuits.
4. Three-phase motor and appliance branch circuits.
5. Flexible raceway runs.

D. Signal and Communication Systems: For telephone, alarm, voice and data, and other communication systems, provide No. 2 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.

1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch grounding bus.
2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

3.03 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking

care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.

C. Metal Water Service and Meter Piping: Grounding to water pipes is prohibited on campus. Campus water mains are non-conducting. Bond building piping to the separate grounding system for the building.

3.04 CONNECTIONS

A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are compatible.

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
2. Make connections with clean, bare metal at points of contact.
3. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

B. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

C. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.

D. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically non-continuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.

E. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

F. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.

G. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

H. Ground bus connections: Shall be one hole, copper cable termination type Burndy HYLUG™, Thomas & Betts Blue, or equal. Install with ¼ - ½" silicon bronze machine bolts with bronze washer each side.

END OF SECTION

SECTION 26 0529

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes the following:

1. Hangers and supports for electrical equipment and systems.
2. Seismic restraints for electrical equipment and systems.
3. Construction requirements for concrete bases.

1.02 DEFINITIONS

A. CBC: California Building Code

B. EMT: Electrical metallic tubing.

C. IMC: Intermediate metal conduit.

D. RMC: Rigid metal conduit.

E. Seismic Restraint: A structural support element such as a metal framing member, a cable, an anchor bolt or stud, a fastening device, or an assembly of these items used to transmit seismic forces from an item of equipment or system to building structure and to limit movement of item during a seismic event.

1.03 SUBMITTALS

A. Product Data: Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of electrical support and seismic-restraint component used.

1. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to the University.

1.04 QUALITY ASSURANCE

A. Comply with seismic-restraint requirements in the California Building Code

B. Testing of Seismic Anchorage Devices: Comply with testing requirements in Part 3 and in Division 26 Section "Common Work Results for Electrical."

C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.05 PROJECT CONDITIONS

A. Project Seismic Zone as Defined in the CBC: Zone 4.

B. Project Seismic Zone Factor as Defined in the CBC: Zone Factor 0.40.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
2. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section “Product Options and Substitutions”. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.02 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed under this Project, with a minimum structural safety factor of five times the applied force.

B. Steel Slotted Support Systems: Comply with MFMA-3, factory-fabricated components for field assembly.

1. Manufacturers:

a. Cooper B-Line; a division of Cooper Industries.
b. ERICO International Corporation.
c. Allied Support Systems; Power-Strut Unit.
d. GS Metals Corp.
e. Michigan Hanger Co., Inc.; O-Strut Div.
f. National Pipe Hanger Corp.
g. Thomas & Betts Corporation.
h. Unistrut; Tyco International, Ltd.
i. Wesanco, Inc.
j. Or equal.

2. Finishes:

a. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-3.
b. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-3.

c. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-3.

3. Channel Dimensions: Selected for structural loading and applicable seismic forces.

C. Raceway and Cable Supports: As described in NECA 1.

D. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Shall not be used in University occupied areas and then only for non-seismic restraints.
2. Threaded-steel stud, for use in hardened Portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

a. Manufacturers:

1) Hilti, Inc.
2) ITW Construction Products.
3) MKT Fastening, LLC.
4) Simpson Strong-Tie Co. Inc.
5) Or equal.

3. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened Portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

a. Manufacturers:

1) Cooper B-Line; a division of Cooper Industries.
2) Empire Tool and Manufacturing Co., Inc.
3) Hilti, Inc.
4) ITW Construction Products.
5) MKT Fastening, LLC.
6) Powers Fasteners.
7) Or equal.

4. Concrete Inserts: Steel or malleable-iron slotted-support-system units similar to MSS Type 18; complying with MFMA-3 or MSS SP-58.
5. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
6. Through Bolts: Structural type, hex head, high strength. Comply with ASTM A 325.
7. Toggle Bolts: All-steel springhead type.
8. Hanger Rods: Threaded steel.

2.03 SEISMIC-RESTRAINT COMPONENTS

A. Rated Strength, Features, and Application Requirements for Restraint Components: As defined in reports by an agency acceptable to the University.

1. Structural Safety Factor: Strength in tension, shear, and pullout force of components used shall be at least five times the maximum seismic forces to which they will be subjected.

B. Angle and Channel-Type Brace Assemblies: Steel angles or steel slotted-support-system components; with accessories for attachment to braced component at one end and to building structure at the other end.

C. Cable Restraints: ASTM A 603, zinc-coated, steel wire rope attached to steel or stainless-steel thimbles, brackets, swivels, and bolts designed for restraining cable service.

