ARIZONA BOARD OF REGENTS
NORTHERN ARIZONA UNIVERSITY

PROJECT MANUAL
BIDDING DOCUMENTS AND SPECIFICATIONS

FOR

Condensate Line Replacement near Reilly Hall

NAU PROJECT NO. 10.010.168

NORTHERN ARIZONA UNIVERSITY
FLAGSTAFF, ARIZONA
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Sealed bids are being solicited by Facility Services, Office of Planning, Design and Construction, Northern Arizona University, for and on behalf of the Arizona Board of Regents, for the furnishing of all labor, material, transportation and services required for Project Number: 10.010.168, Project Name: Condensate Line Replacement near Reilly Hall on the Campus of Northern Arizona University, Flagstaff, Arizona, in accordance with the plans and specifications on file at Facility Services, Office of Planning, Design and Construction.

Bids will be received at Facility Services, Building #77, Administrative Services, Room 108, Northern Arizona University, Flagstaff, Arizona, until April 28, 2016 at 3:00PM. Bids will be opened publicly directly thereafter and read aloud in the Facility Services conference room. A mandatory Pre-Bid Conference will be held at April 18, at 3:00PM in the Facility Services Conference Room A. Plans and Specifications for the proposed work may be inspected online at http://nau.edu/Facility-Services/Bids_RFQ/. The scope of work for this project is to replace failed condensate line and steam line insulation between Reilly Hall and a steam vault. A more detailed scope of work will be provided at the mandatory pre-bid meeting.

All vehicles parking on campus must have a permit. Parking permits for the pre-submittal meeting are available at the parking kiosks at the entrances to campus. See http://nau.edu/parking-shuttle-services/ for more information.

A certified check, cashier’s check or NAU Bid Bond Form FS#9 for ten percent (10%) of the amount of bid, must accompany each proposal, as a guarantee that the Contractor will enter into a contract to perform the proposal in accordance with the plans and specifications or as Liquidated Damages in the event of failure or refusal of the Contractor to enter into the contract. Checks or bonds will be returned to the unsuccessful bidders, and to the successful bidder upon the execution of a satisfactory bond and contract, as prescribed by Arizona Revised Statutes.

The Contractor, to whom the contract is awarded, shall, after receipt of Notice of Intent to Award, furnish to the aforesaid Board of Regents a satisfactory performance and payment bond in an amount equal to one hundred percent (100%) of the full amount of the proposal, such bond not to be expressly limited as to time in which action may be instituted against the surety company for possible nonperformance of the Contractor. Bonds must be from a corporate surety company licensed to issue surety bonds in the State of Arizona. Individual sureties will not be accepted.

Work shall commence immediately after receipt of Notice to Proceed and shall be Substantially Complete by August 5, 2016, and shall be Finally Complete by October 7, 2016. Bonds and insurance certificates must be submitted and approved prior to commencement of work.

The Board of Regents reserves the right to reject any or all proposals, to waive or decline to waive irregularities in any bid, or to withhold the award for any reason it may determine, and also reserves the right to hold any or all bids for a period of 60 days after the date of the opening thereof. No bidder may withdraw a bid during this 60-day period without forfeiture of the bid bond.

Women owned and minority owned firms are encouraged to apply. Persons with a disability may request a reasonable accommodation by contacting Facility Services, (928) 523-4227.

ARIZONA BOARD OF REGENTS

Bid should be addressed to:
NAU Planning, Design and Construction
Attention: Patrick Ryan
PO Box 5637
Flagstaff, Arizona 86011
Phone: (928) 523.4227
Facsimile: (928) 523.9441

NORTHERN ARIZONA UNIVERSITY – Technical Standards
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00 21 00 Instructions

00 21 13 Instructions to Bidders

00 21 13.1 Correspondence

All correspondence relating to the project should be addressed to:
Facility Services
Planning, Design, and Construction
Northern Arizona University
P.O. Box 5637
Flagstaff, AZ 86011

All correspondence should reference Project by both name and NAU project number.

00 21 13.2 Sealed Proposals

Northern Arizona University will receive sealed bids (at the time and place specified in Section 00 11 13, Notice to Contractors of Intent to Receive Bids) for the labor, equipment and materials necessary to perform all functions and work indicated on the drawings and specified herein. Proposals shall be submitted on the required forms included in Section 00 43 00 of these specifications.

00 21 13.3 Execution of Contract and Bonds

The Contract Agreement, which the successful bidder, as Contractor, will be required to execute, is referenced in Section 00 52 00 of this manual. The form of Bonds and insurance certificates required to be furnish are included in Section 00 62 16 of this manual and shall be carefully examined by the bidder. The successful bidder will be required to execute the Standard Form Agreement between Owner and Contractor (Contract) and submit completed bonds and insurance certificates within five (5) working days after Notice of Intent to Award Contract. Failure to execute a Contract Agreement and to file satisfactory payment and performance bonds and insurance certificates issued by companies deemed qualified by the Owner Section 00 61 13 of the Standard Form Agreement Between Owner and Contractor) shall be just cause for the cancellation of the Award of Project and the forfeiture of the Bid Bond which shall become the property of the Owner, not as a penalty, but in liquidation of damages sustained. Award may then be made to the next lower responsible bidder, canceled, or re-advertised as the Owner may elect.

The University reserves the right to waive irregularities in consideration of award to the lowest responsive and responsible bidder.

00 21 13.4 Bidding Documents

Bidders may obtain from the Office of Facility Services, Administrative Services, complete sets of Bidding Documents stated in the Invitation to Bid, section 00 11 13 of this document. Electronic copies of these documents can be found at: http://nau.edu/Facility-Services/Bids_RFQ/.

General Contractors shall be responsible for distribution of bidding documents to Subcontractors.
Complete sets of Bidding Documents are to be used in preparing Bids. Neither Owner nor DP assumes any responsibility for errors or misinterpretations resulting from using incomplete sets of Bidding Documents.

Owner or DP, in making copies of Bidding documents available on above terms, does so only for purpose of obtaining bids on the Work and does not confer a license or grant for any other use.

00 21 13.5 Interpretation or Correction of Bidding Documents
Bidders shall notify Owner and/or DP promptly of any ambiguity, inconsistency or error discovered upon examination of Bidding Documents or of site and local conditions. Failure to so notify Owner/DP is deemed a waiver of any claim by Contractor, based upon any such ambiguity, inconsistency or errors. The DP shall maintain a log of all inquiries and shall provide written notification of such to the Facility Services Project Manager.

Interpretation, correction or change of Bidding Documents will be made by written Addendum. Interpretations, corrections or changes of Bidding Documents made in any other manner will not be binding; Bidders may not rely upon such interpretations, corrections and changes.

00 21 13.6 Bidder's Representation
Each Bidder by making their Bid represents that:

They have read and understand the Bidding Documents and all Contract Documents and that Bid is made in accordance therewith.

They have visited the site and are familiar with local conditions under which Work is to be performed, including verification of all field measurements, and have inspected all accessible spaces.

They have thoroughly familiarized themselves with all specific products and their proposed uses.

Their bid is based upon the materials, systems and equipment described in the Bidding Documents without exceptions.

They have satisfied themselves that the products specified are appropriate for the uses proposed.

Their subcontractors with project involvement exceeding $100,000 are bondable.

They have advised each subcontractor to become thoroughly familiar with the Contract Documents, including the specifications and referenced standards, insofar as they affect each subcontractor.

They will install all Work properly, will place their warranty on the Work, and provide guarantees required.
00 21 13.7 Bid Period
Unless otherwise noted, all bids and bid prices shall remain firm for a period of sixty (60) days after the date of Bid opening and the Contractor shall be prepared to begin construction within ten (10) calendar days of receipt of notice to proceed.

00 21 13.8 Contractor Qualifications
The Contractor shall submit with bid package the Statement of Qualifications included in Section 00 45 13 of these specifications.

The competency and responsibility of Bidders, of their proposed Subcontractors, and of the Surety issuing the Contractor’s performance and payment bonds, will be reviewed prior to award.

00 21 14 Bidding Procedure

00 21 14.1 Form and Style of Bids
Bids must be submitted on Form of Proposal (FS#1) provided in Section 00 41 13 of these specifications. Blanks on the Form of Proposal shall be typed in or printed legibly in ink.

Where indicated on Form of Proposal, express sums both in words and digits; in case of discrepancy between the two, the written amount shall govern.

Signer of Bid must initial any insertion, alteration or erasure.

Each copy of Bid shall include (on the FS #2) the legal name of Bidder and statement whether Bidder is sole proprietor, partnership, corporation or other legal entity. Each copy shall be signed by person, or persons, legally authorized to bind Bidder to a contract. Bid by a corporation shall give the state of incorporation and have corporate seal affixed. Bid bonds submitted by agent must have current Power of Attorney attached certifying agent’s authority to bind Bidder.

Other **required** forms include:

**Required Bid Forms**
1. Form of Proposal (FS#1)
2. Contractor Statement of Qualifications (FS#2)
3. Subcontractor List (FS#3)
4. Bid Bond (FS#9)
5. Notification & Confirmation of Asbestos Containing Materials (FS#13)

All additional forms that are standard for the University and must be used throughout the Contract for Construction are noted in Section 00 52 00 of these specifications and available through the office of Facility Services, Planning, Design and Construction.

00 21 14.2 Supplements to Bid Forms
00 21.14.21 Bid Bond
A Certified or Cashier’s Check or Bid Bond (NAU form FS#9, see Section 00 43 13) of a corporate surety acceptable to the Arizona Board of Regents, payable to Northern Arizona University for Ten (10%) percent of the amount of the bid, is required as a guarantee that the bidder will enter into the contract if awarded and shall be declared forfeited as Liquidated Damages if the successful bidder refuses to enter into said contract after being requested to do so by the Arizona Board of Regents/Northern Arizona University.

00 21.14.22 Bidders Qualifications
Bids will be accepted only from those Contractors who are licensed in the State of Arizona and qualified under the laws of the State of Arizona to perform the work specified. All work performed under the Contract by such licensed Contractors must be made to comply with all applicable laws and requirements of any governing bodies or regulatory agencies having jurisdiction over such Work.

The General Contractor shall determine that subcontractors are licensed, insured, and qualified to perform their respective work under the contract and shall determine that they are bondable, as required in Section 00 43 36. Each Bidder shall also submit a Subcontractor List (form included in Section 00 43 36 of these specifications) as outlined below in Section 00 43 00.

00 21.14.3 Subcontractors

00 21.14.31 Subcontractor List Form
In compliance with Contract, the Contractor shall list on the Subcontractor list form provided in Section 00 43 36, the names of all qualified subcontractors and/or suppliers he will employ for the various portions of the work indicated for this Project. All technical sections of this specification shall be included. Failure to provide complete list of subcontractors (FS#3) may be considered non-responsive. In addition to the general information required on that form, the Contractor shall provide the license number and class for each subcontractor proposed to do work under the contract. Failure on the part of the Contractor to completely list the names of all anticipated subcontractors will constitute sufficient grounds to reject the bid.

If the Contractor is going to do any portions of the work himself, he shall enter the word “Self” opposite that item in the list; list only one name for each item.

The Subcontractor List must be included inside bid packet. No subcontractor substitutions will be permitted without prior written approval by the Owner.

A complete up-to-date revised list of Subcontractors shall be submitted to the Owner with indications of any work performed by Subcontracting firms classified as minority owned or small businesses, and final contract values, as part of the close-out procedures prior to Final Payment.

The Owner will promptly reply to the Contractor in writing stating if the Owner or the DP, after due investigation, has any objection to any such proposed subcontractor or supplier. The Contractor shall
not employ any subcontractor or supplier against whom the Owner or the DP has reasonable objection. If, prior to the award of the Contract, the Owner or DP has a reasonable objection to any subcontractor or supplier and refuses in writing to accept such person or organization, the apparent low bidder may, prior to the award, either withdraw his bid without forfeiture of bid security or may propose an acceptable substitution thereof provided that same results in no change in the bid price. Failure of the bidder to submit an acceptable substitute in a timely manner shall render its bid non-responsive.

No substitution or change shall be made by the Contractor in the subcontractor/supplier list after its submission to the Owner without prior written approval by the Owner. Unapproved or untimely substitutions may be cause for invalidation of the Contractor's bid in the Owner's discretion, thereby rendering the Contract voidable.

All work performed for the Contractor by a subcontractor shall be pursuant to an appropriate written agreement which specifically binds the subcontractor to all applicable terms and conditions of the Contract Documents, but no contractual relationship shall exist between any subcontractor or supplier of any tier and the Owner, unless the Owner invokes the assignment provisions of the following subsection. Upon request, the Contractor shall provide fully executed copies of any subcontracts and purchase orders to the Owner.

**00 21 14.32 Subcontractor Bonds**
The General Contractor shall require all Subcontractors with project involvement in excess of $100,000 to be bonded for 100% of their contract amount to that General Contractor. Bonds will guarantee the faithful performance of the subcontract and the payment of all obligations thereunder by the subcontractor. The General Contractor shall provide Owner with a copy of each required Subcontractor's bond, on the required form FS#4 & FS#5, within fourteen (14) calendar days after the Notice to Proceed is issued by the Owner and prior to the commencement of their work. Copies of all applicable bonds must be received before processing of the first pay application will occur.

**00 21 14.33 Subcontractor Insurance**
All Subcontractors are required to maintain insurance in force according to the Construction Agreement.

**00 21 14.41 Qualification of Substitutions**

**00 21 14.42 Addenda**
Any addenda issued by the Owner during the time of bidding shall be considered to be included in the proposal, and will become a part of the executed contract. Acknowledgement of receipt of Addenda shall be made on the Proposal Form in the space provided.

Final Addenda shall be issued a minimum of three (3) days prior to the bid date.

If a Bidder should fail to receive any addendum, or should fail to acknowledge receipt of same, the Bidder shall have the option of accepting a contract, if offered, including all addenda, at the Bid price, or withdrawing the bid without penalty. NAU and/or the DP are not responsible for assuring delivery of
addenda to any Bidder. Failure to receive addenda or failure to acknowledge receipt shall not constitute a basis for claim, protest, or re-issue of the invitation to bid.

00 21 14.5 Submittal of Bids
Copies of the Form of Proposal (FS#1), Bid Bond (FS#9) or Certified Check or Cashier’s Check for ten percent of the amount of the bid, and other documents required to be submitted with Bid per Section 00 43 13 (see required forms, Section 00 43 13) shall be enclosed in sealed, opaque envelope. The Subcontractors List (FS#3) must be included inside the bid package, per requirements of Section 00 43 36. Address envelope to Facility Services, identifying project name, Bidder's name and address.

If Bid is sent by mail to PO BOX 6016, Flagstaff AZ, 86011, a sealed envelope shall be enclosed within a separate mailing envelope with "BID ENCLOSED" and identification of the Project and date and time for Bid Opening plainly indicated on the face thereof.

Bids must be received at the designated location prior to time and date for receipt of Bids indicated in advertisement. If received after the time and date for receipt of Bids, or any extension thereof made by Addendum, the bid package will be returned unopened.

Bidder assumes full responsibility for timely delivery of bids. Bids sent by mail that have not been delivered to Facility Services, Building 77, Administrative Services, Room 108 by the designated time of the Bid Opening will not receive consideration; including specifically, but not limited to, bids received by NAU Post Office but not delivered to the bid opening location.

Electronic, oral, telephonic, FAXES, or telegraphic Bids are invalid and will be considered non-responsive.

00 22 00 Supplementary Instructions
00 22 11 Drawings and Schedules
00 22 11.1 Complimentary Drawings
Upon award of Contract, the Contractor will be furnished any available sets of Plans, Specifications, and project manuals. Additional sets may be printed from: http://nau.edu/Facility-Services/Bids_RFQ/.

00 22 11.2 Interpretation of Drawings and Specifications
The Contractor shall study and compare the Contract Documents sufficiently in advance of bidding the work to be performed and immediately report any material error, inconsistency, conflict, ambiguity, or omission that is discovered.

The Drawings are intended to show general arrangements, design and extent of Work and are not intended to serve as Shop Drawings. Where required, the Contractor shall perform no portion of the Work without approved Shop Drawings, Product Data or Samples; any Work performed in violation of this provision will be solely at the Contractor’s risk regardless of DP’s and/or Owner’s knowledge of such Work.
Contract Documents shall be interpreted as being complementary, requiring a complete project or designated portion thereof. Generally, the specifications address quality, types of materials and contract...
conditions while the drawings show placement, sizes, and fabrication details of materials. In the event of conflict in the Contract Documents, the priorities stated below shall govern:

A. Addenda shall govern over all other Contract Documents;
B. Subsequent addenda shall govern over prior addenda, but only to the extent modified;
C. In case of conflict between drawings and specifications, the specifications shall govern;
D. Conflicts within the plans:
   (1) Schedules, when identified as such, shall govern over all other portions of the plans.
   (2) Specific notes shall govern over all other notes and all other portions of the plans, except the schedules described in 00 22 11.2 D (1) above.
   (3) Larger scale drawings shall govern over smaller scale drawings.
   (4) Figured or numerical dimensions shall govern over dimensions obtained by scaling.
E. Conflicts within the specifications:
   Contract General Conditions shall govern over all sections of the specifications except for specific Modifications thereto that may be stated in Supplementary General Conditions or addenda. No other section of the specifications shall modify the Contract General Conditions.
F. In the event provisions of codes, safety orders, Contract Documents, referenced manufacturer’s specifications or industry standards are in conflict, the more restrictive or higher quality shall govern.
G. In the event of any conflict or ambiguity, the Contractor shall request an interpretation by the DP before performing the Work.
H. In the event of any conflict between the Specifications and Northern Arizona University Technical Standards, the Contractor shall notify the Owner for direction prior to bid. Otherwise the more restrictive or higher quality shall govern.

If the Contract Documents are not complete as to any minor detail of a required construction system or with regard to the manner of combining or installing of parts, materials, or equipment, but there exists an accepted trade standard for good and skillful construction, such detail shall be deemed to be an implied requirement of the Contract Documents in accordance with such standard.

“Minor detail” shall include the concept of substantially identical components, where the price of each such component is small even though the aggregate cost or importance is substantial, and shall include a single component which is incidental, even though its cost or importance may be substantial.

The quality and quantity of the parts or material so supplied shall conform to trade standards and be compatible with the type, composition, strength, size, and profile of the parts or materials otherwise set forth in the Contract Documents.
Definitions set forth in General Conditions of the Standard Form Agreement Between Owner and Contractor, or in other Contract Documents are applicable to Bidding Documents. Definitions below are in addition to the definitions of the contract documents and are not considered a replacement.

Bidding Documents: Include Advertisement for Bids, Instructions to Bidders, Bid Form, other bidding and Contract forms and Contract Documents including Addenda issued prior to receipt of bids.

Addenda: Written or graphic instruments issued by DP, or the Owner, prior to execution of Contract Bidding documents by addition, deletion, clarification or correction.

A Bid is a complete and properly signed proposal to do the Work or designated portion thereof for some stipulated sum therein supported by data required in Bidding Documents.

Base Bid: A sum stated in the Bid for which Bidder offers to perform Work described as base, to which Work may be added or deducted for sums stated in Alternate Bid(s).

Alternate Bid(s): A sum stated in addition to the base bid for which Bidder offers to perform Work described as the alternate. The university may select all, none or any combination of alternates.

Bidder: One who submits a Bid for prime Contract with Owner for Work described in the Contract Documents.

Design Professional: The DP is the individual or legal entity identified in the Contract Documents and/or otherwise designated by the Owner who is retained by the Owner to design and/or oversee the Project. Where used in these Documents, the term "DP" or “Architect” shall be interchangeable with NAU assigned Project Manager for such projects that are designed by Facility Services personnel.

General Conditions: The General Conditions apply to the entire work of the Contract and, where so indicated, to other elements of work which are included in the project.

Approved: Where used in conjunction with the DP’s response to SUBMITTALS, requests, applications, inquiries, reports and claims by the Contractor, the meaning of the term "approved" will be held to the limitations of the DP’s responsibilities and duties as specified in the General and Supplementary Conditions. In no case will "approval" by the DP be interpreted as a release of the Contractor from responsibilities to fulfill the requirements of the Contract Documents.

Project Site: The space available to the Contractor for the performance of the work, 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 upon which the project is to be built.
**Furnish**: Except as otherwise defined in greater detail, the term "furnish" is used to mean supply and deliver to the project site, ready for unloading, unpacking, assembly, installation, etc., as applicable in each instance.

**Install**: Except as otherwise defined in greater detail, the term "install" is used to describe operations at the project site including unloading, unpacking, assembly, erection, placing anchoring, applying, working to dimension, finishing, curing, protection, cleaning and similar operations, as applicable in each instance.

**Provide**: Except, as otherwise defined in greater detail, the term "provide" means furnish and install, complete and ready for the intended use, as applicable in each instance.

**Installer**: The entity (person or firm) engaged by the Contractor or its subcontractor or sub-subcontractor for the performance of a particular unit of work at the project site, including installation, erection, application and similar required operations. It is a general requirement that such entities (Installers) be expert in the operations they are engaged to perform.

**Testing Laboratory**: An independent entity engaged to perform specific inspections or tests of the work, both at the project site or elsewhere; and to report and (if required) interpret the results of those inspections or tests.

**Owner**: The word Owner shall mean the State of Arizona and Northern Arizona University and Arizona Board of Regents.

### Scopes

**00 24 00**

**Scopes of Bids**

**00 24 13**

**Base Scope**

The base scope of work includes replacement of a leaking condensate line serving Reilly Hall. The extent of pipe to be replaced is from the steam pit inside the Reilly Hall mechanical room to “Steam Pit No. 1” outside the East corner of Reilly Hall. Replacement of all condensate components inside of steam pit no. 1 is included in the base scope (pipe, valves, condensate trap, unions, ball joints, and insulation). Dewatering of the steam pit shall be performed by the contractor as needed to complete the work. The steam trap on the steam system shall also be replaced in this pit. Components in the mechanical room steam pit shall be replaced, up to and including the drip trap.

The contractor shall excavate and replace the 3” condensate pipe. New gilsulate insulation will be placed around both the 3” condensate and existing 5” steam line in quantities based on manufacturers recommendations. The adjacent steam line will be excavated to allow full insulation replacement. New steam pipe is not in the base scope, but identification of deteriorated pipe shall be presented to the project manager.

All landscaping and irrigation system components within the path of excavation shall be replaced. All pipe guides, supports and anchors exposed shall be replaced with new. Bluestake marks on concrete, asphalt and metal surfaces shall be removed by the contractor upon substantial completion.
### List of Alternates

**Addition/Alteration #1:**
Replace the leaking condensate line from Steam Pit No. 1 to Steam Pit No. 2 (Southeast of Allen Hall). Aside from connecting the new condensate line, replacement of components inside Steam Pit No. 2 is not in scope.

Dewatering of the steam pit shall be performed by the contractor as needed to complete the work. Replacement of steam line components is not included in the base scope of work.

The contractor shall excavate and replace the 3” condensate pipe. New giltsulate insulation will be placed around both the 3” condensate and existing 5” steam line in quantities based on manufacturers recommendations. The adjacent steam line will be excavated to allow full insulation replacement. New steam pipe is not in the base scope, but identification of deteriorated pipe shall be presented to the project manager.

Asphalt and concrete shall be replaced, to include road striping. Asphalt concrete shall be installed per the attached detail. Concrete will be removed and replaced up to an existing joint. Traffic and pedestrian control measures shall be provided by the contractor, and two-way traffic on University Drive must be maintained at all times. The driveway South of Allen Hall shall remain accessible at all times.

All landscaping and irrigation system components within the path of excavation shall be replaced. All pipe guides, supports and anchors exposed shall be replaced with new. Bluestake marks on concrete, asphalt and metal surfaces shall be removed by the contractor upon substantial completion.

**Addition/Alteration #2:**
In the event deteriorated steam pipe is discovered, replacement of 5” steam pipe will be included. This alternate should be bid based linear feet of pipe replacement. Excavation, insulation, and backfill work is included the base scope and/or add/alt #1.

### Procurement Meetings

**00 25 00**

**00 25 13**

**Pre-Bid Meeting**

A Mandatory Pre-Bid Meeting will be held at the Conference Room A, Facility Services (Capital Assets and Services), Building 77, Northern Arizona University, Flagstaff, Arizona, for benefit of all plan holders on **April 18, 2016 at 3:00 p.m.** Facility Services, Planning, Design, and Construction Staff and DP will be present to discuss technical aspects of the project. **All Bidders are required to be represented in order for their bid to be accepted by Owner.**

**00 25 13.1**

**Pre-Bid Site Inspection**

The Pre-Bid Site Inspection will be held immediately after the Pre-Bid Meeting. Each Bidder must be represented. No other formal inspection tours should be anticipated. Bidders should come prepared with Project Manual, tools, measuring devices, personnel, etc., as desired to gather all on-site information necessary for preparing proposal. A Bidder may arrange for supplemental site visits as necessary to prepare a responsive proposal. It is the responsibility of the Bidders to thoroughly
familiarize themselves with all conditions and matters, which may in anyway affect the Work or cost thereof.

No allowance shall be made on behalf of any contractor or subcontractor for errors due to his/her negligence in not being familiar with existing site and/or project conditions.

00 25 13.1.1 Supplementary Site Visits
Arrangements for supplemental visits to the job site are to be made through:
NAU Facility Services
Planning, Design and Construction
(928) 523-4227
Northern Arizona University
Flagstaff, Arizona 86011

00 26 00 Substitution Procedures
There are currently no approved product substitutions. If contractor wishes to submit a product for consideration, refer to the Substitution Request Form. Product Substitution Requests must be received 6 days before bid opening at Facility Services, Administrative Services.

To obtain approval to use unspecified products, Bidders can request substitutions of items felt to be equal to those listed in the specification and must be submitted, in writing, to Facility Services, Administrative Services for approval. If Owner/DP approves any such alternate product, notification shall be made to all plan holders a minimum of three business days prior to Bid. All such notifications shall be by Addendum.

Identification of material or equipment by manufacturer's name or trade name is not meant to give preference to any manufacturer but merely to establish a standard. In some cases, the specified product is required as it is used campus wide and is the only product stocked for repair and maintenance reasons.

Requests shall clearly describe the product for which approval is asked, including data necessary to demonstrate acceptability. The Owner and DP shall consider and either approve or reject proposals submitted. The Bidder’s request for approval shall include the following:

a. Complete data substantiating compliance of the proposed substitution with the Contract Documents.
b. Product identification, including manufacturer's name, address and phone number.
c. Manufacturer's literature showing complete product description, performance and test data, and all reference standards.
d. Samples and colors in the case of articles or products, as appropriate.
e. Name and address of similar projects on which the product was used and date of installation.
f. For construction methods, include a detailed description for proposed method and drawings illustrating same.
g. Itemized comparison of proposed substitution with product or method specified.

Substitution requests shall be made on the "SUBSTITUTION REQUEST FORM" included with the Bid Forms.
The decision of the Owner or DP regarding the approval of items for which substitution is requested will be final. In the event an approved substitution is later determined by the Owner or Design Professional to be unacceptable for any reason, including the necessity to perform extended redesign or rework of the project in order to accommodate the substitution, or if it becomes apparent to the Design Professional that the substituted item will not perform or function as well as the specified item, the Bidder will be required to furnish the original specified item or request approval to use another substitution. The Bidder will pay all costs, expenses or damages associated with or related to the unacceptability of a substitution and the resultant utilization of any item. The Bidder further understands and agrees that a time extension will not be granted due to delays associated with or related to the unacceptability of a substitution.

If a substitution is approved, no subsequent change in brand or make will be permitted unless satisfactory written evidence is presented to the Design Professional and approved by the Owner that the manufacturer cannot make scheduled delivery of the approved substitute item.

**END OF SECTION**
00 30 00 Available Information
00 31 00 Available Project Information
  00 31 13 Preliminary Schedule
  00 31 13.13 Preliminary Project Schedule
  First Advertisement:  April 14, 2016
  Pre-Bid Conferences:  April 18, 2016
  Bid Date:  April 28, 2016
  Construction Start:  May 23, 2016
  Substantial Completion:  August 5, 2016
  Final Completion:  October 7, 2016

00 31 13.16 Preliminary Construction Schedule
  Steam pit abatement: May 23-24
  Construction Schedule Noted Above

00 31 13.23 Preliminary Project Phases
00 31 13.26 Preliminary Project Sequencing
00 31 13.33 Preliminary Project Milestones
00 31 19 Existing Condition Information
  Existing condensate line is in a failed condition and leaking.

00 31 19.13 Movement and Vibration Information
00 31 19.16 Acoustic Information
00 31 19.19 Traffic Information
00 31 21 Survey Information
00 31 21.13 Site Survey Information
00 31 21.16 Measured Drawing Information
00 31 21.19 Photographic Information
00 31 24 Environmental Assessment Information
00 31 24.13 Soil Contamination Report
00 31 24.23 Environmental Impact Study Report
00 31 24.26 Environmental Impact Report Evaluation
00 31 24.29 Record of Environmental Impact Decision
00 31 24.33 Environmental Impact Mitigation Report
00 31 25 Existing Material Information
00 31 25.16 Existing Concrete Information
00 31 25.19 Existing Masonry Information
00 31 25.23 Existing Metals Information
00 31 25.26 Existing Wood, Plastics, and Composites Information
00 31 25.29 Existing Thermal and Moisture Protection Information
<table>
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<tr>
<th>Section Number</th>
<th>Title</th>
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<tr>
<td>00 31 26</td>
<td>Existing Hazardous Material Information</td>
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<tr>
<td>00 31 26.23</td>
<td>Existing Asbestos and Lead Information</td>
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</table>
NORTHERN ARIZONA UNIVERSITY: WORKPLACE HAZARD
NOTIFICATION FOR CONTRACTORS AND SUBCONTRACTORS (FS#13)
INSPECTION REQUEST PHONE # 928-523-6435

PLEASE ALLOW UP TO TWO (2) WEEKS PROCESSING TIME FOR INSPECTIONS REQUIRING SAMPLE COLLECTION


PROJECT NAME: Repair buried steam/condensate lines at Reilly Hall

AUTHORIZED PREPARER: [Signature]

INITIAL INSPECTION AND A FOLLOW-UP (IF REQUIRED) IS AT NO COST TO THE REQUESTOR.
SAMPLE ANALYSIS FEES MAY BE CHARGED, AT THE STANDARD RATE TO THE CLIENT DEPARTMENT OR PROJECT

This inspection does not waive the supervisor/contractor responsibility to provide adequate worker training/PE

The Requestor is responsible for submitting an Inspection request with adequate time prior to commencing work to arrange and complete any necessary hazard abatement activities BEFORE other work begins. Inspection request form is located on the Engineering/Inspections website. Supervisors shall make this form or the information contained within it available for review by all employees present at the work site.

<p>| HAZARD TYPE |</p>
<table>
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<tr>
<th>Asbestos/Lead/PCB</th>
<th>Radiation</th>
<th>Biological</th>
<th>Chemical</th>
<th>Other</th>
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The purpose of this form is to notify Contractors and Subcontractors and their employees working at Northern Arizona University of known or anticipated workplace hazards. NAU maintains comprehensive material/safety inspections and safety programs for campus buildings. Test results and safety programs are available for review in the NAU offices of Material Safety or Environmental Health and Safety. The following known and assumed hazards have been identified to be present in the work area located in Building(s): Exterior __ Room/Area: Steam vaults and buried lines at Reilly Hall

Pipe insulation and gaskets are assumed to contain asbestos and will be professionally abated prior to other work at the Site. Following abatement, the balance of the work may proceed with no additional environmental controls. Alternatively, this material may be tested and if results refute the assumption of asbestos then those results will be amended onto the attached survey summary to document that asbestos is not present. If any materials not listed on the attached summary are scheduled for disturbance, please contact the material safety office for guidance or a supplemental inspection before proceeding.

NAU is responsible for informing you of the presence of hazards in your project work area on the NAU campus. If you encounter any previously unidentified hazards stop all work immediately and contact the NAU Project Manager or Material Safety Official (928-523-6435). By law, Employers must provide adequate training and protection for employees who will be exposed to hazards including those in this notification. The responsible party signing below agrees that it is the responsibility of the Contractor or Subcontractor to be knowledgeable of and comply with all applicable local, state, and federal safety regulations, and with university policies related to the hazards detailed in this form.

Your signature below acknowledges that you have received notice from NAU that hazardous materials or conditions are or may be present in your work area(s), and that you agree to fully assume the responsibility for ensuring the safety of yourself and your employees, which includes ensuring that you comply with all applicable local, state, and federal laws, and with university policies governing hazardous materials or conditions.

If you have any questions, please contact the NAU Material Safety Official at 928-523-6435.

COMPANY NAME:

NAME OF RESPONSIBLE PARTY: TITLE:

SIGNATURE: DATE:

No work shall be authorized nor shall it commence prior to completion and return of Form FS#13 by the vendor and return of the completed form to the NAU Project Manager or the party authorizing the work.
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<th>Section Number</th>
<th>Title</th>
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<tr>
<td>00 31 26.29</td>
<td>Existing Polychlorinate Biphenyl Information</td>
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<td>00 31 26.33</td>
<td>Existing Mold Information</td>
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<td>00 31 26.36</td>
<td>Existing Hazardous Waste Drum Information</td>
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<td>00 31 31.13</td>
<td>Seismic Investigations Information</td>
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<td>00 31 31.16</td>
<td>Gravity Investigations Information</td>
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<td>00 31 31.19</td>
<td>Magnetic Investigations Information</td>
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<td>Electromagnetic Investigations Information</td>
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<td>Electrical Resistivity Investigations Information</td>
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<td>Magnetotelluric Investigations Information</td>
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<td>Subsurface Drilling and Sampling Information</td>
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<td>Material Testing Information</td>
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<td>Exploratory Excavation Information</td>
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<td>00 31 32.23</td>
<td>Geotechnical Monitoring Information</td>
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<tr>
<td>00 31 43.00</td>
<td>NAU Permit Application</td>
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<td>The NAU permit application and procedure can be found at</td>
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<td><a href="http://nau.edu/Facility-Services/DP_Contract/">http://nau.edu/Facility-Services/DP_Contract/</a></td>
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| 00 31 46 | Other Permits |
FORM OF PROPOSAL (FS#1)
CONDENSATE LINE REPLACEMENT NEAR REILLY HALL
NAU PROJECT NO. 10.010.168

The undersigned hereby proposed, and agrees to furnish all labor, material, transportation, supervision and services necessary to complete all work as called for in the plans and specifications, and that the lump sum bid includes all applicable costs of bonds, insurance, permits, fees, and sales tax, or any applicable taxes.

We acknowledge the following addenda and have included their provisions in this proposal.

Addendum No. ______________ Dated ______________
Addendum No. ______________ Dated ______________
Addendum No. ______________ Dated ______________
Addendum No. ______________ Dated ______________

BASE BID: The undersigned proposes to complete all work as required per the Specifications, for a lump sum of:

$______________________________Dollars

Additive Alternatives:

Alternate #1: (Work between Pit #1 and Pit #2)

$______________________________Dollars

Alternate #2: (Linear Foot Price to Replace 5” Steam Line)

$______________________________Dollars

All Alternate Bid Groups are additive to the Base Bid. For each Alternate Bid Group, Bidders are instructed to provide only the incremental difference in cost of adding that particular work to the project scope of work. Do not provide cumulative costs that include values already included in the Base Bid as NAU will be evaluating bids and considering bid award based on the sum of the Base Bid and any combination of Alternate Bid Groups.

Enclosed herewith is a cashier's check or Bid Bond (NAU form FS#9) made payable to the Owner in the amount of $_______, which is not less than 10% of the amount of the total bid proposal, as a guarantee that the undersigned will furnish required Performance Bond and Labor and Material Bond, and enter into contract, on basis of above proposal.

Undersigned further agrees that said check (or Bid Bond) shall be forfeited as Liquidated Damages (no penalty) if undersigned fails to enter into contract after requested to do so by Owner.

Bids shown above are valid for a period of 60 days after the date of opening bids, and may be withdrawn following that
The undersigned understands that the Owner reserves the right to reject any or all bids, or to waive any informality in receipt of the above Proposal. **Owner reserves the right to award by Base Bid alone, by the sum of Base Bid and any combination of Alternate Bid Group Amounts, or as the sum of the Base Bid and all the Alternate Bid Group Amounts, whichever is deemed most advantageous to Owner.**

It is hereby understood and mutually agreed by and between the Contractor and the Owner that the date of beginning, rate of progress, and time of completion of the Work as set forth in the contract documents are of the essence of the contract. The amount of **$1,200.00 per calendar day** will be assessed against the contract for work not completed at the Substantial Completion date. Said amounts shall accrue until such time that the Work covered under this contract is complete, not as a penalty, but as Liquidated Damages.

In addition, it is mutually agreed by and between the Contractor and the Owner, the amount of **$225.00 per calendar day** will be assessed against the contract for work not completed at the Final Completion date. Said amounts shall accrue until such time that the Work covered under this contract is complete, not as a penalty, but as Liquidated Damages.

The Proposer hereby certifies that he/she is the holder of a valid Contractor's License in accordance with Arizona State Law and that such license classification allows the Contractor to perform the type of construction identified by these Bid Documents. The proposer also certifies that he/she holds all of the required certifications and licenses outlined in the bidding documents and shall provide proof of all certifications, licenses and warranties within 5 days of Owner notification to the apparent low bidder with the Intent to Award.

If corporation, __________________________________________________________________________

Company/Corporation

_____________________________________________________________________________________

Signature Date

Signature Arizona License Class and Number
KNOW ALL MEN BY THESE PRESENTS, that we ________________________________ (Here insert full name and address or legal title of Contractor) as Principal, hereinafter called the Principal, and ________________________________ (Here insert full name and address or legal title of Surety) as corporation duly organized under the laws of the State of ________________________________, as Surety, hereinafter called the Surety, are held and firmly bound unto ________________________________ (Here insert full name and address or legal title of Owner) as Obligee, hereinafter called the Obligee, in the sum of Dollars ($_________ ), for the payment of which sum well and truly to be made, the said Principal and the said Surety, bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has submitted a bid for ________________________________ (Here insert full name, address and description of project)

NOW, THEREFORE, if the obligee shall accept the bid of the Principal and the Principal shall enter into a Contract with the Obligee in accordance with the terms of such bid, and give such bond or bonds as may be specified in the bidding or Contract Documents with good and sufficient surety for the faithful performance of such Contract and for the prompt payment of labor and material furnished in the prosecution thereof, or in the event of the failure of the Principal to enter such Contractor and give such bond or bonds, it the Principal shall pay to the Obligee the difference not to exceed the penalty hereof between the amount specified in said bid and such larger amount for which the Obligee may in good faith contract with another party to perform the Work covered by said bid, then this obligation shall be null. and void, otherwise to remain in full force and effect.

Signed and sealed this _________________ day of ________________________________, 20__.

______________________________ (Principal)  ________________________________ (Seal)

______________________________ (Witness)

______________________________ (Title)

______________________________ (Surety company)  ________________________________ (Seal)
<table>
<thead>
<tr>
<th>Section Number</th>
<th>Title</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>00 43 21</td>
<td>Allowance Form</td>
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<tr>
<td>00 43 22</td>
<td>Unit Prices Form</td>
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<tr>
<td>00 43 23</td>
<td>Alternates Form</td>
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</table>
SUBSTITUTION REQUEST FORM

TO: ____________________________________________________________

PROJECT: __________________________________________________________

We hereby submit for your consideration the following product instead of the specified item for the above project:

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
<th>Paragraph/Line</th>
<th>Specified Item</th>
</tr>
</thead>
</table>

Proposed Substitution: ____________________________________________________________

Attached complete product descriptions, drawings, photographs, performance and test data, and other information necessary for evaluation.

A. Will changes be required to building design in order to properly install proposed substitution? Yes ___ No ___. If Yes, explain: ____________________________________________________________

B. Will the undersigned pay for changes to the building design, including engineering and drawing costs, caused by requested substitution? Yes ___ No ___.

C. What differences exist between proposed substitution and specified item? ____________________________________________________________

D. Does substitution affect Drawing dimensions: Yes ___ No ___. If yes, explain. ____________________________________________________________

E. What affect does substitution have on other trades? ____________________________________________________________

F. Does Manufacturer's warranty of proposed substitution differ from that specified? Yes ___ No ___. If yes, explain. ____________________________________________________________

G. Will substitution effect progress schedule? Yes ___ No ___. If yes, explain: ____________________________________________________________

H. Will substitution require more license fees or royalties than specified product?
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Yes ___ No ___. If Yes, explain ____________________________________________

I. Will substitution cost more than specified product? Yes ___ No ___ If yes, explain how much ____________________________________________

J. Will maintenance and service parts be locally available for substitution? Yes ___ No ___. If no, explain ____________________________________________

Submitted By:

__________________________ For DP's Use Only: Signature
Signature

__________________________ __ Accepted __ Accepted As Noted
Firm

__________________________ __ Not Accepted __ Received Too Late
Address

__________________________ By ________________________________
Date ________________________________
Remarks ________________________________

Telephone __________________________________

NORTHERN ARIZONA UNIVERSITY – Technical Standards
(10/01/2015)
29 OF 55
<table>
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<tr>
<th>Section Number</th>
<th>Title</th>
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<tbody>
<tr>
<td>00 43 26</td>
<td>Estimated Quantities Form</td>
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<tr>
<td>00 43 27</td>
<td>Separate Prices Break-Out Form</td>
</tr>
</tbody>
</table>
Proposer is to list every subcontractor and supplier proposed to be employed on the above project as required by the bidding documents. **All Sections of the specifications must be included below.** Any work proposed to be done by the Proposer should be listed as a line item with the word "Self" inserted under firm name. Designation of subcontractors is subject to University approval. No change in subcontractor's list will be permitted without the University's prior written consent. **Failure to provide a complete list with all information may be considered non-responsive.** Subcontractor List must be enclosed inside bid package per Section 00 43 36. All bidders must sign page 3 of this subcontractor list, even if all work will be self performed.

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<td>10.010.168</td>
<td>Condensate Replacement – Reilly Hall</td>
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I submit that the preceding is correct and current as of ________________________________.

[BID OPENING DATE]

[COMPANY] [AUTHORIZED REPRESENTATIVE] [DATE]
<table>
<thead>
<tr>
<th>Section Number</th>
<th>Title</th>
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<tbody>
<tr>
<td>00 43 83</td>
<td>Proposed Construction Schedule Form</td>
</tr>
<tr>
<td>00 43 93</td>
<td>Bid Submittal Checklist</td>
</tr>
</tbody>
</table>
CONTRACTOR STATEMENT OF QUALIFICATIONS FS#2

(Failure to include the Statement of Qualifications within the bid packet will be considered non-responsive)

Fill in all blanks. If not applicable, insert "N.A."

COMPANY NAME: ________________________________

CONTACT: _____________________ PHONE: ___________________ FAX: ___________________

YEARS IN BUSINESS UNDER ABOVE NAME: __________ YEARS IN BUSINESS IN ARIZONA: __________

ADDRESS: __________________________________________

CITY, STATE, ZIP: ____________________________________

[ ] SOLE PROPRIETORSHIP [ ] PARTNERSHIP [ ] CORPORATION [ ] STATE OF INCORPORATION
[ ] WOMEN-OWNED BUSINESS [ ] MINORITY-OWNED BUSINESS [ ] SMALL BUSINESS (LESS THAN $4M GROSS/YR OR LESS THAN 100 FTE)

Check any that apply to your business

CONTRACTOR LICENSE NO: _____________________ CLASS: ___________________ STATE: __________

BONDING COMPANY: _____________________ AGENT: _____________________

ANY OTHER BUSINESS NAMES USED: _____________________ YEARS __ TO ______________

PLEASE CHECK AREAS OF SPECIALTY:

GENERAL [ ] PAVING [ ] CONCRETE [ ]
ASBESTOS [ ] ROOFING [ ] ELECTRICAL [ ]
PLUMBING [ ] EXCAVATING [ ] MECH/HVAC [ ]
OTHER [ ]

PREFERRED PROJECT SIZE:

[ ] 1. $10,000 - $100,000 # OF PROJECTS COMPLETED IN PAST 5 YEARS ______________________

[ ] 2. $100,000 - $500,000 # OF PROJECTS COMPLETED IN PAST 5 YEARS ______________________

[ ] 3. $500,000 - $2,000,000 # OF PROJECTS COMPLETED IN PAST 5 YEARS ______________________

[ ] 4. $2,000,000 + # OF PROJECTS COMPLETED IN PAST 5 YEARS ______________________

PERCENTAGE OF WORK NORMALLY ACCOMPLISHED WITH YOUR OWN FORCES: ______________________

PRESENT NUMBER OF PERSONNEL: ______________________

WILL YOU EXPAND YOUR WORK FORCE FOR THIS PROJECT? _______ HOW MANY? ______________________

COMPUTER SOFTWARE USED FOR SCHEDULING PURPOSES: ______________________

COMPUTER SOFTWARE USED FOR DOCUMENT TRACKING PURPOSES: ______________________
REFERENCES: (BANK, TRADE, PROFESSIONAL)

1. [NAME] [ADDRESS] [PHONE NO.]
2. [NAME] [ADDRESS] [PHONE NO.]
3. [NAME] [ADDRESS] [PHONE NO.]

MY NOTARIZED SIGNATURE BELOW I HEREBY SWEAR THAT THE ANSWERS TO THE FOREGOING QUESTIONS AND ALL STATEMENTS HERE CONTAINED AND ATTACHED ARE TRUE AND CORRECT.

[CONTRACTOR NAME OR AGENT] [DATE]

SUBSCRIBED AND SWORN BEFORE ME THIS _____________ DAY OF _____________, 20___.

NOTARY PUBLIC: ____________________________________________

MY COMMISSION EXPIRES: ________________________________
**END OF SECTION**
<table>
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<tbody>
<tr>
<td>00 60 00</td>
<td>Project Forms</td>
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<tr>
<td>00 61 00</td>
<td>Bond Forms</td>
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<tr>
<td>00 61 13</td>
<td>Performance and Payment Bond Forms</td>
</tr>
</tbody>
</table>
KNOW ALL MEN BY THESE PRESENTS:

That, ____________________________ (hereinafter called the Principal), as Principal, and ____________________________ a corporation organized and existing under the laws of the State of ____________________________, with its principal office in the City of ____________________________ (hereinafter called the Surety), as Surety, are held and firmly bound unto the Arizona Board of Regents, (hereinafter called the Obligee), in the amount of ____________________________ Dollars ($_______________________), for the payment whereof, the said Principal and Surety bind themselves, and their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has entered into a certain written contract with the Obligee, dated the __________ day of ________, 20____, to construct and complete a certain work described as ____________________________, which contract is hereby referred to and made a part hereof as fully and to the same extent as if copied at length herein.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH, that if the said Principal shall faithfully perform and fulfill all the undertakings, covenants, terms, conditions and agreements of said contract during the original term of said contract and any extension thereof, with or without notice to the Surety and during the life of any guaranty required under the contract, and shall also perform and fulfill all the undertakings, covenants, terms, conditions, and agreements of any and all duly authorized modifications of said contract that may hereafter be made, notice of which modifications to the Surety being hereby waived; then the above obligation shall be void, otherwise to remain in full force and effect.

PROVIDED, HOWEVER, that this bond is executed pursuant to the provisions of Board of Regents Policy Section 3-804E, and all liabilities on this bond shall be determined in accordance with the provisions of the section, to the same extent as if copied at length herein.

The prevailing party in a suit on this bond, including any appeal thereof, shall recover as a part of his judgment such reasonable attorneys' fees as may be fixed by a judge of the Court.

Witness our hands this ______ day of ____________________________, 20____.

__________________________          ____________________________
PRINCIPAL                     Surety
By: ____________________________          By: ____________________________

__________________________
Agent Name & Telephone

__________________________
Agent Address

__________________________
agent Name & Telephone

__________________________
Bonding Company Address

Project 10.010.168– Condensate Replacement – Reilly Hall

NORTHERN ARIZONA UNIVERSITY – Technical Standards
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Arizona Board of Regents  **PAYMENT BOND FS#5**  
**PURSUANT TO BOARD OF REGENTS POLICY 3-804E**  
(Penalty of this bond must be 100% of the Contract Amount)

**KNOW ALL MEN BY THESE PRESENTS:**

That, ___________________________________________ (hereinafter called the Principal), as Principal, and ___________________________________________ a corporation organized and existing under the laws of the State of ___________________________________________, with its principal office in the City of ___________________________________________ (hereinafter called the Surety), as Surety, are held and firmly bound unto the Arizona Board of Regents, (hereinafter called the Obligee), in the amount of ___________________________________________ Dollars ($__________), for the payment whereof, the said Principal and Surety bind themselves, and their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has entered into a certain written contract with the Obligee, dated the ___________ day of _________________, 20__, to construct and complete a certain work described as ___________________________________________ which contract is hereby referred to and made a part hereof as fully and to the same extent as if copied at length herein.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH, that if the said Principal shall promptly pay all monies due to all persons supplying labor or materials to him/her or his/her subcontractors in the prosecution of the work provided for in said contract, then this obligation shall be void, otherwise to remain in full force and effect.

