NOVA SOUTHEASTERN UNIVERSITY

Criteria Manual of Design and Specifications Standards

for

Design Professionals

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Divisions 14 through Divisions 33

Nova Southeastern University

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DIVISION 21 FIRE SUPPRESSION

21.1 General Requirements

This chapter identifies criteria for the design of fire suppression systems in Nova Southeastern University buildings with the purpose of establishing minimum standards to be used as a basis of design for Nova Southeastern University (NSU) Buildings at the Main Campus, Fort Lauderdale, Florida. NSU experiences with various materials, products and installations have led to the selections, products and practices noted under this Division 21. The fire suppression systems/products provided under this division must be selected to provide a work environment for the occupants in a sustainable and reliable design. In some cases qualitative standards are cited by name. It is the intention that the name/items(s) be incorporated in the project. In such cases Nova Southeastern University maintain "in-house" expertise, parts and maintenance stock to service the items indicated. Further, it is in the best interest of Nova Southeastern University to have consistency if only from the standpoint of sheer logistics of maintaining and supplying it many buildings.

The fire suppression system products must be designed to comply with the following objectives:

1. Longevity.
2. Occupant Safety.
5. Easy of maintenance.
6. Compatibility with all adjacent materials both new and existing.
7. Solutions with the best value considering a life cycle cost analysis to account for total project cost.

These objectives are in line with the objectives of all Divisions and should be coordinated with requirements in Division 1 Section "SUSTAINABLE DESIGN REQUIREMENTS."

This division identifies criteria to program and design fire suppression systems for university buildings with the following general objectives:

1. Life Safety – For the use in public, building occupants and emergency responders by minimizing fire related injuries as well as prevent loss of life.
2. Property Protection – Minimize damage to buildings and its contents from fire.
3. Continuity of Operations – Provide ongoing production or operating capabilities where deemed necessary by the university.
4. Historic Preservation – ensure that intended or unintended operation of fire protection measures do not result in damage or loss of character-defining spaces, features and finishes of existing structures that have been identified by the university as having a historic level of significance.

5. Building service for typical structures is considered to be 50 years.

21.1.1 Submittals

Submittals shall include coordinated shop drawing plans, technical specifications and reports as well as calculations and engineering judgment statements submitted to the authority having jurisdiction.

21.2 Codes and Standards

21.2.1 Fire Protection System Design Standards

Fire Protection Engineering Documents shall be provided in accordance with Florida Administrative Code (FAC) of the state of Florida statutes as follows:

Department 61:	Department Of Business and Professional Regulation
Division 61G-15:	Board of Professional Engineers
Rule Chapter:	Responsibility Rules of Professional Engineers Concerning The Design of Fire Protection Systems

Applicable codes and standards should be the most recent editions adopted by the State, County and City. The primary documents for these systems are as follows:

1. Florida Fire Prevention Code
2. Florida Building Code: Building and Existing Building editions
3. National Fire Protection Association (NFPA) standards including but not limited to the following:
   - a. No. 1 — Uniform Fire Code
   - b. No. 10 — Standard for Portable Fire Extinguishers
   - c. No. 13 — Standard for the Installation of Sprinkler Systems
   - d. No.13R — Standard for the Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height.
   - e. No. 14 — Standard for the Installation of Standpipe, Private Hydrants, and Hose Systems
   - f. No. 20 — Standard for the Installation of Stationary Pumps for Fire Protection
   - g. No. 24 — Standard for the Installation of Private Fire Service Mains and their Appurtenances
   - h. No. 2001 — Standard on Clean Agent Fire Extinguishing Systems

These requirements are considered minimum for satisfactory system performance during a fire condition. Insurance carrier requirements for the premises may supersede these minimal requirements mandated by the codes and standards. As such, specific property loss prevention required by the insurance carrier shall be confirmed and incorporated accordingly into the fire suppression system design. In the event that applicable codes and standards fail to address specific protection requirements, alternative research and testing as permitted by chapter 471 of the Florida Statutes shall be utilized to demonstrate equivalency. The use of systems, methods, or devices of equivalent or superior quality, strength, fire resistance, effectiveness, durability and safety shall be approved by the authority having jurisdiction.

21.3 Fire Suppression Design Criteria

21.3.1 General Requirements

1. Scope of design for a fire protection system shall be provided protection from fire throughout all proposed building areas. Systems include where applicable the following:
   a. A supervised automatic wet sprinkler system installed in accordance with NFPA 13
   b. A wet standpipe system installed in accordance with NFPA 14
   c. A fire pump system installed in accordance with NFPA 20
   d. A clean-agent fire extinguishing system installed in accordance with NFPA 2001

2. Structural support required by the fire protection system shall be accounted for as a superimposed dead load on the structural design. Hanging, bracing and restraint of the fire protection system shall be provided in accordance with NFPA 13 and manufacturer recommendations of system components. The superimposed dead load shall be stated as required on the structural engineering documents.

3. Requirements for interlocks, safety related devices, indicators and alarms shall be in accordance with the Design Professional and fire alarm system designs.

4. All fire suppression system components except for piping and fittings shall be cataloged with a component description, its location and its identification. This information shall be submitted to Nova Southeastern University for record and used by operations and maintenance personnel.

5. Install or permanently fasten labels to all fire protection system equipment where it is accessible and visible.

21.3.2 Water Based Fire Protection Systems

1. Water based fire protection systems include wet automatic sprinkler systems, wet standpipe systems and fire pump systems.

2. Point of service shall be provided from the underground municipal water supply or existing fire protection system water supply.

21.3.3 Non-Water Based Fire Suppression Systems

1. A Clean-Agent Fire-Extinguishing System shall be considered only and be an engineered system for total flooding of the hazard area. System consists of a single-zone above and/or below the ceiling and raised floor of the protected space.

21.4 Specific Fire Suppression Requirements (Organized by CSI Master Format 2013 Numbers & Titles

21 11 00	Facility Fire-Suppression Water-Service Piping
21 12 00	Fire Suppression Standpipes
21 13 13	Wet-Pipe Sprinkler Systems
21 22 00	Clean-Agent Fire-Extinguishing Systems
21 31 13	Electric-Drive, Centrifugal Fire Pumps
21 34 00	Pressure-maintenance Pumps
21 39 00	Controllers for Fire-Pump Drivers

21 11 00 Facility Fire-Suppression Water Service Piping

Section includes fire-suppression water-service piping and related components outside the building and service entrance piping through floor into the building and service entrance piping through wall into the building.

Design Standards

1. Point of service shall be provided from the underground municipal water supply or existing fire protection system water supply.

2. Public water supply flow test data shall be provided and include the following information:
   a. Date of test
   b. Time of test
   c. Elevation of outlet
   d. Static pressure
   e. Residual pressure
   f. Hydrant flow
   g. Available flow at 20 PSI residual
   h. Friction coefficient
   i. Hydrant Location

3. Valving of the fire protection system as well as flow and tamper switch designations for the valves shall be specified on the fire protection drawing plans and shall be supervised in accordance with NFPA 13-8.15.1.1.2.1 (2002 Edition). Sprinkler zone control valves and test/drain valve assemblies shall be located wherever possible within exit stairs. Valves shall be located a maximum of 7-feet above the floor level as per NFPA 13-8.16.4.2.

4. Installer shall confirm that there are no conditions in the water supply that may lead to microbial induced corrosion (MIC).

5 Backflow prevention device selection shall prevent the reverse flow of fire protection system water supply from being pumped or siphoned into the potable water supply.

6. A backflow prevention device shall be located and oriented such that it is not in proximity to the main entry of the building. In cases where this is not possible, the device shall be installed such that it is an unobtrusive location, in harmony with the aesthetic nature of the building entry.

7. The isolation valves for the backflow prevention device shall be considered in lieu of a post indicator valve to comply with applicable code for control of the water supply to the fire protection system if the backflow prevention device is serving one building only.

8. Fire Department Connection finish, whether free-standing or wall-mounted shall be coordinated with shall be coordinated with the project architect.

Product Standards

1. Ductile-Iron Pipe and Fittings
   Provide products by one of the following:
   a. Anvil International, Inc
   b. Shurjoint Piping Products
   c. Star Pipe Products
   d. Victaulic Company

2. Tubular-Sleeve Pipe Couplings
   Provide products by one of the following:
   a. Cascade Waterworks Manufacturing
   b. Dresser, Inc.; Dresser Piping Specialties
   c. Ford Meter Box Company, Inc. (The); Pipe Products Division
   d. JCM Industries
   e. ROMAC Industries Inc
   f. Smith-Blair, Inc.; a Sensus company
   g. Viking Johnson

3. Gate Valves
   Provide products by one of the following:
   a. American AVK Company; Valve & Fittings Division
   b. American Cast Iron Pipe Company; American Flow Control Division
   c. American Cast Iron Pipe Company; Waterous Company Subsidiary
   d. Clow Valve Company; a division of McWane, Inc
   e. Crane Co.; Crane Valve Group; Jenkins Valves
   f. Crane Co.; Crane Valve Group; Stockham Division
   g. East Jordan Iron Works, Inc.
   h. Hammond Valve
   i. Kennedy Valve; a division of McWane, Inc.
   j. M&H Valve Company; a division of McWane, Inc.
   k. Milwaukee Valve Company
   l. Mueller Co.; Water Products Division
   m. NIBCO Inc.
   n. Shurjoint Piping Products
   o. Troy Valve; a division of Penn-Troy Manufacturing, Inc
   p. Tyco Fire & Building Products LP
   q. United Brass Works, Inc.
   r. U.S. Pipe
   s. Watts Water Technologies, Inc.

4. Tapping-Sleeve Assemblies
   Provide products by one of the following:
   a. American Cast Iron Pipe Company; Waterous Company Subsidiary

b. Clow Valve Company; a division of McWane, Inc.
c. East Jordan Iron Works, Inc.
d. Flowserve
e. Kennedy Valve; a division of McWane, Inc.
f. M&H Valve Company; a division of McWane, Inc.
g. Mueller Co.; Water Products Division
h. U.S. Pipe

5. Post Indicator Valves
Provide products by one of the following:
a. American AVK Company; Valves & Fittings Division
b. American Cast Iron Pipe Company; American Flow Control Division
c. American Cast Iron Pipe Company; Waterous Company Subsidiary
d. Clow Valve Company; a division of McWane, Inc.
e. Crane Co.; Crane Valve Group; Stockham Division
f. Kennedy Valve; a division of McWane, Inc.
g. Mueller Co.; Water Products Division
h. NIBCO Inc.
i. Tyco Fire & Building Products LP

6. Fire Hydrants
a. Provide products by one of the following:
b. American Cast Iron Pipe Company; American Flow Control Division
c. American Cast Iron Pipe Company; Waterous Company Subsidiary
d. American Foundry Group, Inc.
e. Clow Valve Company; a division of McWane, Inc.
f. East Jordan Iron Works, Inc.
g. Kennedy Valve; a division of McWane, Inc.
h. M&H Valve Company; a division of McWane, Inc.
i. Mueller Co.; Water Products Division
j. Troy Valve; a division of Penn-Troy Manufacturing, Inc.
k. U.S. Pipe

7. Fire Department Connections
a. Provide products by one of the following:
b. Elkhart Brass Mfg. Company, Inc.
c. Fire-End & Croker Corporation
d. Guardian Fire Equipment, Inc.
e. Kidde Fire Fighting
f. Potter Roemer
g. Reliable Automatic Sprinkler Co., Inc.

21 12 00 Fire Suppression Standpipes

Design Standards

1. Standpipe system shall be provided for the proposed building as required by applicable codes and standards. A Class I automatic, wet standpipe system shall be provided for the purpose of maintaining system pressure and delivering the standpipe system demand without intervention and use from fire department apparatus.

2. Piping material for standpipe systems shall be schedule 40.

3. Hose connections adjacent to standpipes shall be arranged such that the valve does not project into the required stair width at the landing.

4. Hose connections located outside exit stairways shall be wall-mounted within cabinets. Pipe escutcheons shall be installed inside the cabinet where the water-supply piping penetrates the cabinet. These hose connections shall be arranged along the path of egress with the valves installed such that connection of fire hose is possible.

5. Hose Connection outlets shall be male hose threads with lugged cap, gasket, and chain. Hose valve threads shall be in accordance with NFPA 1963 and match City of Fort Lauderdale Fire-Department threads.

6. Structural support required by the standpipe system shall be accounted for as a superimposed dead load on the structural design. Hanging, bracing and restraint of the fire protection system shall be provided in accordance with NFPA 14 and manufacturer recommendations of system components. The superimposed dead load is stated as required on the structural engineering documents.

Product Standards

1. Check Valves
   Provide products by one of the following:
   a. AFAC Inc.
   b. American Cast Iron Pipe Company; Waterous Company Subsidiary
   c. Anvil International, Inc.
   d. Clow Valve Company; a division of McWane, Inc.
   e. Crane Co.; Crane Valve Group; Crane Valves
   f. Crane Co.; Crane Valve Group; Jenkins Valves
   g. Crane Co.; Crane Valve Group; Stockham Division
   h. Fire-End & Croker Corporation
   i. Fire Protection Products, Inc.
   j. Fivalco Inc.
   k. Globe Fire Sprinkler Corporation
   l. Groeniger & Company
   m. Kennedy Valve; a division of McWane, Inc.
   n. Matco-Norca
   o. Metraflex, Inc.
   p. Milwaukee Valve Company
   q. Mueller Co.; Water Products Division
   r. NIBCO Inc.
   s. Potter Roemer
   t. Reliable Automatic Sprinkler Co., Inc.
   u. Shurjoint Piping Products
   v. Tyco Fire & Building Products LP
   w. United Brass Works, Inc.
   x. Venus Fire Protection Ltd.
   y. Victaulic Company
   z. Viking Corporation

aa. Watts Water Technologies, Inc.

2. Iron OS&Y Gate Valves
Provide products by one of the following
a. American Cast Iron Pipe Company; Waterous Company Subsidiary
b. American Valve, Inc.
c. Clow Valve Company; a division of McWane, Inc.
d. Crane Co.; Crane Valve Group; Crane Valves
e. Crane Co.; Crane Valve Group; Jenkins Valves
f. Crane Co.; Crane Valve Group; Stockham Division
g. Hammond Valve
h. Milwaukee Valve Company
i. Mueller Co.; Water Products Division
j. NIBCO Inc.
k. Shurjoint Piping Products
l. Tyco Fire & Building Products LP
m. United Brass Works, Inc.
n. Watts Water Technologies, Inc.

3. Indicating-Type Butterfly Valves
Provide products by one of the following
a. Anvil International, Inc.
b. Fivalco Inc.
c. Global Safety Products, Inc.
d. Kennedy Valve; a division of McWane, Inc.
e. Milwaukee Valve Company
f. NIBCO Inc.
g. Shurjoint Piping Products
h. Tyco Fire & Building Products LP
i. Victaulic Company

4. Angle Valves and Globe Valves
Provide products by one of the following
a. Fire Protection Products, Inc.
b. United Brass Works, Inc.

5. Ball Valves
Provide products by one of the following
a. Affiliated Distributors.
b. Anvil International, Inc.
c. Barnett
d. Conbraco Industries, Inc.; Apollo Valves
e. Fire-End & Croker Corporation
f. Fire Protection Products, Inc.
g. Flowserve
h. FNW
i. Jomar International, Ltd.
j. Kennedy Valve; a division of McWane, Inc.
k. Kitz Corporation
l. Legend Valve
m. Metso Automation USA Inc.

n. Milwaukee Valve Company
o. NIBCO Inc.
p. Potter Roemer
q. Red-White Valve Corporation
r. Southern Manufacturing Group
s. Stewart, M. A. and Sons Ltd.
t. Tyco Fire & Building Products LP
u. Victaulic Company
v. Watts Water Technologies, Inc.

6. Nonadjustable-Valve Hose Connections
Provide products by one of the following
a. AFAC Inc.
b. Elkhart Brass Mfg. Company, Inc.
c. Fire-End & Croker Corporation
d. Fire Protection Products, Inc.
e. GMR International Equipment Corporation
f. Guardian Fire Equipment, Inc.
g. Kennedy Valve; a division of McWane, Inc.
h. Mueller Co.; Water Products Division
i. NIBCO Inc.
j. Potter Roemer
k. Tyco Fire & Building Products LP
l. Wilson & Cousins Inc.

Performance Standards

1. Minimum residual pressure at each hose-connection outlet shall be NPS 2-1/2 Hose Connections: 100 psig.

2. Maximum residual pressure at required flow at each hose-connection outlet is as follows unless otherwise indicated for a NPS 2-1/2 (DN 65) Hose Connection shall be 175 psi.

21 13 13 Wet-Pipe Sprinkler Systems

Design Standards

1. Classification of occupancy as per NFPA 13 shall be as follows:
a. Offices, residential areas, classrooms, reading areas, study rooms, activity rooms, bar/snack area, sauna, locker rooms, and fitness centers shall be classified as light hazard in accordance with NFPA 13. Reading and stack area, composed of individual bookshelves, tables and chairs shall be classified as light hazard in accordance with NFPA 13.
b. Kitchen areas, electrical rooms, storage rooms, pump rooms, mechanical rooms and automobile parking areas shall be classified as ordinary hazard group 1 in accordance with NFPA 13.
c. Library large stack room areas, high density file rooms, machine shops and stages shall be classified as Ordinary Hazard Group 2 in accordance with NFPA 13.

2. Fire protection system design shall be as follows:
   a. Wet pipe automatic sprinkler system and wet standpipe system throughout premises as required by applicable codes and standards.
   b. Control rooms, communication equipment rooms and telecommunication rooms shall be provided with a pre-action type of sprinkler system in lieu of wet-pipe sprinkler protection should non-water based fire suppression be disavowed by Nova Southeastern University with a clean agent fire extinguishing system.
   c. Generator rooms shall be provided with high temperature sprinklers.
   d. Building areas provided with ceilings shall be protected with concealed type sprinklers. Color of cover plate assemblies shall be coordinated with ceiling finishes.
   e. Sprinkler piping provided in exterior areas such as covered walkways shall be galvanized.
   f. Sprinkler piping throughout building premises shall be concealed with the exception of exposed ceiling areas.
   g. Sprinkler piping shall be schedule 40 steel pipe.
   h. Areas subject to frequent remodeling shall consider the use of flexible sprinkler hose fittings to facilitate the relocation of sprinklers when the area undergoes a modification.
   i. The roof/ceiling construction assembly of exterior areas, including balconies, terraces and breezeways, where the area beneath is not utilized to store or handle combustibles and comprised of noncombustible material shall have sprinkler protection omitted as permitted by NFPA 13.

Product Standards

1. Check Valves
   Provide products by one of the following:
   a. AFAC Inc.
   b. American Cast Iron Pipe Company; Waterous Company Subsidiary
   c. Anvil International, Inc.
   d. Clow Valve Company; a division of McWane, Inc.
   e. Crane Co.; Crane Valve Group; Crane Valves
   f. Crane Co.; Crane Valve Group; Jenkins Valves
   g. Crane Co.; Crane Valve Group; Stockham Division
   h. Fire-End & Croker Corporation
   i. Fire Protection Products, Inc.
   j. Fivalco Inc.
   k. Globe Fire Sprinkler Corporation
   l. Groeniger & Company
   m. Kennedy Valve; a division of McWane, Inc.
   n. Matco-Norca
   o. Metraflex, Inc.
   p. Milwaukee Valve Company
   q. Mueller Co.; Water Products Division
   r. NIBCO Inc.
   s. Potter Roemer
   t. Reliable Automatic Sprinkler Co., Inc.
   u. Shurjoint Piping Products
   v. Tyco Fire & Building Products LP
   w. United Brass Works, Inc.
   x. Venus Fire Protection Ltd.

y. Victaulic Company
z. Viking Corporation
aa. Watts Water Technologies, Inc.

2. Iron OS&Y Gate Valves
Provide products by one of the following:
a. American Cast Iron Pipe Company; Waterous Company Subsidiary
b. American Valve, Inc.
c. Clow Valve Company; a division of McWane, Inc.
d. Crane Co.; Crane Valve Group; Crane Valves
e. Crane Co.; Crane Valve Group; Jenkins Valves
f. Crane Co.; Crane Valve Group; Stockham Division
g. Hammond Valve
h. Milwaukee Valve Company
i. Mueller Co.; Water Products Division
j. NIBCO Inc.
k. Shurjoint Piping Products
l. Tyco Fire & Building Products LP
m. United Brass Works, Inc.
n. Watts Water Technologies, Inc.

3. Indicating-Type Butterfly Valves
Provide products by one of the following:
a. Anvil International, Inc.
b. Fivalco Inc.
c. Global Safety Products, Inc.
d. Kennedy Valve; a division of McWane, Inc.
e. Milwaukee Valve Company
f. NIBCO Inc.
g. Shurjoint Piping Products
h. Tyco Fire & Building Products LP
i. Victaulic Company

4. Ball Valves
Provide products by one of the following:
a. Affiliated Distributors.
b. Anvil International, Inc.
c. Barnett
d. Conbraco Industries, Inc.; Apollo Valves
e. Fire-End & Croker Corporation
f. Fire Protection Products, Inc.
g. Flowserve
h. FNW
i. Jomar International, Ltd.
j. Kennedy Valve; a division of McWane, Inc.
k. Kitz Corporation
l. Legend Valve
m. Metso Automation USA Inc.
n. Milwaukee Valve Company
o. NIBCO Inc.
p. Potter Roemer

q. Red-White Valve Corporation
r. Southern Manufacturing Group
s. Stewart, M. A. and Sons Ltd.
t. Tyco Fire & Building Products LP
u. Victaulic Company
v. Watts Water Technologies, Inc.

5. Freestanding, Fire-Department Connections
Provide products by one of the following:
a. AFAC Inc.
b. Elkhart Brass Mfg. Company, Inc.
c. GMR International Equipment Corporation
d. Guardian Fire Equipment, Inc.
e. Potter Roemer

6. Branch Outlet Fittings
Provide products by one of the following:
a. Anvil International, Inc.
b. National Fittings, Inc.
c. Shurjoint Piping Products
d. Tyco Fire & Building Products LP.
e. Victaulic Company

7. Flow Detection and Test Assemblies
Provide products by one of the following:
a. AGF Manufacturing Inc.
b. Reliable Automatic Sprinkler Co., Inc.
c. Tyco Fire & Building Products LP
e. Victaulic Company

8. Branch Line Testers
Provide products by one of the following:
a. Elkhart Brass Mfg. Company, Inc.
b. Fire-End & Croker Corporation
c. Potter Roemer

9. Flexible Sprinkler Hose Fittings
Provide products by one of the following:
a. Fivalco Inc.
b. FlexHead Industries, Inc.
c. Gateway Tubing, Inc.

10. Sprinklers
Provide products by one of the following:
a. Globe Fire Sprinkler Corporation.
b. Reliable Automatic Sprinkler Co., Inc.
c. Tyco Fire & Building Products LP
d. Venus Fire Protection Ltd.
e. Victaulic Company
f. Viking Corporation

Performance Standards

1. Sprinkler water supply and hose stream for the occupancy classifications shall be as follows:
   a. Light Hazard classification shall utilize density/area curve method (NFPA 13 for a density of 0.10 gallons per minute (GPM) for a minimum remote area of 1500 square feet (ft^2). The total combined inside and outside hose stream shall be 100 GPM in accordance with NFPA 13.
   b. Ordinary Hazard Group 1 classification shall utilize density/area curve method (NFPA 13 for a density of 0.15 gallons per minute (GPM) for a minimum remote area of 1500 square feet (ft^2). The total combined inside and outside hose stream shall be 250 GPM in accordance with NFPA 13.
   c. Ordinary Hazard Group 2 classification shall utilize density/area curve method (NFPA 13 for a density of 0.20 gallons per minute (GPM) for a minimum remote area of 1500 square feet (ft^2). The total combined inside and outside hose stream shall be 250 GPM in accordance with NFPA 13.

2. A 10 percent margin of safety for the design pressure of the fire protection system shall be included as part of the calculated demand of the system. The demand shall also include losses through water-service piping, valves, and backflow prevention devices.

3. Sprinkler temperature ratings shall be 155 degrees Fahrenheit throughout all areas of the building except as follows:
   a. Sauna shall have a temperature rating of 286 degrees Fahrenheit
   b. Skylight area shall have a temperature rating of 175 degrees Fahrenheit
   c. Elevator pit and machine room space shall have a temperature rating of 175 degrees Fahrenheit.

4. Sprinkler spacing and locations shall be in accordance with sprinkler layout as indicated on fire protection drawing plans.

5. A combination standpipe/riser providing water supply to the sprinkler system shall be provided wherever possible within exit stairs. These risers can also be located in spaces along the perimeter of a building where Fire Department access is provided.

6. Valving of the fire protection system as well as flow and tamper switch designations for the valves shall be specified on the fire protection drawing plans and shall be supervised in accordance with NFPA 13. Sprinkler zone control valves and test/drain valve assemblies shall be located wherever possible within exit stairs. Valves shall be located a maximum of 7-feet above the floor level to ensure accessibility.

7. Fire protection system components identified in the fire protection drawing plans shall be Underwriters Laboratories listed and Factory Mutual approved where applicable to ensure quality of system components. Components shall also be provided in accordance with performance requirements indicated in the fire protection technical specifications.

21 22 00 Clean Agent Fire Extinguishing Systems

Design Standards

1. Clean-Agent Fire Extinguishing System basis of design shall consider the use of FM-200 (HFC-227 EA) or Inergen (IG-541) as the extinguishing agent to be utilized.

2. A clean-agent and concentration suitable for normally occupied areas shall be utilized.

3. Total corresponding clean-agent flooding quantity shall be determined in accordance with NFPA 2001 Sections 5.4 and 5.5 and manufacturer data.

4. The basis of design shall include a main and a reserve clean agent cylinder supply configuration to provide 100% of the total flooding capacity.

5. Clean-Agent Fire Extinguishing Systems shall be designed for class B and C fires as appropriate for areas being protected.

6. Clean-Agent Fire Extinguishing System shall be single-zoned and provided with verified smoke detection in the protected areas. Verified smoke detection ensures that clean-agent discharge does not occur without the actuation of two smoke detectors in the protected areas.

7. System Operating Sequence: Smoke and duct smoke detection shall report to a fully Programmable Microprocessor-Based Control Panel programmed to operate as follows:
   a. Clean Agent Smoke Detection System
      1) Actuating First Detector: Visual indication on Annuciator Panel, energize audible alarms and visual alarms (slow pulse), shut down air conditioning and ventilating systems serving protected areas, close doors in protected areas, and send signal to Fire Alarm System.
      2) Actuating second detector: visual indication on Annuciator Panel, energize audible and visual alarms (fast pulse), shut down power to protected equipment, start time delay for extinguishing agent discharge for 30 seconds, and discharge extinguishing agent.
      3) Extinguishing agent will operate audible alarms and strobe lights inside and outside the protected area.

8. Manual stations shall immediately discharge extinguishing agent when activated.

9. The system shall be configured such that operating abort stations will delay extinguishing-agent discharge while the system was activated, and resetting of switches would be required to prevent agent discharge. Release of hand pressure on the switch will cause agent discharge if the time delay has expired.

Product Standards

1. HFC 227ea Clean Agent: Heptafluoropropane
   Provide products by one of the following
   a. DuPont
   b. Great Lakes Chemical Corporation; a Chemtura company

2. IG-541 Clean Agent: Mixture of nitrogen, argon, and carbon dioxide inert gases

Provide products by one of the following
a. Ansul Incorporated

Performance Standards

1. The design concentration for the extinguishing system shall have a minimum hold time of 10-minutes.

2. Design calculations shall be completed considering the enclosure volume to be maintained at a temperature of 70°F and a pressure of 1 ATM.

3. FM-200 (HFC-227ea)
   a. Discharge HFC 227ea shall occur within 10 seconds and maintain 7.1 percent concentration by volume at 70 degrees Fahrenheit for 10-minute holding time in hazard areas. HFC 227ea concentration in hazard areas greater than 9.0 percent immediately after discharge or less than 5.8 percent throughout holding time will not be accepted without written authorization from Owner and authorities having jurisdiction.
   b. Minimum calculated working pressure shall be 620-psig and 360-psig for an initial charging pressure.

4. Inergen (IG-541)
   a. Discharge IG-541 within 60 seconds and maintain 38 percent concentration by volume at 70 degrees Fahrenheit for 10-minute holding time in hazard areas.
   b. IG-541 concentration in hazard areas greater than 40 percent immediately after discharge or less than 32 percent throughout holding time will not be accepted without written authorization from Owner and authorities having jurisdiction.
   c. Minimum calculated working pressure shall be 2175-psig upstream from orifice union, 1000-psig downstream from orifice union, and 2175-psig for an initial charging pressure.

21 31 13 Electric Drive Centrifugal Fire Pumps

Design Standard

1. The use of horizontal split case fire pumps shall be used to achieve required design pressures for the proposed fire protection system.
2. Vertical in-line fire pumps shall be considered where small design flows are required.
3. A Fire pump test header shall be located such that it is not in proximity to the main entry of the building. In cases where this is not possible, the device shall be installed such that it is an unobtrusive location, in harmony with the aesthetic nature of the building entry.

Product Standard

1. In-Line Fire Pumps
   Provide products by one of the following
   a. A-C Fire Pump Systems; a business of ITT Industries
   b. Corcoran Piping System Co.
   c. Patterson Pump Company; a subsidiary of the Gorman-Rupp Company
   d. Peerless Pump, Inc.
   e. Pentair Pump Group; Aurora Pump
   f. Pentair Pump Group; Fairbanks Morse

g. Plad Equipment, Ltd.
h. Reddy-Buffaloes Pump Company
i. S.A. Armstrong Limited

2. Horizontally Mounted, Single Stage, Split-Case Fire Pumps
Provide products by one of the following
a. A-C Fire Pump Systems; a business of ITT Industries
b. Corcoran Piping System Co.
c. Patterson Pump Company; a subsidiary of the Gorman-Rupp Company
d. PACO Pumps; Grundfos Pumps Corporation, U.S.A.
e. Peerless Pump, Inc.
f. Pentair Pump Group; Aurora Pump
g. Reddy-Buffaloes Pump Company
h. Ruhrpumpen, Inc.
i. S.A. Armstrong Limited

3. Vertically Mounted, Single Stage, Split-Case Fire Pumps
Provide products by one of the following
a. A-C Fire Pump Systems; a business of ITT Industries
b. Patterson Pump Company; a subsidiary of the Gorman-Rupp Company
c. Peerless Pump, Inc.
d. Pentair Pump Group; Aurora Pump
e. Reddy-Buffaloes Pump Company

4. Relief Valves
Provide products by one of the following
a. BERMAD Control Valves
b. CLA-VAL Automatic Control Valves
c. Kunkle Valve; a part of Tyco International Ltd.
d. OCV Control Valves
e. Watts Regulator Company; a division of Watts Water Technologies, Inc.
f. Zurn Plumbing Products Group; Wilkins Water Control Products

5. Flowmeter Systems
Provide products by one of the following
a. Emerson Process Management; Rosemount Division.
b. Fire Research Corp.
c. Gerand Engineering Co.
d. Hydro Flow Products, Inc.
e. Hyspan Precision Products, Inc.
f. Meriam Process Technologies
g. Preso Meters; Division of Racine Federated Inc.
h. Reddy-Buffaloes Pump Company
i. Victaulic Company

Performance Standards

1. Fire pumps shall be selected to supply a design flow in the range of operation from 90% to 150% of its rated capacity.

21 34 00 Pressure Maintenance Pumps

Design Standards

1. Pressure maintenance pumps shall be provided for every fire pump system to maintain the fire protection system pressure and minimize fire pump operation due to water supply leakage from underground piping systems.

Product Standards

1. Multistage, Pressure-Maintenance Pumps
   Provide product by one of the following
   a. A-C Fire Pump Systems; a business of ITT Industries
   b. Grundfos Management A/S; Grundfos Pumps Corporation U.S.A.
   c. PACO Pumps; Grundfos Pumps Corporation U.S.A.
   d. TACO Incorporated

Performance Standards

1. Pressure maintenance pumps shall be selected to supply one percent of the fire pump rated capacity and have a pressure rating that is 10 psig greater than the pressure rating of the fire pump system.

21 39 00 Controllers for Fire Pump Drivers

Design Standards

1. Controllers shall be of the across-the-line method of starting or of the reduced voltage starting utilizing the following methods
   a. Primary Reactor
   b. Primary Resistance
   c. Autotransformer
   d. Solid State Soft Start/Stop

2. Controllers shall be installed within sight of their respective drivers. Units located indoors shall be provided with a NEMA 12 rated dust tight, drip tight enclosure. Units located outdoors shall be provided with a NEMA 4 rated water tight enclosure.

3. Controllers for pressure maintenance pumps shall be provided with pump running and power available/failure contacts.

Product Standards

1. Full-Service Controllers
   Provide products by one of the following:
   a. Aquarius Fluid Products, Inc.
   b. ASCO Power Technologies, LP; Firetrol Products
   c. Eaton Electrical Inc.; Cutler-Hammer Business Unit
   d. Hubbell Incorporated; Hubbell Industrial Controls
   e. Joslyn Clark Corporation

f. Master Control Systems, Inc.
g. Metron, Inc.
h. Tornatech

2. Pressure-Maintenance-Pump Controllers
Provide products by one of the following:
a. Aquarius Fluid Products, Inc.
b. ASCO Power Technologies, LP; Firetrol Products
c. Eaton Electrical Inc.; Cutler-Hammer Business Unit
d. Hubbell Incorporated; Hubbell Industrial Controls
e. Joslyn Clark Corporation
f. Master Control Systems, Inc.
g. Metron, Inc.
h. Tornatech

Performance Standards

1. Provide controllers with a withstand rating of 200,000 Amperes at 480 Volts or less and 100,000 Amperes at 600 Volts.

END OF DIVISION 21.

DIVISION 22 PLUMBING

22.1 General Requirements

This chapter identifies criteria for the design of plumbing systems and accessories in Nova Southeastern University buildings with the purpose of establishing minimum standards to be used as a basis of design for Nova Southeastern University (NSU) Buildings at the Main Campus, Fort Lauderdale, Florida. NSU experiences with various materials, products and installations have led to the selections, products and practices noted under this Division 22. The plumbing systems/products provided under this division must be selected to provide a work environment for the occupants in a sustainable and reliable design. In some cases qualitative standards are cited by name. It is the intention that the name/items(s) be incorporated in the project. In such cases Nova Southeastern University maintain "in-house" expertise, parts and maintenance stock to service the items indicated. Further, it is in the best interest of Nova Southeastern University to have consistency if only from the standpoint of sheer logistics of maintaining and supplying it many buildings.

The plumbing system products must be designed to comply with the following objectives:

1. Sustainable Design and products under the criteria to meet LEED "silver" standards as a minimum to reduce the total building energy consumption.
2. Reflectivity for energy conservation.
3. Longevity.
4. Weather tight and watertight building envelope. Hurricane and puncture resistance. Ability to comply high velocity wind zone (HVWZ) requirements.
5. Users comfort.
6. Easy of maintenance.
7. Compatibility with all adjacent materials both new and existing.
8. Solutions with the best value considering a life cycle cost analysis to account for total project cost.

These objectives are in line with the objectives of all Divisions and should be coordinated with requirements in Division 1 Section "SUSTAINABLE DESIGN REQUIREMENTS."

