PROJECT MANUAL

for

Cyber Security Solutions
Gilchrist & S.R. Collins Building Retrofits
(PV-0534)

at

PRAIRIE VIEW A & M UNIVERSITY
Gilchrist Engineering building
520 ANNE PRESTON STREET, PRAIRIE VIEW, TEXAS 77446

PRAIRIE VIEW A & M UNIVERSITY
Sam R. Collins building
775 D.W. Martin Street PRAIRIE VIEW, TEXAS 77446

CONSTRUCTION DOCUMENTS – ISSUE FOR BID
DATE: 12 JULY 2017

PRAIRIE VIEW A & M UNIVERSITY
Construction & Planning Office
PO Box 0519, MS 1311
Prairie View, Texas 77446

General Information

The design of the mechanical system and other building components shall be integrated together to produce a building that meets the project programmed functional, sustainable and energy requirements. Mechanical systems must be coordinated with all other building systems and features. Mechanical systems in all buildings should be designed to exceed the minimum performance requirements of ASHRAE 90.1-2010 and incorporate cost effective energy conservation measures that do not compromise building performance or occupant comfort. Mechanical systems must be maintainable and all components reliable. The mechanical design and installation of all components and equipment shall allow for eventual removal and replacement.

All mechanical system components shall be manufacturers' standard commercial product. A standard commercial product is a product that has been sold for a period of at least three years on the commercial market, is listed in the manufacturers' catalogs and brochures and represents the latest production models.

HVAC systems shall be designed to allow systems to be scheduled off or set-back during unoccupied hours, weekends, and holidays. Allow a small AHU with O/A to be scheduled on to maintain positive building pressure. VAV boxes will be tied to lighting occupancy sensors to allow for zero air flow in unoccupied rooms when lights are off.

The GC/CM is responsible for creating a model using BIM authoring software. All clearances required for maintenance, repair, and adjustment shall be shown for coordination purposes. All mechanical equipment shall be labeled using parametric objects in the model. These labels shall be unique to each piece of equipment. The minimum parametric data required for each piece of equipment is room number (should be automatically generated), manufacturer, model number, and type of equipment. The type of equipment shall be easily identifiable by the object's name. Care shall be taken to reduce the various sizes of equipment particularly pumps that perform the similar tasks. This will help reduce the various spare parts that need to be stocked to maintain the building.

The model shall be used to derive shop, installation, and as-built drawings.

Label major mechanical equipment with a permanently affixed label containing equipment identification number or bar code as assigned by the facility management software.

System designs shall be evaluated by the design team on the basis of total ownership and operations cost over a period of twenty (20) years, not energy or capital cost alone. Submission of owning and operation cost analysis shall be required at the completion of Design Development phase.

1. Underground piping to be self restrained ductile iron preinsulated.

2. All valves on underground piping shall be ductile iron butterfly.

3. All gaskets shall be E.P.D.M.

4. All above ground piping to be type L copper or schedule 40 A53 black pipe.

5. All pressure piping shall be tested at 150 psi or greater for 4 hour minimum.

6. All hangers shall be hot dipped galvanized in the crawl space and wet areas and cad plated otherwise.

7. All ball valves shall be two piece threaded 600 with stainless steel ball and stem.

8. All gate valves to be rising stem.

9. All ducts to be fabricated from G-90 galvanized materials.

Ductwork

All spin-ins shall be of the conical type with damper shaft mounted horizontally.

All grilles shall be regulated by a volume damper, when possible, in lieu of an OBD.

All metal components on galvanized sheet metal ducts shall be galvanized materials such as angle stiffeners. Trapeze hangers, rods, straps, etc.

All exposed ductwork to have internal insulation and metal liner and be fabricated from paint grip metal. The use of fiberglass internal duct liner is prohibited

Provide hangers for all slot diffusers and insulate. Provide detail on drawings.

Provide hinged access doors for duct access.

Provide required upstream straight duct for all air flow measuring station.

Provide air foil turning vanes.

All large round duct to be hung with half-round saddles and rods. Cable hangers are NOT acceptable.

Provide cover plates with appropriate finish for all recessed damper operators.

Provide a duct leakage test procedure.

Verify **ALL** return air paths.

Verify that there are sufficient dampers in the system to operate as specified, e.g. economizer.

Foil backed tape on ducts is not permitted. Use fiberglass and Benjamin Foster sealant with fiberglass mat embedded in sealant.

All exterior duct insulation shall have a vapor seal and metal jacket applied with fiberglass mesh installed and resealed with vapor barrier sealer.

Metering

All buildings shall be designed for metering of campus thermal utilities. All auxiliary areas in a building shall be piped in a manner to allow sub-metering.

Piping

In-line pumps are not to be used except for small fractional horsepower circulators.

Piping shall not be buried beneath the lowest floor level except for soil pipe. Piping will not be run in concrete floors. If pressure piping placement under slabs is unavoidable then the piping must be run in a steel pipe sleeve so leakage can be channeled off.

All condensate drain lines shall be insulated to the vertical main. In exposed areas insulation shall be premolded. In unexposed areas the insulation can be foil wrapped.

All hangers on domestic water and hydronic lines shall be installed on the exterior of the insulation.

3/4" is the smallest size for a hydronic pipe to a coil.

All ball valves on insulated piping to have extension handles.

Provide metal jacket on all crawl space piping, exterior insulate piping and mechanical room piping (up to 8'-0" AFF) insulation.

Density of fitting for insulated piping shall be the same as the specified pipe insulation. Use pre-molded fitting insulation, and loose fill are not acceptable.