PROVIDED, HOWEVER, that this bond is executed pursuant to the provisions of Board of Regents Policy Section 3-804E, and all liabilities on this bond shall be determined in accordance with the provisions of the section, to the same extent as if copied at length herein.

The prevailing party in a suit on this bond, including any appeal thereof, shall recover as a part of his judgment such reasonable attorneys' fees as may be fixed by a judge of the Court.

Witness our hands this ___________ day of _________________, 20__.

<table>
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<tr>
<th>PRINCIPAL</th>
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<td>BY: ________________</td>
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__________________________
Bond Number

__________________________
Agent Name & Telephone

__________________________
Agent Address

__________________________
Bonding Company Address

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<table>
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<tbody>
<tr>
<td>00 62 00</td>
<td>Certificates and Other Forms</td>
</tr>
<tr>
<td>00 62 11</td>
<td>Submittal Transmittal Form</td>
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</table>
ARIZONA BOARD OF REGENTS
CERTIFICATE OF INSURANCE (FS#6)

PROJECT NAME: Condensate Line Replacement Near Reilly Hall
NAU PROJECT #: 10.010.168

<table>
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<th>PRODUCER</th>
<th>COMPANIES AFFORDING COVERAGE</th>
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<tr>
<td></td>
<td>Insurance is to be placed with duly licensed or approved non-admitted insurers in the State of Arizona with an A.M. Best rating of not less than A-VII.</td>
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<tr>
<td>Contractor shall furnish Northern Arizona University with certificates of insurance (ACORD form or equivalent approved by the State of Arizona). The certificates for each insurance policy are to be signed by a person authorized by that insurer to bind coverage on its behalf. All certificates of endorsements are to be received and approved by Northern Arizona University before work commences. Each insurance policy required by this Contract must be in effect at or prior to commencement of work under this Contract and remain in effect for the duration of the project. Failure to maintain the insurance policies as required by this Contract, or to provide evidence of renewal, is a material breach of contract.</td>
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THIS CERTIFICATE APPLIES TO ANY AND ALL PROJECTS AT NORTHERN ARIZONA UNIVERSITY. DESCRIPTION OF OPERATIONS/LOCATIONS/VEHICLES/SPECIAL ITEMS:

*THE POLICIES FOR GENERAL LIABILITY AND AUTOMOBILE LIABILITY SHALL BE ENDORSED TO INCLUDE THE FOLLOWING ADDITIONAL INSURED LANGUAGE: "THE STATE OF ARIZONA, ITS DEPARTMENTS, AGENCIES, BOARDS, COMMISSIONS, UNIVERSITIES AND ITS OFFICERS, OFFICIALS, AGENTS, AND EMPLOYEES SHALL BE NAMED AS ADDITIONAL INSURED WITH RESPECT TO LIABILITY ARISING OUT OF THE ACTIVITIES PERFORMED BY OR ON BEHALF OF THE CONTRACTOR."

*IT IS AGREED THAT COVERAGES AFFORDED UNDER THE POLICIES CERTIFIED IN THIS CERTIFICATE SHALL BE PRIMARY FOR THE PERSON OR ORGANIZATION SHOWN IN THE SCHEDULE, BUT ONLY WITH RESPECT TO LIABILITY ARISING OUT OF YOUR WORK FOR THAT INSURED BY OR FOR YOU. OTHER INSURANCE AFFORDED TO THAT INSURED WILL APPLY AS EXCESS AND NOT CONTRIBUTE AS PRIMARY TO THE INSURANCE AFFORDED BY THIS ENDORSEMENT.

*IT IS FURTHER AGREED THAT SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, THE ISSUING INSURER WILL ENDEAVOR TO MAIL 30 DAYS WRITTEN NOTICE TO THE CERTIFICATE HOLDER. THIS CERTIFICATE IS NOT VALID UNLESS COUNTERSIGNED BY AN AUTHORIZED REPRESENTATIVE OF THE INSURANCE COMPANY.

*POLICIES FOR GENERAL LIABILITY, AUTO LIABILITY, AND WORKERS' COMPENSATION SHALL CONTAIN A WAIVER OF SUBROGATION AGAINST THE STATE OF ARIZONA, ITS DEPARTMENTS, AGENCIES, BOARDS, COMMISSIONS, UNIVERSITIES & ITS OFFICERS, OFFICIALS, AGENTS, & EMPLOYEES FOR LOSSES ARISING FROM WORK PERFORMED BY OR ON BEHALF OF THE CONTRACTOR.

CERTIFICATE HOLDER/ADDITIONAL INSURED
NORTHERN ARIZONA UNIVERSITY
THE ARIZONA BOARD OF REGENTS
THE STATE OF ARIZONA
FACILITY SERVICES
BOX 5637
FLAGSTAFF, AZ 86011

AUTHORIZED REPRESENTATIVE OF THE INSURANCE COMPANY

SIGNATURE DATE
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<tr>
<th>Section Number</th>
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<tr>
<td>00 62 23</td>
<td>Construction Waste Diversion Form</td>
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<td>00 62 34</td>
<td>Recycled Content of Materials Form</td>
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<tr>
<td>00 62 76</td>
<td>Application for Payment Form</td>
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</tbody>
</table>

**Clarification and Modification Forms**

Many of the NAU forms will be located at: [http://nau.edu/Facility-Services/DP_Contract/](http://nau.edu/Facility-Services/DP_Contract/).

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<thead>
<tr>
<th>Section Number</th>
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<tr>
<td>00 63 13</td>
<td>Request for Interpretation Form</td>
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<td>00 63 19</td>
<td>Clarification Form</td>
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<td>00 63 25</td>
<td>Substitution Request Form (During Construction)</td>
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<td>00 63 33</td>
<td>Supplemental Instruction Form</td>
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<td>00 63 36</td>
<td>Field Order Form</td>
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<td>00 63 43</td>
<td>Written Amendment Form</td>
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<td>00 63 46</td>
<td>Construction Change Directive Form</td>
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<td>This form can be located on the NAU Facility Services website.</td>
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<td>00 63 57</td>
<td>Construction Change Proposal Request</td>
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<td>This form can be located on the NAU Facility Services website.</td>
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<td>00 63 63</td>
<td>Change Order Form</td>
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<td>00 63 66</td>
<td>Contingency Use Authorization Form</td>
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<td>This form can be located on the NAU Facility Services website.</td>
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<tr>
<td>00 63 69</td>
<td>Allowance Use Authorization Form</td>
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<td>This form can be located on the NAU Facility Services website.</td>
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</tbody>
</table>

**Closeout Forms**

Closeout Forms and Other Project Closeout Requirements - may include but are not limited to the following:

A. **Substantial Completion**
   1. Fire Marshal Acceptance Alarm/Sprinkler and State Fire Marshal Acceptance Report
   2. State Elevator Inspection Report
   3. Insurance Carrier Certificate for Boiler Inspection
   4. Preliminary Balance Report
   5. Preliminary As-Builts
   6. Attic Stock
   7. Substantial Completion Project Inspection (FS #15)
   8. Punchlist Issued (FS#24)
   9. Certificate of Substantial Completion (FS#81)
   10. Schedule of Required Maintenance (FS#88)
B. Final Completion
1. Final Balance Report
2. Final As-Builts
3. First Season Commissioning Complete
4. Second Season Commissioning Complete
5. Operations and Maintenance Manuals
6. Electronic Copy of All Approved Submittals and Shop Drawings
7. Special Warranties
8. Keys Returned (FS#10)
9. Project Final Inspection (FS#15)
10. Punchlist Complete (FS#24)
11. Project Warranty (FS#80)
12. Certificate of Final Completion (FS#81A)
13. Affidavit Non Use Asbestos Certificate (FS#83)

C. Final Payment
1. Contractor Final Payment Application
2. Final Subcontractor List (FS#82)
3. All Subcontractor Lien Releases (FS#84)
4. Consent of Surety to Final Payment Received (FS#88)
5. General Contractor Lien Release (FS#89)
6. Contractor Affidavit of Payment (FS#99)

Templates of the forms (FS#) can be found at: [http://nau.edu/Facility-Services/DP_Contract/](http://nau.edu/Facility-Services/DP_Contract/)

00 65 14  Punchlist Form (FS#24)
00 65 15  Project Inspection Form (FS#15)
00 65 16  Certificate of Substantial Completion Form (FS#81)
00 65 17  Schedule of Required Maintenance Form (FS#88)
00 65 19  Certificate of Final Completion Form (FS#81A)
00 65 19.13  Affidavit of Payment (FS#99)
00 65 19.16  General Contractor Lien Release Form (FS#89)
00 65 19.17  Subcontractor Lien Release Form (FS#84)
00 65 19.19  Consent of Surety to Final Payment Form (FS#87)
00 65 19.19  Final Subcontractor List (FS#82)
00 65 36  Warranty Form (FS#80)

**END OF SECTION**
Division 0 – Bidding Requirements
Contract Forms and Conditions

Section Number  Title

00 70 00  Conditions of the Contract
00 71 00  Contracting Definitions
00 72 00  General Conditions

The General Conditions of the Standard Form Agreement Between Owner and Contractor, Arizona Board of Regents are hereby made part of the Contract Documents, as if they are included in the following pages. A copy is appended to the construction agreement and available for review at http://nau.edu/Facility-Services/DP_Contract/ or information purposes only.

The General Conditions are a part of the Contract and shall be binding on the General Contractor and all Subcontractors as if bound into this document.

00 73 00  Supplementary Conditions
00 73 15  Bonds and Certificates

The Bid price shall include the cost of Payment and Performance Bonds. Bonds shall cover the faithful performance, labor and material (100%) of the Contract and payment of all obligations (100%) arising thereunder in the form prescribed in Arizona Board of Regents Policy 3-804E. Bonds shall be executed by Corporate Sureties licensed in Arizona. Bonds must be submitted on the forms included in Section 00 61 13.

Performance Bond
Pursuant to Arizona Board of Regents Policy, the Contractor shall file with the Owner at or prior to the time of execution of the Contract, a Performance Bond on the Owner approved Form, referenced in, Section 00 61 13.13 in the full amount of the Contract. The Performance Bond must be executed on the noted form. Substitutions will not be allowed. The Surety furnishing this bond shall be satisfactory to the Owner and shall be authorized to do business in the State of Arizona.

Payment Bond
Pursuant to Arizona Board of Regents Policy, the Contractor shall file with the Owner at or prior to the time of execution of the Contract, a Payment Bond on the Owner approved Form, referenced in Section 00 62 13, in the full amount of the Contract. The Payment Bond must be executed on the noted form. Substitutions will not be allowed. The Surety furnishing this bond shall be satisfactory to the Owner and shall be authorized to do business in the State of Arizona.

Certificates of Compliance with Applicable Laws and Regulations
Lien Releases
Upon completion of this Project and before final payment is made, the Contractor will furnish to the Owner written 100% Unconditional Lien Releases from all subcontractors, material dealers and other participants doing work under this Contract.
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If payment to Subcontractors is outstanding pending final payment by the University, or if for any other reason 100% Unconditional Lien Releases cannot be obtained from all subcontractors, the Contractor may provide the University with an indemnity bond.

**Insurance Requirements**

Insurance Requirements are defined by the contract. Please refer to [http://nau.edu/Facility-Services/DP_Contract/](http://nau.edu/Facility-Services/DP_Contract/) for specific language.

**Affirmative Action for Disabled Workers**

Refer to [http://nau.edu/Facility-Services/DP_Contract/](http://nau.edu/Facility-Services/DP_Contract/) for specific requirements within the Construction Agreement.

**Equal Employment Opportunity Requirements**

Northern Arizona University is an equal opportunity employer and all contracts with the University are subject to the conditions and requirements of Executive Order No. 99-4 as stated below.

**EXECUTIVE ORDER No. 99-4**

**PROHIBITION OF DISCRIMINATION IN STATE CONTRACTS, NON-DISCRIMINATION IN EMPLOYMENT BY GOVERNMENT CONTRACTORS AND SUBCONTRACTORS**

**PART I:**

Non-discrimination in employment by government contractors and subcontractors.

All government contracting agencies shall include in every government contract hereinafter entered into the following provisions:

A. The contractor will not discriminate against any employee or applicant for employment because of race, age, color, religion, sex or national origin. The contractor will take affirmative action to ensure that applicants are employed and that employees are treated during employment without regard to their race, age, color, religion, sex or national origin. Such action shall include but not be limited to the following: Employment, upgrading, demotion or transfer, recruitment or recruitment advertising, lay-off or termination, rates of pay or other forms of compensation, and selection for training, including apprenticeship. The contractor agrees to post in conspicuous places available to employees and applicants for employment notices to be provided by the contracting officer setting forth the provisions of this nondiscrimination clause.
B. The contractor will in all solicitations or advertisement for employees placed by or on behalf of the contractor state that all qualified applicants will receive consideration for employment without regard to race, age, color, religion, sex or national origin.

C. The contractor will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding a notice to be provided by the agency contracting officer advising the labor union or workers’ representative of the contractor’s commitments under this Executive Order and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

D. The contractor will furnish all information and reports required by the contracting agency and will permit access to his books, records and accounts by the contracting agency and the Civil Rights Division for purposes of investigation to ascertain compliance with such rules, regulations and orders.

E. In the event of the contractor’s noncompliance with the nondiscrimination clauses of this contract or with any of such rules, regulations or order of the Arizona Civil Rights Division said noncompliance will be considered a material breach of the contract and this contract may be canceled, terminated or suspended in whole or in part, and the contractor may be declared ineligible for further government contracts until said contractor has been found to be in compliance with the provisions of this order and the rules and regulations of the Arizona Civil Rights Divisions, and such sanctions may be imposed and remedies revoked as provided in Part II of this order, and the rules and regulations of the Arizona Civil Right Division.

F. The contractor will include the provisions of paragraphs A through E in every subcontractor purchase order so that such provisions will be binding upon each subcontractor or vendor. The contractor will take such action with respect in the subcontract or purchase order as the contracting agency may direct as a means of enforcing such provisions, including sanctions for noncompliance; provided, however, that in the event the contractor becomes involved in or is threatened with litigation with a subcontractor or vendor as a result of such direction by the contracting agency, the contractor may request the State of Arizona to enter into such litigation to protect the interests of the State of Arizona.

G. Each contractor having a contract containing the provisions prescribed in this section shall file and shall cause each of his subcontractors to file compliance reports with the contracting agency or the Civil Rights Division, as may be directed. Compliance reports shall be filed within such ties and shall contain such information as the practices, policies, programs and employment policies, programs and employment statistics of the contractor and each subcontractor and shall be in such form as the Arizona Civil Rights Division may prescribe.
H. Bidders or prospective contractors or subcontractors shall be required to state whether they have participated in any previous contract subject to the provisions of this order or any preceding similar Executive Order and in that event to submit on behalf of themselves and the proposed subcontractors compliance reports prior to, or as an initial part of negotiation of a contract.

I. Whenever the contractor or subcontractor has a collective bargaining agreement or other contract or understanding with a labor union or an agency referring workers or providing or supervising apprenticeship or training for such workers, the compliance report shall include such information from such labor unions or agency practices and policies affecting compliance as the contracting agency or Civil Rights Division may prescribe; provided that, to the extent such information is within the exclusive possession of a labor union or an agency referring workers or providing supervision apprenticeship or training and such labor union or agency shall refuse to furnish such information to the contractor, the contractor shall so certify the contracting agency as part of its compliance report and shall set forth what efforts he has made to obtain such information.

J. The contracting agency or the Civil Rights Division shall require that the bidder or prospective contractor or subcontractor shall submit as part of his compliance report a statement in writing signed by an authorized officer or agent on behalf of any labor union or any agency referring works or providing or supervising apprenticeship or other training with which the bidder or prospective contractor deals with supporting information to the effect that the signer’s practices and policies do not discriminate on the ground of race, color, religion, sex or national origin, and that the signer either will affirmatively cooperate in the implementation of the policy and provisions of this order or that it consents and agrees that recruitment employment and the terms and conditions of employment under the proposed contract shall be in accordance with the purpose and provisions of this order. In the event that the union or the agency shall refuse to execute such a statement, the compliance shall so certify and set forth what efforts have been made to secure such a statement and such additional factual material as the contracting agency or the Civil Rights Division may require.

PART II.

Enforcement

The parties to the contract agree that the Civil Rights Division may investigate the employment practices of the contractor or any subcontractor employed by the contractor or initiate an investigation by an appropriate contracting agency or determine whether or not any of the contractual provisions pertaining to discrimination in this contract have been violated. Such investigations shall be conducted in accordance with the procedures established by the Civil Rights Division, and the investigation agency shall report to the Civil Rights Division any action taken or recommended. The Civil Rights Division may receive and investigate or cause to be
investigated complaints by employees or prospective employees of the contractor or subcontractor under this agreement which allege discrimination contrary to the contractual provisions of this agreement. If the investigation is conducted for the Civil Rights Division by an agency other than the Civil Rights Division, that agency shall report to the Civil Rights Division what action has been taken or is recommended with regard to such complaint.

00 73 37 Legal Worker Requirements
Refer to http://nau.edu/Facility-Services/DP_Contract/ for specific requirements within the Construction Agreement.

00 73 38 Sudan and Iran
Refer to http://nau.edu/Facility-Services/DP_Contract/ for specific requirements within the Construction Agreement.

00 73 39 Minority Business Enterprise Requirements
Refer to http://nau.edu/Facility-Services/DP_Contract/ for specific requirements within the Construction Agreement.

00 73 50 Liquidated Damages
It is hereby understood and mutually agreed, by and between Contractor and Owner, that the date of beginning, rate of progress and the time for completion of the work to be done hereunder are essential conditions of this Contract; and it is further mutually understood and agreed that the work embraced in this Contract shall be commenced on the date to be specified in the Notice to Proceed.

The Contractor agrees that said work shall be prosecuted regularly, diligently and uninterruptedly at such rate of time he specifies. It is expressly understood and agreed, by and between the Contractor and Northern Arizona University, that the time for completion of the work will be set by the substantial and final completion dates as identified in Invitation to Bid.

Now, if the said Contractor shall neglect, fail, or refuse to complete the work by the specified date, then the Contractor does hereby agree, as a part consideration for the awarding of the Contract, to pay the Owner a certain sum, as outlined hereafter, per calendar day, until the Project is completed, not as a penalty, but as Liquidated Damages for each breach of contract as hereinafter set forth, for each and every calendar day that the Contractor shall be in default after the time stipulated in the Contract for completing the work.

For each calendar day that any part of the work remains uncompleted after the expiration of the time specified and/or allowed for completion of the work stipulated in the contract or approved increase by the additional work or materials ordered after the contract is signed, effecting the

NORTHERN ARIZONA UNIVERSITY – Technical Standards

Project 10.010.168 – Condensate Line Replacement near Reilly Hall

(10/01/2014)

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critical path schedule of the project, the sum per day shall be deducted from any monies due the Contractor, or if no money is due the Contractor, the Owner shall have the right to recover said sum or sums from the Contractor, from the surety or from both.

It shall be understood that the time to complete the Project, beyond the contractual date of completion is in itself prima facie evidence of actual damages incurred, and the amount of these deductions are to cover the Liquidated Damages caused by the loss of use, or limited use, of the building and other additional Owner incurred losses, or expenses, including supervisory and consulting services, due to the failure of the Contractor to complete the work within the time specified.

The said amount is fixed and agreed upon by and between Contractor and Owner because of the impracticality and extreme difficulty of fixing and ascertaining the actual damages Owner would in such event sustain, and said amount is agreed to be the amount of damages which the Owner would sustain.

It is further agreed that time is of the essence of each and every portion of this contract and of the specifications where a definite and certain length of time is fixed for the performance of any act whatsoever; and when under the Contract an additional time is allowed as hereinbefore mentioned for the completion of any Work, the new time limit fixed by such extension shall be of the essence of this Contract, provided that the Contractor shall not be charged with Liquidated Damages or any excess cost when the delay in completion of Work is due:

To unforeseeable cause beyond the control and without fault or negligence of the Contractor, including, but not restricted to, acts of God, or of the public enemy, acts of the Owner, acts of another Contractor in the performance of a contract with the Owner, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, and unusually severe weather. The unusualness of the weather shall be determined by statistics from the local Weather Bureau over a period of the last 10 years. Upon request of the DP, the Contractor shall obtain statistical information from the Weather Bureau to support his claim for extension caused by unusual weather condition.

If the Contractor is delayed at any time in the progress of the Work by any act or neglect of the Owner or the DP, or by any separate Contractor employed by the Owner, or by changes in the Work, or by labor disputes, fire, unusual delay in transportation, unusually severe weather conditions, adverse soil conditions, unavoidable casualties, delays specifically authorized by the Owner, or by causes beyond the Contractor's control, avoidance, or mitigation, and without any fault or negligence of the Contractor or Subcontractor or Supplier at any tier, then the Contract Time shall be extended by Change Order for such reasonable time as the Owner may determine that such event has delayed the critical path of the Work or individual milestone or overall completion of the Work after considering the advice of the DP, if the Contractor complies with
the notice and documentation requirements set forth below. The Contractor shall pay any additional fees or costs incurred by the Owner or DP as the result of delays caused by the Contractor for circumstances not excused as provided herein.

Initial notice of any delay in the Work shall be made in writing to the DP and Owner immediately but in no event later than 24 hours after discovery of the event giving rise to the delay. Then, Contractor shall provide additional details of the delay in writing to the DP and the Owner within seven (7) calendar days from the beginning of the delay. Failure to meet these time requirements shall absolutely bar any and all later claims. The detailed notice shall indicate the cause of the delay, the anticipated length of the delay, the probable effect of such delay upon the progress and cost of the Work, and potential mitigation plans. If the cause of the delay is continuing, the Contractor must give written notice every month at the same time it submits the updated progress Narrative Report to the DP. Within fifteen (15) days after the elimination of any such delay, the Contractor shall submit further documentation of the delay and, if applicable, a formal written request covering an extension of time for such delay. The written request for time extension shall state the cause of the delay, the number of days extension requested and provide a fully documented analysis of the Progress Schedule, including a fragment and any other data demonstrating a delay in the critical path of the Work or individual milestone or the overall project completion. If the Contractor does not comply with the notice and documentation requirements set forth above, the claim for delay is absolutely barred.

Schedule of Liquidated Damages shall be as follows:

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<tr>
<th>Substantial Completion:</th>
<th>$1,200.00 (Dollar Amount)</th>
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<td>for every day beyond the scheduled date of Substantial Completion through to and including the date indicated on the Official Certificate of Substantial Completion when issued by the DP.</td>
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<th>Final Completion:</th>
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<td>for every day beyond the date of Final Completion as established in the Contract Documents and per Sections 31 and 32 of the Construction Agreement. Work to be completed prior to a determination of Final Completion includes the fulfillment of all Contractual requirements, including the completion of all punch list items and Contract Closeout documents.</td>
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This clause applies to any cost reduction proposal (hereinafter referred to as a Value Engineering Change Proposal (VECP)) initiated and developed by the Contractor for changing the drawings, designs, specifications, or other requirements of this contract. This clause does not, however, apply to any such proposal unless it is identified as a VECP by the Contractor at the time of its submission to the Owner.

Definition
All VECP's must:
Result in a savings to the Owner by providing a decrease in the cost of the performance of this contract without impairing any required functions and characteristics such as service life, reliability, economy of operation, ease of maintenance, desired appearance, standardized feature, fire protection features, safety features.

Require, in order to be applied to this contract, a change order to this contract.

Proposal Screening
The Contractor will present anticipated proposals to the DP for proposal screening. During this screening, the DP will render an opinion as to the relative merits of the proposal.

The DP will provide as a part of the screening, the minimum technical content requirements to be submitted by the Contractor as a part of the formal VECP.

Concurrence by the Owner and the DP with merits of the proposal during the screening is not to be assumed that the VECP will automatically be accepted.

In the event a VECP is received which has not had the proposal screening, it may be rejected without review.

VECP Content
As a minimum, the following information must be submitted by the Contractor with each VECP.

A description of the difference between the existing contract requirement and that proposed, the comparative advantages and disadvantages of each, a justification when an item's function or characteristics are being altered, and the effect of the change on the end item's performance.

A list and analysis of the contract requirements that must be changed if the VECP is accepted, including any suggested specification revisions.

A separate, detailed cost estimate for (1) the affected portions of the existing contract requirement and (2) the VECP.
A description and estimate of costs the University may incur in implementing the VECP, such as test and evaluation and operating and support costs.

A prediction of any effects the proposed change would have on collateral costs to the agency.

A statement of the time by which a Change Order accepting the VECP must be issued in order to achieve the maximum cost reduction, noting any effect on the contract completion time or delivery schedule.

Identification of any previous submissions of the VECP, including the dates submitted, the agencies and contract numbers involved, and previous University actions, if known.

The Contractor may withdraw, in whole or in part, a VECP that has not been accepted by the Owner within the period specified in the VECP.

Owner Action
The DP shall notify the Contractor of the status of the VECP within 30 days after submitted for review. If additional review time is required, the DP shall notify the Contractor of this within the original 30-day period. The Owner or DP shall not be held liable for any delays in acting upon a VECP.

If a VECP is not accepted, the DP shall notify the Contractor in writing, explaining the reasons for rejection. The notice of rejection shall be submitted within the review period referenced above.

Any VECP may be accepted, in whole or in part by the Owner. The Owner may modify a VECP, with the concurrence of the Contractor, to make it more acceptable. If any modification increases or decreases the savings resulting from the VECP, the Contractor's fair share will be determined on the basis of the VECP as modified. Unless and until a change order applies a VECP to this contract, the Contractor will remain obligated to perform in accordance with the terms of the existing contract. The Owner may accept in whole or in part any VECP submitted pursuant to this clause by issuing a change order which will identify the VECP on which it is based.

Payment
If a VECP submitted pursuant to this clause is accepted under this contract an equitable adjustment in the contract price shall be made. The equitable adjustment shall be determined by the following method: subtract any ascertainable costs to the Owner, multiply this amount by 50 percent and subtract from the original contract price to determine the adjusted contract price.

Rights to Data
The Contractor may restrict the Owner's right to use any sheet of a VECP or of the supporting data, submitted pursuant to this clause, in accordance with the terms of the following legend if it is marked on the sheet:

These data furnished pursuant to a value engineering incentive clause and shall not be disclosed to other than the Owner and DP, or be duplicated, used, or disclosed, in whole or in part, for any purpose other than to evaluate a value engineering change proposal submitted under said clause.

This restriction does not limit the Owner's right to use information contained in these data if it is or has been obtained from another source, or is otherwise available, without limitations. If such a proposal is accepted by the Owner by issuance of a change order under the "Changes" clause of said contract after the use of these data in such an evaluation, the Owner shall have the right to duplicate, use, and disclose any data pertinent to the proposal as accepted in any manner and for any purpose whatsoever and have other so do.

In the event of acceptance of a VECP, the Contractor hereby grants to the Owner all rights to use, duplicate, or disclose in whole or part, in any manner and for any purpose whatsoever, and to have or permit others to do so, any data reasonably necessary to fully utilize such proposal. Contract modifications made as a result of this clause will state that they are made pursuant to it.

Payment for Rejected Proposals
In the event that the DP and the Owner accept a VECP presented by the Contractor which is subsequently withdrawn by the Contractor, the DP’s costs realized for evaluating the VECP will be reimbursed by the Contractor.

**END OF SECTION**
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<tr>
<th>Section</th>
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<tr>
<td>00 90 00</td>
<td>Revisions, Clarifications and Modifications</td>
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<td>00 91 00</td>
<td>Pre-contract Revisions</td>
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<td>00 91 13</td>
<td>Addenda</td>
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<td>00 91 16</td>
<td>Bid Revisions</td>
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<tr>
<td>00 93 00</td>
<td>Record Clarifications and Proposals</td>
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<tr>
<td>00 93 13</td>
<td>Record Requests for Interpretation</td>
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<td>Record Clarification Notices</td>
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<td>00 93 53</td>
<td>Record Proposal Requests</td>
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<tr>
<td>00 93 54</td>
<td>Record Proposal Worksheet Summaries</td>
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<td>00 93 57</td>
<td>Record Change Order Requests</td>
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<td>00 94 00</td>
<td>Record Modifications</td>
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<tr>
<td>00 94 33</td>
<td>Record Minor Changes in the Work</td>
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<td>00 94 36</td>
<td>Record Supplemental Instructions</td>
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<td>Record Field Orders</td>
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DIVISION 1 – GENERAL REQUIREMENTS

01 11 00 Summary of Work
01 11 13 Base Scope

The base scope of work includes replacement of a leaking condensate line serving Reilly Hall. The extent of pipe to be replaced is from the steam pit inside the Reilly Hall mechanical room to “Steam Pit No. 1”, outside the East corner of Reilly Hall. Replacement of all condensate components inside steam pit no. 1 is included in the base scope (pipe, valves, condensate trap, unions, ball joints, and insulation). Dewatering of the steam pit shall be performed as needed to complete the work. The steam trap on the steam system shall also be replaced in this pit. Components in the mechanical room steam pit shall be replaced, to include the traps and valves.

The contractor shall excavate and replace the 3” condensate pipe. New insulation will be placed around both the 3” condensate and existing 5” steam line. The adjacent steam line will be excavated to allow full insulation replacement. New steam pipe is not in the base scope, but identification of deteriorated pipe shall be presented to the project manager.

All landscaping and irrigation system components within the path of excavation shall be replaced.

All pipe guides, supports and anchors exposed shall be replaced with new.

Bluestake marks on concrete, asphalt and metal surfaces shall be removed by the contractor upon substantial completion.

List of Alternates
Addition/Alteration #1:
Replace the leaking condensate line from Steam Pit No. 1 to Steam Pit No. 2 (Southeast of Allen Hall). Aside from connecting the new condensate line, replacement of components inside Steam Pit No. 2 is not in scope.

Dewatering of the steam pit shall be performed as needed to complete the work. Replacement of steam line components is not included in the base scope of work. The contractor shall excavate and replace the 3” condensate pipe. New insulation will be placed around both the 3” condensate and existing 5” steam line. The adjacent steam line will be excavated to allow full insulation replacement. New steam pipe is not in the base scope, but identification of deteriorated pipe shall be presented to the project manager.

Asphalt and concrete shall be replaced, to include road striping. Asphalt concrete mix shall be a MAG ½” 75 Blow Marshall (High Traffic) Mix Design.

Traffic and pedestrian control measures shall be provided by the contractor, and two-way traffic on University Drive must be maintained at all times. The driveway South of Allen Hall shall remain accessible at all times.

All landscaping and irrigation system components within the path of excavation shall be replaced.

All pipe guides, supports and anchors exposed shall be replaced with new.
Bluestake marks on concrete, asphalt and metal surfaces shall be removed by the contractor upon substantial completion.

Addition/Alteration #2:
In the event deteriorated steam pipe is discovered, replacement of 5” steam pipe will be included. This alternate should be bid based linear feet of pipe replacement. Excavation, insulation, and backfill work is included the base scope and/or add/alt #1.

If using Division 1 for subcontractor bid packages the contractor shall incorporate applicable language from their Construction Agreement with NAU.

Work by Owner
This section is to include project specific information which will be provided by the Project Manager if applicable.

The Owner reserves the right to award other contracts related to the Project, or to perform certain work itself. Any such other work may or may not be known to the Owner or disclosed to the contractor prior to execution of the Agreement. The Contractor shall afford the Owner and such other contractors reasonable opportunity for the introduction and storage of their materials and equipment and the execution of their work, and shall properly coordinate its Work with theirs in such manner as the Owner or Design Professional may direct. The Contractor shall also assure at its own cost reasonable access of other contractors to their site and their work.

Multiple Contract Summary
This section is to include project specific information which will be provided by the DP (if applicable).

Summary of Contracts

Work Sequence

Contract Interface

Work Restrictions

Access to Site
This section is to include project specific information which will be provided by the DP.
Truck washing stations, truck tire scraping grates and street sweeping may be required. Access to site shall be provided as to keep construction activity, dirt and mud on site.

01 14 16 Coordination with Occupants
Communication with the occupants is to be sent through the NAU Project Manager. Impact requests should be requested a minimum of 72 hours prior to the proposed starting time. Requests may not be approved and may be rescheduled to meet occupant needs.

01 14 19 Use of Site
*This section is to include project specific information which will be provided by the DP.*

Use of the site is restricted to materials and equipment necessary to completion of the Work. It is the contractor’s responsibility to ensure enclosure of the site from the general public.

01 18 00 Project Utility Sources

01 18 13 Utility Service Connections
*This section is to include project specific information which will be provided by the DP.*

The Contractor shall prearrange time with the DP and Owner whenever it becomes necessary to energize new services or interrupt any service to make connections, alterations or relocations and shall fully cooperate with the Owner in doing Work so as to cause the least annoyance and interference with the continuous operation of the Owner's business or official duties. Following this meeting the Contractor shall submit a work authorization request that will include a detailed procedure, schedule for each task within the procedure, any safety controls being implemented and signoff locations for tasks completed. The work authorization request will be similar to the document identified in 29 CFR 1910.147 App A and must be approved by the trade supervisor for the intended utility. The work authorization document is considered a submittal subject to the review periods indicated in the contract and must be approved prior to scheduling work.

Any existing plumbing, heating, ventilating, air conditioning or electrical disconnections which may affect portions of existing buildings or other construction projects must be coordinated with the DP and Owner to avoid any disruption of operation. While bidding, the Contractor shall assume that all shutdowns shall occur during afterhours and/or weekends unless specifically stated otherwise in the contract documents. In no case, unless previously
approved in writing by Owner, shall utilities be left disconnected at the end of a work day or over a weekend. Any interruption of utilities shall be reported immediately to the NAU Project Manager. Such interruptions, whether negligently, intentionally, or accidentally, shall not relieve the Contractor's responsibility for the interruption or from liability for loss or damage caused by such interruption even though such loss or damage was not foreseeable by Contractor or subcontractor, or from responsibility for repairing and restoring the utility to normal service. Repairs and restoration shall be made before the Contractor leaves the project site.

**END OF SECTION**
01 20 00  PRICE AND PAYMENT PROCEDURES

01 21 00  Allowances
The Contractor’s price for the Work shall include all of the Contractor’s costs associated with such allowance or allowances. If the actual costs to the Contractor of such allowance or allowances is different from the specified sum, increases or decreases in the cost of the allowance and associated Contractor’s cost shall be adjusted in accordance with the Construction Agreement.

Use of Allowances must be requested and approved through the Allowance Use Authorization form.

01 26 00  Contract Modification Procedures

01 26 13  Requests for Interpretation
Requests for Interpretation (RFI) will be sent electronically the NAU Project Manager and the DP concurrently. The RFI must indicate the NAU project number, RFI #, spec section and plan sheet impacted, trades involved, images if applicable, a proposed solution and potential cost or time impact.

01 26 19  Clarification Notices

01 26 33  Minor Changes in the Work

01 26 36  Supplemental Instructions

01 26 39  Field Orders

01 26 43  Amendments

01 26 46  Construction Change Directives
A construction change directive (CCD) may only be used at Owner’s discretion when the identified field change must be completed before a formal change order can be issued to the Contractor. The Contractor shall provide the Owner a description of the required change and a not to exceed value. When signed by the Owner and Design Professional and received by the Contractor, the CCD becomes effective immediately and the contractor shall proceed with the change(s) described. The appropriate adjustments to the contract will be made through a change order amendment. Actual costs must be fully substantiated before an amendment will be issued.
01 26 49 Work Change Directives
N/A

01 26 53 Proposal Requests
Refer to Section 01 26 57

01 26 54 Proposal Worksheet Summaries
Refer to Section 01 26 57

01 26 57 Construction Change Proposal Request
The CCPR form is required to be completed by the contractor with a detailed description and cost breakdown for each individual requested change. Please refer to FS#12 available at: http://nau.edu/Facility-Services/DP_Contract/.

01 26 63 Change Orders
No changes in the work shall be undertaken by the Contractor without written direction by the Owner or DP. Any changes made without such written direction are done so at the Contractor's own risk. Change Orders shall be processed as identified in the construction agreement.

Change procedures must follow the requirements outlined in the Construction Agreement Between Owner and Contractor. A copy of the latest version of the Construction Agreement between Owner and Contractor is available at http://nau.edu/Facility-Services/DP_Contract/.

After the Contract is signed, modifications in the Contract Price, the Contract Time or scope of the Work may only be made by written Change Order.

01 29 00 Payment Procedures

01 29 73 Schedule of Values
Individual construction activities which are indicated by the Schedule of Values shall coincide with activities presented on the Contractor’s Construction Schedule. Contractor shall submit proposed schedule of values for review and approval by DP and by Owner, per the Construction Agreement between Owner and Contractor, prior to submission of first pay application.

01 29 76 Progress Payment Procedures
Contractor will submit payments electronically to the Project Manager, DP and Owner’s Designated Contracts Administrator concurrently and then follow up with a physical copy to the Project Manager. Payments will be measured against the Schedule of Values as approved by the DP, Owner and CM (as applicable).
For all Testing and Inspection Services, the Testing and Inspection Log (FS#105) shall be completed and shall accompany each pay app for that billing period.

Payment procedures shall be per the Construction Agreement. The Pay Application form can be found at: http://nau.edu/Facility-Services/DP_Contract/.

**END OF SECTION**
01 30 00  ADMINISTRATIVE REQUIREMENTS

01 31 00  Project Management and Coordination

01 31 13  Project Coordination
Project coordination and communication procedures will be discussed in detail at the Pre-Construction Conference. The minutes of this meeting shall serve as reference and documentation of proper coordination and communication channels.

01 31 14  Facility Services Coordination
An emergency contact sheet will be provided to the Contractor with contacts for the different departments in Facilities. The Contractor will fill out with their emergency numbers and return to the Owner for distribution.

01 31 16  Multiple Contract Coordination

01 31 19  Project Meetings
Please refer to the required project meetings in the Construction Agreement.

01 31 19.13  Preconstruction Meetings
A preconstruction conference shall be held for all projects. Notification of the time and date of such conference shall be made to the selected Contractor in the Letter of Intent To Award.

01 31 19.14  Inspection Meeting
A preconstruction meeting will be held between NAU Project Manager, NAU Lead Building Inspector, all Trades Inspectors and the General Contractor to discuss inspection procedures and establish expectations.

01 31 19.15  Blue Stake Meeting
Contractor and earthwork/underground foreman will attend a Blue Stake Kickoff Meeting lead by the NAU Blue Stake Coordinator prior to starting work.

01 31 19.16  Site Mobilization Meetings

01 31 19.23  Progress Meetings
Progress meetings shall occur on a regular basis (weekly) according to a schedule determined at the pre-construction conference or as established in the contract.

01 31 19.33  Pre-Installation Meetings
The contractor shall schedule a pre-installation meeting before starting any major trade, between the Inspector, General Contractor and Subcontractor. For projects over $100,000 schedule a 10 - 15% Installation Completion Meeting to verify proper installation practices are implemented. The pre-installation meeting will review the inspection protocol and review project specifications and drawings with the General Contractor and Subcontractor. The preinstallation meetings, to be scheduled the same day of the weekly construction meeting, shall be specified when applicable:

- Concrete formwork and placing
- Waterproofing
- Mortar / masonry
- Flashing
- Roofing
- Sealant
- Vapor Barrier
- Sprinkler
- Ductwork
- Painting

### Construction Progress Documentation

#### Scheduling of Work

In general, hours of construction activity shall be limited to 7 a.m. until 7 p.m. unless written approval is obtained from the Project Manager. Additionally, the Contractor shall agree to limit any noisy activities during “reading week” and “finals week”. Reading Week and Finals Week generally occurs during the first weeks of May and December.

**Project work adjacent to or within Residence Halls shall be more strictly limited to the hours of 8:00 a.m. until 6:00 p.m, unless written approval is obtained from the Owner. This includes any work that may negatively impact students. In addition to these hours, work performed on weekends will not be permitted without prior authorization from NAU’s department of Residence Life.**

#### Construction Progress Schedule

The following requirements shall support and amplify the requirements of the Construction Agreement Between Owner and Contractor.
In conjunction with the Contractor’s Construction Schedule, the Contractor shall provide a Procurement Schedule for all major project components to be purchased and incorporated by the Contractor into the Project.

The Procurement Schedule shall indicate scheduled delivery of major Project components, both equipment and materials, in support of the activities included on the Contractor’s Construction Schedule.

Revisions to the Contractor’s Construction Schedule shall be coordinated with revisions to the Procurement Schedule.

In the event significant delays or lags in schedule, as determined by the Owner, are encountered, the Contractor shall provide to the Owner a revised Contractor’s Construction Schedule indicating proposed rescheduling of subsequent activities to achieve project completion by the Contract Completion Time or Amended Completion Time.

Additions to or deletions from the Contract, authorized through Change Orders, shall be reflected in the Contractor’s Construction Schedule if such changes affect the critical path of project completion.

**Owner’s Approval of Phasing**

The Owner reserves the right to review and approve scheduling or phasing of construction activities which have an impact on University functions or operations.

Contractor shall be aware of the impact of such construction activities and shall advise the Owner when they are indicated by the schedule. The Contractor shall act to lessen or avert impact to University operations through alternative phasing of activities or other measures.

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<td>01 32 23</td>
<td>Survey and Layout Data</td>
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This information to be provided by Design Professional.
Project Manager to determine if all underground utilities exposed by their project will be located and documented by GPS.

01 32 26  Construction Progress Reporting
The Contractor shall maintain a written daily log in accordance with the Construction Agreement.

01 32 29  Periodic Work Observation

01 32 33  Photographic Documentation
Photos are required on all projects, submitted electronically with pay application, and representative of the work for which the Pay Application is for. Photographs shall be a minimum of 5 megapixels, the number of photos and different views is to be selected by the Owner at the preconstruction meeting. The file name will be labeled with first with the location of the photo, direction of view and then description. For example, a civil project will have the GPS coordinates, direction and description.

01 32 36  Video Monitoring and Documentation

01 32 43  Procurement Tracking
In conjunction with the Contractor’s Construction Schedule, the Contractor shall provide a Procurement Schedule for all major project components to be purchased and incorporated by the Contractor into the Project. The Procurement Schedule shall indicate scheduled delivery of major Project components, both equipment and materials, in support of the activities included on the Contractor’s Construction Schedule. Expediting Reports shall be provided by the Contractor to the Owner in the event that scheduled deliveries, of a significant nature, do not arrive as planned and the Contractor shall make all reasonable effort to expedite deliveries in accordance with the Procurement Schedule.

Reports shall indicate the Contractor’s efforts in this regard.

Claims for extension of Contract Completion. Time submitted by the Contractor on the basis of delayed material or equipment deliveries, shall be accompanied by documentation from the Vendor/Supplier indicating the date order was placed, usual time required for delivery and the date of scheduled delivery.

01 33 00  Submittal Procedures
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This section is to include project specific information which will be provided by the DP if applicable.

01 33 16  Design Data

01 33 19  Field Test Reporting
Copies of Field Test Reports will be turned over monthly along with the Pay Application.

01 33 23  Shop Drawings, Product Data, and Samples
The Submittal Procedure shall be per the requirements of the Construction Agreement.

01 33 26  Source Quality Control Reporting

01 33 29  Sustainable Design Reporting

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<td>01 33 29.03</td>
<td>Metal-Containing Product List</td>
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<td>Material Content Form</td>
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<td>New Product Source Form</td>
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<td>01 33 29.06</td>
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<td>01 33 29.07</td>
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01 35 00  **Special Procedures**

01 35 13  Special Project Procedures
This section is to include project specific information which will be provided by the DP if applicable.

01 35 13.19  Special Project Procedures for Healthcare Facilities

01 35 13.26  Special Project Procedures for Clean Rooms

01 35 13.43  Special Project Procedures for Contaminated Sites
Alteration Project Procedures

Owner Safety Requirements
The contractor’s Responsibility for Project Safety is according to the Construction Agreement. The Contractor shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with Contractor's Work.

The Contractor shall designate an employee as Safety Officer at the Project Site whose duties shall include prevention of accidents and monitoring/enforcement of the Contractor's safety program. This person shall be the Contractor's Superintendent unless otherwise designated in writing by the Contractor and shall be acceptable to the Owner.

The Contractor's Safety Officer shall attend the Preconstruction Conference and shall be designated as such to the Owner.

The Contractor's Safety Officer will be responsible for continued monitoring of the job site to maintain safe working conditions in strict compliance with State of Arizona Occupational Safety and Health Standards for the Construction Industry (29 CFR Part 1926). Specific attention is called to Housekeeping (Section 1926.25, ADOSH, 29 CFR Part 1926).

The General Contractor and all Subcontractors shall clear away all debris which poses an unsafe condition as required in Section 1926.25 on a daily basis.

Failure of the Contractor to promptly correct unsafe conditions, subsequent to written notification by the Owner, shall constitute violation of the standards indicated herein. The Owner reserves the right, in the event of such violation, to correct unsafe conditions through the most expedient means available. Any costs incurred by the Owner for such corrective work shall be reimbursed by the Contractor, via deductive Change Order.

Governmental Safety Requirements
All workmen employed by the General Contractor or subcontractors shall have adequate safety training for their respective facets of the work as specifically required by document #2254, Training Requirements and OSHA Standards and Training Guidelines (USDA, OSHA 1985).

Health, Safety, and Emergency Response Procedures for Contaminated Sites

NAU’s Emergency Response Call Sheet can be found at: http://nau.edu/Facility-Services/DP_Contract/
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<td>The Owner shall have first right of refusal on all materials and equipment which are salvaged as part of the Project construction process to include materials both above and below the existing ground surface.</td>
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<td>Contractor shall notify the Owner prior to disposing of such materials and equipment. Owner will notify the Contractor promptly if possession is to be taken by the Owner. Materials not claimed by the Owner within three working days shall be removed from the Project site by the Contractor and disposed of appropriately.</td>
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<td>Hazardous Materials Procedures</td>
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<td>This information can be obtained at the following link: <a href="http://nau.edu/Facility-Services/Operations/Ops/">http://nau.edu/Facility-Services/Operations/Ops/</a></td>
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<td>This information can be obtained from the Office of Environmental Health &amp; Safety.</td>
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<td>Asbestos Abatement</td>
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<td>NAU has completed asbestos surveys for the majority of buildings currently present on the Flagstaff Campus and remote campuses. Survey results are housed in the NAU Asbestos Program office and are available for review or notification purposes.</td>
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<td>To maintain compliance with all applicable state and Federal EPA and OSHA regulations, NAU Policy requires that a site specific asbestos inspection be completed to determine the need for abatement before any work involving the disturbance of pre-existing building components is conducted. This inspection and any other required asbestos information and guidance may be requested directly by calling the Asbestos Program office at (928) 523-6435, or by completing the online asbestos inspection request (<a href="http://www.orc.nau.edu/Asbestos.html">http://www.orc.nau.edu/Asbestos.html</a>). Asbestos inspections may involve additional sampling of previously untested materials, and may facilitate the need for NESHAP notified abatement work, so an appropriate amount of lead time must be allotted in the project schedule.</td>
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|             | All asbestos-containing materials (ACM) in the work area are to be removed, containerized, and disposed of in accordance with all applicable Federal, State, and Local regulations. This work must be performed by NAU or by a licensed asbestos abatement contractor before any other work which may impact the materials in question. Work must be scheduled and performed in a manner which
DIVISION 1 – GENERAL REQUIREMENTS

minimizes the chance of contamination of non-asbestos materials. The asbestos removal work must comply with the NESHAP (40 CFR 61, subpart M), AHERA (40 CFR 763, subpart E), and OSHA Asbestos construction standard (29 CFR 1926.1101) and general industry standard (29 CFR 1910.1001), whichever may apply.

Abatement oversight must be conducted by NAU, or by an approved third party oversight contractor. No additional demolition or renovation activities may proceed in the selected abatement area until appropriate clearance of the work by the oversight contractor and/or NAU. The oversight contractor or NAU will have the authority to stop work immediately if abatement or demolition procedures are found to be inadequate to control the release of asbestos fibers, or if asbestos is being disturbed in an uncontrolled or unsafe manner.

NAU will issue a written or verbal authorization to proceed with non-asbestos demolition/renovation activities following achievement of acceptable clearance of the asbestos abatement. Prior to authorization to proceed, the oversight contractor or NAU Asbestos Program Manager must complete a visual inspection and/or analytical sampling of the area to document completeness of the work. If contamination is found following abatement, the abatement contractor will be required to perform additional cleaning until acceptable levels are achieved, at no additional cost to the University.

Abatement activities are the responsibility of NAU and may not be subcontracted as part of the larger abatement project. When abatement is necessary, the Project Manager shall work in cooperation with EH&S to develop specifications, collect bids, and contract/complete any necessary abatement independently from the larger construction contract and unless otherwise authorized by EH&S, abatement shall be completed prior to any other construction activities at the work site.

It is the responsibility of the construction or demolition contractor to furnish an accurate work schedule to the University in order to allow for timely abatement and good coordination between vendors. The construction/demolition contractor may be held accountable for additional fees incurred by the university due to improper scheduling or communication on the part of the contractor.