These objectives are in line with all Divisions and should be coordinated with all disciplines in a holistic way.

Plumbing systems shall provide enough capacity for future additions or renovations and allow modifications to be made in one area without causing major disruptions in other areas of the facility. It is the goal of Nova Southeastern University to build facilities equipped with the latest advances in technology. The design of the plumbing systems and other building components shall all combine together to produce a building that meets the project's programmed sustainability rating (LEED rating) and assigned energy target, of the specific project. Also, the design work shall be done in accordance with all rules, regulations, by-laws and requirements of all authorities having jurisdiction.

22.1.1 General Plumbing Requirements

Plumbing drawings shall contain floor plans and isometric drawings for the following systems to the extent of 5 feet beyond the building perimeter:

1. Domestic water
2. Sanitary building drainage
3. Storm drainage
4. Liquefied petroleum gases (LPG) or compressed natural gas (CNG)
5. Fuel oil
6. Acid resistant piping and dilution tank
7. HVAC condensate piping
8. Boilers and domestic hot water generators including boilers necessary for space heating
9. Heating and domestic water heat exchangers and storage tanks
10. Compressed air, excluding HVAC controls
11. Steam and condensate return
12. Solar energy
13. Miscellaneous piping
14. Rainwater collection

22.1.2 Submittals

1. Submittals shall include coordinated shop drawings including all systems using same spaces.

2. Provide written specifications indicating type of fixtures and manufacturers, including submittal of data sheets of fixtures and warranties.

3. Provide a set of prints and clearly mark, as the job progresses, including all changes and deviations from that shown on Contract Drawings. Drawings shall be kept up-to-date during construction and in addition to field measurements shall include; change orders, field instructions and all other changes.

22.2 Codes and Standards

22.2.1 Plumbing Design Standards

1. The plumbing systems and accessories shall be designed by a Professional Engineer licensed in Florida who shall follow these applicable Design and Specifications Standards.

2. The plumbing systems shall comply with the requirements of the applicable authorities having jurisdiction and with the edition in force at the time of the project, of following codes and standards:
   a. Florida Building Code, including all Referenced Standards.
   b. National Fire Protection Association (NFPA) codes and standards.
   c. Local building code and county ordinances.
   d. ADA Latest Edition.
   e. LEED requirements for the target certification level.
   f. ASPE Standards (American Society of Plumbing Engineers)

22.2.2 Cold Water Flow Rates

1.	Water closets:	1.28 GPF maximum
2.	Urinals:	0.125 GPF maximum
3.	Lavatories:	0.5 GPM maximum
4.	Showers:	2.0 GPM maximum

22.3 Plumbing Design Criteria

1. Gas lines shall not be installed in student residential areas.

2. Shut-off valves for all systems, cold water, hot water, etc. shall be tagged and numbered.

3. Location of any valve or other component above a suspended ceiling shall include a location marker permanently attached to the ceiling grid system.

4. All permanently installed equipment or appliance shall be of industrial quality. Warranty for such equipment shall be reviewed and approved by Nova Southeastern University.

5. Hose bibs are not required in bathrooms where janitor closets are located nearby. All floor drains shall have non-mechanical priming systems.

6. Hose bibs or hose connections shall be protected with a vacuum breaker to prevent backflow.

7. Exterior hose bibs shall be recessed wall hydrants, loose keyed, flanged, chrome plated, independently valved, vacuum breaker equipped, and at the building perimeter or courtyards at intervals not to exceed 150 feet.

8. Each restroom shall be equipped with a main shut off valve, located for easy access and maintenance.

9. Concrete housekeeping pads shall be provided for all floor mounted pumps, water heaters, etc. and shall be 4 inches high minimum.

10. A piping and valve chart/legend shall be provided by the contractor at the end of construction. A copy of this chart shall be affixed in a visible place inside the mechanical room.

11. Provide cleanouts at end of laterals serving water closets.

12. Provide clean outs at all changes of direction 90° and higher, at bottom of all vertical risers and on horizontal lines at intervals not to exceed 100 feet.

13. Provide cleanouts at vertical risers serving urinals.

14. All shut off valves and cleanouts serving toilets should have access panels.

15. All toilet rooms having more than two fixtures should have floor drains and hose bibs.

16. All floor drains in toilet rooms shall have trap resealers attached to flush valve tailpieces. All other floor drains shall be resealed using mechanical trap resealers. Show location of resource on plans.

17. All fixtures should have support carriers.

18. Water closets at public toilets shall be wall mounted unless existing conditions require floor mounted toilets. All other water closets shall be as deemed appropriate for the specific condition and function intended.

19. Faucets at gang toilets shall be of the electronic sensor and hardwire type. Sloan Optima ETF-80.

20. If drinking fountains are to be installed, provide a combined fountain/ bottle filling station using Elkay Retro Bottle Filling Stations LZWSRK and shall be all stainless steel finish, all sides.

21. Minimum chase and wall requirements for plumbing fixtures:
    a. Water closets: Wall hung horizontal carrier, back to back. Clear space between chase walls shall be not less than 24 inches.
    b. Water closets: Wall hung horizontal carrier. Single clear space between chase walls or rough thick single wall shall be not less than 14 inches.
    c. Wall for other types of fixtures shall not be less than 6 inches thick.
    d. Installation of all fixtures shall be in accordance with all applicable codes, including ADA where required.
    e. Locate pipe chases clear of structural elements.
    f. Fixtures in common chase shall be installed back to back or aligned to facilitate installation.

22. Provide a dousing shower and eyewash for emergency use at water treatment areas for chillers and other areas according to OSHA.

23. Locate an exterior master shut-off valve underground in a lockable valve box near each building served.

24. Elevated water storage tanks are prohibited.

25. Provide domestic water pressure booster systems where street pressure is insufficient to maintain required water pressure levels.

22.3.1 Performance Standards

1. The plumbing systems must be designed in compliance with the Florida Building Code in relation to energy and the performance goals established for the project.

2. Factory performance testing and start-up services will be required for large system components like boiler plants, domestic water heaters, and laboratory equipment and booster pump systems.

3. The Vendors shall provide certified test reports confirming required performance to the Nova Southeastern Facilities Design and Construction Department.

4. Booster pumping equipment:
   a. Provide a domestic water pump pressure booster system only if available street pressure is insufficient to serve the plumbing fixture requirements.
   b. Variable flow pressure booster systems shall be provided completely assembled and wired.
   c. For applications with less than 100 pounds per square inch (psi) boost, and flow (as sized by Hunter's curve) of 300 gallons per minute (gpm) or less, specify a duplex close-coupled end-suction booster with variable frequency drive (VFD) controls and a remote mounted 100 to 200 gallon tank. Each pump should be sized for 50 percent capacity minimum, and trim the impeller to horsepower.
   d. For higher flows but still less than 100-psi boost. specify triplex or quadruplex end suction boosters with no more than 300 gpm per pump. For example, a 400-gpm booster should be a triplex with a minimum 133 gpm per pump. A 1,000-gpm booster should be a quadruplex with 250 gpm per pump.

5. Equipment nameplates: Metal nameplates permanently fastened to equipment and having data engraved or stamped.

6. Piping System: Install pipe markers on each system. Include arrows showing normal direction of flow.

22.3.2 Products Standards

1. Piping:
   a. Sanitary waste and storm drainage: (Below Ground) Six stories or less:
      1) Service weight cast iron hub and spigot with neoprene gaskets or PVC Piping Schedule 40 to a point 5’-0” outside of building.
   b. Sanitary waste and storm drainage; (Above Ground) service weight hubless cast iron with stainless steel and neoprene seals.
   c. Domestic water:
      1) Above ground: copper type “L”
      2) Below ground: 3” and smaller copper type “K”
      3) Below ground – 4” and larger ductile iron.

2. Valves:

a. Brass body gate or ball valves with full post opening in copper pipe.
b. Semi-steel or cast iron body valves for ferrous metal pipe only.

3. Plumbing Fixtures
Appendix to Section 224000

4. Water Closets:
   a. Wall Hung Water Closet:
      1) White vitreous china, top spud, siphon jet flush action, 1.28 gpf max. elongated bowl.
         Afwall by American Standard.
         Kingston by Kohler.
         Toto or approved equal.
      2) Flush Valve: Sloan Optima Royal 111 - 1.28 ESS, 1.28 gpf
      3) Seat: Elongated, open front less cover.
         (1.) 95 by Olsonite.
         (2.) Lustra K-4670-C by Kohler.
         (3.) 50ESS by Sperzel.
         (4.) SC514 by Toto.

   b. Wall Hung Water Closet, HC Accessible (for replacement at existing conditions with non ADA carrier):
      1) White vitreous china, top spud, siphon jet flush action, 1.28 gpf, and elongated bowl.
         (1.) Afwall ADA Retrofit EL 1.28 gpf by American Standard.
      2) Flush Valve: Sloan Optima Royal 111 – 1.28 ESS.
      3) Seat: Elongated, open front less cover.
         (1.) 95 by Olsonite.
         (2.) 9500C by Church.
         (3.) 50ESS by Sperzel.
         (4.) SC514 by Toto.

   c. Floor Mounted Water Closet:
      1) White vitreous china, top spud, siphon jet flush action, 1.28 gpf and elongated bowl.
         (1.) Maderal 1.28 gpf by American Standard.
         (2.) Wellcomme Lite by Kohler.
         (3.) or approved equivalent.
      2) Bolt Caps: by American Standard or accepted equivalent.
      3) Flush Valve: Sloan Optima Royal 111 – 1.28 ESS, 1.28 gpf.
      4) Seat: Elongated, open front less cover.
         (1.) 95 by Olsonite.
         (2.) Lustra K-4670-C by Kohler.
         (3.) 50ESS by Sperzel.
         (4.) SC514 by Toto.
      5) Seat, HC Accessible: 3” or 4-5/8” high seat lift, elongated, closed front, hollow core heavy duty plastic, vinyl coated offset mounting bracket by Bemis or accepted equivalent.

   d. Floor Mounted Water Closet, HC Accessible:

1) White vitreous china, top spud, siphon jet flush action 1.28 gpf. and elongated bowl.
   (1). Madera 17 inches high, 12 inches rough – by American Standard.
   (2.) Anglesey by Kohler.
   (3.) or approved equivalent.
2) Bolt Caps: by American Standard or accepted equivalent.
3) Flush Valve: Sloan Optima Royal 111 – 1.28 ESS, 1.28 gpf

5. Urinal:
   a) Siphon Jet Flush Action: Wall hung, 1.0 gpf max. vitreous china, ¾" top inlet spud.
      1) Allbrook 1.0 6541.132 by American Standard.
      2) Dexter K5016-T by Kohler.

   b) Optional Blowout Flush Action, Wall hung, 1 ¼" top inlet spud
      1) Lynbrook 0.85 6601.012 by American Standard
      2) Stainwell K 4972 T by Kohler.

   c) Flush Valve: Sloan Optima Royal 111 ES.

6. Service Sink:
   a) Enameled cast iron, 22 inches x 18 inches, plain back, rim guard.
      1) Lakewell 7692.023 by American Standard.
      2) Bannon K-6718 by Kohler.

   b) Fitting: Exposed yoke, wall mounted, vacuum breaker, top brace, stops in shanks.
      1) Heritage 8344.111 by American Standard
      2) Knoxford K-8904-RP by Kohler.

   c) "P" Trap: Strainer, outlet to wall.
      1) 7798.176 by American Standard.
      2) K-6673 by Kohler.

7. Mop Receptor:
   a) Molded resin, 24 inches x 24 inches x 10 inches, rim guards, center drain.
      1) Model MSR-2424 by Florestone.
      2) Model MSB-2424 by Fiat.

   b) Fitting: Exposed yoke, wall mounted, vacuum breaker, top brace, stops in shanks.
      1) Heritage 8344.111 by American Standard.
      2) Knoxford K-8904-RP by Kohler.
      3) 1340.0000 by American Standard
      4) 333-669 by Chicago Faucets.
      5) K-7504-C by Kohler

   c) Hot and Cold Water Fitting: 4 inch centers, 4 inch spout, 2 ½" lever handles, 2 gpm flow maximum, vandal resistant aerator.

1) 5502.140 by American Standard
2) 802A-369 by Chicago Faucets.
3) K-7404-K/K-16010-4 by Kohler.

d) Supply Pies: 3/8" rigid riser with loose key controls. By McGuire or accepted equivalent.

e) "P" Trap: Adjustable with tubing drain to wall, cleanout plug and wall escutcheon. By McGuire or accepted equivalent.

f) Grid drain: Perforated, chrome plated, 1-1 ¼" tailpiece. By McGuire or accepted equivalent.

8. Lavatories:

a) Wall Hung (HC Lav):

1) Vitreous China, 20 inches x 18 inches, 3 hole, 4 inch centers, with lug holes for concealed carrier arms.
   (1.) Roxalyn 0195.073 by American Standard.
   (2.) Chesapeake K-1729 by Kohler.
   (3.) Accepted equivalent.
2) Use electronic sensor type faucets at public toilets. SLOAN Optima Systems, electric ETF-80
3) Cold Water Fitting, accessible: Single lavatory fitting, self closing metering, adjustable time cycle, push handle, vandal resistant aerator.
   (1.) 1340.000 by American Standard.
   (2.) 333-669 by Chicago Faucets
   (3.) K-7504 by Kohler.
4) Hot and Cold Water Fitting, accessible: 4 inch centers, 4 inch spout, 2- 2 ½" lever Handles, 1.5 gpm flow maximum, vandal resistant aerator.
   (1.) 5502.140 by American Standard.
   (2.) 802A-369 by Chicago Faucets.
   (3.) K-7404-K/K-16010-4 by Kohler
5) Hot Water Guard:
   (1.) White, Handi-Lav-Guard Insulation Kit 102/105 by Truebro.
   (2.) White, Handi-Shield Original Series by Plumberex, Palm Springs, CA.
   (3.) Use manufacturer's vandal resistant fasteners.
6) Supply Pipe: 3/8" rigid riser with loose key control. By McGuire or accepted equivalent.
7) "P" Trap: Adjustable offset with tubing drain to wall, cleanout plug and wall escutcheon. By McGuire or accepted equivalent.
8) Floor Mounted Carrier Arms: Josam 17100-M-628 or accepted equivalent.

b) Countertop Mounted Lav (HC Lav):

1) Vitreous China, 20 inches x 17 inches, self rimming, 4 inch centers.
   (1.) Aqualyn 0476.028 by American Standard
   (2.) Penmington K-2196-4F by Kohler

2) Use electronic sensor type faucets at public toilets. SLOAN Optima Systems, electric ETF-80.
3) Cold Water Fitting: Single lavatory fitting, self closing metering, adjustable time cycle, push hand, vandal resistant aerator.
   (1.) 1340.000 by American Standard
   (2.) 333-669 by Chicago Faucets
   (3.) K-7504-C by Kohler.
4) Hot and Cold Water Fitting: 4 inch centers, 4 inch spout, 2- 2 ½" lever handles, 1.5 gpm flow, vandal resistant aerator.
   (1.) 5502.140 by American Standard
   (2.) 802A-369 by Chicago Faucets
   (3.) K-7404-K/K-16010-4 by Kohler.
5) Supply Pipe: 3/8" rigid riser with loose key control. By McGuire or accepted equivalent.
6) "P" Trap: Adjustable with tubing drain to wall, cleanout plug and wall escutcheon. By McGuire or accepted equivalent.
7) Hot Water Guard: White, Handi Lav-Guard Insulation Kit 102/105 by Truebro.
8) Grid drain: Perforated, chrome plated, 1- ¼" tailpiece. By McGuire or accepted equivalent.

9. Sinks:

a) Double Compartment Stainless Steel Sink:
1) 33 inches x 22 inches, 8 inches deep, 18 gage, Type 302 stainless steel, self-rimming.
   (1.) LR-3322 by Elkay
   (2.) Accepted equivalent

2) Cold Water Fitting: Gooseneck faucet, single hole inlet, 8 inch swing spout, vandal resistant aerator, 2- ½" lever handle.
   (1.) 350-GN8A-E12VP-369 by Chicago Faucets.
   (2.) Accepted equivalent

3) Hot and Cold Water Fitting: Gooseneck faucet, 8 inch centers, 8 inch spout, vandal resistant aerator, 2- ½" lever handles.
   (1.) 6275.000/0000.172V by American Standard
   (2.) 201.GN8A-E12VP-369 by Chicago Faucets or accepted equivalent.

b) Single Compartment Stainless Steel Sinks:
1) Type 302 stainless steel, 18 gage, self-rimming.
2) Sizes and model numbers by Elkay or accepted equivalent:

Length x Width (inches)	Depth (inches)	Model #
(SK-1) 25 x 22	8.0	LR-2522
(SK-2) 31 x 22	7.5	LR-3122
(SK-3) 17 x 22	10.0	DLR-1722-10
(SK-4) 22 x 22	10.0	DLR-2222-10
(SK-5) 25 x 22	10.0	DLR-2522-10
(SK-6) 31 x 22	11.5	DLR-3122-12

3) Cold Water Fitting: Gooseneck faucet, single hotel inlet, 5- 3/8" spout, 2- ½" lever handle, vandal resistant aerator.
   (1.) 7100-271H by American Standard
   (2.) 350 by Chicago Faucets
   (3.) Bardney K-7895 by Kohler

4) Hot and cold Water Fitting: Gooseneck faucet, single hole inlet, 5-3/8" spout, 2- ½" lever handles, vandal resistant aerator.
   (1.) 7190-000.242H by American Standard
   (2.) 50 by Chicago Faucets
   (3.) Blagdon K-7894 by Kohler.

5) Supply Pipes: Flexible risers and loose key controls. 2303.063 by American Standard.

6) "P" Trap: Adjustable with tubing drain to wall, cleanout plug and wall escutcheon. 4419-030 by American Standard or accepted equivalent.

7) Grid Drain: Perforated with 1- ½" diameter tailpiece. LK18 by Elkay or accepted equivalent.

c) Wash Sink:

1) Enameled cast iron, 72 inches x 18 inches, drilled back
   (1.) Carnegie 8536.000 by American Standard
   (2.) Brockway K-3204 by Kohler.

2) Fitting: Exposed yoke, wall mounted, vacuum breaker, stops in shanks
   (1.) Heritage 8341.075 by American Standard
   (2.) Knoxford K-3204 by Kohler

3) Solids Interceptor: Gasketed cover, stainless steel screens. 61040 by Josam or accepted equivalent. Josam claim interceptor Model H-32-11 under sink.

10. Electric Water Coolers:
    a) Wall mounted, 2 stream mound building projector, self-closing valve with automatic stream regulator, polished chrome plated brass bubbler, push bars in front and on both sides, for handicapped and standard use. All stainless steel body.
       1) Halsey Taylor: Model HAC8FS
       2) Haws: Model HWBF8
       3) Oasis: Model P8AM

    b) No lead shall be allowed in the manufacture of any piece of equipment within water coolers nor in any piping joint or connection within the unit.

    c) Provide dual units when required for accessibility compliance.
11. Combined Retro Bottle Filling Station:

a) Elkay LZWSRK Model for use with Elkay 115V/60 Hz push bar activated EZ style single, bi-level reverse water coolers

22.4 Utility Coordination

1. Sanitary, domestic, storm and gas load calculations shall be provided to the civil engineer; as well as plumbing systems required and proposed location for such utilities.

2. Location of utilities serving the plumbing systems and any other equipment must be coordinated with the architect and civil engineer to avoid conflicts and must consider all owner and local requirements, specially clearance and accessibility.

22.5 Mechanical Rooms (for plumbing equipment)

1. Provide mechanical rooms lockable and accessible only to qualify persons; and not accessible to professors or students or for use as storing.

2. Space shall be adequate for all the plumbing equipment to be installed. Minimum size shall be as required to accommodate all necessary equipment in accordance with the Codes and for easy maintenance access. Room doors shall swing out.

3. The process of allocating the mechanical room should consider the noise, heat output, ventilation requirements, power requirements, drainage, water and fuel.

4. Sufficient access to the room shall be included to permit replacement of any equipment.

5. There shall be 40% additional space for future equipment.

6. Mechanical rooms shall be clear of columns or beams as well as shear walls, stairways, duct shafts, elevators and other obstructions to permit a clear running of the plumbing lines to assigned spaces.

7. Rooms shall be sprinklered in fully sprinklered facilities.

8. Fasten equipment to 4 inch high minimum housekeeping concrete pads. Extend pad at least 6 inches form equipment outline. Vibration isolation requirements may require larger pads.

22.6 Specific Plumbing Requirements (Organized by CSI Master Format® 2013 Numbers & Titles)

22 05 16	Expansion Fittings and Loops for Plumbing Piping
22 05 17	Sleeves and Sleeves Seals for Plumbing Piping
22 05 19	Meters and Gages for Plumbing Piping
22 05 23	General Duty Valves for Plumbing Piping
22 05 29	Hangers and Supports for Plumbing Piping and Equipment

22 05 53	Identification for Plumbing Piping and Equipment
22 07 16	Plumbing Equipment Insulation
22 07 19	Plumbing Piping Insulation
22 11 16	Domestic Water Piping
22 11 23	Domestic Water Pumps
22 13 16	Sanitary Waste and Vent Piping
22 13 23	Sanitary Waste Interceptors
22 14 29	Sump Pumps
22 15 13	General Service Compressed Air Piping
22 15 19	General Service Packaged Air Compressors and Receivers
22 33 00	Electric Domestic Water Heaters
22 34 00	Fuel Fired Domestic Water Heaters
22 40 00	Plumbing Fixtures
22 45 00	Emergency Plumbing Fixtures
22 47 13	Drinking Fountains and Remote Water Coolers

22 05 16 Expansion Fittings and Loops for Plumbing Piping

Design Standards:

1. All connections and changes in direction of the sanitary drainage system shall be made with approved drainage fittings.

Product Standards:

1. Preferred manufacturers: Mueller, Nibco, Elkhart or Propress.

Performance Standards:

1. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.

2. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

22 05 17 Sleeves and Sleeve Seals for Plumbing Piping

Design Standards:

1. Annular spaces between sleeves and pipes shall be filled or tightly caulked in an approved manner. Annular spaces between sleeves and pipes in fire-resistance-rated assemblies shall be filled or tightly caulked in accordance with the Code requirements. Any pipe that passes under a footing or through a foundation wall shall be provided with a relieving arch, or a pipe sleeve shall be built into the foundation wall. The sleeve shall be two pipe sizes greater than the pipe passing through the wall.

Product Standards:

1. Preferred manufacturers: Advance Products and Systems, Inc; Zurn; or Pipeline Seal and Insulator, Inc.

22 05 19 Meters and Gages for Plumbing Piping

Design Standards:

1. At points of building service provide sub-metering connected to EMS.

2. Provide pressure gauge fittings at top floor of facilities.

Product Standards:

1. Preferred manufacturer for Test-Plug Kits: Nibco.

2. Preferred manufacturer for Thermometers: Watts Regulators Co or Weiss Instruments, Inc.

Performance Standards:

1. Water meter selection shall be based on a 5 to 8psig pressure drop at peak design flows and not maximum capacity, regardless of pressure drop.

2. For LEED projects the OPR will indicate the BMS system to monitor the sub-metering of energy consuming equipment. This relates also to EAc 5 Measurement and Verification.

22 05 23 General Duty Valves for Plumbing Piping

Design Standards:

1. Provide high quality ball valves and fittings.

2. Provide isolation valves on each floor and bathrooms with ID tags.

3. Provide isolation valves at all branch take-offs from main distribution line.

4. Preferred ball valves: full port

5. Provide a valve location plan at the equipment room, showing what they control.

6. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

7. Equipment or hose bibbs typically not receiving service stops shall be provided with valves.

8. All valves shall be accessible.

9. Locate valves for easy access and provide separate support where necessary.

Product Standards:

1. Preferred manufacturers:
   a. Mueller
   b. Nibco
   c. Elkhart
   d. Propress.

22 05 29 Hangers and Supports for Plumbing Piping and Equipment

Design Standards:

1. Provide non corroding materials only.

2. The spacing of hangers shall be based on the strength and modulus of elasticity of each piping material.

3. Rigid support sway bracing shall be provided at changes in direction greater than 45 degrees for pipes sizes 4” and larger.

4. Anchorage shall be provided to restrain drainage piping from axial movement.

5. Piping shall be isolated from incompatible materials.

Product Standards:

1. Preferred manufacturers:
   a. Allied Tube & Conduit.
   b. Flex-Strut Inc.
   c. GS Metals Corp.
   d. Thomas & Betts Corporation.
   e. Unistrut Corporation; Tyco International, Ltd.

Performance Standards:

1. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under working conditions and not be detrimental to the pipe they support.

22 05 53 Identification for Plumbing Piping and Equipment

Design Standards:

1. Label all piping per industry standards at equipment room and 10' o.c. thereafter.

2. Provide ID tags at all valves and plumbing equipment.

Product Standards:

1. Metal labels for equipments.

2. Stencil material and paint for piping.

3. Aluminum Tags for valves.

Performance Standards:

1. Piping and equipment shall be labeled as per current industry standards.

22 07 16 Plumbing Equipment Insulation

Design Standards:

1. Insulation is required for unfired hot water storage tanks to conserve energy.

2. Protect the insulation against physical damage by adding a strong jacket or delaying installation on a piping system.

3. If the insulation is to be installed in a corrosive atmosphere, the proper jacket shall be installed to withstand the most severe conditions.

4. Space conditions may dictate the use of one insulation system over another to fit in a confined space.

Product Standards:

1. Preferred manufacturers:
   a. CertainTeed Corp.; Duct Wrap.
   b. Knauf Insulation; Duct Wrap.
   c. Manson Insulation Inc.; Alley Wrap.
   d. Owens Corning; All-Service Duct Wrap.

Performance Standards:

1. Equipment insulation installed shall be able to comply with the following purposes:
   a. The retardation of heat or cooling temperature loss through the piping.
   b. The elimination of condensation.
   c. Personnel protection by keeping the surface temperature low enough to touch.
   d. The protection of equipment from abrasion or damage from external forces.

22 07 19 Plumbing Piping Insulation

Design Standards:

1. Provide fiberglass insulation for all hot water lines.

2. Provide foamed rubber insulation for all condensate piping.

3. Provide fiberglass insulation for all horizontal roof drain lines above ceilings.

4. Protect the insulation against physical damage on a piping system.

5. If the insulation is to be installed in a corrosive atmosphere, the proper insulation shall be installed to withstand the most severe conditions.

6. Space conditions may dictate the use of one insulation system over another to fit in a confined space.

Product Standards:

1. CertainTeed Corp.; Duct Wrap.

2. Knauf Insulation; Duct Wrap.

3. Manson Insulation Inc.; Alley Wrap.

4. Owens Corning; All-Service Duct Wrap.

Performance Standards:

1. The retardation of heat or cooling temperature loss through the piping.

2. The elimination of condensation.

3. Personnel protection by keeping the surface temperature low enough to touch.

4. The appearance of the pipe, where aesthetics are important.

5. The protection of pipe from abrasion or damage from external forces.

6. The reduction of noise from a piping system.

22 11 16 Domestic Water Piping

Design Standards:

1. Use of PVC or CPVC in domestic water distribution is prohibited.

2. No gate valves allowed in the domestic water system.

3. Design flow velocity shall not be greater than 8 feet per second.

4. The flow velocity of the water distribution system shall be controlled to reduce the possibility of water hammer.

5. Provide water hammer arrestors at all fixture groups.

6. Emergency water supply shall have locked and labeled valve at fixture branch feed line. There shall not be any additional valves or stops downstream of the locked and labeled valve.

Product Standards:

1. Domestic water:
   a. Above ground: copper type "L"
   b. Below ground: 3" and smaller copper type "K"
   c. Below ground – 4" and larger ductile iron.

Performance Standards:

1. The primary task of a building cold water service and distribution system is to provide adequate flow, pressure and volume suitable for human consumption at every device that uses water, even when the system is at peak demand.

2. All hot water distribution pipe and tubing shall have a minimum pressure rating of 100 psi at 180 degrees or as required to meet building static head.

3. The piping system, components and fixtures in a water distribution system shall be designed to withstand a pressure of 80 psi as the minimum working pressure of the system or as required to meet building static head.

4. Prior to disinfection, connection to faucets and equipment, and installation of pipe insulation, the domestic water system should be hydrostatically tested for leakage.

22 11 23 Domestic Water Pumps

Design Standards:

1. Where the water pressure in the public water main is insufficient to supply the minimum pressure and quantities specified by code, the supply shall be supplemented by a water pressure booster system.

2. Provide water booster pumps on by-pass for use if primary system fails.

3. Provide pressure level alarms at all domestic water pumps.

4. Variable flow pressure booster systems shall be provided completely assembled and wired.

5. For applications with less than 100 pounds per square inch (psi) boost, and flow (as sized by Hunter's curve) of 300 gallons per minute (gpm) or less, specify a duplex close-coupled end-suction booster with variable frequency drive (VFD) controls and a remote mounted 100 to 200 gallon tank. Each pump should be sized for 50 percent capacity minimum, and trim the impeller to horsepower.

6. For higher flows but still less than 100-psi boost. specify triplex or quadruplex end suction boosters with no more than 300 gpm per pump. For example, a 400-gpm booster should be a triplex with a minimum 133 gpm per pump. A 1,000-gpm booster should be a quadruplex with 250 gpm per pump.

Product Standards:

1. Preferred manufacturers:
   a. Grundfos
   b. Bell & Gosset

Performance Standards:

1. High efficiency pumps shall be specified.

22 13 16 Sanitary Waste and Vent Piping

Design Standards:

1. Every building in which plumbing fixtures are installed shall be connected to a public sewer, where available, or an approved sewage disposal in accordance with the current code and local ordinances.

2. Provide floor drains in all restrooms and janitor closets.

3. In addition to cleanouts requirements by the Florida Building Code, provide additional cleanouts on laterals that serve three or more fixtures in a less visible area.

4. Provide acid resistant piping system for science labs separate form sanitary waste and vent lines until neutralized. Provide acid neutralizing tank located outside building, below grade. Continue acid waste piping beyond neutralization tank to a point where it is washed by minimum of two water closets.

5. The vent system for a chemical waste system shall be independent of the sanitary vent system and shall terminate separately through the roof to the open air.

Product Standards:

1. Piping:
   a. Sanitary waste and storm drainage: (below ground) Six stories or less:
      1) Service weight cast iron hub and spigot with neoprene gaskets or PVC Piping Schedule 40 to a point 5'-0" outside of building.
      2) Sanitary waste and storm drainage; (above ground) service weight hubless cast iron with stainless steel and neoprene seals.
   b. Acid resistant piping shall be polypropylene with electrofusion pipe joints.

Performance Standards:

1. Components and installation shall be capable of withstanding a minimum working pressure, of 10-foot head of water.

22 13 23 Sanitary Waste Interceptors

Design Standards:

1. Interceptors and separators shall be provided to prevent the discharge of oil, grease, sand and other substances harmful or hazardous to the building drainage system, the public sewer, or sewage treatment plan or processes.

2. Locate interceptors as close as feasible to the exterior wall of the served area.

3. Waste lines normally receiving grease waste shall be routed through the interceptor.

4. Individual grease interceptor capacity shall be at least 750 gallons.

5. Maximum individual grease interceptor capacity shall not exceed 1,250 gallons.

6. Provide multiple 1,250 gallon capacity interceptors in series for required capacities above 1,250 gallons.

Product Standards:

1. Grease interceptors:
   a. Precast concrete

2. Oil interceptor:
   a. Precast concrete
   b. Factory fabricated, cast iron or steel body; with removable sediment bucket or strainer, baffles, vents and flow-control fitting on inlet.

Performance Standards:

1. The interceptors, as the name indicates, shall intercept substances that have been separated from the waste water, which is then discharged, leaving behind the separated material in the interceptor itself.

22 14 29 Sump Pumps

Design Standards:

1. Where the drainage system or portions thereof cannot discharge by gravity to the sewer, the drainage shall be collected in a tightly sealed and vented sump and pumped to a gravity sewer or drain.

2. The sump must be sized to provide adequate holding capacity and to limit the retention period of the waste.

3. The minimum capacity of the sump must be such that the pumping equipment operates for at least 15 seconds per pumping cycle to prevent short cycling, thereby extending the life of the equipment.

4. A check valve and full open valve, located on the discharge side of the check valve, shall be installed in the pump or ejector discharge piping between the pump or ejector and the gravity drainage system.

Product Standards:

1. Preferred manufacturer:
   a. Goulds

Performance Standards:

1. The sump pump capacity and head shall be appropriate to anticipate use requirements.

2. Sump pit shall be not less than 18 inches in diameter and 24 inches in deep, unless otherwise approved.

22 15 13 General Service Compressed Air Piping

Design Standards:

1. Automatic water traps with shut-off valves and piped drains shall be provided at the following locations:
   a. Airline exiting the air compressor.
   b. Compressor storage tank.
   c. First air riser form the compressor and risers over 1 story in height.
   d. End of the main line branch.
   e. Provide a petcock at the bottom of piping riser/drops without an automatic water trap, and at the bottom of each air outlet.

2. Provide 1 inch in 40 feet slope down in the airflow direction of airlines and avoid water collection pockets. Reverse slopes are not allowed. Air branch lines shall be taken from only the top of the main line.

3. In anticipation of expansion, consideration should be given to over sizing some components, such as filters, dryers, and main pipes, to avoid costly replacement in the future and to save downtime while expansion is underway.

4. Information about pressure and flow rate parameters for individual equipment and tools shall be obtained from the manufacturer, end user, facility planner, or owner.

5. Provide refrigerated after cooler at compressor discharge.

Performance Standards:

1. Compressed air system must be designed (controlled, regulated, and sized) to ensure that an adequate volume of air at a pressure and purity that will satisfy users requirements is delivered at any outlet, particularly the most hydraulically remote, during the period of heaviest use.

22 15 19 General Service Packaged Air Compressors and Receivers

Design Standards:

1. Air compressors shall be located in a mechanical equipment room.

2. Compressors shall be tank mounted and sized to accommodate the diverse requirements.

3. Compressors 3HP and larger shall be two stage.

4. Receivers should be sized on the basis of system demand and compressor size, using the starts per hour and running time best suited for the project.

Product Standards:

1. Preferred manufacturer
   a. Ingersoll-Rand; Air Solution Group.

Performance Standards:

1. Compressed air system must be designed (controlled, regulated, and sized) to ensure that an adequate volume of air at a pressure and purity that will satisfy users requirements is delivered at any outlet, particularly the most hydraulically remote, during the period of heaviest use

22 33 00 Electric, Domestic Water Heaters

Design Standards:

1. Hot water of a desired temperature should be readily available at any fixture.

2. Domestic hot water shall be limited to 110 degrees F; temperature at food preparation areas per Health Authority requirements.

3. Tankless water heaters may be used at custodial sinks and remote fixture locations requiring hot water. Hot water shall be thermostatically controlled and shall not exceed 100 degrees F. Heater capacity shall be as per manufacturer's recommendation.

4. Provide domestic hot water hot water recirculation systems at kitchen and other high hot water demand systems where piping runs exceed 60 feet.

5. Minimum insulation thickness for domestic hot water mains shall be 1 inch thick.

6. Water heaters and storage tanks shall be located and connected so as to provide access for observation, maintenance, service and replacement.