All auto air vents shall be constructed with a cast iron body and stainless steel ball and seat.

All manual air vents shall be plugged.

All valves preceding pressure gauges shall be needle type with snubbers installed on the discharge side of the pump.

Do not use red rubber gaskets on hot water lines and heat exchangers. Instead use EPDM or hard Garlock gaskets. Use EPDM gaskets in "push on" joints.

Anchor all condensate lines to floor. Do not gang condensate lines together.

Require high density polyethylene HPDE jacket or high density polyurethane polymer jacket on preinsulated piping. Provide insulation on all chilled water pumps and air separators.

Do not use gate valves in hydronic piping, use ball valves 2" and smaller (e.g. stainless steel ball and stem) and butterfly valves for 2-1/2" and larger.

Butterfly valves shall have ductile iron disc and stainless steel nosing and stem.

Ball valves (HVAC and Plumbing) to have stainless steel balls and stem.

All hangars and associated hardware in crawl spaces, under foundations, and in wet areas shall be hot dipped galvanized. Otherwise, hangars and hardware shall be cadmium plated.

For hydrostatic pressure tests, they are to be performed at either 150psi or 1.5 times the operating pressure, whichever is greater. The pressure tests are to have a minimum duration of four (4) hours.

Mechanical Equipment Rooms

Access to equipment rooms shall be direct from hallways. Do not provide entrance through other rooms.

Special attention must be given to control the effects of sound and vibration from mechanical equipment to surrounding spaces.

Provide a curb around all penetrations through the mechanical room floor and all penetrations shall be sealed with appropriate fire stopping material.

Depress the floor of all mechanical rooms 1-1/2" and uniformly slope entire floor to minimum 4 inch floor drain(s). All floor drains to have trap primers and be connected to building sanitary sewer system

Provide positive ventilation in all equipment rooms that are not return air plenums.

Equipment rooms with other equipment than those items directly related to air handling equipment will not be used for return air plenums. The use of rooms as plenums is permissible provided outside air and return air are directed to the plenum and volume control dampers are provided to control the quantity of each entering the plenum. Each component of an air handling system shall be spaced so there is ample room on all sides for inspection and maintenance (filter removal, bearing replacement, coil replacement, cleaning, etc.) and man sized hinged access doors shall be provided for ready access to the spaces in the air handling equipment. These required clearances shall be included in the BIM for coordination.

Air handlers suspended must be provided with permanent platforms for maintenance. The maintenance platform must be a minimum of 7'-0" clear from floor below.

Provide dedicated 120 VAC duplex electrical outlets for maintenance equipment, and separate mechanical keying with University master keying system.

Provide conditioned, supply air into each mechanical room and electrical room for tempering the air in the space. This may be accomplished with a “spin-in” and manually adjustable damper and branch duct or a variable air volume terminal located in the room.

Flow Diagrams

A basic flow diagram indicating major components for pressurized circulating water systems and air systems will be provided with the Design Development submittal. Detailed flow diagrams to include all line sizes, in-line devices (valves, strainers, control valves, thermometers, pressure gauges, flow measuring devices), and flow quantities for headers and branch lines will be provided in the Construction Documents phase.

Space Conditioning

Provide comfort conditioning winter and summer for all spaces except mechanical spaces. HVAC systems are to be selected, zoned, and designed to efficiently and effectively control the heat and humidity gain (or loss), and gains due to lighting, equipment, personnel, other special loads, and building exposures. Provide a separate system for areas where timing of functional uses may so require.

The Project A/E shall consider systems such as: Variable air volume air distribution, variable speed pumping, dedicated outdoor air handlers to meet the Indoor Air Quality requirements of ASHRAE Standard 62 (*Ventilation for Acceptable Indoor Air Quality*), Newer ASHRAE Standard energy recovery systems, high efficiency equipment and other accepted and normally utilized strategies to provide an energy efficient building. The Project A/E should be aware of the potential for mold and mildew problems in the humid climate at many of the campuses.

Consider not designing systems that require remote reheat piping to terminal boxes, design systems that locate all water piping in the mechanical rooms, consider dual duct, or multi-zone systems.

Varied levels of air filtration will be required in the building. Give consideration to design features to provide good indoor air quality (IAQ). In addition to filtration, these features would include double wall air handlers with stainless steel drain pans sloped to drain, exterior duct insulation, and provisions for access for duct cleaning

The A/E shall require controls contractor to supply one, or more, temperature-sensing element(s) in each Air Handling Unit. The sensor shall be required to be installed in a serpentine manner so that at least 75% of the coil's surface is covered and a representative average temperature can be transmitted to the Energy Management System (EMS). The length of sensor should be one (1) foot of length per square foot of coil area. Air Handling Units' condensate drain pans shall be constructed of stainless steel, pitched two ways per Code, with a minimum 1½" drain connection.

Ventilation

Provide power ventilation for restrooms, custodial areas, copy rooms, mechanical spaces, student and research laboratories, building crawl space, as well as other areas where required if there is the possibility of excess heat build-up, as required by code, and by the intended use of the space. The Design Team shall consider the efficiency of the ventilation equipment in their design.

Laboratory Design

The primary objective in the design of HVAC Systems for laboratories is to provide a safe environment for laboratory personnel to conduct their work.

General laboratories shall typically have a maximum of 8 and a minimum of 4 air changes per hour. Lighting occupancy sensors shall detect occupancy and operate the lights and adjust ACH based on occupancy.

Laboratories must be maintained under negative pressure in relation to the corridor of other less hazardous spaces.