In cases which abatement is performed by the renovation/construction contractor, or by a subcontractor retained by the construction contractor, the construction contractor or abatement subcontractor must meet the minimum qualifications and insurance for abatement contractors under the Arizona state purchasing system.
DIVISION 1 – GENERAL REQUIREMENTS

Following completion of all abatement activities, the contractor shall provide copies of closeout documents including the date, location, and scope of work, negative exposure assessment and air sampling data, daily logs, and waste shipment records. Copies of all closeout documents shall be furnished to both the Project Manager and Asbestos Program office.

To satisfy its obligations under OSHA, NAU will issue a written notification of the presence of asbestos in the work area and building which work is being conducted in; and specific abatement requirements which may be required for the project. The contractor is responsible for the health and safety of its own employees and for meeting OSHA communication of hazard, training, and PPE requirements. Worker compliance with all applicable regulations will be enforced by the contractor.

The contractor shall comply with the provisions of the following regulations:

The National Emission Standard for Hazardous Air Pollutants (NESHAP), 40 CFR 61, subpart M, enforced by the Arizona Department of Environmental Quality, regulating the removal and disposal of asbestos-containing materials.

The contractor will be required to notify the State of Arizona Department of Environmental Quality NESHAP office 10 business days before removal of threshold amounts of friable asbestos or RACM as specified in 40 CFR 61.145. The Contractor shall send a copy of this notice to the NAU Asbestos Program Manager. A NESHAP notification is also required 10 days prior to commencement of demolition of any building on NAU campus even if no asbestos abatement is required.

When applicable, or requested by NAU, the contractor shall follow the guidelines and procedures of the Asbestos Hazard Emergency Response Act (AHERA), 40 CFR 763. subpart E, regulating identification and management of asbestos in schools.

The Contractor shall inform NAU Office of Environmental Health & Safety and the Project Manager of any hazardous chemicals they will be using on campus. The Contractor shall comply with the requirements specified in OSHA's Hazard Communication program (29 CFR 1910.1200). The Contractor shall assume responsibility for the safe and legal disposal of all chemicals used on the job site.

During and following completion of the renovation, all newly installed building materials shall be analyzed for asbestos and a report containing the analytical results shall be furnished to the Asbestos Program Office to maintain complete records of NAU buildings in the future. Testing shall conform to the guidelines set forth in the EPA AHERA regulation. This testing shall be conducted by an AHERA certified building inspector and if requested, shall be conducted by the
### Blasting Policy

Blasting is not considered a preferred process on campus. Any use of explosives must be approved in writing by NAU Fire Marshal and must conform to The City of Flagstaff policies and procedures. The City of Flagstaff maintains jurisdiction for all blasting.

Prior to any use of explosives on the University campus, the NAU Project Manager with Facility Services, Planning, Design and Construction will notify Campus Police and NAU Office of Environmental Health & Safety. The Contractor shall submit to the Facility Services, Planning, Design and Construction, prior to any blasting, appropriate employee certification for use of explosives.

No explosives will be stored on the campus overnight or weekends. No quantity of explosives will be brought to the campus beyond that which will be used on the day blasting operations are to be performed.

No blasting shall take place earlier than 8 a.m. or later than 5 p.m.

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<tr>
<th>Section Number</th>
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<tr>
<td>01 35 43.13</td>
<td>Environmental Procedures for Hazardous Materials</td>
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<td>01 35 43.16</td>
<td>Environmental Procedures for Toxic Materials</td>
</tr>
<tr>
<td>01 35 46</td>
<td>Indoor Air Quality Procedures</td>
</tr>
<tr>
<td>01 35 53</td>
<td>Security Procedures</td>
</tr>
<tr>
<td></td>
<td>Contractor is responsible for securing access to all construction areas to prevent damage or theft. This may include but is not limited to securing site fencing, temporary construction and building entrances. After hours and work within tunnels must be coordinated with NAU Project Manager and NAU PD.</td>
</tr>
<tr>
<td>01 35 63</td>
<td>Sustainability Certification Project Requirements</td>
</tr>
<tr>
<td></td>
<td><em>This section is to include project specific information which will be provided by the DP if applicable.</em></td>
</tr>
<tr>
<td>01 35 66</td>
<td>Sustainability Certification Project Procedures</td>
</tr>
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<td><em>This section is to include project specific information which will be provided by the DP if applicable.</em></td>
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</tbody>
</table>
### Historic Treatment Procedures

This section is to include project specific information which will be provided by the DP if applicable. **END OF SECTION**

### QUALITY REQUIREMENTS

#### Regulatory Requirements

Any work performed on or within the boundaries of the Northern Arizona University campus shall be subject to special inspections, periodic inspections, Code compliance inspections, and pre-occupancy and/or final inspections by the following agencies as applicable:

- State Fire Marshal's Office (Fire alarm, sprinkler systems, underground fire lines and automatic extinguishing systems)
- Arizona Corporation Commission (Gas line installation)
- State Risk Management Division
- City of Flagstaff (for utilities installations that cross campus boundaries)
- State Elevator Inspector (Elevator installations)
- State Boiler Inspector (Boiler installations)
- NAU Facility Services, Planning, Design and Construction
- NAU Facility Services, Operations / Maintenance Inspectors
- NAU Facility Services, Lead Building Inspector
- NAU Office of Environmental Health & Safety
- NESHAP

It is the responsibility of the General Contractor to provide a complete copy of the construction plans, specifications and other pertinent documents as necessary for review and approval by the NAU Fire Life Safety Division (FLS) and NAU Lead Building Inspector.

No construction shall commence until the General Contractor receives from NAU-FLS and NAU Lead Building Inspector the approved stamped copy of the construction plans, permit, and other documents provided.

#### Codes

All design and construction work shall be done in such a manner that the completion of project is in compliance with the following codes. When reference is made to "this code" it shall mean all the codes listed below.

- International Building Code 2012 (IBC)
- International Existing Building Code 2012 (IEBC)
- International Plumbing Code 2012 (IPC)
- International Mechanical Code 2012 (IMC)
- National Electrical Code 2011 (NEC) (NFPA 70)
- International Fuel Gas Code 2012 (IFGC)
DIVISION 1 – GENERAL REQUIREMENTS

- International Fire Code 2012 (IFC)
- National Fire Alarm Code 2013 (NFPA 72)
- Installation of Sprinkler Systems 2013 (NFPA 13)
- NAU Fire Code (Most recent edition unless otherwise required)
- Arizona State Fire Code
- 2010 ADA Standards for Accessible Design as approved by the Department of Justice on July 26, 2010 (published in the Federal Register on September 15, 2010) and any more recent related Federal and State requirements with their related standards as they may apply.
  - FYI: Please be advised that where there is a conflict between any applicable accessibility requirements the most restrictive shall apply (e.g. 2012 IBC, 2010 ADA, 2009 ICC/ANSI A117.1, other NAU, State & Federal requirements, etc.).
- NAU Design Guidelines for Disabled Access Parking and Accessible Route at Vehicular Traffic Areas (Most recent edition unless otherwise required)
- 2007 ASME A17.1, Safety Codes for Elevators and Escalators (unless otherwise required)
  - AZ Elevator Act (Title 23, Chapter 2, Article 12)
  - Latest ADOSH Arizona Elevator Rules
- AZ Executive Order 2008-29 (FYI: Reaffirms Executive Order 2005-05. Requires all new state-funded buildings to meet the Silver LEED standard, at a minimum.)
- ASHRAE 90.1 – Most recent edition (FYI: 2004 is mandatory for AZ state-owned and state-funded buildings.)
- ASHRAE Design Codes 189/1 (Most recent edition unless otherwise required)
- Arizona Revised Statutes, including:
  - 34-451 (energy conservation standards)
  - 34-452 (solar design standards and energy life cycle costing)
- Occupational Safety and Health Administration Regulations
- NAU Material Safety Policies (e.g. Program Manuals such as Asbestos, Lead, PCB, etc.) (Most recent edition unless otherwise required)
- IAQ Guidelines for Occupied Buildings Under Construction (SMACNA) (Most recent edition unless otherwise required)
- ACGIH Industrial Ventilation Manual of Recommended Practices (Most recent edition unless otherwise required)
- ANSI/AIHA Z9.5 Laboratory Ventilation (Most recent edition unless otherwise required)
- NAU Technical Standards (Most recent edition unless otherwise required)

Compliance shall conform to the requirements of the latest editions of all state regulations and the various codes which have been adopted by the University at the time of selection of the Design Professional (or at time of bid if the University
does not designate a Design Professional), unless otherwise required by Federal or State regulation (such as ADA code compliance which is required at time of bid).

Contractor will be held to have examined and to have become familiar with these regulations in all ways they apply to the project.

The aforementioned document will be hereby made part of the Contract Document between NAU and DP and between NAU and Contractor, and shall be binding to the same extent as if they were written in full herein.

If a conflict is found between any Code requirement and information given in written or graphic specifications, Contractor will abide by the more stringent of the two. Such conflict shall be reported in writing to the DP, to NAU FLS Division and NAU Lead Building Inspector.

The issuance of approved plans, specifications, and computations shall not be construed to be a permit for, or an approval of, any violation of any of the provisions of the above-listed codes, the NAU Fire Prevention Manual and the NAU Technical Standards.

The issuance of approved plans, specifications, and other data shall not prevent Facility Services from thereafter requiring the correction of errors in said plans, specifications and other data, nor shall issuance of such approved plans, specifications, or other data preclude the prevention of building operations being carried on there under when in violation of the above-listed codes.

By signing a contract with NAU or as a subcontractor to a General that has a contract with NAU the contractor agrees to follow NAU’s Blue Stake procedure under ARS 40-360.22-K.

It is the responsibility of the Contractor to make all utility staking requests. To request utility staking for any project the Contractor must call the Arizona811 Center and email FACILITY SERVICES. All requests are given a log number. It is the Contractor’s responsibility to note that number for future reference.

For the complete Bluestake Procedure, Contractor shall refer to http://nau.edu/Facility-Services/DP_Contract/

DO NOT DIG UNTIL BLUE STAKING HAS BEEN CLEARED! ALL KNOWN UTILITIES MUST BE POTHOLLED!
The Contractor is required to pressure wash blue stake marks at the end of the excavation phase and/or at the end of a project in a manner that does not damage finished surfaces.

Rules

Permit Requirements
NAU permit requirements and applications can be found at: http://nau.edu/Facility-Services/DP_Contract/

References

Abbreviations and Acronyms
Definitions
Reference Standards

Quality Assurance

Manufacturer Qualifications
Supplier Qualifications
Fabricator Qualifications

Installer Qualifications
This section is to include project specific information which will be provided by the DP.

Testing and Inspecting Agency Qualifications
This section is to include project specific information which will be provided by the DP for the purposes of NAU's ARQ inspection selections.

Code-Required Special Inspector Qualifications
This section is to include project specific information which will be provided by the DP for the purposes of NAU's ARQ inspection selections.

Manufacturer’s Field Services

Field Samples
Re-inspection of uncompleted work shall be at the contractors expense, via deductive Change Order.

Reinforcing steel or structural framework of any part of any building or structure shall not be covered or concealed without first obtaining approval of the DP or Structural Engineer.

Foundation Inspection: To be made after excavations for footings are complete and any required reinforcing steel is in place. For concrete foundations, any required forms shall be in place prior to inspection.

Concrete Slab or Under-Floor Inspection: To be made after all in-slab or under-floor building service equipment, conduit, piping accessories and other ancillary equipment items are in place, but before any concrete is placed or floor sheathing installed, including the sub-floor.

Frame and Rough-In Mechanical, Plumbing and Electrical Inspection: To be made after the roof, all framing, fire blocking and bracing are in place and all pipes, chimneys and vents are complete and the rough electrical, plumbing, and heating, pipes and ducts, and fire sprinkler piping are approved.

Lath and/or Gypsum Board Inspection: To be made after all lathing and gypsum board, interior and exterior, is in place but before any plastering is applied or before gypsum board joints and fasteners are taped and finished.

Substantial Completion Inspection: Prior to issuance of the Substantial Completion Certificate, all required in progress inspections listed in form FS#15 shall be passed. The contractor must schedule a walkthrough with each trade inspector.
individually to sign off on the substantial completion lines of the FS#15 and provide a punch list.

Final Completion Inspection: Prior to Final Payment the Contractor must schedule an additional walk with each trade inspector ensure that all punch work is completed and inspected, and all required inspections listed in form FS#15 shall be passed.

01 45 26  Plant Inspection Procedures
01 45 29  Testing Laboratory Services
01 45 33  Code-Required Special Inspections and Procedures

**END OF SECTION**
### TEMPORARY FACILITIES AND CONTROLS

#### Temporary Utilities
Temporary construction utility connections are to be approved by the Director of Utilities and metered.

- **01 51 00** Temporary Utilities
- **01 51 13** Temporary Electricity
- **01 51 16** Temporary Fire Protection
- **01 51 19** Temporary Fuel Oil
- **01 51 23** Temporary Heating, Cooling, and Ventilating
- **01 51 26** Temporary Lighting
- **01 51 29** Temporary Natural-Gas
  - Temporary Natural-Gas is not allowed. Propane may be used for temporary heating.
- **01 51 33** Temporary Telecommunications
  - Temporary telephone service is available through either NAU Telecomm. Contractor is responsible for all connection, maintenance, and service fees.
- **01 51 36** Temporary Water
  - Temporary water connections must have a back flow prevention device installed by the contractor.

#### Construction Facilities
The Contractor shall provide a staging plan/site logistic plan at the preconstruction meeting. The staging plan shall clearly identify the following items:

- Construction Trailer
- Material Staging
- Wash down areas (concrete, mud, etc.)
- Dumpsters
- Traffic Control including signals and barricades
- Signage
- Site Fencing including gate locations and height of the fence
- Site Access for contractors, material delivery and waste haul off
- Sanitary Facilities
## Division 1 – General Requirements

### Temporary Utilities
- Temporary Utilities
- Temporary Parking
- SWPPP measures
- ADA accessible routes
- Pedestrian/bikes routes
- Vehicle routes
- Emergency Access

Any other provision, direction or accommodation agreed to and approved by NAU, the CM and DP, shall be clearly noted and conveyed on the staging/site demolition plan.

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<td>Field Offices and Sheds</td>
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<td>01 52 16</td>
<td>First Aid Facilities</td>
</tr>
<tr>
<td>01 52 19</td>
<td>Sanitary Facilities</td>
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<tr>
<td></td>
<td>Contractors shall not use the Universities sanitary facilities. Contractors are responsible for providing and maintaining adequate temporary sanitation facilities and indicate location(s) on the site logistics plan.</td>
</tr>
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</table>

### Temporary Construction

#### Temporary Bridges
- 01 53 13

#### Temporary Decking
- 01 53 16

#### Temporary Overpasses
- 01 53 19

#### Temporary Ramps
- 01 53 23

#### Temporary Runarounds
- 01 53 26

### Construction Aids

#### Temporary Elevators
- 01 54 13

#### Temporary Hoists
- 01 54 16

#### Temporary Cranes
- 01 54 19

#### Temporary Scaffolding and Platforms
- 01 54 23

#### Temporary Swing Staging
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<td>Temporary Access Roads</td>
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<td>Temporary Parking Areas</td>
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<tr>
<td>01 55 23</td>
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<td>Traffic Control</td>
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<tr>
<td>01 55 29</td>
<td>Staging Areas</td>
</tr>
</tbody>
</table>

Temporary Access Roads
Optimum truck routes and access roads, including fire department access, to the Project site shall be identified at the pre-construction conference and noted in the site logistics plan.

Temporary Parking Areas
All persons driving or parking on the NAU campus are subject to NAU parking regulations. NAU parking policies are available at [http://nau.edu/Parking-Shuttle-Services/Policies/](http://nau.edu/Parking-Shuttle-Services/Policies/).

All vehicles parking within campus boundaries must display permits. Vehicles without permits will be ticketed by the NAU Police Department. Vehicles parked within the fenced staging / storage area, identified on the Construction Documents, do require parking permits. The General Contractor will be required to make a written request to the University Project Manager at the preconstruction meeting for parking permits for all vehicles to be parked within the campus boundaries. NAU Parking Services will attempt to meet requests for specific parking areas, however, due to availability; alternative parking areas may be assigned. Storage / Staging areas will be requested in writing to the University Project Manager prior to bidding.

Temporary Roads

Traffic Control
All traffic control shall be coordinated with the Facility Services Project Manager, and shall be approved by: NAU Parking Services, NAU Shuttle Services, NAU Police Department, NAU Fire Marshal, NAU Office of Environmental Health & Safety and City of Flagstaff Fire Department.

All proposed traffic control plans or modifications shall be submitted to the Facility Services Project Manager five (5) working days prior to the change and receive approval, as stated above.

Staging Areas
The Contractor shall submit a site logistics plan at the preconstruction meeting. Storage / Staging Areas must be maintained and returned to the condition they were in prior to occupation by the Contractor. Patch, repair or replace any and
all damaged areas upon completion of the work. The area must receive final inspection and approval by the Owner prior to final payment.

**01 56 00** Temporary Barriers and Enclosures

**01 56 13** Temporary Air Barriers

**01 56 16** Temporary Dust Barriers

Dust control is the Contractor’s responsibility at no additional cost to the Owner. The Contractor shall address complaints regarding dust control within four (4) hours. Air, water, surface, and subgrade conditions shall be protected from pollution by the Contractor. Such protection requirements as detailed in all State and Federal regulations shall apply. Arizona State DEQ, OSHA, and NAU Office of Environmental Health & Safety may inspect for compliance without notice.

**01 56 19** Temporary Noise Barriers

*This information to be provided by Design Professional (if applicable)*

**01 56 23** Temporary Barricades

**01 56 26** Temporary Fencing

**Project Site Fencing**

Contractor shall erect and maintain in good condition a six-foot high chain link fence of standard construction surrounding the Project site and enclosing the area of work and materials staging. Location of the fence shall be approved by the Owner prior to erection. Fence gates shall remain locked when unattended to discourage access by unauthorized persons.

This applies to large construction projects and small projects with multiple locations.

**Staging Area Fencing**

A commercial grade chain-link fence around the entire perimeter of the staging area will be required.

The fence may be ground-set or tee supported, but must remain stable in high or gust wind conditions and scaling by pedestrians. The Contractor shall coordinate all fence pole locations that are to be pounded into the ground with NAU Grounds and Bluestake to avoid shallow utilities and irrigation. The Contractor is responsible for all repairs required to return to area to original condition after fencing is removed, including, but not limited to, sod, asphalt and concrete repair.
Post holes in asphalt will be repaired using Fastpatch DPR Pourable Asphalt Repair. Using a hot or cold patch for the post holes is not allowed.

An 8’ wide, two section chain-link access gate shall be required in the fence and the Facility Services’ Project Manager and Construction Manager (as applicable) shall be given a key(s) to the gate lock by the Contractor for emergency access.

Fencing shall be placed immediately after or during site preparation, and remain in place for the entire duration of construction.

The staging plan shall note that the Contractor is to maintain the fence in a neat and orderly appearance.

Temporary Protective Walkways
Temporary Security Barriers
Temporary Security Enclosures
Temporary Tree and Plant Protection

Existing trees and plants designated to remain shall be fenced off outside the drip line (this includes all memorial trees). No construction activity shall occur within fenced area. Provide site maintenance and control of erosion, weeds, snow, debris, etc. Irrigation is not a standard part of the blue stake procedure. The contractor is responsible for coordinating with NAU Grounds to determine location prior to bid. The contractor shall be responsible for relocating/repairing any irrigation equipment.

Temporary Erosion and Sediment Control
Temporary Pest Control
Temporary Environmental Controls
Temporary Storm Water Pollution Control
Site Watering for Dust Control

Temporary Project Signage
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<td>Temporary Interior Signage</td>
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</table>

Free-standing or hanging signs for General Contractors, Sub-contractors or suppliers are not allowed on University property. Site safety signage is allowed but must be approved by the NAU Project Manager.

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<td>01 65 00</td>
<td>Product Delivery Requirements</td>
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<tr>
<td>01 66 00</td>
<td>Product Storage and Handling Requirements</td>
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<td>Product Storage and Handling Requirements for Hazardous Materials</td>
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<tr>
<td>01 66 16</td>
<td>Product Storage and Handling Requirements for Toxic Materials</td>
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Cutting and patching of asphalt and concrete may necessitate removal of embedded utility survey markers. The Contractor is required to field verify marker locations prior to biding and include replacement of markers where necessary. Refer to Division 33 for installation standards. Verification of marker location requires signoff on the FS15 prior to substantial completion.

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</table>
Progress Cleaning
The Contractor shall maintain all work and staging areas in a clean and orderly condition to enhance the safety and appearance of the jobsite. Accumulations of refuse will not be permitted except as specifically approved in writing by the Owner.

Site Maintenance

Construction Waste Management and Disposal
The Contractor will provide proper and adequate trash containers at no additional cost to the Owner. These containers will be emptied at regular intervals so that trash will not be allowed to overflow and/or collect around the dump area.

The placing of trash or debris in any University trash container by the General Contractor or any Subcontractor is expressly forbidden. Contractor shall be responsible for costs incurred by the Owner for the removal of trash placed in University trash containers.

Final Cleaning
Provide final cleaning of the Work prior to Owner occupancy. Final cleaning shall mean cleaning each surface or unit of work to conditions expected in a first-class building and maintenance program. Comply with manufacturer's instructions for cleaning operations. Cleaning shall include but not be limited to all of the following as applicable:

- Clean transparent/reflective surfaces to a polished, streak free condition including all mirrors, windows and door glass. Remove all paint, putty, labels or other vision obscuring materials. Replace any broken or damaged surfaces.
- Remove marks, stains, fingerprints, other soil and dirt from painted, decorated or stained work.
- Clean polish and/or wax woodwork as preferred by Owner.
- Clean light fixtures and lamps so as to function at full efficiency. Remove dirt, dust, fingerprints, excess lubrication, drywall, paint etc. and all non-permanent labels.
- Wipe clean all mechanical and electrical equipment; remove excess lubrication and other substances.
- Clean exposed interior and exterior surface finishes to condition free of dirt, dust, stains, films or other noticeable distracting substance.
- Clean exterior and interior metal surfaces, including doors and windows, of oil, stains, dust, dirt, paint and the like.
- Clean and polish all hard floors, remove dirt, material or water stains, scratches etc.; clean and vacuum all carpeted areas.
### DIVISION 1 – GENERAL REQUIREMENTS

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<td>01 75 13</td>
<td>Checkout Procedures</td>
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<td>This information to be provided by the Design Professional.</td>
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<tr>
<td>01 75 16</td>
<td>Startup Procedures</td>
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<tr>
<td></td>
<td>Signoff from the NAU Director of Utilities is required before any utility is energized. Refer to Division 33 for individual utility requirements.</td>
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<td>The Preliminary Balance Report shall have been submitted by the Contractor to the Owner prior to, and as a requirement of, Substantial Completion.</td>
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<td>The Final Balance Report shall have been submitted by the Contractor to the Owner prior to, and as a requirement of, Final Completion.</td>
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<td>Systems start-up, commissioning, and balancing shall be 100% complete prior to, and as a requirement of, Final Completion.</td>
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<td>Any additional information to be provided by the Design Professional.</td>
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- Clean plumbing fixtures to polished, sanitary condition free of stains including those resulting from water exposure.
- Except as otherwise indicated or requested by Owner, remove all temporary protection devices and facilities which were installed during the course of the work.

Make building ready for occupancy in all respects. Protect cleaned areas until final inspection and acceptance.

All existing improvements inside or outside the property which have been disturbed, damaged or destroyed by the Work under the Contract shall be restored to the condition in which they originally were, including all storage and staging areas. Final inspection of storage / staging areas used during construction is required prior to final payment.

If the General Contractor fails to clean up during, or at the completion of the Work, or fails to enforce such clean up by subcontractors, the Owner, subsequent to advising the Contractor in writing, may after five (5) working days proceed to perform clean-up of areas which pose a threat to life/safety or are excessively unsightly. The cost of cleaning provided by the Owner under this condition shall be borne by the General Contractor, via deduct Change Order.
DIVISION 1 – GENERAL REQUIREMENTS

01 77 00  Closeout Procedures

01 77 13  Preliminary Closeout Reviews
The Contractor shall request the Owner to schedule a closeout meeting to be scheduled 30 days prior to substantial completion. An example of the project agenda and attendees required can be found at: http://nau.edu/Facility-Services/DP_Contract/

01 77 16  Final Closeout Review
The contractor will schedule a meeting with the Owner and DP when all the document packages are ready for the individual substantial completion, final completion and final payment phases.

01 77 19  Closeout Requirements
For all closeout requirements, please refer to the Construction Agreement located at http://nau.edu/Facility-Services/DP_Contract/
All contracts are listed under “Contracts”. Please refer to the appropriate contract’s closeout requirements specific to the project you are contracted for.

01 78 00  Closeout Submittals

01 78 13  Completion and Correction List

01 78 19  Maintenance Contracts

01 78 23  Operation and Maintenance Data

01 78 23.13  Operation Data
Upon completion of the installation of all work specified in Construction Documents, and prior to Final Completion, contractor shall furnish to the DP for review; one (1) complete bound copy and one (1) electronic copy of operating and maintenance instructions and parts lists for all material and equipment, including electrical and control items, being supplied. Upon receipt of review, the contractor shall submit three (3) complete bound corrected copies and one (1) electronic corrected copy of the operating and maintenance instructions and parts list for all material and equipment in divisions 2-48. Operation and maintenance manuals for all specified equipment and systems shall be provided as part of the contractor’s base bid.

Assemble Maintenance Manual and Operating Instructions in hard-back 3-ring loose leaf binders. Manuals will be organized by division will all warranties in a separate section at the back of the manual. Suitably label and index all material contained therein for ready reference.
DIVISION 1 – GENERAL REQUIREMENTS

Operating instructions shall include complete operating sequence, control diagrams, description of method of operating machinery, machine serial numbers, factory order numbers, parts lists, instruction books, suppliers’ phone numbers and addresses and individual equipment guarantee. Parts lists shall be complete in every respect, showing all parts and part numbers for ready reference.

O&M materials related to any of the following building components (as applicable for each project) are to be provided by the contractor to the project manager to then be submitted to the Office of Regulatory Compliance:

- boilers
- emergency generators
- acid neutralization tanks
- grease interceptors
- sand/oil separators
- cooling towers
- chillers (documenting refrigerant type used)
- pre/post construction stormwater controls/NOI’s
- emergency showers
- bulk chemical storage locations
- fume hoods/bio-safety cabinets
- location of sanitary sewer drains

01 78 23.16 Maintenance Data
Close-out submittals shall include a completed “Maintenance Check List” (FS#88) indicating all maintenance and frequency required for warranty purposes.

01 78 23.19 Preventative Maintenance Instructions

01 78 29 Final Site Survey

At the completion of underground utilities and final site work, the Contractor shall provide an as-built drawing of all work completed. An as-built drawing for underground utilities shall be provided within 30 days of completion of this work. The final site work drawing shall be provided after all site work is complete. The as built drawings shall consist of the following:

- Drawing must be CAD format, no PDF’s
- All buried and concealed items must be located with GPS coordinates. This includes tie-in locations, pipe alignments, change in direction, valves, manholes, utility crossings, and depth of utility.
- The site survey shall also include site as built grades which have been surveyed and verified by a licensed surveyor.
- The as‐builts must be certified by a licensed surveyor who is currently registered in the State of Arizona certifying the drawing and GPS coordinates are accurate.
The Contractor’s Warranty shall commence on the date of Substantial Completion and remain in effect for two years. Prior to Final Completion the contractor shall schedule a 1 year and 2 year warranty walkthrough with the University.

All other warranties shall commence at Substantial Completion unless otherwise specified by manufacturer. These warranties are to remain in effect per the Construction Documents.

The General Contractor shall provide 24-hour response to all critical building systems, i.e., loss of heating, cooling and control systems. If applicable, the General Contractor shall provide at Substantial Completion, service agreements between service companies and the University for all critical areas. The service agreement shall include 24-hour phone numbers and contact persons’ names the University may use in case of emergency. The Emergency Service Agreement shall remain in effect for the two-year warranty period. The General Contractor shall provide a contact person’s name and phone number for Contractor’s bonding company for use if the University experiences problems during the warranty.

All other, noncritical warranty items will be corrected within five (5) working days; unless the General Contractor notifies the University in writing that a delay will be experienced due to shipping of materials. A shipping date must be provided to advise the University of the Approximate Date of warranty repair. All warranty work must commence as soon as reasonably possible and be diligently prosecuted to completion.

For all project record documentation procedures, please reference the Construction Agreement located at [http://nau.edu/Facility-Services/DP_Contract/](http://nau.edu/Facility-Services/DP_Contract/).

Refer to FS 76 at [http://nau.edu/Facility-Services/DP_Contract/](http://nau.edu/Facility-Services/DP_Contract/) for example of As-Builts required.
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02 20 00  EXISTING CONDITIONS

02 22 00  Existing Conditions Assessment

Part 1 – General
This section applies to all new buildings, building expansions, utility expansions, parking structures, surface parking lots, campus mall amenities, or any other design/construction activity that materially change or affect the current features found on campus. Areas incorporated into this section are civil surveys, geotechnical engineering investigation, archaeological studies and utility mapping.

Part 2 – Products
N/A

Part 3 – Execution
All existing built site features shall be noted as to their disposition during and after construction, i.e., removed, relocated, demolished, stored, etc. Contractor is to provide record photographs, prior to the start of construction, documenting the condition of site features to remain.

All landscape material (trees, shrubs, etc.) and irrigation supply devices shall be noted as to remain, stored, relocated or demolished. If existing plant material is to remain or be stored for future project use, it shall be noted as the Contractor’s responsibility to maintain such plant material for the duration of construction.

Any existing site feature (built or plant material) shall be clearly identified as to whom will remove, relocate, demolish or store it (Contractor or NAU).

**END OF SECTION**
Part 1 – General
Design Professional shall determined, based on ICC Codes, using information such as existing soil conditions provided by a soil investigation, type of foundation system, building structural loads, type of building occupancy, etc... what seismic requirements are to be followed on this project. Typically, projects on NAU Campus have been designed under Seismic zone. Design Professional shall determine the Occupancy Category (A category used to determine earthquake design loads based on the nature of the occupancy) and Seismic Category (A classification assigned to a structure based on its occupancy category and the severity of the design earthquake ground motion at the site as defined in IBC and ASCE 7.) Furthermore, using information such as but not limited to existing site-specific soil conditions provided by a soil or geotechnical engineering investigation, type of foundation system, building structural loads, type of building occupancy, etc. The registered design professional in responsible charge shall state the applicable seismic qualification requirements for designated seismic systems on the construction documents that are to be followed on the project.

This topic includes information related to seismic inquiries and investigations required prior to design and performed prior to construction. Seismic investigations survey soil stability to understand soil composition, solidity and quality in addition to determining the depth of soil layers, bedrock and water table. The results define the suitability of land for development, volume of excavation, and structural requirements. Design Professional shall determine, based on ICC Codes, using information such as existing soil conditions provided by a soil investigations, type of foundation system, building structural loads, type of building occupancy, etc... what seismic requirements are to be followed on this project.

Typically, older projects on NAU Campus had been designed under “Seismic Zones”; and newer projects on NAU Campus are designed under “Seismic Design Categories”. As-built construction documents may be available for review upon request from Facility Services. The International Building Code (IBC) classifies structures into Seismic Design Categories (SDC): this is different from the older Uniform Building Code (UBC) which classified them into Seismic Zones. Seismic Design Categories go much further than merely outlining various regions of the country. Seismic Design Categories are site specific and include classifications of A, B, C, D, E and F and are based on the following three (3) basic criteria. 1. Probable Site Ground-motion: 2. Soil (Site Class): 3. Building Occupancy Use. The process to determine the Seismic Design Categories must be done by an engineer.

Registered Design Professional shall determine the Occupancy Category: One of the first considerations in the design of any structure starts with determining the occupancy category of the structure. The purpose of determining occupancy category is to set a
particular amount by which something is multiplied (or safety factor) in calculating the structural requirements based on occupancy. This requires classification of the occupancy category of any building in accordance with the nature of occupancy as described in the International Building Code or ASCE 7. The occupancy category serves as a threshold for a variety of code provisions related to earthquake, flood, snow and wind loads. Particularly noteworthy are the importance factors that are used in the calculation of design earthquake, snow and wind loads. The value of the importance factor generally increases with the importance of the facility. Structures assigned greater importance factors must be designed for larger forces. The result is a more robust structure that would be less likely to sustain damage under the same conditions than a structure with a lower importance factor. The intent is to enhance a structure’s performance based upon its use or the need to remain in operation during and after a design event. The impact of a higher occupancy category classification is not limited to increasing the design loads. Compared to Occupancy Category I, II or III, for instance, an Occupancy Category IV classification can lead to a higher seismic design category classification that can, in turn, require more stringent seismic detailing and limitations on the seismic-force-resisting system. This can also affect the seismic design requirements for architectural, mechanical and electrical components and systems.

Considerations:
The Occupancy Category and Importance Factor are outlined by IBC and ASCE 7 as minimum required guidelines, with the primary intent of protecting the life and safety of the public. This does not necessarily include protecting the aesthetics or functionality of the structure after a severe event. In other words, the structure is designed not to fail, but may endure significant damage (structural or otherwise). This damage may prevent full functionality of the facility after a severe event. This is the reason the code increases the Importance Factor for Occupancy Categories III and IV. A higher Importance Factor improves the reliability (safety factor) of the structure, which helps protect its occupants (School, Buildings with Public Assembly Areas containing greater than 300 occupants), as well as its function (Police, Designated Emergency Shelters), during and after a major environmental event. There may be instances where increasing these parameters above “code minimums” should be considered such as:

- Facilities’ ability to function after a major environmental event
- Increased Safety Factor
- Future use of Facility
- Importance factor of closely situated structures, for the purpose of emergency egress and rescue efforts.
- Building design Life Span
- Insurance Carrier Requirements

The desire to increase the Importance Factor should be made aware to the Structural Engineer as early in the project as possible.
Registered Design Professional shall determine the Seismic Design Category:
A classification assigned to a structure based on its occupancy category and the severity of the design earthquake ground motion at the site. The seismic design category serves as a trigger mechanism for many seismic requirements, including such as the following:
1. Permissible seismic-force-resisting systems.
2. Limitations on height.
3. Consideration of structural irregularities.
4. The type(s) of lateral force analysis that may be used.
5. The need for additional special inspections.

Registered Design Professional In Responsible Charge of the project shall state the applicable seismic qualification requirements for designated seismic systems on the construction documents that are to be followed on the project. The earthquake load design basis, indicated on the construction documents by the design professional, provides information that allows facilitating the plan review process. All buildings, except those indicated in the IBC exceptions (e.g. Section 1613.1), are to be designed for earthquake effects. The earthquake design data for a specific building are required to meet or exceed the minimum requirements established by NAU adopted codes (e.g. IBC Section 1613.)

Part 2 – Products
N/A

Part 3 – Execution
N/A

02 32 13 Subsurface Investigation

Part 1 – General
✓ Any project requiring subsurface investigation work shall be coordinated through NAU Facility Services.
✓ Soils investigations to determine subsurface conditions shall be made prior to the design and construction of new buildings and other structures. Such investigations shall also be conducted when additions to existing facilities are considered and are of such a scope that would significantly increase or change the distribution of foundation loads.
✓ Geotechnical investigations prepared for adjacent construction projects are another potential source of available site information.
✓ In accordance with the exception as prescribed in the International Building Code (IBC), where geotechnical data from adjacent areas are well known, the NAU building official (and along with a written request from the Design Professional in
responsible charge of the project) can accept the use of local engineering practices for the design of foundations.

- The investigation is to be performed by a “registered design professional”, which in most cases would be an “approved agency” geotechnical engineer (see Part 2 & 3 Definitions).
- The “registered design professional” shall have a fully qualified representative on site during all boring or sampling operations.
- After an “approved agency” has been “approved”, then the NAU Project Manager will typically contract these services directly with geotechnical engineering/soil investigation firm.
- The registered design professional in responsible charge of the project (e.g. Architect) along with all other “registered design professional” (e.g. Geotechnical Engineer, Structural Engineer, Etc.) shall participate, such as identifying the type of tests, # of tests, frequency of tests, requirements of tests, etc....
- Where geotechnical investigations are required, a written report of the investigations shall be submitted at the time of permit application.
- In any event, geotechnical investigations shall be conducted and reported in accordance with (and fully comply with) the applicable requirements as specified in the most recent edition of the NAU adopted International Building Code (IBC).

Part 2 – Approved Agency

Definitions

- **Approved Agency** – An established and recognized agency regularly engaged in conducting tests or furnishing inspection services, when such agency has been “approved”.

- **Approved** – Acceptable to the NAU Building Official, whereas deemed qualified as per the applicable necessary preconditions as outlined in the International Building Code (IBC).

Such work shall be performed by an independent testing agency. An approved agency shall provide all information as necessary for the NAU Project Manager, Registered Design Professional in Responsible Charge and NAU Building Official to determine that the agency meets the applicable requirements as specified in the International Building Code. An approved agency shall be objective, competent and independent from the contractor responsible for the work being inspected. The agency shall also disclose possible conflicts of interest so that objectivity can be confirmed. An approved agency shall have adequate equipment to perform required tests. The equipment shall be periodically calibrated. An approved agency shall employ experienced personnel educated in conducting, supervising and evaluating tests and/or inspections.
As part of the basis for approval of a particular inspection agency, the agency must demonstrate its objectivity and competence. The judgement of objectivity is linked to the financial and fiduciary independence of the agency. The competence of the agency is judged by its experience and organization, and the experience of its personnel. For example, suppose that ACME Agency is the inspection agency employed by Builder’s, Inc. for factory-built fireplaces. During an investigation of the agency, it is discovered that ACME and Builder’s are subsidiaries of the same parent company, Conglomerate, Inc. The inspection agency and manufacturer clearly have a relationship that is undesirable from the standpoint of independence.

Part 3 – Geotechnical Investigations Required

Definitions

- **Registered Design Professional** – An individual who is registered or licensed to practice their respective design profession as defined by the statutory requirements of the professional registration laws of the state or jurisdiction in which the project is to be constructed.

The purpose of a Geotechnical Investigation is to determine the engineering qualities of the subsurface such as soils or rocks at a site, and how their location and depth affects an envisioned construction project. The presence of any buried organic materials with poor engineering qualities, obstructions to earthwork, and the depth of the water table are also important to identify during a geotechnical investigation. Geotechnical investigations shall be conducted in accordance with applicable requirements as specified in the most recent edition of the NAU adopted International Building Code (IBC). IBC sections 1803 address the conditions that mandate a geotechnical investigation, as well as the information that must be included in the report. The investigation of soils is to be done by a registered design professional in recognition that the testing and calculations necessitate individuals with significant experience in soil and foundation analysis. The field of soil mechanics and foundation engineering is diverse and complicated, and since it is not an exact science, its application requires specialized knowledge and judgment based on experience. Where subsurface conditions are found or suspected to be of a critical nature, the Design Professional in responsible charge of the project shall seek the professional advice of highly experienced foundation engineers.”

Soils investigations to determine subsurface conditions shall be made prior to the design and construction of new buildings and other structures. Such investigations shall also be conducted when additions to existing facilities are considered and are of such a scope that would significantly increase or change the distribution of foundation loads.

Part 4 – Geotechnical Investigations Exception

The NAU Building Official (and along with a written request from the Design Professional in responsible charge of the project) shall be permitted to waive the requirement for a geotechnical investigation where satisfactory data from adjacent areas is available that
numbers encountered in the investigation is not necessary for any of the conditions as noted in the applicable code sections of the IBC (e.g. Sections 1803.5.1 through 1803.5.6 and Sections 1803.5.10 and 1803.5.11.) FYI: There are two main objectives for conducting a soils investigation. The first is of a confirmatory nature. Its purpose is to obtain information already known from adjacent structures, such as soil-boring records, field test results, laboratory test data and analyses and any other knowledge useful in the design of the foundation system. The second objective is of an exploratory nature. It is warranted where soils information does not exist or is insufficient or unsatisfactory for use in the design of the foundation system.

Regardless of the objective of the soils investigation, the information generally required includes one or more (or all) of the following items for determining subsurface conditions:

1. The depth, thickness and composition of each soil stratum;
2. For rock, the characteristics of the rock stratum (or strata), including the thickness of the rock to a reasonable depth;
3. The depth of ground water below the site surface; and
4. The engineering properties of the soil and rock strata that are pertinent for the proper design and performance of the foundation system.

For shallow foundations, the soils investigation should yield sufficient information to establish the character and load-bearing capacity of the soil (or rock) at depths that will receive the foundations.

Foundation problems are not uncommon and may vary greatly, ranging from very simple and manageable problems to very complex situations that may be either manageable or without practical remedy.

As indicated in the IBC exception, where geotechnical data from adjacent areas are well known, the building official (and along with a written request from the Design Professional in responsible charge of the project) can accept the use of local engineering practices for the design of foundations.

PART 5 – Information to be included in Construction Documents

When a written report is required by the International Building Code, it is required to include at a minimum the items listed in the applicable code sections. These items will establish a retrievable and verifiable record of the soil conditions if problems are encountered in the future. These items also provide the minimum necessary information for compliance with the code and an adequate foundation system. Load-bearing values for soils must be documented so that the foundation design can be verified.

Also show all: existing conduits, drains, utility lines, sewers, tunnels, cables, trees, paving, walks, foundations and other objects or obstructions, whether in use or abandoned. State
that information is for contractor’s use and that in no way shall the University be held responsible for accuracy of the information.

PART 6 – Preparation of Plans for Borings
In the preparation of plans for boring locations, the Architect/Engineer shall study plans of existing underground utilities and shall locate borings to avoid these utilities. Where excavation will remove lateral support from any foundation, an investigation shall be conducted to assess the potential consequences and address mitigation measures. Maps showing underground installations may be available for review upon request from Facility Services.

**END OF SECTION**
This section shall be used by the Design Professional to accurately define the scope of the demolition effort required for the project. Whenever possible a demolition plan shall be created to graphically show the extent of the demolition work and its impact to adjacent areas. Adequate provisions must be made to maintain traffic (vehicles, bikes and pedestrians) through/past the construction zone via the use of temporary walkways, signage, barricades, etc. Emergency egress paths are particularly critical, so closure of existing building exits and egress paths must be coordinated with the NAU Fire Marshal. Develop Traffic Control Plans for vehicles, bikes and pedestrians in advance for NAU review/approval. NAU may from time to time choose to assist with minor signage, but the bulk of the traffic control measures during construction lies with the contractor.

Provisions shall be made in the documents to require that all demolition work be performed without disruption to adjacent occupied areas, i.e., off hours work. Only when the anticipated demolition work will not present disruption to the user or occupant can the assumption be made that it can be conducted at any time.

Demolition work is usually associated with trash and dust. Appropriate provisions shall therefore be made to address mitigation procedures in the demolition work.

The demolition plan shall identify all materials/equipment, etc., which are to be reused and/or salvaged by either the University or the Contractor. Please keep in mind that all equipment and building material is ultimately the property of NAU and only when its salvage cost exceeds its usable value is it to be considered unwanted. This determination can only be made by NAU.

A complete investigation of the area(s) shall be performed so that all existing aspects and elements affected by the project are either removed under the demolition plan or incorporated into the new work with the installation drawings, i.e., existing/abandoned outlets, t-stats, etc. Where callouts such as ‘Match Existing’ are used, these locations shall be field checked during design to verify that the proposed improvement will indeed fit well to the existing.

Part 1 – General
Other than items with are to be reused there are basically two groups of salvageable material presented with nearly all projects. Care must be exercised when handling all salvageable material so as to maintain its value.

The following items are always salvaged by the University:

- LED exit lights
- Door Hardware
- Fire Alarm Exits
• Chalk/White boards
• Drinking Fountains
• EMCS Equipment
• Window Blinds
• Lab Fixtures
• Meters (all kinds)
• Backflow Preventers

The following is a representative, but not conclusive, list of items in which salvage may be considered:
• Wood/HM Doors
• Plumbing Fixtures
• Electrical Light Fixtures
• Electrical panels
• Casework
• Electrical Equipment
• Mechanical Equipment
• Disconnect switches
• Starters
• Ceiling diffusers
• Elevator equipment
• Windows
• Projection screens
• Soap dispensers
• Transformers
• Mirrors
• Clocks
• Thermostats
• Irrigation equipment
• Access doors
• Shelving
• Refrigeration equipment
• Landscape planting
• HVAC mixing boxes
• Lab equipment (hoods)

Prior to finalizing the construction documents the DP shall conduct a site meeting with the appropriate Facility Services personnel and determine precisely what items are to be salvaged. The documents should then clearly identify what is to be salvaged, by whom and where it is to be delivered to or stored. Options include but are not limited to:
Removal and transport by contractor.
- Removal by contractor and transport by NAU.
- Removal and transport by NAU.

Whenever NAU is to participate in either the removal or transportation of salvage materials a time frame and contact person shall be identified and referenced in the documents.

All items encountered which contain an affixed Northern Arizona University Control Tag require special procedures for dispersal. Consequently, these items should be brought to the attention of the NAU Project Manager. Items which contain this tag are part of the registered inventory of a particular NAU department or unit and dispersal must be coordinated through their respective business manager.

Fluorescent light fixture tubes and certain light fixture ballasts must be separately disposed of in accordance with applicable environmental regulations. Consequently, the removal and disposal of existing fluorescent light fixtures shall include the following:

- All fluorescent tubes shall be removed and packaged by the Contractor in cartons supplied by the Facility Services Electrical Shop. The number of tubes in each carton shall be clearly marked on the outside of the carton. Contractor to deliver packaged tubes to Facility Services Electrical Shop for disposal.
- Fixture ballasts not clearly marked as containing “NO PCB’s” shall be removed by the Contractor and after short clipping all wires place them in a metal drum supplied to the jobsite by Northern Arizona University Safety and Environmental Services department. After completion of the demolition effort, Northern Arizona University Safety and Environmental Services will remove the drum for disposal offsite. Apportioned disposal costs are then to be charged to the project.

Part 2 – Products
N/A

Part 3 – Execution
All electrical services discontinued with the demolition effort shall be properly “tagged out”.

Prior to starting any demolition work, Contractor shall verify with NAU Project Manager (and with NAU Trades) that all utilities have been disconnected.

In the case of a building renovation, some of the utilities might need to stay on during the renovation work, to keep the building under a conditioned environment (i.e. heating system stays on during a winter interior renovation project). Close coordination with the
NAU Project Manager and NAU Trades will then be required to ensure safe work environment during renovation. Contractor shall also coordinate with NAU Fire Marshal and, as applicable depending on the nature of the renovation work, shall present a plan identifying how the building FLS systems will remain active and protect the building against fire during the renovation process.

In the case of the demolition of street lighting and pedestrian lighting, there should never be a time when travelways for vehicles, bikes and pedestrians experience a substandard level of lighting. This may be special sequencing of the demolition work to keep the existing lights in place until the new lighting is operational, or the provision for temporary lighting, or some other means to maintain safe lighting levels.

All permits and fees for demolition are the responsibility of the contractor but these requirements should be specifically identified in the contract documents.

**END OF SECTION**
02 50 00 SITE REMEDIATION

Part 1 – General
Through the Office of Environmental Health and Safety, NAU will provide some information on potential existing site conditions that might require Site Remediation. This could also be discovered during subsurface investigations. Depending on the nature of the required remediation, NAU will elect to either hire an independent Contractor to conduct the remediation effort, or have the DP and Contractor identify the nature of the remediation and hire some experts appropriately.

If during the course of construction, some unknown conditions are discovered by the Contractor, they should be reported immediately to NAU Project Manager who will take the appropriate measure, including contacting the Office of Environmental Health and Safety.

Part 2 – Products
N/A

Part 3 – Execution
N/A

**END OF SECTION**
02 60 00  CONTAMINATED SITE MATERIAL REMOVAL

Part 1 – General
During earthwork activities, should the Contractor encounter contaminated site materials; Contractor shall stop all work and report immediately to NAU Project Manager. Depending on the nature of the contamination, NAU Project Manager, in collaboration with the Office of Environmental Health and Safety, will make the determination to either contract the Contractor to remove all contaminated materials, or hire an independent Contractor to perform such task.

Part 2 – Products
N/A

Part 3 – Execution
N/A

**END OF SECTION**
PART 1 – General

The Design Professional and Contractor shall review the Geotechnical or Soil Investigation Report and determine if water might be an issue during excavation activities. If such, Design Professional shall provide recommendations on how to perform water remediation and include in the design ways to divert the water, collect it, or deal with it with appropriate choice of foundation system.

However, Design Professionals and Contractors should be aware of the fact that NAU Campus has numerous sporadic groundwater springs that may not always been found during subsurface investigations, especially depending on the time of the year the investigation is being performed. We’ve seen numerous springs developing unpredictably within caissons or footings during excavation, requiring water pumping, or switching to a different type of concrete mix design or foundation system to adjust to soil conditions. Contractor shall be aware of this risk and be prepared to take appropriate measures should water remediation be necessary on the project.