Product Standards:

1. Preferred manufacturer:
   a. Lochinvar Corporation.

2. A.O. Smith products shall not be used.

Performance Standards:

1. Domestic water heating system must be designed to ensure that an adequate volume of hot water at the prescribed temperature to all fixtures and equipment is delivered at all times at any outlet, particularly the most hydraulically remote, during the period of heaviest use.

2. The system shall perform its function safely.

22 34 00 Fuel Fired, Domestic Water Heaters

Design Standards:

1. Hot water of a desired temperature should be readily available at any fixture.

2. Domestic hot water shall be limited to 110 degrees F.

3. Hot water at food preparation areas per Health Authority requirements.

4. Provide domestic hot water hot water recirculation systems at kitchen and other high hot water demand systems where piping runs exceed 60 feet.

5. Utilize high efficiency, closed combustion heaters when possible.

6. Minimum insulation thickness for domestic hot water mains shall be 1 inch thick.

7. Water heaters and storage tanks shall be located and connected so as to provide access for observation, maintenance, service and replacement.

Product Standards:

1. Preferred manufacturer:
   a. PVI Industries, Inc.
   b. Lochinvar Corporation.

2. A.O. Smith products shall not be used.

Performance Standards:

1. Domestic water heating system must be designed to ensure that an adequate volume of hot water at the prescribed temperature to all fixtures and equipment is delivered at all times at any outlet, particularly the most hydraulically remote, during the period of heaviest use.

22 40 00 Plumbing Fixtures

Design Standards:

1. All fixtures and accessories to be "hands free operation.

2. All fixtures sensors to be hard wired.

3. Provide a 30 sq.ft minimum janitorial closet in each floor with mop sink and floor drain.

4. Waterless urinals use is prohibited.

5. No substitution allowed on preferred manufacturers.

Product Standards:

1. Lavatory faucets: Sloan Optima ETF-80.

2. New water closet flush valves: Sloan Optima, Royal model # 111ES.

3. New urinal flush valves: Sloan.

4. Retrofit water closet flush valves: Sloan Optima, model # RESS-C-MC with courtesy flush override.

5. Retrofit urinal flush valves: Sloan Optima, model # RESS-U-MC with courtesy flush override.

6. Preferred manufacturers for wall hung toilets: Kohler, American Standard and Elger.

Performance Standards:

1. Water closets consumption: Not to exceed 1.28 GPF

2. Urinals consumption: Not to exceed 0.125 GPF

3. Lavatories consumption: Not to exceed 0.5 GPM

4. Showers consumption: Not to exceed 2.0 GPM

22 45 00 Emergency Plumbing Fixtures

Design Standards:

1. Water supplies for drench hoses, emergency showers and eyewashes shall be from an independent secure source not prone to inadvertent shutoff.

2. The emergency water supply to each area or room shall be equipped with a single, rising stem branch shut-off valve, chained and locked in the open position, labeled “EMERGENCY WATER SUPPLY”.

3. The emergency water supply piping shall be at least 1-1/2” diameter.

4. Emergency water supply shall not have additional valves or stops downstream of the locked and labeled valve.

5. Identify emergency plumbing fixtures with highly visible signs. Area around them shall be well illuminated.

Product Standards:

1. Preferred manufacturers:
   a. Acorn Safety
   b. Bradley Corporation
   c. Guardian Equipment
   d. Speakman Company

Performance Standards:

1. Minimum flushing fluid:
   a. Self-Contained Emergency Shower: 20 GPM at 30 PSI for 15 minutes.
   b. Self-Contained Eyewash: 0.4 GPM at 30 PSI for 15 minutes.
   c. Eye/Face wash equipment: 3 GPM at 30 PSI for 15 minutes.

2. Valve should easily activate in a second or less and remain open until it is intentionally turned off.

22 47 13 Drinking Fountains and Remote Water Coolers

Design Standards:

1. Water coolers shall be all stainless steel finish, top, front and sides.

2. Double height units shall be provided to comply with accessibility requirements.

3. Water coolers at exterior program required locations shall have weatherized stainless steel finishes, secured remote chillers, vandal resistant components.

Product Standards:

1. Preferred manufacturers:
   a. Elkay
   b. Halsey-Taylor
   c. Haws

Performance Standards:

1. No lead shall be allowed in the manufacture of any piece of equipment within water coolers or in any piping joint or connection within the unit.

END OF DIVISION 22.

DIVISION 23 HEATING, VENTILATION AND AIR CONDITIONING

23.1 General Requirements

This chapter identifies criteria for the design of heating, ventilation and air conditioning systems and accessories in Nova Southeastern University buildings with the purpose of establishing minimum standards to be used as a basis of design for Nova Southeastern University (NSU) Buildings at the Main Campus, Fort Lauderdale, Florida. NSU experiences with various materials, products and installations have led to the selections, products and practices noted under this Division 23. The heating, ventilation and air conditioning systems/products provided under this division must be selected to provide a work environment for the occupants in a sustainable and reliable design. In some cases qualitative standards are cited by name. It is the intention that the name/items(s) be incorporated in the project. In such cases Nova Southeastern University maintain "in-house" expertise, parts and maintenance stock to service the items indicated. Further, it is in the best interest of Nova Southeastern University to have consistency if only from the standpoint of sheer logistics of maintaining and supplying it many buildings.

The plumbing system products must be designed to comply with the following objectives:

1. Sustainable Design and products under the criteria to meet LEED "silver" standards as a minimum to reduce the total building energy consumption.
2. Reflectivity for energy conservation.
3. Longevity.
5. Users comfort.
6. Easy of maintenance.
7. Compatibility with all adjacent materials both new and existing.
8. Solutions with the best value considering a life cycle cost analysis to account for total project cost.

These objectives are in line with the objectives of all Divisions and should be coordinated with requirements in Division 1 Section "SUSTAINABLE DESIGN REQUIREMENTS."

These objectives are in line with all Divisions and should be coordinated with all disciplines in a holistic way.

Heating, ventilation and air conditioning systems shall provide whenever possible enough capacity for future additions or renovations and allow modifications to be made in one area without causing major disruptions in other areas of the facility. It is the goal of Nova Southeastern University to build facilities equipped with the latest advances in technology. The design of the HVAC systems and other building components shall all combine together to produce a building that meets the project's programmed sustainability rating (LEED rating) and assigned energy target, of the specific project. Also, the design work shall be done in accordance with all rules, regulations, by-laws and requirements of all authorities having jurisdiction.

23.1.1 General Heating, Ventilation and Air Conditioning Requirements

1. Description

   a. Section Includes:
      (1) General requirements for all Division 23 work.
      (2) General submittal requirements.
      (3) General quality assurance requirements.

23.1.2 Submittals

1. Submittals shall include coordinated shop drawings including all systems using same spaces.

2. Provide written specifications indicating type of fixtures and manufacturers, including submittal of data sheets of fixtures and warranties.

3. Provide a set of prints and clearly mark, as the job progresses, including all changes and deviations from that shown on Contract Drawings. Drawings shall be kept up-to-date during construction and in addition to field measurements shall include; change orders, field instructions and all other changes. Include HVAC controls, wiring and equipment locations

4. Shop drawings of ductwork and piping layouts shall be as described in the applicable section.

5. The Contractor shall cross-check shop drawings of ductwork, piping and equipment against each other and against the contract drawings to avoid interference and coordinate the work. Contractor shall then provide two traditional copies to Nova Southeastern University Physical Plant Department.

6. Two additional copy of all final corrected shop drawings and product data submissions for HVAC systems shall be furnished labeled "for the Test & Balance Agency" and Nova Southeastern Physical Plant Department..

8. Product data submittals shall be made on the following items specified under Division 23:
      (1) All items with the manufacturers specified.

(2) All items with motors or electrical equipment or burners or automatic controls.
(3) Valves, stops, hydrants, and tanks.

9. Submittals shall include the following information:
   (1) Product data:
      (a) Equipment capacity at design conditions.
      (b) Shipping weight.
      (c) Installed weight.
      (d) Operating weight.
      (e) Furnished specialties and accessories.
      (f) Installation instructions.
      (g) Start-up instructions.
   (2) Shop drawings which indicate:
      (a) Equipment dimensions.
      (b) Weight distribution.
      (c) Required clearances.
      (d) Methods of assembly.
      (e) Location and size of all field connections.
   (3) Wiring diagrams:
      (a) Required power supply.
      (b) Control ladder diagram including interlocks.
      (c) Clearly differentiate between factory installed wiring and field wiring.
      (d) BAS controls diagrams including physical controls parts
      (e) BAS controls and IP topology.

10. Sleeve and Insert Layout Drawings: Submit drawings to show the size and locations of all mechanical equipment sleeves and openings through structural elements for piping and ducts. Submit drawings showing inserts located in post tensioned or prestressed structural elements for support of piping, ducts and mechanical equipment.

11. Project Record Documents: Upon substantial completion of the 100% operational system complete installation, submit three copies of record (as-built) documents. Provide the specified number of copies on both paper and as electronic media.
   (1) Drawings shall be submitted in both DWG or DXF and PDF format.
   (2) Approved submittal data, as-built information, construction test reports, checklists, manufacturer O & M manuals and training manuals shall be submitted as Adobe PDF files. PDF files shall be organized with Bookmarks. Provide Bookmarks for each Specification Section, each type of equipment. PDF shall be generated directly from Adobe and shall be word searchable. Scanned images are not acceptable.
   (3) The documents shall be submitted for approval prior to final completion and shall include:

(a) Buried Piping: Mark the actual installed depths (invert elevations) of all buried piping and show the measured horizontal distances from permanent features such as building walls on record drawings. Mark all changes in the location of piping, ducts and equipment in accordance with Section 018000 - Project Record Documents.

(b) Shop Drawings, corrected for as-built condition, for all systems including piping, ductwork and HVAC controls.

(4) Operating and Maintenance Manuals

(a) Provide manuals as required by Section 016100 - Product Requirements as described under heading of Operating and Maintenance Data. Use multiple binders if a single binder would exceed 2-1/2 inches in thickness. Arrange the data in the same sequence as the specification sections; delete or mark through extraneous data. Furnish 4 copies of manuals for work in Division 23.

(b) Provide tab pages with metal or plastic reinforced holes to separate each major item or closely related group of items with typed item names on the tabs. Supply a table of contents at the beginning of each volume listing all items, the manufacturers and the name, address and phone number of the nearest authorized service representative.

(c) Manuals shall be submitted to Design Professional for approval within two (2) weeks of approval of submittal data.

(d) Manuals shall include the following:

(1.) Valve lists for the various piping systems.
(2.) Schedule of all air filters.
(3.) Equipment performance curves and tables (from submittal data).
(4.) Control diagrams of factory wired equipment.
(5.) Temperature control system product data and shop drawings.
(6.) Warranties and guarantees that extend more than one year from the date of Substantial Completion, bound in Copy No. 1.

(e) Approved submittal data for all equipment, manuals shall be provided that include:

(1.) Equipment start-up and shutdown procedures.
(2.) Troubleshooting procedures.
(3.) Parts list.
(4.) Equipment servicing.
(5.) Preventative maintenance schedules and procedures.
(6.) List of special tools required for maintenance.
(7.) Maintenance instruction.
(8.) Lubrication requirements.

(5) Manufacturer's Qualifications: Firms regularly engaged in manufacture of mechanical products of types and sizes required, and whose products have been in satisfactory use in similar service for not less than 5 years unless specified otherwise in another section of this specification.

(6) Installer's Qualifications: Firm with not less than 5 years of experience installing equipment and products similar to that required for this project unless specified otherwise in another section of this specification

11. Asbestos Prohibition

(1). Asbestos and asbestos-containing products shall not be used.

12. Manufacturers

(1). Manufacturers listed in this specification will only be considered provided they comply with all of the requirements of the Drawings and Specifications. A manufacturer's listing in this specification does not ensure that the manufacturer's product meets the requirements of the Drawings and Specifications.

(2). All equipment and materials shall be new unless noted otherwise.

(3). General : BAS HVAC Controls shall be Alerton.

(4). Labs: -Environmental Labs: BAS HVAC Controls shall be Price.

(5). All VFD"s shall be Honeywell and include bypass.

23.2 Codes and Standards

23.2.1 Heating, Ventilation and Air Conditioning Design Standards

Mechanical systems shall comply with the requirements of the authorities having jurisdiction and shall conform to applicable requirements, recommendations and criteria set forth in the latest editions of the following codes and standards:

1. Florida Building Code, Mechanical; including all Referenced Standards.
2. Florida State Board of Health.
3. Sanitary Code of Florida
4. Public Law 91-596 Occupational Safety and Health Act.
5. ASHRAE Standards Equipment, Systems and Applications
6. National Fire Protection Association (NFPA) codes and standards.
7. NFPA No. 90A Air Conditioning and Ventilating.
8. NFPA No. 91 Blower and Exhaust Systems
9. NFPA No. 101 Safety to Life from Fire in Buildings.
10. UL 555 – Fire Dampers.
11. SMACNA- Low Velocity Duct Construction Standards.

12. SMACNA- High Velocity Duct Construction Standards.
13. ANSI B9.1-1971 Safety Code for Mechanical Refrigeration.
14. ANSI B31.1, 0-1967 (with Agenda) Power Piping.
15. ANSI B31.2- Fuel Gas Piping.
16. UL Codes and Standards.
17. Town of Davie Ordinances.
18. ADA Latest Edition.

23.3 Heating, Ventilation and Air Conditioning Design Criteria

All new buildings, additions and renovations shall be designed considering the following priorities in terms of cooling options;

1. Cooling needs served by the Nova Southeastern University chilled water loop.

2. Dedicated chilled water system, water cooled or air cooled, connected to the EBMS. Only where the campus chilled water loop is not accessible. If this option is used, provisions shall be made for future connection to the campus' chilled water system expansion.

3. Dedicated direct expansion equipments, using split type or package roof top type systems. This is the last choice and must be approved in writing by the Nova Southeastern University.

4, Design Parameters:

a. Outdoor Design Conditions:

(1)	Summer (General) (1.0% DB/WB)	91°F DB / 79°F WB
(2)	Summer (Dedicated Outdoor Air Units) (0.4% DB, 0.4% Evap WB)	91°F DB, 80°F WB
(3)	Condensing Units (0.4% DB + 4°F)	95°F DB
(4)	Evaporative Cooling Equipment (0.4% Evap WB + 1°F)	81°F WB
(5)	Winter (99.0% DB)	46°F DB
(6)	ASHRAE 90.1 Weather Zone:	1A

b. Indoor Design Conditions:
The follow summary is for general information only; specific conditions are indicated in the calculations, herein:

(1)	Classrooms, Offices, Auditoriums	(Summer)	74°F/50% rh.
		(Winter)	70°F.
(2)	Other types of spaces:	ASHRAE 55 Latest Edition	

c. Ventilation Requirements: Outdoor Air (min.): Complies with edition in effect of ASHRAE Standard 62.1 or Florida Mechanical Code. Compliance with ASHRAE 62.1 "Ventilation Rate Procedure" is required for all LEED projects.

d. Envelop Heat Transfer Coefficients: Complies with edition in effect of ASHRAE Standard 90.1.

e. Electrical Power Limits: If actual quantities are not available; lighting power densities shall be per ASHRAE Standard 90.1 and miscellaneous equipment shall be per ASHRAE Fundamentals "Nonresidential Heating and Cooling Load Calculations".

5. The noise criteria for HVAC design shall conform to latest editions of ASHRAE Handbooks. Acceptable acoustics are determined by the use of a space and the requirements of its occupants.

6. The HVAC system for every new project shall consider a safety factor of 50% unless otherwise indicated, in writing, by Nova Southeastern University.

7. Direct driven equipment shall be Honeywell variable frequency drives (VFD) are the preferred choice for HVAC equipment selection. Synchronous belt driven equipments are also acceptable.

8. Non-metal HVAC ductwork is not allowed in Nova Southeastern University premises.

9. Manufacturers for mayor HVAC equipment shall be: Trane, York, and Carrier. Other manufacturers may be acceptable upon Nova Southeastern University approval.

10. Provide access doors for all maintenance items above inaccessible ceilings and into inaccessible walls. If necessary, fire rated access doors shall be used to preserve wall fire rating.

11. Locate filter boxes and other maintainable equipment outside of critical areas served, so that items can be serviced without disrupting operations in the room or releasing contaminants into space.

12. Locate fan coil units, terminal boxes, and other equipment containing water over hallways rather than occupied or critical spaces wherever possible. Where necessary to locate such equipment over such spaces, provide secondary drain pans.

13. In atriums or other multi-story open to roof areas, maintenance and accessibility shall be a consideration when mounting fans, lights and other equipment above the floor.

14. Primary manufacturer/model number to be specified for various types of mechanical equipment is specified herein. Provide a minimum of two additional and equivalent valve manufacturers and model numbers for each primary manufacturer and model number listed.

15. Process cooling requirements shall be addressed by a dedicated process cooling system.

16. Process cooling shall not be achieved using the building chilled water system, the campus chilled water system or the building domestic water system.

17. BAS HVAC Controls shall be Alerton.

18. BAS Lab Environmental Controls shall be Price.

23.4 Utility Coordination

Detailed information of Chilled Water pipes size and location shall be provided to the University civil engineer for coordination with other utilities and connection to the University Chilled Water loop.

23.5 Air Distribution System

1. The air distribution system for new projects shall be variable volume type using single duct VAV (Variable Air Volume) boxes with electric heating for perimeter areas. The core areas shall be provided with cooling only, except as required to meet ASHRAE 62.1 Minimum Ventilation Standards. Non-typical spaces shall be designed according to their specific requirements.

2. All HVAC ducts shall be made of galvanized sheet metal in accordance to the latest edition of SMACNA Standards. All ductwork shall be constructed to meet required pressure classification. Flexible ducts are allowed to connect the main trunk to the air terminals only. Flexible ducts exceeding 10 feet in length are not acceptable. All HVAC ducts shall be insulated using a minimum R-Value of 6.

3. Ductwork dedicated to special services, such as kitchen exhaust, acid fumes exhaust, clothes dryer exhaust, etc., shall be constructed in strict compliance with applicable codes and standards.

4. Ducts, grilles and diffusers serving showers or other areas of high humidity shall be of aluminum construction.

5. Where fume hoods are present, provision must be made for make-up-air, such as hoods being of the "add-air" or "auxiliary-air" design and including a motor operated shut off valve in the exhaust stack.

6. Ceiling returns plenums shall be avoided whenever possible.

7. No interior duct insulation (liner) shall be used except when used for sound attenuation. Sound liners shall be protected by an acrylic coating to avoid exposed fibers in airstreams and by internal perforated sheet metal.

8. Duct insulation shall be by use of one of the following:

    a. Exterior duct wrap.

    b. Factory fabricated double wall metal duct with solid metal inner wall with insulation between walls.

c. Factory fabricated double wall metal duct with perforated metal inner wall with insulation between walls and 2 mil thick Mylar between inner liner and insulation. (Use this method only where noise is of particular concern)

d. Double wall construction shall be specified for Air Handling Units, Fan Coil Units, Variable Air Volume Boxes or other Terminal Boxes. Insulation shall be between the inner and outer walls. The inner wall shall be solid metal(not perforated) so that no insulation is exposed to the air stream.

e. Ductwork that is exposed to the weather shall be double wall, smooth inside and out, insulated, with flanged connections. Joints shall be insulated and the outside panel painted with weather resistant paint or be stainless steel exterior.

23.6 Mechanical Rooms

1, Provide mechanical rooms with lockable and accessible only to qualified persons; No accessibility shall be provided to professors or students or for use as storage.

2. Space shall be adequate for all the mechanical equipment to be installed including recommended installation clearances, maintenance space and coils pull out clearance space for air handling units. Minimum size shall be as required by Code to accommodate all necessary equipment. Provide Mechanical Room with double doors swinging out.

3. Return and outside air duct connections to air handlers shall be ducted. Do not use room as a return air plenum. Rooms shall be air conditioned.

4. The process of allocating the mechanical room should consider the noise, accessibility, heat output, ventilation requirements, power requirements, drainage, water and fuel.

5. Sufficient access to the room shall be included to permit replacement of any equipment.

6. Mechanical rooms shall be clear of columns or beams as well as shear walls, stairways, duct shafts, elevators and other obstructions to permit a clear running of the HVAC ductwork and piping.

7. Rooms shall be sprinklered in fully sprinklered facilities.

23.7 Laboratory Buildings

1. ”Manifolding” or mixing of general laboratory exhaust and exhaust directly from fume hoods is allowable as long as it is accomplished in compliance with any applicable building and life safety codes.

2. Where fume hoods and general room exhaust streams are combined, the duct shall be round stainless steel Type 316 ductwork with welded seams and flanged or welded connections. The stainless steel ductwork shall be run from the point of collection (hood connection or room exhaust grille/inlet) to the main riser for that portion of the building.

Ducts riser may be constructed of stainless steel. Additional anti-corrosion coating shall be provided whenever the duct system conveys highly corrosive fumes. Where exhaust streams are NOT combined, only the fume hood exhaust ductwork need be run in stainless steel, coated, or other suitable anti-corrosion materials.

3. No heat recovery wheels (or any other technology which does not completely separate the exhaust and intake airstreams) will be considered for energy recovery building exhausts which handle fume hood exhaust, whether combined or not.

4. Variable air volume control dampers controlling the exhaust flow from fume hoods and general room exhaust shall fail OPEN upon loss of control power or control air.
   a. Venturi valves shall be utilized when operations are controlled via BAS.

5. Emergency generators shall be sized to provide adequate power for all exhaust fans serving combined fume hood and general room exhaust systems. Supply air handler outside air intake louvers shall fail or power OPEN to prevent excessive negative building pressurization upon loss of primary power source. Supply air handlers do not have to be included in emergency generator capacity. Where fume hood exhaust is separate from general room exhaust, only the fume hood exhaust fans need to be included in calculating the emergency generator capacity.

6. Co-mingled or combined fume hood and general room exhaust systems must be considered and designed as "hazardous exhaust systems" in accordance with the International Mechanical Code, and other applicable building and life safety codes.

23.8 Specific Mechanical Requirements (organized by CSI Master Format® 2013 Numbers & Titles) Division 23

23 05 14	Wiring, Motors, Starters and Variable Frequency Drives for HVAC Equipment
23 05 16	Expansion Fittings and Loops for HVAC Piping
23 05 19	Meters and Gages for HVAC Piping
23 05 23	General-Duty Valves for HVAC Piping
23 05 29	Hangers and Supports for HVAC Piping and Equipment
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23 05 93	Testing, Adjusting, and Balancing for HVAC
23 07 00	HVAC Insulation
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23 11 13	Facility Fuel-Oil Piping
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23 21 13	Hydronic Piping
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23 23 00	Refrigerant Piping
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23 31 13	Metal Ducts
23 31 19	HVAC Casings
23 33 00	Air Duct Accessories
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23 36 00	Air Terminal Units
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23 37 23	HVAC Gravity Ventilators
23 41 00	Particulate Air Filtration
23 41 33	High-Efficiency Particulate Filtration
23 57 00	Heat Exchangers for HVAC
23 64 16	Centrifugal Water Chillers
23 64 23	Scroll Water Chillers
23 64 26	Rotary-Screw Water Chillers
23 65 00	Cooling Towers
23 72 00	Air-To-Air Energy Recovery Equipment
23 73 13	Modular Central-Station Air-Handling Units
23 74 13	Packaged, Outdoor, Central-Station Air-Handling Units
23 74 33	Packaged, Outdoor or Rooftop Air Conditioning Units
23 81 13	Packaged Terminal Air-Conditioners
23 81 23	Computer-Room Air-Conditioners
23 81 26	Split-System Air-Conditioners
23 82 16	Air Coils
23 82 19	Fan Coil Units

23 05 14 Wiring, Motors, Starters and Variable Frequency Drives for HVAC Equipment

Design Standards:

1. Motors for HVAC equipments shall provided sufficient capacity to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

Product Standards:

1. Acceptable Manufacturers:

a. Honeywell International, Inc. (includes bypass on all drives).

Performance Standards:

1. Electric Wiring
   a. All wiring shall conform to Division 26, Electrical.

2. Motors and Starters
   a. Motors larger than 1/2 HP shall be 3 phase, unless noted otherwise on Drawings; 1/2 HP and smaller shall be single phase unless otherwise indicated. Motors and other electrically operated equipment shall be nameplate rated to operate with the voltage, phase and Hertz indicated on the Electrical Drawings. Motor nameplate ratings shall be 200 V for 208 V circuits, 230 V for 240 V circuits, 265 V for 277 V circuits and 460 V for 480 V circuits.

   b. All three phase motors shall be designed for inverter duty unless noted otherwise.

   c. All three phase motors shall meet or exceed the NEMA Premium nominal energy efficiency ratings.

   d. Actual motor full load amperes shall not exceed full load ampere ratings as listed in NEC Article 430.

   e. Job installed starters shall be Joslyn-Clark, Allen-Bradley, Square D, Gould, General Electric, Cutler Hammer/Westinghouse or Siemens.

   f. Starters for 3 phase motors shall be magnetic type and unless otherwise indicated shall be as follows:
      (1) NEMA 1 enclosure, combination line starter with fused disconnect and thermal overload protection on all 3 phases. Starters outdoors shall have rainproof NEMA 3R enclosures. (Where fused disconnects are specified, provide fuses per Division 16 - Disconnect Switches.)
      (2) 24 V coil or 120 V coil (to agree with control circuit - not to exceed 120 V) and control transformer built-in, with fuses in primary leads and in hot secondary lead, other secondary grounded.
      (3) Two sets of auxiliary contacts plus additional interlock contacts as required for specified performance.
      (4) Provide red running lights for all starters.
      (5) H.O.A. control for all automatically controlled starters and remotely controlled starters. Furnish ON-OFF selector switch where there is no automatic, remote or interlock control.
      (6) Additional starter specifications are given in other sections.
      (7) The Short Circuit Ampere Interrupting Capacity Rating shall be as indicated on the Electrical Drawings. Coordinate the AIC rating with the electrical engineer. If AIC rating greater than 5000 amp (for starter sizes 0 thru3)or greater

than 10,000 amps (for starter sizes 4 and larger), specify a fused combination starter.

g. Starters for single phase motors shall be manual type motor rated switches with thermal overload device (except omit overload device from switches for motors with built-in overload protection) and NEMA type 1 enclosure except for installation in toilets or public spaces or when noted for flush mounting. In such locations, furnish jumbo stainless steel flush plate and pull box. Provide red running lights for all starters.
   (1) Single phase motors remotely controlled by Building Management Control System or central Temperature Control System shall be provided with H.O.A control switch.

h. Furnish starters (motor control switches) for all motors supplied with mechanical equipment except where starters are indicated in motor control centers on the Electrical Drawings, which are specified in the Electrical Division.

3. Variable Frequency Drives (VFD)

a. Variable Speed Drives shall vary the speed of the induction motors. The motor speed control shall be UL, ETL or CSA approved. All VFD's shall be Honeywell and include bypass.

b. The variable frequency power and logic unit shall be completely solid state with a pulse width modulated (PWM) output waveform. VVI, six-step, and current source drive are not acceptable. and shall transform 3 phase 60 Hertz input power into frequency and voltage controlled 3 phase output power suitable to provide positive speed and torque control to standard induction motors. The variable speed drive shall be completely enclosed in a NEMA 1 enclosure, completely assembled and tested by the manufacturer. The speed control shall be stepless throughout the speed range under variable torque load on a continuous basis. The variable frequency drive shall employ a full wave rectifier (to prevent input line notching), DC Line Reactor, capacitors, and insulated Gate Bipolar Transistors (IGBT's) as the output switching device (SCR's, GTO's and Darlington transistors are not acceptable). The adjustable frequency control shall have a power factor of 0.98 or better and a drive efficiency of 0.97 percent or better at all operating speeds and loads.

c. The Short Circuit Ampere Interrupting Capacity (AIC) Rating shall be as indicated on the Electrical Drawings. If not indicated on the Electrical

d. The following features and adjustments for self-protection and reliable operation shall be included:
   (1) PI set point controller shall be standard in the drive, allowing a pressure or flow signal to be connected to the VFD, using the microprocessor in the VFD for the closed loop control.

e. Surge Protection: The VFD shall be provided with protection against under voltage and overvoltage, including low energy lightening surges introduced on the primary AC source. This shall include:
   (1) Input AC overvoltage protection for over 120% of rated voltage.

(2) Input AC under voltage protection for under 65% of rated voltage.

f. Additionally Provide:
(1) Current limit to 110% of the inverter rating, but not trip on momentary overload.
(2) Instantaneous overcurrent trip at 225% of inverter rating.
(3) Under voltage trip at 65% of rated voltage.
(4) Overvoltage trip for DC voltage at 130% of rated voltage.
(5) Over temperature trip for the inverter at 70 degree C.
(6) Ground fault trip, either running or at start.
(7) Adjustable motor overload (I squared T) trip (60 -100%).
(8) Adjustable current limit.
(9) The drive shall employ current limit circuits to provide trip free operation.
(10) Adjustable volts per hertz (+10%, -10%).
(11) Adjustable accelerate/decelerate rate (1-300 sec.).
(12) Adjustable minimum and maximum speeds (0-100%).
(13) Adjustable offset and gain of input signal.
(14) Two (2) programmable analog outputs proportional to Frequency, Motor Speed, Output Voltage, Output Current, Motor Torque, Motor Power (KW), DC Bus voltage, or Active Reference.
(15) Input signal inversion.

g. Contacts to indicate enabled current limit and fault conditions.
(1) Control shall be capable of operation without a motor connected.

h. Speed Command Input shall be via:
(1) Keypad.
(2) Two analog inputs, each capable of accepting a 0-20 mA, 4-20 mA, 0-10 V signal. Input shall be isolated from ground, and programmable for different uses. Analog inputs shall have a programmable filter to remove any oscillation of the reference signal. The filter shall be adjustable from 0.01 to 10 seconds. The analog input shall be able to be inverted, so that minimum reference corresponds to maximum speed, and maximum reference corresponds to minimum speed. The minimum and maximum values (gain and offset) shall be adjustable within the range of 0-20 mA and 0-10 Volts. The active analog input shall have loss of reference protection.
(3) Floating point input shall accept a three-wire input from a Dwyer Photohelic (or equivalent type) instrument.

i. Door interlocked disconnect switch, fused.

j. Contactor bypass switch with 3 contactors, motor overload relay, safety circuit terminal strip, "power on" light, mode selector and indicator lights, normal operation/test selector, and safety circuit trip light.

k. Built-in digital display to indicate output frequency, voltage and current, speed, % torque, % power, elapsed time, and KWH.

l. Alpha Display or Status Lights : Power On, Enabled, Overtemperature, Current Limit, Undervoltage, Overvoltage, Overcurrent and External Fault Trip.

m. Auto restart: In the event of a momentary or sustained power loss, the control shall shut down safely without component failure. Upon return of power, the system shall automatically return to normal operation, if the system is in the "On" condition. On return to normal operation, the system shall be protected against, or able to restart into, a rotating motor, forward or reverse, and regain positive speed control without shutdown or component failure.

n. Isolation: Current and voltage signals shall be isolated from logic circuitry.

o. Logic: Drive logic shall be microprocessor based.

p. Short circuit protection: In the event of a phase-to-phase short circuit or short to ground, the control shall shut down safely without component failure.

q. Power interruption: In the event that an input or output power contactor is opened or closed while the control is activated, no damage to the control shall result.

r. Output frequency shall not vary with +10% input voltage changes or with temperature changes within the ambient specification of 0 deg C to 40 deg C.

s. Start/stop control: The controller shall be constructed to be started or stopped by the following:
(1) A start-stop push button on the door.
(2) Contacts for connection to a two-wire circuit to thermal overload switches in the motor, freezestat, smoke detector and time switch or other remote on-off control.

t. Speed control: Provide a sensing device in the motor control that will increase or decrease the fan motor speed from 2 to 10 VDC or 4 to 20 mA signal. The motor speed control shall be field adjustable for speed increase/decrease timing.

u. AC reactor/DC Link Choke to improve the power factor and suppress the harmonic current of the inverter while in operation. Comply with IEEE 519 – Harmonic Analysis for particular jobsite including total voltage harmonic distortion and total current distortion.

v. The VFD manufacturer shall provide calculations, specific to this installation, showing total harmonic voltage distortion is less than 5%. Input line filters shall be sized and provided as required by the VFD manufacturer to ensure compliance with IEE 519-1992, “Guide for Harmonic Control and Reactive Compensation for Static Power Converters”. The acceptance of this calculation must be completed prior to VFD installation.

w. Prior to installation, the VFD manufacturer shall provide the estimated total harmonic distortion (THD) caused by the VFD’s. The result shall be based on a computer aided circuit simulation of the total actual system, with the information obtained from the power provider and the user.

x. If the voltage THD exceeds 5%, the VFD manufacturer is to recommend the additional equipment required to reduce the voltage THD to an acceptable level. Existing harmonic distortion must be measured by an independent organization to assure compliance prior to the VFD evaluation

y. Provisions for stop and automatic re-start from external safety devices:
   (1) After shutdown from any external safety such as fire alarm or freezestat, VFD shall automatically re-start when external fault or safety is cleared. Provide logic to automatically re-start VFD when external safeties are cleared.

z. Serial Communications:
   (1) The VFD shall have an RS-485 port as standard.
   (2) The VFD shall be able to communicate with PLC's, DCS's, and DDC's.
   (3) Serial communication capabilities shall include, but not be limited to, run-stop control, speed set adjustment, proportional/integral PI controller adjustment, current limit, and accel/decel time adjustments.
   (4) The drive shall have the capability of allowing the DDC to monitor feedback such as output speed/frequency, current (in amps), % torque, % power, kilowatt hours, relay outputs, and diagnostic fault information.

aa. Provide critical frequency jump to allow inverter to ride through resonance frequencies.

bb. The VFD shall be equipped with an automatic extended power loss ride-through circuit which will utilize the inertia of the load to keep the drive powered. Minimum power loss ride-through shall be one-cycle, based on full load and no inertia.

cc. Accessories: The variable frequency motor control units shall be provided with all accessory equipment required for self-protection, motor protection and prevention of interference in the power supply system. Units that contain SCR's or other devices that create line notching shall have isolation transformer. Provide data line module to allow RS 232 link for personal computer to allow PC control of start/stop, forward/reverse, frequency, status, mode.

23 05 16 Expansion Fittings and Loops for HVAC Piping

Design Standards:

1. Expansion fittings and loops for HVAC piping shall be designed to prevent damages on piping systems due to dimensional changes that occurs for temperature variations in the fluid being carried.

2. Welding joints for expansion loops shall be according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

Product Standards:

Materials shall be corrosion resistant.

Performance Standards:

1. Expansion fittings shall have the capability to absorb 200 percent of maximum piping expansion between anchors. These fittings must be compatible with the product suitable for piping system fluids, materials, working pressures, and temperatures.

23 05 19 Meters and Gages for HVAC Piping

Design Standards:

1. Meters and gauges shall be installed in strict accordance with the manufacturer's recommendations for orientation, required straight length of upstream/downstream position. Pressure ports shall not be pointed downward to prevent the accumulation of trash and debris inside the ports

Product Standards:

1. Thermometers, General
   a. Scale Range: Temperature ranges for services listed are as follows:
      (1) Domestic Hot Water: 30 to 240 deg F, with 2-degree scale divisions.
      (2) Domestic Cold Water: 0 to 100 deg F, with 2-degree scale divisions.
      (3) Chilled Water: 0 to 100 deg F, with 2-degree scale divisions.
   b. Accuracy: Plus or minus 1 percent of range span or plus or minus one scale division to maximum of 1.5 percent of range span.
   c. 5 inch diameter face minimum, stainless steel housing.