Fume hoods should not be the sole means of room exhaust. General room exhaust shall be provided to maintain air change rates and temperature control. Install variable speed exhaust fans, do not use constant speed fans with by-pass dampers.

Operable windows are prohibited in laboratories.

Type 316 stainless steel should be used for all parts of the fume hood exhaust system. The exhaust duct should have as few bends as possible and minimal horizontal runs.

The design of the laboratory ventilation system should follow the low pressure drop design concepts developed by Laboratories for the 21th Century.

Fume hoods shall maintain a minimum face velocity of 100 fpm with no measure point less than 80 fpm when the sash is open 18 inches. When the sash is fully open the minimum face velocity shall be 100 fpm with the building lab air supply sized with a 60 % diversity factor.

Exhaust Fan Assembly:

> The exhaust fan assembly shall be located on the roof or external to the building (penthouse?). The fan shall be either a mixed-flow dilution fan or industrial single width centrifugal type. Fan may be either belt-driven or direct drive, with motors isolated from the exhaust airstream and accessible from the fan exterior for inspection and service. Fan shall be AMCA 99 certified for Spark Resistant Construction. Fan shall be coated inside and out with coating suitable for products being conveyed. All fasteners shall be 316 stainless steel.
>
> Fan and stack shall meet the requirements of ANSI Z9.5 for discharge velocity and stack height, unless a wind tunnel study can verify a lower discharge velocity or stack height will not be detrimental to occupants and air intakes for the building under design and the surrounding buildings.

Refer to Division 11 in the Facility Design Guidelines for additional fume hood requirements.

Acoustics

Provide sound traps in the ductwork, noise suppression devices in the design of piping and equipment and other acoustical or vibration control as required. Design Team shall provide all acoustic calculations a minimum of one week prior to the 100% Detailed Design for the noise levels at each air handling unit and mechanical room.

The Variable Air Volume (VAV) terminals and fan powered terminals shall be sized to have a room Noise Criteria (NC) rating so that the final discharge, or radiated sound pressure does not exceed the recommended values in Table 11 of Chapter 7, Sound and Vibration, of the 2001 American Society of Heating, Refrigerating, Air-Conditioning Engineers, Inc. (ASHRAE) Fundamentals Handbook.

Fan powered terminals shall be located outside of any noise sensitive areas. Refer to Requested Facilities section for identification of specific areas. More stringent criteria may be required in some areas.

Corresponding requirement for sound attenuation shall apply to the Variable Air Volume (VAV) terminals and fan powered terminals serving these areas.

Calculations for HVAC Design

Submit cooling and heating load calculations for each individual zone in the building's HVAC system and sizing data for all applicable proposed equipment such as air handling units, VAV terminals, boilers, fan/coils, pumps, etc. for piping systems along with the 50% Construction Documents submittal. Also, provide representative "cut sheets" for equipment and materials.

Each zone calculation shall indicate, at a minimum: individual rooms, total and sensible loads, and air flow requirements. The heating and cooling loads shall represent all loads: people loads (including diversity factors), appliances, fresh air for ventilation in accordance with ASHRAE Standard 62.1, and external loads (e.g. solar and fenestration). Calculations shall be performed using a standard HVAC load calculation program such as: Elite Software's CHVAC, DOE2, Carrier's E20 or HAP, Trane Tracer, or other software regularly used and accepted in the HVAC industry.

The engineer shall submit necessary calculations to verify the design meets the requirements of ASHRAE Standard 62.1. This shall be in the form of calculations indicating that the necessary outside air is supplied to each system, or zone, to comply with the requirements of the ASHRAE Standard. Where the engineer utilizes diversity factors and the multiple spaces portions of the Standard to supply the required outdoor air for ventilation, he must also submit documentation verifying the requirements of the Standard are met.

Mechanical and Electrical General

Room numbers must appear on air conditioning and electrical plans and room names where space is available. Column lines or designations shall appear on all MEP sheets as they appear on Architectural sheets.

Plumbing and air conditioning systems shall be drawn as separate drawings. These systems may be combined on common drawings only by written permission of the FPC Project Manager.

Where piping systems are to be installed underfloor, these shall be shown on an underfloor plan and not on the plan prepared for the space above. Floor plans for mechanical systems shall be drawn to show pipes, ducts, etc. on the floor in which they are installed. In general, underfloor plans shall be drawn to show all piping underfloor and, from there up, the systems between each floor slab shall be shown only on the appropriate floor plan.

All construction details shall be shown on the drawings and shall not be bound in the specifications.

All equipment and material specifications shall be bound in the specifications and shall not be shown on the drawings.

Performance data for all mechanical and electrical equipment shall be attached to objects as parametric data. The data shall be used to derive schedules on the drawings. The data may also be included in the project specifications. Data shall be linked between the object and schedule to ensure that the correct data is updated at all locations.

The A/E shall identify on the drawings all areas that may be classified as hazardous in accordance with the latest edition of the NFPA Code or that may pose a health hazard due to noise levels, radiation, chemical fumes, etc. The A/E shall describe how each such area will be treated in the building design.

The A/E shall design the facility to connect to the central utility systems as available and as directed in the POR.

Design Conditions

The following information should be clearly shown on the General Information Sheet. Additions and deletions may be required if package unit equipment is incorporated in the design of facilities.