PART 2 – Products

N/A

PART 3 – Execution

N/A

**END OF SECTION**
Part 1 – General
As part of the existing conditions investigation to be performed during the Programming phase of the project (especially in the case of a renovation project), NAU Project Manager will contact the Office of Environmental Health and Safety and have them provide survey report on potential existing Hazardous Materials (such as Asbestos, Lead, Radioactive materials, hazardous chemicals, etc...).

Such report shall be provided to the Design Professional and Contractor at the end of the Programming Phase.

As the project design evolves and scope is being defined more precisely, the DP shall identify existing building components that will need to be demolished or disturbed during the renovation process and provide a detailed demolition scope that will help the Office of Environmental Health and Safety define further the level of facility remediation required for the project. The Office of Environmental Health and Safety shall be informed of all changes of scope throughout the project with adequate lead time to ensure that any additional necessary remediation is accounted for and completed prior to the commencement or continuance of work in the target area.

On almost all renovation projects, NAU Office of Environmental Health and Safety will handle the facility remediation scope, hiring an independent Contractor to perform the work. All required remediation work shall be scheduled and performed prior to the commencement of other demolition or construction activities. Remediation of all hazards may require removal of materials which are not otherwise impacted by the project if contact or disturbance hazards to workers exist or may arise during the project. Office of Environmental Health and Safety will make recommendations for abatement scope based on their evaluation of the demolition scope, building area, applicable regulations, and NAU standards and policies.

Refer to Section Division 1 for additional procedural information.

Part 2 – Products
N/A

Part 3 – Execution
N/A

**END OF SECTION**
DIVISION 03 – CONCRETE

03 00 00 CONCRETE

***ALL CONCRETE HARDSCAPE & RELATED SITE CONCRETE MUST ALSO ADHERE TO THE 2015 LANDSCAPE MASTER PLAN AS WELL AS THE DIVISION 3 TECHNICAL STANDARDS. THE LANDSCAPE MASTER PLAN CAN BE FOUND BY CLICKING ON THE LINK PROVIDED BELOW. NOTE THAT THE EXISTING DIVISION 3 TECHNICAL STANDARDS INCLUDED IN THIS DOCUMENT ARE STILL APPLICABLE FOR ALL OTHER FORMS OF CONCRETE AS WELL AS THE TYPICAL STANDARDS NOT ADDRESSED IN THE LANDSCAPE MASTER PLAN. ALL NEW CONCRETE SITE WORK MUST CONFORM TO THE LANDSCAPE MASTER PLAN & THESE TECHNICAL STANDARDS UNLESS WRITTEN EXCEPTION IS MADE BY THE NAU PROJECT MANAGER. IT IS THE CONTRACTORS AND DESIGN PROFESSIONALS RESPONSIBILITY TO IDENTIFY IN WRITING TO THE NAU PROJECT MANAGER ANY DISCREPANCIES IDENTIFIED BETWEEN THESE TWO DOCUMENTS THAT MAY ALTER A PROPOSAL OR BID.

2015 LANDSCAPE MASTER PLAN LINK:

http://nau.edu/uploadedFiles/Administrative/Finance_and_Administration/Facility_Services/Documents/DP_Contract/2015%20Landscape%20Masterplan%20Final.pdf

03 10 00 CONCRETE FORMING AND ACCESSORIES
03 11 00 Concrete Forming
03 11 13 Structural Cast-in-Place Concrete Forming
03 11 16 Architectural Cast-in-Place Concrete Forming
03 15 00 Concrete Accessories

03 20 00 CONCRETE REINFORCING
03 21 00 Reinforcing Steel
03 22 00 Welded Wire Fabric Reinforcing
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03 30 00 CAST-IN-PLACE CONCRETE
03 31 00 Structural Concrete
03 34 00 Low Density Concrete
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03 40 00 PRECAST CONCRETE
03 41 00 Precast Structural Concrete
03 45 00 Precast Architectural Concrete
03 48 00 Precast Concrete Specialties
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All concrete work shall conform to the code requirement in Section 01 41 00 and ACI Standards 301 (Specifications for Structural Concrete), 305 (Hot Weather Concreting), 306 (Cold Weather Concreting), 308 (Recommended Practices for Curing Concrete) & 318 (Building Code Requirements for Structural Concrete). Any non-conforming work shall be removed and replaced at the contractor's expense.

Inspections required per Section 01 41 00.

DP to specify both cold and hot weather requirements for mix, placement, and curing of concrete.

All concrete foundation walls require waterproofing. The DP shall specify the methods and products that may be used for this purpose. Foundation wall waterproofing must be backfilled within 3 days. Inspection required prior to backfill.

Concrete civil work design shall conform to the details set forth in the City of Flagstaff Engineering Design and Construction Standards and Specifications.

Concrete curb cuts, ramps etc. to allow for handicapped accessibility shall meet the requirements outlined in Section 01 41 00. A copy of this law with design details are on file at Facility Services.

Supplementary Cementitious materials

Fly ash may be added to concrete as a supplementary cementitious material with explicit approval of the Facility Services Project Manager. If fly ash is required as part of the mix design, maturity modeling of the mix during curing is required.

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**Part 1 – General**
The concrete contractor shall supply all formwork complete with necessary shoring, bracing and anchorage.

**Earth forms**
Earth forms are permitted in the forming of appropriate subgrade elements. Sides of earth forms shall be hand trimmed and bottoms swept clean of all loose dirt prior to placement of concrete. No concrete shall be placed in earth forms prior to review and inspection by the DPs and the FS project manager.

**Part 2 – Products**

**Part 3 – Execution**
The proper concrete hydration reaction is particularly sensitive to cold temperatures when using earth forms. The following standards shall be in place for cold weather concrete placement in addition to the ACI 306 guidelines for Cold Weather Concreting as referenced by MAG2010.

All temperatures referenced under cold weather concrete are to be taken in the shade and away from artificial heat sources. Temperatures shall be collected and recorded in Fahrenheit degrees.
In cases with ambient temperature concrete, concrete placement operations shall not be continued when a descending air temperature falls below 40 degrees F; nor shall concrete placement operations be resumed until an ascending air temperature reaches 35 degrees F. Mixing and placing concrete shall continue no later in any day than that time which will allow sufficient time to place, finish and protect the concrete already placed before the air temperature drops to 35 degrees F.
When using heated concrete mixes, concrete operations may be allowed with specific DP and CAS approval, although the air temperature in the shade and away from artificial heat is below the limit permitted above. Where concrete operations are thus allowed, the contractor shall use equipment to heat the aggregates or water or both, prior to mixing. Aggregates shall be uniformly heated to at least 60 degrees F. and shall have no chunks of ice. Equipment used to heat the aggregates shall be such that uniform temperatures are obtained throughout the aggregate within each batch and from one batch to another. Water shall not be heated in excess of 150 degrees F.
The contractor shall provide adequate insulation or heat or both, to protect the concrete after placement. This protection shall be to the extent required to maintain a temperature under the insulation of the concrete of from 60 to 90 degrees F. for a period of 72 hours after placement and from 40 to 90 degrees F. for an additional 96 hours.
Regardless of the air temperature at the time of mixing and placing concrete, the protection specified above shall be provided at all times when the air temperature is below 35 degrees F.
Forms shall remain in place throughout any required curing period. All portions or pieces of any wood forms shall be removed completely after the cure period has been completed and prior to Owner possession.

03 11 13 Structural Cast-in-Place Concrete Forming

Part 1 – General
All Structural Cast-in-Place Concrete Forming shall be in accordance with MAG2010 standard Section 505.3: Forms for Concrete Structures

Forms shall be of suitable material and of type, size, shape, quality, and strength to enable construction as designed. The forms shall be true to line and grade, mortar tight, and sufficiently rigid to resist any appreciable amount of springing out of shape during placing of the concrete. The responsibility for their adequacy shall rest with the Contractor. All dirt, chips, sawdust, nails, and other foreign matter shall be completely removed from forms before any concrete is deposited. The surfaces of forms shall be smooth and free from irregularities, dents, sags and holes that would appreciably deface the finished surface. Forms previously used shall be thoroughly cleaned of all dirt, mortar and foreign matter before being reused, and the reuse of forms shall be subject to the approval of the Design Professional. Before concrete is placed in forms, all inside surfaces of the forms shall be thoroughly treated with an approved releasing agent that will leave no objectionable film on the surface of the forms that can be absorbed by the concrete. Care shall be exercised that no releasing agent is deposited on previously placed concrete. (MAG2010, p 505-4).

Waterproofing will be applied to foundation walls after removal of the forms but prior to backfilling the excavation. Foundation wall waterproofing must be backfilled within 3 days. Inspection is required prior to backfill. Refer to Section 01 41 00 in Division 1 for inspection guidelines.

Part 2 – Products

Part 3 – Execution
Part 2 – Products
At a minimum all form materials shall be in accordance with MAG2010 standard Section 505.3: Forms for Concrete Structures. Form materials, metal or wood shall be specified with requirements listed below:

Exposed concrete - use HDO plyform
Unexposed concrete – use A-C plywood
DP will specify the grade and thickness of plywood form material. Plans and specs will limit reuse to 3 times.

Part 3 – Execution

03 15 00 Concrete Accessories

Part 1 – General
All anchors and inserts in exterior work exposed to weather shall be inset and/or protected to prevent rusting. The concrete cover for anchors and inserts must meet the minimum concrete cover requirements per ACI 318.

Part 2 – Products

Part 3 – Execution

**END OF SECTION**
03 21 00 Reinforcing Steel

Part 1 – General
All reinforcement shall be in conformance with MAG 2010 Section 727: Steel Reinforcement. All placement of reinforcement shall be in accordance with Section 505.5 Placing reinforcement.

Reinforcing steel shall be a minimum of 60 ksi yield grade, deformed. Exceptions to this shall require DP approval.

All sidewalks shall have, placed to reinforce the slab at midpoint, steel welded wire mesh with 6 in x 6 in openings.

Exterior facilities that are exposed to weather that may be subjected to deicing during the winter including but not limited to: stairs, walks, ramps, curbs and loading docks, shall have all reinforcing steel and accessories epoxy coated per ASTM A775.

Concrete features that house interior corrosive environments such as chemical storage rooms and swimming pool buildings shall have all reinforcing steel and accessories epoxy coated per ASTM A775.

Other reinforcement may be uncoated per MAG2010 section 727.

Part 2 – Products

Part 3 – Execution

03 22 00 Welded Wire Fabric Reinforcing

Part 1 – General

Part 2 – Products

Part 3 – Execution
Welded wire fabric shall be held firmly in place and spliced not less than 2 meshes per MAG 505.5.3.
03 24 00 Fibrous Reinforcing

Part 1 – General
Fiber mesh reinforcement is an allowable substitute for wire mesh with DP written approval.

Part 2 – Products
N/A

Part 3 – Execution
N/A

**END OF SECTION**
DIVISION 03 – CONCRETE

03 30 00 CAST-IN-PLACE CONCRETE

Part 1 – General
All cast-in-place concrete shall conform to the MAG Uniform Standard Specifications for Public Works Construction (MAG 2010) for portland cement concrete (PCC). PCC shall be composed of cementitious materials, fine and coarse aggregates, water, and, if specified or allowed, certain chemical admixtures and additives in conformance to MAG 2010 Section 725.

Only the following classes of concrete will be considered acceptable for construction at Northern Arizona University: Class AA and Class A in conformance to MAG 2010 Section 725.

All exterior concrete shall conform to the specifications for Class AA concrete with 5% to 7% air entrainment (containing at a minimum: 600 pounds per cubic yard of cementitious materials and having a minimum compressive strength of 4000 psi at 28 days).

Upon the recommendation and specification of a DP, all interior concrete shall conform to the specifications for Class A concrete (containing at a minimum: 520 pounds per cubic yard of cementitious materials and having a minimum compressive strength of 3000 psi at 28 days).

PCC Street pavement shall conform to MAG 2010 Section 324.

Part 2 – Products

Part 3 – Execution

03 31 00 Structural concrete

Part 1 – General
All structural concrete shall conform to the MAG Uniform Standard Specifications for Public Works Construction (MAG 2010) for portland cement concrete (PCC). PCC shall be composed of cementitious materials, fine and coarse aggregates, water, and, if specified or allowed, certain chemical admixtures and additives in conformance to MAG 2010 Section 725.

Only the following classes of concrete will be considered acceptable for construction at Northern Arizona University: All exterior concrete shall conform to the specifications for Class AA concrete containing 5% to 7% air entrainment (containing at a minimum: 600 pounds per cubic yard of cementitious materials and having a
minimum compressive strength of 4000 psi at 28 days). Upon the recommendation and specification of a DP, all interior concrete shall conform to the specifications for Class A concrete (containing at a minimum: 520 pounds per cubic yard of cementitious materials and having a minimum compressive strength of 3000 psi at 28 days).

No structural concrete shall be placed without the approval of the FS project manager or the special inspector representing the FS project manager.

Part 2 – Products

Part 3 – Execution

03 34 00 Low Density Concrete

Part 1 – General
Lightweight concrete shall not exceed 110 pounds per cubic foot and shall be made from lightweight coarse aggregates and a blend of lightweight and normal weight fines.

Part 2 – Products

Part 3 – Execution

03 35 00 Concrete Finishing

Part 1 – General
In general exterior concrete traffic surfaces shall be designed with a heavy broom finish.

All stoops, porches, steps and any other exterior concrete shall be finished so as to slope to drain and shall be placed per the plans within the dimensional tolerances for concrete slabs (+¼ to -¼ inches). Ponding or puddling resulting from finish work that does not address this requirement shall be repaired at the Contractor's expense.

Concrete Finished Floors

Generally concrete finished floors are to receive a hardener with colorant. Positive protection shall be provided to prevent staining and chipping during construction work. DP to specify products finish required and positive protection required.

All slabs with floor drains shall be required to slope to floor drains with no ponding areas, and be dished ½ inch deep around all floor drains.
A suitable sealant or paint shall be specified for interior exposed concrete.

Part 2 – Products

Part 3 – Execution

03 39 00 Concrete Curing

Part 1 – General
All concrete must be cured in accordance with MAG2010 Section 505.8. DP must specify the methods or materials necessary for proper curing of concrete structural elements. Examples include water fog, chemical membrane, wet burlap, or cold weather blanket protection. DP should include the weather conditions wind, hot or cold temperatures that may trigger special curing methods as applicable to structural features. The Contractor is solely responsible for protection of all concrete products throughout the curing period. Any damage to partially cured concrete shall require removal and replacement at no cost.

Non-structural concrete must be cured a minimum of three days prior to form removal. Normal concrete in structures and pavement shall be cured a minimum of seven days.

On all formed structural concrete, forms shall remain in place until work has reached 90% of its design strength or as specified by Structural Engineer of record.

High strength concrete and concrete that includes supplemental cementitious materials such as fly ash may require extended curing and weather protection. DP shall provide guidelines and requirements for curing protection and if appropriate, maturity modeling methods and procedures for concrete.

Part 2 – Products

Part 3 – Execution

**END OF SECTION**
This work shall consist of furnishing and placing precast prestressed concrete members in accordance with the details shown on the plans, and as provided in the MAG 2010 specifications and special provisions.

All precast concrete that is part of an exterior feature or element that will be exposed to the weather, shall be formed with Class AA PCC with five to seven percent air entrainment.

Precast Structural Concrete

Part 1 – General
Projects designed with precast, tilt-up, or special finished concrete shall include in the Project Specifications a requirement for a sample panel, constructed as specified. The panel shall be a minimum of 36 square feet. It shall be erected at, and remain on the jobsite as the visual criterion which the final product must match.

Part 2 – Products

Part 3 – Execution

Precast Architectural Concrete

Part 1 – General
This section applies to areas of a building that the DP may be considering for the use of precast panels, or special design features or projection from and around the building that will be visible.

As noted above, projects incorporating architectural precast concrete shall have included in the specifications a requirement for a sample. Such sample shall be made at the site and remain on site as a visual criterion through project completion.

The manufacturer of precast pre-stressed concrete shall submit structural calculations, certified by an Arizona registered Engineer, to the DP for approval.

As part of design proposal and approval process, colors, finishes and scoring of materials shall be presented to the facility owner and each selection shall be clearly delineated either by a sample or a drawing of a scale that can be viewed across a conference room. Elevations that contain precast material or features shall be keyed to such a sample or drawing.

Precast in-fill panels, elements or exposed precast structural members shall be designed and detailed in a manner that clearly and concisely conveys the architectural meaning and significance of its use.
Rough or heavy textured precast should be avoided immediately adjacent to heavy pedestrian traffic flow, or in the interior of the building (particularly corridors).

Precast concrete panels shall be water sealed with products warranted for a minimum of five years against UV breakdown.

Exposed panel fastening devices should be avoided due to annual maintenance costs (paint and rust inhibitors) and eventual staining of the panel.

Special consideration should be given to panel joinery and caulking when panels are intended to act as weather tight assemblies. The design of such joinery must facilitate required amounts of expansion/contraction and facilitate a neat appearance and weather tightness of the caulk joint.

**END OF SECTION**
03 50 00  CAST DECKS AND UNDERLAYMENT

03 52 16  Lightweight Insulating Concrete

Part 1 – General
Lightweight concrete insulating fill roof decks shall not be used in conjunction with urethane roof systems. Lightweight structural concrete shall not be allowed.

Part 2 – Products
N/A

Part 3 – Execution
N/A

**END OF SECTION**
03 60 00  GROUTING

Grouting of concrete structures shall be in accordance with MAG 2010 Section 505.

03 63 00  Epoxy Grouting

Part 1 – General
Use of epoxy grout is not encouraged. However it may be used as a retrofit or repair material upon approval by the design professional.

Part 2 – Products

Part 3 – Execution

**END OF SECTION**
**03 80 00**  **CONCRETE CUTTING AND BORING**

**03 81 00**  **Concrete Cutting**

- **Part 1 – General**
- **Part 2 – Products**
- **Part 3 – Execution**

Control joints shall be tooled or cut into in slabs on grade so that the length to width ratio of each cut portion of the slab is no more than 1.25 to 1. Control joints shall be completed within 12 hours or optimal time of concrete placement per ACI specs. Control joint depth shall be ¼ the thickness of the slab whether tooled or cut.

**03 82 00**  **Concrete Boring**

- **Part 1 – General**
- **Part 2 – Products**
- **Part 3 – Execution**
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23 05 13   Common Motor Requirements for HVAC Equipment
23 05 16   Expansion Fittings and Loops for HVAC Piping
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<td>Decentralized Unitary HVAC Equipment</td>
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<td>23 81 26</td>
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</tr>
<tr>
<td>23 83 13</td>
<td>Radiant-Heating Electric Cables</td>
</tr>
</tbody>
</table>
All work shall be subject to inspection by the following agencies as appropriate to the stage of construction:

- State Fire Marshal's Office
- State Risk Management Office
- State Boiler Inspector
- NAU Risk Management Office
- NAU Facility Services Code Inspectors
- NAU Facility Services Planning, Design and Construction
- NAU Facility Services Trades

All work shall conform to the requirements of all Federal, State and local laws, including but not limited to Codes and Standards referenced in section 01 41 00 of this Project Manual.

Campus Energy Infrastructure

North Campus
A central steam generation plant is located in Building 24 on North Campus with a steam supply and condensate systems routed through a subterranean network of tunnels and enclosed pipe chases. Process, domestic and comfort heating to all new buildings in proximity to the distribution grid is to be provided by the central distribution system. Maximum design steam pressure is 150 psig, design operating conditions are saturated at 60 psig. Heat shall be transferred from the campus distribution system to building hydronic systems via tube in shell heat exchangers. Condensate return is pumped from atmospheric receivers at each building to the plant. Pump discharge pressure varies from 25 psig to 50 psig and must be calculated for each new building system depending on location and head required. Steam pipe and heating water extensions from the distribution system of greater than 100 LF shall be in walkable tunnels (7 ft x 7 ft minimum). Extensions less than 100 LF may be in enclosed concrete structures, provided reasonable access to serviceable components (ie valve expansion joints and drip assemblies) is provided from above, and the lid can be removed to allow pipe replacement. Compensation for thermal stress shall be considered in all steam and condensate pipe design. Pipe stress supporting calculation shall be provided.
A central chilled water production and distribution system is located in building 24 on North Campus with a direct buried supply and return water distribution grid. Process and comfort cooling to all new buildings in proximity of the distribution grid is to be provided by the central system. The chilled water system is configured as Direct Primary, Variable Flow, with a single set of distribution pumps located within the plant. The central utility pumping is controlled to provide a differential pressure of 15 psig across building piping entry point. Internal building piping and coils shall be designed to meet peak anticipated demands without the use of secondary booster pumps or hydraulic decoupling within the building. Central chilled water supply temperature setpoint in summer time is 42 F. The chilled water supply temperature may be reset upward to 48 F in wintertime to allow use of the plant hydronic economizer. Building coils designed for dissipation of internal winter loads shall accommodate elevated (48 F) chilled water supply temperature. The University prefers that new air handler coils be selected for peak anticipated design at 42 F with a 20 F degree temperature split. At a minimum, all new building coils (including fan coils) shall be specified to provide a 16 F temperature rise under peak load with 42 F supply. All coils (including fan coils) shall be controlled with two way valves that modulate based on leaving air temperature.

South Campus
A central high temperature hot water plant is located in Building 67 on South Campus with a heating water supply and return distribution system routed through a subterranean network of tunnels and enclosed pipe chases. Process, domestic and comfort heating to all new buildings in proximity of the designated grid shall be provided by the central system. Any modification or extension to the high temperature heating water system shall be designed under ASME piping code for 600 psig pressure and 400° F temperature. The university operates the system at 160 psi, 250° F supply and 210 returns (40 degree split). Heat shall be exchanged from the high temperature loop to the building system via tube in shell heat exchangers, selected to meet peak anticipated building demand with 250 F campus supply and a 40 F temperature split.

A central chilled water production and distribution system is located in Building 67 on South Campus with a direct buried supply and return water distribution grid. Process and comfort cooling to all new buildings in proximity of the distribution grid shall be expanded by the central system. The chilled water system is configured as Direct Primary, Variable Flow, with a single set of distribution pumps located within the plant. The central utility pumping is controlled to provide a differential pressure of 15 psig across building piping entry point. Internal building piping and coils shall be designed to meet peak anticipated demands without the use of secondary booster pumps or hydraulic decoupling within the building. Central chilled water supply temperature setpoint in summer time is 42 F. The chilled water supply
temperature may be reset upward to 48 F in wintertime to allow use of a plant hydronic economizer. Building coil design for dissipation of internal winter loads shall accommodate elevated utility chilled water supply temperature. All building coils shall be specified to provide a 20 F temperature split under peak load with 42 F supply. All coils shall be controlled with two way valves that modulate based on leaving air temperature.

Local Environmental Conditions
Building design shall account for the ambient environmental conditions in Flagstaff. The Design Professional shall familiarize himself with special altitude and climatic conditions experienced in Flagstaff, and adapt the designs and specifications to suit.

Among important considerations for HVAC system designs are:

Elevation
All equipment, as appropriate, shall be de-rated for operation at 7,000 feet altitude. Design Professional shall request verification of BTU and specific gravity content of supplied gas in order to specify altitude corrections. Other equipment requiring de-rating includes, but may not be limited to, transformers, motors, fans, blowers and air moving equipment, ducts, controls, atmospheric heat exchangers, and motor speed controls. Motors, variable frequency drives and control equipment enclosures shall be specified to account for altitude effect on temperature dissipation.

Design low temperature
All air handling units with outside air shall be equipped with freeze stats with manual reset, outside air dampers and low-limit controls. All heating water valves shall fail to heating position. Design all HVAC systems for -20 F minimum outside air temperature.

Design high temperature
Building HVAC systems shall be designed to satisfy peak anticipated load under a 90 F outside air dry bulb.

Design wet bulb temperature
Outside air coils, evaporative media and cooling towers shall be specified to meet design performance under a wet bulb of at least 65 F

Diurnal Temperature Swing
Mechanical systems shall be designed to accommodate, and respond to, diurnal freeze-thaw cycle of as much as 50 F.
Solar Radiation
Characteristics of solar radiation shall be considered under all seasonal conditions. Solar gain effect of low winter sun angle on south facing vertical fenestration shall be evaluated.

Design maximum snowfall
Periodic occurrence of snowfall in excess of five feet and potential for drifting snow shall be considered in location of outside air intakes, along with relief and exhaust systems. Use of exterior ducting and equipment is discouraged.

Fly snow
Frequent occurrence of light, dry, crystalline “fly” snow shall be considered in design of outdoor air intake ducting and transitions. Baffles, stilling wells and drain pans may be required.

Wind Rose, gust velocity and intermittency
Seasonal wind direction shall be considered in location and design of building exhaust, intake, relief louvers and in placement of emergency generator exhaust. Wind gust velocity and intermittency shall be considered in design and location intake and exhaust louvers and of natural ventilation systems.

Building System Design Criteria

HVAC Baseline
An HVAC system with which NAU has considerable long term operating experience and consider being their baseline system is described as follows:

Central Utility Connections
Utilizes Campus Central Heating and Cooling distribution systems.

Building Core
Single Duct, indoor unit with terminal reheat variable air volume boxes.
Ducted return
Digital controls on air handler and terminal devices.

Full outside air enthalpy based economizer with return/relief and outside air dampers.

Single Class II supply fan selected and sized with fan speed less than 1500 RPM.

Air side pressure drop external to unit less than 1.5 inch water column.
Heating coils and terminals utilizing building heating water loop.
For systems with nominal outside air requirement in excess of 50%, a separate glycol loop to preheat coil is allowed.

Air to Air heat recovery for systems operating year around with more that 50% outside air.
Air handler freeze stat with manual reset

Chilled water cooling coil and/or direct evaporative section with face and bypass dampers are included. Cooling components sized for operation at less than 450 fpm face velocity.

Building Perimeter
Fin tube or convector units with sufficient tube surface to satisfy full heating load with 160 F heating water supply.

Life Cycle Cost Analysis
Consideration of alternative HVAC systems that offer the potential of substantial improvement in energy efficiency, maintainability, first cost, or a legitimate potential to better achieve the Universities sustainability goals is encouraged. A Life Cycle Cost Analysis that compares a proposed alternative system against the baseline system shall be provided for all energy consuming HVAC systems and sub-systems and shall conform to the requirements of Arizona Revised Statute #34-454. Life cycle costs shall be calculated based on owning, operating, and maintaining each system. Included are such factors as initial construction cost, fuel, energy, maintenance labor, replacement components, long term cost of service, and estimated useful service life. Electrical rates used in life cycle cost analysis shall be actual demand and consumption costs, not "average" costs. The baseline system described above shall be among the alternatives compared. The life cycle is the expected life of the system, or twenty years, whichever is shorter. Technical and economic assumptions used in life cycle cost analysis shall be coordinated with NAU Project Manager prior to submittal of result. Life cycle cost will be one of several criteria used by NAU in accepting use an alternative HVAC system. Other criteria include demonstration that the system or product proposed has been in satisfactory service in similar applications and environments for at least three years, necessity of special training or maintenance skills by NAU Shop Personnel, local availability of service parts and track record of vendor or service contractor in resolving issues raised during and after the warranty period. Quality of environmental control may be a factor. NAU reserves the right to reject alternative system proposals.

The suitability of using evaporative cooling, whether alone or in addition to a mechanical or indirect evaporative system, shall be evaluated. For wet wall
installations, face and bypass dampers must be used for temperature control. Wet wall pump cycling shall not be an option for temperature control. Bypass dampers shall be sized to allow full air flow around the wet wall. Where possible, evaporative cooling will be among cooling alternatives considered in Life Cycle Evaluation.

The use of any electrical source heating equipment, including heat pumps, heat tape, baseboard heat, and electric domestic hot water heaters, shall not be considered unless a minimum of 20 year life cycle cost analysis of all alternatives demonstrates it to be the most cost effective for the 20 year life cycle. The determination of energy costs must include both kwh and demand charges.

System sizing
All utility service and supply systems, including, but not limited to, steam, high temperature hot water, natural gas, domestic water, waste, and electrical, shall be sized for peak anticipated demand throughout the project and shall be sized as far back as the main meter or central distribution system. The adequacy of any central distribution system to carry all added peak loads shall be determined by the Designer Professional, and no loads shall be connected to any such system that is determined to be undersized. Calculations demonstrating adequacy of existing infrastructure shall be provided to NAU Director of Utilities with drawing submissions.

HVAC Design Requirements
The University prefers low pressure, low velocity (2000 FPM max, 2 inches WG max) air distribution systems. Designs involving higher velocity and/or pressure shall be reviewed and approved in writing by University Project Manager.

Noise level volumes of air movement and equipment shall be designed and installed as compatible for intended functions within building spaces. The Design Professional will be held responsible for designing systems that maintain acceptable sound levels as defined by ASHRAE.

The Design Professional shall evaluate the potential for overheating of building spaces. Particular attention shall be paid to areas which house computer or other electronic equipment. Evaluation shall consider all factors including but not limited to equipment, passive solar gain, and occupant loads. Where such potential exists, the value and cost effectiveness of mechanical cooling shall be analyzed. Where possible, IT and Computer Server rooms shall be located at an exterior wall.

All mechanical rooms shall be ventilated. Location and size of louvers and vents to the outside shall be coordinated with piping and equipment to preclude the possibility thermal stratification and/or freeze up. Any ventilated space which
houses water piping, vessels, or equipment, such as equipment rooms, shall be heated to a minimum of 50°F. When equipment rooms must be ventilated to provide boiler combustion air, the heat source shall be independent of the boiler. Provision for temporary mechanical ventilation shall be provided in vaults and chases that are not normally accessible.

All mechanical rooms and spaces shall be adequately sized, lighted and arranged so that any and all repair and maintenance that may be necessary can be performed. Controls, mixing boxes, balance dampers, fire dampers, valves, filter banks, heat exchanger coils, pumps, belts, etc., shall be accessible for repair or replacement, and shall not be obstructed by any pipe, conduit, or other obstacle. Heat exchanger tube bundle and coil pull space shall be provided and shown graphically on the design drawings, along with vendor required service space for all HVAC equipment and Code required clearance for all electrical equipment and panels. Where possible, mechanical rooms are to be located at grade, on an exterior wall, and provided with an exterior door of sufficient size to move the largest piece of equipment through. Equipment rooms not located at grade shall be provided with a conventional access stair or elevator. Access to mechanical equipment room by means of a ladder is not acceptable. Access for handling component replacement, such as motors, shafts, drives and coils shall be provided. Where equipment must be raised vertically through a hatch, a structurally designed overhead lifting beam of sufficient capacity shall be provided.

Ample minimum access shall be provided to overhead mechanical equipment, such as in line exhaust fans, terminal boxes or fan coil units and shown graphically on design drawings. Ample access is defined as access that is sufficient to allow 2’ 6” of clearance in front of a service technicians head when standing on a ladder with shoulders at the level of the equipment.

Gauges and thermometers and isolation valves shall be specified for all HVAC equipment.

No underground storage tanks of any type shall be specified without signed prior approval by the Director of Utilities.

**Quality Assurance**
The selection of products or service companies shall be from those firms whose products or services have proven satisfactory in similar service for not less than three years. Repair or replacement parts, or required service, shall be readily available, and the supplier of products or services shall have a proven track record of response to complaints or problems during, and after, the warranty period.
All parts or products shall be of commercial or industrial quality, and shall be suitable for heavy duty use.

Installers and sub-contractors shall have at least three years experience in installation of similar equipment on similar projects. All sub-contractors shall have a proven track record of response to complaints or problems during and after the warranty period.

Design Professional Requirements
The Design Professional through his sub-consultants shall be responsible for defining the coordination of all systems including but not limited to: electrical systems, control systems, heating and cooling systems, plumbing systems, and any other mechanical systems included in the building design. This responsibility to prepare a coordinated design extends to Federal, State, and local agencies, and franchised service companies.

Performance specifications shall not be used in lieu of designed systems unless specifically authorized by the Project Manager on an item-by-item basis.

Design Document Requirements
The Design Professional shall submit a set of General Arrangement drawings at the Schematic and again at the Design Development stage. Locations and sizes of major HVAC equipment, including fans, air handlers, pumps, heat exchangers and steam control stations will be shown on these drawings along with electrical equipment and panels. General arrangement drawings will demonstrate code clearances along with maintenance and service access.

The Design Professional shall provide a process and instrumentation diagram drawing at Design Development and Construction Documents depicting all pressure gauges, thermometers and flow meters required for the project. Included on this drawing shall be actual design flows pressures and temperatures for each and every system.

Submittal Information and Close Out Materials
At a minimum, one set of “As Built” drawings and one set of O&M manuals shall be provided to the HVAC department.

Design Professional shall include in contract documents the requirements that NAU is provided with the following minimum submittal information and close out materials:
NOTE: Sequence of control diagrams shall be required to be submitted within 21 days of notice to proceed.

Provide Shop Drawings and product data prior to start of construction as applicable for the following:

- Equipment room layouts, drawn to scale, showing all equipment, piping and accessories and clearances for operation and servicing.
- Provide submittal information including equipment cut sheets for at a minimum, the following components and equipment.
  - All HVAC equipment including boilers, heat exchangers, pumps, tanks, valves, hangers, air handlers, filters, louvers and dampers, relief valves, strainers, traps and drip legs, etc.
  - All terminal equipment including volume control boxes, registers, grills, diffusers, etc.
- Design curves and characteristics of fans, blowers and pumps.
- Control diagrams and sequence of operations for all HVAC equipment.
- HVAC and motor control wiring or pneumatic diagrams.
- Plumbing fixture cuts, trim and fittings, rough-in dimensions and special supports.
- Plumbing fixtures, equipment and specialties.
- Piping materials, fittings, specialties.
- Expansion loops, joints, guides, and anchors.
- Foundations, supports, hangers and inserts.
- Drains (roof/floor) carriers, cleanouts, downspout nozzles.
- Insulation materials and finishes, duct and piping.

- Mechanical identification.
- Converters with saddles and relief valves.
- Gauges and thermometers.
- Flow fittings.
- Utility sets with vibration isolation.
- Dampers - back draft, volume, smoke, fire, combination smoke/fire.
- Temperature control equipment, schematics and diagrams.
- Panel boards, gauges and thermometers.
- Fire protection system - hydraulic calcs.
- Fire protection equipment and specialties (wet, dry and chemical).
- Wiring diagrams and motor control equipment. (Wiring diagrams must be project specific, manufacturer's standard diagrams will not be accepted).
- Pressure testing procedure

All close-out submittals shall be indexed to the specifications, separated by dividers and bound in three ring binders.
Provide product extras as applicable from the following:
Desktop computer, programming devices or applicable software
Thermometers, each type.
Two sets keys/wrenches for any covers.
Spare belts for all fans.
Spare thermostats.
Chemical test kits as appropriate.
One set of filters installed just prior to final balancing.
One extra set of filters.
One set of any proprietary trouble shooting or maintenance tools.
Two copies any proprietary computer software for systems control, program back-up, troubleshooting or maintenance.
1 - 3 day start-up training as applicable (coordinated with Facility Services.) To be videotaped by the University.
Valve tag index mounted under rigid clear protection in the mechanical room(s) and diagram submitted with the O & M manuals.
Hard copies of all control codes and sequence of operations.
Specialty tools specific to system operations

Provide Manufacturer's certificates or test results for the following:
Air balance reports.
Heat exchangers.
Boilers and chillers
Chemical treatment products, application limits, test methods, and apparatus.
Glycol mixing formula.
Backflow preventers (per R18-4-232).
Potable water system purification.
Hydrostatic test on sprinkler system.
Hydronics balancing.
Field test make up air units and fans.
Final inspection from Mechanical Engineer.

Warranty
All HVAC systems equipment and components shall be warranted for 2 years minimum.

**END OF SECTION**
Section Title

23 05 00 Common Work Results for HVAC

23 05 13 Common Motor Requirements for HVAC Equipment

Part 1 – General
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.

Part 2 – Products
All motors shall be high efficiency with sizing and winding insulation specified to compensate for altitude. (7,000 ft)

All motors shall be Premium Efficiency

Part 3 – Execution
All pump motors located remote from the master control center shall have a local disconnect that may be locked out.

23 05 16 Expansion Fittings and Loops for HVAC Piping

Part 1 – General
Section Includes:

Flexible, ball-joint, packed expansion joints.
Expansion-compensator packless expansion joints.
Metal-bellows packless expansion joints.
Pipe loops and swing connections.
Alignment guides and anchors.

Design Professional shall calculate thermal pipe stress and design compensation system. Pipe stress analysis of steam and high temperature hot water system to be sealed by Professional Engineer and submitted to NAU.

Construction drawings shall contain sufficient detail to clearly identify location and method of support for pipe anchors, thrust blocks, guides, expansion compensators, arresters, etc. Details shall be such that the contractor has no question of how the work is to be accomplished.
Part 2 – Products
Steam/Condensate distribution system: Hyspan 3500 externally pressurized bellows joint.
High Temperature Heating Water systems: Barco Ball Joint.

Part 3 – Execution
Space anchors, guides and supports per manufacturers requirements.

23 05 19 Meters and Gages for HVAC Piping

Part 1 – General
Specify Totalizing meters for chilled water
steam/condensate
reclaimed water
natural gas
domestic water

Specify additional meters to comply with additional project requests (e.g. ASHRAE 189.1).

Utility meters shall be designed and specified by the Design Professional. Project Contractor shall furnish and install all utility meters. Utility meter commissioning shall be a joint effort between the Project Contractor, Design Professional, Commissioning Agent, (where applicable) and the University. The University will not energize any utility until the meter has been shown to be fully functioning and operational.

Design and construction documents to specify, schedule and require furnishing, installing, and commissioning of all utility meters. Documents shall include a flow meter schedule that explicitly defines:
Utility service
Meter type
Meter size
Maximum, minimum and normal Flow range
BTU range
Temperature and pressure

Design documents shall include meter installation details that are complete and include all necessary information, including, but not limited to, length of straight pipe required upstream and downstream, distance required from valves or fittings, any required concentric reducers and location of temperature and pressure sensors.
Utility meters shall be specified to provide a local readout- either in transmitter head or in a suitably rated box on an adjacent wall. In either case meter readout shall be designed to be readily accessible- between 4 and 5’6” AFF.
Utility meters shall communicate with the University’s campus EMS system. Specify all necessary components and communication protocols to assure meter information can be mapped to campus Building EMS Web Page.

Part 2 – Products
All gas and steam flow meters shall be temperature and pressure compensating.

South Campus

Chilled and Heating Water Meters
All items necessary to allow the chilled water flow sensors to function as energy meters shall be specified and shown on the drawings and included in installation details.
Output of energy meter shall be in BTU’s and totalized in MBTU’s.
These additional items shall include, but are not limited to, temperature sensors, BTU totalizing computer, connection requirements to the campus EMS system, programming requirements and software.
Delta temperature transmitters shall be platinum 1000 OHM RTD, Where 1000 ohms equals 32° F.
Delta temperature sensors shall be matched pairs of calibrated sensors with an accuracy of 0.12° F.
Flow transducers shall be selected for the expected flow range encountered at present design conditions, pipe size and material. Particular attention shall be made to design minimum flow conditions.
For all installations an energy totalizing computer will be required.
Insertible Magnetic Flow Meter- Onicon F3500 with Onicon Series 10 Totalizer

Steam Meters
All items necessary to allow the steam flow sensors to be fully functional shall be specified and shown on the drawings and included in installation details.
Output of energy meter shall be in lbs/hr with pressure/temperature compensated conversion to BTU and totalized in MBTU’s.

These additional items shall include, but are not limited to, flow (in lb/hr) totalizing computer, connection requirements to the campus EMS, programming requirements and software.
Temperature transmitters shall be platinum 1000 OHM RTD, Where 1000 ohms equals 320 F.
Flow transducers shall be selected for the expected flow range encountered at present
design conditions, pipe size and material. Particular attention shall be made to minimum flow conditions.
For all installations an energy totalizing computer will be required.
Insertion type vortex meter Onicon F2500 with Onicon Series 2500 totalizer

**Domestic and Reclaim Water Meter**
Positive displacement meter with pulse counter and totalizing head
Specify compound meter where necessary to manage high (maximum – minimum) turn down
Onicon meter

**Pressure Gages**
Specify 6” minimum diameter, liquid filled gages with snubbers, stand offs and isolation cocks. Pressure gauges shall normally read at 60% of total gauge pressure capability.
Pressure gauges shall be required on all inlet and outlet lines of the following:
Boilers
Converters
Pumps
Pneumatic Controls
Main steam supply line
Static pressure gauges on all static controlled fans

**Thermometers**
Specify thermometers to be provided on all of the following:
Air Handlers (mixed air, hot deck, cold deck)
Boilers
Converters
Cooling equipment, chillers
Heat recovery systems
Heat transfer coils with pipe size greater than 2 inches.
Building chilled water point of entry and exit.

**Part 3 – Execution**
The supply of any utility to a building shall not be activated until the specified metering is in place, functional, and has been commissioned.
During the final phase of the project and before final close out, project contractor shall be required to prove that all utility meters are installed properly and function as designed and specified. The utility meter commissioning shall be accomplished by the contractor in conjunction with the Design Professional, Commissioning Agent (where applicable) and the University.
Require calibration data, O & M manuals, details, etc., to be submitted after
meters accepted. Provide air vent in pipe riser. Install automatic air vents in equipment rooms and manual air vents elsewhere, with isolation valve at all system high points and piped to drain. Minimum vent piping size is 1/2 ".

Meter EMS Displays: Displays within the EMS for meters shall include the following when applicable.

HTHW: flow in GPM, energy flow in BTU/hr, totalized Energy in BTU’s, maximum and minimum instantaneous GPM and BTU/hr with the date and time that point was reached.

Steam: Flow BTU/hr, totalized energy in BTU’s, pressure in psi, maximum and minimum BTU/hr with the date and time that point was reached.

Chilled Water: Flow in GPM, energy flow in BTU/hr, totalized energy in BTU’s, maximum and minimum GPM, BTU/hr and peak load in tons with the date and time that point was reached.

Domestic Water: Flow in GPM, totalized in gallons. Peak flow rate with the date and time that point was reached.

Reclaimed Water: Flow in GPM, totalized in gallons. Peak flow rate with the date and time that point was reached.

Electric: demand in KW, Totalized in kWh, total voltage, voltage per phase, total amperage, amperage per phase, total power factor, and power factor per phase.

All maximum and minimum values shall have a button to reset when those values were tracked from. Multiple meters may be required to record maximum and minimum flows. Trends on flow rate and totalized energy must be setup within the EMS prior to substantial completion.

23 05 23 General Duty Valves for HVAC Piping

Part 1 – General
Section Includes:
Brass ball valves.
Bronze ball valves.
Iron ball valves.
High-performance butterfly valves.
Chainwheels.
**Part 2 – Products**

**Valves**

<table>
<thead>
<tr>
<th>Service</th>
<th>Size</th>
<th>Type</th>
<th>Material</th>
<th>Connections</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Gas</td>
<td>All</td>
<td>Ball Valve</td>
<td>Iron or Bronze Body</td>
<td>Threaded</td>
</tr>
<tr>
<td>(inside building)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydronic Piping</td>
<td>Thru 2.5”</td>
<td>Ball</td>
<td>Bronze Body</td>
<td>Threaded</td>
</tr>
<tr>
<td>2.5” &amp; Larger</td>
<td></td>
<td>Butterfly</td>
<td>Iron Body with</td>
<td>Lug Type flg</td>
</tr>
<tr>
<td>Steam</td>
<td>Thru 2”</td>
<td>Ball</td>
<td>Bronze Body</td>
<td>Threaded</td>
</tr>
<tr>
<td>Steam</td>
<td>Above 2”</td>
<td>HP Butterfly</td>
<td>Carbon Stl Body</td>
<td>Lug type flg</td>
</tr>
<tr>
<td>Condensate</td>
<td>All</td>
<td>Ball</td>
<td>Bronze Body</td>
<td>Threaded</td>
</tr>
<tr>
<td>HTHW</td>
<td>All</td>
<td>Ball on HP Butterfly</td>
<td>Stainless Steel</td>
<td>Lug Type Threaded</td>
</tr>
</tbody>
</table>

Steam valves and steam pressure regulators shall be as manufactured by Fisher (TYPE 92B).

Ball valves shall be 100% full port, full line size.
Butterfly valves to have 100% bubble tight-shut-off and full port sizing.

Valves shall be domestic manufacturer and have two year warrantee. University prefers valves to be manufactured by Milwaukee.

Provide and secure brass identification tags to all valves. Incorporate in valve tag index.

**Automatic Valves**
All automatic valves must be able to communicate with the universities EMCS and shall be Belimo or approved equivalent.

**Part 3 – Execution**
All valves underground or in vaults shall be gate valves.
Install all valves for easy access for operation, repair and maintenance without use of ladders. Specify chainwheel where floor access to valve handle is not possible and valves are 4” and over and located 7’0” AFF.

Specify and show isolation valves on drawings at all equipment and on all main branch take-offs.

Specify automatically controlled Heating valves as **fail to heat** (normally open). Domestic steam valves shall **fail closed**.

Specify and show unions installed on the downstream side of all non flanged valves for access and repair of systems.

Provide isolation valves on each side of strainers and full port ball valve on blow down.

Provide ball valves with hose end threads for system drains and strainer blow down.

When an existing system “hot tap” is necessary, specify a full port ball valve to isolate the new branch line.

Do not allow use of circuit setter as isolation valve.

Provide relief valves on piping and equipment as needed to meet code requirements.

Provide plug cock valves at connections to gas-fired equipment and in all branch piping.

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**Part 1 — General**

**Test and Balance Firm Considerations**

The General Contractor shall hire the Test and Balance firm, but shall have approval from by the Owner on who they receive bids from and who they contract with.

The air distribution system shall be tested and balanced by an independent firm licensed, bonded and certified to perform such work in the state of Arizona.

The work of the Test and Balance Contractor shall be specified in the Construction Documents by the Design Professional.
Design and Specification Considerations
The air flows shall be specified to be set within 3% of the design requirements.

Specify that all air distribution systems shall be balanced in the **heating mode and have flows measured in cooling mode**.

The Professional Consultant shall specify all the necessary dampers, controls and sheaves required to meet the balance conditions.

The Professional Consultant shall specify final mechanical system noise levels that are to be compatible with intended functions within the building spaces.

Specify that the final air balance will be conducted after all systems are in place and operational and have been accepted.

Specify that all systems start-up, testing, balancing, Final Operations & Maintenance Manuals and training shall be completed on or before, and is a requirement of, substantial completion.

Test and Balance Submittal Requirements
Contractor shall submit Test and Balance firm’s certifications along with a test and balance plan including but not limited to where test points shall be taken, any traverse test being performed and any potential complications.

The testing agency shall provide verification that systems operate at 50% to 75% **and at 100%** capacity as designed.

Final balance report shall include copies of pump and fan curves.

Four hard copies of the air system testing, adjustment, and balancing report shall be provided to NAU with one copy provided to the HVAC department.

Part 2 – Products
N/A

Part 3 – Execution
N/A
Instrumentation and Control for HVAC

Part 1 – General
Design Considerations

Heating Ventilating and Air Conditioning system design shall be zoned to differentiate between north, south, east and west exposures, internal areas, locations of large glass areas with independent controls for each zone, and shall include outside air and zone temperature reset, and solar gain compensation.

A maximum of 4 individual rooms shall be ganged on a single thermostatically controlled temperature zone, provide the rooms have compatible exposure, occupancy and setpoint conditions.

Unless otherwise directed by NAU Project Manager, indoor space temperatures shall be specified to be maintained at a maximum of 72° F. in a heating mode, as measured 4’ above the floor and 2’ from the exterior wall shielded from the sun and artificial heat sources.

Unless otherwise directed by NAU Project Manager, indoor space temperatures shall be specified to be maintained at a minimum of 76° F. in a cooling mode as measured 4’ above the floor and 2’ from any exterior walls.

Large classrooms/conference rooms may have large temperature variations across the room. DP is to develop a control strategy to maintain heating and cooling temperature setpoints in the center of the room.

In general, air handlers shall be configured with 100 % outside air economizers using enthalpy based control logic.

Design and specify installation of temperature sensors for outside air, return air, mixed air on each air handler or variable box.

Design and Specify systems with sufficient instrumentation that energy efficiency can be trend monitored. This is to include filter pressure gages, air handler valve and damper position feedback, terminal box flow, temperature and valve position, VFD speed indication, running amps of large motors and motor driven equipment

Every building control system shall be specified to integrate with the NAU head end, located in the HVAC department. Specify that every control contractor is required to furnish all labor, hardware and applicable software and graphics necessary to integrate and maintain the system.
Design Submittal Requirements

*Design Professional shall write a detailed sequence of operations in plans. Any proposed changes to the sequence shall be done through a RFI and included in the as-builts and controls O&M’s.*

Design Professional submittals shall include:

- Piping and Instrumentation Diagram, Control System Architecture diagram
- Points list
- Control component specification
- EMS sequence of operation

Control System Architecture diagram shall depict in single line the communication interfaces between campus head end, building energy management, air handler and plant controllers and all terminal controllers, along with interface to building metering and monitoring devices.

Installation of control systems shall not proceed without sign off approval of sequence of operations and control diagrams and shop drawings by the Facility Services HVAC department.