2. Liquid-In-Glass Thermometers
   a. Description: ASTM E 1.
   b. Case: Stainless Steel case, glass front, spring secured, 9 inches long.
   c. Adjustable Joint: Finish to match case, 180-degree adjustment in vertical plane, 360-degree adjustment in horizontal plane, with locking device.
   d. Tube: Red or blue reading, organic-liquid filled with magnifying lens.
   e. Scale: Satin-faced non-reflective aluminum with permanently etched markings.
   f. Stem: Copper-plated steel, aluminum, or brass for separable socket; of length to suit installation.

3. Separable Sockets
   a. Description: Fitting with protective socket for installation in threaded pipe fitting to hold fixed thermometer stem.
      (1) Material: Brass, for use in copper piping.
      (2) Material: Stainless steel, for use in steel piping.
      (3) Extension-Neck Length: Nominal thickness of 2 inches, but not less than thickness of insulation. Omit extension neck for sockets for piping not insulated.
      (4) Insertion Length: To extend to center of pipe.

4. Thermometer Wells

a. Description: Fitting with protective well for installation in threaded pipe fitting to hold test thermometer.
   (1) Material: Brass, for use in copper piping.
   (2) Material: Stainless steel, for use in steel piping.
   (3) Extension-Neck Length: Nominal thickness of 2 inches, but not less than thickness of insulation. Omit extension neck for wells for piping not insulated.
   (4) Insertion Length: To extend to center of pipe.
   (5) Cap: Threaded, with chain permanently fastened to socket.

5. Pressure Gages
   a. Description: ASME B40.1, phosphor-bronze bourdon-tube type with bottom connection; dry type, unless liquid-filled-case type where gages are connected across pumps and chillers.
   b. Case: Brass, or aluminum with 4-1/2-inch-diameter, glass lens.
   c. Connector: Brass, NPS 1/4.
   d. Scale: White-coated aluminum with permanently etched markings.
   e. Accuracy: Grade A, plus or minus 1 percent of middle 50 percent of scale.
   f. Range: Comply with the following:
      (1) Vacuum: 30 inches Hg of vacuum to 15 psig of pressure.
      (2) Fluids under Pressure: Two times the operating pressure.
   g. Extension-Neck Length: Insulated Piping – Omit extension neck for wells for piping not insulated.
   h. Pressure transmitters are to be selected such that the pressure range midpoint shall coincide with the anticipated normal operating pressure.

6. Pressure-Gage Fittings
   a. Valves: NPS 1/4 brass or stainless-steel needle type.
   b. Syphons: NPS 1/4 coil of brass tubing with threaded ends.
   c. Snubbers: ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant porous-metal disc of material suitable for system fluid and working pressure.

7. Test Plugs
   a. Description: Nickel-plated, brass-body test plug in NPS 1/2 fitting.
   b. Body: Length as required to extend beyond insulation.
   c. Pressure Rating: 500 psig minimum.
   d. Core Inserts: Two self-sealing valves, suitable for inserting 1/8-inch OD probe from dial-type thermometer or pressure gage.
   e. Core Material for Air, Water, Oil, and Gas: 20 to 200 deg F, chlorosulfonated polyethylene synthetic rubber.
   f. Core Material for Air and Water: Minus 30 to plus 275 deg F, ethylene- propylene-diene terpolymer rubber.
   g. Test-Plug Cap: Gasketed and threaded cap, with retention chain or strap.
   h. Test Kit: Pressure gage and adapter with probe, two bimetal dial thermometers, and carrying case.
      (1) Pressure Gage and Thermometer Ranges: Approximately two times the system's operating conditions.

8. Flow-Measuring Systems
   a. System includes calibrated flow element, separate meter, hoses or tubing, valves, fittings, and conversion chart compatible with flow element, meter, and system fluid.
      (1) Flow range of flow-measuring element and meter covers operating range of equipment or system where used.
      (2) Display: Visual instantaneous rate of flow.

   b. Portable Meters: Differential-pressure gage. Include two 12-foot hoses in carrying case with handle.
      (1) Scale: Inches of water, unless otherwise indicated.
      (2) Accuracy: Plus or minus 2 percent between 20 and 80 percent of range.
   c. Include complete operating instructions with each meter.
   d. Venturi Flow Elements: Differential-pressure-design, flow-element fitting made for installation in piping.
      (1) Construction: Bronze, brass, or factory-primed steel; with brass fittings and attached tag with flow conversion data. Include ends threaded for NPS 2 and smaller elements and flanged or welded for NPS 2-1/2 and larger elements.
      (2) Pressure Rating: 250 psig.
      (3) Temperature Rating: 250 deg F.

9. Vortex-Shedding Flowmeters
   1. Insertion Vortex-Shedding Flowmeter: Made for installation in pipe; measures flow directly in gallons per minute.
   2. Construction: Stainless-steel probe, with integral transmitter and direct-reading scale.
      (1) Pressure Rating: 1000 psig minimum.
      (2) Temperature Rating: 500 deg F minimum.
      (3) Display: Visual instantaneous rate of flow.
      (4) Integral Transformer: For low-voltage power connection.
      (5) Accuracy: Plus or minus 1 percent for liquids and 1-1/2 percent for gases.
      (6) Output: 0-10 DC, 4-20 mA.
      (7) Special: Hot tap assembly.

10. Turbine Flow Meters
   a. Flow meter shall be four-dual turbine flow meter:
      (1) For use as flow monitoring in central plant and distribution loop chilled water, hot water, and condenser water flow measurement applications.
      (2) The Flow Meter shall provide analog outputs for flow rate for connection to the central control system.
      (3) The Flow Meter shall be “hot tap” style flow sensor, which can be installed, serviced and recalibrated without system shutdown.
   b. General Description:
      Furnish and install an Insertion Flow Meter complete with all installation hardware necessary to enable insertion and removal of the flow meter under pressure without system shutdown. When dictated by short available pipe runs, the flow measurement station shall provide compensation for rotational distortion in the velocity flow profile

caused by upstream conditions. Each sensor shall be covered by a manufacturer's two-year "No Fault" warranty.

c. Accuracy & Calibration:
Each flow sensor shall be individually wet-calibrated and tagged accordingly against the manufacturers primary volumetric standards, which must be accurate to within 0.1% and traceable to the U.S. National Institute of Standards and Technology (NIST). The manufacturer shall provide a certificate of NIST traceable wet-calibration for each sensor. Accuracy shall be as follows:
(1) + 0.5% of actual reading at the calibrated typical velocity
(2) + 1% of reading over a 10:1 turndown (from 3 to 30 ft/s)
(3) + 2% of reading over a 50:1 turndown (from 0.4 to 20 ft/s)
(4) Overall rangeability shall be from 0.17 ft/s to 30 ft/s (175:1 turndown ratio).

d. General Specifications:
The sensor shall have a maximum operating pressure of 400 PSI, maximum operating temperature of 200^0 F and a pressure drop of less than 1 PSI at 17 feet per second flow velocity. The flow sensor shall be constructed of plated brass with standard features to include a weather-tight aluminum electronics enclosure and ½" conduit connection fitting.

e. Electronic Outputs:
The sensor shall have two integral analog outputs, one 0-10 VDC and one 4-20 mA, for connection to a Central Control System. The sensor shall also include integral frequency outputs for diagnostic purposes and for connection to local display. All outputs shall be linear with flow rate.

11. Flow Indicators
a. Description: Instrument for visual verification of flow; made for installation in piping systems.
b. Construction: Bronze or stainless-steel body, with sight glass and plastic pelton- wheel indicator.
c. Pressure Rating: 125 psig.
d. Temperature Rating: 200 deg F.

Performance Standards:

1. Meters and Gauges shall be calibrated according to the manufacturer recommendations and the procedures established by the U.S. National Institute of Standards and Technology (NIST). The manufacturer shall provide a certificate of NIST traceable wet-calibration for each device.

23 05 23 General-Duty Valves for HVAC Piping

Design Standards:

1. Ferrous valve dimensions and design criteria shall comply with ASME B16.10 and ASME B16.34. Power piping valves shall comply with ASME B31.1. Building services piping valves shall comply with ASME B31.9.

2. Valve pressure and temperature ratings shall not be less than that required for system pressures and temperatures.

3. Ball, butterfly or gate valves shall be used for shut-off service applications.

4. Provide ball valves on chilled and hot water supply and return piping with balancing cock on return line to all air handling units. Provide ball valves and tee handle up to 3". Provide two-way modulating Honeywell globe valves and Honeywell actuators on chilled and hot water return lines at all air handling units. Provide gauge cocks and thermometer wells on supply and return piping on all air handling units.

5. In most cases, valve sizes shall be the same as upstream piping.

6. The following valve actuator types shall be used:
   a. Gear Actuator: For quarter-turn valves NPS 8 and larger.
   b. Hand wheel: For valves other than quarter-turn types.
   c. Hand lever: For quarter-turn valves NPS 6 and smaller except plug valves.
   d. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 5 plug valves, for each size square plug-valve head.
   e. Chain wheel: Device for attachment to valve hand wheel, stem, or other actuator; of size and with chain for mounting height.

7. Valves in insulated piping shall be provided with 2-inch stem extensions and the following features:
   a. Gate Valves: With rising stem.
   b. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
   c. Butterfly Valves: With extended neck.

8. Valve-End Connections shall be in accordance with the following:
   a. Flanged: With flanges according to ASME B16.1 for iron valves.
   b. Grooved: With grooves according to AWWA C606.
   c. Solder Joint: With sockets according to ASME B16.18.
   d. Threaded: With threads according to ASME B1.20.1.

9. The following valves shall be used for chilled water piping with a diameter of 2 inches or less:
   a. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
   b. Bronze Angle Valves: Class 125, bronze or nonmetallic disc.
   c. Ball Valves: Two, three piece, full port, bronze with bronze trim.
   d. Bronze Swing Check Valves: Class 125, bronze or nonmetallic disc.
   e. Bronze Gate Valves: Class 125, bronze.
   f. Bronze Globe Valves: Class 125, bronze or nonmetallic disc.

10. The following valves shall be used for chilled water piping with a diameter of 2-1/2 inches or more:
    a. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.

b. Iron Ball Valves, NPS 2-1/2 to NPS 10: Class 150.
c. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12: 200 CWP, EPDM or NBR seat, aluminum-bronze stainless-steel disc.
d. Iron Swing Check Valves: Class 125, metal or nonmetallic-to-metal seats.
e. Iron Swing Check Valves with Closure Control, NPS 2-1/2 to NPS 12: Class 125, lever and spring.
f. Iron, Grooved-End Check Valves, NPS 3 to NPS 12: 300 CWP.
g. Iron, Center-Guided Check Valves: Class 125, compact-wafer, metal, resilient seat.
h. Iron, Plate-Type Check Valves: Class 125; single dual plate; metal, resilient seat.
i. Iron Gate Valves: Class 125.
j. Iron Globe Valves: Class 125.
k. Lubricated Plug Valves: Class 125, regular gland or cylindrical, threaded or flanged.
l. Eccentric Plug Valves: 175 CWP, resilient seating.

11. The following valves shall be used for heating water piping with a diameter of 2 inches or less:
a. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
b. Bronze Angle Valves: Class 125, bronze disc.
c. Ball Valves: Two piece, full regular port, bronze with bronze trim.
d. Bronze Swing Check Valves: Class 125, bronze disc.
e. Bronze Gate Valves: Class 125,
f. Bronze Globe Valves: Class 125, bronze disc.

12. The following valves shall be used for heating water piping with a diameter of 2-1/2 inches or more:
a. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
b. Iron Ball Valves, NPS 2-1/2 to NPS 10: Class 150.
c. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12: 200 CWP, EPDM or NBR seat, aluminum-bronze ductile-iron, stainless-steel disc.
d. Iron, Single-Flange Butterfly Valves, NPS 14 to NPS 24: 150 CWP, EPDM or NBR seat, aluminum-bronze, ductile-iron, stainless-steel disc.

13. Globe Valves shall be the following:
a. Honeywell Globe Valves up to 4" w/ ML7421A1032 or 3 series or Honeywell Zone Valves V5862 or 3 series: ¾" or less w/ ML6410A1029 or M7410F100 actuator.

Product Standards:

1. Preferred Manufacturers:
a. Crane Co.
b. Flo Fab Inc.
c. Hammond Valve.
d. Honeywell International, Inc.
e. Kitz Corporation.
f. Legend Valve.
g. Milwaukee Valve Company.
h. Powell Valves.
i. Red-White Valve Corporation.
j. Watts Regulator Co.

23 05 29 Hangers and Supports for HVAC Piping and Equipment

Design Standards:

1. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

2. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.

3. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

Product Standards:

1. Pipe Hangers and Supports
   a. Hangers for Pipe Sizes 1/2 to 1-1/2 Inches: Carbon steel, adjustable swivel, split ring.
   b. Hangers for Pipe Sizes 2 to 4 Inches: Carbon steel, adjustable, clevis.
   c. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
   d. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
   e. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.
   f. Vertical Support: Steel riser clamp.
   g. Floor Support for Pipe Sizes Up to 4 Inches and All Cold Pipe Sizes: Cast iron adjustable pipe saddle, locknut, nipple, floor flange and concrete pier or steel support.
   h. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
   i. Shield for Insulated Piping 2 Inches and Smaller: 18 gauge galvanized steel shield over insulation in 180 degree segments, minimum 12 inches long at pipe support.
   j. Shield for Insulated Piping 2-1/2 Inches and Larger (Except Cold Water Piping): Pipe covering protective saddles.
   k. Shields for Vertical Copper Pipe Risers: 1/8 inch thick minimum neoprene sheet.
   l. Use double nuts and lock washers on threaded rod supports.

2. Duct Hanger Straps
   a. 1 inch x 18 gauge galvanized steel fastened with screws to rectangular ducts and with a bolt to round ducts.

3. Hanger Rods
   a. Hanger rods for steel wrought iron and brass pipe shall be installed in accordance with the following schedule:

Pipe Size	Rod Diameter	Maximum Spacing
Up to 3”	3/8”	8’-0”
4”	1/2”	10’-0”
5” and Up	5/8”	10’-0”

b. Hanger rods for copper pipe and tube shall be installed in accordance with the following schedule:

Pipe Size	Rod Diameter	Maximum Spacing
Up to 1”	3/8”	6’-0
1-1/4” and 1-1/2”	3/8”	8’-0”
2”	3/8”	9’-0”
2-1/2”	1/2“	9’-0”
3” and 4”	1/2”	10’-0”

4. Roof Curbs
   a. Curbs to be a minimum of 18 inches high for either finished flat roofs or finished pitched roofs, manufactured of 18 gauge galvanized steel shell and base with a mitered 3 inch cant, continuously welded longitudinal seams and metal corners, internally reinforced with bulkheads and spreaders on 24 inch centers, factory insulated with 1-1/2 inch thick/3 PCF density fiberglass board insulation, factory installed 2 inch x 4 inch wood nailer strip, gasketing and 18 gauge galvanized steel counterflashing. Curb to be of the same manufacturer of the equipment that it will support.

5. Sleeves
   a. Sleeves for Pipes through Non-Fire Rated Floors: 18 gauge galvanized steel.
   b. Sleeves for Pipes Through Underground Non-Fire Rated Walls and Footings: Schedule 40 PVC.
   c. Sleeves for Pipes through Fire Rated Walls and Floors: Factory fabricated UL fire rated sleeves including seals.
   d. Sleeves for Rectangular Ductwork: Galvanized steel.
   e. Sleeves for Round Ductwork: Galvanized Steel.

6. Fabrication
   a. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
   b. Design hangers without disengagement of supported pipe.
   c. Provide copper plated hangers and supports for copper piping and 1/8 inch minimum thick neoprene sheet packing between hanger or support and ferrous piping.

23 05 48 Vibration Controls for HVAC Piping and Equipment

Design Standards:

1. Concrete Inertia Bases. Inertia bases shall be provided for reciprocating and centrifugal chillers, air compressors, all pumps, axial fans above 300 RPM, and centrifugal fans above 37.3 kW (50 hp).

2. Flexible duct connections shall be provided at fan outlets and inlets or AHU supply and return duct connections to minimize vibration transmission through ducts, except for smoke control and kitchen exhaust systems.

3. Piping Hangers and Isolation. Isolation hangers shall be used for all piping in mechanical rooms and adjacent spaces, up to a 50 ft distance from vibrating equipment. The pipe hangers closest to the equipment shall have the same deflection characteristics as the equipment isolators. Other hangers shall be spring hangers with 0.75 in deflection. Positioning hangers shall be specified for all piping 8 in and larger throughout the building. Spring and rubber isolators are recommended for piping 2 in and larger hung below noise sensitive spaces.

4. Floor supports for piping may be designed with spring mounts or rubber pad mounts. For pipes subject to large amounts of thermal movement, plates of Teflon or graphite shall be installed above the isolator to permit horizontal sliding.

5. Anchors and guides for vertical pipe risers usually must be attached rigidly to the structure to control pipe movement. Flexible pipe connectors shall be designed into the piping before it reaches the riser.

6. Provide channel supports for multiple pipes and heavy duty steel trapezes to support multiple pipes. Hanger and support schedule shall have manufacturer's number, type and location. Comply with MSS SP69 for pipe hanger selections. Spring hangers and supports shall be provided in all the mechanical rooms.

7. Horizontal Pipe in Mechanical Rooms: Horizontal pipe in mechanical rooms, after the first three hangers, is to be evaluated for possible vibration isolation. The Engineer is to determine if vibration isolation is required, based on the specific application. If continued vibration isolation is warranted, then the hanger shall be of the steel spring and neoprene element in series.

Product Standards:

1. Preferred manufacturers:
   a. Mason Industries
   b. Vibration Eliminator Company, Inc.
   c. Factory installed by HVAC equipment manufacturers.

Performance Standards:

1. Vibration isolation shall be specified, as required, to reduce vibration and noise transmission.

2. The requirements and recommendations as described in the sound and vibration control chapter of the ASHRAE Handbook HVAC Applications and other recognized industry standards shall be used as the basis of design for vibration isolation.

   State criteria for maximum allowable equipment vibration. State type and deflection of each vibration isolator. This shall apply to all rotating equipment. The type of vibration isolator and the minimum static deflection shall be specified. In addition, the selection shall be based on location and type of equipment.

23 05 53 Identification for HVAC Piping and Equipment
Design Standards:

1. All mechanical equipment and devices shall be clearly identified using the different methods described on section 230553 of the mechanical specifications. The identifications shall be permanent and a description of each equipment tag shall be described in the maintenance facility log.

Product Standards:

1. Metal Labels for Equipment:
   a. Material and Thickness: Brass, 0.032-inch (0.8-mm), Stainless steel, 0.025-inch (0.64-mm) or anodized aluminum, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
   b. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
   c. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
   d. Fasteners: Stainless-steel rivets or self-tapping screws.
   e. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

2. Plastic Labels for Equipment:
   a. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.
   b. Letter Color: White.
   c. Background Color: Black.
   d. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
   e. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
   f. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
   g. Fasteners: Stainless-steel rivets or self-tapping screws.
   h. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

3. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

3. Equipment Label Schedule: for each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where

equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

23 05 93 Testing, Adjusting, and Balancing for HVAC

Design Standards:

1. The Testing and Balancing contractor shall have up to date certification by Associated Air Balance Council (AABC), the National Environmental Balance Bureau (NEBB), or the Testing, Adjusting, and Balancing Bureau (TABB).

2. The A/E shall specify that factory representatives be present for startup of all major equipment, such as boilers, chillers, air-handling units, packaged pump systems, and automatic control systems.

3. Include in the Testing, Adjusting and Balancing Section of the specification, a sub-section for vibration isolation acceptance tests. Detail the tests that will confirm the successful design and the proper installation of the specified equipment.

Product Standards:

1. The test and balance report shall contain detailed information of the project including testing and balance procedures for each type of system, description of measurement devices and instruments used for each parameter, final results and recommendations for system improvements.

Performance Standards:

1. A/E to specify performance testing of all systems and equipment including chillers, boilers, air-handling units, exhaust fans, water heaters, and other systems for part load and full load as per the schedules specified by the designer.

2. Ductwork Pressure and Leak Testing. Tests shall be conducted at static pressures equal to maximum design pressure of system and maximum leakage allowable shall not exceed 50 percent of that allowed in SMACNA's HVAC Air Duct Leakage Manual.

3. Piping and Equipment Pressure and Leak Testing. Leak testing shall be conducted at static pressures as required by code (or as 120 percent of maximum design working pressure of system where no code requirement exists), with maximum permissible leakage.

4. All systems shall be operating within +/- 10% of the specified design parameters.

23 07 00 HVAC Insulation

Design Standards:

1. Insulation shall be provided in accordance with ASHRAE Standard 90.1 and Florida Energy Code. Insulation that is subject to damage or reduction in thermal resistivity if wetted shall be enclosed with a vapor seal (such as a vapor barrier jacket).
   All supply air ducts must be insulated and shall have a vapor barrier jacket. The insulation shall cover the duct system with a continuous, unbroken vapor seal.

2. Insulation is required for all return air systems.

3. Insulation of exhaust air systems needs to be evaluated for each project and for each system to guard against condensation formation and heat gain/loss on a recirculating or heat recovery system.

4. All exposed ductwork shall have sealed canvas jacketing. All concealed ductwork shall have foil face jacketing.

5. All duct insulation requiring a more finished appearance and/or requiring protection from damage (such as ductwork in Equipment Rooms within seven feet of the floor) shall be additionally covered with a continuous layer of pre-sized 8 oz. fiberglass cloth applied with fire resistive mastic.

6. Piping Insulation
   a. All piping systems must be insulated in accordance with ASHRAE Standard 90.1.
   b. All piping systems with surface temperatures below the average dew point temperature of the indoor ambient air and where condensate drip will cause damage or create a hazard shall be insulated with a vapor barrier to prevent condensation formation regardless as to whether piping is concealed or exposed. Chilled water piping systems shall be insulated with non-permeable insulation (of perm rating 0.00) such as cellular glass. All exposed and concealed piping shall have PVC jacketing.
   c. Insulated piping lines running outdoors shall have corrugated or plain 0.016 in. aluminum jacket complete with integral longitudinal Pittsburgh seam and butt joint strips to lock out the weather. In addition to the vapor barrier, this jacket is required on cold lines.
   d. Underground pipe insulation shall have a continuous fiber-reinforced plastic (FRP-60 mils minimum thickness) applied directly over the cellular glass or polyurethane insulation on all straight pipe and fittings. FRP jacket shall form a complete monolithic vapor/weather barrier for the entire underground piping system
   e. Gauge cocks, temperature sensing wells, strainer caps and blow-down valves, etc., shall be insulated with carefully fitted foamed plastic insulation vapor sealed at all joints and ends.
   f. Whenever a manufacturer offers customized foam plastic insulation for their equipment, the contractor must use this option. All serviceable items shall have removable caps or plugs that have tight fit and can be removed as required without disturbing permanent adjacent insulation. All foamed plastic insulation exposed to the weather and exposed in mechanical equipment rooms shall be painted with two coats of white latex paint. Refer to Standard Detail for strainer insulation

Product Standards:

1. Duct Insulation preferred manufacturers:
   a. CertainTeed Corp.; SoftTouch Duct Wrap.
   b. Johns Manville; Microlite.
   c. Knauf Insulation; Friendly Feel Duct Wrap.
   d. Manson Insulation Inc.; Alley Wrap.
   e. Owens Corning; SOFTR All-Service Duct Wrap.

2. Piping Insulation preferred manufacturers:
   a. Aeroflex USA, Inc.; Aerocel.
   b. Armacell LLC; AP Armaflex.
   c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.

Performance Standards:

1. All insulation materials shall comply with the fire and smoke hazard ratings (25 for flame spread; 50 for smoke developed) as indicated by ASTM-E84, NFPA 255 and UL 723. Accessories such as adhesives, mastics, cements and tapes shall have the same or better fire and smoke hazard ratings

23 08 00 Commissioning of HVAC

Design Standards:

1. List the project-specific items of Mechanical equipment and systems to be commissioned.

2. List applicable standards and codes that apply to the commissioning of the equipment and systems commissioned in this section.

3. List other sections of the specifications that relate to the commissioning work of this section, and require coordination and cooperation by Contractor and all subcontractors.

4. As a minimum, the following commissioning tasks will require the cooperation, labor, materials and assistance from the Contractor and subcontractors:
   a. Mechanical equipment installation verification
   b. Mechanical system and equipment startup testing, adjusting and calibration
   c. Mechanical Systems Functional Performance Testing

Product Standards:

1. Sample Forms/Reports: Provide adequately detailed sample forms, checklists and report formats for all commissioning inspections, tests and reports which require the cooperation and assistance of the Contractor and subcontractors for completion.

Performance Standards:

1. Test Procedures: Provide adequately detailed test procedures for all commissioning pre-functional and functional performance tests and inspections, which require the cooperation and assistance of the Contractor and subcontractors for completion.

2. Testing and Re-Testing: Require that the Contractor and subcontractors provide all required assistance, labor, materials and supplies for specified commissioning tests. Specify that tests failed due to improper Contractor work or preparation shall be rescheduled, and all costs of re-testing will be borne by the Contractor.

3. Project Closeout: Specify that the Contractor is responsible for the satisfactory completion of all commissioning items of this section, and of Division 1 – General Commissioning Requirements, prior to approval of project closeout.

23 09 00 Instrumentation and Control for HVAC

Design Standards:

1. Comply with ASHRAE 135 for DDC system components.

Product Standards:

1. DDC Equipment:
   - a. DDC Manufacturer: Alerton, Inc.
   - b. All controls shall meet BACnet Standards for communications.
   - c. Application Software: With dynamic color graphic displays, alarm and event processing, automatic restart, and data collection.
   - d. Diagnostic Terminal Unit: Portable notebook-style microcomputer.
   - e. Control Units: Modular, comprising processor board with programmable, nonvolatile, random-access memory; local operator access and display panel; integral interface equipment; and backup power source.
   - f. Local Control Units: Modular, comprising processor board with electronically programmable, nonvolatile, read-only memory; and backup power source.
   - g. Hardwired I/O interface.
     - (1) Power supplies.
     - (2) Power line filtering.
   - h. Unitary Controllers: Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application.
   - i. Alarm Panels: Unitized cabinet with suitable brackets for wall or floor mounting. Indicating light for each alarm point, single horn, acknowledge switch, and test switch, mounted on hinged cover.
   - j. Analog Controllers:
     - (1) 6- or 10-stage-type step controllers.
     - (2) Remote-bulb or bimetal rod-and-tube-type, electric outdoor-reset controllers.
     - (3) Wheatstone-bridge-amplifier-type electronic controllers.

(4) Solid-state fan-speed controllers.
(5) Single- or multiple-input receiver controllers.

k. Time Clocks: Solid-state, programmable time control with separate programs.

l. Electronic Sensors: Wall, immersion, or duct mounting.
(1) Thermistor temperature sensors and transmitters.
(2) RTDs and transmitters.
(3) Humidity sensors.
(4) Pressure transmitters/transducers.

m. Status Sensors:
(1) Status inputs for fans.
(2) Status inputs for pumps.
(3) Status inputs for electric motors.
(4) Voltage transmitters (100- to 600-V ac).
(5) Power monitors.
(6) Current switches.
(7) Electronic valve/damper position indicators.
(8) Water-flow switches.

n. Gas Detection Equipment:
(1) Carbon monoxide detectors.
(2) Carbon dioxide sensor and transmitters.
(3) Oxygen sensor and transmitters.
(4) Occupancy sensors.

o. Duct airflow station

p. Thermostats:
(1) Combination thermostat and fan switches.
(2) Electric, solid-state, microcomputer-based room thermostats.
(3) Low-voltage, on-off thermostats.
(4) Line-voltage, on-off thermostats.
(5) Remote-bulb thermostats.
(6) Fire-protection thermostats.
(7) Immersion thermostats.
(8) Airstream thermostats.
(9) Electric, low-limit duct thermostats.
(10) Electric, high-limit duct thermostats.
(11) Heating/cooling valve-top thermostats.

q. Humidistats: Duct-mounting and pneumatic duct-mounting type.

r. Actuators:
(1) Manufacturers:
(a) Belimo, Inc.
(b) Honeywell International, Inc.
(c) Bray, Inc.
(2) Electric motors.
(3) Electronic actuators.

s. Control Valves:
(1) Globe Valves:
(a) Manufacturers: Honeywell International, Inc.

(b) NPS 2 and Smaller: Class 125 bronze body, bronze trim, rising stem, renewable composition disc, and screwed ends with backseating capacity repackable under pressure.
(b) NPS 2-1/2 and Larger: Class 125 iron body, bronze trim, rising stem, plug-type disc, flanged ends, and renewable seat and disc.
(c) Internal Construction: Replaceable plugs and stainless-steel or brass seats.
(1.) Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom.
(2.) Double-Seated Valves: Balanced plug; cage trim provides seating and guiding surfaces for plugs on top and bottom.
(3.) Two-way Cartridge Globe Valves: Balanced plug; cage trim provides seating and guidelines surfaces for plugs on top. Honeywell international, Inc. V5852 or 63 Series.

(d) Sizing: 3-psig maximum pressure drop at design flow rate or the following:
(1.) Manufacturers; Price Industries, Inc.
(2) Two Position: Line size.
(2.) Two-Way Modulating: Either the value specified above or twice the load pressure drop, whichever is more.
(3.) Three-Way Modulating: Twice the load pressure drop, but not more than value specified above.

(e) Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.

(f) Close-Off (Differential) Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating of 150 percent of total system (pump) head for two-way valves and 100 percent of pressure differential across valve or 100 percent of total system (pump) head.

(2) Butterfly Valves:
200-psig, 150-psig maximum pressure differential, ASTM A 126 cast-iron or ASTM A 536 ductile-iron body and bonnet, extended neck, stainless-steel stem, field-replaceable EPDM or Buna N sleeve and stem seals.
(a) Body Style: Wafer, Lug or Grooved.
(b) Disc Type: Nickel-plated ductile iron, Aluminum bronze, or Elastomer-coated ductile iron.
(c) Sizing: 1-psig maximum pressure drop at design flow rate.

(3) Terminal Unit Control Valves (Heating Hot Water Reheat Systems Only): Bronze body, bronze trim, two or three ports as indicated, replaceable plugs and seats, and union and threaded ends shall be Honeywell zone valve V5862 or 63 series

(a) Rating: Class 125 for service at 125 psig and 250 deg F operating conditions.
(b) Sizing: 3-psig maximum pressure drop at design flow rate, to close against pump shutoff head.
(c) Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.

(4) Self-Contained Control Valves:
Bronze body, bronze trim, two or three ports as indicated, replaceable plugs and seats, and union and threaded ends.
(a) Rating: Class 125 for service at 125 psig and 250 deg F operating conditions.
(b) Thermostatic Operator: Liquid-filled integral sensor with remote adjustable dial.

t. Dampers: AMCA-rated, opposed-blade design, for standard-pressure and low-leak applications.
u. Air Supply:
(1) Tank: ASME storage tank.
(2) Refrigerated air dryers.
(3) Desiccant dryers.
(4) Pressure gages.
(5) Instrument pressure gages.
(6) Diaphragm control and instrument valves.
(7) Gage cocks.
(8) Relays.
(9) Switches.
(10) Pressure regulators.
(11) Particle filters.
(12) Combination filter/regulators.
(13) Airborne oil filters.
(14) Pressure relief valves.

23 09 93 Sequence of Operations for HVAC Controls

Design Standards:

1. The sequence of operations must define the manner and method by which HVAC equipment functions. The sequence of operation shall be designed to be implemented using the instrumentation and controls for HVAC systems specified on section 230900.

2. Sequence of operations shall be included on design drawings rather than on specifications.

3. Sequence of operations shall be accompanied by control diagrams and written description.

Product Standards:

Not applicable.

Performance Standards:

1. The sequence of operation must be capable to execute the actions to be done by all mechanical equipment and coordinate their interaction without deviations of the design intent.

23 11 13 Facility Fuel-Oil Piping

Design Standards:

1. Pressurized fuel oil piping must have an automatic leak detection method. Leak detection system shall meet the requirements of EPA.

2 Fuel-Oil piping corrosion protection shall be provided to lessen or prevent the deterioration of the piping system from exposure to its contents or its environment.

3. Pipe sizing should be based on the flow rate of the product, the allowable friction loss of the fluid through the system, and the fluid velocity.

4. Piping material chosen shall be compatible with the liquids being handled.

5. Pipe should be installed in a flat and level trench, far enough underground to prevent vehicular damage.

6. For pressurized piping, use a minimum of a 2-inch size.

7. Restraint and anchors for fuel-oil piping, ASTs, and equipment, shall be designed based on performance requirements.

8. Piping system shall contain valves to operate the system properly and to isolate the equipment in the event of an emergency.

9. Piping system in connection with pumps shall contain valves to properly control the flow of liquid both in normal operation and in the event of an emergency.

10. Fuel tanks shall be aboveground on-site tanks, protected with concrete filled bollards at new facilities. Comply with NFPA 58 for locations.
    a. Facilities requiring the replacement or relocation of fuel tanks, shall receive aboveground fuel tanks.
    b. New underground or relocated underground fuel oil tanks are not allowed.
    c. Locate fuel tanks as far as possible from student occupied areas.
    d. Aboveground fuel oil lines shall be painted.

Product Standards:

1. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.

2. Drawn-Temper Copper Tube: Comply with ASTM B 88, Type K

3. Annealed-Temper Copper Tube: Comply with ASTM B 88, Type K

Performance Standards:

1. The design, fabrication, assembly, testing, and inspection of piping system shall be suitable for the working pressures and structural stresses to be encountered by the piping system.

2. Maximum Operating-Pressure Ratings: 3-psig fuel-oil supply pressure at oil-fired appliances.

3. Piping must be tested hydrostatically at a pressure of 100 psig for a period of 30 minutes with no leakage allowed.

23 11 23 Facility Natural-Gas Piping

Design Standards:

1. Gas service available to students shall be provided with clearly labeled master emergency shut-offs.

2. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below sub grade under pavements and slabs.

3. Engineering plans shall show the proposed location of piping, the size of different branches, the various load demands, and the location of the point of delivery.

4. When additional appliances are being connected to a gas piping system, the existing piping shall be checked to determine whether it has adequate capacity.

5. Gas meter and regulators shall be located in ventilated spaces readily accessible for examination, reading, replacement, or necessary maintenance.

6. Gas piping in contact with earth or other material that could corrode the piping shall be protected against corrosion in an approved manner.

7. Piping in systems shall be run as directly as is practical from one point to another, with as few fittings as practical.

8. Prohibited Locations:
   a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
   b. Do not install natural-gas piping in solid walls or partitions.
   c. Gas lines shall not be installed in student residential areas.

d. Gas meter and regulators shall not be placed where they will be subjected to damage, such as adjacent to a driveway, under a fire escape, in public passages, halls, or coal bins, or where they will be subject to excessive corrosion or vibration.
e. Gas lines shall not be installed below slabs or in return air plenums.

9. Gas piping shall not be used as a grounding conductor or electrode.

10. Where a lighting protection system is installed, the bonding of the gas piping shall be in accordance with NFPA 780.

11. Gas piping installation shall meet all requirements of NFPA 54.

Product Standards:

1. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.