1. Manufacturers:

   a. Amber/Booth Company, Inc.
   b. Loos & Co., Inc.
   c. Mason Industries, Inc.
   d. Or equal.

2. Seismic Mountings, Anchors, and Attachments: Devices as specified in Part 2 "Support, Anchorage, and Attachment Components" Article, selected to resist seismic forces.
3. Hanger Rod Stiffener: Reinforcing steel angle clamped to hanger rod, of design recognized by an agency acceptable to the University**.** Retain both subparagraphs below for projects subject to seismic design requirements; delete if bushing requirements are included in details or charts on Drawings.
4. Bushings for Floor-Mounted Equipment Anchors: Neoprene units designed for seismically rated rigid equipment mountings, and matched to type and size of anchor bolts and studs used.
5. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for seismically rated rigid equipment mountings, and matched to type and size of attachment devices used.

PART 3 - EXECUTION

3.01 APPLICATION

A. Comply with NECA 1 for application of hangers and supports for electrical equipment and systems, except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, and RMC as scheduled in NECA 1, where Table 1 lists maximum spacing less than stated in. Minimum rod size shall be 1/4 inch in diameter.

C. For individual conduit runs not directly fastened to the structure, use rod hangers.

D. Arrange conduit supports to prevent distortion of alignment by wire pulling operations. Fasten conduit using galvanized straps, lay-in adjustable hangers, clevis hangers, or bolted split galvanized hangers.

E. Do not fasten conduit with wire or perforated pipe straps. Remove wire used for temporary conduit support during construction before conductors are pulled. Do not use ceiling wire to support conduit.

F. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits. Supports should be spaced for maximum deflection of conduit not greater than 1/8".

1. Secure raceways and cables to trapeze member with clamps approved for application by an agency acceptable to the University.

3.02 SUPPORT AND SEISMIC-RESTRAINT INSTALLATION

A. Comply with NECA 1 for installation requirements, except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, RMC may be supported by openings through structure members, as permitted in CEC (NFPA 70).

C. Install seismic-restraint components using methods approved by the evaluation service providing required submittals for component.

D. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

E. Field Welding: Comply with AWS D1.1/D1.1M.

3.03 INSTALLATION OF SEISMIC-RESTRAINT COMPONENTS

A. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolts and mounting hole in concrete base.

B. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

C. Restraint Cables: Provide slack within maximums recommended by manufacturer.

D. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, upper truss chords of bar joists, or at concrete members.

E. Provide raceway fixtures and equipment systems with appropriate longitudinal and cross bracing to satisfy Seismic Zone 4 requirements.

3.04 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Make flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross expansion and seismic-control joints, where adjacent sections or branches are supported by different structural elements, and where they terminate with connection to electrical equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.05 FIELD QUALITY CONTROL

A. Testing: Test pullout resistance of seismic anchorage devices.

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with University's Representative, through Architect, before connecting anchorage device to restrained component (unless post connection testing has been approved), and with at least seven days' advance notice.
3. Obtain University Representative's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test at least four of each type and size of installed anchors and fasteners selected by University's Representative.
5. Test to 90 percent of rated proof load of device.
6. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

B. Record test results.

***** END OF SECTION *****

SECTION 26 0533

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.02 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. LFMC: Liquidtight flexible metal conduit.

D. RNC: Rigid nonmetallic conduit.

1.03 SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings.

B. Shop Drawings: Show fabrication and installation details of components for raceways, fittings, boxes, enclosures, and cabinets.

1.04 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with CEC.

1.05 COORDINATION

A. Coordinate layout and installation of raceways, boxes, enclosures, cabinets, and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.
2. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Specific procedures must be followed before use of an unnamed product or manufacturer.

2.02 METAL CONDUIT AND TUBING

A. Manufacturer**s**:

1. AFC Cable Systems, Inc.
2. Alflex Inc.
3. Anamet Electrical, Inc.; Anaconda Metal Hose.
4. Electri-Flex Co.
5. Grinnell Co..
6. LTV Steel Tubular Products Company.
7. Manhattan/CDT/Cole-Flex.
8. O-Z Gedney.
9. Wheatland Tube Co.
10. Or equal.

B. Rigid Steel Conduit: ANSI C80.1.

C. Plastic-Coated Steel Conduit and Fittings: NEMA RN 1.

D. EMT and Fittings: ANSI C80.3.

1. Fittings: Set-screw type.

E. LFMC: Flexible steel conduit with PVC jacket.

F. Fittings: NEMA FB 1; compatible with conduit and tubing materials.

2.03 METAL WIREWAYS

A. Manufacturer**s**:

1. Hoffman.
2. Square D.
3. Or equal.

B. Material and Construction: Sheet metal sized and shaped as indicated, NEMA 1 or 3R as indicated.

C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Select features, unless otherwise indicated, as required to complete wiring system and to comply with CEC.