**Part 2 – Products**

All DDC controls shall be native BAC net and fully communicate with existing Campus system. The preferred control component manufacturer is Alerton.

Controls contractor to provide one workstation with computer, hard drive, keyboard, monitor, and mouse in a locked cabinet.

Major equipment such as Chillers, Boilers, VFDs, Fume Hood and Room/Lab Pressurization systems shall be fully integrated and communicate with the BACnet DDC System.

System requirements are listed below:

- **Processor:** 2.8 GHZ Intel Pentium (Minimum)
- **Memory:** 4GB DDR3 SDRAM Memory
- **Cache:** 16 MB
- **Hard Drive:** 1 TB 7200 RPM SATA (Minimum)
- **Video Card:** 1 GB Meg AGP Video Card
- **DVD Drive:** 16 Speed High Density DVD-RW +/- Optical Drive
- **Operating System:** Microsoft Windows 7 Professional
- **Keyboard/Mouse:** Standard ASCII Keyboard/ Wireless Intellimouse
- **Monitor:** 22” LCD Type, 1280x1024, noninterlaced
Network Interface Integrated 1—100-1000 Base T Ethernet NIC
Modem: 56K Modem
Printers 600 dpi Color Laser Printer

A back-up software controls program for the building shall be provided by the controls contractor to the HVAC department. The controls contractor shall provide service or warranty work within 24 hours of notification by NAU, excluding weekends and holidays.

Air handling systems shall be provided with freeze protection controls which are hardwired for failsafe operation as well as controlled by the DDC system. Fail safe, hardware protection shall include a manually reset low temperature switch, freeze-stat, activated by a sensor, capillary tube, downstream of the preheat or heating coil or between the heating coil and the chilled water coil which drives outside air damper close, opens heating hot water valve and opens chilled water valve and shuts down the fan. Access doors shall be provided for low temperature switch, freeze-stat, for removal and service.

Factory set (pre-programmed) HVAC control modules shall not be acceptable. Proportional authority percentage (re-set) shall be field adjustable.

Sequence of operations and control diagrams and shop drawings require sign off approval by Facility Services HVAC department. The system shall be user programmable.

Pneumatic Control Systems
All control panels, consoles, etc., shall have a minimum of 3' clearance to the front. Gauges shall be installed on all controller inlet and outlet ports.

Control air tubing shall be copper when located in close proximity to any heat source. Plastic tubing shall be laid in troughs or installed in conduit. Unsupported tubing shall not be installed.

When plant air is used, a back-up air compressor must be installed.

All pneumatic systems shall have an air dryer installed on the main air supply and shall be equipped with an in-line outlet oil filter.

Part 3 – Execution
Maintenance training sessions shall be required to be provided on all systems. All sessions shall be scheduled through Facility Services. Sessions shall be videotaped by the University.
All required close-out diagrams, sequence of operations and O/M manuals shall be on-site and available at the time of the scheduled training sessions. All training shall be completed in such a manner so as to assure proper end-user competency.

Training shall include both on-site, in-building efforts and remote site training at Control Contractor’s facility.

*Controls contractor shall set up trends on energy management components listed in part 1, meter instantaneous demand and totalized usage, and all space temperature setpoints. The design professional may indicate additional trends in the project specifications.*

**END OF SECTION**
DIVISION 23 – HEATING VENTILATING AND AIR CONDITIONING

Section Number

23 20 00 HVAC PIPING AND PUMPS

23 21 00 Hydronic Piping and Pumps

23 21 13 Hydronic Piping

Part 1 – General
This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:

Hot-water heating piping
Chilled-water piping
Dual-temperature heating and cooling water piping
Condenser-water piping
Glycol-water piping
Makeup-water piping
Condensate-drain piping
Blowdown-drain piping
Air-vent piping
Safety-valve-inlet and -outlet piping

Part 2 – Products
Pipe Schedule - Above Ground

<table>
<thead>
<tr>
<th>Size</th>
<th>Pipe</th>
<th>Fittings</th>
<th>Joint</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 2&quot;</td>
<td>Copper Type &quot;L&quot;</td>
<td>Wrought copper</td>
<td>Less Than 0.2% Lead Alloy</td>
</tr>
<tr>
<td>2 1/2&quot; larger</td>
<td>seamless hard drawn</td>
<td>Wrought copper</td>
<td>Solder</td>
</tr>
<tr>
<td>Schedule 40</td>
<td></td>
<td>Or</td>
<td>15% silver brazed</td>
</tr>
<tr>
<td>Black Steel</td>
<td></td>
<td>Or</td>
<td></td>
</tr>
<tr>
<td>Pipe Schedule</td>
<td></td>
<td>Forged carbon</td>
<td>bevel welded</td>
</tr>
<tr>
<td>Below Ground</td>
<td></td>
<td>steel</td>
<td></td>
</tr>
<tr>
<td>Up to 2&quot;</td>
<td>Copper Type “K”</td>
<td>Wrought Copper</td>
<td>6% silver solder</td>
</tr>
<tr>
<td>Seamless hard</td>
<td></td>
<td>Wrought Copper</td>
<td></td>
</tr>
<tr>
<td>drawn</td>
<td>2-1/2”</td>
<td>15% silver brazed</td>
<td></td>
</tr>
<tr>
<td>Seamless</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>hard drawn</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Mechanical pipe joining systems such as Victaulic or groove lock are not allowed
without express written permission of University Project Manager and HVAC Supervisor.

Press fit coupling systems such as ProPress are not allowed without express written permission of University Project Manager and HVAC Supervisor.

Pipe Gasketing - Water Services – Garlock. Spiral wound metallic for high temperature hot water, steam and condensate.

**Expansion Tanks**
Provide diaphragm-type compression tank with replaceable diaphragm.

**Air Vents**
Provide automatic float and trap air vents in mechanical rooms only.

**Part 3 – Execution**
Copper: Maintain a minimum of 50% penetration of brazed joints.

Steel: Perform a minimum of three passes on weld joints (root, filler, cap).

Route piping to allow sufficient access to all equipment, valves, controls, etc., for maintenance.

In general, piping shall be installed below electrical conduits not requiring maintenance access.

All chilled water coils and DX coils located in a Fan Coil Unit above the ceiling shall have a secondary drain pan under the Fan Coil Unit. The secondary drain pan shall drain to a custodial sink. Such piping shall be directly connected to the secondary drain pan and maintain a minimum horizontal slope in direction of discharge of not less than one-eighth unit vertical in 12 units horizontal (1-percent slope).

Piping shall be secured at each trapeze hanger or support.

All hydronic piping heating hot water or chilled water shall not be exposed to the weather elements; all piping shall be within the building structure.

Install piping sufficiently below structure to allow top air vents.

Provide isolation valves on each side of strainers and full part ball valve on blow down. Provide hose thread connection on blow down port 3/4" and below.
Provide air vent in pipe riser. Install automatic air vents in equipment rooms and manual air vents elsewhere, with isolation valve at all system high points and piped to drain. Minimum vent piping size is 1/2 ".

**Piping Systems Flushing and Testing**
Specify that each system (steam, water, condensate) shall be flushed, checked for leaks, corrosion inhibitors added where applicable, disinfected for domestic water and otherwise made ready for acceptance. Notice of such tests will be given to Facility Services and Coconino County Health Department.
Design Professional shall specify testing on all backflow preventers. Testing shall be performed by a certified tester and results shall be submitted in writing to Facility Services.
Specify that Domestic water supply systems shall be charged with a sterilization solution conforming to Federal Specification 0-8-441, Grade D (chlorine).

Specify that Solution shall remain in system (8) Hours. System shall then be flushed and test results provided to the NAU PM or CM.

Specify that all pressure tests shall be performed using a certified gauge which has been approved for use by the HVAC Manager.

Specify that pressure testing needs to be conducted on the new system only. The new system needs to be isolated from the existing system during the pressure testing.

Specify that pressure testing procedure is to test the new system at 1.5 times the operating pressure for a period of two hours. A testing procedure needs to be submitted to the HVAC Manager and approved prior to any testing.
DIVISION 23 – HEATING VENTILATING AND AIR CONDITIONING

Dual system back-up pumps shall be specified in the base bid and installed on all new building and water heating and cooling systems. All heating, cooling, and domestic hot water circulation pumps shall have back-up. Automatic switch over in case of failure is to be required on heating water pumps.

This standard does not apply to Design of Pumps for use in central plant.

Part 2 – Products
All HVAC pumps shall be Bell & Gossett.

All pump motors shall be specified for high efficiency and sizing shall be compensated for altitude.

Part 3 – Execution
All heating hot water and domestic hot water circulating pumps shall be designed to have back-up, and shall have automatic change-over on HHW pumps.
All critical area chilled water pumps for stand-alone chiller systems shall be backed-up, and provided with automatic change over.

All pumps shall be selected for minimum maintenance, such as in-line circulators where appropriate. Specification for all coupled pumps shall require laser alignment after installation, and alignment documentation shall be provided to University.

All pumps shall have in-line strainers installed upstream of suction.

All pumps shall automatically restart after a power outage.

All HVAC equipment shall be connected to a Hand/Off/Auto starter, specification shall not allow use of momentary starters.

All pump motors located remote from the master control center shall be designed with a local disconnect that may be locked out.

Design and specify housekeeping pads for all base mounted pumps. After completion of alignment and testing grout pumps to pads with non-shrink grout.

Ball isolation valves shall be installed so that the pump can be isolated for repair. No butterfly valves shall be used on pipe under 4” in size at suction and discharge of pump.
Part 1 – General
This Section includes the following for steam and condensate piping:
Pipe and fittings
Strainers
Flash tanks
Safety valves
Pressure-reducing valves
Steam traps
Thermostatic air vents and vacuum breakers
Steam and condensate meters

Part 2 – Products
Pipe Schedule

<table>
<thead>
<tr>
<th>Service</th>
<th>Size</th>
<th>Pipe</th>
<th>Fittings</th>
<th>Joints</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steam</td>
<td>Up to 2&quot;</td>
<td>Sch. 40</td>
<td>Forged carbon</td>
<td>threaded,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>bevel,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Seamless, black</td>
<td>weld or</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>steel</td>
<td>socket</td>
</tr>
<tr>
<td>Steam</td>
<td>2 1/2 &quot;</td>
<td>Sch. 80</td>
<td>Forged carbon</td>
<td>bevel welded</td>
</tr>
<tr>
<td></td>
<td>and</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>larger</td>
<td>seamless, black</td>
<td>steel</td>
<td></td>
</tr>
<tr>
<td>Condensate</td>
<td>All</td>
<td>Sch. 80</td>
<td>forged carbon</td>
<td>15% silver</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Seamless, black</td>
<td>brazing</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>steel</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

All steel piping for steam and condensate duty shall be domestic.

Pipe Gasketing - Steam services – Spiral wound – “Flexautalic”.

Brass, copper and bronze fittings and/or valves shall not be permitted for steam service. Valves 2” and smaller shall be carbon steel, quarter turn ball valves. Valves larger than 2” shall be high performance butterfly, bubble tight shutoff, and bi-directional if the piping can or will be pressurized from two directions.

Steam and Condensate Valves
Condensate valves to be steam rated ball valves
Steam valves to be steam rated ball valves or high performance butterfly

Pressure Gauges Shall Be:
Rated for steam service
Cast aluminum with 4 1/2" dial
Selected with normal operating range at the midpoint of the scale
Furnished with pressure snubber and shutoff valve

Strainers Shall Be:
Screwed 250# cast-iron, threaded through 2"
Flanged (150 lb.) 2 1/2" and larger cast iron
Size 100 mesh

Steam Traps preferred manufacturers are:
 Armstrong bucket for end of line drip and main lines
 TLV float & thermostatic for modulating service
 Pressure Regulators Shall Be:
 Fisher, Industrial Type 92B
 Globe valve in by-pass
 Vented to exterior of building through relief valve

Expansion Joints Shall Be:
Externally pressurized bellows type, weld end Hyspan 3500

Condensate Pumps shall be:
Duplex electric pump
Cast-iron housing

Part 3 – Execution
Design to provide isolation valves at all equipment and on all main branch take-offs.

Design to include pressure gages on both sides of all pressure regulators and at all steam using equipment.

Design to provide strainers with isolation valves and piped blow down ahead of steam traps and control valves. Design to provide unions to allow disassembly of strainer.

All steam and condensate piping shall be designed and detailed to include adequate expansion joints or loops and such joints or loops shall compensate for expansion of the supply piping that it is connected to.

Steam piping design shall include location and detailing of drip legs sufficient to ensure dry steam supplies, and to prevent water hammer.
Steam system design shall be such that use of steam pressure is not necessary to raise condensate through any heat exchanger, or in any area where steam hammer noise will be objectionable.

Design to detail location of atmospheric vent lines and pressure relief vent lines out of doors in a safe location. Design to include drip pan elbow for all pressure relief vent lines.

Design and specify steam piping to use eccentric reducers in to assure level bottom. Design and specify piping systems such that steam and condensate piping pitch downward in direction of flow at 1/2” per 10 ft.

The use of thermostatic or orifice type traps is discouraged.

Direct - buried steam and condensate systems are not allowed. All steam and condensate lines to be in accessible location.

23 23 00 Refrigerant Piping

Part 1 – General
This Section includes refrigerant piping used for air-conditioning applications. Design and specification are not to allow use of pre-charged line sets.

Part 2 – Products
Pipe Schedule - Above grade

<table>
<thead>
<tr>
<th>Service</th>
<th>Size</th>
<th>Pipe Fittings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refrigerant Piping</td>
<td>All</td>
<td>Type 'L' ACR Wrought Copper 15% Silver Solder</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15% Silver Solder Or Cast Brass</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Brazed</td>
</tr>
</tbody>
</table>

Pipe Schedule - below grade

<table>
<thead>
<tr>
<th>Service</th>
<th>Size</th>
<th>Pipe</th>
<th>Fittings</th>
<th>Joints</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refrigerant Piping</td>
<td>All</td>
<td>Type &quot;K&quot; ACR</td>
<td>Wrought Copper 15% Silver Solder</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>or Cast Brass Brazed</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Use long radius fittings only

Part 3 – Execution
All refrigerant piping shall be designed, sized and detailed to comply with manufacturers recommendations concerning size, rise, insulation, etc. to ensure that oil migration does not occur.

Refrigeration isolation valves shall be designed and detailed to be installed at each refrigerant section i.e. compressor, condenser, and evaporator; so that the charge does...
not have to be removed for repair and maintenance. Design to detail installation of isolation valves between split system components.

Refrigerant piping systems shall be designed, detailed and specified to be installed with:
- Piping supports at a minimum of 6 feet
- Line size traps at a minimum of every 25 feet of vertical lift
- Liquid line filter drier before any expansion valve
- Suction line filter drier before compressor
- Shraeder valves on suction and liquid line and across filter driers
- Specification to require installation by qualified technicians
- Piping to be installed per ASHRAE standards

Include explicit requirements that:
- Nitrogen purge to be provided during soldering
- NAU reserves the right to cut into any two fittings to confirm the use of nitrogen purge.

**END OF SECTION**
Part 1 – General
Section Includes:
Metal Ductwork, Flexible Ductwork, Exhaust Ductwork
Sheet metal materials
Sealants and gaskets
Hangers and supports

The University prefers low pressure, low velocity (2000 FPM max, 2" WG max) air distribution systems. Designs involving higher velocity and/or pressure shall be reviewed and approved in writing by University.

Noise level volumes of air movement and equipment shall be designed and installed as compatible for intended functions within building spaces. The Design Professional will be held responsible for maintaining acceptable sound levels in all systems.

The design documents will call out in the specification and show locations on the drawings for all dampers, fire dampers, extractors and other controls. Duct pressure classes are to be shown on duct layout drawings.

Part 2 – Products
Supply, Return, General Exhaust

Galvanized Steel shall be ASTM A 527, G90 of lock forming quality.

Heating & cooling supply and return, non-chemical exhausts – minimum 24 gauge and as required by SMACNA.

Ductwork downstream of air handling units shall be constructed in accordance with 100% effective duct length as per ASHRAE and latest SMACNA standards.

Flexible Ductwork
Ductwork to be constructed in accordance with NFPA 90A, 90B, UL181 Class 1

Chemical Fume Exhaust
Fume hood branch duct, manifolded main ducts and any duct subject to concentrated chemical fumes shall be:
Stainless Steel shall be ASTM A 240, type 316, minimum 22 gage
Spiral or welded for fumehood applications.
Fittings shall be continuously welded – liquid tight.
Spiral duct, with flanged connections.
Joints will be constructed with a process equal to the Thermofit Wrap-around Duct Bands manufactured by Raychem.
Longitudinal, all welded seams shall be specified for perchloric or other highly corrosive applications.

Coated Galvanized Steel
Under special circumstances, with University permission, coated galvanized steel ducts may be used for manifolded general chemical exhaust plenums which are large enough to allow duct internal inspection and repair of coating. Specification for coating type and thickness shall be reviewed with University.

Duct Sealants
Specify use of Use Hardcast AFG-1 402 Foil-Grip tape, Hardcast DT-Tape with FTA-20 adhesive, or water based paint-on duct sealant for indoor use, or RTA-50 adhesive for outdoor use, to seal all duct joints.

Part 3 – Execution

Supply, Return, General Exhaust

Ductwork to be constructed per latest SMACNA HVAC Duct Construction Standards.

90° bends and offsets in ductwork will be kept to an absolute minimum. When they are required, they will be designed with long radius sweeps to avoid turbulence in the duct.

Specify use of long radius (center radius of 1.5 times duct width (minimum)) on tees, bends, and elbows.

Require that Ductwork be stored in a clean location prior to installation. Openings shall be covered to prevent entry of dust, moisture and general construction dirt/debris. Plastic sheeting securely taped over open ends will be acceptable.

Specify and balancing dampers at all branch ducts and show location on drawings.
Specify use of single thickness turning vanes only in ductwork up to 2” pressure class.
Specify airfoil type vanes for higher pressure class Install per SMACNA.
Specify that turning vanes are not allowed in reducing elbows.
Design to utilize 45° branch duct entries with main duct size reduction downstream for medium and high velocity systems. Design to utilize 45° branch duct entries or full conical taps for low pressure ductwork. No Bellmouth, Flanged or Notch Spin-In connections permitted except at terminal/diffuser take-offs.

Specify that no extractors allowed.

Design with 15° convergence and divergence preferred. Absolute maximum of 30° divergence or 45° convergence.

**Flexible Ductwork**

Specify maximum flexible ductwork lengths - 18" on high pressure systems, 48" on low pressure systems.

Design and specify that high pressure flexible ductwork shall not be used for changes in direction.

Design and specify that low pressure flexible ductwork may only be used to accommodate a total of a 45° change in direction. Hard elbows shall be used at diffusers.

Specify that flexible ductwork shall be secured utilizing steel draw-band clamp.

**Chemical Fume Exhaust**

Chemical exhaust ductwork to conform to ANSI/AI HA standard 29.5 – 1992

Exhaust system designs shall conform to AIHA Industrial Ventilation manual.

Design all exhaust ductwork within the building to be under negative pressure, with the exception of a limited length of pressurized duct from the fan discharge to outside.

Design exhaust ductwork connections to equipment shall allow for proper drainage flow.

Fumehood exhaust ductwork can be manifolded only if multiple exhaust fans are used. Fume hood exhaust systems are to be designed and specified to prevent any inside surface protrusions especially at joint connections that can catch condensation of fume hood vapors. This includes screwed duct connections.

Filters shall be 2" thick, pleated, 300 FPM maximum velocity, mean efficiency of 36% according to ASHRAE 52-68.
DIVISION 23 – HEATING VENTILATING AND AIR CONDITIONING

Section 23 33 00 Air Duct Accessories

Part 1 – General
Section Includes:
Backdraft and pressure relief dampers
Barometric relief dampers
Manual volume dampers
Control dampers
Fire dampers
Ceiling dampers
Smoke dampers
Combination fire and smoke dampers
Corridor dampers
Flange connectors
Duct silencers
Turning vanes
Remote damper operators
Duct-mounted access doors
Flexible connectors
Flexible ducts

Part 2 – Products
N/A

Part – Execution
The Design Professional will call out in the specification and show locations on the drawings for all dampers, fire dampers, extractors and other controls.

23 34 00 HVAC Fans

23 34 16 Centrifugal HVAC Fans

Part 1 – General
Section Includes:

Air Handling fans, blowers and accessories
Design and selection of all air handling fans and blowers shall consider air density effects of NAU’s 7000 ft elevation.
The University prefers that no centrifugal fan or blower be operated at greater than 2000 RPM. Specific applications requiring centrifugal fans to operate at greater than 2000 RPM shall be reviewed and approved in writing by NAU.
Centrifugal fans handling more than 1,000 CFM shall have backward inclined blades unless approved in writing by University.

Variable frequency drives shall not be specified for forward curved fans unless approved in writing by University.

Design and specify utility fans serving fume hoods to discharge out top of stack at a minimum velocity of 3000 f.p.m.

All air handling fans and blowers shall be selected and specified to deliver design air flow and pressure at less than maximum fan RPM of fan pressure class specified.

All air handling fans and blowers shall be selected and specified to deliver design air flow and pressure without vibration and noise problems, and to enable air balancing without fan or blower over-speed.

Toilets, shower rooms, laundries, and kitchens shall be designed to be individually power exhausted and not tied into any other building exhaust or ventilating systems. Unless approved by University through life cycle analysis, heat recovery shall be specified.

**Part 2 – Products**
Specify that fans shall be tested in accordance with ANSI/ASHRAE STD 51 and ANSI/AMCA STD 210.

**Standard Products** – Specify use of same manufacturer for multiple installations for the same type.
*Preferred centrifugal fan manufacturers; Greenheck, ILG, Trane.*

Specify that fans shall be statically and dynamically balanced at the factory.

Specify that bearings shall be heavy duty split pillow block, self-aligning ball bearings with seals and grease nipples, minimum service life of 200,000 hrs. Permanently lubricated bearings are not acceptable.

Specify short coupled, multi-belted fans to utilize companion sheaves in lieu of variable pitched sheaves.

Specify drain connection in bottom of fan housing - minimum size 3/4".

Specify access doors to blower section - minimum size 18" x 18".

Design duct systems such that fan are located indoors. Where fans must be located
outdoors, specify weather-proof package.
Min. height of discharge stack for chemical exhaust fan to be minimum 10' above
adjacent accessible roof.

All control dampers shall be Tampco Damers.

Part 3 – Execution

In-line fans/blowers shall have adequate access panels for service and maintenance.
Grease fittings shall be extended for easy access without the need for equipment
shutdown.

Design and detail centrifugal fan installation such that fan shaft and wheel can be
removed without disassembly of adjacent equipment.

23 36 00 Air Terminal Units

Part 1 – General
This section includes:
Single-duct air terminal units
Dual-duct air terminal units
Fan-powered air terminal units
Induction air terminal units
Shutoff, single-duct air terminal units
Diffuser-type air terminal units

Specification for terminal Box test submittal data shall require compliance with ADC/ARI
Standard 880-89.

Part 2 – Products
Specify use of only 'long' terminal boxes for any air volume control application requiring
accuracy greater than +/- 25%.

Specify Terminal Box controllers to be Direct Digital and compatible with Campus EMS.
Prefer DDC controllers are factory mounted.

Specify that all Terminal Box controls and actuators shall be externally mounted.

Specify minimum press drop across Terminal Box to be 0.1" wg with control damper fully
open.

Specify maximum sound power level to meet HVAC acoustical requirements.
Specify terminal Boxes to have screwed access doors if serviceable items are enclosed.

Specify that terminal Box damper leakage shall not exceed 2% of nominal box rating at 4" static pressure.

**Part 3 – Execution**

Design and specify duct systems such that minimum of 18" clearance access for service and maintenance is available. Show service access clearance requirements in graphic form on drawings.

Provide detail of terminal box support system on drawings. Detail to require unistrut trapeze hanger where possible. Sheet metal strap hangers screwed to side of terminal box is not allowed.

Detail and specify acceptable box entry and exit conditions. Design high velocity ductwork to provide sufficient straight duct and low turbulence to meet manufacturer’s requirements. Specify maximum allowable offset in flexible duct connection to inlet of box.

**END OF SECTION**
23 50 00 CENTRAL HEATING EQUIPMENT

23 52 00 Heating Boilers

Part 1 – General
Section Includes:
Stand Alone Gas Fired Boilers
University prefers that all facilities are connected to existing central heating utilities. Design use of standalone boilers only when permitted in writing by University.

Boilers shall be specified for operation at 7000 ft. elevation. This may require modification of standard factory unit. Specify that boiler/burner shall be stamped for design performance at 7000 ft. elevation.

Part 2 – Products
Specify all boilers to be commercial/industrial quality.

Specify that make and model of boiler shall have been continuous commercial service in the continental US for more than three years.

Parts and service for specified boiler shall be readily available through a distribution system in the continental US.

Boiler manufacturer, make and model require prior written approval by Facility Services Gas/HVAC department. Submit proposed manufacturers for written approval before finalizing specifications.

Part 3 – Execution
Design all stand alone boiler installations to allow for a three foot clear working area around all sides of the boiler, including the top.

All safeties shall be non-lockout, unless codes require otherwise.

23 57 00 Heat Exchangers for HVAC

Part 1 – General
This Section includes shell-and-tube exchangers.
Design and specify building heat, domestic heat and preheat exchangers with 100% redundancy. Dual heat exchangers are required for all applications.
Design physical layout of heat exchangers in building mechanical rooms to provide service access. Heat exchangers are to be located no more that 5’ above finish floor. Heat exchangers are not to be mounted to ceiling. Demonstrate adequacy of mechanical room geometry for purpose of heat exchanger service clearance in Design Development drawings.

Specify Isolation valves and unions on all heat transfer units on both sides of heat exchanger, both sides of pumps, at strainers and air separators. All Isolation valves shall be ball valves.

Specify all glycol to be Propylene Glycol with inhibitors. NAU uses Dowfrost in the glycol system.

Design outside air preheat loops with 40/60 glycol mixture for freeze protection, use closed loop with no City make-up water connection. Design, specify and detail a mixing tank and pressurization pump for this application.

For applications with extensive outdoor glycol piping, provide 50/50 mix for freeze protection.

Size and specify glycol recovery tank with volume sufficient to allow complete system drainback.

Part 2 – Products
Domestic Water Heater Exchangers refer to Section 22 35 00.

Specification of factory assembled heat transfer skids, including heat exchangers, pumps, air separator, piping and controls is acceptable, provided a minimum of 36” outboard of skid is provided and maintenance access to all components is provided. Require complete manufacturer dimensional shop drawings showing all components and service access, including tube bundle pull space to be shown graphically.

Specification of field erected heat transfer systems is acceptable. Design drawings to provide sufficient detail to show all components and minimum service access clearances. Service access, including tube bundle pull space to be shown graphically. Require contractor submit complete shop drawings including dimension plan, elevation and isometric for engineer review and approval prior to construction.

Part 3 – Execution
All heat exchangers used for space heating purposes shall have controls that fail to the heating mode.

**END OF SECTION**
23 60 00 CENTRAL COOLING EQUIPMENT

23 62 00 Packaged Compressor and Condensate Units

Part 1 – General
This Section includes air and water cooled condensing units.

Mechanical air conditioning systems shall be utilized only when specifically authorized by NAU in writing. Life cycle costing shall be utilized to determine the most appropriate type of cooling or mechanical refrigeration as described in 23 00 00 and below.

The selection of the type of air conditioning to be used shall be based on a 15-year life cycle cost analysis of all viable alternatives. This analysis shall include all expenses including equipment purchase and anticipated replacement costs, maintenance, refrigerant handling, replacement, and disposal costs, and anticipated costs of energy and water. Where applicable, the efficiency of equipment shall be calculated, and used in the life cycle cost analysis, for all expected load ranges. Electrical rates used in life cycle cost analysis shall be actual demand and consumption costs, not "average" costs.

As a baseline, summertime cooling systems shall have economizer cycles with 100% outside air capability. Enthalpy controls shall be provided on all systems that run continuously. Indirect evaporative cooling shall be considered as an additional capacity system. All central air conditioning systems shall have air-side economizers with enthalpy controls. Wet side economizers shall be evaluated using life cycle cost analysis.

The suitability of using evaporative cooling, whether alone or in addition to a mechanical or indirect evaporative system, shall be evaluated. For wet wall installations, face and bypass dampers must be used for temperature control. Wet wall pump cycling shall not be an option for temperature control. Bypass dampers shall be sized to allow full air flow around the wet wall.

When A/C systems are proposed to run year round for critical areas, refrigerant receivers and suction line accumulators shall be used. All "critical area" A/C systems shall be redundant or a parts inventory shall be included in close-out submittal requirements to cover emergency repairs. This inventory shall include any and all controls motors or equipment required to make the system operational in an emergency.

Part 2 – Products
Specify only commercial or institutional grade refrigeration equipment.

Specify equipment to operate with refrigerant 410A unless otherwise approved in writing by University.
Crank case heaters shall be installed on all compressors.

All necessary valves and equipment to permit refrigerant recovery/recycle.

Specify low ambient controls for equipment that operates year around. Specify head pressure or equivalent control. Variable speed for primary condenser fan is preferred.

Provide hail guards on outdoor condensers.

**Part 3 – Execution**

Provide 3 feet clearance around rooftop units or remote condensing units.

Provide maintenance access to all equipment requiring service.

All outdoor compressor units shall be located under permanent covers. Designer shall consider potential of snow drifting or falling icicles in placement of outdoor unit.

Provide low ambient controls on outdoor condensers.

**23 64 00 Packaged Water Chillers**

**23 64 23 Scroll Water Chillers**

**Part 1 – General**

Section Includes:

Packaged, water and air-cooled, electric-motor-driven, scroll water chillers.

Systems to be designed with scroll water chillers only when connection to central chilled water service is not possible, when full backup plant redundancy is required, and when with written permission of University.

Design and specify Air and water cooled scroll chillers up to 100 tons.

Design Scroll chiller equipment rooms within existing codes, EPA regulations and ASHRAE design standards, in particular ASHRAE 15 including the separation of refrigerant and combustion equipment and provision of alarms.

**Part 2 – Products**

Specify only commercial or industrial grade equipment.
Acceptable manufacturers: Trane, Carrier, York, McQuay.

**Unit Description**
Liquid chillers can be semi hermetic or scroll compression design. Separate refrigerant circuits shall include the following: liquid line solenoid valve, filter dryer, sight glass, thermostatic expansion valve and service valves.

Unit efficiency shall meet ASHRAE 90.1

**Evaporator**
Shell and tube design manufactured in accordance with ASME standard, fully insulated and equipped with a drain connection.

**Condensers**
Copper tube aluminum fin pressure tested to ASHRAE standards. Provide head pressure control.

**Electrical**
All electric installations shall comply with the latest NEC standard. Include motor starters with equipment.

**Controls**
All equipment shall be complete with leaving water control and unloading capability, low/high pressure switches, low ambient, freeze stat, flow switch and motor overload safeties, low oil pressure safety switches.

**Receivers**
Shall be capable of entire refrigerant charge pumpdown.

**Head Pressure / Load Control**
Shall be capable of running in low load and low ambient conditions. Provide compressor cylinder unloading where applicable. Provide variable speed condenser fan. Provide hail guard on air cooled condenser.

**Refrigerant**
Specify Use of R-410A.

**Part 3 – Execution**
Remote Interface - provide interface with building/campus energy management system for alarms, start/stop, status, water temperatures.
All systems are to be dehydrated, leak tested charged and tested for proper control and operation.

23 65 00 Cooling Towers

Part 1 – General
Section Includes:

Closed-circuit, forced-draft cooling towers
Closed-circuit, induced-draft cooling towers
Open-circuit, forced-draft cooling towers.
Open-circuit, induced-draft, counterflow cooling towers
Open-circuit, induced-draft, crossflow cooling towers

Towers used for water cooled condensing or for indirect evaporative cooling shall be designed and specified to be protected from freeze damage. Whenever condenser water is pumped through a coil located in a tower, redundant pumping with automatic start of the alternate pump is required. These systems shall be remotely alarmed upon loss of flow through the coil.

It is preferred that sumps drain to storage rather than to waste for freeze protection.

Consider noise, drift and proximity to outside air intakes in location of cooling towers.

Part 2 – Products
Marley, Evapco, Baltimore Aircoil

Specify stainless steel cold water basin

Part 3 – Execution
All systems shall be specified to be equipped with chemical feed systems as coordinated by the University’s chemical treatment consultant. Tower sump and evaporative cooling sumps shall have TDS controlled blowdown; continuous blowdown is not acceptable.

**END OF SECTION**
DIVISION 23 – HEATING VENTILATING AND AIR CONDITIONING

Section Number Title
23 70 00 CENTRAL HVAC EQUIPMENT
23 73 00 Indoor Central-Station Air-Handling Units
23 73 13 Modular Indoor Central-Station Air-Handling Units

Part 1 – General
Section Includes:

Constant-air-volume, single-zone air-handling units
Constant-air-volume, multizone air-handling units
Constant-air-volume, dual-duct air-handling units
Variable-air-volume, single-zone air-handling units
Variable-air-volume, dual-duct air-handling units
Universities Preferred system design is based on Single Duct VAV Concept
AHU to be 'draw-thru' type.
Fan Coil Units

Consider location of OA intakes in concept design. Preferred location is above roof level - not ground level. However, avoid location of AHU outside air intake in vicinity of exhaust louvers, plumbing vent stacks, emergency generator stacks, loading dock areas, smoking area. Consider potential for drift snow and fly snow in sizing and placing outside air intakes.

Design and specify OA intakes to be hard ducted through Mechanical Rooms.

Design to ensure access is provided to both sides of AHU fans to allow bearing replacement.

Design to ensure smooth, uniform inlet and discharge flow conditions to and from AHU to avoid significant static pressure penalty of “system effect”.

Air handler to be specified to provide 'minimum' of one fan impeller diameter upstream of fan.

Provide vibration safety switches on all Vane Axial type fans.

When Vane Axial fans are used ensure suitable access is provided for servicing/removal. Control valves shall be located outside of air handler enclosure.

All chilled water coils and DX coils located in fan coil unit above the ceiling shall have a
secondary drain pan under the fan coil unit. The secondary drain pan shall drain to a custodian sink. Such piping shall be directly connected to the secondary drain pan and maintain a minimum horizontal slope in the direction of discharge of not less than one-eight unit vertical in 12 units horizontal (1-percent slope).

**Part 2 – Products**

Air handlers to be institutional grade. Energy Labs, Hunt Air or equivalent. Fan Coil Units to be Carrier, Trane, or McQuay or equivalent.

Minimum Air Handler specification shall include the following:

- Double walled casing - minimum 18 gauge. AHU shall not be constructed using porous or semi porous materials.
- Hinged access doors to both sides of coils, fans, filters and damper sections.
- Large AHU to have inspection windows in access doors.
- AHU shall have interior inspection lights.
- Side access doors for slide in/slide out filter tanks.
- Removable side panels in fan sections to allow for fan and shaft removal/replacement.
- Utilize only ‘premium efficiency’ motors in AHU’s.

**Part 3 – Execution**

Design and specify that all air handling units with outside air shall be equipped with freeze stats with manual reset, outside air dampers and low-limit controls. All heating water valves shall fail to heating position. All outside air dampers shall fail closed.

Specify that all heating coils that may be exposed to outside air shall be protected by a low temperature control, located downstream of the heat or preheat coil, which will open the supply valve upon failure to maintain the minimum temperature set point. Further, any fan or blower that moves air across such a coil shall shut down upon failure to maintain a minimum temperature, which should have a lower set point than the supply coil low limit. Outside air dampers shall be closed and a hot water valve shall be opened.

Ensure coil drain pans and condensate pipework is pitched to drain, (minimum pitch 1/4” per foot). Provide a secondary drain pan outside of the air handler unit and fan coil unit and provide piping from secondary pan to visible building drain like a custodial
In new construction utilize AHU to 'flush' building to reduce off-gasing of interior furnishings prior to occupancy. Fit AHU with temporary filters during this period.

Replace filters before system balancing.

### 23 74 00 Packaged Outdoor HVAC Equipment

- **Part 1 – General**
  - Outdoor air handlers are not allowed.

- **Part 2 – Products**
  - N/A

- **Part 3 – Execution**
  - N/A

**END OF SECTION**
Mechanical air conditioning systems shall be utilized only when specifically authorized by NAU in writing. Life cycle costing shall be utilized to determine the most appropriate type.

Summertime cooling systems shall have economizer cycles with 100% outside air capability. Enthalpy controls shall be provided on all systems that run continuously. Indirect evaporative cooling shall be considered as an additional capacity system.

When A/C systems are proposed to run year round for critical areas, refrigerant receivers and suction line accumulators shall be used. All "critical area" A/C systems shall be redundant or a parts inventory shall be included in close-out submittal requirements to cover emergency repairs. This inventory shall include any and all controls motors or equipment required to make the system operational in an emergency.

Crank case heaters shall be installed on all compressors.

All outdoor compressor units shall be located under permanent covers.

Provide all necessary valves and equipment to permit Freon recovery/recycle.

All air cooled condensers shall have low ambient temperature controls, and head pressure sensing or equivalent controls. Variable speed for the primary condenser fan is preferred.
This Section includes the following types of air coils that are not an integral part of air-handling units:

- Hot-water
- Chilled-water
- Steam
- Refrigerant

**Coil Section**
Consider high dewpoint outside conditions when sizing cooling coils.

Select cooling coils with water temperatures of 42/62°F EWT/62°F LWT (summer) and 48/60°F EWT/62°F LWT (winter).

Select heating coils with a 40°F water temperature differential.

Maximum coil face velocity 400 fpm.

Maximum coil pressure drop 0.5" SP.

All heating coils that may be exposed to outside air shall be protected by a low temperature control, located downstream of the coil, which will open the supply valve upon failure to maintain the minimum temperature set point. Further, any fan or blower that moves air across such a coil shall shut down upon failure to maintain a minimum temperature, which should have a lower set point than the supply coil low limit. Outside air dampers shall be closed and a hot water valve shall be opened.

**Part 2 – Products**
N/A

**Part 3 – Execution**
Provide 3 feet clearance around rooftop units or remote condensing units.
Provide maintenance access to all equipment requiring service.

**23 83 00 Radiant Heating Units**

**23 83 13 Radiant-Heating Electrical Cables**

**Part 1 – General**
Provide electric-resistance snowmelt cabling at rooflines. Coordinate requirements with NAU Roofing Shop and NAU Electric Shop prior to design.
Ground fault equipment protection for circuits is required.

Provide automatic controller.

Provide receptacle connection for each snowmelt cable.

Sidewalk electric snowmelt shall not be used; this application requires hydronic snowmelting.

**END OF SECTION**
DIVISION 32 – EXTERIOR IMPROVEMENTS

32 00 00  EXTERIOR IMPROVEMENTS

***EXTERIOR IMPROVEMENTS MUST ADHERE TO THE 2015 LANDSCAPE MASTER PLAN AS WELL AS THE DIVISION 32 TECHNICAL STANDARDS. THE LANDSCAPE MASTER PLAN CAN BE FOUND BY CLICKING ON THE LINK PROVIDED BELOW. NOTE THAT THE EXISTING DIVISION 32 TECHNICAL STANDARDS INCLUDED IN THIS DOCUMENT ARE STILL APPLICABLE DURING THE ROLL-OUT OF THE NEW MASTER PLAN. SOME OVERLAP & DISCREPANCIES MAY OCCUR BETWEEN THE TWO DOCUMENTS AND NOT ALL EXISTING STANDARDS ARE INCLUDED IN THE MASTER PLAN. AS A RESULT BOTH DOCUMENTS ARE TO BE UTILIZED HOWEVER WORK MUST CONFORM TO THE LANDSCAPE MASTER PLAN UNLESS WRITTEN EXCEPTION IS MADE BY THE NAU PROJECT MANAGER. IT IS THE CONTRACTORS AND DESIGN PROFESSIONALS RESPONSIBILITY TO IDENTIFY IN WRITING TO THE NAU PROJECT MANAGER ANY DISCREPANCIES IDENTIFIED BETWEEN THESE TWO DOCUMENTS THAT MAY ALTER A PROPOSAL OR BID.

2015 LANDSCAPE MASTER PLAN LINK:
http://nau.edu/uploadedFiles/Administrative/Finance_and_Administration/Facility_Services/Documents/DP_Contract/2015%20Landscape%20Masterplan%20Final.pdf

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This section covers paving, site improvements and landscaping requirements for NAU.

Part 1 – General
A specification section shall be provided for work under this section including Special Provisions and other qualifications as necessary to make the specifications project specific.

Consultants shall tailor their specifications to local practice and University requirements. Testing of materials will be by qualified materials testing laboratory hired by either the Contractor or the University.

Require repaving and stripping if staging or yard areas for construction are in an existing parking lot or an adjacent street. Any pavement damage or significant increased wear as a result of a construction project’s laydown area(s) and/or site operations are the responsibility of the prime contractor. The contractor may be required to repave the entire parking lot or roadway section. The contractor may provide an alternate asphalt/concrete treatment to remediate the damaged condition back to a like new condition for review and approval. An alternate treatment would only be considered when recommended, designed, & stamped by a civil engineer registered in the state of Arizona. Any additional assessment, engineering, or other design and construction costs associated with these types of repairs are the responsibility of the contractor and cannot be charged back to the project budget.

The most current version of the Flagstaff/Coconino County Pedestrian and Bicycle Design Guide shall be used for design and specification of paving and signage for bicycle routes and facilities.

Concrete surfaces shall be provided at motorcycle parking and in maintenance areas where oil or gas spillage could occur.

Access ramps shall be provided when the project is located at an intersection and at other intervals along a street if crosswalks are provided. Inclusion of these ramps must be evaluated with the FS PM for ADA Compliance.

Dead end driveways are highly discouraged, but if site restrictions mandate this design approach, there shall be a minimum of 20' of unobstructed pull in length; width equal to the driveway.

The DP is required to obtain all information regarding parking stall layout, flow
and stall dimensioning from Parking Services, Mountain Campus Transit, NAU Department of Public Safety and NAU Disability Resources per the NAU Design Guidelines, along with formal written approvals of the design concept from these entities at the completion of the 30%, 60%, and 90% Construction Drawing phases.

Part 2 – Products
Portland Cement Concrete 03 00 00, Asphalt 32 12 16 and Masonry Pavers 04 22 33 are included in this division. In addition to testing required by MAG2014, Aggregates must be subjected to five cycles of the sodium sulfate soundness test in accordance with the requirements of AASHTO T-104. The total loss shall not exceed ten percent by weight of the aggregate as a result of the test.

During construction projects that affect the parking areas on campus, the Contractor shall be responsible for providing barricades and appropriate signage for all parking lot entrances.

Signs shall read:
"Parking Lot Closed From _____ to _____
Use Lot # ____"

Part 3 – Execution

32 11 00 Base Courses

Part 1 – General
Base course materials and preparation shall be determined by a geotechnical engineer after an investigation of the proposed project area and the existing surface (may be pavement) and subgrade conditions present.

Complete base course design includes subgrade soil preparation information and compaction standards, base course composition, depth and compaction standards. Base course placement will comply with MAG 2014 Section 310.

Part 2 – Products
Base course materials shall be tested in accordance with MAG2014 Section 701 and shall be consistent with Section 702.

Part 3 – Execution
The aggregate base course to be 6" minimum in depth, (more as defined on a project specific basis) 100% crushed rock conforming to MAG Specification 702, Type B, compacted per ASTM D1557-78;
Part 1 – General
This section will cover asphalt and permeable asphalt paving at NAU. Pavements are part of the site grading and storm drainage and will be designed in conformance with the stormwater design guidelines (00 00 00). Use of permeable (also called porous or pervious) asphalt requires special permission by the FS project team.

Asphalt and pervious or permeable pavements shall be designed by a geotechnical engineer registered in the state of Arizona. A life cycle cost analysis (including proper maintenance procedures).

The Contractor shall furnish the Engineer with a job-mix formula for the asphalt concrete not less than ten (10) days in advance of actual placement of the material. The job mix formula, upon approval of the Engineer, shall be used to establish the standards to which field test results will be compared, and to determine compliance of the materials furnished with all physical properties of the composite mix and its individual components as shown on the approved job-mix formula. The job-mix formula, with the allowable tolerances for a single test, shall be used for monitoring compliance with the specifications.

Part 2 – Products
Products will be consistent with Section 32 12 16 Asphalt Paving or as specified in the plans and specifications by the pavement designer.

Part 3 – Execution
Execution of flexible pavements will be consistent with Section 32 12 16 Asphalt Paving or as specified in the plans and specifications by the pavement designer.

32 12 16 Asphalt Paving

Part 1 - General
This section is written as design guidance for any NAU paving project and is intended to give sufficient detail to provide a designer the information required to prepare design development documents (60 %) for asphalt and MAC paving projects throughout campus including roadways, parking lots, driveways, bike paths, pedestrian ways and sidewalks. This section also applies to patching and repairing of the above listed pavements. Further refinement should not be made without specific input from the FS project team.

All new and replacement full pavement sections shall include subgrade, base course, asphalt, and chip seal. Patches shall match existing pavement sections.
Throughout the design process (CD 30%, 60%, 90%) formal written approvals are required.

The designer shall follow the recommendations of the geotechnical engineer with regard to pavement design, including but not limited to asphalt cement type, subgrade thickness, and pavement thickness. If a geotechnical engineer has not been retained for the work, then the minimum standards contained in this section shall be used.

Damage to existing utilities shall be repaired and made good by the contractor.

Cold patching may be used only as a temporary measure. Permanent patches must be hot mix.

If asphalt patch is less than 25 sq. ft., hand method of placement and screening can be used. Materials must be hot mix.

If asphalt patch is greater than 25 sq. ft. or a critical area, use lay down machine.

When working at curbs, widen excavation, form and pour curb, cut straight asphalt edge, and patch.

All asphalt cuts shall be saw cut.

Manholes and valves shall be adjusted to grade after paving. Final adjustment shall be provided with concrete paving patch to roadway grade.

No asphaltic concrete curbing or driveway aprons are allowable.

Testing Requirements:
Contractor will secure an independent testing lab for quality control purposes. The Owner shall employ an independent testing lab for quality assurance. All testing shall be documented and reports shall be provided to the owner’s representative on an ongoing basis as soon as the results are obtained. The schedule for testing and results will be developed between the owner and the lab as part of contract agreement but shall not be longer than 2 days from when the tests results are obtained. Tests within the acceptable ranges are not as critical as tests falling outside the acceptable range. Failing tests are to be reported immediately to the contractor and the Owner. Retesting required due to test failures are to be paid for by the Contractor. Testing is to be scheduled along with the work and delays caused by testing will not be subject to change orders for more time.
Asphalt paving shall be tested according to the MAG2014 criteria for asphalt and any additional testing required to confirm consistency to the mix design.

Geotechnical testing shall be provided during paving operations.

In general paving shall conform to MAG2014 Sections 321-336 and materials Sections 709-717.

Due to the variation in costs between conventional asphalts and polymer modified mixes, the University may require that alternative mix designs be developed for paving including a low initial cost material and a higher initial cost/longer life material. Designers may use the FHWA spreadsheet RealCost Life Cycle cost Analysis for evaluating mix designs for life cycle cost. A link to this free software is: http://www.fhwa.dot.gov/infrastructure/asstmgmt/lccasoft.cfm

**Part 2 - Products**

At a minimum asphalt shall be in conformance with AASHTO Designation MP-1, Table I and shall be PG 58-26 for 19 mm asphaltic concrete and PG 58-22 for modified asphaltic concrete (MAG). MAG2014 Table 710-3 Marshall Mix Design Criteria will be used for both 19 mm (3/4 in) and MAC. The aggregates and mix to be incorporated into the work shall also meet the following additional requirements.

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<th>Test Results MAC</th>
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<td>0 - 1%</td>
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<td>0 - 2.25%</td>
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<tr>
<td>Flow (ASTM D1559) Units of .01 inches</td>
<td>8 to 18</td>
<td>15 min</td>
</tr>
<tr>
<td>Air Voids Content (mix)</td>
<td>3% to 5%</td>
<td>3% to 5%</td>
</tr>
<tr>
<td>Tensile Strength Ratio (TSR) (AASHTO T 283, with optional freeze cycle)</td>
<td>0.75 min</td>
<td>0.75 min</td>
</tr>
<tr>
<td>Sodium Sulfate Soundness (AASHTO T-104)</td>
<td>12 % max</td>
<td>12 % max</td>
</tr>
<tr>
<td>Percent Carbonates (Arizona test Method 238)</td>
<td>30 % max</td>
<td>30 % max</td>
</tr>
<tr>
<td>Binder Content</td>
<td>5.3% to 6.0%</td>
<td>8.0% to 9.0%</td>
</tr>
</tbody>
</table>
All asphaltic concrete and modified asphaltic concrete shall contain a minimum of 1% Portland cement or dry hydrated lime by weight of total aggregate added to the aggregate in a pug mill prior to addition of the binder. The moisture content of the aggregate immediately prior to the addition of the admixture shall be a minimum of 3.0%.

See Section 714 for modified asphaltic concrete specifications.