2. Corrugated, Stainless-Steel Tubing: Comply with ANSI/IAS LC 1.

3. Preferred manufacturers:
   a. OmegaFlex, Inc.
   b. Parker Hannifin Corporation; Parflex Division.
   c. Titeflex.
   d. Tru-Flex Metal Hose Corp.

4. Cast iron pipe shall not be used.

Performance Standards:

1. Minimum Operating-Pressure Ratings:
   a. Piping and Valves: 100 psig minimum unless otherwise indicated.

2. Gas piping system shall be of such size and so installed as to provide a supply of gas sufficient to meet the maximum demand and supply gas to each appliance inlet at not less than the minimum supply pressure required by the appliance.

23 11 26 Facility Liquefied-Petroleum Gas Piping

Design Standards:

1. Gas service available to students shall be provided with clearly labeled master emergency shut-offs.

2. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below sub-grade under pavements and slabs.

3. Engineering plans shall show the proposed location of piping, the size of different branches, the various load demands, and the location of the point of delivery.

4. When additional appliances are being connected to a gas piping system, the existing piping shall be checked to determine whether it has adequate capacity.

5. Gas piping in contact with earth or other material that could corrode the piping shall be protected against corrosion in an approved manner.

6. Piping in systems shall be run as directly as is practical from one point to another, with as few fittings as practical.

7. Prohibited Locations:
   a. Do not install gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
   b. Do not install gas piping in solid walls or partitions.
   c. Gas lines shall not be installed in student residential areas.
   d. Do not install gas piping below slabs or in return air plenums.

8. Gas piping shall not be used as a grounding conductor or electrode.

9. Where a lighting protection system is installed, the bonding of the gas piping shall be in accordance with NFPA 780.

10. All gas piping shall meet the requirements of NFPA 54.

Product Standards:

1. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.

2. Corrugated, Stainless-Steel Tubing: Comply with ANSI/IAS LC 1.

3. Preferred manufacturers:
   a. OmegaFlex, Inc.
   b. Parker Hannifin Corporation; Parflex Division.
   c. Titeflex.
   d. Tru-Flex Metal Hose Corp.

4. Cast iron pipe shall not be used.

Performance Standards:

1. Gas piping system shall be of such size and so installed as to provide a supply of gas sufficient to meet the maximum demand and supply gas to each appliance inlet at not less than the minimum supply pressure required by the appliance.

2. Minimum Operating-Pressure Ratings:
   a. Piping containing only vapor: 125 psig minimum unless otherwise indicated.
   b. For Piping Containing Liquid:
      (1) Piping between Shutoff Valves: 350 psig unless otherwise indicated.

(2) Piping Other Than Above: 250 psig unless otherwise indicated.
(3) Valves and Fittings: 250 psig unless otherwise indicated.

23 21 13 Hydronic Piping

Design Standards:

1. Piping shall conform to applicable ASTM standards.

Product Standards:

Piping Applications
1. Hot-water heating piping, aboveground, NPS 2 and smaller, shall be the following:
   a. Type L (B), drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
   b. Schedule 40 steel pipe; Class 150, malleable-iron fittings; and threaded joints.

2. Hot-water heating piping, aboveground, NPS 2-1/2 and larger, shall be the following:
   a. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.

3. Hot-water heating piping installed below ground and within slabs shall be the following:
   a. Type K annealed-temper copper tubing, wrought-copper fittings, and soldered joints. Use the fewest possible joints and offsets.

4. Chilled-water piping, aboveground, NPS 2 and smaller, shall be the following:
   a. Schedule 40 steel pipe; Class 150, malleable fittings and threaded joints.

5. Chilled-water piping, aboveground, NPS 2-1/2 and larger, shall be the following:
   a. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints
.
6. Chilled-water piping installed belowground and within slabs shall be either of the following:
   a. Schedule 40 steel pipe; Class 150, malleable-iron fittings; forged-steel flanges and flange fittings; and threaded joints. Piping shall be pre-insulated with 3” thick polyurethane with FRP or PVC jacket.

7. Makeup-water piping installed aboveground shall be the following:
   a. Type L (B), drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

8. Makeup-Water Piping Installed below ground and within Slabs: Type K, annealed temper copper tubing, wrought-copper fittings, and soldered joints. Use the fewest possible joints.

Performance Standards:

1. Hydronic piping components and installation provided shall be capable of withstanding minimum working pressure and temperature requirements according to the application.

2. Minimum working pressure and temperature requirements for hydronic piping components and installation are the following:
   a. Hot-Water Heating Piping: 150 psig at 200 deg F (93 deg C).
   b. Chilled-Water Piping: 150 psig at 200 deg F (93 deg C).
   c. Makeup-Water Piping: 100 psig at 150 deg F.

23 21 23 Hydronic Pumps

Design Standards:

1. Pumps shall be of a centrifugal type (End-Suction, Split-Case, Vertical In-line) and shall generally be selected to operate at 1750 RPM. Both partial load and full load must fall on the pump curve. The specified pump motors shall not overload throughout the entire range of the pump curve.

Product Standards:

1. Individual pumps serving variable flow systems with a head value exceeding 100 ft and motor exceeding 50 hp shall have controls and/or devices (such as variable speed control) that will result in pump motor demand of no more than 30% of design wattage at 50% of design water flow. Variable volume pumping shall be considered for all piping systems.

2. Preferred Manufacturers:
   a. Bell & Gossett
   b. Taco, Inc.
   c. Armstrong Pumps Inc.

Performance Standards:

1. The pump shall be selected to operate in the best efficiency region of the curve.

23 23 00 Refrigerant Piping

Design Standards:

1. Refrigerant piping shall comply with ASTM 88 Standard B280, ASHRAE 15, "Safety Code for Refrigeration Systems" and ASME B31.5, "Refrigeration Piping and Heat Transfer Components".

2. Refrigerant piping lines shall be the following according to the application:
   a. Suction Lines NPS 1-1/2 and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.
   b. Suction Lines NPS 2 to NPS 4 for Conventional Air-Conditioning Applications: Copper, Type L (B), drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.

c. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.
d. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type K or L (B), drawn-temper tubing and wrought-copper fittings with soldered joints.
e. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications:
   (1) NPS 1-1/2 and Smaller: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.
   (2) NPS 1-1/2 and Smaller: Copper, Type ACR L (B), drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.
   (3) NPS 2 to NPS 3: Copper, Type K (A), annealed- or drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.
   (4) NPS 4: Copper, Type K (A) or L (B), drawn-temper tubing and wrought-copper fittings with soldered joints.

3. Refrigerant piping shall be installed in accordance with ASHRAE standards. Refrigerant piping shall be insulated in accordance with ASHRAE Standard 90.1 6.4.4.1.3.

4. Nitrogen purging shall be provided during soldering. Piping shall be supported every 6-feet. A line size trap shall be provided every 25 feet of vertical lift.

Product Standards:

1. Preferred manufacturer for refrigerant piping: US Manufacturers

Performance Standards:

1. Line Test Pressure for Refrigerant R-134a:
   a. Suction Lines for Air-Conditioning Applications: 115 psig.
   b. Suction Lines for Heat-Pump Applications: 225 psig.
   c. Hot-Gas and Liquid Lines: 225 psig.

2. Line Test Pressure for Refrigerant R-410A:
   a. Suction Lines for Air-Conditioning Applications: 300 psig.
   b. Suction Lines for Heat-Pump Applications: 535 psig.
   c. Hot-Gas and Liquid Lines: 535 psig.

23 25 00 HVAC Water Treatment

Design Standards:

1. The water treatment for all hydronic systems shall be designed by a qualified specialist. The design system shall address the three aspects of water treatment: biological growth, dissolved solids and scaling, and corrosion protection.

2. The methods used to treat the systems' make-up water shall have prior success in existing facilities on the same municipal water supply and follow the guidelines outlined in ASHRAE Applications Handbook.

Product Standards:

1. The system shall operate with an injection pump transferring chemicals from solution tank(s) as required to maintain the conditions described. The chemical feed system shall have BACnet self-contained controls.

2. Preferred Manufacturers:
   a. Filtration Systems Division of Mechanical Mfg. Corporation
   b. Miami Filters LLC
   c. Ecolochem

Performance Standards:

1. The performance of the water treatment systems shall produce, as a minimum, the following characteristics; hardness: 0.00; iron content: 0.00; dissolved solids: 1,500 to 1,750 ppm; silica: 610 ppm or less; and a PH of 10.5 or above.

23 31 13 Metal Ducts

Design Standards:

1. Low-pressure supply ductwork shall be sized for a static pressure drop of 0.08 inch water gage per 100 feet up to 2500 cfm and for a velocity of 1200 fpm above 2500 cfm. Low-velocity return and exhaust ductwork shall be sized for a static pressure drop of 0.08 inch water gage per 100 feet up to 4000 cfm and for a velocity of 1000 fpm above 4000 cfm.

2. Medium and high pressure supply ductwork shall be sized for a static pressure drop of 0.3 inch water per 100 feet. Air velocity shall not exceed 2000 fpm.

3. Special duct systems such as exhaust from laboratory hoods shall be made of acid resistant construction and/or coatings.

4. Duct systems serving showers and other spaces of high humidity shall be of aluminum construction.

5. Specify on plans minimum SMACNA duct construction pressure classification for all systems.

Product Standards:

1. Duct leakage rates, construction, including sheet metal thicknesses, seam and joint construction, reinforcements and hangers and supports shall comply with SMACNA's "HVAC Duct Construction Standards- Metal and Flexible". Latest Edition.

23 31 19 HVAC Casings

Design Standards:

1. Factory-fabricated, field-assembled, double-wall casings shall be provided for HVAC equipment.

2. HVAC casing material shall comply with SMACNA's "HVAC Duct Construction Standards-Metal and Flexible," Chapter 6, "Equipment and Casings", for acceptable materials, material thicknesses, and casing construction methods. Casings shall be fabricated with more than 3-inch wg negative static pressure according to SMACNA's "Rectangular Industrial Duct Construction Standards." Casings with more than 2-inch wg positive static pressure may be fabricated according to SMACNA's "Rectangular Industrial Duct Construction Standards."

3. Double-wall, insulated, pressurized equipment casings shall be used. Casings shall consist of a solid, galvanized sheet steel exterior wall and solid, galvanized sheet steel interior wall with space between wall filled with insulation. Wall thickness shall be 2 inches. Sheet metal exterior and interior minimum wall thicknesses shall be 0.040 inch and 0.034 inch, respectively.

4. Access doors shall be fabricated as per SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," and according to pressure class of the plenum or casing section in which access doors are to be installed. Doors shall open against air pressure.

Product Standards:

1. Casing Preferred Manufacturers:
   a. Acoustical Surfaces, Inc.
   b. AeroSonics, Inc.; a division of TUTCO, Inc.
   c. CertainTeed Corp.; Insulation Group.
   d. CLEANPAK International.
   e. D&D Sound Control.
   f. IACL.
   g. Industrial Noise Control, Inc.
   h. McGill AirSilence LLC.
   i. SEMCO Incorporated.
   j. Vibro-Acoustics.

Performance Standards:

1. Static-Pressure Classes:
   a. Upstream from Fan(s): 2-inch wg.
   b. Downstream from Fan(s): 4-inch wg.

2. Acoustical Performance:
   a. NRC: 1.09 according to ASTM C 423.
   b. STC: 40 according to ASTM E 90.

3. Structural Performance:
   a. Casings shall be fabricated to withstand 133 percent of the indicated static pressure without structural failure. Wall and roof deflection at the indicated static pressure shall not exceed 1/8 inch per foot of width.
   b. Fabricate outdoor casings to withstand wind load of 150 lbf/sq. ft

23 33 00 Air Duct Accessories

Design Standards:

1. Air duct accessories provided shall be suitable for their intended use.

2. Air duct accessories shall comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems." Air duct accessories shall also comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated.

Product Standards:

1. Backdraft and Pressure Relief Dampers/ Barometric Relief Dampers Preferred Manufacturers:
   a. Air Balance Inc.; a division of Mestek, Inc.
   b. American Warming and Ventilating; a division of Mestek, Inc.
   c. Cesco Products; a division of Mestek, Inc.
   d. Duro Dyne Inc.
   e. Greenheck Fan Corporation.
   f. Lloyd Industries, Inc.
   g. Nailor Industries Inc.
   h. NCA Manufacturing, Inc.
   i. Pottorff; a division of PCI Industries, Inc.
   j. Ruskin Company.
   k. SEMCO Incorporated.
   l. Vent Products Company, Inc.

2. Manual Volume Dampers Preferred Manufacturers:
   a. Air Balance Inc.; a division of Mestek, Inc.
   b. American Warming and Ventilating; a division of Mestek, Inc.
   c. Flexmaster U.S.A., Inc.
   d. McGill AirFlow LLC.
   e. METALAIRE, Inc.
   f. Nailor Industries Inc.
   g. Pottorff; a division of PCI Industries, Inc.
   h. Ruskin Company.
   i. Trox USA Inc.
   j. Vent Products Company, Inc

3. Control Dampers Preferred Manufacturers:
   a. American Warming and Ventilating; a division of Mestek, Inc.

b. Arrow United Industries; a division of Mestek, Inc.
c. Cesco Products; a division of Mestek, Inc.
d. Duro Dyne Inc.
e. Flexmaster U.S.A., Inc.
f. Greenheck Fan Corporation.
g. Lloyd Industries, Inc.
h. M&I Air Systems Engineering; Division of M&I Heat Transfer Products Ltd.
i. McGill AirFlow LLC.
j. METALAIRE, Inc.
k. Metal Form Manufacturing, Inc.
l. Nailor Industries Inc.
m. NCA Manufacturing, Inc.
n. Ruskin Company.
o. Vent Products Company, Inc.
p. Young Regulator Company.

4. Fire Dampers Preferred Manufacturers:
a. Air Balance Inc.; a division of Mestek, Inc.
b. Arrow United Industries; a division of Mestek, Inc.
c. Cesco Products; a division of Mestek, Inc.
d. Greenheck Fan Corporation.
e. McGill AirFlow LLC.
f. METALAIRE, Inc.
g. Nailor Industries Inc.
h. NCA Manufacturing, Inc.
i. PHL, Inc.
j. Pottorff; a division of PCI Industries, Inc.
k. Prefco; Perfect Air Control, Inc.
l. Ruskin Company.
m. Vent Products Company, Inc.
n. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

5. Smoke Dampers Preferred Manufacturers:
a. Air Balance Inc.; a division of Mestek, Inc.
b. Cesco Products; a division of Mestek, Inc.
c. Greenheck Fan Corporation.
d. Nailor Industries Inc.
e. PHL, Inc.
f. Ruskin Company.

6. Combination Fire and Smoke Dampers Preferred Manufacturers:
a. Air Balance Inc.; a division of Mestek, Inc.
b. Cesco Products; a division of Mestek, Inc.
c. Greenheck Fan Corporation.
d. Nailor Industries Inc.
e. Ruskin Company.

7. Flexible Ducts Preferred Manufacturers:
   a. Flexmaster U.S.A., Inc.
   b. McGill AirFlow LLC.
   c. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

8. Duct Silencers Preferred Manufacturers:
   a. Dynasonics.
   b. Industrial Noise Control, Inc.
   c. McGill AirFlow LLC.
   d. Ruskin Company.

Performance Standards:

Duct accessories shall be designed for the following working conditions:

1. Backdraft and Pressure Relief Dampers:
   a. Maximum Air Velocity: 2000 fpm.
   b. Maximum System Pressure: 2-inch wg.

2. Barometric Relief Dampers:
   a. Maximum Air Velocity: 2500 fpm.
   b. Maximum System Pressure: 2-inch wg.

3. Fire Dampers:
   a. Closing rating in ducts up to 4-inch wg static pressure class and minimum 4000- fpm velocity.

4. Combination Fire and Smoke Dampers:
   a. Closing rating in ducts up to 4-inch wg (1-kPa) static pressure class and minimum 4000-fpm (20-m/s) velocity.

5. Flexible Ducts:
   a. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.
      (1) Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
      (2) Maximum Air Velocity: 4000 fpm.
      (3) Temperature Range: Minus 10 to plus 160 deg F.
      (4) Insulation R-value: Comply with ASHRAE/IESNA 90.1-2004.
   b. Insulated, Flexible Duct: UL 181, Class 1, black polymer film supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.
      (1) Pressure Rating: 4-inch wg positive and 0.5-inch wg negative.
      (2) Maximum Air Velocity: 4000 fpm.
      (3) Temperature Range: Minus 20 to plus 175 deg F.
      (4) Insulation R-Value: Comply with ASHRAE/IESNA 90.1-2004.
   c. Insulated, Flexible Duct: UL 181, Class 1, multiple layers of aluminum laminate supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.

(1) Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
(2) Maximum Air Velocity: 4000 fpm.
(3) Temperature Range: Minus 20 to plus 210 deg F.
(4) Insulation R-value: Comply with ASHRAE/IESNA 90.1-2004.

d. Insulated, Flexible Duct: UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.
(1) Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
(2) Maximum Air Velocity: 4000 fpm.
(3) Temperature Range: Minus 20 to plus 210 deg F.
(4) Insulation R-value: Comply with ASHRAE/IESNA 90.1-2004.

e. Insulated, Flexible Duct: UL 181, Class 0, interlocking spiral of aluminum foil; fibrous-glass insulation; aluminized vapor-barrier film.
(1) Pressure Rating: 8-inch wg positive or negative.
(2) Maximum Air Velocity: 5000 fpm.
(3) Temperature Range: Minus 20 to plus 250 deg F.
(4) Insulation R-value: Comply with ASHRAE/IESNA 90.1-2004.

23 34 23 HVAC Power Ventilators

Design Standards:

1. Select power ventilators to have the operation point at right side of the system curve.

2. Ratings for HVAC power ventilators shall be based on tests and procedures performed in accordance with AMCA Publication 211 and AMCA Publication 311 and comply with the requirements of the AMCA Certified Ratings Program.

3. Ceiling-Mounted Ventilators
Centrifugal fan (ceiling-mounted ventilator) shall be designed for installation in ceiling, wall, or concealed inline applications and shall include housing, fan wheel, grille, remote fan speed control, and accessories.

4. Centrifugal Roof Ventilators
Belt-driven or direct-drive centrifugal ventilators shall consist of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories (i.e., bird screens, dampers, roof curbs, etc.).

5. Utility Set Fans
Belt-driven, centrifugal fans shall consist of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and accessories (i.e., backdraft dampers, access doors, etc.).

6. Axial Roof Ventilators
Belt-driven or direct-drive, axial fans shall consist of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories (i.e., bird screens, dampers, roof curbs, etc.).

7. Up blast Propeller Roof Exhaust Fans
   Belt-driven or direct-drive propeller fans shall consist of housing, wheel, butterfly type discharge damper, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.

8. Centrifugal Wall Ventilators
   Belt-driven or direct-drive centrifugal wall ventilators shall consist of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and accessories (i.e., bird screens, dampers, etc.).

9. Any fan whose rotational speed is not controlled by a variable frequency drive shall be equipped with a speed controller.

Product Standards:

1. All air moving devices shall be tested in accordance to ANSI/ASHRAE Standard 51 (ANSI/ACMA Standard 210)

2. The specified power ventilator motors shall not overload throughout the entire range of the system curve.

3. Preferred Manufacturers:
   a. Loren Cook
   b. Greenheck

Performance Standards:

1. Fans shall be factory fabricated and assembled, factory tested, and factory finished with indicated capacities and characteristics. Fans and shafts shall be statically and dynamically balanced. *Fans are to be* designed for continuous operation at the maximum rated fan speed and motor horsepower.

2. Fans and ventilators to be installed outdoors shall be designed to withstand a wind load of 150 lbf/sq. ft

23 36 00 Air Terminal Units

Design Standards:

1. Terminal units shall be pressure independent.

2. Terminal units shall be selected so that design air volume is approximately three-quarters of the terminal box's maximum capacity. Air terminal units shall be single-duct, shut-off type.

3. Volume dampers in terminal units shall be located at least 1.6 ft from the closest diffuser and the use of grille mounted balance dampers shall be restricted except for those applications with accessibility problems.

4. Terminal units shall be equipped with supply air temperature sensor and air flow measuring device.

Product Standards:

1. Preferred Manufacturers:
   a. Titus
   b. Trane
   c. Envirotec
   d. Price

Performance Standards:

1. Terminal units shall provide the minimum and maximum air flows indicated on design documents within 10%.

23 37 13 Diffusers, Registers, and Grilles

Design Standards:

1. Air Distribution Terminal Devices shall be designed and selected so as to integrate well into the architectural features of the ceilings, walls and soffits.

Product Standards:

1. Preferred Manufacturers
   a. Titus
   b. Price
   c. Anemostat
   d. Krueger

Performance Standards:

1. Design parameters to be considered are adequate “throw”, avoidance of “drafts”, sufficient air quantities for the space covered, and maximum separation between supply and return terminals. The following are basic terminal devices suitable for most applications:
   a. Rectangular and square ceiling diffusers.
   b. Ceiling linear diffuser, single or multiple slots.
   c. Sidewall register.
   d. Louvered or “egg-crate” ceiling return grille
   e. Ceiling linear return, single or multiple slots.
   f. Sidewall return grille.

2. Diffusers, registers and grilles used in variable-air-volume flow air distribution systems shall be suitable for this use..

3. All supply air grilles, registers and ceiling outlets shall be aluminum.

4. All sidewall supply grilles and registers shall be double deflection type.

5. Multi-blade volume control dampers which are adjustable by removable key from the front of each outlet shall be provided for all air distribution devices.

23 37 23 HVAC Gravity Ventilators

Design Standards:

1. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with architect and structural engineer.

2. Neck velocities shall not exceed 700 feet per minute.

3. Gravity ventilators shall be provided with bird screens.

Product Standards:

1. Preferred Manufacturers:
   a. Carnes
   b. Greenheck
   c. JencoFan
   d. Loren Cook

Performance Standards:

1. HVAC gravity ventilators shall withstand the effects of gravity loads and wind loads within limits and under conditions indicated without permanent deformation of ventilator components, noise or metal fatigue caused by ventilator blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.

2. HVAC gravity ventilators shall also allow for thermal movements from ambient and surface temperature changes, without buckling, opening of joints, overstressing of components, failure of connections, or other detrimental effects. Temperature change (range) to be considered shall be 120 deg F, ambient and 180 deg F, material surfaces.

23 41 00 Particulate Air Filtration

Design Standards:

1. Particulate air filtration shall be provided in air-handling units. A pre-filter and a final filter shall be provided upstream of the air-handling unit cooling and heating coils. Fibrous shedding of the filter media shall not exceed levels prescribed by ASHRAE Standard 52.2-2007. 0.5 percent of the design supply airflow rate shall be considered as the maximum bypass leakage air around the filter media in the design of filter racks. A maximum face velocity of 500 fpm shall be used for filter sizing. The filter housing and air-handling unit components downstream of the filter housing

shall not be internally lined with fibrous insulation. An externally insulated sheet metal housing or double-wall construction may be used. Fan pressure requirements shall be determined using the filter change out pressure drop. In cases where building use or occupancy generate airborne particles, vapors or gases that exceed typical concentrations special filtration components shall be used for the supply and return air. Alternatively, dedicated exhaust systems may be used to control the contaminants.

2. Panel filters have a low pressure drop, low cost, good efficiency on lint and larger particles (5 µm and larger), but low efficiency on normal atmospheric dust. This type of filter is commonly used as a pre-filter for higher efficiency filters. UL 900 Class 1 and Class 2 pleated panel features may be used. The filter media shall be cotton and synthetic fibers coated with nonflammable adhesive with a VOC content of 80 g/L or less. Media shall be bonded to frame to prevent air bypass and coated with an antimicrobial agent. Separators shall be bonded to the media to maintain pleat configuration. Welded wire grid shall be on downstream side to maintain pleat. Members on upstream and downstream sides shall be supported to maintain pleat spacing.

3. UL 900 Class 1 and 2 v-bank cell filters may also be used. V-bank cell filters consist of fibrous material constructed so individual pleats are maintained in tapered form under rated-airflow conditions by flexible internal supports. Filter media frames shall be galvanized steel and mounting frames shall be welded galvanized steel with gaskets and fasteners.

Product Standards:

1. Filter Preferred Manufacturers:
   a. AAF International.
   b. Airguard.
   c. Camfil Farr.
   d. Columbus Industries, Inc.
   e. CRS Industries, Inc.; CosaTron Division.
   f. D-Mark.
   g. Filtration Group.
   h. Flanders-Precisionaire.
   i. Koch Filter Corporation.
   j. Purafil, Inc.
   k. Research Products Corp.
   l. Tri-Dim Filter Corporation.

Performance Standards:

1. Prefilters shall have a MERV of 8, while final filters shall have a MERV of 13 as per ASHRAE Standard 52.2- 2007.

2. Maximum or rated face velocity for pleated panel filters shall be 300 fpm. The filter efficiency shall be 90 percent on particles 20 micrometers and larger at 500 fpm.

3. Maximum or rated face velocity for v-bank cell filters shall be 500 fpm.

23 41 33 High-Efficiency Particulate Filtration

Design Standards:

1. High-efficiency particulate air (HEPA) filters and ultra low-penetration air (ULPA) filters are used for clean room and toxic-particulate applications.

2. The following high-efficiency particulate filtration components may be used:
   a. HEPA rigid-cell box filters
   b. HEPA V-bank cell filters
   c. HEPA filter diffusers
   d. HEPA filter fan modules
   e. ULPA filters
   f. 95 percent DOP filters

Product Standards:

1. Preferred Manufacturers:
   a. AAF International
   b. Airguard
   c. Camfil Farr Co
   d. Flanders-Precisionaire

Performance Standards:

1. HEPA and ULPA filters operate at duct velocities near 250 fpm, with resistance rising from 0.5 to more than 2.0 in. of water over the filter service life.

23 57 00 Heat Exchangers for HVAC

Design Standards:

1. Shell-and-tube or plate heat exchangers shall be used.

2. Shell-and-tube heat exchangers shall comply with "TEMA (Tubular Exchanger Manufacturers Association) Standards". Heat exchanger length, surface area, shell diameter, number of passes and quantity of heat exchanged shall be specified. For water-to water heat exchangers water flow rate, pressure drop, inlet/outlet temperatures, fouling factor and inlet/outlet sizes shall be specified.

3. Plate heat exchangers shall consist of frames with sufficient capacity to accommodate 20 percent additional plates. Plate heat exchangers selected shall have a 0.024 inch thick plate of Type 304 stainless steel. Heat exchanger surface area, number of plates, number of passes and quantity of heat exchanged shall be specified. For water-to water heat exchangers water flow rate, pressure drop, inlet/outlet temperatures, fouling factor and inlet/outlet sizes shall be specified.

4. Heat exchanger piping connections shall be fabricated of materials compatible with heat exchanger shell. Heat exchanger piping connections shall be consistent with the following according to pipe size:
   a. NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.
   b. NPS 2-1/2 (DN 65) and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges and according to ASME B16.24 for copper and copper-alloy flanges.

Product Standards:

1. Preferred Manufacturers:
   a. Armstrong
   b. TACO Incorporated
   c. Bell & Gossett
   d. Alpha-Laval

23 64 16 Centrifugal Water Chillers

Design Standards:

1. Chiller full load COP and IPLV/NPLV shall be included on drawings. Chiller efficiencies shall meet or exceed the minimum requirements of ASHRAE 90.1. Chillers shall be rated in accordance with the latest edition of ARI Standard 550/590 and shall conform to the latest edition of ASHRAE 15 Safety Code. IPLU / NPLU ratings and condenser water relief shall be based on typical design temperatures encountered in South Florida.

2. Refrigerant shall be R-134a.

3. Compressors: Hermetic drive centrifugal compressor type is preferred over open drive compressor type.

4. Evaporator and Condenser:
   Chiller capacity selection shall be based on a water side fouling factor of 0.00010 in the evaporator tubes and 0.00025 in the condenser tubes. Evaporator and condenser water pressure drops shall not exceed those scheduled on the Drawings.
   Evaporator and condenser connections shall be flange pipe connections.

5. Controls:
   Provide stand-alone direct digital controller for each chiller. Controller shall be microprocessor-based and BACnet compatible with factory packaging and testing of required control components for reliable equipment operation.
   The chiller control panel shall provide control of chiller operation and monitoring of chiller sensors, actuator, relays and switches. The panel shall be a complete system for stand-alone chiller control and include controls to safely and efficiently operate the chiller. The panel shall be equipped with building automation system (BAS) interface.

6. Safeties: The chiller control panel shall monitor such safeties as motor starting and running, time between compressor motor starts, low chilled water temperature, high condenser, refrigerant pressure, low evaporator refrigerant temperature, evaporator and condenser water flows, low oil pressure, high oil temperature, and proper operation of unit controls and sensors.

7. Variable Frequency Drive: Provide where scheduled on Drawings. Justify the use of variable frequency drives by means of a Life-Cycle Cost Analysis.

8. Refrigerant Monitor: Provide calibrated, refrigerant monitor for specific refrigerant used, capable of detecting concentrations of 10 ppm for low level detection. Comply with applicable requirements of edition in effect of ASHRAE 15.

9. Chiller Purge System: Not required for chillers sing R-134a refrigerant.

10. Pump-out System:
    a. Units operating with refrigerant having positive pressure at 75 degrees F (HFC- 134a, etc.) shall have the capability of storing the entire refrigerant charge in the condenser or shall be provided with a pump-out system for each machine.
    b. Pump-out systems shall be complete with transfer pump, condensing unit, and tank constructed in accordance with ASME Code for Unfired Pressure Vessels bearing the National Board stamp.
    c. Pump-out systems shall be supplied and warranted by the chiller manufacturer.

Product Standards:

1. Preferred Manufacturers:
    a. Trane
    b. York
    c. Carrier

2. Chillers using Hydro chlorofluorocarbon (HCFC) type refrigerants are not acceptable.

3. Specify that a factory performance test for each chiller under full load and part load conditions in an ARI certified test facility. The manufacturer shall supply a certified test report to confirm performance as specified.

4. Notify the Owner fourteen (14) calendar days in advance to witness the performance test. Include in the bid price, all travel expenses for two (2) Owner's representatives to travel to testing facility to witness the performance test.

5. A certified test report of all data shall be submitted to the Engineer prior to Substantial Completion. An officer of the manufacturer's company shall sign the factory certified test report. Preprinted certification will not be acceptable; certification shall be in the original.

Performance Standards:

1. The selected chiller shall comply with the project sound levels requirements while running at full capacity.

2. The chiller shall perform at partial load according to ARI 550/590.

3. Efficiencies shall be as follow, comply with ASHRAE 90.1

23 64 23 Scroll Water Chillers

Design Standards:

1. Comply with ARI 590 Certification program for scroll chillers.

2. Chiller controls shall be base on BACNET protocol of communication.

3. Refrigerant shall be R-134a or R-410a.

4. Controls: Provide stand-alone direct digital controller for each chiller. Controller shall be microprocessor-based and BACnet compatible with factory packaging and testing of required control components for reliable equipment operation.

5. The chiller control panel shall provide control of chiller operation and monitoring of chiller sensors, actuator, relays and switches. The panel shall be a complete system for stand-alone chiller control and include controls to safely and efficiently operate the chiller. The panel shall be equipped with building automation system (BAS) interface.

6. Safeties: The chiller control panel shall monitor such safeties as motor starting and running, time between compressor motor starts, low chilled water temperature, high condenser, refrigerant pressure, low evaporator refrigerant temperature, evaporator and condenser water flows, low oil pressure, high oil temperature, and proper operation of unit controls and sensors.

Product Standards:

1. Preferred Manufacturers:
   a. Trane
   b. York
   c. Carrier

2. Chillers using Hydro chlorofluorocarbon (HCFC) type refrigerants are not acceptable.

3. Specify that a factory performance test for each chiller under full load and part load conditions in an ARI certified test facility. The manufacturer shall supply a certified test report to confirm performance as specified.

4. Notify the Owner fourteen (14) calendar days in advance to witness the performance test. Include in the bid price, all travel expenses for two (2) Owner's representatives to travel to testing facility to witness the performance test.

5. A certified test report of all data shall be submitted to the Engineer prior to Substantial Completion. An officer of the manufacturer's company shall sign the factory certified test report. Preprinted certification will not be acceptable; certification shall be in the original.

Performance Standards:

1. The selected chiller shall comply with the project sound levels requirements while running at full capacity.

2. The chiller shall perform at partial load according to ARI 550/590.

3. Efficiencies shall be as follow, comply with ASHRAE 90.1

23 64 26 Rotary-Screw Water Chillers

Design Standards:

1. Comply with ARI 590 Certification program for rotary-screw water chillers.

2. Chiller controls shall be base on BACNET protocol of communication.

3. Refrigerant shall be R-134a or R-410a.

4. Controls: Provide stand-alone direct digital controller for each chiller. Controller shall be microprocessor-based and BACnet compatible with factory packaging and testing of required control components for reliable equipment operation.
5. The chiller control panel shall provide control of chiller operation and monitoring of chiller sensors, actuator, relays and switches. The panel shall be a complete system for stand-alone chiller control and include controls to safely and efficiently operate the chiller. The panel shall be equipped with building automation system (BAS) interface.

6. Safeties: The chiller control panel shall monitor such safeties as motor starting and running, time between compressor motor starts, low chilled water temperature, high condenser, refrigerant pressure, low evaporator refrigerant temperature, evaporator and condenser water flows, low oil pressure, high oil temperature, and proper operation of unit controls and sensors.

Product Standards:

1. Preferred Manufacturers:
   a. Trane
   b. York
   c. Carrier

2. Chillers using Hydro chlorofluorocarbon (HCFC) type refrigerants are not acceptable.

3. Specify that a factory performance test for each chiller under full load and part load conditions in an ARI certified test facility. The manufacturer shall supply a certified test report to confirm performance as specified.

4. Notify the Owner fourteen (14) calendar days in advance to witness the performance test. Include in the bid price, all travel expenses for two (2) Owner's representatives to travel to testing facility to witness the performance test.

5. A certified test report of all data shall be submitted to the Engineer prior to Substantial Completion. An officer of the manufacturer's company shall sign the factory certified test report. Preprinted certification will not be acceptable; certification shall be in the original.

Performance Standards:

1. The selected chiller shall comply with the project sound levels requirements while running at full capacity.

2. The chiller shall perform at partial load according to ARI 550/590.

3. Efficiencies shall be as follow, comply with ASHRAE 90.1.

23 65 00 Cooling Towers

Design Standards:

1. All cooling towers shall be factory fabricated vertical discharge, induced draft counter flow type. The manufacturers shall comply with CTI testing requirements and make sure that their equipments are rated for minimum hurricane loads of 125 psf.

2. The cooling tower(s) shall be installed on steel structural support in accordance with manufacturer's installation recommendations

3. No modular cooling towers are acceptable.

Product Standards:

1. Acceptable manufactures are:
   a. Marley
   b. BAC
   c. Evapco
   d. American Cooling Towers

2. Construction shall be all stainless steel.

3. Basin Sections:
   a. Provide cold water basin with side outlet connections consisting of suction, overflows, and drain piping.

b. Condenser water outlet connections with a clog resistant, lift out strainer with perforated openings sized smaller than spray nozzle orifices, mounted in assemble with an anti-cavitations device.