Mechanical		
Summer Outside		(°F.D.B.) (°FWB)
Summer Inside		(°F.D.B.) (%R.H.)
Winter Outside		(°F.D.B.)
Winter Inside		(°F.D.B.)
Total Cooling Capacity		(Tons) Total Connected load of Building
Total Cooling Max. Demand		(Tons)
Total Heating Capacity		(BTUH) Total Connected Load of Building
Total Heating Max. Demand		(BTUH)
Chilled Water		(gpm)
Heating Water		(gpm)
Fresh Air Req'd,	Winter	(cfm)
	Summer	(cfm)
Domestic Hot Water, Capacity		(gpm)
Domestic Hot Water Max. Demand		(gpm)
Steam, Capacity		(#hr)
Steam Max. Demand		(#hr)
Condensate, returned		(gph)
Fixtures (plumbing)		(fixture units)
Sanitary Sewer		(gpm)
Gas, natural		(cfh)

Determine the economic feasibility of incorporating solar energy for space heating, cooling, and water heating into the building design and proposed energy system.

Economic feasibility for each function shall be determined by comparing the estimated cost of energy procurement using conventional sources and energy systems with the estimated cost of using solar energy during the economic life of the proposed building.

Boilers

Specifications for boilers to include the following:

1. Chemically treat and flush boiler system prior to initial startup.
2. Begin internal boiler treatment with chemical comparable with JD-701 (Fort Bend Services).
3. Provide and install an automatic blow down system.
4. Provide and install a conductivity meter.
5. Provide and install means for future chemical treatment.

Hydronic Piping Cleaning Guidelines

- Cleaning and Flushing of piping systems must be done by an independent, third party company that specializes in this type of work
- Submit detailed plan for Engineer's and Owner's review and approval prior to any piping being installed. Plan shall describe in full detail the individual steps associated with this process before any piping is installed. Plan must include a drawing indicating phasing of systems to be cleaned, locations of drains or other temporary connections required for cleaning system, recommended time for cleaning agent circulation and clean water flushing, and cut sheet of proposed temporary pump(s).
- Clean and flush thoroughly to remove construction debris (e.g., rust, dirt, piping compound/dope, mill scale, oil, grease) and contamination before placing pipe in service. Provide necessary temporary connections, bypass piping or hoses and valves that are required for cleaning, purging and circulating. Provide temporary bypasses around AHUs, fan coil units, and cooling and hot water coils. Bypasses are to be the same size as the supply and return pipe size. Also, do not flush through chillers, cooling towers, pumps, or other equipment. Remove flow meters from building piping prior to cleaning/flushing operation.
- Cleaning & Flushing fluid velocities are to achieve a minimum velocity of 10 ft/sec to achieve a thoroughly clean system, free of construction debris and contamination before placing piping systems in service
- Cleaning chemicals/agents must be environmentally friendly. Submit chemical cut sheets to Owner for approval prior to cleaning.
- Third party is to provide their own temporary pumps and connections as required to achieve minimum velocities for cleaning, purging and circulating. Likewise, third party is to provide temporary strainers necessary to protect sensitive equipment and components during cleaning/flushing process.

- Install temporary strainers in front of pumps, tanks, solenoid valves, control valves, and other equipment where permanent strainers are not indicated. Keep these strainers in service until the cleaning and flushing process has ended and the system has been deemed clean and ready for use. Then remove the entire strainer or strainer element only. Replace the strainer basket and gasket. Contractor shall notify Owner so that the reinstallation of clean strainer screens may be witnessed.
- Do not flush thru our coils (AHUs or air boxes) – normally only up to the isolation valves.
- Discharge the "dirty" water to the sanitary waste stream – NOT the storm drains.
- After systems have been cleaned and flushed, third party to provide a written certification that the systems are clean and ready for use.

Campus Specific Information

Texas A&M University

Mechanical systems shall be designed to exceed the minimum performance requirements of ASHRAE 90.1-2010 by 20% in new construction, and 15% in existing building renovations. Additionally, all projects are required to earn 5 points within EA credit 1, under the USGBC's LEED 2009 rating system

Chilled Water (CHW) and Heating Hot Water (HHW) Systems

The Project A/E shall refer to Utilities & Energy Services – Design Standards & Guidelines for additional information. This can be found at https://utilities.tamu.edu/design-standards/

Metering

The Project A/E shall refer to Utilities & Energy Services – Design Standards & Guidelines for additional information. This can be found at https://utilities.tamu.edu/design-standards/

Central Plant Utility Systems

The Texas A&M University Utilities and Energy Management produces and distributes all of the utility services required by academic, general purpose and research facilities. The following are design criteria for the central utilities systems which should be used in the design of building systems which are connected to the central system.

Chilled Water: Shall not be used for any purpose other than comfort space conditioning.

Chilled Water temperature is reset based on outside air temperature.

- O/A less than 40 deg.f. CHW = 48 deg.f.
- O/A from 40 to 50 deg.f. CHW = 46.5 deg.f.
- O/A from 50 to 60 deg.f. CHW = 45 deg.f.
- O/A from 60 to 70 deg.f. CHW = 43.5 deg.f.
- O/A greater than 80 deg.f. CHW = 42 deg.f.

Consult Texas A&M Utilities and Energy Management for supply and return pressure data.

Heating Water: Shall not be used for any purpose other than comfort space conditioning.

Heating Hot Water temperature is reset based on outside air temperature.

- O/A less than 30 deg.f. HHW = 180 deg.f.
- O/A from 30 to 40 deg.f. HHW = 170 deg.f.
- O/A from 41 to 50 deg.f. HHW = 160 deg.f.
- O/A from 51 to 60 deg.f. HHW = 150 deg.f.
- O/A greater than 60 deg.f. HHW = 140 deg.f.

Consult Texas A&M Utilities and Energy Management for supply and return pressure data.

Domestic Hot Water: Consult Texas A&M Utilities and Energy Management for pressure and temperature data.