**REQUIREMENTS FOR ANIONIC/CATIONIC EMULSIFIED ASPHALT**

(revise to include the following for CRS-2P)

**CATIONIC RAPID-SETTING POLYMER-MODIFIED ASPHALTIC EMULSION, CRS-2P**

**MATERIAL SPECIFICATIONS FOR CHIP SEAL COATING**

<table>
<thead>
<tr>
<th>Test Description</th>
<th>Test Method</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEST OF EMULSION</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Viscosity, SFS @ 122 F</td>
<td>D244</td>
<td>125</td>
<td>400</td>
</tr>
<tr>
<td>Settlement, 5 days, %</td>
<td>D244</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Storage Stability 1 Day, %</td>
<td>A244</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Class, Un-coated Par</td>
<td>A502</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>Particle Charge Test</td>
<td>D244</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Sieve Test, %</td>
<td>D244</td>
<td>0.30</td>
<td></td>
</tr>
<tr>
<td>Oil Distillate, % V of Emulsion</td>
<td>D244</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Residue by Distillation, %</td>
<td>D244</td>
<td>66</td>
<td></td>
</tr>
<tr>
<td>Tests on Residue by VACUUM RECOVERY A512</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Viscosity, ABS, Poise @ 140 F</td>
<td>D2171</td>
<td>1800</td>
<td>2800</td>
</tr>
<tr>
<td>Pen @ 77F, 100g/5 sec, Dmm</td>
<td>D5</td>
<td>40</td>
<td>90</td>
</tr>
<tr>
<td>Ductility, 77F, 5 cm/min, Cm</td>
<td>D113</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>Solubility in TCE, %</td>
<td>D2042</td>
<td>97.5</td>
<td></td>
</tr>
<tr>
<td>Toughness, inch-pounds</td>
<td>(1)</td>
<td>150</td>
<td></td>
</tr>
<tr>
<td>Elastic Recovery by means of Ductilometer, %</td>
<td>T301</td>
<td>58</td>
<td></td>
</tr>
<tr>
<td>Tenacity, inch-pounds</td>
<td>(1)</td>
<td>110</td>
<td></td>
</tr>
<tr>
<td>Polymer Content (by wt. Of solids) %</td>
<td>CAL-401</td>
<td>2.5</td>
<td></td>
</tr>
<tr>
<td>TEST ON RTFO RESIDUE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aging Ratio, ABS viscosities</td>
<td>D2171</td>
<td>2.5</td>
<td></td>
</tr>
</tbody>
</table>
1) Benson method of toughness and tenacity: Scott tester, inch-pounds @ 77ºF, 20 inches per minute pull. Tension head 7/8” diameter.

2) Upon standing undisturbed for a period of 24 hours, the emulsion shall show no white milky film upon the surface.

3) The base asphalt shall be modified prior to emulsification.

4) The emulsion shall be pre-certified prior to use. A one-quart sample each of the base asphalt and polymer shall be supplied to the agency 10 days in advance to the project start.

**MODIFIED ASPHALTIC CONCRETE**

Modified Asphalt Concrete (MAC) shall consist of a mixture of paving asphalt, modifiers and mineral aggregate which, with the addition of mineral filler and blending sand as may be required, shall be mixed at a central mixing plant in the proportions hereinafter specified to provide a homogeneous and workable mixture.

Modified Asphaltic Concrete (MAC) shall consist of furnishing asphaltic concrete with binder meeting the requirements of either:

- Rubberized Asphaltic Concrete (RAC)
- Polymer Modified Asphalt Concrete (PMA)
- Polymer Modified Rubberized Asphalt Concrete – Dry Process (PMRAC)
- SHRP graded PG64-28TR=(TR+)

At the locations shown on the plans in accordance with the following specifications. Within 10 calendar days of notice of award, the contractor shall submit in letterform, the name of the supplier and a type of MAC to be supplied.

Two weeks prior to construction the contractor shall submit three (3) gallons of the modified asphalt binder for testing. Application and testing will be in accordance with MAG 321 as amended by the General Provisions and Special Provisions.
MATERIAL

BINDER

The asphalt rubber binder in the mix shall comply with MAG 717 and 335 except the rubber shall be type II and the minimum rubber content for RAC shall be 17% as a percentage of total binder. Asphalt cement for all MAC shall meet the requirements of PG 58-22 as per AASHTO MP-1 Table I. Polymer shall be Type SBS and shall be 5.5% to 7% of the total binder for PMA. Twenty percent of the modifier for PMA shall be ground tire rubber. The PMA shall be such that the materials conform to the specification requirements. Ground rubber shall be Type II with the following gradation:

Gradation - Ground Rubber (Type II)

<table>
<thead>
<tr>
<th>Sieve No.</th>
<th>% Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>#10</td>
<td>100</td>
</tr>
<tr>
<td>#16</td>
<td>70-100</td>
</tr>
<tr>
<td>#30</td>
<td>25-60</td>
</tr>
<tr>
<td>#50</td>
<td>0-20</td>
</tr>
<tr>
<td>#200</td>
<td>0-5</td>
</tr>
</tbody>
</table>

Binder for Rubberized Asphaltic Concrete (RAC) shall conform to the following specifications:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apparent viscosity, centipoise, 350ºF, Spindle 3, 20 RPM (ASTM D2196)</td>
<td>1500-6000 Centipoise</td>
</tr>
<tr>
<td>Penetration, 77ºF, dmm, 100g, 5 sec (ASTM D-5)</td>
<td>25 minimum 90 maximum</td>
</tr>
<tr>
<td>Penetration, 39.2ºF, dmm, 200 g, 60 sec (ASTM D-5)</td>
<td>15 minimum</td>
</tr>
<tr>
<td>Cone Penetration, 77ºF, dmm,150g, 5 sec (ASTM D-5)</td>
<td>25 minimum</td>
</tr>
<tr>
<td>Resilience, 77ºF, % (ASTM D-3407)</td>
<td>20 minimum</td>
</tr>
<tr>
<td>Softening Point, ºF (ASTM D-36)</td>
<td>135 minimum</td>
</tr>
<tr>
<td>TFOT Residue (ASTM D1754)</td>
<td>75 minimum</td>
</tr>
<tr>
<td>Penetration Retention, 39.2ºF, %&quot;</td>
<td></td>
</tr>
</tbody>
</table>

Haake type viscosity may be substituted for field control
Binder for Polymer Modified Asphalitic Concrete shall conform to the following specifications:

<table>
<thead>
<tr>
<th>Specification:</th>
<th>ASTM METHOD</th>
<th>SPEC. LIMITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>ORIGINAL ASPHALT</td>
<td>D5</td>
<td>MIN. 25</td>
</tr>
<tr>
<td>Penetration, 39.2 F (200g/60 sec), dmm</td>
<td>D5</td>
<td>MAX. 90</td>
</tr>
<tr>
<td>Penetration, 77 F (100g/5 sec), dmm</td>
<td>D5</td>
<td></td>
</tr>
<tr>
<td>Softening point, F</td>
<td>D36</td>
<td>180</td>
</tr>
<tr>
<td>Flash point, F</td>
<td>D92</td>
<td>450</td>
</tr>
<tr>
<td>Ductility, 39.2 F (5 cm/min), cm</td>
<td>D113</td>
<td>30</td>
</tr>
<tr>
<td>Ductility, 77 F (5 cm/min), cm</td>
<td>D113</td>
<td>100</td>
</tr>
<tr>
<td>Viscosity, 275 F, cst</td>
<td>D2170</td>
<td>1000</td>
</tr>
<tr>
<td>Recovery, 39.2 F, %</td>
<td>D113 MOD</td>
<td>60</td>
</tr>
<tr>
<td>Solubility, Trichlorethylene %</td>
<td>D2042</td>
<td>99</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>AGED ASPHALT (RTFO)</th>
<th>METHOD</th>
<th>MIN. 60</th>
<th>MAX. 15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retained Penetration, 77 F, %</td>
<td>D5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Viscosity Ratio, 275 F, %</td>
<td>D2170</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Softening Point, F</td>
<td>D36</td>
<td>175</td>
<td></td>
</tr>
<tr>
<td>Ductility, 39.2 F (5 cm/min), cm</td>
<td>D113</td>
<td>20</td>
<td></td>
</tr>
</tbody>
</table>

The asphalt binder modifier for the PMA shall contain a minimum of 20% recycled material.

The Polymer Modified Rubberized Asphalt Concrete – Dry Process (PMRAC-DP) and SHRP graded PG64-28TR+ shall conform to requirements of Superpave Grade PG64-28 (AASHTO MP-1 and MAG Section 335) except as follows:

<table>
<thead>
<tr>
<th>Test Properties</th>
<th>Specification</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scrap whole tire rubber (Type II) content, %, Minimum</td>
<td>17.0</td>
<td>8.0</td>
</tr>
<tr>
<td>Trans-polyoctenamer rubber polymer (TOR), %, Based on the weight of the tire rubber</td>
<td>4.5</td>
<td></td>
</tr>
<tr>
<td>SBS Polymer content %, Minimum</td>
<td>2.0</td>
<td></td>
</tr>
</tbody>
</table>

Original Testing
<table>
<thead>
<tr>
<th>Section Number</th>
<th>Title</th>
<th>Standard</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>COC Flash Point, °C, Minimum</td>
<td>ASTM D92</td>
<td>232</td>
<td>232</td>
</tr>
<tr>
<td></td>
<td>Softening Point, °C, Minimum</td>
<td>ASTM D36</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>Elastic Recovery, 10°C, 10cm, % recovery/1hr, Minimum</td>
<td>ASTM D6084</td>
<td>55</td>
<td>55</td>
</tr>
<tr>
<td></td>
<td>Solubility in Trichloroethylene, Minimum, %</td>
<td>ASTM D2042</td>
<td>97.5</td>
<td>97.5</td>
</tr>
<tr>
<td></td>
<td>Dynamic Shear, 64°C, 10 rad/sec, G*/sin delta, kPa, Minimum</td>
<td>AASHTO TP5</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>Dynamic Shear, 64°C, 10 rad/sec, G*/sin delta, phase angle, degrees, Maximum</td>
<td>AASHTO TP5</td>
<td>75</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td>RTFO Residue Testing</td>
<td>AASHTO TP5</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dynamic Shear, 64°C, 10 rad/sec, G*/sin delta, kPa, Minimum</td>
<td>AASHTO TP5</td>
<td>2.20</td>
<td>2.20</td>
</tr>
<tr>
<td></td>
<td>PAV Aging Residue Testing</td>
<td>AASHTO TP5</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dynamic Shear, 25°C, 10 rad/sec, G*/sin delta, kPa, Maximum</td>
<td>AASHTO TP5</td>
<td>5000</td>
<td>5000</td>
</tr>
<tr>
<td></td>
<td>Bending Beam Rheometer</td>
<td>AASHTO TP5</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Creep stiffness, -18°C, MPa/60 sec, Maximum</td>
<td></td>
<td>300</td>
<td>300</td>
</tr>
<tr>
<td></td>
<td>M-Value, -18°C, 60 sec, Minimum</td>
<td></td>
<td>0.300</td>
<td></td>
</tr>
</tbody>
</table>

Aggregate shall conform to Section 710.2.2.

The aggregate gradation will be as follows:

<table>
<thead>
<tr>
<th>Sieve No.</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>5/8</td>
<td>100</td>
</tr>
<tr>
<td>1/2</td>
<td>98 +/- 2</td>
</tr>
<tr>
<td>3/8</td>
<td>85 +/- 7</td>
</tr>
<tr>
<td>4</td>
<td>35 +/- 7</td>
</tr>
<tr>
<td>8</td>
<td>20 +/- 5</td>
</tr>
<tr>
<td>30</td>
<td>10 +/- 5</td>
</tr>
<tr>
<td>200</td>
<td>5 +/- 2</td>
</tr>
</tbody>
</table>

**AGGREGATES CHARACTERISTICS**

Combined aggregates shall conform to 710.2.2 except the minimum sand equivalent shall be 65 and at least 85% by weight of the aggregate retained on the #8 sieve shall consist of particles with at least one rough, angular surface
produced by crushing.

**MINERAL FILLER AND ANTI-STRIPPING AGENT**

Mineral filler and anti-stripping agent shall be as per Section 710.2.3.

**MIX DESIGN REQUIREMENTS**

The provisions of 710.3 MIX DESIGN REQUIREMENTS shall apply to MAC except that:

References to asphalt, liquid asphalt, bituminous cement shall be changed to "binder conforming to 714.2.1."

For estimating purposes, the percentage of binder in the MAC shall be 8% for PMA and RAC. For estimating purposes, the percentage of binder in the MAC shall be 7% for TR+ and for PMRAC-DP. The exact amount of binder in the MAC shall be subject to the Engineer’s approval after review of the contractor’s job mix formula and materials submittals. Marshal mix design criteria will be used for MAC.

**PRODUCTION TOLERANCES**

The provisions of 710.4 PRODUCTION TOLERANCES shall apply to MAC except that:

References to asphalt, liquid asphalt, bituminous cement shall be changed to "binder conforming to 714.2.1."

**PRODUCTION REQUIREMENTS**

The provisions of 710.5 shall apply for MAC except that:

References to asphalt, liquid asphalt, bituminous cement shall be changed to "binder conforming to 714.2.1."

Bituminous binder course shall 2" thick, conforming to MAG Specifications Section 710;

Bituminous surface course shall be 2" thick, conforming to MAG Specifications Section 710.

Sealer coat shall be applied after completion of laying of asphalt. DP to specify
time frame and procedures.

Designer to include in asphalt section design.

32 12 19 Asphalt Paving Wearing Courses

Part 1 – General
All new asphaltic pavements shall include a wearing course.

Part 2 – Products
Quick setting and emulsified asphalt per MAG spec type CRS-2.
Aggregate gradation shall conform to MAG spec table 716-1 for moderate traffic areas and MAG spec Table 716-2 for high traffic areas. ADOT specification CM 11 will be considered as an alternate subject to availability of MAG specification material and credit price.

Submit chip sample for testing prior to application.

Part 3 – Execution
Loose chips shall be swept and removed within a 24-hour period and again at a later date if required.

Contractor is responsible for protection of all manholes and valve covers. All manholes and valve covers shall be marked with non-permanent orange paint and protected with cardboard (or equally effective material) prior to chip sealing.

32 12 36 Seal Coats

Part 1 – General
Bituminous surfacing shall be used only in exceptional cases. Chipseal is the preferred preservation method.

Part 2 – Products

Part 3 – Execution

32 12 73 Asphalt Paving Joint Sealants

Part 1 – General
Expansion joint filler material is used with asphalt pavements per MAG2014 Sections 321-336.
Part 2 – Products
Joint materials shall be in conformance with MAG2014 Section 729

Part 3 – Execution

32 13 00 Rigid Paving

This section includes concrete and pervious Portland cement based concrete pavements.

32 13 13 Concrete Paving

Part 1 – General
Concrete Ramps must meet the requirements of the NAU Design Guideline for Campus Accessibility.

Submittals

Shop Drawings: Submit sections and details where not fully dimensioned on the drawings.

Manufacturer's Data: Submit for proprietary products.

Mix Design: Prior to pouring any concrete, submit concrete mixes for approval in accordance with Section 03 00 00. Separate mix designs shall be submitted for each type of concrete to be used in the project.

Record of Work: Provide record of time and date of placement, temperature, water additions to the mix, and weather conditions.

Quality Assurance:

For placement restrictions see Division 03 concrete.

All materials to conform to Division 03 concrete

Prior to placement of concrete, independent testing lab must confirm subgrade compaction, responsible party shall confirm that the form placement conforms to the survey and is within the tolerances. Reinforcement shall be tied and supported in rebar chairs as approved by the DP. If welded wire mesh is used, support shall conform with plans and specs. The responsible party shall confirm proper placement and spacing between the rebar or weld wire mesh and the
Minimum Thicknesses:

1. Sidewalks not Subject to Vehicle Traffic: 4”.
2. Sidewalks and Drives Subject to Vehicle Traffic: 6”.
3. Structurally Supported Slabs (Such as Over Tunnels): As required to meet potential loading conditions.
4. Loading docks: 8”

Part 2 – Products
Reinforcement shall conformance with 03 21 00 Reinforcing Steel.

All campus loading docks shall be paved in concrete and reinforced per DP specifications.

Provide either welded wire fabric or fibrous reinforcement in concrete. One type is required for all on-grade slabs.

Curbs, gutter and cross pans finished with burlap drag or wood float. Do not plaster surfaces.

Immediately after float finishing sidewalks and ramps, slightly roughen the concrete surface by brooming in the direction perpendicular to the main traffic route. Use fine hair fiber-bristle broom except on inclined slab surfaces provide a coarse, non-slip finish by scoring surface with a stiff-bristled broom, perpendicular to the line of traffic.

Special Finishes: Do not use special finishes such as colored concrete, exposed aggregate, etc. unless specific approval from NAU Project Manager is obtained. Evaluation will be made on a job-by-job basis. Do not use metal nosings on exterior concrete stairs.

Part 3 – Execution
Deposit concrete near final position on grade with minimum segregation and without damage of subgrade. Consolidate concrete so that concrete shall fill the forms and be free from rock pockets, bee holes, and honeycombing.

Finishing
Use equipment designed to spread, consolidate, screed and float freshly placed concrete in one pass, providing well consolidated, homogeneous mixture, requiring minimum of hand finishing to meet surface tolerances.
Finished surface tolerances:

Tested with 10' straight edge parallel to center line immediately following first float-ing of surface.

Advance straight edge 5'; space under straight edge shall not exceed 3/16".

Joints
Control joints, 1. Shall have a minimum depth of 1/4 thickness in the concrete or a minimum of ¾ inch.
Space at even intervals perpendicular to the path of travel.

The jointing pattern shall be equal to the width of the walk or drive to a maximum of 6 feet o.c. on any side or 10 feet for curb and gutter.

For small concrete replacements the jointing pattern shall match existing adjacent work.

Expansion joints with preformed joint filler in a vertical position, deviating not more than 1/4" from a straight line. Expansion joints shall be installed when abutting existing concrete or fixed structure. Expansion joint material shall be ½" thick and shall extend the full depth of contact surface and shall be at a maximum spacing of 60 foot o.c.

Saw Cutting and Patching
Joints shall be sawcut or added during placement with a jointing tool to eliminate random expansive cracking of slab surfaces. Sawcutting shall be performed within 24 hours of the slab

Curing
Required curing practices will be specified by the design professional in the design documents. As is standard practice, contractors will have their curing equipment and accessories ready for use prior to placement of the concrete to ensure prompt curing once the exposed surfaces are finished.

Designers will provide for curing options for warm, dry and cold weather.
Concrete operations: Curing of the concrete should begin immediately upon finishing the surface. Finishing should not be completed until surface bleeding has stopped and the bleed water has dried immediately after finishing and water film has evaporated from surface. Do not use liquid membrane type on surfaces to receive mortar bed finishes.
Field Quality Control / Testing
General: All testing, shall be performed by an approved testing laboratory. The following tests and procedures are subject to change during construction at the discretion of the Engineer.

Control Tests: Control test of concrete work shall be made at such times and in such manner as directed by the Engineer at the expense of the owner. Each test shall consist of 3 standard 6” test cylinders cast and cured in accordance with ASTM C31 and C172. One cylinder shall be broken at the end of 7 days after placing, one cylinder shall be broken at the end of 28 days after placing, and the remaining cylinder shall be kept for disposition is determined by Engineer. The remaining cylinder will be broken only when the previous test reports indicate unsatisfactory results. Tests shall be made at the time test cylinders are taken, and recorded on the reports to determine the slump, air content, unit weights, and temperature of the concrete. All tests shall be made in accordance with ASTM C39, C138, or C231.

Protection
Protect fresh uncured surfaces from rain.

Cold Weather: Maintain temperature of concrete above 50 degrees F. for minimum five days from placement.

No vehicle loads exceeding design loading. No equipment permitted on new pavement until design strength is attained.

Engineer to specify cure of 3 to 7 days minimum unless special use / mix.

Concrete Paving

Part 1 – General

Part 2 – Products

Part 3 – Execution Description
This section includes all general concrete paving for pedestrian travel ways or entry features, that do not have special prominence dictating special design finishes.

Design Standard
A. 6' design width in areas of low pedestrian travel, 8' design width in areas of high pedestrian travel, including collector walks at residence hall buildings.
Paving continuing or connecting major mall travelways (i.e., Tyler Mall), or major/significant building entries shall be of a width justified by traffic volume and aesthetic precedent.

B. All curb cuts, ramps and level transition shall conform to the most recent edition of ANSI "Specifications for Making Buildings and Facilities to, and Usable for, the Physically Handicapped," Arizona Revised Statues, Title 34.

C. Sidewalks that are 5 feet in width or wider should have 6 inches of concrete over 4 inches of base course.

D. Magnesium floated, with a "rosebud" texture.

E. Expansion joints 20' maximum in a single run of paving.

F. Architectural scoring or joints to be at the same interval as the design width of the subject travel way. Designers option for widths greater than 8', or walks requiring special design consideration.

G. An additional 3' of width is required for walks that are adjacent to surface parking lots, where the edge facing parking is used as a wheel stop or overhang area.

H. Walk intersection corners shall be rounded and at all grade changes shall have appropriate curb cuts and transitions that allow full handicap accessibility and safety.

I. A minimum 12' radius turn-around area is required for any dead-end walk.

J. Walks over 8' in width, adjacent to grade changes of over 4 inch, adjacent to planter beds, walks crossing of vehicular travelways, special entry features or major mall connections or extensions shall also consist of a border/curb design as described in Division 03, Section 03 35 23.

K. Minimum parking stall size is 9'-0" x 18'-0", handicap accessible stalls 11'-0” x 18'-0” with a 5’-0” unload zone.

32 13 16 Decorative Paving
No information

32 13 73 Concrete Paving Joint Sealants
No information

32 14 00 Unit Paving

32 14 13 Precast Concrete Unit Paving

Part 1 - General
Concrete paving stones are the University preference. 2 3/8" interlocking paving stones, in "N.A.U. Triblend" colors. Unit pavers used in walkways shall have bands of "Finetta" I.P.S. Spacing of bands shall be equal to walkway width. (Reference the pedway for example of the above criteria).
This section covers unit pavers.

**Submittals**
Prior to construction of the sample pavement submit one set of six units each for each type and color of paver required, showing full range of colors and textures. A materials palette was established for use for all new construction as part of the campus master planning. Pavers shall be consistent with the materials palette.

Materials included in the palette are the only materials allowed for use in the exterior of all new buildings and renovations. Brick, sandstone and stone veneer are the masonry elements described. Along with the acceptable materials list the approved local suppliers for LEED accreditation are listed.

For all new and infill masonry pavers adjacent to existing pavement, a 36 square foot sample pavement (mock up) shall be constructed on site near the proposed work area to evaluate the selected brick for matching. DP shall require the contractor to allow for sufficient time for the owner and the DP to evaluation and approve the proposed pavement.

On new construction, a minimum 36 square foot sample pavement (mock up) should be constructed to establish the standard of acceptance for all elements of the work, including but not limited to: curbing and expansion, bond pattern, tie-in with other materials and finishes, accessories, etc. The sample panel shall be approved by the owner and the design professional prior to ordering materials and commencement of masonry work.

Retain sample pavement (mock-up) during construction as a standard for judging completed unit paver work. Do not move or destroy mock-up until work is completed.

For roadway applications pavement section should include a concrete subbase for pavers. Consult with geotechnical engineer if the area will see lots of vehicular traffic.

**Part 2 – Products**
Paver units shall be whole and undamaged prior to installation. Units that are chipped, cracked, broken or stained are not allowed.

Provide materials obtained from only one source for each type and color of pavers.

Bedding and joint sand shall be clean, non-plastic, and free from deleterious or
DIVISION 32 – EXTERIOR IMPROVEMENTS

<table>
<thead>
<tr>
<th>Section Number</th>
<th>Title</th>
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<tr>
<td>32 14 40</td>
<td>Stone Pavers</td>
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foreign matter. The sand shall be natural or manufactured from crushed rock. Limestone screenings or stone dust or lightweight aggregates that do not conform to the grading requirements in Table 1 shall not be used. The sands shall be as hard as practically available.

Sound durable particles free from organics, clays, deleterious and foreign matter
Use an aggregate base course material per MAG2014 Section 702.

Bed Sand shall conform to ASTM C33 and joint sand shall conform to ASTM C144 not more than 1% passing No. 200 sieve.

ACCESSORIES
Upon recommendation by the geotechnical engineer, a geotextile fabric may be specified for paver installation. Use of fabric is reserved for areas with clay soil or damp conditions.

Part 3 – Execution
Contact Bluestake before conducting any excavations

Excavate the pavement area to allow for the pavers, the bedding sand layer

Prepare subgrade soil per the recommendations of the soils report. In all cases, this will include even grading of the area and compaction. The subgrade shall be free from water, clay and rocks. If recommended, provide a geotextile fabric.

Install edge restraints per plans

Verify location, type, installation and elevations of edge restraints around the perimeter area to be paved.

Place an approximately 1-1 ¼ inch deep sand bed

Lay out work in pattern provided in the plans and specs to minimize cutting. Cut pavers as necessary to fit within the edge restraints.

Lay the pavers with consistent spacing for joints and provide an even flat surface with no elevation deviation between pavers of greater than 1/16" will be unacceptable. Pavement tolerance of 3/16" is allowed over a distance of ten feet.
Generally, the project budget will preclude the use of large areas of stone pavers, however in limited areas and as accents, the material can greatly enhance the overall aesthetic character of the design.

**Design Standard**

Pavers: 1/2 inch minimum thickness, thick-set. A material should be chosen that is relatively impervious to moisture absorption and has a high degree of slip coefficient. Polished or honed finishes as a major field finish are not acceptable.

### 32 15 00 Aggregate Surfacing

#### 32 15 13 Cinder Surfacing

Clean cinders are not allowed for anything in the County. Dirty cinders are used for bedding pipes and shading trenches. City calls out cinder sand for curbs stops and valve boxes and allows for ½ inch diameter red and black cinders as rock mulch.

### 32 15 40 Crushed Stone Surfacing

#### Part 1 – General

Gravel roads shall be constructed with the proper cross section to allow for drainage and maintenance. Use the county lot split standard for sloping of roadway bed and shoulders for emergency and maintenance access driveways.

#### Part 2 – Products

If no geotechnical recommendations are available surfacing and subgrade for gravel roadways, use the recommended gradation from the EPA gravel roadway guidelines: [http://www.epa.gov/nps/gravelroads/](http://www.epa.gov/nps/gravelroads/).

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Aggregate Base Course</th>
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<tr>
<td>Sieve</td>
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<td>Percent Passing</td>
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<td>No. 200</td>
<td>3-12</td>
<td>4-15</td>
</tr>
<tr>
<td>Plasticity Index</td>
<td>0-6</td>
<td>4-12</td>
</tr>
</tbody>
</table>
Part 3 – Execution
Contractor to call bluestake before grading the roadway area.

Excavate within the area to allow for driveway material, shoulders, and drainage areas.

Scarify and compact the subgrade per MAG2014 Section 301

Install the subgrade ABC per MAG2014 Section 310.

Install the crushed stone (gravel surfacing) wearing course per MAG2014 Section 310.

32 16 00  Curbs and Gutters

Curbs are used to define the roadway areas and for drainage control.

Part 1 – General
For concrete curbs Please see NAU Technical Standards, Division 03  Concrete.

Part 2 – Products

Part 3 – Execution

32 16 13  Concrete Curbs and Gutters

Part 1 – General

Part 2 – Products

Part 3 – Execution

32 16 19  Asphalt Curbs

32 17 00  Paving Specialties

No info

32 17 13  Parking Bumpers

Parking bumpers shall be specified for all pavement installations within 2’ of existing structures or fences.
Pavement Markings

All roadway pavement markings other than lane striping (bike lane assembly, turn arrows, stop bars, crosswalks, etc.) are to be thermoplastic per ADOT SS704. They may not be painted.

Painted traffic markings to be 4" wide and contain glass beads.

All bike lane assemblies, turn arrows, stop bars, crosswalks, or similar roadway pavement markings that are newly constructed or re-striped on a chip seal asphalt treatment that is less than 6 months old are to be high visibility preformed tape pavement markings per ADOT Standards.

Typical right angle parking stalls are to be installed at a minimum stall size of 9'x18' and are to be striped on-center of these dimensions. ADA parking stall sizes, quantities, locations, signage, & paths of travel must adhere to the 2010 ADA Standards for Accessible Design.

Each accessible parking stall shall have a surface identification duplicating the following scheme: The NAU CDAD Approved “Accessible Icon” shall be in white on a blue background, and outlined in a white border. A likeness and description of the “Accessible Icon” itself can be found at the following website: http://www.accessibleicon.org. The overall surface identification shall be a minimum 36 inches wide (3’x3’) and shall be aligned with the end of the stall or space adjacent to the traffic aisle so that it is visible to a traffic enforcement officer when a vehicle is properly parked in the space.

Marking of Ground or Surface at Access Aisle: The accessible loading and unloading access aisle shall be marked by a border, whereas the painted lines are White and at least 4 inches wide. Within the border, hatched lines a maximum of 36 inches on center shall be at least 4 inches wide and painted Blue. The words "NO PARKING" shall be painted on the ground within each 5-foot wide loading and unloading access aisle. This notice shall be painted Blue in UPPERCASE letters, no less than 10 inches high, and clearly identifiable as written, and located so that it is visible to traffic enforcement officials.

Parking lot striping color schemes:
White – Used for vehicle stall lines & motorcycle parking hatched areas
Yellow – Hatches used for no parking of any type. Stenciled inside “no parking”.
Blue – Hatched Accessible aisles, ADA Stall Lines & Accessible Icons. Stenciled “no parking” inside of hatched areas.
Red – Curbs, Fire Lanes, & Hatched Areas anywhere we do not want there to be
parking. Typically associated with fire truck access areas. Stenciled “no parking” inside of hatched areas.

32 17 26 Tactile Warning Surfacing

Where ever curb ramps are installed they should comply with the Design Guidelines for universal accessibility. These ramps shall also include a tactile warning area paved using detectable warning/truncated domes in an area determined by the ADA Design guideline requirements. Cast Iron Truncated Dome plates by the Neenah Foundry are the preferred basis of design.

32 18 00 Athletic and Recreational Surfacing

32 18 13 Synthetic Grass Surfacing

32 18 16 Synthetic Resilient Surfacing

32 18 23 Athletic Surfacing

Part 1 – General

Part 2 – Products

Part 3 – Execution

**END OF SECTION**
SITE IMPROVEMENTS

Part 1 – General
All site improvements on the campus of NAU shall be designed with sustainability in mind and shall conform to the Design Guidelines for Sustainability.

Part 2 – Products
Products used for site improvements are covered in Sections 31 00 00 and 32 00 00.

Part 3 – Execution
If no direction is given in the plans and specs follow manufacturer’s recommendations or MAG2014 applicable sections.

Fences and Gates

The University has a standard design for the masonry pillar/ornamental iron fence that surrounds the campus. The DP shall obtain this design standard from the Facility Services project manager for projects which require additions to this fence.

Retaining Walls

NAU prefers a dry stack locking material for site retaining walls. Any retaining wall must match the surrounding area where it is built. Submit samples to DP and Owner prior to purchase.

Screening Devices

**END OF SECTION**
### Part 1 – General
All irrigation system for new construction shall be designed as part of the landscaping plans and shall be considered in the grading, and stormwater management of the site and the surrounding areas. The design professional shall include adequate irrigation for planting and use reclaimed water for irrigation where it is available.

The contractor will be responsible for all blue staking before and during the project.

**Warning Tape:** Each 2” line shall have warning tape provided directly above line, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs. **All main lines shall have tracer wires for efficient locating.** Provide detectable warning tape (“water” blue for domestic and potable water and “reclaimed” purple for reclaimed water) with metallic core encased in a protective jacket for corrosion protection for irrigation mains, conduit or other underground services outside of building line.

Reduced pressure backflow preventers shall be installed at all connections to water distribution mains. Immediately downstream of the back-flow preventer shall be a Calsense flow sensor of appropriate size.

### Drawings
Prior to construction, preliminary design plans must be submitted to NAU Grounds for approval. At the completion of each project, accurate, reproducible, as-built drawings will be provided to NAU Ground Department. AutoCad compatible files (*.dwg, *.dxf) will be provided so the sprinkler system may be entered into the campus infrastructure data.

### Part 2 – Products
#### Pipe and Fittings
All pipe used for main lines and auxiliary lines shall be schedule 40 PVC pipe with ratings printed on pipe.

All fittings shall be schedule 40, pressure rated, PVC fittings.

Fittings between the auxiliary (lateral) line and any sprinkler head or hose bib shall consist of rigid PVC full circle swing joint.

Specifications for piping shall include standards that all piping shall be free from
cracks, holes, and foreign materials, blisters, inside bubbles, wrinkles, and dents.

If pipe is stored outside it shall be protected from direct sunlight.

No galvanized nipples, elbows, or other fittings shall be used with PVC pipe installations.

Standard specifications for the piping materials shall include that the pipe shall be free from cracks, sunburn, discoloration, holes, foreign materials, blisters inside, bubbles, wrinkles and dents.

Controllers
The controller shall be Calsense ET2000e Irrigation Controller.

Flow Sensors shall be Calsense FM Flow Sensors.

The master valve will be located in the control box.

Controller Wires
Electronic controller cable to be solid copper wire, UL approved for direct burial, minimum gauge 14 UV for runs under 1000 L.F., 12 UF for runs over 1000 L.F. Control wires must be buried at least 18" below finish grade.

Electric control wires shall be color coded so that neutrals are white, grass areas are red, shrub areas are blue, flower beds are green and drip irrigated areas are brown.

All connections to valves and all splices shall be made with "SNAP-TITE" connectors and PT-55 sealer, or approved equal.

Valves
Valves shall have a minimum size of 1". EFB-CP Series Rainbird. Ball valves to be installed before all control valves to isolate.

Clocks
Heads for lawn areas less than 25 feet wide shall be Hunter I 20 or approved equal.

Heads for strips and shrubs shall be Rainbird 1800 series.
Heads for open areas 25 feet or wider shall be Hunter I 40 or approved equal.

Heads for large areas with few trees shall be RAINBIRD SAMS or Hunter I40 or approved equal.
**Backflow Prevention**

Backflow preventers shall be reduced pressure type and shall be installed at all connections to domestic water distribution mains. Preferred manufacturers are FEBCO, WATTS or pre-approved equal. Reclaimed water mains will require pressure reducing valves (PRV).

By code, back-flow preventers must be a minimum of 12 inches above grade.

**Part 3 – Execution**

**Trenching: Cover Requirements:**

- All pipe and wire under pavement: 24"  
- Pressurized Lines: 18"  
- Non-pressurized lines: 12"  
- Non-pressurized drip laterals: 8"  
- Control Wire: 18"

Lines bordering curbs and sidewalks shall be held 12" away to allow for maintenance and access to the lines.

Backfill around and over pipes shall be with sandy soil free from rocks over 1/8" in diameter. Where existing soil does not meet this requirement, sandy soil shall be imported for backfilling.

Pipe and control wiring and tubing under walks, roads and other hard surfaces shall be installed in schedule 40 sleeves that are two times the size of the pipe. Sleeves shall extend a minimum of 12" beyond the hard surface.

Heads, bubblers, and drip lines shall maintain a minimum of 2' 0" setback from walks, drives or building faces. Special care shall be utilized in design to avoid the possibility of wind driven mist from wetting paving and building surfaces.

**Pipe and Fittings**

All main lines shall be looped whenever possible so as to improve pressure and flow.

Glued joints shall set for 24 hours before pressure is applied to lines.

If pipe is stored outside, it shall be protected from direct sunlight.

PVC joints shall be glued according to manufacturer’s recommendations.

**Control Wires**
Lawn, shrub, flower beds, xeriscape and drip areas shall be valved separately and have separate stations on the time clock.

All splices shall be made in valve boxes.

All wire runs shall have expansion loops at all corners.

**Valves**

All valves shall be EFB-CP Series Rainbird valves. Avoid locating valves in areas where curbs and walks come together.

Main valves should be located, when possible, in a grassed area, five feet from sidewalks curbs, or other traffic areas. Ball valve isolation valve installed before all control valves.

Valve boxes shall be set at finished grade with valve stems 4" below top of the box. Each valve box or group of valves shall have a quick connect on the pressure side of the valve.

Valves to be separated where possible.

All valves shall be placed in valve boxes so to allow access for servicing. 3" of gravel shall be placed under all valves (electric, gate and sectional).

**Clocks**

Clocks shall be mounted outside the buildings or any other proximate built structure.

**Heads**

Placement of heads shall be influenced by prevailing wind direction, location of mounds and placement and location of trees.

Provide diagrams for all head installation.

All lines shall be flushed before the heads are installed.

A non-fading, weather resistant copy of the irrigation diagram and controller name-label shall be affixed to the inside of the controller cabinet door. The irrigation diagram shall show all valves operated by the controller, valve sizes and type of plantings irrigated.

**Backflow Prevention**

All backflow preventers shall be assembled with pipe fittings and risers of
galvanized steel, or copper.

Valves and drains shall be placed so the entire system may be winterized.

Trenching
Immediately downstream of the back-flow preventer shall be a water meter or flow sensor of appropriate size. Flow sensors shall be 2 feet before and two feet after any joints to insure accurate readings.

1. Main lines shall be a minimum of 24 inches deep; auxiliary lines shall be 4 inches deeper than the bottom of the head being used.
2. Lines bordering curbs, sidewalks or other hard surfaces shall be held 12 inches away to allow for maintenance and access to the lines.
3. Sand shall be used in all trenches as bedding material for all PVC piping and also used as a covering for all piping. There shall be a minimum depth of 2 inches over the top of all piping.
4. Pipe, drip tubing and control wire being routed under walks, roads or other hard surfaces shall be installed in schedule 40 sleeves.

Warning Tape
Provide warning tape in the trench with irrigation lines 12 inches above the line and provide detectable warning tape with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector for irrigation mains, conduit or other underground services outside of building line.

32 90 00  PLANTING

Part 1 - General
Designers are encouraged to use plant material in energy conserving, climate ameliorating ways. Combinations of deciduous and evergreen shade trees can do much to mediate weather and climatic extremes.

Designers shall refer to site paving drawings and coordinate size of plant pits so as to not undermine hardscape.

Designers to include specifications so that the landscape contractor shall maintain all planting until accepted. Maintenance operations shall include: watering, mulching, tightening or adjusting of tree ties, resetting plants to proper grade, restoration of irrigation basins, fertilization and weeding. Landscape contractor shall commission the irrigation system prior to acceptance. Replacement materials shall meet all specifications of original materials.
All plant materials shall be guaranteed for 1 full year following substantial completion or replacement.

**Part 2 - Products**
Fertilizer shall be commercial Ammonium Phosphate w/an NPK ration of 16-20-0.

Mulch - Fine Screen Organic Top Dressing shall be composted, well rotted, free of refuse and containing not more than 25% straw or other bedding material.

Tree stakes shall be three (3) inch diameter by eight (8) feet long, pressure-treated Lodgepole Pine, free of any weakening knots or other defect. Stake trees up to 15 gallon size with two (2) stakes. Larger sizes shall be staked or guyed.

Guy wire shall be new, 12 gauge, annealed, galvanized.

Chafing guards shall be new, 3/4" dia. reinforced rubber or vinyl hose, 12" long (min) or as necessary to protect tree from guy wires.

Sod shall be cut, delivered and installed (remove mesh from sod rolls) within a 24 hour period. Cultivate subgrade to a depth of 6" prior to placing topsoil and remove all stones and debris 1" and greater in dia. Place topsoil to a depth of 9" over cultivated subgrade. Topsoil shall consist of equal parts topsoil, sand and fine screened organic mulch top dressing.

**Part 3 - Execution**
Where plant material will be placed in soil beneath existing pavement, especially asphalt pavement, or other condition where soil sterilant or other treatment potentially harmful to plant material may have been applied shall be tested for the presence of any such chemicals or condition. Affected soils shall be treated and/or excavated and disposed of in accordance with local codes.

Areas to receive ground cover plants shall be excavated in their entirety to 18" below finish grade and backfilled with backfill mix described above.

Planting pit percolation rates to be determined prior to planting in the presence of NAU Grounds representative.

After water settling backfill, set plants lower than finish grade to create irrigation basins such that the crown of the root ball shall be 4" lower than surrounding finish grade. Basins shall be as wide as the plant pit. Top of rootball shall be flush with finish grade of the basin.
2" of mulch shall be incorporated into the top 3" of soil in irrigation basin areas.

Where existing lawns have been damaged by construction and are to be repaired by the contractor, follow these instructions:

Loosen compacted soil to a depth of 9" min.

Remove debris and rock larger than 1" and all contaminated soil.

Add topsoil to the level of original grade and allow for settlement.

Rototill into the top 6" a 3" layer of fine screened organic mulch top dressing, 2 pounds Ammonium Phosphate (16-20-0).

Plant NAU approved grass seed (99% pure, 85% minimum germination) at the rate of three pounds per 1000 sf and cover with a thin layer of fine screened organic mulch top dressing. The contractor is required to provide a seed bag tag submittal for review and approval prior to installation which includes at a minimum the Purity %, Test Date, Germination Rate, and Weed Seed Content.

Maintenance for new or reestablished turf areas shall be as follows:

Maintenance period shall be for 1 year. New sod shall be mowed in ½” increments.

Spray heads shall be initially set at finish grade. During the warranty period additional height adjustments by the contractor at no additional cost may be required once turf is established. Irrigation shall not result in wilting, puddles or runoff.

After 3 weeks and again at the end of the maintenance period, fertilize with a fertilizer that provides one pound available Nitrogen per 1000 sf.

Final acceptance will occur with a satisfactory stand of grass (solid, healthy growth, without bare spots) at the end of the maintenance period.

Berms and swales shall be formed as continuous, smooth landforms with no obvious top or bottom to slopes or grade change from berm to swale.

Provide positive drainage away from buildings and structures. Direct runoff water to planting areas.
Soil Preparation

Part 1 – General

Part 2 – Products

Topsoil

Topsoil shall be friable, loam topsoil, free from sticks, stones over 1" in diameter, roots, refuse, noxious weeds or any other material toxic to plant growth.

Shall have:

- Loam and soil texture (USDA classification)
  - 30% to 50% sand
  - 10% to 25% clay
  - 30% to 50% silt
- PH. - 6.0 - 7.5

All in-place soil and topsoil shall be free from nut grass, refuse, roots, noxious weeds, or any material toxic or a hinderance to plant growth.

Unless otherwise specified, all in-place and/or imported soil will be prepared and conditioned as topsoil to meet the following minimum specifications:

- PH shall not exceed 7.5 or lower than 6.0
- Electrical conductivity (ec) shall be less than 4.0 milliohms per centimeter as measured on the saturation extract.
- Sodium absorption ratio of less than 5 as measured on the saturation extract.
- Shall contain approximately 1.5%, by dry weight, organic matter either natural or added.
- Soil gradation shall be in accordance with the IBC and the City of Flagstaff Engineering Design and Construction Standards and Specifications.
- Any use of manure as a soil conditioner is not acceptable.

All planted areas shall be conditioned by spreading evenly, over the areas, and thoroughly incorporating (rototilled) into the soil to a depth of 6 inches the following material, per 1000 square feet:

- 20 lbs of 6-20-20 commercial fertilizer.
- 3 cubic yards of nitrogen stabilized amendment derive from redwood sawdust, fir sawdust or finely ground bark.

Part 3 – Execution
The contractor may be required to furnish the University at no additional cost, a numerical analysis and test from a soils laboratory for imported materials which will include:

- Nitrogen
- Phosphorus
- Potassium
- Electrical conductivity (ec)
- Sodium absorption
- PH
- Percentage of sand, silt, clay, organic matter, water holding capacity

Landscape or planting areas shall not be cultivated when they are so wet as to cause excessive compaction or so dry as to cause excessive dust or the formation of large clods.

If existing topsoil is to be used, it should be filled to 3” depth and graded.

If imported soil is specified the existing soil shall be scarified to a minimum depth of 8 inches prior to placing topsoil. All clods and rocks over 1 inch in diameter, within 6 inches of the surface, shall be removed and disposed of offsite. The thickness of the topsoil shall be at least 4 inches.

32 91 19 Landscape Grading

32 91 19.13 Topsoil Placement and Grading

NONE Found

**END OF SECTION**
TURFS AND GRASSES

Part 1 – General
No more than 10% of the area around newly constructed facility shall be turf or other type of water intensive vegetation.

Lawns shall be specified only where maintainable with full normal access (no inner courtyards not directly accessible from outside) for irrigation, mowing, fertilizing, and pest control operations.

Lawn areas shall be designed open and clutter free, as far as practical, shrubs and ground cover areas shall be separated by concrete, exposed aggregate, 6"x6" or greater treated timbers or occasionally brick headers, their tops being 1/2 inch above sod/soil level.

Lawn grass shall not be used in any planting strip less than 36" wide unless it has an extension of a continuous larger area.

Lawn soil surfaces shall be constructed 1/2 inch below walks, curbs, mow strips or other adjacent paving.

Any valve boxes installed in turfed areas shall be made flush with the finish grade not turf height.

Single isolated posts in lawn areas shall be fitted with a concrete mow strip at least 6 inches wide around the post.

Part 2 – Products

Hydroseeding

Part 1 - General
Hydroseeding must be approved by the Director of Operations and the Grounds Supervisor.

Part 2 – Products
The preferred grass seed mix is a perennial rye/bluegrass mix. Submit species for approval. Reference page 77 of the Landscape Master Plan for the specific locations and types of grasses required. Different campus areas referred to as different “NAU Zones” in the master plan require different products.

Any wildflower seed mix shall be submitted to the NAU Facility Services Grounds division prior to specifying.
Part 3 – Execution
Lawns may be established cut sod or by hydroseeding. In either case the soil shall be thoroughly rototilled and leveled to receive the grass.

All specified hydroseeding must be in place prior to August 1 and protection must be provided for 1 year.

32 92 23 Sodding

Part 1 - General
NAU prefers the placement of sod for turf areas when budget constraints allow.

Part 2 – Products
Sod will be a bluegrass/perennial rye mix. It will come from an area with similar climate and soil conditions to the University. Sod grown on a sandy loam soil will not be accepted.

Part 3 – Execution
Lawns may be established cut sod or by hydroseeding. In either case the soil shall be thoroughly rototilled and leveled to receive the grass.

All sod must be in place prior to September 1 and warranty must be provided for 2 years from the date of substantial completion.

32 93 00 Plants

32 93 43 Trees, Plants and Ground Covers

Part 1 – General
All planting shall be guaranteed by the Contractor for a minimum of one year after substantial completion.

All specified planting materials shall be of species that have a proved history of resilience in the Northern Arizona locale. Preference shall be given to designs that center around a xeriscape approach and utilize drip irrigation.

NAU permits many tree, shrubs, ground covers and flowers to be used for landscaping purposes. Plant selected for landscaping are either included on the focus plant material list or on the permitted list. Designers should not specify or permit the substitution of materials that do not appear on the approved lists.
Part 2 – Products
The following trees and shrubs have been identified and labeled as focus plant material to be utilized in campus planting:

**Trees**
- Acer Platanoides: Red Maple
- Malus: Flowering Crabapple
- Pinus nigra: Australian Black Pine
- Picea Pungens: Colorado Blue Spruce
- Populus Tremuloides ‘Kaibab’: Kaibab Aspen
- Robinia pseudoacacia: Black Locust

**Shrubs**
- Callery Pear (Fallugia paradoxa): Apache Plume
- Juniperus spp: Juniper
- Flaxgolia: Oregon Grape
- Pinus mugo mugas: Dwarf’ Mugo Pine
- Potentilla Fruticosa: Potentilla
- Rhus spp: Sumac
- Ribes spp: Currant
- Ribes iburnum Opulus: Snowball Viburnum

The following trees and shrubs may be utilized on campus with the approval of the Manager of Planning and Design and the Grounds Supervisor:

**Acceptable Plant Material (Trees)**
- Abies Concolor: White Fir
- Abies Lasiocarpa Arizonica: Corkbark Fir
- Acer ginnala: Amus Maple
- Acer Saccharum: Sugar Maple
- Acer Negundo: Boxelder
- Acer Saccharinum: Silver Maple
- Betula Pendula: European White Birch
- Fraxinus Americana: American Ash
- Catalpa spp: Catalpa
- Fraxinus Pennsylvanica: Green Ash
- Gleditsia Tracanthos: Honeylocust
- Picea Abies: Norway Spruce
- Picea Engelmannii: Englemann Spruce
- Pinus Aristata: Bristlecone Pine
- Pinus Flexilis: Limber Pine
<table>
<thead>
<tr>
<th>Scientific Name</th>
<th>Common Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delosperma nubigenum</td>
<td>Ice Plant</td>
</tr>
<tr>
<td>Lonicera arizonica</td>
<td>Arizona Honeysuckle</td>
</tr>
<tr>
<td>Partheocissus quinquefolia</td>
<td>Virginia Creeper</td>
</tr>
<tr>
<td>Sedum spp.</td>
<td>Stonecrop</td>
</tr>
</tbody>
</table>

**Acceptable Plant Material (perennial flowers)**

<table>
<thead>
<tr>
<th>Scientific Name</th>
<th>Common Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Archillea spp.</td>
<td>Yarrow</td>
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<tr>
<td>Berlandiera lyrata</td>
<td>Chocolate Flower</td>
</tr>
<tr>
<td>Campanula Glomerata</td>
<td>Clustered Bellflower</td>
</tr>
<tr>
<td>Cetnranthis ribber</td>
<td>Red Valerian</td>
</tr>
<tr>
<td>Chamaemelum Nobile</td>
<td>Chamomile</td>
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Clematis spp
Coreopsis spp
Eschscholzia californica
Gaillardia grandiflora
Sempervivum tectorum
Geum triflorum
Hemerocallis spp
Ipomopsis aggregate
Iris spp
Linum perenne
Lupinus spp
Kniphofia uvaria
Oenothera caespitosa
Oryzopsis hymenoids
Penstemon spp.
Phlox spp
Potentilla spp.
Ratibida columnifera
Salvia spp
Thymus spp.
Zinnia grandiflora

Clematis
Coreopsis
California Poppy
Blanket Flower
Hens and Chickens
Old Man’s Whiskers
DayLily
Skyrocket
Bearded Iris
Blue Flax
Lupine
Red hot Poker
Tuft Evening Prim-rose
Indian Rice Grass
Beardtongue
Phlox
Cinquefoil
Mexican Hat
Sage
Thyme
Prairie Zinnia

**Acceptable Plant Material (Flowers)**
The flower list subject to approval of the Director of Operations and the Grounds Supervisor.