4. Fan Sections:
   a. Provide ultra low noise fans.
   b. Provide single fan propeller type with corrosion resistant cast aluminum blades, adjustable pitch, individually attached to a cast aluminum or cast iron hub.
   c. Provide heavy gauge hot dipped galvanized wire grill type fan guard over fan cylinder.
   d. Provide fan with vibration switch to de-energize fan in the event of excessive vibration.

5. Fan Bearings
   a. Heavy duty roller type bearings integral with gear reducer.

6. Fan Drives
   a. Fan shall be driven through helical gear reducer. Gear reducer shall have synthetic rubber oil seals and shall be designed to require oil changes on five year intervals. Speed reducers employing pulleys and belts shall not be acceptable unless manufacturer warrants such speed reducing equipment to be maintenance free for a five (5) year period.

7. Fan Motor
   a. Motor(s) shall be TEFC, 1.15 service factor, variable torque, and specially insulated for cooling tower duty. Motor shall operate in the shaft-horizontal position and nameplate horsepower shall not be exceeded at design operation.
   b. All cooling towers shall have variable speed driven fans.

8. Tower fill and drift eliminators
   a. Tower fill shall be lightweight and manufactured of non-corrosive material.
   b. Drift eliminators shall be two-pass manufactured of non-corrosive honeycomb type material supported in galvanized steel framing. Maximum allowable drift loss shall be less than 0.2 percent of the water circulated.

Performance Standards:

1. The cooling towers shall be designed for incoming water at 95°F degrees. Leaving water temperature shall be at least 10°F degrees lower.

2. Bearings shall be provided for a minimum of 75,000 hours of operation.

3. The drift rate shall not exceed 0.005% of the circulating water rate.

4. The cooling tower shall be provided with a Five years total tower warranty.

23 72 00 Air-To-Air Energy Recovery Equipment

Design Standards:

1. Design documents shall include summer and winter performance of energy recovery equipment including entering and leaving dry bulb and wet bulb temperatures, and energy recovery effectiveness.

2. Coordinate with other disciplines to ensure provisions for maintenance including a nearby hose bibb.

3. Insulation shall comply with NFPA 90A requirements for flame spread and smoke generation.

4. Unit cabinet and exterior components shall be tested and certified weatherproof.

5. Provide filters for every air intake. Filters shall be disposable.

6. All electrical components, devices, and accessories listed and labeled as defined in NFPA 70 Article 100 by a testing agency shall be acceptable to authorities having jurisdiction and shall be marked for intended use.

Product Standards:

1. Manufacturer[s]: Subject to compliance with requirements, provide units by one of the following:
   a. AnnexAir
   b. Des Champs
   c. Semco
   d. Venmar Ventilation

Performance Standards:

1. Manufacturer shall provide an 18-month warranty on all parts and labor, and a 5-year on the enthalpy wheel excluding labor.

23 73 13 Modular Indoor Central-Station Air-Handling Units

Design Standards:

1. The minimum wall thickness for modular units shall be 2". The minimum wall thickness for custom units with fiberglass insulation shall be 4", except 2" foam insulated panels are permitted if such panels match the performance of 4" thick fiberglass insulated panels.

2. For units above 10,000 CFM, each access section shall be illuminated.

3. Drain pans shall be designated as above floor type. Avoid floor recessed drain pans due to the difficulty of replacement. Drain pans shall be stainless steel. Plastic drain pans are acceptable in units of less than 2000 CFM. Drain pans shall be sloped.

4. Access sections shall be provided to allow up and down stream access to every unit component. For example, an access module shall be provided between each heating coil and cooling coil section; both the air entering and air leaving side of each coil shall be visible for inspection. The designer must accommodate these access sections when fitting units into the available space.

5. For large custom and modular units (> 20,000 CFM), in particular those with a large outside air component, consider (with the NSU Design Coordinator) providing an access section between the pre and final filters of adequate size to allow the final filters to be replaced from the upstream side without removing the pre-filters. As an alternative to the above, a hinged pre-filter section may be specified. For hinged pre-filter configurations, also specify a gap between the pre-filter and final filter frames to allow a static pressure tip to be installed so that a separate pressure drop reading may be taken across the pre and final filter banks.

6. Hinged access doors are required in each access section.

7. Maximum face velocities shall be based on any future capacity allowance for the AHU.

8. For units 10,000 CFM or greater, coil tracks and individual coil access panels shall be specified.

9. Coils shall have a maximum fin spacing of 10 FPI. When this criterion cannot be met, provide two coils piped in a series arrangement.

10. When multiple coils are stacked vertically, each coil in the stack shall be equipped with a balancing valve.

11. Units shall be provided with ultra violet section with access panels.

12. Units shall include pre-filters and final filters. Except in very small, non-critical units. Filters shall be disposable.

13. Limit fans speeds to 1200-1400 RPM.

14. Forward curved fans shall not be specified accept when air foil or backward inclined or plenum fans are available. When plenum fans are utilized, specify a “guard cage” around the fan for safety. The impacts on fan performance of such cages as well as impacts from any inlet mounted back draft dampers shall be evaluated when selecting such fans. Specify multiple direct drive, VFD controlled, plenum fans whenever possible.

Product Standards:

1. Preferred Manufacturers:
   a. Trane
   b. York
   c. Carrier

Performance Standards:

1. Units casing shall be leak free, as well as the units coil.

2. The unit shall deliver the specified airflow (+/-10%) once installed.

3. Submittal data shall include certified sound power data for all air handling units for review and approval. Submit ratings in the eight-octave bands for radiated casing, discharge supply opening and discharge return opening sound power levels. AHU's shall not exceed the following sound power levels.

23 74 13 Packaged, Outdoor, Central-Station Air-Handling Units

Design Standards:

1. Consult the Design Professional and the Nova Southeastern University to determine if a custom paint color or screening is required.

2. Design documents shall require unit a factory roof curb to be included. Whenever units are to be installed above sound and/or vibration sensitive areas, specify insulated roof curbs with vibration isolation base rails.

3. The minimum wall thickness for modular units shall be 2". The minimum wall thickness for custom units with fiberglass insulation shall be 4", except 2" foam insulated panels are permitted if such panels match the performance of 4" thick fiberglass insulated panels.

4. Units shall meet Florida Building Code requirements for outdoor equipment wind ratings.

5. For units above 10,000 CFM, each access section shall be illuminated.

6. Drain pans shall be designated as above floor type. Avoid floor recessed drain pans due to the difficulty of replacement. Drain pans shall be stainless steel. Plastic drain pans are acceptable in units of less than 2000 CFM. Drain pans shall be sloped.

7. Access sections shall be provided to allow up and down stream access to every unit component. For example, an access module shall be provided between each heating coil and cooling coil section; both the air entering and air leaving side of each coil shall be visible for inspection. The designer must accommodate these access sections when fitting units into the available space.

8. For large custom and modular units (> 20,000 CFM), in particular those with a large outside air component, consider (with the Nova Southeastern University) providing an access section between the pre and final filters of adequate size to allow the final filters to be replaced from the upstream side without removing the pre-filters. As an alternative to the above, a hinged pre-filter section may be specified. For hinged pre-filter configurations, also specify a gap between the pre-filter and final filter frames to allow a static pressure tip to be installed so that a separate pressure drop reading may be taken across the pre and final filter banks.

9. Hinged access doors are required in each access section.

10. Maximum face velocities shall be based on any future capacity allowance for the AHU.

11. For units 10,000 CFM or greater, coil tracks and individual coil access panels shall be specified.

12. Coils shall have a maximum fin spacing of 10 FPI. When this criterion cannot be met, provide two coils piped in a series arrangement.

13. When multiple coils are stacked vertically, each coil in the stack shall be equipped with a balancing valve.

14. Units shall be provided with ultra violet section with access panels.

15. Units shall include pre-filters and final filters. Except in very small, non-critical units. Filters shall be disposable.

16. Limit fans speeds to 1200-1400 RPM.

17. Forward curved fans shall not be specified when air foil or backward inclined or plenum fans are available. When plenum fans are utilized, specify a "guard cage" around the fan for safety. The impacts on fan performance of such cages as well as impacts from any inlet mounted back draft dampers shall be evaluated when selecting such fans. Specify multiple direct drive, UFD controlled, plenum fans whenever possible.

Product Standards:

1. Preferred Manufacturers:
   a. Trane
   b. York
   c. Carrier

Performance Standards:

1. Units casing shall be leak free, as well as the units coil.

2. The unit shall deliver the specified airflow (+/-10%) once installed.

3. Submittal data shall include certified sound power data for all air handling units for review and approval. Submit ratings in the eight-octave bands for radiated casing, discharge supply opening and discharge return opening sound power levels.

23 74 33 Packaged, Outdoor or Rooftop Air Conditioning Units

Design Standards:

1. Packaged unit controls shall be base on BACNET protocol of communication.

2. Refrigerant shall be R-410a or equal. The units, completely factory assembled and tested, piped, internally wired, shall be fully charged with refrigerantR-410A (or equal), compressor oil and shipped in one piece.

3. Design documents shall require unit a factory roof curb to be included. Whenever units are to be installed above sound and/or vibration sensitive areas, specify insulated roof curbs with vibration isolation base rails.

4. Exterior surfaces of unit shall be phosphatized, zinc-coated steel (1.25 oz. per square foot minimum), with baked enamel finish. Screws shall be coated with zinc-plus-zinc chromate and with neoprene washers where sealing is required.

5. Hinged access doors shall provide access to control components, filters, outside/return air dampers, evaporator coil, and supply and exhaust fan sections. Access doors and removable panels shall be double wall construction with 2 lb density insulation sandwiched between galvanized steel panels and complete with neoprene gaskets.

6. Drain shall be provided on each side of the evaporator section. Drain pans shall be stainless steel, sloped.

7. Units serving variable air volume air distribution systems shall be suitable for their intended use and shall be equipped with variable frequency drives to modulate supply fan speeds. Units serving variable air volume systems shall be equipped with compressors that are capable of modulating between 10% and 100% of cooling capacity. Units shall be provided with hot gas bypass.

8. Obtain approval from Nova Southeastern University whenever a packaged variable air volume system that uses a change-over bypass is intended.

9. If applicable, for building air relief, require a factory installed exhaust fan and required dampers.

10. Filters shall be disposable.

Product Standards:

1. Preferred manufacturers:
   a. Trane
   b. AAON
   c. Carrier
   d. York

Performance Standards:

1. Warranty Period for Compressors: Five years from date of Substantial Completion.

2. Warranty Period for Heat Exchangers: Ten years from date of Substantial Completion.

23 81 13 Packaged Terminal Air-Conditioners

Design Standards:

1. The following packaged terminal air conditioner configurations may be used if suitable for their intended use:
   a. Through-the-wall and freestanding air conditioners.
   b. Cooling-only units.
   c. Heat-pump units.
   d. Cooling units with electric heat.
   e. Cooling units with hydronic heat.
   f. Cooling units with indirect-fired gas heat.

2. Packaged terminal air-conditioners are typically used to provide total cooling functions for a room or zone and are specifically for through-the-wall installation.

3. Packaged terminal air-conditioners shall be factory-assembled and tested, self-contained units with room cabinet, electric refrigeration system and temperature controls. Unit shall be fully charged with refrigerant R-410A and filled with oil. Unit shall have a cord-connected or hardwired chassis.

4. Unit refrigeration system shall consist of a direct-expansion indoor coil with capillary restrictor and hermetically sealed scroll compressor with vibration isolation and overload protection. Indoor and outdoor coils shall consist of seamless copper tubes mechanically expanded into aluminum fins with capillary tube distributor on indoor coil.

5. Drain pan construction and connections shall comply with ASHRAE 62.1.

6. Filters shall be disposable.

Product Standards:

1. Preferred Manufacturers:
   a. Carrier
   b. ClimateMaster
   c. General Electric
   e. Trane

Performance Standards:

1. Packaged terminal air-conditioners shall comply with applicable requirements in ASHRAE 62.1, and ASHRAE 90.1.

23 81 23 Computer-Room Air-Conditioners

Design Standards:

1. The units (CRAC Units) dedicated to serve computer rooms shall be independent from other systems. Cross connections with other systems shall be provided for back-up purposes. Units shall communicate to BAS via BACnet.

2. Redundancy on computer room air conditioning systems shall be provided to compensate for failures and maintenance without reducing the required cooling capacity.

3. Where Chilled water is available provide dual coil CRAC Units (Chilled water and DX)

4. Designer shall require CRAC units with humidifiers whenever the anticipated relative humidity (based on psychometric analysis) is below 30%.

5. Whenever the heat dissipation density from computer equipment is unreasonably high, consider using in-rack cooling systems as opposed to air distribution systems to address the equipment loads. However, even when in-rack cooling systems are present, CRAC units are required to address loads from the building envelope, lighting, occupants, UPS and other computer equipment not contained in racks.

6. Obtain approval from university authorities for the main cooling source of any in-rack cooling system.

7. CRAC units, as well as any powered component of an in-rack cooling system shall be included in the emergency generator power.

8. Filters shall be disposable.

Product Standards:

1. Preferred manufacturers:
   a. Liebert Corporation
   b. APC

2. Computer Room Air Conditioning Units shall be built and tested in accordance with ANSI/ASHRAE Standard 127.

Performance Standards:

1. CRAC Units shall be capable to overcome the computer room load on a year round 24/7 schedule and maintain a maximum temperature of 70°F and relative humidity between 30% and 50%.

2. Units shall comply with applicable requirements in ASHRAE 62.1,and ASHRAE 90.1.

23 81 26 Split-System Air-Conditioners

Design Standards:

1. Split-system air conditioners shall provide sufficient capacity to cool the proposed space or building. Split-system air-conditioning units consist of separate evaporator-fan and compressor-condenser components. Units shall utilize refrigerant R-410.

Product Standards:

1. Preferred Manufacturers:
   a. Trane
   b. Carrier
   d. York

Performance Standards:

1. Units shall comply with applicable requirements in ASHRAE 62.1 and ASHRAE 90.1.

23 82 16 Air Coils

Design Standards:

1. Water, and refrigerant coils selected shall be tested and rated according to ARI 410 and ASHRAE 33.

Product Standards:

1. Preferred Manufacturers:
   a. Aerofin Corporation
   ~~b.~~ Carrier
   c. Trane.
   d. USA Coil & Air

Performance Standards:

1. Coils shall be suitable for their intended use and shall provide the performance specified in design documents without unwanted variations.

23 82 19 Fan Coil Units

Design Standards:

1. Fan coil units shall be factory-packaged and tested according to ARI 440, ASHRAE 33, and UL 1995.

2. Coordinate finishes of exposed units with architects and university authorities.

Product Standards:

1. Preferred Manufacturers:
   a. Carrier
   b. International Environmental Corporation
   d. Trane
   e. York

Performance Standards:

1. Units shall comply with applicable requirements in ASHRAE 62.1and ASHRAE 90.1.

2. Units shall be provided with three row cooling coils, minimum.

END OF DIVISION 23.

DIVISION 26 ELECTRICAL

26.1 General Requirements

This chapter identifies criteria for the design of electrical systems in Nova Southeastern University buildings with the purpose of establishing minimum standards to be used as a basis of design for Nova Southeastern University (NSU) Buildings at the Main Campus, Fort Lauderdale, Florida. NSU experiences with various materials, products and installations have led to the selections, products and practices noted under this Division 23. The electrical systems/products provided under this division must be selected to provide a work environment for the occupants in a sustainable and reliable design. In some cases qualitative standards are cited by name. It is the intention that the name/items(s) be incorporated in the project. In such cases Nova Southeastern University maintain "in-house" expertise, parts and maintenance stock to service the items indicated. Further, it is in the best interest of Nova Southeastern University to have consistency if only from the standpoint of sheer logistics of maintaining and supplying it many buildings. The electrical systems shall support all the equipments and accessories from other disciplines systems as required, as well as all systems necessary for the building users in a sustainable and reliable fashion.

The electrical system products must be designed to comply with the following objectives:

1. Sustainable Design and products under the criteria to meet LEED "silver" standards as a minimum to reduce the total building energy consumption.
2. Reflectivity for energy conservation.
3. Longevity.
5. Users comfort.
6. Easy of maintenance.
7. Compatibility with all adjacent materials both new and existing.
8. Solutions with the best value considering a life cycle cost analysis to account for total project cost.

These objectives are in line with the objectives of all Divisions and should be coordinated with requirements in Division 1 Section "SUSTAINABLE DESIGN REQUIREMENTS."

These objectives are in line with all Divisions and should be coordinated with all disciplines in a holistic way.

Electrical systems shall provide whenever possible enough capacity for future additions or renovations and allow modifications to be made in one area without causing major disruptions in other areas of the facility. Electrical systems shall provide ample capacity for increased load concentrations in the future as described in section 26.3 It is the goal of Nova Southeastern University to build facilities equipped with the latest advances in technology. The design of the electrical systems and other building components shall all combine together to produce a building that meets the project's programmed sustainability rating (LEED rating) and assigned energy target, of the specific project. This intent shall be extended to include the future evolution of automated office. Making this concept a reality requires a comprehensive design for engineering systems that goes beyond the requirements of the immediate building program. It also requires a higher level of integration between architecture and engineering systems than one would usually expect in an office building. Also, the design work shall be done in accordance with all rules, regulations, by-laws and requirements of all authorities having jurisdiction.

26.1.1 Submittals

Submittals shall include coordinated shop drawings including all disciplines using same spaces.

26.1.2 Workmanship requirements

Comply with NECA 1 and NECA 101. Good workmanship shall be apparent in the installation of all electrical materials and equipment. All surfaces including any existing left in place fixtures shall be cleaned and left in fully operational and functional status.

26.2 Codes and Standards

26.2.1 Electrical Design Standards

The electrical systems must be designed by a Professional Engineer licensed in Florida that shall follow these Building Standards.

The electrical systems shall comply with the requirements of the applicable authorities having jurisdiction and with the in force (or current) edition at the time of the project of following codes and standards:

1. National Electrical Code (NFPA 70)
2. Florida Building Code in force at the time of the project; including all Referenced Standards.
3. National Fire Protection Association (NFPA) codes and standards.
4. IESNA: Illuminating Engineering Society of North America
5. IEEE: Institute of Electrical and Electronics Engineers

26.3 Design Criteria

26.3.1 Building Energy Performance

The electrical systems must be designed in compliance with the Florida Building Code in relation with energy and the performance goals established for the project for LEED rating.

26.3.2 Lighting Control

1. Interior and exterior lighting shall be controlled with automatic control devices to shut off building lighting in all spaces. Acceptable automatic control devices include:

    a. A scheduled basis using a time-of-day operated control device that turns lighting off at specific programmed times—an independent program schedule shall be provided for areas of no more than 25,000 square feet but not more than one floor. Clock switch shall automatically compensate for the length of the day and how it changes throughout the year (astronomical clock) switch and 10-year power failure memory and clock that restores lighting to settings prior to power interruption
    b. A vacancy sensor that shall turn lighting off within 30 minutes of an occupant leaving a space.
    c. A signal from another control or alarm system that indicates the area is unoccupied.
    d. In the case of IT, storage and other rooms with the same pattern of utilization the use of Digital Wall Switch Timer is preferred.
    e. In the case of exterior lighting; photosensor control shall ensure of turning off exterior lighting when sufficient daylight is available; ensure photosensors are not influenced by adjacent lighting.

2. Lighting control systems shall be controllable and programmable by existing campus BMS using BACnet protocol.

3. Exceptions:

    The following lighting shall not require an automatic control device:

    a. Lighting intended for 24-hour operation shall not require an automatic control device.
    b. Lighting in spaces where patient care is rendered.
    c. Spaces where an automatic shutoff would endanger the safety or security of the room or building occupant(s).

4. In the case of electrical, IT, mechanical, storage and other rooms with the same pattern of utilization the use of Digital Wall Switch Timer is preferred.

5. Daylighting harvesting shall be used whenever possible, using dimming or switching according Owner's program requirements.

6. All classrooms and conference rooms shall be provided with dimming capabilities, providing not less than 2 zones and shall work with the daylighting harvesting system for

the specific room. These dimming systems shall be controllable and programmable by existing campus BMS using BACnet protocol. Dimmers shall regulate voltage to maintain a constant light level with no visible flicker and with a dimming range 0 to 80%.

7. All lighting projects shall include lighting calculations.

26.3.3 Electrical Systems Spare Capacity

The electrical system must be sized for the electrical load with additional minimum spare capacity as follows:

1. Main switchgear or switchboard: 20% spare ampacity and 10% spare breakers.

2. Switchboards and distribution panels: 20% spare ampacity and 10% spare breakers.

3. Panel boards for branch circuits: 20% spare ampacity and 10% spare breakers. In case the Owner's program requirements include known future expansions, the spare capacity shall be additional to the future expansion needs.

26.4 Utility Coordination

A load calculation and type of electrical system to be employed shall be provided to Florida Power and Light (FPL) upon initial contact with them, in accordance with section 26.5 (Distribution Systems) along with possible location of service entrance.

Location of service entrance and location of FPL transformers, switchgears, meters, right of way and any other equipment must be coordinated with the architect and civil engineer to avoid conflicts and must consider all Florida Power and Lighting (FPL) requirements, especially clearance and accessibility. For utility transformers located on Nova Southeastern University property the preferred design is to locate them in a vault that must comply with Florida Power and Lighting (FPL) requirements; including vehicular accessibility. No aerial conductors shall be used.

26.4.1 Short circuit calculations

The symmetrical fault current shall be calculated from the maximum available fault at service entrance, according to utility and the specific building electrical system.

The short circuit withstands and/or interrupting capacity for any electrical equipment will be selected according the values of the short circuit calculations, above mentioned, at the location of the specific equipment.

26.4.2 Service entrance

1. Service entrance shall be by underground conduits. Provide underground service entrance conduits of Rigid Metal Conduit (RGM) or Rigid Polyvinyl Chloride Conduit (PVC) Schedule 40 encased in concrete.

    a. Concrete encasement shall be 2 inches on all sides with 1 inch minimum separation between power conduits. If conduits from different systems

share the same concrete encasement, the minimum separation between power conduits and signal conduits shall be 3 inches.

b. The minimum depth of underground conduits beyond the building perimeter shall be 24" to the top of the concrete encasement.

26.5 Distribution System

Distribution Systems Voltage.

1. For new construction projects, equal or larger than 100 KVA, use 277V/480V, 3 phase, 4-wire, grounded wire.

2. For new construction new projects smaller than 100 KVA, use 120V/208V, 3 phase, 4-wire grounded wire.

Total voltage drop including feeders and branch circuit shall not exceed 5%.

26.6 Electrical Rooms & Data Rooms

Design Standards

1. Provide Electrical Rooms lockable and accessible only to qualified persons; and not accessible to professors or students or for use as storage.

2. Space shall be adequate for all the electrical equipment to be installed. Minimum size shall be as required to accommodate all necessary equipment in accordance with the FBC, but in no event shall it be less than 6'-0" x 8'-0". Room doors shall swing out.

3. Sufficient access to the room shall be included to permit replacement of any equipment.

4. There shall be 40% additional space for future equipment.

5. Electrical rooms shall be clear of columns or beams as well as shear walls, stairways, duct shafts, elevators and other obstructions to permit secondary distribution of electrical to assigned spaces.

6. Electrical rooms shall be centrally located, close to larger loads.

7. Satellite electric rooms shall be provided throughout the facility spaced at an interval of no greater than 300 feet (minimum one per floor).

8. Rooms shall be sprinklered in fully sprinklered facilities.

9. In the case of multistory buildings, the electrical rooms shall be stacked.

10. Floor mounted switchboards and motor control centers shall be on 4" high concrete curbs.

11. Switchboards, panel boards, contactors, and any other electrical equipment shall be installed in electrical rooms.

12. Rooms shall be provided with conditioned air cooling adequate to condition space to a temperature not to exceed 74 degree F.

26.7 Specific requirements (organized by CSI Master Format® 2013 Numbers & Titles)

26 05 13	Medium-Voltage Cables
26 05 19	Low Voltage Electrical Power Conductors and Cables
26 05 23	Control Voltage Electrical Power Cables
26 05 26	Grounding and Bonding for Electrical Systems
26 05 29	Hangers and Supports for Electrical Systems
26 05 33	Raceways and Boxes for Electrical Systems
26 05 36	Cable Trays for Electrical Systems
26 05 39	Underfloor Raceways for Electrical Systems
26 05 43	Underground Ducts and Raceways for Electrical Systems
26 05 44	Sleeves and Sleeve Seals for Electrical Raceways and Cabling
26 05 48	Vibration and Seismic Controls for Electrical Systems
26 05 53	Identification for Electrical Systems
26 05 73	Overcurrent Protective Device Coordination Study
26 09 13	Electrical Power Monitoring and Control
26 11 16	Secondary Unit Substations
26 12 00	Medium-Voltage Transformers
26 13 00	Medium-Voltage Switchgear
26 22 00	Low Voltage Transformers
26 23 00	Low Voltage Switchgear
26 23 13	Paralleling Low-Voltage Switchgear
26 24 13	Switchboards
26 24 16	Panelboards
26 24 16.16	Electronically Operated Circuit-Breaker Panelboards
26 24 19	Motor-Control Centers
26 25 00	Enclosed Bus Assemblies
26 26 00	Power Distribution Units
26 27 13	Electricity Metering
26 27 26	Wiring Devices
26 28 13	Fuses
26 28 16	Enclosed Switches and Circuit Breakers
26 29 13	Enclosed Controllers
26 29 23	Variable-Frequency Motor Controllers
26 31 00	Photovoltaic Energy Equipment
26 32 13	Engine Generators

26 33 23	Central Battery Equipment
26 33 53	Static Uninterruptible Power Supply
26 35 33	Power Factor Correction Equipment
26 36 00	Transfer Switches
26 41 13	Lightning Protection for Structures
26 42 00	Cathodic Protection
26 43 13	Surge Protection for Low-Voltage Electrical Power Circuits
26 51 00	Interior Lighting
26 55 61	Theatrical Lighting
26 56 00	Exterior Lighting
26 56 68	Exterior Athletic Lighting

26 05 13 Medium-Voltage Cables

This section might be used in future projects including medium-voltage cables (Cables, splices, terminations, connectors, and fault indicators for 2001 to 35,000V).

Use of aluminum wires

26 05 19 Low-Voltage Electrical Power Conductors and Cables

Design Standards

1. All conductors shall be copper with insulation as required for specific application

2. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3. Install bushings at the end of sleeves to avoid damage to conductor's insulation. Product Standards

26 05 23 Control Voltage Electrical Power Cables

This section must be coordinated with Integrated Automation, Communications and, Electronic Safety and Security.

26 05 26 Grounding and Bonding for Electrical Systems

Design Standards

1. Equipment Grounding
   a. Install insulated equipment grounding conductors with all feeders and branch circuits.
   b. Provide grounding bars in all electrical rooms.

26 05 29 Hangers and Supports for Electrical Systems

Design Standards

1. Only steel hot-dip galvanized after fabrication or aluminum support systems are admissible. In the case of hangers and supports of steel hot-dip galvanized; Care shall be taken during the

installation to assure the integrity of corrosion protection. Damaged corrosion protection shall be repaired during or after installation.

2. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

3. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

4. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

5. Steel slotted support systems shall be implemented with use of threaded rod hangers.

26 05 33 Raceways and Boxes for Electrical Systems

Design Standards

1. Raceway Application

   a. Outdoors: Apply raceway products as specified below unless otherwise indicated:
      (1) Exposed Conduit: RMC (Galvanized rigid steel conduit) or IMC.
      (2) Concealed Conduit, Aboveground: RMC (Galvanized rigid steel conduit) or IMC.
      (3) Underground Conduit: RNC, Type EPC-40-PVC.
      (4) Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
      (5) Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

   b. Indoors: Apply raceway products as specified below unless otherwise indicated:
      (1) Exposed, Not Subject to Physical Damage: EMT.
      (2) Exposed, Not Subject to Severe Physical Damage: EMT.
      (3) Exposed and Subject to Severe Physical Damage: RMC (Galvanized rigid steel conduit). Raceway locations include the following:
         (a) Loading dock.
         (b) Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
         (c) Mechanical rooms.
         (d) Gymnasiums.
      (4) Concealed in Ceilings and Interior Walls and Partitions: EMT.
      (5) Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
      (6) Damp or Wet Locations: RMC (Galvanized rigid steel conduit)
      (7) Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in commercial kitchens and damp or wet locations.
      (8) Underground Conduit: RNC, Type EPC-40-PVC.

c. Minimum Raceway Size: 3/4-inch (21-mm) trade size.

d. Raceway Fittings: Compatible with raceways and suitable for use and location.
   (1) Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
   (2) PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
   (3) EMT: Use setscrew or compression, steel fittings. Comply with NEMA FB 2.10.
   (4) Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

e. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

f. All raceways in public spaces shall be concealed.

2. Boxes, Enclosures, and Cabinets

   a. Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
   b. Sheet Metal Outlet and Device Boxes: Outlets boxes shall be pressed - stamped; not welded; with no concentric or eccentric knockouts.
   c. Gangables boxes are prohibited.

26 05 36 Cable Trays for Electrical Systems

Design Standards

1. Only steel hot-dip galvanized after fabrication or aluminum cable trays systems are admissible.

2. Ground cable trays according to NFPA 70 unless additional grounding is specified. Cable trays with electrical power conductors shall be bonded together with splice plates listed for grounding purposes or with listed bonding jumpers.

Product Standards

1. Cable Trays and Accessories: Identified as defined in NFPA 70 and marked for intended location, application, and grounding.

26 05 39 Underfloor Raceways for Electrical Systems

This section might be used in future projects that include under floor raceways including single-channel and multichannel flat-top, flush, three-cell, cellular metal, and trench types, plus electrification products for structural cellular metal and concrete floor decks, and junction boxes and service fittings for the above products.

26 05 43 Underground Ducts and Raceways for Electrical Systems

Design Standards

1. Layout and installation of ducts, manholes, handholes, and boxes shall be coordinated with final arrangement of other utilities, site grading, and surface features as determined in the field. Verify field measurements, routing and termination locations of duct bank prior to excavation for rough-in. Coordinate duct bank installation with underground Work and site Work and other site improvement Work specified in other Divisions.

2. Actual routing of duct bank shall be included on Project record documents, and submit to Nova Southeastern University.

3. Duct Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and hand holes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes to drain in both directions.

4. Earthwork
   a. Excavation and Backfill: Comply with Section "Earth Moving", but do not use heavy-duty, hydraulic-operated, compaction equipment.
   b. Prepare excavation, base material installation, and compaction necessary for the specific ductbank arrangement.
   c. Verify that excavation, base material installation, and compaction is completed.
   d. Backfill trenches as specified in Section "Earth Moving".

5. Concrete: Comply with ASTM C 858.

Product Standards

1. Conduit: RNC: Type EPC-40-PVC with matching fittings by same manufacturer as the conduit.

2. Duct Accessories
   a. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and sizes of ducts with which used, and selected to provide minimum duct spacings indicated while supporting ducts during concreting or backfilling.
   b. Warning Tape: Underground-line warning tape detectable and pigmented polyolefin, bright color, continuous printed with utility inscription, compounded for direct burial.

3. Concrete Warning Planks:
   a. Nominal 12 by 24 by 3 inches (300 by 600 by 76 mm) in size, manufactured from 6000-psi (41-MPa) concrete.
   b. Color: Red dye added to concrete during batching.
   c. Mark each plank with "ELECTRIC" in 2-inch- (50-mm-) high, 3/8-inch- (10-mm-) deep letters.

26 05 44 Sleeves and Sleeve Seals for Electrical Raceways and Cabling

Design Standards

1. This Section shall specify penetration methods into and through unrated walls, ceilings, and floors. Sealing of conduit penetrations against water shall be included. For rated walls, ceilings, and floors see Section 078413 "Penetration Firestopping."

2. Sleeve installation must be closely coordinated with concrete and masonry work.

3. Sleeves are specifically required:
   a. To prevent movement of air through a raceway from a warmer to a colder section (as in a raceway used to enclose lighting and refrigeration branch-circuit conductors for a walk-in cooler), which might lead to condensation within the raceway. This condition can be prevented by sealing the raceway with a suitable pliable compound before it enters the colder section.
   b. For busway runs that have sections located both inside and outside of buildings. These runs are required to have a vapor seal at the building wall to prevent interchange of air between indoor and outdoor sections.

4. Firestopping is required for conduits, tubing, cables, and cable trays penetrating fire-resistance-rated walls, horizontal assemblies, or smoke barriers. See Section "Penetration Firestopping" for firestopping systems and installation requirements.

5. Sleeve-seal systems are required.

26 05 48 Vibration and Seismic Controls for Electrical Systems

This Section specifies seismic criteria, seismic restraints and supports, and vibration isolation devices. Seismic design according current Florida Building Code and ASCE/SEI 7 (Minimum Design Loads for Buildings and Other Structures).

This Section does not specify basic hangers, supports, anchors, and concrete base construction requirements for electrical work. See Section 260529 "Hangers and Supports for Electrical Systems" for these items.

26 05 53 Identification for Electrical Systems

Design Standards

1. All electrical equipment shall be provided with permanent identification nameplates as follows

   a. The following identification markings shall be provided on each circuit breaker, disconnect switch, contactor, motor starter, etc.
      (1) Equipment designation shown on the drawings.
      (2) Voltage and amperage.
      (3) Load identification in sufficient detail to allow specific circuit be distinguished unequivocally.

b. The following identification markings shall be provided on each transformer:
   (1) Transformer designation shown on the drawings.
   (2) Voltage (primary/secondary).
   (3) Transformer capacity
   (4) Name of panels supplied by the secondary of the transformer.

c. The following alkyd paint, stenciled inscription markings shall be provided on the outside face and on the inside face of each feeder splice box, feeder junction box, and feeder pull box cover plate:
   (1) Designation of source.
   (2) Designation of item of equipment served.
   (3) Voltage.

d. The following identification markings shall be provided on each switchgear, paralleling switchgear, switchboards, and panelboards:
   (1) Designation shown on the drawings.
   (2) Source of supply designation.
   (3) Voltage (primary/secondary).

e. Device plates for switches, toggle switch type manual starters, pilot lights, and other electrical items, whose function is not readily apparent, shall be provided with engraved suitable inscriptions or plastic laminate nameplates describing the equipment controlled or indicated.

f. Each wire and each cable shall be labeled at terminals and at all accessible points in equipment, panelboards, manholes, handholes, and pull boxes. Labels shall be self-sticking wire markers.

g. Conduits, shall be tagged at the ends and in intermediate boxes, chambers, manholes, handholes, and other enclosures in accordance with the same inscriptions as shown on the drawings.

h. Phase identification letters, in readily visible locations, shall be stamped into the main bus bars of switchgear, switchboards and panelboards.

i. On the exterior door of each vault or other room or enclosure containing equipment operating over 600 volts, provide a vitreous enameled metal sign, red or white, reading "Warning - High Voltage - Keep Out."

j. In each switchboard room, electrical closet, or other space containing electrical equipment, a vitreous enameled metal sign, red on white, reading "Electrical Equipment Room - No Storage Permitted" shall be provided. Signs shall be mounted at clearly visible locations within the rooms or on the inside of doors where wall space within the room is not available.

k. In all Electrical Rooms a framed behind-glass ONE LINE or RISER DIAGRAM drawings including the equipments located in the specific electrical room highlighted in yellow, complete with the feeder schedules, shall be provided. The print shall be made from the latest "Record" drawing at 100%. The preferred

location of the drawings is the back of the door to avoid using usable space for future electrical equipment.

l. Color code covers of each box and panel for identification as follows:
(1) Normal Power System: Gray (in the case of boxes, natural steel color is acceptable)
(2) Emergency (essential for safety to human life) Power System: Pink
(3) Standby Power System: Black
(4) Uninterruptible Power Supply (UPS) system: Orange

m. The following colors are reserved for other systems:
(1) Fire alarm: Red
(2) Security alarm: Blue
(3) Sound: Yellow
(4) Telephone/IT: Green
(5) TV: Brown
(6) Controls: Purple
(7) Clock: Vanilla

n. Color coding of conductors:
(1) Wiring for 120/208 Volt System shall be coded as follows:
(a) Phase "A" - Black
(b) Phase "B" - Red
(c) Phase "C" - Blue
(d) Neutral - White
(e) Ground - Green

o. (2) Wiring for 277/480 Volt System shall be coded as follows:
(a) Phase "A" - Brown
(b) Phase "B" - Orange
(c) Phase "C" - Yellow
(d) Neutral - Natural Gray
(e) Ground - Green

p. Colors on conductor 6 AWG and smaller shall be integral part of insulation, on conductor 4 AWG and larger conductors, either color coding tape or painted with two coats of correct color paint at all terminals and connection points.