E. Wireway Covers: Screw-cover type.

F. Finish: Manufacturer's standard enamel finish.

2.04 BOXES

A. Manufacturer**s**:

1. Cooper Crouse-Hinds
2. Emerson
3. Hoffman.
4. Hubbell, Inc.
5. O-Z/Gedney;
6. Thomas & Betts Corporation.
7. Wiremold Company.
8. Or equal

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, with gasketed cover.

D. Nonmetallic Outlet and Device Boxes: NEMA OS 2.

E. Floor Boxes: Cast metal, fully adjustable, rectangular.

F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

G. Cast-Metal Pull and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.

2.05 FACTORY FINISHES

A. Finish: For raceway, enclosures, or cabinet components, provide manufacturer's standard prime-coat finish ready for field painting.

B. Finish: For raceway, enclosures, or cabinet components, provide manufacturer's standard paint applied to factory-assembled surface raceways, enclosures, and cabinets before shipping.

PART 3 - EXECUTION

3.01 RACEWAY APPLICATION

A. Indoors:

1. Exposed: EMT
2. Concealed: EMT.
3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
4. Damp or Wet Locations: Rigid steel conduit.
5. Mechanical Rooms: Rigid steel conduit.
6. Boxes and Enclosures: NEMA 250, Type 1, except as follows:

    a. Damp or Wet Locations: NEMA 250, Type 4, stainless steel

B. Minimum Raceway Size: 3/4-inch trade size.

C. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings approved for use with that material. Patch nicks and scrapes in PVC coating after installing conduits.

D. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

E. Do not install aluminum conduits embedded in or in contact with concrete.

3.02 INSTALLATION

A. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

B. Complete raceway installation before starting conductor installation.

C. Install temporary closures to prevent foreign matter from entering raceways.

D. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above the finished slab.

E. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated.

F. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.

1. Install concealed raceways with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.

G. Raceways Embedded in Slabs: New installations are prohibited.

H. Install exposed raceways parallel or at right angles to nearby surfaces or structural members and follow surface contours as much as possible.

1. Run parallel or banked raceways together on common supports.
2. Make parallel bends in parallel or banked runs. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.

I. Join raceways with fittings designed and approved for that purpose and make joints tight.

1. Use insulating bushings to protect conductors.

J. Tighten set screws of thread less fittings with suitable tools.

K. Terminations:

1. Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against box. Use two locknuts, one inside and one outside box.
2. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.

L. Install pull ropes in empty raceways. Use braided polypropylene with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull rope.

M. Telephone and Signal System Raceways, 2-Inch Trade Size and Smaller: In addition to above requirements, install raceways in maximum lengths of 150 feet and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.

N. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where otherwise required by CEC.

O. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with finished floor.

P. Flexible Connections: Use maximum of 72 inches of flexible conduit for recessed and semi recessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for motors. Use LFMC in damp or wet locations, mechanical rooms, and electric motors. Install separate ground conductor across flexible connections.

Q. Surface Raceways: Install a separate, green, ground conductor in raceways from junction box supplying raceways to receptacle or fixture ground terminals.

3.03 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.04 CLEANING

A. After completing installation of exposed, factory-finished raceways and boxes, inspect exposed finishes and repair damaged finishes.

END OF SECTION

SECTION 26 0553

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Equipment identification labels.

1.02 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

1.03 QUALITY ASSURANCE

A. Comply with ANSI A13.1 and IEEE C2.

B. Comply with CEC.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.04 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.01 MATERIALS

A. For fixture descriptions in other Part 2 articles where the subparagraph titles "Products," and "Manufacturers" introduce a list of manufacturers and their products or manufacturers only, the following requirements apply for product selection:
   1. Products: Subject to compliance with requirements, provide one of the products specified in other Part 2 articles.
   2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified in other Part 2 articles.
   3. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.02 POWER RACEWAY IDENTIFICATION MATERIALS

A. Colors for Raceways Carrying Circuits at 600 V or Less:
   1. Black letters on an orange field
   2. Legend: Indicate voltage and system or service type.

2.03 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

C. Write-On Tags: Polyester tag, 0.015 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
   1. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.04 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

B. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

C. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

2.05 FLOOR MARKING TAPE

A. 2-inch- wide, 5-mil pressure-sensitive vinyl tape, with black and yellow stripes and clear vinyl overlay suitable for moderate traffic.