Large users shall be connected to central system if in close proximity to existing distribution system. Small users may generate their own domestic hot water with gas or electric heaters. Heating water shall not be used as the heat source in producing domestic hot water.

Compressed Air: Consult Texas A&M Utilities and Energy Management for the availability of centrally produced compressed air for laboratory and instrumentation usage. Do not use for space conditioning instrument except as back-up for reliability.

Steam: Consult Texas A&M Utilities and Energy Management for the availability of centrally produced steam.

Condensate: Consult Texas A&M Utilities and Energy Management for condensate return data.

Domestic Water: Consult Texas A&M Utilities and Energy Management for pressure data.

Sanitary Sewer: All buildings with sanitary facilities will be tied into the sanitary sewer system.

Project A/E shall consult with and obtain the approval of the Department Head of System Member Environmental Health & Safety Department, Department Head of System Member Utilities and Energy Management Department and Director of Project Delivery, Facilities Planning and Construction prior to the anticipated used of the sanitary sewer system for the disposal of animal waste.

Storm Sewer: Used exclusively for rainfall run-off.

Prairie View A&M University

Central Plant Utility Systems

The Prairie View A&M University Utilities Plant produces and distributes the following utility services required by academic, genral purpose and research facilities. The following are design conditions for these systems.

Chilled water: Shall not be used for any purpose other than comfort space conditioning.

Supply:	Pressure:	60 psi Normal, 95 psig Max.
	Temperature:	43°
Return:	Pressure:	45 psi
	Temperature:	54°F

Domestic Hot Water: Large users shall be connected to central system unless otherwise specified in Program of Requirements. Small users shall generate their own Domestic hot water utilizing steam as the heat source.

Pressure:	60 psig Max., 50 psig Normal
Temperature:	140°F

Steam:

Pressure:	150 psig and 15 psig
Temperature:	550°F Max., 365°F Normal and 365°F Max., 250°F Normal.

Condensate:

Return Header Pressure: 15 psig

Domestic Water:

Pressure: 54 psig

Sanitary: All buildings will be connected to this system. Do not use for storm drainage.

Storm Sewer: Used exclusively for rainfall run-off. Buildings shall have roof drain systems conveyed to underground storm sewers.

Tarleton State University

Central Plant Utility Systems

The Tarleton State University Utilities Department provides the following utility services required by academic, general purpose and research facilities. The following are design and general conditions for these systems.

Steam:

Pressure:	20 psig
Temperature:	259°F

Condensate:

Return Header Pressure: Gravity

Domestic Water:

Pressure:	55 psig

Sanitary Sewer: All buildings will be connected to this system. Do not use for storm drainage.

Storm Sewer: Used exclusively for rainfall run-off. Buildings shall have roof drain systems conveyed to underground storm sewers.

Texas A&M University at Galveston

Central Plant Utility Systems

The Texas A&M University at Galveston Utilities Department provides the following utility services required by academic, general purpose and research facilities. The following are design and general conditions for these systems.

Chilled Water: Shall not be used for any purpose other than comfort space conditioning.

Supply:	Pressure
Temperature:	45°F

Return: Pressure
Temperature: 56°F

Heating Water:

Supply: Pressure
Temperature: 180°F

Return: Pressure
Temperature: 150°F

Domestic Water:

Pressure:

Sanitary Sewer: All buildings will be connected to this system. Do not use for storm drainage.

Storm Sewer: Used exclusively for rainfall run-off. Buildings shall have roof drain systems conveyed to underground storm sewers.

West Texas A&M University

Chilled Water Piping:

Steel Pipe: ASTM A53, Schedule 40, 0.375 inch wall for sizes 12 inch and over, black.

2 inch and Smaller:
Fittings: ASTM B16.3, extra heavy malleable iron class 250 or ASTM A234, forged steel welding type.
Joints: Threaded or AWS D1.1 welded.

2-1/2 inches and larger – in mechanical rooms and crawl spaces.
Mechanical Grooved Fittings: ASTM A536 ductile iron, grade 65-45-12
Mechanical Grooved Couplings: ASTM A-536 Ductile iron housing clamps to engage and lock, "C" shaped EPDM elastomeric sealing gasket, steel bolts, nuts, and washers.

2-1/2 inches and larger – in concealed spaces, above finished spaces, and all connecting piping to air handling units.

Fittings: ASTM A234 forged steel welding type, Class 300.
Joints: AWS D1.1 welded.

Heating Water Piping:

2-1/2 inches and larger:
Steel Pipe: ASTM A53, Schedule 40, 0.375 inch wall for sizes 12 inch and over, black.

2-1/2 inches and larger – in mechanical rooms and crawl spaces.
Mechanical Grooved Fittings: ASTM A536 ductile iron, grade 65-45-12
Mechanical Grooved Couplings: ASTM A-536 Ductile iron housing clamps to engage and lock, "C" shaped EPDM elastomeric sealing gasket, steel bolts, nuts, and washers.

2-1/2 inches and larger – in concealed spaces, above finished spaces, and all connecting piping to air handling units.

Fittings: ASTM A234 forged steel welding type, Class 300.
Joints: AWS D1.1 welded.

2 inches and smaller:
Copper Tubing: ASTM B88, Type L, hard drawn.
Fittings: ASME B16.18, cast brass, or ASME B16.22, solder wrought copper.
Tee Connections: Mechanically extracted collars with notched and dimpled branch tube.
Joints: Solder, lead free, ASTM B32, 95-5 tin-antimony, or tin and silver, with melting range 430 to 535 degrees F.