**Trees and Shrubs**
All specified tree and shrub plant material must be in place prior to August 1.
All plant materials used shall be of types proven hardy for the area and situation.
New, novel or "different" plants shall be restricted to a bare minimum. All plants shall be healthy, true to name and full size of specifications (no recent shifts to larger container).
The minimum caliper size for new trees shall be 2 inches.

Trees planted in lawns shall be provided with 24 inches of bare, sod free soil beyond and around the full circle of the tree. This area shall also be depressed (dish shaped) to help deep watering of the tree.
Deciduous trees shall be planted no closer than 8 feet from any walk or drive and evergreen trees planted no closer than 2 feet greater than the anticipated mature radius of branching.
Trees planted in rows shall be uniform in size and shape.

Trees and shrubs shall not be planted until all construction working the area has
### Part 3 – Execution

#### Temporary Protection

Provide temporary fencing, barricades or guards to protect from damage existing trees, lawn, and other plants which are designated to remain on site.

Protect root systems by not storing construction materials, debris, or excavated material within five (5) feet of the drip line of the tree (outer perimeter of the branches). Do not permit vehicle traffic within stated area and restrict foot traffic to prevent excessive compaction of the soil over root systems.

#### Repair and Replacement of Trees, Shrubs and Lawn

Repair trees, shrubs and lawns damaged by construction in a manner acceptable to the Landscape Architect and/or the Facility Services Grounds Supervisor. Make repairs promptly after damage occurs to prevent progressive deterioration of damaged trees, shrubs, and lawns.

Remove and replace dead and damaged trees, lawns, and shrubs, which are determined by the Grounds Supervisor to be incapable of restoration to normal growth patterns.

Provide new trees of same size and species, unless such plant is on the "DO NOT PLANT" list. Plant and maintain as specified under landscaping section of the specifications. For any trees requiring replacement due to neglect by the contractor that have a caliper greater than 4", a penalty of $1,000.00 per tree will be assessed. Dig plant pocket for trees a minimum of 24" wider and 6" deeper than root ball, unless otherwise specified.

Dig plant pocket for shrubs a minimum of 12" wider and 6" deeper than root ball, unless otherwise specified.

Loosen subsoil to a depth of 4". Loosen earth on sides of pocket to break the glaze caused by digging.

Set plants at finished grade.

Fill prepared soil to 1/2 the depth of ball, pack firmly, and settle with water.

If balled and burlapped, loosen and remove burlap and all lacing and remove
wire baskets from root ball. Absolutely no packaging material is allowed to be left with the tree.

Backfill with prepared soil which, after compaction, is flush with ground level.

Cover plant pocket area with 3" to 4" of mulch.

Prune, wrap and brace as specified.

32 94 00 Planting Accessories

Part 1 – General

Part 2 – Products

Part 3 – Execution

32 96 00 Transplanting

Part 1 – General
Salvage of existing trees from a project shall be performed by a firm approved by the University and with at least four years experience with this type of work. The work shall be guaranteed and conducted in a manner consistent with local practice. The University shall designate a holding area and source of irrigation for boxed or otherwise temporarily stored trees. NAU Landscape has first right of refusal for all plantings or materials removed or transplanted from the site. Contractor is required to provide the NAU Landscape department and NAU Project Manager a minimum 72 hours’ notice prior to any site removals or anticipated transplants.

Part 2 – Products
No specific products included.

Part 3 – Execution
Transplanting of plant materials shall be consistent with the execution section of 32 90 00.

32 96 33 Shrub and Tree Transplanting

All trees and shrubs shall be container grown, not balled and burlap, unless otherwise approved by NAU Grounds Department.

**END OF SECTION**
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<thead>
<tr>
<th>Section Number</th>
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<tbody>
<tr>
<td>33 00 00</td>
<td>UTILITIES</td>
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<td>33 10 00</td>
<td>WATER UTILITIES</td>
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<tr>
<td>33 11 00</td>
<td>Water Utility Distribution Piping</td>
</tr>
<tr>
<td>33 11 16</td>
<td>Site Water Utility Distribution Piping</td>
</tr>
<tr>
<td>33 11 50</td>
<td>Reclaimed Water Distribution System</td>
</tr>
<tr>
<td>33 30 00</td>
<td>SANITARY SEWERAGE UTILITIES</td>
</tr>
<tr>
<td>33 31 00</td>
<td>Public Sanitary Utility Sewerage Piping</td>
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<tr>
<td>33 40 00</td>
<td>STORM DRAINAGE UTILITIES</td>
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<td>33 41 00</td>
<td>Public Storm Utility Drainage Piping</td>
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<tr>
<td>33 50 00</td>
<td>FUEL DISTRIBUTION UTILITIES</td>
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<td>33 51 13</td>
<td>Natural Gas Piping</td>
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<tr>
<td>33 60 00</td>
<td>HYDRONIC AND STEAM ENERGY UTILITIES</td>
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<tr>
<td>33 61 13</td>
<td>Chilled Water Distribution System</td>
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<tr>
<td>33 63 20</td>
<td>Steam and High Temperature Hot Water Tunnels</td>
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<tr>
<td>33 70 00</td>
<td>ELECTRICAL UTILITIES</td>
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<td>33 71 00</td>
<td>Electrical Utility Transmission and Distribution</td>
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<td>33 71 39</td>
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<td>33 71 73</td>
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<td>33 73 00</td>
<td>Utility Transformers</td>
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<td>Communications Underground Ducts, Manholes, and Handholes</td>
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<td>33 82 00</td>
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<tr>
<td>33 82 01</td>
<td>Switching Center Terminations</td>
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<tr>
<td>33 82 13</td>
<td>Copper Communications Distribution Cabling</td>
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<tr>
<td>33 82 23</td>
<td>Optical Fiber Communications Distribution Cabling</td>
</tr>
</tbody>
</table>
**NAU Utility Services, in conjunction with the DP firm and NAU Trade Personnel, shall establish the connection point for each required service during schematic design and before design development.**

The DP shall submit hydraulic calculations for each utility system in the BOD along with each design phase submittal.

The NAU Director of Utilities will need to sign off on the FS15 prior to utilities being energized. A meter to track consumption must be operational before the utility is energized. Refer to each section for the individual requirements.

Utility metering will be reviewed for accuracy after the individual utility system is energized. The contractor will have 1 week to respond to any accuracy issued found and an additional week to make any corrections. If corrections are not made at the end of the 2 week period NAU may de-energize the utility in question until satisfactory progress is made.

_Shading around all utility pipe shall be constructed as follows:_

<table>
<thead>
<tr>
<th></th>
<th>Bottom</th>
<th>Sides</th>
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<tr>
<td>Chilled Water</td>
<td>6”</td>
<td>6”</td>
<td>12”</td>
</tr>
<tr>
<td>Sewer</td>
<td>6”</td>
<td>6”</td>
<td>12”</td>
</tr>
<tr>
<td>Gas</td>
<td>8”</td>
<td>8”</td>
<td>8”</td>
</tr>
<tr>
<td>Domestic Water</td>
<td>6”</td>
<td>6”</td>
<td>12”</td>
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<tr>
<td>Electrical</td>
<td>6”</td>
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<tr>
<td>Storm Drain</td>
<td>6”</td>
<td>6”</td>
<td>12”</td>
</tr>
</tbody>
</table>

**Locator Wire**

Locator wire is required on all utility installations. It shall be 12 AWG solid copper wire, PVC insulated, type UF, UL listed for direct burial in ground. Provide wire in 1,000 feet or 2,500 feet rolls. Splicing system shall consist of a copper wire crimp, PVC split case gland, and epoxy waterproof sealing compound.
Trace wire shall be required on all newly installed utilities that extend outside of the building to the point where contract boundaries end. If tying into an existing utility and that utility will not come above ground, (tying into an existing sewer line, for example), then the trace wire shall be brought to the surface and terminated in a small underground j-box directly above the newly installed utility. J-box lid shall be marked “trace wire”, and what utility the trace is for. If a utility comes above ground then the trace wire shall come above ground with the same utility in valve cans, manholes, junction boxes, box pads as well is in or wrapped around any other component that comes out of the ground. Installation is required to be inspected and signed off on the FS15 on line B3.

Tracer wire damaged during excavation will be repaired to the satisfaction of the Locator Supervisor and be included in the inspection signoffs.

Utility Survey Markers

Utility survey markers will be required on all new construction projects and renovation/replacement projects that do not have existing markers placed directly above the utility line. On exterior walls where the utility enters the building the marker shall be installed 1‘ above finished grade with the wording parallel to the ground and not upsidedown. Cast/wet set in the top of curbs on both sides of a street/pedway when within a project boundary with the wording parallel to the utility flow direction. NAU may request markers be placed in other locations on new construction, renovation or on concrete replacement projects. NAU will provide the survey markers on new marker locations.

Building, utility and concrete renovation projects may run into existing survey markers. The Contractor is required to preserve the markers, reset the existing markers or replace the marker if damaged during removal. NAU will not provide replacement survey markers.

Verification of marker location requires signoff on the FS15 prior to substantial completion.

33 11 00  Water Utility Distribution Piping

33 11 16  Site Water Utility Distribution Piping

Part 1 - General

This section defines the general design parameters for the water distribution system, including domestic and fire protection water distribution, service lines, fire hydrants and system appurtenances.
The Design Professional (DP) shall conduct a Fire Flow test at the project site. Tests shall be performed by the University and witnessed by the University Fire Marshal.

Refer to Division 21 for fire requirements.

Design and construction of all water systems shall comply with the rules and regulations of the Arizona Department of Environmental Quality (ADEQ), the Arizona Administrative Code (ACC), and MAG Standards.

The Design Professional (DP) shall size the piping system based on the design flows. Coordinate with the Project Manager and Director of Utilities regarding existing flows and pressures within the system and provisions for future campus expansion and additional demands in the system.

Refer to Division 23 for meter requirements and connections to the EMCS system.

Part 2 – Products
All materials that will come in contact with potable water shall conform to ANSI/NSF Standard 61 and the rules and regulations of the Arizona Department of Environmental Quality.

Chlorination shall be separate for all site piping and building infrastructure.

All material used in the construction of Fire Service lines shall conform to NFPA 13 and NFPA 24. All material shall conform to the requirements of Underwriter’s Laboratory (UL) or Factory Mutual (FM), and listed.

Polyvinyl Chloride (PVC) Pipe 4-inch diameter to 12” diameter shall conform to AWWA C900, Class 200 (SDR 14) and cast iron outside diameter. Elastomeric gaskets shall conform to ASTM F477 providing a water tight seal when tested in accordance with ASTM D3139. Fittings used on PVC pipe shall be mechanical joint ductile iron (DI) fittings as specified below.

Ductile Iron Pipe
Ductile Iron Pipe (DIP): All pipes shall be push-on Tyton joint, mechanical joint (MJ) joint or integral restrained joint ductile iron pipe. The pipe shall be manufactured and tested in accordance with the American Water Works Association (AWWA) Standard C151, and have working pressure (pressure class) of not less than:

4”-12” dia (Class 350) 350 PSI
Rubber gasket joints shall satisfy requirements of AWWA C111. Flanged ductile iron pipe shall be manufactured in accordance with AWWA C115, Flange Class 250. The minimum thickness class for ductile iron pipe to be threaded shall be thickness Class 53. Threads for threaded flanged pipe shall be taper pipe threads in accordance with ANSI B2.1, with thread diameters adjusted to conform to ductile iron pipe standard outside diameters.

All ductile iron pipe shall have a standard thickness cement-mortar lining followed by a seal coat of asphaltic material in accordance with AWWA C104. The exterior surfaces of all ductile iron pipe and fittings shall be coated with a bituminous material in accordance with AWWA C151 before shipment.

Ductile Iron Fittings and specials shall conform to AWWA C110, AWWA C153, and AWWA C111. Fittings and specials shall be cement-mortar lined in accordance with AWWA C104. Linings shall be standard thickness and seal coated with a bituminous material. The exterior surfaces of all ductile iron fittings shall be coated with a bituminous material in accordance with AWWA C110.

Control Valves
Gate valves (4” to 12”) shall be resilient seated gate valves meeting the requirements of AWWA C509, and Maricopa Association of Governments Uniform Standard Specifications and Details for Public Works Construction Standard Specification No. 630. The valves shall be rated bubble tight at 200 PSI. The exterior and interior shall be coated with a thermo-setting or fusion bonded epoxy coating meeting the requirements of AWWA C550. The dry coating thickness shall not be less than 12 mils. Valves shall have mechanical style connections, except flanged joints may be used on the side of the valve that connects directly to a tee or tapping sleeve. Direct buried valves shall have a 2-inch operating nut. Direct buried valves shall be supported by a concrete base according to MAG standards.

The direction to open the valve shall be to the left (counter clockwise). Valves shall have a minimum of two (2) turns per inch of diameter.

Valves shall be rate for a minimum working pressure 250 PSI and be tested and certified by the manufacturer as being bubble tight at 200 PSI.

Fire Hydrants shall comply with the City of Flagstaff (COF) Engineering Design Standard 9-06-060. Fire Hydrants shall be manufactured and tested in accordance with AWWA C502, dry barrel fire hydrants. Hydrants shall be traffic type with break-a-way flange unit installed just above grade. Hydrants shall be Wattrous.
Tapping Sleeves shall conform to MAG Specification No. 630 with prior approval from the NAU Plumbing Shop. Sleeves shall be ductile iron or fabricated from ¾-inch (minimum) ASTM 286 Grade C steel or ASTM A-36 steel. Sleeves shall be factory coated with corrosion resistant epoxy in accordance with AWWA C550. Flange shall be 150 LBS MSS-SP60. Bolts shall be corrosion resistant, high strength, low –alloy, per AWWA C-111. Gasket shall be Burna-N or neoprene. Sleeves shall be rated for 250 psi. Tapping sleeves shall be furnished with a 3/4 inch test plug. Plug shall be bronze NPT, coupling shall be epoxy coated.

Backflow Assemblies shall be reduced pressure backflow assemblies conforming to AWWA C511 and approved by the Foundation for Cross-Connection Control and Hydraulic Research at the University of Southern California. Assemblies shall have OS&Y resilient seated gate valves and shall be epoxy coated per AWWA C550. Assemblies shall be installed in buildings unless approved by NAU Plumbing Supervisor. If exposed to the elements then it must be protected from freezing. Backflow Assemblies shall be reduced model Wilkons XL 975 or approved equal.

Couplings used on ductile iron and PVC C900 pipe shall be ductile iron, solid sleeves with mechanical joints, complying with AWWA C110 and C111 and as specified for ductile iron fittings. Couplings shall be fully restrained.

Air Relief Valves shall be vacuum and air relief valves shall be of the size shown on the plans. Corporations shall be full opening with O-ring seal and bronze ball and conform to AWWA C800. Taps into ductile iron pipe may be made by direct tapping of the pipe or with a service saddle. Taps into PVC pipe shall be made with a service saddle. Service saddles shall conform to AWWA C800, and be constructed of bronze or epoxy coated ductile iron. Saddles shall have a single or double strap. The outlet of the valve shall be equipped with a gooseneck and stainless steel screen as indicated on the drawings. Copper tubing shall be Type K, ASTM B88.

**Joint Restraint Devices**

All joints, fittings, and valves within the system shall be fully restrained.

Ductile iron fittings mechanical style joints - EBAA Iron Sales, Inc. “Mega Lug” joint restraint or approved equal. The specific model utilized shall be compatible with the type of pipe (DIP or PVC) connected to the fitting.

PVC pipe push-on style joints – EBAA Iron Sales Series 1600, or approved equal.

Ductile iron push-on style joints – EBAA Iron Sales Series 1700, or approved equal.
Ductile iron pipe and PVC integral joint restraint type - U.S. Pipe “TR Flex” restrained joint pipe and fittings. Pacific States Thrust-Lock.

Integral joint restraint type - U.S. Pipe “TR Flex” restrained joint pipe and fittings, Pacific States “Thrust Lock” joint system, Griffin Pipe “Snap Lok” joint system, or approved equal.

Thrust blocks shall be used in conjunction with joint restraint devices and constructed according to MAG standards.

The use of gaskets with integral restraint grippers shall not be permitted.

Valve Boxes and cover shall consist of a cast iron box and cover and PVC riser. The valve box and cover casting shall be manufactured in conformance with ASTM A48, Class 30B. Cover shall be labeled “Water”, and paint box blue. Valve can risers shall have a debris cap with a color handle applicable to the designated utility.

Valve stem risers shall comply with Maricopa Association of Governments Uniform Standard Specifications and Details for Public Works Construction Standard Specification No. 610 and as detailed on the plans.

Polyethylene Encasement (DI Pipe) shall conform to AWWA C105. The color of the polyethylene encasement shall be black or blue.

Tracer Wire shall be 12 AWG solid copper, or stranded copper wire, PVC insulated, type UF, UL listed for direct burial in ground. Provide wire in 1,000 feet or 2,500 feet rolls. Splicing system shall consist of a copper wire crimp, PVC split case gland, and epoxy waterproof sealing compound.

Install locator wire to the top of the all water lines. The Contractor shall minimize the number of splices in the wire. All splices shall be made with a watertight gland.

Trace wire shall be required on all newly installed utilities that extend outside of the building to the point where contract boundaries end. If tying into an existing utility and that utility will not come above ground, (tying into an existing sewer line for example), then the trace wire shall be brought to the surface and terminated in a small underground j-box directly above the newly installed utility. J-box lid shall be marked “trace wire” and what utility the trace wire is for. If a utility comes above ground, (fire hydrant for example), then the trace wire shall come above ground with the same utility. Trace wire shall come up in all valve cans.
Part 3 – Execution

General
Fire service lines shall be installed in accordance with NFPA 13 and NFPA 24. Minimum depth of cover, measured from top of pipe, shall be as follows;
Water Mains: 42-inches
Fire Service Mains: 42-inches (12-inches below frost depth).

In order to energize water to a building the contractor must have U3, U5 and U6 on the FS15 signed, and an approved FS15A for B1-B3 and C6 for the water system.

Pipe and Fittings
Do not make the connections to the existing system until such time that the system has been cleaned; flushed, disinfected, and all hydrostatic testing has been completed and accepted.

All work associated with modifications to the water system, fire service lines, and building service lines shall be carried an expeditious manner to minimize the time frame during which the water supply to the campus facilities and building automatic fire sprinkler system is impacted. All shutdowns shall be scheduled in advanced with the Owner, and the Owner reserves the right to require shutdowns to occur during non-standard work times to mitigate the impact on the campus functions. No water main or service line shall be taken out of service until all piping, fittings, and appurtenances, required to complete the system modifications and return the system to operating condition, are available on the project site.

PVC pipe shall be installed in accordance with the requirements of AWWA C605, the manufacturer’s recommendations and Maricopa Association of Governments Uniform Standard Specifications and Details for Public Works Construction Standard Specification No. 610, and as specified herein.

Ductile-Iron Pipe
Install in accordance with the recommended procedures set forth in AWWA C600 and Maricopa Association of Governments Uniform Standard Specifications and Details for Public Works Construction Standard Specification No. 610, and as specified herein.

The maximum allowable joint deflection will be as given in AWWA C600, AWWA C605. If the alignment required deflection in excess of the above limitations, special bends or a sufficient number of shorter lengths of pipe shall be utilized to provide angular deflections within the limits set forth.
Install all joint restraint devices in accordance with the manufacturer's instructions and prior to pressure testing of the system. Do no bend or deflect the pipe.

All piping shall be fully restrained.

Install all valves in accordance with the manufacturer's instructions. When the top of the operating nut is 4 feet or greater below finish grade, install a valve nut extension.

Install air relief valves at high points.

Cleaning and Flushing
It shall be the responsibility of the Contractor to keep the lines clean of all foreign materials during construction. Flush lines per ADEQ Rules and regulations.

The system shall be flushed at a minimum of 2.5 FPS for a minimum of 60 seconds per 100 feet of pipe. Water used for flushing shall be potable water.

Should dirt, debris, and/or foreign material be allowed to accumulate in the lines, the Contractor shall be responsible to remove all such material from the line by flushing the lines or other approved methods. In the event that such measures are required, the Contractor shall provide a written proposal to the Owner stating the methods to be utilized. In review of the proposal, the Owner will consider the potential for adverse impacts on the Campus.

Disinfection
Disinfect all lines per ADEQ rules and regulations. Disinfect all lines per ADEQ Engineering Bulletin No. 8.

The Contractor shall submit a disinfecting plan to the Owner’s review. The plan shall detail the method for disinfecting the system and identify the certified laboratory that will sample and perform the microbiological testing. The Contractor shall be responsible for the cost of all laboratory testing.

Separation Between Potable Water Mains and Sewers/Reclaimed Water Mains Per ADEQ rules and regulations.

Hydrostatic testing shall conform to AWWA C600 / C605 at a test pressure of 200 PSI, modified as follows.

Allowable Leakage Determination: During the 2 hour, 200 PSI pressure test, the makeup water to maintain the test pressure within 5 psi of the test pressure and...
re-pressurize the system to the starting pressure shall be measured. Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or approved section thereof, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled. No piping installation will be accepted until the leakage is less than the number of gallons per hour as determined by the formula:

\[ L = 0.00013 \times N \times D \times (P \text{ raised to } 1/2 \text{ power}) \]

In which \( L \) equals the allowable leakage in gallons per hour; \( N \) is the number of joints in the length of pipeline tested; \( D \) is the nominal diameter of the pipe in inches; and \( P \) is the average test pressure during the leakage test, in psi gauge. Should any test of pipe disclose leakage greater than that specified in the foregoing table, the defective joints shall be located and repaired until the leakage is within the specified allowance, without additional cost to the Owner.

The Contractor shall provide certified test pressure gauges, calibrated within 8 months of the test. The gauges shall be a minimum of 4-inches in diameter, with a 1 psi scale.

After installation of the tapping sleeve and valve and prior to making the tap, the sleeve shall be tested at 200 psi for 2 hours. There shall be no pressure drop during the test period.

**System Connections**

Unless specifically approved by the Owner in writing, connections to the existing system shall be made only after all pipes have been disinfected and all hydrostatic testing have been approved by the Owner.

Where utility access hatches/vaults/manholes are installed within 2 feet of sidewalks, they shall be 1 inch below top of finished sidewalk to accommodate snow removal without damage to boxes or lids.

Where utility access hatches/vaults/manholes are installed in sidewalks, patios, roadways, or any other structure where snow removal shall occur, the top of the access hatches shall be a minimum of \( \frac{1}{4}'' \) and a maximum of \( \frac{1}{2}'' \) below finished surface of concrete to accommodate for snow removal without damage to boxes or lids.
The Design Professional (DP) shall size the piping system based on the design flows. The maximum velocity in the system shall be 5 feet per second. Coordinate with the Project Manager the existing flows and pressures within the system and provisions for future campus expansions. Submit calculations to the Project Manager.

Valves, install valves on three sides of all tees and four sides of all crosses. Maximum spacing between valves shall not exceed 300 feet.

Refer to Division 23 for meter requirements and connections to the EMCS system.

Part 2 – Products
Refer to Domestic Water standards for products but use Reclaimed designations for installation.

Part 3 – Execution
Minimum depth of cover, measured from top of pipe, shall be as follows;
- Reclaimed water mains: 42-inches
- Reclaimed water service lines: 36-inches

In order to energize water to a building the contractor must have U3, U7 and U8 on the FS15 signed and an approved FS15A for B1-B3 and C6 for the reclaimed water system.

Pipe and Fittings
PVC pipe shall be installed in accordance with the requirements of AWWA C605, the manufacturer’s recommendations and Maricopa Association of Governments Uniform Standard Specifications and Details for Public Works Construction Standard Specification No. 610, and as specified herein.

Ductile-Iron Pipe: Install in accordance with the recommended procedures set forth in AWWA C600 and Maricopa Association of Governments Uniform Standard Specifications and Details for Public Works Construction Standard Specification No. 610, and as specified herein.

The maximum allowable joint deflection will be as given in AWWA C600, AWWA C605. If the alignment required deflection in excess of the above limitations, special bends or a sufficient number of shorter lengths of pipe shall be utilized to provide angular deflections within the limits set forth. Do no bend or deflect the pipe.

Install all joint restraint devices in accordance with the manufacturer's instructions and prior to pressure testing of the system.
All piping shall be fully restrained.

Install all valves in accordance with the manufacturer’s instructions. When the top of the operating nut is 4 feet or greater below finish grade, install a valve nut extension as detailed on the drawings.

Install air relief valves at high points. Install locator wire to the top of the all water line. The Contractor shall minimize the number of splices in the wire. All splices shall be made with a watertight gland.

Concrete Encasement
The Contractor shall coordinate with the Owner if the existing main can be depressurized during concrete encasement work. The Contractor shall adjust their schedule to correspond with the approved shut down period. In the event that the existing system cannot be depressurized, the contractor shall construct the encasement in segments that allows the system to remain in service. Prior to placing the concrete the existing joints in the existing system shall be exposed and inspected under system pressure. Any leaks or damage to the existing pipe shall be repaired prior to placing concrete.

The Contractor shall install all required temporary supports required to support the existing piping while excavating around the pipe. If the existing pipe is deflected or damaged during construction, all damage piping shall be replaced by the Contractor.

Filling System, the pipe shall be filled with potable water or from the existing reclaimed water system. It shall be the responsibility of the Contractor to keep the lines clean of all foreign materials during construction. All lines shall free of debris and soil materials. Should soil, sand, debris, and/or foreign material be allowed to accumulate in the lines, the Contractor shall be responsible to remove all such material from the line by flushing the lines or other approved methods. In the event that such measures are required, the Contractor shall provide a written proposal to the Owner stating the methods to be utilized. In review of the proposal, the Owner will consider the potential for adverse impacts on the Campus.

Separation Between Reclaimed Water Mains and Potable Water Mains
The minimum separation between potable water mains and reclaimed water mains shall be six (6) feet vertically, with the water main above the reclaimed water line, and six (6) feet horizontally, unless extra protection is provided.
case shall the reclaimed water main be placed within one (1) foot vertical or horizontal of a water main.

Extra protection shall be mechanical joint ductile iron pipe, restrained joint push on ductile iron pipe, or concrete encasement of the pipe within a minimum of 6-inches of concrete on all sides of the pipe.

Where reclaimed water lines crosses above or less than six (6) feet below a water line, or within 6-feet horizontally of a water main, the reclaimed water line shall be constructed of mechanical joint ductile iron pipe for a distance of ten (10) feet on either side of the water main crossing, or both the water and the reclaimed water main shall be concrete encased.

The horizontal and the vertical dimensions shall be measured from outside of pipe to outside of pipe.

Comply with ADEQ’s Rules and regulations.

Hydrostatic testing shall conform to AWWA C600 / C605 at a test pressure of 200 PSI, modified as follows:

Allowable Leakage Determination: During the 2 hour, 200 PSI pressure test, the makeup water to maintain the test pressure within 5 psi of the test pressure and re-pressurize the system to the starting pressure shall be measured. Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or approved section thereof, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled. No piping installation will be accepted until the leakage is less than the number of gallons per hour as determined by the formula:

\[
L = 0.00013 \times N \times D \times (P^{\frac{1}{2}})
\]

In which \(L\) equals the allowable leakage in gallons per hour; \(N\) is the number of joints in the length of pipeline tested; \(D\) is the nominal diameter of the pipe in inches; and \(P\) is the average test pressure during the leakage test, in psi gauge. Should any test of pipe disclose leakage greater than that specified in the foregoing table, the defective joints shall be located and repaired until the leakage is within the specified allowance, without additional cost to the Owner. The Contractor shall provide certified test pressure gauges, calibrated within 8 months of the test. The gauges shall be a minimum of 4-inches in diameter, with a 1 psi scale.
After installation of the tapping sleeve and valve and prior to making the tap, the sleeve shall be tested at 200 psi for 2 hours. There shall be no pressure drop during the test period.

**System Connections**
Unless specifically approved by the Owner in writing, connections to the existing system shall be made only after all pipes have been disinfected and all hydrostatic testing have been approved by the Owner.

Before any installed utility is covered/backfilled, contractor shall call for an “ok to cover and backfill” inspection. Failure to comply will result in contractor unearthing utilities for said inspection.

**END OF SECTION**
33 31 13 Public Sanitary Utility Sewerage Piping

Part 1 – General
This section defines the general design parameters for the sanitary sewer collection system, including pipe and fittings, service lines, manholes and system appurtenances.

General Design Considerations:
Minimum velocity when flowing full, and a Manning n=0.013.
Normal reaches 2.5 feet per second.
Terminal reaches 3.0 feet per second.
Maximum wet weather flow shall not exceed 0.75 percent of the pipe diameter.

Minimum Pipe Diameter:
Mains 8-inch.
Terminal reaches less than 200 feet 6 inch.
Service lines 4 inch.

Manholes:
Install manholes at horizontal deflection points, grade changes, all sewer main line junctions, and at all building service lines 6-inch or larger.

Install water tight covers on manholes that may be subject to surface stormwater flows.

Install bull horn clean out no more than 5’ from building.

The maximum spacing between manholes shall not exceed 350 feet.

Do not use curvilinear sewers.

The Design Professional (DP) shall size the piping system based on the wet weather peak design flows. Coordinate with the Project Manager regarding existing flows within the system and provisions for future upstream campus expansions. Submit flow and hydraulic calculations to the Project Manager.

The Design Professional (DP) shall design a Flow Management Plan (FMP) when the construction restricts the flow in the existing system. The FMP shall detail all temporary bypass pumping facilities required to maintain continued sewer service to the upstream users.
Pipe lining and other in-situ rehabilitation shall be coordinated with the Project Manager.

Design of all sanitary sewer system shall comply with the rules and regulations of the Arizona Department of Environmental Quality (ADEQ) and the Arizona Administrative Code (ACC).

**Part 2 – Products**
All sanitary sewer piping, manholes and fittings shall conform to the Maricopa Association of Governments Uniform Standard Specifications and Details for Public Works Construction and the rules and regulations of the Arizona Department of Environmental Quality.

Polyvinyl Chloride (PVC) Pipe, ASTM D-3035, SDR-35 minimum, pipe and fittings shall have integral bell gasketed joint, gaskets shall conform to ASTM F-477.

**Ductile Iron Pipe**
Push-on Tyton joint, mechanical joint, epoxy lined. Rubber gasket joints shall be in accordance with AWWA C111. Epoxy lining shall be a Hybrid novolac epoxy lining system a minimum of 40 Mil thick.

Manholes shall be precast concrete riser sections conforming to ASTM 478, with cast in place concrete base. Minimum manhole diameter shall be 5-feet. Frames and covers shall be cast iron with a minimum diameter of 24-inches. Frame and covers shall be labeled “Sanitary Sewer”. All manholes shall have steel reinforced polypropylene steps.

Couplings shall be epoxy coated steel barreled, compression styled couplings, sized for the OD of the pipe.

Polyethylene encasement for ductile iron pipe shall conform to AWWA C105. Color shall be black or green.

**Part 3 – Execution**
General Installation, install system in accordance with the Maricopa Association of Governments Uniform Standard Specifications and Details for Public Works Construction and the rules and regulations of the Arizona Department of Environmental Quality (ADEQ).

Minimum depth of cover, measured from top of pipe, shall be as follows;
- Sewer Mains: 48-inches.
- Service Lines: 36-inches
General Installation
Install per the Maricopa Association of Governments Uniform Standard Specifications and Details for Public Works Construction.

Install manholes at horizontal deflection points, grade changes, all sewer main line junctions, and at all building service lines 6-inch or larger.

Where utility access hatches/vaults/manholes are installed within 2 feet of sidewalks, they shall be 1 inch below top of finished sidewalk to accommodate for snow removal without damage to boxes or lids.

Where utility access hatches/vaults/manholes are installed in sidewalks, patios, roadways, or any other structure where snow removal shall occur, the top of the access hatches shall be a minimum of ¼” and a maximum of ½” below finished surface of concrete to accommodate for snow removal without damage to boxes or lids.

Do not use curvilinear storm sewers.

During all periods when flow is restricted within the existing sanitary sewer system, the Contractor shall erect all provisions of the Flow Management Plan (FMP) and provide 24-hour per day maintenance for the pumping and force main equipment. All pumping equipment shall have redundant capacity. All pumping equipment used shall be set in a containment area acceptable to the Owner.

Report all Sanitary Sewer Overflows (SSO’s) immediately to the Owner. The Contractor shall be responsible for containing and cleaning up all SSO’s. The Contractor shall not allow the release of silt, soil or other debris into the existing sewer system. If material is released into the existing system, the Contractor shall be solely responsible for cleaning the existing system.

Testing
Test lines and manholes per the Maricopa Association of Governments Uniform Standard Specifications and Details for Public Works Construction and per ADEQ Rules and regulations. Testing shall include, but not limited to the following: Vacuum testing of manholes, and structures per ASTM C1244.

Low pressure air testing of pipe lines per MAG Standard Specification 615. Deflection testing of all mains per ASTM D-3034. Lamp testing of mains.
The Owner requires closed circuit television (CCTV) inspections of the sewer by the contractor upon substantial completion. The DVD shall be required as part of the closeout package.

**Separation Between Sanitary Sewers and Water Mains**
The minimum separation between potable water mains and sanitary sewers shall be two (2) feet vertically, with the water main above the sanitary sewer, and six (6) feet horizontally, unless extra protection is provided. In no case shall the sewer main be placed within one (1) foot vertical or horizontal of a water main.

Extra protection shall be mechanical joint ductile iron pipe, restrained joint push on ductile iron pipe, or concrete encasement of the pipe within a minimum of 6-inches of concrete on all sides of the pipe.

Where water lines crosses above or less than two (2) feet above a sewer main line, or within 6-feet horizontally of a water main, the sanitary sewer or the water mains shall be constructed of mechanical joint ductile iron pipe for a distance of ten (10) feet on either side of the water main crossing, or both the water and the sewer main shall be concrete encased.

The horizontal and the vertical dimensions shall be measured from outside of pipe to outside of pipe.

Per ADEQ Rules and regulations.

**END OF SECTION**
33 40 00  STORM DRAINAGE UTILITIES

33 41 13  Public Storm Utility Drainage Piping

**Part 1 – General**
This Section includes the following for storm sewer (storm drainage) system:
Pipe and fittings.
Manholes.
Catch Basins.
Testing.

**General Design Considerations**
Minimum velocity when flowing full, and a Manning n=0.013.
Mains 2.0 feet per second
Terminal reaches 2.5 feet per second
Minimum pipe diameter.
Mains 18-inch diameter.
Laterals less than 40 feet 12 inch diameter.
Storm Drains shall be designed to convey the 10 year storm event.
Hydrologic and hydraulic calculations shall be based on City of Flagstaff MHDUD (Manual for hydraulic Design for Urban Drainage).
The hydraulic grade line shall be computed at all junctions. At all inlet junctions the hydraulic grade line shall be within the limits set forth in the MHDUD (City of Flagstaff Manual for hydraulic Design for Urban Drainage).
The design flow and the hydraulic grade line shall be shown on the storm drain profile for each reach of the system.
Storm drainage piping, manholes catch basins, and junction structures shall be design for AASHTO HS20 wheel loads, and the design dead loads.

**Part 2 – Products**
General, all piping, manholes, catch basins and fittings shall conform to the Maricopa Association of Governments Uniform Standard Specifications and Details for Public Works.

Polyvinyl Chloride (PVC) Pipe and Fittings, ASTM D-3035, SDR-35 minimum, pipe and fittings shall have integral bell gasketed joint, gaskets shall conform to ASTM F-477.

High Density Polyethylene (HDPE) and Fittings, profile-reinforced and corrugated (Type S or Type D) pipe manufactured per ASTM F-894, AASHTO M-252 or AASHTO M-294 for gravity flow, low pressure storm drain systems. Pipe and fittings shall have gasketed joints.
Reinforced Concrete Pipe (RCP) and Fittings, ASTM C76, Class III, or ASTM C655, D-load as indicated on the Drawings. Rubber gaskets shall conform to ASTM 765.

Corrugated Metal Pipe (CMP), AASHTO M-36, galvanized. Steel thickness shall be indicated on the drawings. Band clamps shall be dimpled. O-rings shall comply with ASTM C 361, Section 5.9 and shall be placed on the first corrugation of the pipe end and compressed by the band clamp.

Spiral Rib Corrugated Steel Pipe (CSP), Pipe shall be ALUMINIZED steel, Type 2, helically wound, with 3/4 by 3/4 by 7-1/2 inch rectangular ribs projecting outwards from the pipe wall and continuous lock seams. The ALUMINIZED steel shall conform to ASTM 929 or AASHTO M274. The pipe shall be manufactured in accordance with ASTM A760 or AASHTO M36. Pipe connected with band clamps shall be manufactured with a minimum of two annular re-rolled corrugations for the purpose of joining pipe together. Steel thickness shall be indicated on the drawings. Joints shall be bell and spigot with fluted gaskets, or band clamps with O-rings gaskets. The bell and spigot and band clamps shall be manufactured of ALUMINIZED Type 2 steel. Band clamps shall comply with AASHTO M-36, manufactured of material two gages thinner than the pipe. Band clamps shall be dimpled. O-rings shall comply with ASTM C 361, Section 5.9 and shall be placed on the first corrugation of the pipe end and compressed by the band clamp.

Ductile Iron Pipe (DIP) and Fittings, Ductile Iron Pipe (DIP): All pipes shall be push-on Tyton joint, mechanical joint, epoxy, lined. Rubber gasket joints shall comply with AWWA C111.

Manholes shall be cast in place concrete or precast concrete riser sections conforming to ASTM 478, with cast in place concrete base. Minimum manhole diameter shall be 4-feet for pipes 18-inches and smaller, 5 feet diameter for pipe between 18 and 36 inch diameter, and the pipe diameter plus 18-inches for pipe larger than 36 inches. Frames and covers shall be cast iron with a minimum.

Catch Basins and Inlets, cast in place concrete, conforming to the Maricopa Association of Governments Uniform Standard Specifications and Details for Public Works Construction. Grates shall be welded steel, galvanized. Grates in pedestrian walkways shall conform to ADA requirements.

Precast junction structures shall be manufactured in accordance with ASTM C-478. Structures shall be sized as indicated on the Drawings. The design of the precast structure shall include the design penetrations in the structure. Frames and covers shall be cast iron with a minimum diameter of 24-inches.
Transition couplings shall be specials manufacture of piping material or shall be a concrete collars conforming to MAG Standard Detail No. 505. Concrete shall be Class A, 3,000 PSI, reinforcement shall be Grade 40. Transition couplings on pipe 12-inches diameter or smaller may be mission style couplings.

Part 3 – Execution

General
Install per the Maricopa Association of Governments Uniform Standard Specifications and Details for Public Works Construction and as specified below.

Install manholes at all changes of slope or pipe deflections.

Do not use curvilinear storm sewers.

During all periods when flow is restricted within the existing storm drainage system, the Contractor shall provide all required temporary conveyance measures to ensure that flooding or hazardous conditions to not occur upstream or downstream of the project.

The Contractor shall not allow the release of silt, soil or other debris into the existing storm drainage system. If material is released into the existing system, the Contractor shall be solely responsible for cleaning the existing drainage system.

Minimum depth of cover, measured from top of pipe, shall be as follows:
Storm sewer mains: 36-inches.
Storm sewer laterals: 24-inches.

Testing
Test all manholes, and structures per ASTM C1244.

Test all piping in accordance with MAG Standard Specification No. 615.

Separation between storm sewers and potable water mains shall be 12 inches minimum.

**END OF SECTION**
This Section includes the following for natural gas distribution systems:
- Piping, valves and fittings.
- Meters and regulators.
- Cathodic protection.

### 33 51 13 Natural Gas Piping
Specifications included below apply to internal and external gas piping.

#### Part 1 – General
NAU is considered an Owner Operator and all Arizona Corporation Commission (ACC) rules and regulations shall apply.

The gas distribution systems and gas service lines shall be constructed of welded steel pipe. High density polyethylene (HDPE), plastic and copper pipe shall not be used in the gas piping system.

Design and Construction shall be in accordance with the Code of Federal Regulations (CFR): Title 49, Chapter 1, Part 192, Transportation of Natural and Other Gas by Pipeline – Minimum Safety Standards, and codes referenced herein.

Cathodic protection shall be designed and constructed for all underground gas piping. The design shall be in accordance with National Association of Corrosion Engineers (NACE) International standards. All calculations, design and testing shall be performed by or supervised by the Corrosion Specialist or Engineer.

#### Part 2 – Products

**Underground Piping**
Black Steel, seamless or ERW, ASTM A53, Grade B, Schedule 40 (minimum), factory coated and protected with cathodic protection, U.S. domestic made pipe.

Shop-applied pipe coating shall be one of the following types:
- Shop-applied pipe coating: Fusion Bonded Epoxy (FBE) meeting the requirements of AWWA C213. Coating thickness shall be a minimum of 14 mil base coat and 15 mil top coat. Repair of the coating shall be per the coating manufacturer’s written instructions.
- Adhesive-Thermoplastic Resin Coating: Fed. Spec. L-C-530, Type I.
- Adhesive-thermosetting Resin Coating: Fed. Spec. L-C-530, Type II.
Field-applied plastic tape material for use on pipe joints and for repairing damaged areas of shop-applied coatings shall conform to Federal Spec. L-T-1512, Type I, 250 μm (10 mils) nominal thickness for pipe joints, and Type II, 500 μm (20 mils) nominal thickness for coating repairs.

All gas lines into building need to have insulating unions installed to isolate building pipe from underground piping.

Fittings
Steel Pipe Fitting:
Butt weld fittings shall be wrought steel, ANSI B16.9.
Socket weld fittings shall be forged steel, 2,000 PSI Class, ANSI B16.11.
Threaded fittings shall be malleable iron, ANSI 16.3 or forged steel, ANSI B16.11.
Flanges shall be steel, Class 150, ANSI B16.5.

Joints
Socket or butt welded for steel pipe, ANSI B31.8. Threaded joints not permitted except at above grade. Flanged joints at valve connections.

Control Valves
Valves 2-inches and larger shall be lubricated plug valves, semi steel, carbon steel, or cast iron, flanged connections conforming to API 6D.

Valves 1.5-inches and smaller shall be lubricated plug valves, semi steel or cast iron, screwed or but welded connections conforming to API 6D.

Direct buried valves shall have a 2-inch operating nut.

Tapping valves shall be cylindrical lubricated plug valves with 100 percent full pipe area, round port.

Valves shall be rate for a minimum working pressure 125 PSI and be tested and certified by the manufacturer.

Taps
Fully welded weld-o-let or welded fittings.

Valve Can
Valve can covers shall consist of cast iron box and riser. All valve can covers shall include a debris cap. The valve box and cover casting shall be manufactured
in conformance with ASTM A48, Class 30B. Covers shall be labeled “GAS” and painted yellow.

**Meters**
Gas meters shall be ONICON F-5000 Series Thermal Mass Flow Meters, or approved equivalent, or the type approved by NAU and as specified herein.

Meters shall comply with ANSI B109.2. Meters shall be pipe or pedestal mounted. Meters shall be provided with over-pressure protection as specified in ASME B31.8, tamper-proof protection, frost protection. Meters shall be suitable for accurately measuring and handling gas at pressures, temperatures, and design maximum and minimum flow rates.

Meters shall have direct reading indexes (cubic feet) and safe pulse output for remote reading. Output from meter shall be compatible with, and connected to, the building EMCS system. Refer to Division 23 for metering EMCS requirements.

**Pressure Regulators**
Pressure regulators for individual service lines shall be capable of reducing distribution line pressure to pressures required for users. Ferrous bodies. Pressure relief shall be set at a lower pressure than would cause unsafe operation of any connected user. Gas valve shall be installed immediately upstream of each pressure regulator and regulator shall have a single port with orifice diameter no greater than that recommended by manufacturer for the maximum gas pressure at the regulator inlet. Regulator vent valve shall be of resilient materials designed to withstand flow conditions when pressed against valve port. Regulator shall be capable of limiting build-up of pressure under no-flow conditions to 50 percent or less of the discharge pressure maintained under flow conditions. Contractor shall be responsible for the flow and lockup test.

**Tracer Wire**
Tracer wire shall be 12 AWG solid copper, or stranded copper wire, PVC insulated, type UF, UL listed for direct burial in ground. Provide wire in 1,000 feet or 2,500 feet rolls. Splicing system shall consist of a copper wire crimp, PVC split case gland, and epoxy waterproof sealing compound.

Trace wire shall be required on all newly installed utilities that extend outside of the building to the point where contract boundaries end. If tying into an existing utility and that utility will not come above ground, (tying into an existing sewer line for example), then the trace wire shall be brought to the surface and terminated in a small underground j-box directly above the newly installed utility. J-box lid shall be marked “trace wire” and identify what utility the trace
wire is for. If a utility comes above ground, (fire hydrant for example) then the trace wire shall come above ground with the same utility.

**Anodes**
Anodes shall be high potential magnesium alloy, factory packed in cloth bag or box containing prepared packing backfill mixture, and lead wires. Backfill materials shall be hydrated gypsum, bentonite, and sodium sulfate. Approximate magnesium alloy weight, 20 pounds, centered in packing, total weight approximately 45 pounds.

**Test Stations**
Test stations shall be weatherproof, located at grade, or aboveground. Enclosed terminals for anode leads, test leads, and leads attached to protected system. Connection points for test instruments. The housing unit shall be of standard design, manufactured for use as a cathodic protection test station, complete with locking cover, terminal board, shunts, and brass hardware. The terminal board shall be removable for easy access to wires and constructed of high impact resistant plastic. Provide means to anchor housing below grade. Test station covers shall consist of manufactured integral yellow color.

**Cable Connections**
Cable Connectors between cables and pipes, casings or structures shall be exothermic fusion welding process using copper oxide, aluminum and vanadium welding material in graphite molds. Connections between cables and between cables and leads shall be corrosion-resistant split bolts. Insulation of cable to cable connections shall be epoxy resin splice kits with two part resin, mold, sealing mastic.

Where underground valve boxes or utility access boxes are installed with 2 feet of sidewalks, they shall be 1 inch below top of finished sidewalk to accommodate snow removal with damage to boxes or lids.

Where underground valve boxes or utility access boxes are installed in sidewalks, patios, concrete steps, or any other structure where snow removal shall occur, the top of the boxes shall be a minimum of ¼” and a maximum of ½” below finished surface of concrete to accommodate for snow removal without damage to boxes or lids.

**Part 3 – Execution**
Prior to the start of construction, the Contractor shall hold a pre-construction meeting with the Owner, NAU’s Plumbing and Natural Gas Department, and the Engineer. The meeting shall be attended by the gas system installers and shall

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review the installation and testing requirements for the installation of the gas system.

In order to energize Natural Gas to a building the contractor must have G8 on the FS15 signed, and an approved FS15A for B1-B3 and C6 for the water system.

**Special Submittal and Approvals**
The Contractor shall submit all data on all materials, welding procedures, welding certifications, shutdown procedures and construction procedures as a package. This submittal will be reviewed by NAU and the DP. Upon approval by NAU and the DP, the submittal shall be sent by the NAU Master Meter Operator to the Arizona Corporation Commission (ACC). The review by the ACC shall take a minimum of 30 days. No work shall be started until approval is obtained from the ACC.

The welder's certification, shall be API-1104, and shall be current under the procedure proposed within the six months of the gas system construction.

The Contractor shall request through the Owner, all inspections required by the ACC. The schedule of the inspection is at the discretion of the ACC inspector. The ACC representative shall witness and/or performed visual inspection, including all pressure tests, pipe installation, bedding and shading operations, coating of pipes, installation and testing of cathodic protection systems, tracer wires and meter sets. No work shall be covered until the ACC has been notified, performed their inspection, and the Owner approves covering the work.