2.06 EQUIPMENT IDENTIFICATION LABELS

A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. Black letters on a light-gray background. Minimum letter height shall be 3/8 inch.

2.07 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.
   1. Minimum Width: 3/16 inch.
   2. Tensile Strength at 73 deg F, according to ASTM D 638: 12,000 psi.
   3. Temperature Range: Minus 40 to plus 185 deg F.
   4. Color: Black except where used for color-coding.

2.08 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: <Comply with requirements in Division 09 Section “Interior Painting” for paint materials and application requirements. >Select paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Secure nameplates to equipment fronts using screws, rivets or adhesive. Secure nameplate to inside face of recessed panel board doors in finished locations. Use weatherproof adhesive for outdoor installation. Do not use tape for nameplates or legend plates.

E. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and other designations with corresponding designations. Use consistent designations throughout project.

F. Self-Adhesive Identification Products: Clean surfaces before applying.

G. Install nameplates and labels parallel to equipment lines.

H. Junction Boxes for Fire Alarm System shall be red.

I. Caution Labels for Indoor Boxes and Enclosures for Power and Lighting: Install labels identifying system voltage with black letters on orange background. Install on exterior of door or cover.

J. Circuit Identification Labels on Receptacles:
1. Public View Areas (lobbies, atrium, public conference and meeting rooms, classrooms, etc.): Permanently engrave circuit information on back of plate.
2. Other Areas: Engraved circuit information on front of plate.

K. Conduit installed below grade shall have underground hazard tape (non-adhesive) installed a minimum of 12 inches above the conduit or top layer of conduits in a duct bank. The tape shall be 6 inches wide and 4 millimeters thick yellow polyethylene for low voltage conduits and red for medium voltage conduits. The tape shall be marked "Caution Buried Electric Line" for low voltage and "Danger High Voltage Line" for medium voltage. Tracer wire shall be used for PVC conduits and non-metallic tape for metallic conduits. The tape shall be installed the entire length of conduit below grade.

L. Color-Coding of Secondary Phase Conductors: Use the following colors for service feeder and branch-circuit phase conductors. Wiring shall be color coded, see section 26 0519, "Low Voltage Electrical Power Conductors and Cables". Low voltage wire markers shall be adhering, preprinted, self-laminating vinyl wrap-around strips. Wire shall be marked with opposite end termination and shall include panel source and circuit numbers. Phasing shall be indicated by colored wire or tape. For other system voltages consult the University:
1. 208/120-V Conductors:
    a. Phase A: Black.
    b. Phase B: Red.
    c. Phase C: Blue.
    d. Switch Leg: Pink.
    e. Switch Traveler: Same as Hot Leg.
2. 480/277-V Conductors:
    a. Phase A: Brown.
    b. Phase B: Orange.
    c. Phase C: Yellow.
    d. Switch Leg: Purple
    e. Switch Traveler: Same as Hot Leg.
3. Neutral and Ground Conductors:
    a. Neutral: White.
    b. Ground: Green.
4. Factory apply color the entire length of conductors, except the following field-applied, color-coding methods may be used instead of factory-coded wire for sizes larger than No. 10 AWG:

a. Colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Use 1-inch- wide tape in colors specified. Adjust tape bands to avoid obscuring cable identification markings.
b. Colored cable ties applied in groups of three ties of specified color to each wire at each terminal or splice point starting 3 inches from the terminal and spaced 3 inches apart. Apply with a special tool or pliers, tighten to a snug fit, and cut off excess length.

M. Power-Circuit Identification: Brass tags wraparound marker bands for cables, feeders, and power circuits in vaults, pull and junction boxes, manholes, and switchboard rooms.
1. Legend: 1/4-inch steel letter and number stamping or embossing with legend corresponding to indicate circuit designations.
2. Tag Fasteners: Nylon cable ties.
3. Band Fasteners: Integral ears.

N. Apply identification to conductors as follows:
1. Multiple Power or Lighting Circuits in the Same Enclosure: Identify each conductor with source, voltage, circuit number, and phase. Use color-coding to identify circuits' voltage and phase.
2. Multiple Control and Communication Circuits in the Same Enclosure: Identify each conductor by its system and circuit designation. Use a consistent system of tags, color-coding, or cable marking tape.

O. Apply warning, caution, and instruction signs as follows:
1. Warnings, Cautions, and Instructions: Install to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.
2. Emergency Operation: Install engraved laminated signs with white legend on red background with minimum 3/8-inch high lettering for emergency instructions on power transfer, load shedding, and other emergency operations.