For copper Pipe sizes 3/4 inch to 2 inch:
Press Fittings: ASME B16.18 or ASME B16.22 copper and copper alloy press fittings conforming to IAPMO PS 117, with EPDM sealing ring factory installed in fitting.

Medium and High Pressure Steam Piping (150 PSIG Maximum)

Steel Pipe:	ASTM A53, Schedule 80, black.
Fittings:	ASTM B16.3 malleable iron Extra Heavy
Joints:	AWS D1.1 welded.

Low Pressure Steam Piping (15 PSIG Maximum)

Steel Pipe:	ASTM A53, Schedule 40, black.
Fittings:	ASTM B16.3 malleable iron Extra Heavy
Joints:	AWS D1.1, welded.

Medium and High Pressure Steam Condensate Piping

Steel Pipe:	ASTM A53, Schedule 80, black.
Fittings:	ASTM B16.3 malleable iron, Extra Heavy
Joints:	Up to 1 inch: Threaded, or AWS D1.1, welded for all piping above 1 inch.

Low Pressure Steam Condensate Piping

Steel Pipe:	ASTM A53, Schedule 80, black.
Fittings:	ASTM B16.3 malleable iron Extra Heavy
Joints:	Up to 1 inch: Threaded, or AWS D1.1, welded for all piping above 1 inch.

Guide Specification

Testing, adjusting and balancing of the air conditioning system, related to ancillary equipment and the domestic water system will be performed by an impartial technical TAB firm selected and employed by the owner

Air Handling Units for Design & Construction

1. Install thermometers and pressure indicators in the hydronic coil piping. Don't rely on the EMS to read these values.

2. Flushing the piping loop(s), primary and secondary, is essential for a dependable maintenance free system. The engineer, or his designate, should be present during the flushing. This will mean a good specification delineating the goals and the definition of what is an acceptable measure of what "a clean piping system" is.

3. Temperature sensors across coils. For best results, temperature sensors on coils should be sized for: In mixing plenums the length of the element should be two (2) feet in length for each square foot of coil area. In other applications the length of the element should be one (1) foot in length for each square foot of coil area.

4. Averaging-type sensors should be installed in a serpentine manner uniformly across the coil cross-section, with radius clips at each bend of the sensor in the coil supporting the sensor.

5. Multiple sensors can be wired in a series/parallel arrangement for complete coverage in plenums. As an alternative, for larger mixing plenums, it may be advantageous to install several analog-input points on the controller. This arrangement allows software averaging of temperatures for control while providing individual temperature indication to monitor stratification conditions with worse-case conditions triggering a software alarm.

6. Double wall casings are required on all air handling units. Gauge thickness shall be no less than 18 gauge exterior and 20 gauge interior. Insulation shall be a minimum of R-12 and conform to NFPA standard 90 requirements. All exterior wall panels shall be made of ASTM A653 G90 galvanized steel and built on a minimum of six inch rails. Units shall have access doors, minimum 15½" width, to access both sides of the coils, filters, fan section and mixing box sections.

7. Interior wall panels may be made of perforated ASTM A653 G90 galvanized steel for sound attenuation. However, other methods, i.e. external methods and devices, of sound attenuation are preferred.

8. Drain pans shall be of double wall construction with a stainless steel inner liner, sloped both ways to a single outlet with a minimum of 2" of uncompressed insulation,

with a minimum condensate connection of 1” NPT stainless steel. Drain pans shall extend downstream of the coil far enough to contain moisture carry-over. Drain pans must be accessible for inspection and cleaning.

9. Cooling coils shall contain a minimum of 6 rows, tube diameter of either ½” with a minimum .025” wall thickness or ⅝” with .028” wall thickness and maximum of 10 fins per inch, and fin thickness of not less than .006 inches.

10. Air handling units shall be constructed to facilitate easy removal of the coil without disassembly of the cabinet. At the manufacturer’s option, the coils may be installed on tracks to facilitate removal.

11. Coils shall comply with ARI Standard 410 for capacity, pressure drops and selection procedure. Where stacked coils are required in large units, the manufacturer shall provided for a means to collect and drain the condensate from the top coil to the drain pan without impingement on the lower coil.

12. If the campus is in excess of 50 miles of the Gulf coast coil tubing shall be copper with aluminum fins. If the campus is within 50 miles of the Gulf coast, tubes and fins shall be copper or, at the engineers’ option, heresite coated aluminum fins.

13. Coil casing shall be stainless steel for chilled water coils. Any penetrations shall have rubber grommets and fully sealed for pressurization and insulated from the casing insulation.

14. Bearings shall self aligning, antifriction type with a life of 200,000 hours of L-10 life with external grease fittings. All bearings shall be factory lubricated and equipped with standard hydraulic grease fittings and lube lines extending to the motor side of the fan.

15. All units with a motor rated at 10 horsepower and larger, shall be furnished with and internal 120 VAC marine light. Lights shall be a weather-resistant, gasketed, incandescent light. Air Handling Units shall also incorporate an inspection window constructed of glass reinforced with safety wire and installed in the fan section on the side from which the belt drives are visible.

16. All units shall have a single point of connection for the electrical service to the unit. The manufacturer shall seal the conduit to the motor with “Sealtite” to prevent condensation in the motor connection housing.

17. Safety latches shall be required on the fan section.

18. Minimum space between the coils in the air handling units shall be 15½” for cleaning coils.

19. Fans for air handling units shall be backward inclined or airfoil centrifugal type certified as complying with ARI 430-89. A/E shall specify the total static pressure and either the brake horsepower or impeller diameter. Fans shall be rated and certified in accordance with ARI Standard 430. All airfoil fans shall bear the ACMA seal. Fan Modulation – VFDs, dampers or inlet guide vanes are not acceptable. Fans shall have internal vibration isolation installed under the fan and motor.