**Trenching**
All underground pipes shall be bedded and shaded with clean cinder sand and install at a depth to provide the minimum cover above the pipe. Shading shall be paced around the pipe, avoiding damage to the pipe coating. Install tracer wire along the top of the pipe and install marking tape at a minimum of 12-inches and a maximum of 18-inch below grade. The minimum depth of cover, measured from top of pipe, shall be as follows;

| Gas Mains: | 30-inches. |
| Service Lines: | 24-inches. |

**Piping**
Gas distribution system and equipment shall be installed in accordance with the manufacturer’s recommendations and applicable sections of ANSI B31.8 and CFR Title 49, Part 192 - Minimum Federal Safety Standards.
All welding shall be done by welders certified for the type and size of the required welds on natural gas systems. All welding shall conform to CFR Title 49, Part 192.225. Certification of welders shall comply with CFR Title 49, Part 192.227. Welding shall be per the approved welding procedures.

The Contractor shall hire an Independent Testing Agency to inspect and test welds in accordance with CFR Title 19, Part 192.241, and pay all costs of the inspection and testing. Separation between gas lines and other utilities and structures shall be in accordance with the ACC Rules and regulations. In no case shall the separation be less than 12-inches minimum from utilities lines or structures.

The gas lines shall be as short and as straight as practicable between the point of connections to the existing gas main and shall not be bent or curved laterally unless necessary to avoid obstructions and permitted by the Owner. Gas lines shall be laid with as few as joints as practicable using standard lengths of pipe.

Make service connections at the top of the main, whenever the depth of the main is sufficient to allow top connections. When service connections cannot be made at the top of the main, they shall be made on the side of the main as close to the top as possible. Service connections shall not be made lower than the horizontal midpoint of the gas main.

Taps on the Existing system shall be welded construction, with flanged, full port, round opening, tapping valves. Tap and valve shall be pressure tested prior to cutting the existing pipe.

Schedule and coordinate with the NAU Gas Shop and the City of Flagstaff Fire Department when working on live gas lines.

**Purging of Gas Lines**
It shall be the responsibility of the Contractor to purge lines in accordance with the rules and regulations of the ACC. Lines shall be purged with nitrogen. Lines shall be purged in such a way as to prevent the flow of natural gas into building, structure or to other ignition sources. All purges shall be coordinated with and supervised by the NAU Gas Department.

**Cathodic Protection**
Install system per the National Association of Corrosion Engineers (NACE) International standards.
Anodes shall be placed anodes into augured holes by grasping the cloth gathered at top of packaged anode. Replace ruptured anode packages with undamaged ones. Under no circumstances lower anode into hole by lead wire alone. Presoak packaged anodes in water for at least 15 minutes prior to installation. Tamp screened soil around anode to insure contact between anode and native earth. Provide adequate slack in the lead wire to preclude tearing lead wire loose during backfilling and compacting procedures. Locate anodes so that minimum distance of 36 inches is maintained between anode and gas line to which it is to be attached. Connect lead wire to piping by using the thermite welding process.

Provide one test station for each eight (8) anodes or 500 feet of piping to permit testing for performance of the cathodic protection system. Use a minimum of No. 12 stranded copper wire and termite welding process.

Testing of the cathodic protection system shall be per the National Association of Corrosion Engineers (NACE) International standards. Tests shall include testing of anodes prior to connecting anode lead wire to the piping and final testing of the cathodic protection system, including measuring pipe-to-soil potentials over the entire system. Make potential measurements with potentiometer voltmeter (minimum internal resistance of 50,000 ohms per volt) and a copper/copper sulfate reference electrode placed at the finished grade level and directly over the pipe. Adequate number of measurements shall be taken over the extent of piping to insure that a minimum potential value of negative 0.85 (-0.85) volts exist over all new gas piping. Upon completion of testing, a report setting forth potential values acquired by location shall be submitted to the Owner.

**Pipeline Testing**
The Contractor shall test all gas lines in accordance with NFPA 54, ANSI B31.8, and CFR 192.509 and 192.511.

All gas lines shall be tested at 90-PSI, or one and one half (1.5) times the system’s design operating pressure, for a minimum period of one (1) hour with no pressure drop.

Holiday testing shall be performed by the NAU Gas Department until coating deficiencies are corrected.

**Sleeves**
Pipelines crossing under structures shall be sleeved. Pipe shall be continuous through sleeves. Vent all sleeves to atmosphere and seal between sleeve and the pipe with modular mechanical type seal.
Split sleeves may be installed where existing lines pass under new construction.

Painting
All exposed exterior gas piping shall be painted with acrylic enamel. Color is to be specified by DP and approved by the NAU PM.

System Abandonment
All abandoned gas line shall be purged and removed by the Contractor. When approved by the Owner, abandoned lines may be abandoned in place. All lines abandoned in place shall be purged, filed with water or nitrogen and capped.

All abandonments and removals shall be noted and dated on the record (as-built) drawings. The Contractor shall submit a written statement to the Owner confirming the date the system was purged, and that purging operations were completed in accordance with all governing regulations.

**END OF SECTION**
33 60 00 HYDRONIC AND STEAM ENERGY UTILITIES

33 61 13 Chilled Water Distribution System

Part 1 – General
This Section includes the following for direct buried chilled water distribution system.

The Design Professional (DP) shall size the piping system based on the design flows and a maximum velocity of 4.5 feet per second. Coordinate with the Project Manager regarding existing flows and pressures within the distribution system and allowances for future expansions of the system.

Valves, install valves on three sides of all tees and four sides of all crosses. Maximum spacing between valves shall not exceed 300 feet.

Refer to Division 23 for meter requirements and connections to the EMCS system.

Part 2 – Products
Polyvinyl Chloride (PVC) Pipe
Polyvinyl Chloride (PVC) Pipe: PVC pipe 4-inch diameter to 12” diameter shall conform to AWWA C900, Class 200 (SDR 14), PVC pipe 12-inch diameter and larger shall conform to AWWA C905, Class 210 (SDR 18), cast iron outside diameter. Elastomeric gaskets shall conform to ASTM F477 providing a water tight seal when tested in accordance with ASTM D3139.

Fittings used on PVC pipe shall be mechanical joint ductile iron (DI) fittings as specified below.

Ductile Iron Pipe (DIP)
Ductile Iron Pipe (DIP): All pipes shall be push-on Tyton joint, mechanical joint (MJ) joint or integral restrained joint ductile iron pipe. The pipe shall be manufactured and tested in accordance with the American Water Works Association (AWWA) Standard C151, and have working pressure (pressure class) of not less than:

4”-12” diameter Pressure Class 350
16” diameter Pressure Class 250

Rubber gasket joints shall satisfy requirements of AWWA C111.
Flanged ductile iron pipe shall be manufactured in accordance with AWWA C115, with Class 150 flanges. The minimum thickness class for ductile iron pipe to be threaded shall be thickness Class 53. Threads for threaded flanged pipe shall be taper pipe threads in accordance with ANSI B2.1, with thread diameters adjusted to conform to ductile iron pipe standard outside diameters.

All ductile iron pipes shall have a standard thickness cement-mortar lining followed by a seal coat of asphalitic material in accordance with AWWA C104.

The exterior surfaces of all ductile iron pipe and fittings shall be coated with a bituminous material in accordance with AWWA C151 before shipment.

**Ductile Iron Fittings**

Fittings and specials shall conform to AWWA C110, AWWA C153, and AWWA C111. Fittings and specials shall be cement-mortar lined in accordance with AWWA C104. Linings shall be standard thickness and seal coated with a bituminous material.

The exterior surfaces of all ductile iron fittings shall be coated with a bituminous material in accordance with AWWA C110.

**Control Valves**

Gate valves (4” to 12”) shall be resilient seated gate valves meeting the requirements of AWWA C509, and Maricopa Association of Governments Uniform Standard Specifications and Details for Public Works Construction Standard Specification No. 630. The valves shall be rated bubble tight at 200 PSI. The exterior and interior shall be coated with a thermo-setting or fusion bonded epoxy coating meeting the requirements of AWWA C550. The dry coating thickness shall not be less than 12 mils. Valves shall have mechanical style connections, except flanged joints may be used on the side of the valve that connects directly to a tee or tapping sleeve. Direct buried valves shall have a 2-inch operating nut.

The direction to open the valve shall be to the left (counter clockwise). Valves shall have a minimum of two (2) turns per inch of diameter.

Valves shall be rate for a minimum working pressure 250 PSI and be tested and certified by the manufacturer as being bubble tight at 200 PSI.

**Joint Restraint Devices**

All joints, fittings, and valves within the system shall be fully restrained. Joint restraint devices shall comply with Maricopa Association of Governments Uniform Standard Specifications and Details for Public Works Construction
Standard Specification No. 750. Acceptable joint restraint devices include the following, or approved equal:

- Ductile iron fittings mechanical style joints - EBAA Iron Sales, Inc. “Mega Lug” joint restraint. The specific model utilized shall be compatible with the type of pipe (DIP or PVC) connected to the fitting.
- PVC pipe push-on style joints – EBAA Iron Sales Series 1600 or approved equal.
- Ductile iron push-on style joints – EBAA Iron Sales Series 1700 or approved equal.
- Ductile iron pipe Integral joint restraint type - U.S. Pipe “TR Flex” restrained joint pipe and fittings, Pacific States “Thrust Lock” joint system, Griffin Pipe “Snap Lok” joint system, or approved equal.
- The use of gaskets with integral restraint grippers shall not be permitted.

**Valve Boxes**
Valve box and cover shall consist of a cast iron box and cover and PVC riser. The valve box and cover casting shall be manufactured in conformance with ASTM A48, Class 30B. Cover shall be labeled “CHW” or with no logo.

Where underground valve boxes or utility access boxes are installed within 2 feet of sidewalks, they shall be 1 inch below top of finished sidewalk to accommodate for snow removal without damage to boxes or lids.

Where underground valve boxes or utility access boxes are installed in sidewalks, patios, roadways or any other structure where snow removal shall occur, the top of the boxes shall be a minimum of ¼” and a maximum of ½” below finished surface of concrete to accommodate snow removal without damage to boxes or lids.

Valve stem risers shall comply with Maricopa Association of Governments Uniform Standard Specifications and Details for Public Works Construction Standard Specification No. 610 and as detailed on the plans.

**Air Relief Valve Vaults**
All cast-in-place concrete shall conform to Maricopa Association of Governments Uniform Standard Specifications and Details for Public Works Construction Standard Specification Section 725, Class “S” (3,000 PSI).

Reinforcement shall conform to MAG Standard Specification 727, Grade 40.

Pre-cast manhole section shall have an inside diameter indicated on the plans and conform to the requirements of ASTM C478.
The frame and cover shall be 30-inch diameter; traffic rated (HS20), and has a bolted watertight lid.

### Air Relief Valves (Manual)
Vacuum and air relief valves shall be of the size shown on the plans. Corrugated shall be full opening with O-ring seal and bronze ball and conform to AWWA C800. Taps into ductile iron pipe may be made by direct tapping of the pipe or with a service saddle. Taps into PVC pipe shall be made with a service saddle. Service saddles shall conform to AWWA C800, and be constructed of bronze or epoxy coated ductile iron. Saddles shall have a single or double strap. The outlet of the valve shall be equipped with a gooseneck and stainless steel screen as indicated on the drawings. Copper tubing shall be Type K, ASTM B88.

### Polyethylene Encasement (Dip Pipe)
Polyethylene encasement shall conform to AWWA C105. The color of the polyethylene encasement shall be purple.

### Mechanical Couplings
Couplings used on ductile iron and PVC C900 pipe shall be ductile iron, solid sleeves with mechanical joints, complying with AWWA C110 and C111 and as specified for ductile iron fittings. Couplings shall be fully restrained.

### Tapping Sleeves
All tapping sleeves shall conform to MAG Specification No. 630. Sleeves shall be ductile iron or fabricated from ¾-inch (minimum) ASTM 286 Grade C steel or ASTM A-36 steel. Sleeves shall be factory coated with corrosion resistant epoxy in accordance with AWWA C550. Flange shall be 150 LBS MSS-SP60. Bolts shall be corrosion resistant, high strength, low –alloy, per AWWA C-111. Gasket shall be Burna-N or neoprene. Sleeves shall be rated for 250 psi.

### Part 3 – Execution

### General
PVC pipe shall be installed in accordance with the requirements of AWWA C605, the manufacturer’s recommendations and Maricopa Association of Governments Uniform Standard Specifications and Details for Public Works Construction Standard Specification No. 610, and as specified herein. Minimum depth of cover, measured from top of pipe, 36-inches.

There shall be 12 inches of red cinders above any direct bury chilled water lines.

In order to energize chilled water to a building the contractor must have U14 and U15 on the FS15 signed, and an approved FS15A for B1-B3 and C6 for the water system.
Ductile-Iron Pipe
Install in accordance with the recommended procedures set forth in AWWA C600 and Maricopa Association of Governments Uniform Standard Specifications and Details for Public Works Construction Standard Specification No. 610, and as specified herein.

The maximum allowable joint deflection will be as given in AWWA C600. If the alignment required deflection in excess of the above limitations, a sufficient number of fittings shall be utilized to provide angular deflections within the limits set forth. Do not bend or deflect the pipe.

Install all joint restraint devices in accordance with the manufacturer's instructions and prior to pressure testing of the system.

All joints, fittings, and valves within the system shall be fully restrained.

Install all valves in accordance with the manufacturer’s instructions. When the top of the operating nut is 4 feet or greater below finish grade, install a valve nut extension as detailed on the drawings.

Install air relief valves at high points. Tap ductile iron or PVC pipe at the high point and install a corporation stop or service saddle and corporation stop. Install copper blow-off line at an upward slope to the air relief valve. Install isolation stop in a location that it is accessible from within the vault.

Attach locator wire to the top of the all chilled water line. The Contractor shall minimize the number of splices in the wire. All splices shall be made with a watertight gland.

Separation Between Chilled Water Lines and Potable Water Lines
The minimum separation between chilled water mains and potable water mains shall be two (2) feet vertically, with the water main above the chilled water main, and six (6) feet horizontally, unless extra protection is provided. In no case shall the chilled water main be placed within one (1) foot vertical or horizontal of a potable water main.

Extra protection shall be mechanical joint ductile iron pipe, restrained joint push-on ductile iron pipe, or concrete encasement of the pipe within a minimum of 6-inches of concrete on all sides of the pipe of the pipe.

Where chilled water mains crosses above or less than two (2) feet below a water main, or within 6-feet horizontally of a water main, the chilled water main shall
be constructed of mechanical joint ductile iron pipe for a distance of ten (10) feet on either side of the water main crossing, or when approved by the Owner, both the chilled water and the water main shall be concrete encased.

The horizontal and the vertical dimensions shall be measured from outside of pipe to outside of pipe.

**Concrete Encasement**

The Contractor shall coordinate with the Owner if the existing main can be depressurized during concrete encasement work. The Contractor shall adjust their schedule to correspond with the approved shut down period. In the event that the existing system cannot be depressurized, the contractor shall construct the encasement in segments that allows the system to remain in service.

Prior to placing the concrete the existing joints in the existing system shall be exposed and inspected under system pressure. Any leaks or damage to the existing pipe shall be repaired prior to placing concrete.

The Contractor shall install all required temporary supports required to support the existing piping while excavating around the pipe. If the existing pipe is deflected or damaged during construction, all damage piping shall be replaced by the Contractor.

**Interior Inspection**

Inspect the interior of pipe, fittings and valves prior to installation. Damage pipe, fittings and valves shall not be installed or repaired to the satisfaction of the Owner prior to installation.

**Inspection, Examination and Testing**

*Inspection and examination will be in accordance with ASME B31.9 except as follows:*

- *This section is applicable for C900 or equivalent only. All other piping is to follow section 33 63 13 requirements.*
- *All welds and connections are subject to visual inspection for compliance with specifications. Contractors shall be responsible for all labor, material and travel expenses involved in the re-inspection and re-testing of any welds deemed unacceptable. In addition, the Contractor shall be responsible for the costs involved in any and all additional testing required or recommended by ASME/ANSI Standards B31.9 and B31.3 due to the discover of poor, unacceptable or rejected connections.*
Leak Testing

- Contractor shall be responsible for all equipment and material necessary to perform leak testing.
- The test equipment shall be examined before pressure is applied to ensure that is tightly connected. All low-pressure filling lines and all other items not subject to the test pressure shall be disconnected or isolated by valves or other suitable means. All test gauges shall be examined to ensure calibrations are current.
- Pneumatic testing may only be used if approved in writing by NAU Central Plant Supervisor prior to inspection request.
- Pressures shall be continuously maintained for a minimum time of 2 1/2 hours and held for such time as may be necessary to conduct the examinations for leakage. The 2 1/2 hour test will not eliminate the requirement to conduct a visual examination of the entire piping system being tested.
- Any initial service leak tests may be allowed according to ASME 31.9 but must be approved in writing by the NAU Central Plant Supervisor.
- When performing an initial service test, the piping system shall be gradually brought up to normal operating pressure and continuously held for a minimum time of 10 minutes. Examination for leakage shall be made of all joints and connections. The piping system exclusive of possible localized instances at pump or valve packing shall show no visual evidence of weeping or leaking.

Filling System
The pipe shall be filled with potable water, not from the chilled water system.

Hydrostatic Testing
Hydrostatic testing shall conform to AWWA C600 / C605 at a test pressure of 200 PSI, modified as follows:

Allowable Leakage Determination
During the 2 hour, 200 PSI pressure test, the makeup water to maintain the test pressure within 5 psi of the test pressure and re-pressurize the system to the starting pressure shall be measured. Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or approved section thereof, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled. No piping installation will be accepted until the leakage is less than the number of gallons per hour as determined by the formula:

\[ L = 0.00013 \times N \times D \times (P \text{ raised to } 1/2 \text{ power}) \]
In which \( L \) equals the allowable leakage in gallons per hour; \( N \) is the number of joints in the length of pipeline tested; \( D \) is the nominal diameter of the pipe in inches; and \( P \) is the average test pressure during the leakage test, in psi gauge. Should any test of pipe disclose leakage greater than that specified in the foregoing table, the defective joints shall be located and repaired until the leakage is within the specified allowance, without additional cost to the Owner.

The Contractor shall provide certified test pressure gauges, calibrated within 8 months of the test. The gauges shall be a minimum of 4-inches in diameter, with a 1 psi scale.

After installation of the sleeve and valve and prior to making the tap, the sleeve shall be tested at 200 psi for 2 hours. There shall be no pressure drop during the test period.

**Cleaning and Flushing**

*C900 or equivalent only, if black iron is to be used, follow the same procedures as Steam, Condensate, and HTHW Distribution Pipe in section 33 63 13. The contractor shall provide all equipment and material necessary to perform cleaning and passivation of the piping system, sampling of treatment water, and testing of water during treatment.*

*Test gauges shall be located in a manner that provides easy access and a clear view to the inspector.*

**Flushing Process:**

*Remove any filters in the system*

*Flush pipe for a minimum of 6 hours or until discharge shows no sign of contaminants using a clean bucket to examine discharge (bucket test).*

*Following the flush, the contractor will depressurize line and if line is not to be used to convey water or it will be more than 2 weeks before system is brought online, drain as much water as possible. If line is to be brought online within 2 weeks and will convey water, then line may be left filled (NAU may specify a pressure to leave the line at).*

**System Connections**

Unless specifically approved by the Owner in writing, connections to the existing system shall be made only after all pipes have been cleaned and all hydrostatic testing have been approved by the Owner.
**Part 1 – General**

This section includes the general requirements for Steam and High Temperature Hot Water Distribution Systems (HTHW) up to a building’s heat exchanger. High pressure steam and condensate pipe, fittings, valves, insulation and accessories shall be in accordance with Division 23. High temperature hot water pipe, fittings, valves insulation and accessories with Division 23.

In order to energize steam or HTHW to a building the contractor must have U11, U12 and U13 on the FS15 signed, and an approved FS15A for B1-B3 and C6 for the water system.

**Part 3 – Execution**

**Inspection Examination and Testing**

Inspection and Examination will be in accordance with ASME B31.9 except as follows:

All welds are subject to visual inspection and a minimum 10% by x-ray, for compliance with specifications. The Owner will, at the Owner’s option, provide a 3rd party testing company for the purposes of performing said x-ray testing. Initial visual and x-ray inspections will be provided by the Owner. Contractor shall be responsible for all labor, material and travel expenses involved in the re-inspection and re-testing of any welds deemed unacceptable. If more than 50% of x-ray inspected welds fail than all welds will be x-ray inspected at the Contractor’s cost. In addition, Contractor shall be responsible for the costs involved in any and all additional testing required or recommended by ASME/ANSI Standards B31.9 and B31.3 due to the discovery of poor, unacceptable, or rejected welds.

Boiler external piping (all pipe upstream of the second isolation valve prior to connecting to the steam main) shall be hydrostatically tested in accordance with the ASME Boiler and Pressure Vessel Code. The test shall be conducted in the presence of a National Board of Boiler Inspectors certified inspector.

**Leak Testing**

Contractor shall be responsible for all equipment and material necessary to perform leak testing.

The test equipment shall be examined before pressure is applied to ensure that it is tightly connected. All low-pressure filling lines and all other items not subject to the test pressure shall be disconnected or isolated by valves or other suitable means. All test gauges will be examined to ensure calibrations are current.
Pneumatic testing may only be used if approved in writing by NAU Central Plant Supervisor prior to inspection request. Pressures shall be continuously maintained for a minimum of 2 ½ hours and held for such time as may be necessary to conduct the examinations for leakage. The 2 ½ hour test will not eliminate the requirement to conduct a visual examination of the entire piping system being tested. Any initial service leak tests may be allowed according to ASME 31.9 but must be approved in writing by the NAU Central Plant Supervisor. When performing an initial service test, the piping system shall be gradually brought up to normal operating pressure and continuously held for a minimum time of 10 minutes. Examination for leakage shall be made of all joints and connections. The piping system exclusive of possible localized instances at pump or valve packing shall show no visual evidence of weeping or leaking.

Cleaning and Flushing
The contractor shall provide all equipment and material to perform cleaning and passivation of the piping system, sampling of treatment water, and testing of water during treatment. Water samples will be taken to the Central Plants for testing. The chemicals listed are based on material provided by the NAU Chemical Treatment Representative. Contractors may contact NAU’s Chemical Treatment Representative to purchase chemicals at the NAU rate. Test gauges shall be located in a manner that provides easy access and a clear view to the inspector.

Flushing Process
Remove any filters in the system.
Flush pipe for a minimum of 6 hours or until discharge shows no sign of contaminants using a clean bucket to examine discharge (bucket test).
Drain system.
Refill with fresh water adding 1% of Ferroquest FQ7101 based on the volume of water in the system. (ex. 100 gallons of FQ7101 would retreat 10,000 gallons of system water).
Note: The conductivity will be ~2000 micromhos higher than the starting conductivity.
Take an initial water sample and check conductivity and pH. Record and retain sample.
As the pH increases during the cleaning, maintain the pH at 6.2 – 6.8 with Ferroquest FQ7102. One gallon/1000 gallons of system volume will drop the pH approximately 0.2 pH units.
Check water sample 3 times per day for pH add Ferroquest FQ7102 as needed to maintain the pH in correct range. Record pH and retain samples.


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<td>33 63 20</td>
<td>Steam and High Temperature Hot Water Tunnels</td>
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**Part 1 – General**

This Section includes the general requirements for utility tunnels and vaults utilized for the campus steam and high temperature hot water distribution systems.

Tunnel and vaults may be precast concrete, cast in place concrete, large diameter pipe conduits, or composite pipe and concrete encasement.

Structural loading, tunnels shall be designed to be capable for supporting the following loads:

Live Loads shall be in accordance with one of the following American Association of State Highway and Transportation Officials (AASHTO) standards:

AASHTO “Standard Specifications for Highway Bridges”. Structures under pedestrian areas, landscape areas, drives and parking lots shall be designed for HS20 truck loading (32 KIP axle load). Tunnels under principal roadways shall designed for the critical controlling loading condition of HS20 or the alternative military/interstate loading (two 24 KIP axle loads, 4 feet apart), in either single or passing mode.

AASHTO “LRFD (Load and Resistance Factor Design) Bridge Design Specifications”. Structures under pedestrian areas, landscape areas, drives and
parking lots shall be designed for HL93 truck loading (32 KIP axle load). Tunnels under principal roadways shall be designed for the critical controlling loading condition of HL93 truck loading or the design tandem load (two 25 KIP axle loads, 4 feet apart). “Lane loads” may be omitted from the loading calculations.

Impact Factor, per AASHTO standards.

Dead loads shall use a minimum soil density of 120 pounds per cubic feet.

Hydrostatic pressure, the design shall consider that excavation in rock or other low permeable soils may result in the backfill around the tunnel being a flow path for infiltrated stormwater. The design shall consider both the existing soil condition as well as all modifications that may result from the construction.

Pipe and equipment load shall be based on design piping configuration. Walking tunnels shall also include a 50 percent allowance for future piping and equipment.

Anchor and thrust restraint loads shall be based on the piping design. In walking tunnels there shall be anchor provisions at each deflection point of the tunnel and at vaults.

**Tunnel Configuration**

Type A tunnels shall be designed to accommodate the piping systems and provide maintenance access through the tunnel system as indicated in Figure 1 and Figure 2.

Piping systems may be orientated along one or both sides of the tunnel.

Maintenance access area shall be a continuous clear area, a minimum of 2’-6” wide by 6’-0” tall. Circular configurations shall have a concrete infill to provide a level walking surface.

Type B tunnels may be designed to only accommodate the piping systems, refer to Figure 3.

The lid or roof of the tunnel shall be removable to accommodate maintenance access. Do not attach pipes, hangers, or supports to the lid or roof.

Mechanical equipment such as expansion joints, ball joints, etc within Type B tunnels shall be located under a hatch that provides maintenance access without the removal of the tunnel lid or roof.
Steam tunnels longer than 150 feet in length, and all steam tunnels that will ultimately provide steam distribution to more than two (2) buildings shall be Type A.

Steam tunnels less than 150 feet in length and will ultimately provide steam distribution to two (2) or less buildings, may be Type A or Type B.

High temperature hot water tunnels may be Type A or Type B.

Figure 1 – Type A Tunnel – Rectangular Cross Section
Figure 2 – Type A Tunnel – Circular Cross Section

Figure 3 – Type B Tunnel Cross Section
Vault shall be located at all junctions and service line connections.

Tunnels shall be water tight. Type A Tunnels may have a gravel floor, or drain sumps. Install sump pumps in low areas.

Ventilation of Type A tunnels and all vaults shall be in accordance with OSHA requirements.

Lighting shall be provided in all Type A tunnels in accordance with OSHA requirements. Avoid installing light above the access corridor that would impede access. Lighting circuits shall be switch at each access point in the tunnel system. Use toggle switches to control lighting circuits.

In Type A tunnels provide 20 amp, 120 volt electrical receptacles at 200 foot spacing for use by maintenance crews.

Grade of tunnel shall be in accordance with the requirements of the piping systems.

Provide all embeds, anchors, and accessories indicated on the drawings, and required to install the utility lines within the tunnel.

Part 2 – Products

Cast-in-place Concrete Tunnels
Cast in placed concrete tunnels shall be designed in accordance with the International Building Code (IBC) and ASCE 7 – Minimum Design Load for buildings and Other Structures.

Precast concrete tunnels

Design Criteria - Design units in accordance with:

ACI 304 and 318.


Applicable ASTM Standard(s).

Concrete: Concrete shall be a uniform mix of quality materials shall be determined by following the standards in ACI 318 Chapter 5. Recommendations for selecting proportions for concrete are given in detail in Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete (ACI 211.1).
Recommendations for lightweight concrete are given in Standard Practice for selecting proportions for Structural Lightweight Concrete (ACI 211.2).

Water-Cement Ratio: Concrete that will be exposed to freezing and thawing shall contain entrained air and shall have water-cement ratios of 0.45 or less.

Portland Cement: ASTM C150, V.

Aggregates: ASTM C33 or C330.

Water: Potable or free of deleterious substances in amounts harmful to concrete or embedded metals.

Admixtures:

Air-entraining: ASTM C260

Water reducing, retarding, accelerating, high range water reducing: ASTM C494

Pozzolans, fly ash and other mineral admixtures: ASTM C618

Ground granulated blast furnace slag: ASTM C989

Reinforcing Bars:

Deformed Billet-steel: ASTM A615.

Deformed Rail-steel: ASTM A616.
Reinforcing Wire: Plain Wire: ASTM A82.


Precast Fabrication
Forms for manufacturing precast concrete products shall be of the type and design consistent with industry standards. They should be capable of consistently providing uniform products and dimensions. Forms shall be constructed so that the forces and vibrations to which the forms will be subjected can cause no product damage. Forms shall be cleaned of concrete build-up after each use. Form release agents shall not be allowed to build up on the form casting surfaces.

Reinforcement: Cages of reinforcement shall be fabricated either by tying the bars, wires or welded wire fabric into rigid assemblies or by welding where
permissible in accordance with AWS D1.4. Reinforcing shall be positioned as specified by the design and so that the concrete cover conforms to requirements. The tolerance on concrete cover shall be one-third of that specified but not more than 1/2 in. Concrete cover shall not be less than 1/2 in. Positive means shall be taken to assure that the reinforcement does not move significantly during the casting operations.

Inserts and Embedded Metal - All items embedded in concrete shall be of the type required for the intended task, and meet the following standards:

Structural steel plates, angles, etc: ASTM A36

Welded studs: AWS D1.1

Finishes: Hot-dipped galvanized: ASTM A152 or Zinc-rich coating: MIL-P-2135 self-curing, one component.

Joint Sealant and Joint Gaskets:

Joints for Concrete Pipe, Manholes, and Manufactured Box Sections Using Preformed Flexible Joint Sealants: ASTM C990

Grout:
Cement grout: Portland cement with enough water for the required strength and sand for proper consistency. May contain mineral or chemical admixtures, if approved by Owner’s representative. Non-shrink grout: Premixed, packaged expansive and non-expansive shrink-resistant grout.

Access Hatches
Access doors and hatches shall be aluminum construction, AASHTO HS-20 rated, gasketed, water tight. Door shall have compression spring assist opening mechanism, stainless steel hold open arms with positive locking, heavy duty hinges, lifting handles, and hasp. Doors shall be lockable.

Where utility access hatches are installed within 2 feet of sidewalks, they shall be 1 inch below top of finished sidewalk to accommodate snow removal without damage to boxes or lids.

Where utility access hatches are installed in sidewalks, patios, concrete steps, or any other structure where snow removal shall occur, the top of the access
hatches shall be a minimum of ¼” and a maximum of ½” below finished surface of concrete to accommodate for snow removal without damage to boxes or lids.

Ladders
Ladders shall be all aluminum, fully welded construction. Rungs shall be ribbed, slip resistant 1-3/8 inch diameter, spaced on 12 inch centers. Rails shall be 3/8” x 2-1/2” flat bar, spaced 16 inches apart. Mounting brackets shall offset the ladder 7 inches from the wall. Provide telescoping extension rails that extend to 36 inches above the vault when extended.

Part 3 – Execution

General
Cast in place tunnels shall be constructed in accordance with the recommendations of the geotechnical report and ACI standards.

Precast concrete tunnels shall be set on an aggregate base course, leveling pad. Install tunnels true to grade and equipped with all appurtenances required for the piping systems.

Minimum depth of cover, measured from top of tunnel, shall be as follows;
Cast-in-place tunnels: 0-inches
Precast tunnels: 12-inches

Embeds
Embedded Items: Embedded items shall be positioned at locations specified in the design documents. Inserts, plates, weldments, lifting devices and other items to be imbedded in precast concrete products shall be held rigidly in place so that they do not move significantly during casting operations.

Placing Concrete
Concrete shall be deposited into forms as near to its final location as practical. The free fall of the concrete shall be kept to a minimum. Concrete shall be consolidated in such a manner that segregation of the concrete is minimized and honeycombed areas are kept to a minimum. Vibrators used to consolidate concrete shall have frequencies and amplitudes sufficient to produce well consolidated concrete.

Cold Weather Requirements: Recommendations for cold weather concreting are given in detail in Cold Weather Concreting reported by ACI Committee 306.

Hot Weather Requirements - Recommendations for hot weather concreting are given in detail in Hot Weather Concreting reported by ACI Committee 305.
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<td><strong>Curing</strong></td>
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<tr>
<td></td>
<td>Curing by Moisture Retention - Moisture shall be prevented from evaporating from exposed surfaces until adequate strength for stripping is reached.</td>
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<tr>
<td></td>
<td><strong>Joints</strong></td>
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<td></td>
<td>Install water-stops or joint sealants in all joints.</td>
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<td></td>
<td><strong>Moisture Protection</strong></td>
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<tr>
<td></td>
<td>Install moisture protection on the top and sidewalls of all cast in place tunnels.</td>
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<td>Install sump pumps as required.</td>
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**END OF SECTION**
In order to energize electricity to a building the contractor must have U3, U5 and U6 on the FS15 signed, an approved FS15A for B1-B3 and C6 for the building and pad mounted switch metering and an approved work authorization.

High voltage switchgear shall be box pad mounted, low profile, dead front type, S&C Manufacturer. High voltage switchgear shall be set on box pads per APS standards.

A fault current indicator shall be provided on each cable at the source of each feeder to help operators locate system faults.

All modifications to or extensions of the existing NAU medium-voltage electrical system require the approval of the NAU Electrical Shop and Director of Utilities at the Schematic Design level.

Medium voltage cable shall be shielded ethylene-propylene-rubber (EPR) insulated, 133% insulation level, copper conductor, as manufactured by Okonite, Kerite, Prysmian, or approved equivalent, with a 40 year warranty.

All cable utilized in a pull shall have been manufactured during the same production run from the factory. All cable on the project shall be new, shall have been manufactured within 12 months of the date of receipt at the job site, and shall be shipped with original manufacturer’s cable end seals. Cable reels shall be shipped and stored with end flanges vertical. Storage of cable prior to installation shall comply with the recommendations of the manufacturer.
Part 3 – Execution
The installing contractor shall have an Arizona high-voltage license. Installing personnel shall be qualified and certified by the manufacturer in the installation and testing of cable, splices, and terminations.

New cables shall be tested after installation by insulation resistance testing and partial discharge testing, or hi-pot testing. Service-aged cables shall be tested after installation by insulation resistance testing and online partial discharge testing.

Testing shall be performed by an independent 3rd-party testing agency; the Design Professional shall coordinate with NAU to properly specify whether NAU or the installing contractor will be responsible for hiring the testing agency.

Insulation-resistance Test: Test all new and service-aged cables with respect to ground and adjacent conductors. Test data shall include megohm readings and leakage current readings. Cable shall not be energized until insulation-resistance test results have been approved by the NAU Electrical Shop. Test voltage shall be 2,500VDC. Minimum acceptable resistance value shall be 5,000 megohms. Provide a comprehensive report that describes the identification, length, terminations and location of cables tested, the test equipment used, and the date tests were performed; identifies the persons who performed the tests; and identifies the insulation resistance for each cable section tested. The report shall provide conclusions and recommendations for corrective action.

Online Partial Discharge Test: Test all new and service-aged cables. Perform tests after cables have passed the insulation-resistance test, and after successful energization. Testing shall use a time or frequency domain detection process incorporating radio frequency current transformer sensors, with a partial discharge detection range of 10khz to 300Mhz. Provide a comprehensive report that describes the identification and location of cables tested, the test equipment used, and the date tests were performed; identifies the persons who performed the tests; and identifies numerically and graphically the magnitude of partial discharge detected for each cable section tested. The report shall provide conclusions and recommendations for corrective action.

Hi-pot test: Maximum test voltage shall be 55kV, or maximum as allowed by cable manufacturer. Apply voltage in approximately 8 to 10 equal steps. Raise the voltage slowly between steps. At the end of each step, allow 5 minutes for the charging currents to decay. Time and record the interval of decay. Make leakage current readings at 1 minute intervals for each voltage step. Read the leakage current and plot a curve of leakage current versus test voltage on graph...
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<td>Electrical Utility Services</td>
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<tr>
<td></td>
<td>Service Entrance Switchboards shall be provided with ammeter, voltmeter (both with phase switching positions and off positions). Provide kilowatt-hour meter with demand register. Multiplier shall be marked on meter. Label switchboards with CT ratios. KWH meters shall be adaptable to supply a pulse train output for future EMCS system.</td>
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<tr>
<td>33 73 00</td>
<td>Utility Transformers</td>
</tr>
<tr>
<td>Part 1 – General</td>
<td>Building service transformers shall be outdoors, located so as to be accessible for maintenance. Transformers shall not be located in basements or other areas subject to contaminant by flood waters. Transformers will be minimum of 6’ from the edge of sidewalks, pedways or roadways.</td>
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<td>Provide bollards to protect transformers. The number of bollards will be determined by transformer location.</td>
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<td></td>
<td>Transformers shall comply with 2010 US Department of Energy requirements.</td>
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<tr>
<td>Part 2 – Products</td>
<td>Service transformers shall be liquid cooled non-PCB type. Locate at exterior service side of building for accessibility. Aluminum or copper windings are</td>
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acceptable. Penta head bolts shall be used on transformer door. (Penta had socket to be turned over to NAU when job is complete.)

**Box pads shall be pre-manufactured fiberglass type.**

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<td>kVA</td>
<td>as required for the project</td>
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<tr>
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<td>Temperature Rise</td>
<td>65 degree average winding rise</td>
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<td>Cooling Class</td>
<td>KNAN</td>
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<td></td>
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<td></td>
<td>Insulating Fluid</td>
<td>Envirotemp FR3</td>
</tr>
<tr>
<td></td>
<td>Elevation</td>
<td>Designed for operation at 2500 m (8250 ft) above sea level</td>
</tr>
<tr>
<td></td>
<td>Efficiency Standard</td>
<td>DOR 2010, 10 CFR Part 431</td>
</tr>
<tr>
<td></td>
<td>Sound Level</td>
<td>NEMA TR1 Standard</td>
</tr>
<tr>
<td></td>
<td>Primary Voltage</td>
<td>12470 Delta</td>
</tr>
<tr>
<td></td>
<td>BIL</td>
<td>kV as required</td>
</tr>
<tr>
<td></td>
<td>kV Class</td>
<td>kV as required</td>
</tr>
<tr>
<td></td>
<td>Primary Configuration</td>
<td>Dead Front</td>
</tr>
<tr>
<td></td>
<td>Primary Configuration</td>
<td>Loop Feed</td>
</tr>
<tr>
<td></td>
<td>Taps</td>
<td>2 – 2.5% taps above and 2 – 2.5% taps below nominal</td>
</tr>
<tr>
<td></td>
<td>Tap Charger</td>
<td>100 amp 5 position tap changer</td>
</tr>
<tr>
<td></td>
<td>Primary Bushings</td>
<td>200 amp copper bushing well(s) (Qty. 6)</td>
</tr>
<tr>
<td></td>
<td>Load-break Switching</td>
<td>630A four position T-blade switch</td>
</tr>
<tr>
<td></td>
<td>Arresters</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>Overcurrent Protection</td>
<td>Bayonet fuse in series with Partial-Range current-Limiting Fuses</td>
</tr>
<tr>
<td></td>
<td>Explosion Fuses</td>
<td>Bayonet fuses</td>
</tr>
<tr>
<td></td>
<td>Bayonet Holder</td>
<td>Copper Bayonet Fuse Holder</td>
</tr>
<tr>
<td></td>
<td>Spare Fuses</td>
<td>Bayonet Fuses</td>
</tr>
<tr>
<td></td>
<td>Secondary Voltage</td>
<td>480Y/277 or 110/208 as required</td>
</tr>
<tr>
<td></td>
<td>BIL</td>
<td>kV as required</td>
</tr>
<tr>
<td></td>
<td>Secondary kV Class</td>
<td>kV as required</td>
</tr>
<tr>
<td></td>
<td>Secondary Bushings</td>
<td>5/8” copper stud with 4-hole screw-on spade bushing(s)</td>
</tr>
<tr>
<td></td>
<td>Cabinet</td>
<td>20in deep cabinet</td>
</tr>
<tr>
<td></td>
<td>Cabinet Hardware</td>
<td>Penta-head cabinet door bolts</td>
</tr>
<tr>
<td></td>
<td>ANSI K-Dimension</td>
<td>Loop feed per ANSI C57.12.34 Figure 2 minimum dimensions</td>
</tr>
<tr>
<td></td>
<td>Notifications</td>
<td>Danger High Voltage decals-one on each side of unit</td>
</tr>
<tr>
<td></td>
<td>Notifications</td>
<td>DOE Efficiency Compliant Decal</td>
</tr>
<tr>
<td></td>
<td>Gauges &amp; Fittings</td>
<td>Liquid Level Gauge</td>
</tr>
<tr>
<td>Section Number</td>
<td>Title</td>
<td></td>
</tr>
<tr>
<td>----------------</td>
<td>---------------------------------</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gauges &amp; Fittings</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Thermometer, dial type</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pressure/vacuum gauge</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Drain valve with sampler in LV Compartment (1”)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Schrader valve</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pressure relief device, 50 SCFM</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tank Accessories</td>
<td></td>
</tr>
<tr>
<td></td>
<td>IEEE standard one-hole ground pads (Qty. 3)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nitrogen Blanket</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Packaging</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pallet</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cover</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bolted Cover</td>
<td></td>
</tr>
</tbody>
</table>

**Part 3 – Execution**

The concrete pad shall extend 6” beyond transformer footprint on sides and rear, and 36” in front of the transformer. Top of pad shall be 3” above finished grade.

Installation shall be in accordance with the Arizona Public Service (APS) standard details.

Provide bollards to protect switchgear. The number of bollards will be determined by switchgear location.

10’ clearance must be maintained on the door side of the transformer.

### 33 77 00 Medium – Voltage Switchgear and Protection Devices

**Part 1 – General**

Each new building shall provide the necessary loop-feed box pad mounted switchgear (South Campus) or primary-selective box pad mounted switchgear (North Campus), and transformer(s) for its connected load. Switchgear will be minimum of 6’ from the edge of sidewalks, pedways or roadways.

Provide spare primary fuses for each conduit installed.

The Design Professional shall use the Arizona Public Service (APS) standard details for installing switchgear, and shall include the appropriate details on the drawings.

New medium voltage box pad mounted switchgear shall be provided with integral bus voltage metering and switch position monitors which shall report to the central metering system at the North Plant.

**Part 2 – Products**

Medium voltage switchgear shall be box pad mounted, low profile, deadfront type, as manufactured by S&C, or approved equal. All fuses shall be S&C SMU-20 with SME-20 fuse holders. *Oil filled switches shall not be accepted.*
Box pads shall be pre-manufactured fiberglass type.

**Part 3 – Execution**
Top of pad shall be 3” above finished grade.

Installation shall be in accordance with the Arizona Public Service (APS) standard details.

Provide bollards to protect switchgear. The number of bollards will be determined by switchgear location.

10’ clearance must be maintained on the door sides of the switch. 6’ of clearance for the other sides.

**END OF SECTION**
NAU communication pathway infrastructure consists of utility tunnel and conduit pathways connecting all campus buildings to three main switching nodes. All pathways and spaces to conform to TIA/EIA-758 standard. The Design Professional shall specify the following site development requirements:

- Minimum of two 4 inch conduits for building entrance cable. Larger complexes may need more. One complete spare must be available after cable is installed. Pull string in place in spare conduit.

**Minimum of one 4 inch conduit populated with two (2) packs of 4” 3 cell Maxcell Sleeves or three (3) packs of 3” 3 cell Maxcell sleeve minimum for Fiber optic cable Coaxial cable, etc.** Once the Maxcell is installed, verification by installation of replacement pull line (1200lb line minimum) in all sleeves shall be performed. Each Maxcell sleeve shall be color coded independently from each other. Consult with NAU ITS prior

- All conduits shall be buried at a minimum depth of 24"

- **Minimum one (1) Maxcell sleeve shall be equipped** with tracer wire.

- Conduit construction to be minimum schedule 40 rigid non-metallic.

- All conduit runs designed with drainage slope and maximum of two 90° bends, all bends encased in concrete.

- The section length shall not exceed 600 ft between pulling points.

- When a joint trench method is used the following vertical and horizontal separations between telecommunications facilities and other facilities shall be maintained.

<table>
<thead>
<tr>
<th>ADJACENT STRUCTURE</th>
<th>MINIMUM SEPARATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power or other foreign conduit</td>
<td>3 inches of concrete</td>
</tr>
<tr>
<td></td>
<td>OR 4 inches of Masonry</td>
</tr>
<tr>
<td></td>
<td>OR 12 inches of earth</td>
</tr>
<tr>
<td>Pipes (gas, oil, water, etc.)</td>
<td>6 inches crossing</td>
</tr>
<tr>
<td></td>
<td>OR 12 inches when parallel</td>
</tr>
</tbody>
</table>
It is the university’s preference that there are no manholes or handholes in the pathway design. However, if access points are necessary, minimum requirements are as follows:

- 4’x 8’x4’ with cover providing full access to entire space
- All access points will be equipped with cable racking. Pulling eyes and sump
- Conduits should enter and exit from end walls of access point
- *All penetrations in maintenance holes shall be sealed and in the building with a reenter-able type solution approved by NAU/ITS. Rigid foams are not permitted.*

**Typical Manhole**

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**Communications Distribution**

The university campus communication system is based on a passive *ring* architecture with three switching centers located in building 24, building 54, and building 64. All copper and optical fiber backbone cabling shall be routed to the appropriate switching center. All distribution design is the responsibility of NAU/ITS, and the installation is the responsibility of the individual project. All University buildings shall be fed with twisted pair copper (number of pairs determined by NAU/ITS on a per-project basis), minimum of 24 strands of Multi-mode optical fiber and minimum of 24 strands of single-mode optical fiber. Special applications may require more fiber strands.
<table>
<thead>
<tr>
<th>Section Number</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>33 82 01</td>
<td>Switching Center Terminations</td>
</tr>
</tbody>
</table>

Building 24 terminate twisted pair on *Circa 1900-100K Series Stub in/out 100pr. BETs with cover* units with gas modules. Building 54 terminate twisted pair on *Circa 1900-100K Series Stub in/out 100pr. BETs with cover* units with gas modules and 25 pair cables terminated on *Rack Mount Hubbell 110 blocks with cable management and CS’s*. Building 64 terminate twisted pair on *Circa 1900-100K Series Stub in/out 100pr. BETs with cover* units with gas modules and cables terminated on *Rack Mount Hubbell 110 blocks with cable management and CS’s*. All optical fiber shall be *fusion spliced* with keyed *LC* type connectors.

<table>
<thead>
<tr>
<th>Section Number</th>
<th>Title</th>
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</thead>
<tbody>
<tr>
<td>33 82 13</td>
<td>Copper Communications Distribution Cabling</td>
</tr>
</tbody>
</table>

Copper cable shall be PE 39 type and meet the following requirements:

- Solid annealed, bare copper conductors
- Solid polyolefin insulation, color coded to telephone industry standards
- Cable core filled with waterproofing compound
- Aluminum shield with polyethylene jacket
- 24 AWG, pair count determined by NAU/ITS per project
- Cable shall meet the requirements of ANSI/CEA S-84-608

<table>
<thead>
<tr>
<th>Section Number</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>33 82 23</td>
<td>Optical Fiber Communications Distribution Cabling</td>
</tr>
</tbody>
</table>

Cable: Glass fiber, loose tube all dielectric gel filled osp cable rated for duct installation. Multi-mode 50 micron core, 125 micron cladding diameter with MIFL of 3.5db/km & 500 MHz-km @ 850nm, 1.5db/km &500 MHz-km @1300nm. Single-mode 125-micron cladding diameter with MIFL of 0.4 db/km at 1300nm and 0.3 db/km at 1550nm. Proof tested to 100kpsi.

Fiber Distribution Shelf: Modular design with jumper routing guides for vertical and horizontal runs and all associated shelves, panels, interconnection couplers and hardware necessary to terminate all fibers with room for 25% growth.

Wall Mount Distribution Units: Metal construction, lockable, capable of splicing and termination in same housing, all hardware necessary to terminate fiber (including cable attachment, connector panels, interconnect couplers, fan-out kits, etc.) All connectors and interconnect couplers must be from same manufacturer.

Connectors: Keyed *LC* compatible with ceramic ferrule. Maximum attenuation of 0.4db and durability of 0.2db after 500 matings. All connectors and interconnect couplers from same manufacturer.
Splice cases: Sealed, reenterable closure designed for fiber optic cable. All necessary trays, hardware, grommets, etc. to complete to manufacturer’s instructions and specifications. All splices to be fusion, no mechanical splicing. All fibers (inter and intra building) tested for continuity and tagged at both ends with building number and ID number. All fibers tested for insertion loss, both directions, at 850nm and 1350nm on multi-mode, and at 1310nm and 1550nm on single-mode. All results documented. OTDR signature trace on all fibers with pertinent points documented (splice, endpoints, etc.) Only test results with University personnel present will be accepted.

**END OF SECTION**
Use 10” ABC thickness in lieu of 6” on University Drive due to unsuitable subgrade.