P. Equipment Identification Labels: Engraved plastic laminate. Install on each unit of equipment, including central or master unit of each system. This includes power, lighting, communication, signal, and alarm systems, unless units are specified with their own self-explanatory identification. Unless otherwise indicated, provide a single line of text with 1/2-inch- high lettering on 2” high label. Use black lettering on white field. Use white lettering on red field for emergency circuited equipment. Apply labels for each unit of the following categories of equipment using mechanical fasteners:
1. Panel boards, electrical cabinets, and enclosures.
2. Access doors and panels for concealed electrical items.
3. Electrical switchgear and switchboards.
4. Electrical substations.
5. Emergency system boxes and enclosures.
6. Motor-control centers.
7. Disconnect switches.

8. Enclosed circuit breakers.
9. Motor starters.
10. Push-button stations.
11. Power transfer equipment.
12. Contactors.
13. Remote-controlled switches.
14. Dimmers.
15. Control devices.
16. Transformers.
17. Inverters.
18. Rectifiers.
19. Frequency converters.
20. Battery racks.
21. Power-generating units.
22. Telephone switching equipment.
23. Clock/program master equipment.
24. Call system master station.
25. TV/audio-monitoring master station.
26. Fire alarm master station or control panel.
27. Security-monitoring master station or control panel.

Q. Low Voltage Identification

1. Equipment nameplates shall be engraved three-layer laminated plastic with white background and black letters. Letters shall be ¼" minimum size. Identifications shall match plan designations and based upon the University's numbering scheme.
2. Legend plates for control panels and indicators shall be provided on disconnect and safety switches and indicating lights. The plates shall be die-stamped metal with mounting hole and positioning key.
3. For panel board directories provide the following:

    a. Provide typewritten directories arranged in numerical order showing number of room in which each device is located.
    b. Verify room numbers to be used with the University's representative prior to typing, since room numbers will most likely not be those shown on the drawings.
    c. Mount directories under a clear plastic cover inside each panelboard door.
4. The following low voltage equipment numbering scheme shall be followed:

TYPE	DESCRIPTION
DP	208/120V Distribution Panelboard
LP	208/120V Panelboard – Receptacles & Lighting
HDP	480/277V Distribution Panelboard
HLP	480/277 V Panelboard – Lighting

ATS	Automatic Transfer Switch
CB	Circuit Breaker
DS	Disconnect Switch
EDP	Emergency 208/120V Distribution Panelboard
ELP	Emergency 208/120V Panelboard

5. Use numbering convention as follows:

   a. First letter or number = floor designation; B = basement, 1, 2, 3, etc. (B).
   b. Subsequent lower case letter = panel number on each floor; a, b, c, etc. (Ba).

      1) Example: Emergency 277/480V Distribution panelboard installed in basement is “EHDP-B”.
      2) Example: second 480/277Vpanelboard installed on third floor for lighting is “HLP-3b”.

R. Telecommunication, Signal Alarm and Control Wiring:
   1. Conductors Terminated or spliced shall be labeled at each end with tape markers.

END OF SECTION

SECTION 26 2816

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes the following individually mounted, enclosed switches and circuit breakers:

1. Fusible switches.
2. Non-fusible switches.

1.02 DEFINITIONS

A. HD: Heavy duty.

1.03 SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current rating.
4. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

1.04 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with CEC.

1.05 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
2. Altitude: Not exceeding 6600 feet.

1.06 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
2. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section “Product Options and Substitutions”. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.02 FUSIBLE AND NONFUSIBLE SWITCHES

A. Manufacturers:

1. Eaton Corporation; Cutler-Hammer Products.
2. General Electric Co.; Electrical Distribution & Control Division.
3. Siemens Energy & Automation, Inc.
4. Square D/Group Schneider.
5. Or equal.

B. Fusible Switch, 600 A and Smaller: NEMA KS 1, Type HD, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Nonfusible Switch, 600 A and Smaller: NEMA KS 1, Type HD, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

D. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded, and bonded; and labeled for copper neutral conductors.
3. Auxiliary Contact Kit: Auxiliary set of contacts arranged to open before switch blades open.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.

B. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated. Anchor floor-mounting switches to concrete base.

C. <**Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."**>

D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

3.03 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Common Work Results for Electrical" and Identification for Electrical Systems."

B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate< **as specified in Division 26 Section "Identification for Electrical Systems"**>.

3.04 CLEANING

A. On completion of installation, vacuum dirt and debris from interiors; do not use compressed air to assist in cleaning.

B. Inspect exposed surfaces and repair damaged finishes.

END OF SECTION