20. Impellers shall be either aluminum or herisite coated. Motors shall be premium efficient rated for VFD operation shall be inverter duty type and capable of withstanding repeated peaks of 1600 volts at 0.1 microsecond rise time. Comply with NEMA MG-1 Part 31, where applied with and of type F insulation NEMA MG 1-10.38 with H rise.

21. Air handling unit installation shall utilize a method to measure the outdoor air flow rate and adjust the outdoor air flow rate to meet the ASHRAE 62-2001 standard. In addition, the A/E shall consider methods of controlling the systems to ensure compliance. For example, a “polling” system for VAV terminals and utilizing the EMS to comply with the ASHRAE 62-2001 standard.

22. Filters – Type, sizes, etc. shall be specified by the A/E and based on the individual application and use for the Air Handling Unit. Efficiency shall be specified by the “dust spot method” in accordance with ASHRAE Standard 52. Minimum efficiency shall be 30% unless otherwise approved by the System Mechanical Engineer. Consider a secondary filter of 60% efficiency.

23. There is a difference in design requirements for AHUs operating under positive pressure (blow through) and negative (draw through) pressure.

A positive pressure trap should have a weir depth of the total expected static pressure plus ½”. This static pressure can be gauged based on the worst case of the fan being “deadheaded” at the full rated speed allowed by the Variable Speed Drive (VSD).

However, a negative pressure trap should have a total depth equal to: 1” for each 1” of maximum negative static pressure, an additional 1”, the weir height, and the pipe diameter and exterior insulation. The weir height should be half of 1” for each 1” of maximum negative static pressure plus the additional 1”.

Without a trap, or if the trap is improperly designed, air will be drawn into the inside of the fan and AHU casing. In a negative pressure situation, this results in water from the condensate pan spraying the inside of the unit. This will eventually result in damage to the equipment and mold and mildew growth.

In a negative pressure situation, if the trap is too tall or too short, water can be drawn back up into the condensate pan and result in flooding the interior of the unit or dry out allowing air intrusion and water spraying into the unit. Using the proper seal height will prevent these problems. The consultant shall not leave the trap design to the contractor.

Guide Specification

Variable Air Volume Terminal Units for Design & Construction

1. Casing - Terminals shall be constructed of a minimum 20 gauge G90 galvanized steel as per ASTM A 653, *Standard Specification for Steel Sheet,Zinc-Coated(Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dipped Process*, capable of withstanding a 125 hour salt spray test as per ASTM B-117, *Standard Practice for Operating Salt Spray (Fog) Apparatus*. Terminal casing shall be assembled with fasteners. Spot welded assemblies are not acceptable. Casing less than 36" wide min 22 gauge; greater than 36" min 20 gauge.

    Internal Liner - Casing shall be internally lined with minimum *1"* thick dual density (1.5 pounds per cubic foot with 4 pounds per cubic foot face) fiberglass insulation rated for a maximum air velocity of 3,600 feet per minute. Insulation shall be fastened with adhesive complying with NFPA 90A. The insulation shall also use spot welded "stick pins" to ensure the insulation is securely fastened. Using adhesive to fasten the insulation to the casing is not acceptable. Insulation minimum "U" value shall be 0.24 Btu/hr-ft^2-^{0}F. Insulation shall meet or exceed the requirements of UL 181 and NFPA 90A. Raw insulation must be covered with a metal liner to eliminate flaking of insulation during installation. Simple "buttering" of raw edges with an approved sealant is not acceptable.

    Options -

    Foil faced insulation – interior insulation shall be covered with scrim backed foil facing. All insulation edges shall be covered with foil or metal nosing. Insulation shall meet ASTM C 1136 *Standard Specification for Flexible Low Permeance Vapor Retarders for Thermal Insulation,* and ASTM 665 *Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing*, for biological growth in insulation.

    Engineers shall specify terminals with a fiber-free close cell electrometric foam liner. (This is to be used for job specific laboratories) Liner shall not absorb water, be smooth, erosion resistant and washable. Liner shall be acoustically superior to standard dual density fiberglass insulation. Liner shall comply with the following Standards: *NFPA 90A – Supplementary materials for air distribution, ASTM E84 and UL 181 (25/50) Smoke and Flame spread, ASTM C1071, G21, and G22 no bacterial or fungal growth*

    Control Assemblies, hot water heating coils, electric heating coils shall not extend beyond the top and bottom of the unit casing.

2. Maximum Static Pressure Drop - At the inlet velocity of 2,000 feet per minute, the static pressure drop across the basic terminal or basic terminal with a sound attenuator shall not exceed .08" w.g for all unit sizes.

3. Primary Air Valve - the primary air valve shall consists of a minimum 22 gauge cylindrical body that includes embossed rings for structural rigidity. The damper blade shall be a connected to a solid shaft by means of an integral molded sleeve which does not require screw or bolt fasteners. The shaft shall be manufactured of a low thermal conducting *composite* material, and include a molded damper position indicator visible from the exterior of the unit. The damper shall pivot on in self lubricating bearings. The damper actuator shall be mounted on the exterior of the terminal for ease of service. The valve assembly shall include internal mechanical stops for both full open and closed positions. The damper seal shall be secured without the use of adhesives. The air valve leakage shall not exceed 1% of maximum inlet rated pressure at 3.0" w.g. inlet pressure.