2. Equipment Identification Labels
a. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for non-corroding type screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.
b. Stenciled Legend: In non-fading, waterproof, black alkyd paint. Minimum letter height shall be 1 inch.

3. Power and Control Cable Identification Materials
a. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted], 3-mil thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the cable diameter such that the clear shield overlaps the entire printed legend.

4. Metal Tags
   a. Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.

5. Color-Coding Conductor Tape
   a. Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

26 05 73 Overcurrent Protective Device Coordination Study

Design Standards

1. The design engineer shall submit a preliminary with the 100% CD.

2. A final coordination and analysis study shall be done once the provider for the over current protective devices have been selected. The final report, showing coordination shall be sent to Nova Southeastern University for review and approval.

3. The coordination study will determine the correct selection and settings for the protective devices which will isolate short circuit or overloads to only the affected area. The coordination study shall include the closest upstream utility protective device down to the panelboard main, branch, or feeder circuit breakers. The coordination study shall consider operation during normal conditions, alternate operation, and during emergency power conditions.

26 09 13 Electrical Power Monitoring and Control

Design Standards

1. Provide an electronic system for local and remote monitoring, metering, and control of electrical power distribution systems. This system shall be controllable and programmable by existing campus BMS using BACnet protocol.

2. At point of electrical service entrance provide metering connected to BMS.

3. Provide metering according Owner's program requirements and the project’s programmed sustainability rating (LEED rating).

4. Provide independent metering for new parking lots and exterior lighting.

Performance Standards

1. Systems shall include the following:
   a. Calculate and Record the Following:
      (1) Load factor.
      (2) Peak demand periods.

   b. Power Quality Monitoring: Identify power system anomalies and measure, display, and record trends and alarms of the following power quality parameters:

(1) Voltage regulation and unbalance.
(2) Continuous three-phase rms voltage.
(3) Periodic max./min./avg. voltage samples.
(4) Harmonics.
(5) Voltage excursions.

2. Metered Data: Display metered values in real time.

3. Remote Control:
   a. Display circuit-breaker status and allow breaker control.
   b. User defined with load-shedding automatically initiated and executed schemes responding to programmed time schedules, set points of metered demands, utility contracted load shedding, or combinations of these.

4. Waveform Data: Display and record waveforms on demand or automatically on an alarm or programmed event. Include the graphic displays of the following, based on user-specified criteria:
   a. Phase voltages, phase currents, and residual current.
   b. Waveforms ranging in length from 2 cycles to 5 minutes.
   c. Disturbance and steady-state waveforms up to 512 points per cycle.
   d. Calculated waveform, based on recorded data, on a minimum of four cycles of data of the following:
      (1) THD (total harmonic distortion).
      (2) rms (root mean square) magnitudes.
      (3) Peak values.
      (4) Crest factors.
      (5) Magnitude of individual harmonics.

5. Data Sharing: Allow export of recorded displays and tabular data to third-party applications software.

6. Activity Billing Software:
   a. Automatically compute and prepare activity demand and energy-use statements based on metering of energy use and peak demand integrated over user-defined interval.
   b. Intervals shall be same as used by electric utilities, including current vendor.
   c. Import metered data from saved records that were generated by metering and monitoring software.
   d. Maintain separate directory for each activity's historical billing information.
   e. Prepare summary reports in user-defined formats and time intervals.

7. Reporting: User commands initiate the reporting of a list of current alarm, supervisory, and trouble conditions in system or a log of past events.
   a. Print a record of user-defined alarm, supervisory, and trouble events on workstation printer.
   b. Sort and report by device name and by function.
   c. Report type of signal (alarm, supervisory, or trouble), description, date, and time of occurrence.
   d. Differentiate alarm signals from other indications.

e. When system is reset, report reset event with same information concerning device, location, date, and time.

26 11 16 Secondary Unit Substations

This section, if use in future projects, should be review by Nova Southeastern University Facilities Design Committee.

26 12 00 Medium-Voltage Transformers

This section might be used in future projects including medium-voltage cables (Transformers 2.4 to 35 kV).

26 13 00 Medium-Voltage Switchgear

This section might be used in future projects including medium-voltage cables (Metal-enclosed interrupter and metal-clad CB type switchgear up to 34 kV class).

26 22 00 Low-Voltage Transformers

Product Standards

1. Subject to compliance with requirements, provide product by one of the following:
   a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
   c. Siemens Energy & Automation, Inc.
   d. Square D; a brand of Schneider Electric.

26 23 00 Low-Voltage Switchgear

Design Standards

1. All switchgears shall be provided with a typewritten directory describing the load connected to each circuit breaker. This requirement shall apply to new and existing switchgears modified during construction.

2. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent minimum conductivity, with copper feeder circuit-breaker line connections. Use copper for connecting circuit-breaker line to copper bus.

3. Contact Surfaces of Buses: Silver plated.

4. Feeder Circuit-Breaker Load Terminals: Silver-plated copper bus extensions equipped with pressure connectors for outgoing circuit conductors.

5. Ground Bus: Hard-drawn copper of 98 percent minimum conductivity, with pressure connector for feeder and branch-circuit ground conductors, minimum size 1/4 by 2 inches (6 by 50 mm).

6. Supports and Bracing for Buses: Adequate strength for indicated short-circuit currents.

7. Neutral bus equipped with pressure-connector terminations for outgoing circuit neutral conductors. Neutral-bus extensions for busway feeders are braced.

8. Multifunction Digital-Metering Monitor: UL-listed or -recognized, microprocessor-based unit suitable for three- or four-wire systems and with the following features:
   a. Inputs from sensors or 5-A current-transformer secondary, and potential terminals rated to 600 V.
   b. Switch-selectable digital display of the following:
      (1) Phase Currents, Each Phase: Plus or minus 1 percent.
      (2) Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
      (3) Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
      (4) Three-Phase Real Power: Plus or minus 2 percent.
      (5) Three-Phase Reactive Power: Plus or minus 2 percent.
      (6) Power Factor: Plus or minus 2 percent.
      (7) Frequency: Plus or minus 0.5 percent.
      (8) Integrated Demand, with Demand Interval Selectable from 5 to 60 Minutes: Plus or minus 2 percent.
      (9) Accumulated energy, in megawatt hours (joules), plus or minus 2 percent; stored values unaffected by power outages for up to 72 hours.

9. Mounting: Display and control unit flush or semi-flush mounted in instrument compartment door.

10. Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. All Molded-Case Circuit Breaker (MCCB) shall be specified with interrupting capacity to meet available fault currents.

11. Communication Capability: A communication module with functions and features compatible with existing NSU power monitoring and control system in the BMS shall be provided.

Product Standards

1. Subject to compliance with requirements, provide product by one of the following:
   a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
   c. Siemens Energy & Automation, Inc.
   d. Square D; a brand of Schneider Electric.

26 23 13 Paralleling Low-Voltage Switchgear

This section might be used in future projects including multiple generator operation.

26 24 13 Switchboards

Design Standards

1. All switchboards shall be provided with a typewritten directory describing the load connected to each circuit breaker. This requirement shall apply to new and existing switchboards modified during construction.

2. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent minimum conductivity, with copper feeder circuit-breaker line connections. Use copper for connecting circuit-breaker line to copper bus.

3. Contact Surfaces of Buses: Silver plated.

4. Feeder Circuit-Breaker Load Terminals: Silver-plated copper bus extensions equipped with pressure connectors for outgoing circuit conductors.

5. Ground Bus: Hard-drawn copper of 98 percent minimum conductivity, with pressure connector for feeder and branch-circuit ground conductors, minimum size 1/4 by 2 inches (6 by 50 mm).

6. Supports and Bracing for Buses: Adequate strength for indicated short-circuit currents.

7. Neutral bus equipped with pressure-connector terminations for outgoing circuit neutral conductors. Neutral-bus extensions for busway feeders are braced.

8. Multifunction Digital-Metering Monitor: UL-listed or -recognized, microprocessor-based unit suitable for three- or four-wire systems and with the following features:

   a. Inputs from sensors or 5-A current-transformer secondary, and potential terminals rated to 600 V.
   b. Switch-selectable digital display of the following:
      (1) Phase Currents, Each Phase: Plus or minus 1 percent.
      (2) Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
      (3) Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
      (4) Three-Phase Real Power: Plus or minus 2 percent.
      (5) Three-Phase Reactive Power: Plus or minus 2 percent.
      (6) Power Factor: Plus or minus 2 percent.
      (7) Frequency: Plus or minus 0.5 percent.
      (8) Integrated Demand, with Demand Interval Selectable from 5 to 60 Minutes: Plus or minus 2 percent.
      (9) Accumulated energy, in megawatt hours (joules), plus or minus 2 percent; stored values unaffected by power outages for up to 72 hours.

9. Mounting: Display and control unit flush or semi-flush mounted in instrument compartment door.

10. Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. All Molded-Case Circuit Breaker (MCCB) shall be specified with interrupting capacity to meet available fault currents.

11. Communication Capability: A communication module with functions and features compatible with existing NSU power monitoring and control system in the BMS shall be provided.

Product Standards

1. Subject to compliance with requirements, provide product by one of the following:
   a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
   c. Siemens Energy & Automation, Inc.
   d. Square D; a brand of Schneider Electric.

26 24 16 Panelboards

Design Standards

1. All panelboards shall be provided with a typewritten directory describing the load connected to each circuit breaker. This requirement shall apply to new and existing panelboards modified during construction.

2. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent minimum conductivity, with copper feeder circuit-breaker line connections. Use copper for connecting circuit-breaker line to copper bus.

3. Contact Surfaces of Buses: Silver plated.

4. Feeder Circuit-Breaker Load Terminals: Silver-plated copper bus extensions equipped with pressure connectors for outgoing circuit conductors.

5. Ground Bus: Hard-drawn copper of 98 percent minimum conductivity.

6. Supports and Bracing for Buses: Adequate strength for indicated short-circuit currents.

7. Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. All Molded-Case Circuit Breaker (MCCB) shall be specified with interrupting capacity to meet available fault currents.

Product Standards

1. Subject to compliance with requirements, provide product by one of the following:
   a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
   c. Siemens Energy & Automation, Inc.
   d. Square D; a brand of Schneider Electric.

26 24 16.16 Electronically Operated Circuit-Breaker Panelboards

This section might be used in future projects including electronically operated circuit-breaker panelboards.

26 24 19 Motor-Control Centers

Design Standards

1. All motor-control centers shall be provided with a typewritten directory describing the load connected to each circuit breaker. This requirement shall apply to new and existing motor-control centers modified during construction.

2. All motor controllers shall have an integral transformer with 120 volt secondary for control circuits.

Product Standards

1. Subject to compliance with requirements, provide product by one of the following:
   a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
   c. Siemens Energy & Automation, Inc.
   d. Square D; a brand of Schneider Electric.

26 25 00 Enclosed Bus Assemblies

Design Standards

1. Enclosed bus assemblies shall be used when they provide savings for the specific project.

2. Obtain feeder-bus assemblies, plug-in bus assemblies and bus plug-in devices from a single manufacturer.

3. Enclosed bus assemblies shall have a maximum temperature rise of 55 deg C above 40 deg C ambient maximum for continuous rated current.

26 26 00 Power Distribution Units

Design Standards

1. All power distribution units shall be provided with a typewritten directory describing the load connected to each circuit breaker. This requirement shall apply to new and existing power distribution units modified during construction.

26 27 13 Electricity Metering

Design Standards

1. Coordinate with Florida Power and Light (FPL) meter enclosures to be used.

26 27 26 Wiring Devices

Design Standards

1. Provide duplex receptacles at intervals not to exceed 50 feet in all corridors for cleaning equipment.

2. Provide a weather proof, GFI receptacle within 25 feet of each trash compactor locations.

3. Do not locate outlets back to back in common walls.

4. Gang adjacent switches under a common faceplate to a maximum of three. If more are required, provide in multiples of two and/or three.

5. Device plates for local toggle switches, toggle switch type manual starters, pilot lights, and other electrical items, which function is not readily apparent, shall be provided with engraved suitable inscriptions or plastic laminate nameplates describing the equipment controlled or indicated.

6. Device Color:
   a. Wiring Devices Connected to Normal Power System: Ivory.
   b. Wiring Devices Connected to Emergency (essential for safety to human life) Power System: Red.
   c. Wiring Devices Connected to Standby Power System: Gray.
   d. Wiring Devices Connected to Uninterruptible Power Supply (UPS) system: Orange.
   e. TVSS Devices: Blue.
   f. Isolated-Ground Receptacles: Brown, with orange triangle on face
   g. Wall Plate Color: Match device color.

7. Duplex receptacles shall be rated at 20A, 125V AC.

8. Plates shall be plastic on type in finished areas.

9. Plates shall be stainless steel in laboratories and other potentially corrosive environments.

10. Plate design shall be smooth and without ornamentation.

Product Standards

1. Subject to compliance with requirements, provide product by one of the following:
   a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
   c. Siemens Energy & Automation, Inc.
   d. Square D; a brand of Schneider Electric.

Performance Standards

1. The engineer's specifications shall require the submittal and approval of shop drawings prior to purchase. The shop drawings shall include illustrations, dimensions and specifications for all devices. The specifications shall also require that samples be submitted if requested.

2. The installation of all wall outlets must be leveled, with faceplates flat and tight to the wall. All devices and plates must be thoroughly cleaned of paint and dirt prior to final acceptance of the project.

26 28 13 Fuses

Design Standards

1. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block and holder.

26 28 16 Enclosed Switches and Circuit Breakers

Design Standards

1. Fusible switches and non-fusible switches shall be heavy duty type.

Product Standards

1. Subject to compliance with requirements, provide product by one of the following:
   a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
   c. Siemens Energy & Automation, Inc.
   d. Square D; a brand of Schneider Electric.

26 29 13 Enclosed Controllers

Design Standards

1. Provide motor controllers as required. Coordinate with other disciplines to confirm all necessary motor controllers are included in the design.

26 29 23 Variable-Frequency Motor Controllers

1. Provide variable-frequency motor controllers as required. Coordinate with other disciplines to confirm all necessary variable-frequency motor controllers are included in the design.

2. Manufacturers: Basis of Design Honeywell International, Inc. with bypass.

3. Provide variable-frequency motor controllers compatible with the specific loads. Coordinate features of motors, load characteristics, installed units, and accessory devices to be compatible with the following:
   a. Torque, speed, and horsepower requirements of the load.
   b. Ratings and characteristics of supply circuit and required control sequence.
   c. Ambient and environmental conditions of installation location.

4. Variable-frequency motor controllers minimum efficiency shall be 97 percent at 60 Hz, full load.

5. Provide the following self-protection and reliability features:
   a. Input transient protection by means of surge suppressors to provide three-phase protection against damage from supply voltage surges 10 percent or more above nominal line voltage.

b. Loss of Input Signal Protection: Selectable response strategy, including speed default to a percent of the most recent speed, a preset speed, or stop; with larm.
c. Under- and overvoltage trips.
d. Inverter overcurrent trips.
e. Variable-frequency motor controller and Motor Overload/Overtemperature Protection: Microprocessor-based thermal protection system for monitoring Variable-frequency motor controllers and motor thermal characteristics, and for providing variable-frequency motor controller overtemperature and motor overload alarm and trip; settings selectable via the keypad.
f. Critical frequency rejection, with three selectable, adjustable deadbands.
g. Instantaneous line-to-line and line-to-ground overcurrent trips.
h. Loss-of-phase protection.
i. Reverse-phase protection.
j. Short-circuit protection.
k. Motor overtemperature fault.

26 31 00 Photovoltaic Energy Equipment

Design Standards

1. Provide photovoltaic panels approved for use in Broward County; according Owner's program requirements.

26 32 13 Engine Generators

Design Standards

1. All projects shall include a connection for a portable generator, including all necessary equipment for connecting a portable generator as for example Manual Transfer Equipment, Connection Point, and so on. The equipment for connecting the portable generator shall be designed to feed the following loads:
   a. Security System
   b. BMS
   c. Elevators according Owner's program requirements.
   d. Computers and data processing equipment – U.P.S. according Owner's program requirements.
   e. Research Labs, selected circuits according Owner's program requirements.
   f. Food storage Refrigeration according Owner's program requirements..
   g. Lighting (non emergency) for selected offices/areas according Owner's program requirements.
   h. HVAC according Owner's program requirements.

2. Connection point shall be coordinated to provide access to the portable generator and refueling service.

3. Portable Generators shall be monitored and controllable by existing campus BMS using BACnet protocol.

4. If an emergency generator is required by any code or regulation, the generator shall be sized to run all emergency (essential for safety to human life) loads; all legally required standby systems and the optional standby loads as follows:
   a. Security System
   b. BMS
   c. Elevators according Owner's program requirements.
   d. Computers and data processing equipment – U.P.S. according Owner's program requirements.
   e. Research Labs, selected circuits according Owner's program requirements.
   f. Food storage Refrigeration according Owner's program requirements..
   g. Lighting (non emergency) for selected offices/areas according Owner's program requirements.
   h. HVAC according Owner's program requirements.
   i. Size generators to serve approximately 110% of design load.
   j. Provide fuel storage according Owner's program requirements in addition to the necessary for the generator working at full load per codes and regulations required loads.

5. Generators shall be monitored and controllable by existing campus BMS using BACnet protocol.

6. Generator/UPS Compatibility: If the project includes UPSs, coordinate compatibility with the specific UPS that will be used.

7. System shall be package of new and current equipment consisting of:
   a. A diesel engine driven electric generating set to provide standby power.
   b. An engine start-stop control system.
   c. An automatic load transfer control to provide automatic starting and stopping of the engine and switching of the load.

8. Obtain packaged generator sets and auxiliary components through one source from a single manufacturer. Informational submittals shall include a certified summary of prototype-unit test report.

9. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories. Tests: Comply with NFPA 110, Level 1 Energy Converters and with IEEE 115.

10. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:
    a. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
    b. Full load run.
    c. Maximum power.
    d. Voltage regulation.
    e. Transient and steady-state governing.
    f. Single-step load pickup.
    g. Safety shutdown.
    h. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.

i. Report factory test results within 10 days of completion of test.

11. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project; and is not more than four hours' normal travel time from Installer's place of business to Project site.

12. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.

13. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

14. Comply with ASME B15.1.

15. Comply with NFPA 37.

16. Comply with NFPA 70.

17. Comply with NFPA 110 requirements for Level 1 and 2 emergency power supply system.

18. Comply with UL 2200.

19. Engine Exhaust Emissions: Comply with applicable state and local government requirements.

20. Noise Emission: Comply with applicable state and local government requirements. Project criteria for maximum noise level at adjacent property boundaries due to sound emitted by generator set including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation shall not be more than 85 dBA.

Product Standards

1. Subject to compliance with requirements, provide product by one of the following:
   a. Caterpillar; CAT Power Generation.
   b. Generac Power Systems, Inc.
   c. Kohler Co.; Generator Division.
   d. Cummins Power Generation.
   e. MTU On Site Energy.

2. Tests and Inspections
   a. Perform tests recommended by manufacturer and each electrical test and visual and mechanical inspection for "AC Generators and for Emergency Systems" specified in NETA Acceptance Testing Specification. Certify compliance with test parameters.
   b. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, single-step full-load pickup test.
   c. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.

(1) Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
(2) Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
(3) Verify acceptance of charge for each element of the battery after discharge.
(4) Verify that measurements are within manufacturer's specifications.

d. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
e. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.
f. Exhaust-System Back-Pressure Test: Use a manometer with a scale exceeding 40-inch wg (120 kPa). Connect to exhaust line close to engine exhaust manifold. Verify that back pressure at full-rated load is within manufacturer's written allowable limits for the engine.
g. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.
h. Harmonic-Content Tests: Measure harmonic content of output voltage under 25 percent and at 100 percent of rated linear load. Verify that harmonic content is within specified limits.
i. Noise Level Tests: Measure A-weighted level of noise emanating from generator-set installation, including engine exhaust and cooling-air intake and discharge, at four locations, and compare measured levels with required values.
j. Coordinate tests with tests for transfer switches and run them concurrently.
k. Test instruments shall have been calibrated within the last 12 months, traceable to standards of NIST, and adequate for making positive observation of test results. Make calibration records available for examination on request.
l. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
m. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
n. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
o. Remove and replace malfunctioning units and retest as specified above.
p. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.
q. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.
r. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each power wiring termination and each bus connection. Remove all access panels so terminations and are accessible to portable scanner.
s. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan 11 months after date of Substantial Completion.

t. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

u. Record of Infrared Scanning: Prepare a certified report that identifies terminations and connections checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken and observations after remedial action.

Performance Standards

1. The electrical contractor shall be responsible to coordinate all trades to ensure the proper functioning of the entire system including but not limited to fuel supply, exhaust equipment and air transfer system. This coordination shall include furnishing all required information to other contractors with regard to fuel, exhaust and cooling system dimensions, pipe and duct sizes, etc. Electrical contractor shall furnish a dimensioned plan layout indicating all generator dimensions, roughing dimensions, piping layout, duct layout, tank locations and elevations and all required electrical wiring and interconnections. Provide a note to this effect in the project manual.

2. Provide operating and maintenance manuals complete with replacement parts data for standby emergency generator system.

3. Standby Emergency Generator shall be installed in accordance with the manufacturer's recommendations and in compliance with the requirements of NFPA and all pertaining codes.

4. Provide a 6 inch high concrete pad under the generator set.

5. Furnish owner with manufacturer’s certification and warranty assuring each item of equipment is complete and in good condition, free from damage, properly installed, connected, adjusted and tested as to full power rating, stability and voltage and frequency regulation.

6. The electric generator set shall receive the manufacturer’s standard testing. Prior to acceptance of the installation, the equipment shall be tested to show it will start automatically, subjected to full load test; or that load which is available at the job-site, shut down and reset. Prior to acceptance, the contractor at his expense shall correct any defects that become evident during this test.

7. On completion of the installation, an independent commissioning agent shall perform the initial start-up. At the time of start-up, operating instructions and maintenance procedures shall be thoroughly explained to operating personnel. Two copies of operating and maintenance instruction books shall be supplied for the electric set and such auxiliary equipment as may require it.

8. Warranty: Standby electric generating set shall be provided by manufacturer and shall be warranted for a period of five years from date of acceptance. Copy of written warranty shall be attached to shop drawing submittal.

26 33 23 Central Battery Equipment

This section might be used in future projects including central battery equipment for supplying power to emergency and standby lighting and power circuits.

26 33 53 Static Uninterruptible Power Supply

Design Standards

1. Generator/UPS Compatibility: If the project includes powering the UPSs from a generator, coordinate compatibility with the specific generator that will be used.

2. Automatic operation includes the following:
   a. Normal Conditions: Load is supplied with power flowing from the normal power input terminals, through the rectifier-charger and inverter, with the battery connected in parallel with the rectifier-charger output.
   b. Abnormal Supply Conditions: If normal supply deviates from specified and adjustable voltage, voltage waveform, or frequency limits, the battery supplies energy to maintain constant, regulated inverter power output to the load without switching or disturbance.
   c. If normal power fails, energy supplied by the battery through the inverter continues supply-regulated power to the load without switching or disturbance.
   d. When power is restored at the normal supply terminals of the system, controls automatically synchronize the inverter with the external source before transferring the load. The rectifier-charger then supplies power to the load through the inverter and simultaneously recharges the battery.
   e. If the battery becomes discharged and normal supply is available, the rectifier-charger charges the battery. On reaching full charge, the rectifier-charger automatically shifts to float-charge mode.
   f. If any element of the UPS system fails and power is available at the normal supply terminals of the system, the static bypass transfer switch switches the load to the normal ac supply circuit without disturbance or interruption.
   g. If a fault occurs in the system supplied by the UPS, and current flows in excess of the overload rating of the UPS system, the static bypass transfer switch operates to bypass the fault current to the normal ac supply circuit for fault clearing.
   h. When the fault has cleared, the static bypass transfer switch returns the load to the UPS system.
   i. If the battery is disconnected, the UPS continues to supply power to the load with no degradation of its regulation of voltage and frequency of the output bus.

2. Manual operation includes the following:
   a. Turning the inverter off causes the static bypass transfer switch to transfer the load directly to the normal ac supply circuit without disturbance or interruption.
   b. Turning the inverter on causes the static bypass transfer switch to transfer the load to the inverter.

Performance Standards

1. The UPS shall perform as specified while supplying rated full-load current, composed of any combination of linear and nonlinear load, up to 100 percent nonlinear load with a load crest factor of 3.0, under the following conditions or combinations of the following conditions:
   a. Inverter is switched to battery source.
   b. Steady-state ac input voltage deviates up to plus or minus 10 percent from nominal voltage.

c. Steady-state input frequency deviates up to plus or minus 5 percent from nominal frequency.
d. THD of input voltage is 15 percent or more with a minimum crest factor of 3.0, and the largest single harmonic component is a minimum of 5 percent of the fundamental value.
e. Load is 50 percent unbalanced continuously.

2. Minimum Duration of Supply: If battery is sole energy source supplying rated full UPS load current at 80 percent power factor, duration of supply shall be 10 minutes unless the Owner's program requirements require more time in which case the duration of supply shall be as indicated.

3. Input Voltage Tolerance: System steady-state and transient output performance remains within specified tolerances when steady-state ac input voltage varies plus 10, minus 15 percent from nominal voltage.

4. Overall UPS Efficiency: Equal to or greater than indicated in the following table:

Nominal Overall UPS Efficiency Ratings			
Size Range of UPS Units	**Efficiency at 100% Rated Load**	**Efficiency at 75% Rated Load**	**Efficiency at 50% Rated Load**
30 KVA and Smaller	86	85	84
37.5 to 74 KVA	89	88	87
75 to 124 KVA	90	88	87
125 to 224 KVA	90	89	88
225 KVA and Larger	90	89	88

5. Maximum Acoustical Noise: maximum allowable values indicated in the following table:

Nominal Overall UPS Audible Noise Ratings		
Size Range of UPS Units	**Maximum Noise Value**	**Distance at which Measured**
10 KVA and Smaller	58 dB	36 inches (900 mm)
20 to 125 KVA	60 dB	48 inches (1200 mm)
150 to 300 KVA	78 dB	48 inches (1200 mm)
300 KVA and Larger	83 dB	48 inches (1200 mm)

6. Maximum Energizing Inrush Current: Six times the full-load current.

7. Maximum AC Output-Voltage Regulation for Loads up to 50 Percent Unbalanced: Plus or minus 2 percent over the full range of battery voltage.

8. Output Frequency: 60 Hz, plus or minus 0.5 percent over the full range of input voltage, load, and battery voltage.

9. Limitation of harmonic distortion of input current to the UPS shall be as follows:
   a. Description: Either a tuned harmonic filter or an arrangement of rectifier-charger circuits shall limit THD to 5 percent, maximum, at rated full UPS load current, for power sources with X/R ratio between 2 and 30.

10. Maximum Harmonic Content of Output-Voltage Waveform: 5 percent rms total and 3 percent rms for any single harmonic, for 100 percent rated nonlinear load current with a load crest factor of 3.0.

11. Maximum Harmonic Content of Output-Voltage Waveform: 5 percent rms total and 3 percent rms for any single harmonic, for rated full load with total harmonic distortion up to 50 percent, with a load crest factor of 3.0.

12. Minimum Overload Capacity of UPS at Rated Voltage: 125 percent of rated full load for 10 minutes, and 150 percent for 30 seconds in all operating modes.

13. Maximum Output-Voltage Transient Excursions from Rated Value: For the following instantaneous load changes, stated as percentages of rated full UPS load, voltage shall remain within stated percentages of rated value and recover to, and remain within, plus or minus 2 percent of that value within 100 ms:
    a. 50 Percent: Plus or minus 5 percent.
    b. 100 Percent: Plus or minus 5 percent.
    c. Loss of AC Input Power: Plus or minus 1 percent.
    d. Restoration of AC Input Power: Plus or minus 1 percent.

14. Input Power Factor: A minimum of 0.70 lagging when supply voltage and current are at nominal rated values and the UPS is supplying rated full-load current.

15. Electromagnetic interference emissions: Comply with FCC Rules and Regulations and with 47 CFR 15 for Class A equipment.

26 35 33 Power Factor Correction Equipment

This section might be used in future projects including power factor correction equipment.

26 36 00 Transfer Switches

Design Standards

1. Provide automatic transfer switches, non-automatic transfer switches, remote annuciator and control panels through one source from a single manufacturer.

2. Transfer switches shall be monitored by existing campus BMS using BACnet protocol.

3. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.

a. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are not acceptable.
b. Switch Action: Double throw; mechanically held in both directions.
c. Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer-switch units, rated 225 A and higher, shall have separate arcing contacts.

4. Use four-pole switches (three phase poles and one neutral pole). Where ground-fault protection is used, a separately switched, fully rated neutral pole may be needed to insure proper operation of the ground-fault relay.

26 41 13 Lightning Protection For Structures

Design Standards

1. Lightning protection systems shall be included in all new buildings.

2. Lightning protection systems shall be designed in accordance with NFPA 780; UL 96 and UL 96A.

3. Down conductors shall be protected against physical damage with approved raceways. Raceways shall be bonded to down conductors at both ends.

4. All grounding systems (electric, telephone, lightning protection, etc.) are to be interconnected.

5. All metallic raceways, enclosures, frames and other non-current carrying metal parts of electric equipment located within 6'-0" of lightning rod conductors are to be bonded to same. Include a note in the project specifications to cover this.

Product Standards

1. All air terminals, conductors, fasteners, air terminal supports, etc. are to be manufactured from copper.

2. Ground rods shall be ¾" minimum diameter, 8 ft long copper clad steel.

Performance Standards

1. Installation of the lightning protection system is to be performed by qualified personnel certified by UL or LPI as a Master Installer/Designer, trained and approved for installation of units required for this Project.

2. The lightning protection systems shall be installed in accordance with NFPA 78 and UL 96A standards.

3. Inspection and Certification: Upon completion of the installation, the contractor shall furnish the Master Label issued by Underwriters Laboratories, Inc. for this system. If the protected structure is an addition to or is attached to an existing structure that does not have a lightning protection system, the contractor shall advise the Owner of installation requirements on the existing

structure to obtain the Master Label. If the existing structure does have a lightning protection system, the contractor shall advise the Owner of any additional work required on the existing system to achieve compliance with current UL Master Label requirements.

26 42 00 Cathodic Protection

This section might be used in future projects including cathodic protection.

26 43 13 Surge Protection for Low-Voltage Electrical Power Circuits

Design Standards

1. Transient Voltage Surge Suppression (TVSS) shall be provided in all switchboards and panel boards.

26 51 00 Interior Lighting

Design Standards

1. Use current IES standards and recommendations as the basis of design. Provide lower range recommended levels of even, ambient illumination throughout the space with local task lights providing greater illuminance at the task. Power density (watts / SF) shall comply with current FBC and current ASHRAE 90.1 used by USGBC (LEED).

2. The luminaires for classrooms and offices shall be high performance overhead 2' X 4' "recessed direct/ indirect" perforated (offices) metal or acrylic (classrooms) basket luminaire with two F28T8 lamps and single normal light output energy efficient electronic program start ballast with a ballast factor of 0.88 using about 55 watts total. Verify dimming requirements.

3. Careful consideration must be taken in the design of lighting systems regarding accessibility for servicing of the fixtures and replacement of lamps.

4. Required illumination:

Area / Activity	Required Illumination Levels at task (average illuminance in footcandle)
Cafeteria eating areas	20
Cafeteria food preparation	75
Classrooms	50
Conference rooms	30
Corridors	15
Labs	75
Library check in/out	75
Library reading area	50
Library stacks	35
Offices at task	50

Offices general lighting	25
Rest rooms	20
Storage active	20
Storage inactive	15
Systems (electrical, IT, mechanical, etc.) rooms	20

6. All lighting projects shall include photometric study.

7. No incandescent or tungsten / halogen lamps allowed.

8. 4100K color temperature.

9. T8 28 watt long life fluorescent lamps in office, classrooms.

10. All ballast shall be electronic program start type.

11. Fluorescent fixtures at offices and similar: recessed direct/ indirect, perforated steel diffuser, 90% efficiency min.

12. 2'x2' preferred at offices, classrooms, public areas.

13. All fluorescent fixtures fully front side serviceable.

14. LED 2 x 2 and 2 x 4 recessed direct/ indirect fixtures are preferred, budget permitting. (Example -CREE CR).

15. Accent/ millwork/ elevator /cove lighting: no tungsten/ halogen allowed, LED preferred.

16. Lighting design per IES 2011; incorporate task lighting in photometric design.

Product Standards

1. a. Incandescent technology is prohibited.
   b. T-12 fluorescent lamps are prohibited.
   c. Halogen / Tungsten lamps are prohibited.

2. General requirements for lighting fixtures and components
   a. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures. They must be fully front serviceable.

   b. Fluorescent Fixtures: Comply with UL 1598. LER tested according to NEMA LE 5 and NEMA LE 5A as applicable.

   c. HID Fixtures: Comply with UL 1598. LER tested according to NEMA LE 5B.

   d. Luminaire Efficacy Rating (LER) must meet or exceeds the following:

Performance Requirement for Compact Fluorescent Lamps	
Luminaire Type	**Required Luminaire Efficacy Rating (LER)**
Open Optics	29 or higher
Baffled Optics	21 or higher
Lensed Optics	24 or higher
Metal Halide Lamps	
Luminaire Type	**Required Luminaire Efficacy Rating (LER)**
Open Optics	35 or higher
Lensed Optics	30 or higher

(per Federal Program Federal Energy Management)

e. Metal Parts: Free of burrs and sharp corners and edges.

f. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.

g. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

h. Diffusers and Globes:
   (1) Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
      (a) Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
      (b) UV stabilized.
   (2) Glass: Annealed crystal glass unless otherwise indicated.

i. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

j. Label shall include the following lamp and ballast characteristics:
   (1) "USE ONLY" and include specific lamp type.
   (2) Lamp diameter code (T-4, T-5, T-8, etc.), tube configuration (twin, quad, triple, etc.), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.
   (3) Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.
   (4) Start type programmed start for fluorescent and compact fluorescent luminaires.
   (5) ANSI ballast type (M98, M57, etc.) for HID luminaires.