   Air leakage thru the primary air valve shall not to exceed 2% (or 5%) of the nominal catalog flow at 3.0" w.g.

4. Airflow Sensor - Differential pressure airflow sensor shall traverse the duct using equal cross sectional area or log-linear traverse method along two perpendicular diameters. Single axis sensor shall not be acceptable for ducts 6" in diameter or larger. A minimum 12 total pressure sensing points shall be utilized. The total pressure inputs shall be averaged using a pressure chamber located at the center of the sensor. A sensor that delivers the differential pressure signal from one end of sensor is not acceptable. The sensor shall output an amplified differential pressure signal that is at least 2.5 times the equivalent velocity pressure signal obtained from a convention pitot tube. The sensor shall develop a differential pressure of 0.03" w.g. at an air velocity of 400 feet per minute. Documentation shall be submitted which substantiates this requirement. Brass balancing taps and airflow calibration charts shall be provided for field airflow measurements.

   The airflow sensor shall be a cross, i.e. two sensor elements that are the full diameter of the inlet duct connection and at 90^0 to each other. Single axis sensors will not be acceptable. The sensor shall develop a differential pressure of 0.03" w.g at air velocities of 450 feet per minute or less. Consultant shall require submittals certifying the sensors do have this capability.

5. Hot Water Coils - where required by the schedules or on the drawings and shall be included in the terminal. The coil shall be manufactured by the terminal unit manufacturer (or approved coil manufacturer) and shall have a minimum of 22 gauge galvanized sheet metal casing with a minimum G90 coating. Stainless steel casings, with a baked enamel paint finish, may be used as an alternative. Coil to be constructed of pure aluminum fins with full fin collars at assure accurate fin spacing and maximum tube contact. Fins shall be spaced with a minimum of 10 fins per inch and mechanically fixed to seamless copper tubes for maximum heat transfer. Each coil shall be tested at a minimum of 350 psig under water.

   0.50" tube diameter with 0.017" wall thickness fins of 0.0045" thickness tested and certified in accordance with ARI Standard 410. Casing material. Specify who is to supply control valves, air vents and drain valves.

   Engineer shall specify that any coil bends or parts exposed to the outside of the terminal shall be insulated to prevent condensation.

6. Electric Resistance Heating Elements - where required by the schedules or on the drawings and shall be included in the terminal. Heater shall be manufactured by the terminal manufacturer (or approved coil manufacturer), and shall be ETL listed. The electric resistance heating element cabinet shall be constructed of not less than 20 gauge galvanized steel with a minimum G 60 zinc coating. Stainless steel casings or galvannealed steel casings with a baked enamel paint finish may be used as an alternative. The electric resistance heating cabinet shall have a hinged access panel for entry to the controls.

   The electric resistance heating element shall be factory installed to the terminal with heating elements located upstream of the airflow control damper to uniform velocity profile over elements. Elements located downstream of the damper are not acceptable.

   An electrical disconnect shall be mounted on the terminal box and shall render the heater non-operable. Heater shall be furnished with all of the controls for safe operation and full compliance with the UL 1995 and the National Electric Code, latest edition.

   Single point access for electrical and multiple access doors if they have more than one motor.

   The electric resistance heating element cabinet shall have a single point electrical connection. The connection shall include a disc-type automatic reset high temperature limit, secondary high limit(s), airflow switch, Ni-Chrome elements, and fusing per UL and NEC. Heater shall have complete wiring diagram with label indicating power requirement and kw input.

7. If the Consultant determines sound attenuators are required, it shall be provided and scheduled on the drawings to meet acoustical performance requirements. The attenuator and terminal unit shall be of single piece construction. Attenuator shall be constructed the same as the base terminal. Terminals shall meet the requirements of ARI Standard 885-98 for sound.

8. Multi-Outlet Plenums - if the Consultant determines a multi-outlet plenums are required, they shall be provided where scheduled on the drawings. The multi-outlet plenums shall have balancing dampers at each outlet with a locking quadrant. Multi-outlet plenums shall be constructed the same as the base terminal.

9. Fans - fan powered terminals shall be utilize a forward curved, dynamically balanced, galvanized wheel with a direct drive motor. The motor shall be permanent split capacitor type with three separate horsepower taps. Single speed motors with electronic speed controllers are not acceptable.

   The fan motor shall be unpluggable from the electrical leads at the motor case for simplified removal (open frame motors only). The motor shall utilize permanently lubricated sleeve type bearings, include thermal overload protection. The motor shall be mounted to the fan housing using torsion isolation mounts properly isolated to minimize vibration transfer.

The terminal shall utilize an electronic (SCR) fan speed controller for aid in balancing the fan capacity. The speed controller shall have a turn down stop to prevent possibility of harming motor bearings.

Options –

1. The Consultant shall examine and determine if the use of ECM motors for the terminals can be economically justified. The terminal shall include a rectifier and filter for AC power to condition the power to the fan.
2. If the use of ECM motors requires additional electrical circuiting or grounding, the design electrical engineer shall notify the design mechanical engineer in writing. The Texas A&M University System Mechanical and Electrical Engineers shall also receive this notification. Prior to proceeding with the design incorporating any ECM motors, concurrence is required by the System Mechanical and Electrical Engineers.

10. Filter Racks - terminals shall contain a filter rack capable of holding a 1” thick filter. Filters shall be secured with quick release clips, allowing removal without horizontal sliding.

    Option - at the Consultant’s discretion, the terminal shall include a V- bank or similar design to ensure the filter velocity is below 600 feet per minute. Field fabricated racks are not acceptable.

11. Casing leakage rates shall be determined by design engineer.