(6) CCT and CRI for all luminaires.
(7) Color temperature in degrees Kelvin.

k. Ballasts and Lamps
(1) Ballasts for linear fluorescent lamps
(a) General Requirements for Electronic Ballasts
(b) Comply with UL 935 and with ANSI C82.11.
(c) Designed for type and quantity of lamps served.
(d) Ballasts shall be designed for full light output unless another BF, dimmer, or bi-level control is indicated.
(e) Sound Rating: Class A.
(f) Total Harmonic Distortion Rating: Less than 10 percent.
(g) Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
(h) Operating Frequency: 42 kHz or higher.
(i) Lamp Current Crest Factor: [1.7] or less.
(j) Power Factor: 0.98 or higher.
(k) Use electronic Programmed-Start Ballasts
(l) Dimming (if required) Range: 100 to 5 percent of rated lamp lumens.
(m) Ballast Input Watts: Can be reduced to 20 percent of normal.
(n) Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated.
(o) Control: Coordinate wiring and/or wireless system from ballast to control device to ensure that the ballast, controller, and connecting wiring are compatible.

(2) Ballasts for compact fluorescent lamps
(a) Description: Electronic-programmed rapid-start type, complying with UL 935 and with ANSI C 82.11, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer or bi-level control is indicated:
(1.) Lamp end-of-life detection and shutdown circuit.
(2.) Automatic lamp starting after lamp replacement.
(3.) Sound Rating: Class A.
(4.) Total Harmonic Distortion Rating: Less than 20 percent.
(5.) Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
(6.) Operating Frequency: 20 kHz or higher.
(7.) Lamp Current Crest Factor: 1.7 or less.
(8.) BF: 0.88 or higher unless otherwise indicated.
(3) Emergency fluorescent power unit (in case generator is not included in the project) Internal Type: Self-contained, modular, battery-inverter unit, factory mounted within lighting fixture body and compatible with ballast. Comply with UL 924, which requires batteries sized to provide a minimum of 90 minutes of operation under connected load with a drop in output to no less than 87.5% of normal voltage.
(a) Emergency Connection: Operate one fluorescent lamp(s) continuously at an output of 1100 lumens each. Connect

unswitched circuit to battery-inverter unit and switched circuit to fixture ballast.

b) Test Push Button and Indicator Light: Visible and accessible without opening fixture or entering ceiling space.
   (1.) Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
   (2.) Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates end of discharge cycle.

c) Battery: Sealed, maintenance-free, nickel-cadmium type.

d) Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.

4) Ballasts for HID lamps
   a) Electromagnetic Ballast for Metal-Halide Lamps: Comply with ANSI C82.4 and UL 1029. Include the following features unless otherwise indicated:
      (1.) Ballast Circuit: Constant-wattage autotransformer or regulating high-power-factor type.
      (2.) Minimum Starting Temperature: Minus 22 deg F for single-lamp ballasts.
      (3.) Rated Ambient Operating Temperature: 104 deg F. Open-circuit operation that will not reduce average life.
      (4.) Low-Noise Ballasts: Manufacturers' standard epoxy-encapsulated models designed to minimize audible fixture noise.
   b) Electronic Ballast for Metal-Halide Lamps: Include the following features unless otherwise indicated:
      (1.) Minimum Starting Temperature: Minus 20 deg F (Minus 29 deg C) for single-lamp ballasts.
      (2.) Rated Ambient Operating Temperature: 130 deg F (54 deg C).
      (3.) Lamp end-of-life detection and shutdown circuit.
      (4.) Sound Rating: Class A.
      (5.) Total Harmonic Distortion Rating: Less than [20] <insert number> percent.
      (6.) Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
      (7.) Lamp Current Crest Factor: 1.5 or less.
      (8.) Power Factor: 0.90 or higher.
      (9.) Protection: Class P thermal cutout.
      (10.) Minimum Starting Temperature: Minus 40 deg F (Minus 40 deg C).

5) Quartz lamp lighting controller
   a) General Requirements for Controllers: Factory installed by lighting fixture manufacturer. Comply with UL 1598.
   b) Standby (Quartz Restrike): Automatically switches quartz lamp on when a HID lamp in the fixture is initially energized and during the HID lamp restrike period after brief power outages.

c) Connections: Designed for a single branch -circuit connection.
d) Switching Off: Automatically switches quartz lamp off when HID lamp reaches approximately 60 percent light output.

6) Exit Signs
a) General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
b) Internally Lighted Signs:
(1.) Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.
2.) Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
a.) Battery: Sealed, maintenance-free, nickel-cadmium type.
b.) Charger: Fully automatic, solid-state type with sealed transfer relay.
c.) Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
d.) Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
e.) LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

7) Emergency lighting units
a) General Requirements for Emergency Lighting Units: Self-contained units complying with UL 924.
1.) Battery: Sealed, maintenance-free, lead-acid type.
2.) Charger: Fully automatic, solid-state type with sealed transfer relay.
3.) Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
4.) Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
5.) LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
6). Exit sign letters color: Red.

8) Fluorescent lamps
   a) T8 programmed-start lamps, rated 28 W maximum, nominal lengths of 48 inches, 2800 initial lumens (minimum), CRI 85 (minimum), color temperature 4100 K, and minimum rated life of 42,000 hr. @ 12 hr. starts. and suitable for use with dimming ballasts when indicated.
   b) T8 programmed-start lamps, rated 17 W maximum, nominal lengths of 24 inches, 1300 initial lumens (minimum), CRI 85 (minimum), color temperature 4100 K, and minimum rated life of 29,000 hr. @ 12 hr. starts. and suitable for use with dimming ballasts when indicated.
   c) Compact Fluorescent Lamps: 4-Pin, CRI 82 (minimum), color temperature 4100 K, minimum rated life of 12,000 hours at three hours operation per start, and suitable for use with dimming ballasts when indicated.
      1.) 13 W: T4, double or triple tube, rated 900 initial lumens (minimum).
      2.) 18 W: T4, double or triple tube, rated 1200 initial lumens (minimum).
      3.) 26 W: T4, double or triple tube, rated 1800 initial lumens (minimum).
      4.) 32 W: T4, triple tube, rated 2400 initial lumens (minimum).
      5.) 42 W: T4, triple tube, rated 3200 initial lumens (minimum).
      6.) 57 W: T4, triple tube, rated 4300 initial lumens (minimum).
      7.) 70 W: T4, triple tube, rated 5200 initial lumens (minimum).
   d) T5 programmed - start lamps, rated 28 W maximum, nominal length of 45.2 inches, 2900 initial lumens (minimum), CRI 85 (minimum), color temperature 4100 K, and average rated life of 20,000 hours unless otherwise indicated. T5 requires approval by Nova Southeastern University.
   e) T5HO programmed – start high-output lamps, rated 54 W maximum, nominal length of 45.2 inches, 5000 initial lumens (minimum), CRI 85 (minimum), color temperature 4100 K, and average rated life of 20,000 hours unless otherwise indicated. T5HO requires approval by Nova Southeastern University Facilities Design and Construction (NSUFDC).
   f) Subject to compliance with requirements, provide product by one of the following:
      1.) General Electric Lighting.
      2.) Philips Lighting.
      3.) Osram Sylvania.

9) HID Lamps
   a) Metal-Halide Lamps: ANSI C78.43, with minimum CRI 80 and color temperature 4100K.
   b) Pulse-Start, Metal-Halide Lamps: Minimum CRI 80, and color temperature 4100 K.
   c) Ceramic, Pulse-Start, Metal-Halide Lamps: Minimum CRI 80, and color temperature 4100 K.

26 55 61 Theatrical Lighting

This section might be used in future projects. Verify with Nova Southeastern University Facilities Design and Construction.

26 56 00 Exterior Lighting

Design Standards

1. Open parking lots and access thereto shall be provided with a maintained minimum of 1 foot-candle on the parking surface from dusk until dawn; provided, however, the lighting level may be reduced by fifty (50) percent on non-business days and commencing thirty (30) minutes after the termination of business on each operating day. The uniformity ratio shall not exceed a twelve to one ratio (10:1) maximum to minimum foot-candles (per I.E.S).

    a. Design exterior lighting so that all site and building-mounted luminaires produce a maximum initial illuminance value no greater than 0.10 horizontal and vertical footcandles at NSU property boundary and no greater than 0.01 horizontal footcandies 10 feet beyond NSU property boundary. Document that no more than 2% of the total initial designed fixture lumens (sum total of all fixtures on site) are emitted at an angle of 90 degrees or higher from nadir (straight down). (per LEED v2009 - Confirm with current version at project time).

    b. All campus signage including building names, shall be illuminated. Light levels shall be per current IES Standards. Lighting power densities shall comply with current Florida Building Code and current ASHRAE 90.1 used by USGBC (LEED).

    c. Outdoor automatic teller machines (ATMs) shall comply with Florida Statute 655.960.

        (1) There shall be a minimum of 10 candlefoot power at the face of the automated teller machine and extending in an unobstructed direction outward 5 feet.

        (2) There shall be a minimum of 2 candlefoot power within 50 feet in all unobstructed directions from the face of the automated teller machine. If the automated teller machine is located within 10 feet of the corner of the building and the automated teller machine is generally accessible from the adjacent side, there shall be a minimum of 2 candlefoot power along the first 40 unobstructed feet of the adjacent side of the building.

        (3) There shall be a minimum of 2 candlefoot power in that portion of the defined parking area within 60 feet of the automated teller machine.

        (4) The operator shall provide reflective mirrors or surfaces at each automated teller machine which provide the customer with a rear view while the customer is engaged in using the automated teller machine.

        (5) The operator, or other person responsible pursuant to ss. 655.960-655.965 for an automated teller machine, shall ensure that the height of any landscaping, vegetation, or other physical obstructions in the area required to be lighted pursuant to subsection (1) for any open and operating automated teller machine shall not exceed 3 feet, except that trees trimmed to a height of 10 feet and whose diameters are less than 2 feet and manmade physical obstructions required by statute, law, code,

ordinance, or other governmental regulation shall not be affected by this subsection. (per 2010 Florida Statutes 655.962).

2. In-ground lighting fixtures are not allowed.

3. All lighting projects shall include photometric study.

4. Provide independent service meters for new parking lot and campus lighting zones.

5. No incandescent or sodium lamps allowed.

6. All exterior light to be full cut-off, horizontal mount, zero sky pollution, glare free.

7. Parking lots and streets 4000K light color temperature or approved alternate options by Nova Southeastern University.

8. Pathways and plazas: 3000K light color temperature or approved alternate options by Nova Southeastern University.

9. Landscape lighting: 3500K light color temperature or approved alternate options by Nova Southeastern University.

10. All fixtures wired for 350ma current for maximum durability.

11. Tree limb mounted LED “moonlighting” (6000K) consider on a per project basis.

12. Roadway / Parking Vehicular: Gardco Gullwing GL 18 fixture. 255W, maximum 4000k. Fixture Finish: Silver RAL 7038. 25’-0” tall mounted on concrete pole (no paint finish).

13. Decorative Vehicular: Custom Solera SR8-O fixture, Opal acrylic cylindrical lens, 60LED, WW-3000k. Mounted on powder coated steel pole, silver/ RAL 7038 or approved alternate options by Nova Southeastern University.

14. Pedestrain Walk/ Plaza Fixture (Poles):

    a. Custom Solera SR8 fixture, Opal acrylic cylindrical lens, 60LED, WW-3000k. Mounted on powder coated steel pole, silver/ RAL 7038.
    b. Lumenton PT970 (or PT275) fixture. Clear polycarbonate lens, 53W LED, WW-3000k. Mounted on powder coated steel pole, silver/ RAL 7038.

15. New exterior light fixtures and arms: factory coating color: RAL 7038.

16. Retrofit fixtures, parking lots, streets / conc. poles: Concrete natural finish allowed if small quantities. Full lot/ street retrofit, factory coating color: RAL 7038.

17. Retrofit fixtures, parking lots, street/ aluminum poles: match existing fixture finish if small quantities. Full lot/ street retrofit, factory coating color: RAL 7038.

18. Bollard light fixtures: Gardco BRM837B, bevel top w/ factory coating color RAL 7038, concrete base, 42”H, LED. Alternate fixtures require approval by Nova Southeastern University Facilities Design and Construction (NSUFDC).

19. Landscape up lights: Provide 8”DIA conc. mount base 12”AFF or approved alternate options by Nova Southeastern University..

20. In-ground lighting fixtures prohibited.

Product Standards

1. All vehicular poles shall be precast concrete 25' high above finish grade with 2 internal 3/4" conduits, 2-3/8” dia. tenons, and a secondary J.B. 36” below the top for CCTV use. No paint finish.

2. All exterior lighting sources shall be induction, CRI 80 (minimum) and minimum rated life of 100,000 hours, or LED, CRI 80, 50,000 hours.

3. All exterior lighting fixtures subject to physical damage shall be vandal and windstorm resistant. Fixtures shall be classified by the fixture manufacturer as “vandal resistant.”

Performance Standards

1. A drawing is required depicting computer generated photometric footcandle calculations showing maintained light levels on a 10’ x 10’ grid for all parking and pedestrian area projects.

2. Exterior or parking garage lighting shall not be placed in permanent use until a letter of compliance from a registered professional engineer has been provided stating that the installation has been field checked and meets Broward County requirements.

26 56 68 Exterior Athletic Lighting

This section might be used in future projects. Verify with Nova Southeastern University Facilities Design and Construction (NSUFDC).

END OF DIVISION 26.

DIVISION 27 COMMUNICATIONS

27.1 General Requirements

This division identifies criteria for the selection of communications systems in Nova Southeastern University Buildings with the purpose of establishing minimum standards, acceptable to Nova Southeastern University (NSU), to be used as the basis of design for NSU Main Campus, Fort Lauderdale, Florida. NSU experiences with various materials, products and installations have led to the procedures and practices noted under this Division 27.

Division 27 “Communications” systems/products shall be selected to provide a safe, secure and controlled campus environment for all students, employees and users of the Nova Southeastern University facilities in a manner that strives to enhance the safety as well as the use of technology for effective communications where appropriate.

Nova Southeastern University Campus and NSU buildings electronic safety and security systems/products shall be designed to comply with the following objectives for both renovations and new facilities scopes:

1. Sustainable design, using sustainable products. At a minimum, all new facilities and renovations must meet LEED "silver" standards.
2. Sustainable Design, reducing total building energy consumption.
2. Users ease and comfort.
3. Easy of maintenance.
4. Solutions with the best value considering a life cycle cost analysis to account for total project cost.

The design of the electronic communication systems and products shall be selected to produce a building that meets the project's programmed sustainability rating ("Silver" LEED rating) when applicable and possible under the proposed design solution provided by all Design Professionals.

At the Nova Southeastern University's discretion prior to the commencement of construction on new buildings and/ or major renovations, the Contractor shall provide a drawing for each building floor level showing coordination of all structural, architectural and MEP items. This includes but is not limited to: Structural members, floor plates, architectural ceilings, soffits, smoke barriers, fire walls, vertical shafts, sleeves, fire dampers, HVAC ductwork and equipment, plumbing piping and equipment, fire protection piping and equipment, alarm systems, communications, electrical distribution and equipment, lighting, controls, BMS, lighting protection, security systems, etc.

27.1.1 Submittals

Submittals shall include product data, shop drawings, samples and coordinated shop drawings including all disciplines using same spaces.

27.1.2 Workmanship requirements

Refer to specific requirements under each section included herein.

27.2 Performance Requirements

The Design professional shall provide the Nova Southeastern University with a complete operational data communication system with integration using an EIA / TIA 568-B.2-1, Category 6 Structured Cabling System (SCS) with all the accessories and a minimum 25 year "link and channel warranty" for the complete and entire system. The indicated warranty shall provide for a guaranteed system performance while providing for labor and material to replace or re-install any defective component or accessory. The objective is to provide an enhanced PDS system that will serve Nova Southeastern University for the transfer of data, video and voice telephony signals throughout the indicated building or buildings from a designated point of service to outlets located at desks, workstations and other designated locations.

The systems shall be installed in such a manner to support all analog and digital voice applications, data, local area networks (LAN), wireless local area network (WLAN), Metro Area network (MAN), Wide Area Network (WAN) video and low voltage devices for building controls and management on a common cabling platform.

27.3 Codes and Standards

Electronic communication systems/ products shall comply with the requirements of the applicable authorities having jurisdiction including but not limited to the following:

1. ADA-American with Disabilities Act.
2. ANSI/ NECA / BICSI Standard, current release for Installing Commercial Building Telecommunications Cabling.
3. BICSI Customer Owned outside Plant Design manual, current published edition.
4. BICSI Telecommunication Cabling installation manual, current published edition.
5. Building industry Consulting Service international (BICSI), BICSI Telecommunications Distribution Design Manual, current published edition.
6. Town of Davie Building Code and Ordinances.
7. Electronic Industry Association / Telecommunication Industry Association, ANSI / TIA/ EIA current release, Commercial Building Telecommunications Cabling Standards.
8. Electronic Industry Association / Telecommunication Industry Association, ANSI / TIA/ EIA current release, Commercial Building Standard for Telecommunications Pathway and Spaces.
9. Electronic Industry Association / Telecommunication industry Association, EIA/ TIA, current release, Administration Standard for the telecommunications infrastructure of Commercial Buildings.
10. Electronic Industry Association / Telecommunication industry Association, EIA/TIA-607 Commercial Building Grounding and Bonding requirements for Telecommunications.
11. Federal Communications Commission 47 CFR 68.
12. Florida Building Code 5th Edition (2014).
13. Florida Fire Prevention Code (FFPC)-2014
14. Institute of Electrical and Electronics Engineers (IEEE): National Electric Safety Code.
15. NEMA – 250.
16. NFPA 70 -2002, Including.
    a) NEC – Article 770
    b) NEC – Article 800
17. Underwriter's Laboratory
18. Standards included under each section.

Where discrepancies exist or occur as to the applicability of the code and standards, the most stringent requirements will be adhered to by the successful contractor.

27.4 Nova Southeastern University Telecommunication Networking Standards

27.4.1 NSU Standard Networking Protocols

The network equipment in use at Nova Southeastern University must support standards-based protocols and industry best-practices to allow for inter-system compatibility and network stability.

1. Layer 2 – Local Area Network (LAN) and Wireless Local Area Network (WLANs). Network equipment supporting the LAN and WLAN at Nova Southeastern University must support Standards-based protocols, including but not limited to:

a) IEEE 802.1Q – Vlan Tagging
b) IEEE 802.1d – Spanning Tree Protocol (STP)
c) IEEE 802.1w – Rapid reconfiguration of Spanning Tree Protocol (RSTP)
d) IEEE 802.1s – Multiple instances of Spanning Tree Protocol (MSTP)
e) IEEE 802.1AB – Link Layer Discovery Protocol (LLDP)
f) LLDP-Media Endpoint Detection (LLDP-MED)
g) IEEE 802.1p – Class of Service (CoS) prioritization
h) Differentiated Services Code Point (DSCP)
i) IEEE 802.3af – Power over Ethernet
j) IEEE 802.3at – Power over Ethernet Plus
k) IEEE 802.3ad – Link Aggregation Control Protocol (LACP)
l) IEEE 802.1X – Port Access Control
m) IEEE 802.3 – 10BASE-T
n) IEEE 802.3u – 100BASE-T
o) IEEE 802.3ab – 1000BASE-T
p) IEEE 802.3z – 1000BASE-X
q) IEEE 802.3ae – 10 Gigabit Ethernet
r) IEEE 802.3x – Pause Frames/Flow Control
s) ITU-T G.8032 – Ethernet ring protection switching
t) IEEE 802.1ad – Q-in-Q
u) IEEE 802.11-2012 (including all amendments up to 2012)
v) RFC 1112, 2236, 3376 – IGMP (Internet Group Management Protocol) versions 1-3.

2. Layer 3 Routing (IPv4) – Metro Area Network (MAN) and Wide Area Network (WAN) Network equipment supporting the MAN and WAN at Nova Southeastern University must support standards-based protocols, including but not limited to:

a) RFC 2328 – OSPF version 2
b) RFC 1771 – BGP-4
c) RFC 1195 – IS-IS
d) RFC 5798 – VRRP – Virtual Router Redundancy Protocol versions 3
e) PIM-SM – Protocol Independent Multicast – Sparse Mode
f) PIM-SSM – Protocol Independent Multicast – Source-Specific Mode,
g) PIM-DM – Protocol Independent Multicast – Dense Mode

3. Layer 3 Routing (IPv6) – Metro Area Network (MAN) and Wide Area Network (WAN) Network equipment supporting the MAN and WAN at Nova Southeastern University must support standards-based protocols, including but not limited to:

a) RFC 1195 – IS-IS
b) RFC 5340 – OSPF version 3

c) RFC 3056 – BGP4+
d) RFC 2710 – MLD
e) RFC 3810 – MLDv2

4. Manageability, Troubleshooting and Security
Network equipment supporting Nova Southeastern University network must use standards-based and/or industry standards for manageability, monitoring, troubleshooting and security. These standards include but are not limited to:

a) RFC 2925 – MIB for Remote Ping, Trace
b) RFC 3176 – sFlow
c) RFC 2030 – SNTP, Simple Network Time Protocol
d) RFC 854 – Telnet client and server
e) RFC 4253 – SSHv2
f) RFC 1905, RFC 1907 – SNMP v2c, SMIv2 and revised MIB-II
g) RFC 2570 – 2575 – SNMPv3, user based security, encryption and authentication
h) RFC 2576 – Coexistence between SNMP Version 1, Version 2 and Version 3
i) RFC 1212, RFC 1213, RFC 1215 – MIB-II, Ethernet-Like MIB & Traps
j) IEEE 802.1X – Port access control
k) RFC 2138 – RADIUS authentication (based on host MAC address)
l) RFC 2139 – RADIUS accounting
m) RFC 3579 – RADIUS EAP Support for 802.1X
n) RFC 1350 – TFTP
o) RFC 792 – ICMP
p) HTTP/HTTPS
q) Access Control Lists (ACLs) and/or Firewall Filters Syslog

27.4.1 Technology Features and Innovations

The network equipment in use at Nova Southeastern University must include feature-rich and innovative solutions that will support the mission of both Information Technology and the established goals and objectives of Nova Southeastern University.

1. General:
   a) General vendor ability to provide feature-rich and technology-scalable solutions.
   b) Ability to provide high-speed connectivity with no or minimal port over-subscription.
   c) Ability to provide highly available solutions with features including, but not limited to:
      1. Hitless-failover.
      2. Redundant hot swappable components.
         In-service software upgrades .

2. Layer 2 – Local Area Network and Wireless Local Area Network.

a) Port-based VLAN
b) MAC-based VLAN
c) Voice VLAN
d) Routing policy
e) RADIUS-based VLANs

3. Layer 3 – Metro Area Network and Wide Area Network
   a) Static routing
   b) Routing policy
   c) Bidirectional Forwarding Detection

27.5 Nova Southeastern University Telecommunication Wiring Standards-Conduit System

27.5.1 Outside Conduit

1. Underground Conduit:
   a) Where underground ducts are required, the duct type will be a minimum of 4-4 inch of corrosion resistant conduit (fiber, fiberglass, concrete, rigid galvanized metal or rigid and non-rigid non-metallic) for entrance into the building. All ducts are to contain a plastic or nylon line with a minimum of 200 lbs of pulling tension. A #10 copper tracer wire shall be installed in conduit duct bank in order to maintain traceability for any future excavation and demolition work. This shall be a requirement by Nova Southeastern on all scope related to this division.
   b) Conduit runs shall have no more than 180 degrees of bend between pulling points which should not exceed 600 feet. Bend radiuses must be no less than 10 times the inside diameter of the conduit except where specified.
   c) Conduits should have a minimum of 24 inches of covered earth with a spacing of 1 inch between conduits filled in with sand or pea rock. A protective blanket of at least 2 inches of sand or pea rock must be above and below the conduit (s).
   d) A buried marker tape is to be placed 12 inches below grade. The warning tape can be non-detectable or detectable.
   e) Separation Requirement of communication conduit from power is 3 inches of concrete or 12 inches of well tempered earth and the separation requirement from pipes (gas, oil, water) is 6 inches when crossing and 12 inches when parallel.
   f) Only rigid conduit shall be used for all conduits emerging from concrete or on grade substrate.

2. Man Holes and Hand Holes
   a) Man-holes (MH) should be of a minimum of 6 feet by 12 feet with a depth of 9 feet and OD height of 8 feet 1 inch. All frames and covers used to be used in roads or driveways must be traffic rated. All covers must have the appropriate identifications (e.g. T-Telephone).

b) The concrete strength used for MH's should be at a minimum of 3,480 psi and the MH's are to be placed on 6 inches of rock or sand to ensure uniform distribution of soil pressure on floor.

c) All MH hardware must be galvanized and equipped with bonding inserts, struts for racking pulling eyes with a minimum of 7/8 inch in diameter, a slump of a minimum 8 inch diameter an entry ladder and noncorrosive metal tag in MH collar that denotes MH size and volume. All holes must have plugs in place when not being occupied and properly sealed when occupied.

d) Most hand-holes (HH) will be Brooks series 200 48" x 30" or equivalent. All HH's are to be placed on 6 inches of rock or sand to ensure uniform distribution of soil pressure on floor. All frames and covers used to be used in roads or driveways must be traffic rated.

27.5.2 Intra-Building Conduit

1. Backbone Riser Conduit:

a) Conduit systems within a building are to be constructed using EMT or IMC (where applicable) type pipe. Systems shall consist of no bend greater than 90 degrees or aggregate of 180 degrees between pull points or pull boxes. Conduits must be bonded to ground on one or both ends. On runs of more than 100 feet in lengths pull boxes or pull points should be inserted. The pull point must be a pull-box, constructed of galvanized steel that will accommodate a worst case bend radius of 10 x the diameter of the conduit. (Example: for a 4" conduit the smallest pull box radius would be 40").

b) Vertically aligned communications riser closets should have a minimum of 4-4" for 40,000 sq ft. of usable floor space between each closet. Slots are to have a minimum of 1 inch high curb and sleeves are to extend 1 inch above the floor level and will be located adjacent to a wall on to which the cable can be supported. The proper firestopping is to be maintained at all times.

2. Station Conduits

a) Station location conduits are to be 1 inch or 1 ½ inch with 4 inch by x4 inch by 2 ½" deep 1900 type outlet boxes. It is preferred not to have these located on outside walls.

The station conduits must comply with one of the following:

b) Home run to the Communications Closet serving the location. If using this method, the conduit shall have no more than two pull points. Each section between pull points shall have no more than 180 degrees of bend and shall not exceed a maximum length of 100 feet. Conduits must have a pull string in each section. (NO CONDULETS or LBs).

c) Stubbed up above the acoustical drop ceiling.

d) Placed in the slab with no more than 180 degrees of bend, with a maximum length of 100 feet.

e) The bend radius must be at least six times the inside diameter of the conduit for conduits under 2 inches.

f) All conduit ends should have connectors, bushings and be equipped with a pull string in each section.

27.5.3 Telecommunication Spaces

1. Equipment Room

   a) The equipment room (ER) must meet EIA/TIA 569 Commercial Building Standard for Telecommunications Pathways and Spaces and will be capable of accommodating future growth, spaced for required equipment. The minimum shall comply with the requirements of industry standards and code requirements where indicated. But, in space allotted for the ER should be not less than 10 feet by 16 feet. The ER should have access for the delivery and installation of large equipment and cables with proximity to electrical services mechanical equipment. The ER room must also provide an environment that supports the data network distribution such as switches, routers…etc. The location of the ER should have access to service entrances for telecommunications, electrical power and proper ventilation/ cooling per requirements of the applicable building code.

   Equipment Room minimum requirements are as follows:

   1. Floor Requirements:
      a) Minimum commercial floor loading of 50 to 250 pounds per square foot and for distributed loading it must be greater than 100 pounds per square foot. The rating for concentrated loading is 2,000 pound per feet. The floor must be level within 1/8 inch over 8 linear feet distance.

      b) Floor surface must be free be within the EIA/TIA 569 Vibration design limits of 5-22 Hz .01 inches double amplitude displacement, 22-500 Hz 0.25 g peak acceleration and 500-22 and 22-5 Hz 0.25 g peak acceleration inches double amplitude displacement.

      c) The surface should be covered with a material that is durable and dust free (linoleum or paint), no carpet is permitted.

   2. Uniform illumination of 50 foot-candles at a height of 3 feet (0.9m) above the floor. Suspended overhead lighting should, when possible, maintain 11 inch (279.4 mm) clearance from the communications equipment including cable supporting hardware. Lighting fixtures should be at a minimum of 8.5 feet AFF.

   3. Walls and ceiling must be sealed and dust free. They must be painted a light color as to aid in the illumination of the room, white is the preferred color unless specifically indicated otherwise and approved by Nova Southeastern University. All the walls must be covered from floor to ceiling with ¾ inch A/C grade or better, void free plywood back board with the C grade facing the wall. The plywood backboard should be painted on all six sides with a fire retardant paint color; black is the preferred color to be used.

   4. Doors must have a minimum height of 84 inches (2,134 mm) and a minimum width of 36 inches (914 mm). The door and frame should provide adequate security and prevent outside dust from entering the room. When possible the door should swing out so as to allow maximum use of the interior space of the telecommunications room.

   5. All TR's require a maintained controlled environment, in which heating and A/C must be able to provide an ambient temperature between 64°F and 75° F with a relative humidity range of between 30 and 55 percent, 24 hours a day 7 days a week.

6. A 12 lug grounding bar must be installed in an accessible location and attached to the building common ground with a number 6 AWG solid or larger wire.

7. Electrical
   a) The room must have a minimum of at least three (3), (L6) 30 amp. mounted on the rack dedicated, non-switched alternating current (ac) duplex receptacles for equipment power. Separate duplex convenience receptacles for use by technicians for tools, instruments…etc. These should be 6 inches above finished floor (AFF) and placed at 6 feet intervals around inner walls. When a UPS is provided the outlets should be feed from the specified Power Distribution Unit (PDU), which is purchased and installed by NSU Telecom.

   b) Any equipment within the ER must be in accordance with the manufacturer's specifications and Nova Southeastern University Design Criteria for use.

   c) If the building has a backup generator with sufficient capacity, the room's electrical service should be included in the generator's configuration and load.

8. Fire Suppression
   a) Sprinkler Heads: must be set to operate at temperatures of 212° F or higher.
   b) It is preferred that the supply pipe to the sprinkler heads have a Pre-Action System installed.

27.6 Nova Southeastern University Telecommunication Wiring Standards-Cabling and Wire

27.6.1 Copper Distribution Cables

1. Copper Distribution Cable Specifications:

   All telephone voice grade cable is to be solid bare copper 24 AWG wire with an inner layer of foam insulation covered by an outer layer of telephone industry accepted color coded solid colored polyolefin jacket. The outer sheath must have an identification marker including Manufacturing ID, pair, count and gage and footage. The identification marker must appear every 2 ft.

   In buried underground and grade level floor slabs applications consider "wet" locations, the cable is to be filled with a compound that aids in the prevention of moisture penetration, an electrically continuous corrugated metallic turn-plate, and an outer black polyethylene sheath.

   Riser cables shall have the proper UL fire rating sheath (riser rated in conduit or stacked riser system and plenum rated when installed in a return air plenum area) and an electrically continuous corrugated metallic turn-plate.

2. Placing Copper Distribution Cable:

   Placement of copper cable shall be performed in compliance with manufacturer's recommendations. Any cable damaged during placement will be replaced by the contractor at no cost to Nova Southeastern University. Bend radius should not be less than eight times the diameter of the cable.

3. Splicing and Termination of Copper Distribution Cable:

    a) All copper splicing shall be performed with Lucent Technologies 710 splicing modules.
    b) Splices must be properly bonded, cased, and encapsulated when applicable.
    c) All cables must be properly supported in buildings & man-holes according to industry standards.
    d) Splices shall be set up using the fold-back method.

The termination of entrance cables will be done as follows:

1. In Building Entrances, where required, 190 type protector tails will terminate on 66M1-50's mounted to 183-A-2 or 183-B-2 green backboards equipped with 89B brackets.
2. In the MDF's 190 type protector tails will terminate on 110 blocks mounted to a distribution frame Chatsworth.
3. Splice closures must have vacant holes plugged and cable entrances must be sealed properly with washers, sealing tape and cord.

4. Grounding and Bonding

    Grounding shall meet the appropriate NEC requirements and practices except where other authorities or codes impose a more stringent requirement or practice. When compatible with required electrical codes, the grounding instructions and requirements of the equipment manufacturer should also be followed. Each and every communications closet shall have an appropriate access to the building common ground. All equipment and hardware must be connected to the building common ground in accordance with manufactures specifications a minimum number 6 AWG solid wire must be used in grounding applications.

5. Entrance Cable Protection

    All copper telephone cables, underground buried or aerial ,that are placed between unattached buildings must be protected on each end with the use of proper cable pair protection equipment. Cable pair protection must be Circa 190 Type or if an entrance cable is 100 pairs or less 189 type protectors may be used. All protectors must be properly grounded and bonded.

6. Tagging and Labeling
    a) All cables entering a building must be tagged and labeled.
    b) All cables entering a communication closet must be tagged and labeled.
    c) All cables placed underground will be tagged and labeled in each Man-hole or Hand-hole through which it passes.
    d) The tag shall contain such information as cable designation and count; example: Centrex 5 cable, pairs 1 to 300 would read CEN 05:1-300.
7. Testing & Acceptance
    a) An end-to-end continuity test must be performed on all cable pairs.

b) A loop resistance test must be performed on one pair in each 25 pair compliment. Loop resistance shall not exceed 27.3 ohms per kft.
c) An insertion loss test must be performed on one pair in each 100 pair compliment. Attenuation loss shall not exceed 5.6 dB per kft @ 68°F on filled cable and 5.9 dB per kft on air core riser cable.
d) Test results are to be furnished in spread sheet form to the Nova Southeastern University Department of Telecommunications.

27.6.2 Fiber Optic Cable

1. Fiber Optic Cables Specifications
   Fiber optic cables may contain a different configuration of Multi-Mode and Single Mode fibers within the same outer sheath. In buried or underground applications the cable is to be of loose tube construction with the tubes having a fill compound that aids in the prevention of moisture penetration. The cable must have a dielectric strength member that is continuous. The outer sheath shall be a black polyethylene sheath. The fibers in the cable may be comprised of one or both of the following types:

   - Multi-Mode fiber OM3 or better
   - Single-Mode Fibers must be 8.3 m core with 125 m cladding.

2. Placement of fiber cable shall be performed in compliance with manufacturer's recommendations. Any cable damaged during placement will be replaced by the contractor at no cost to Nova Southeastern University. It is required to have 20 foot slack loop in each Man-hole and a 30 foot slack loop in each end.

3. Fiber Optic Connectors & Termination Methodology
   All fiber optic connectors will be Leviton "LC", ceramic or composite, Epoxy Heat, UV Cured or mechanical. All fiber optic connecting hardware, connectors, cable, etc., will be installed and terminated abiding with all pertinent standards, codes and manufacturers recommended installation procedures. The termination methodologies acceptable are UV, Heat Cured or Cam Locking Mechanical. Only a dB loss of 0.75 or less per connector or 1.5 dB per connector pair will be acceptable.

4. Fiber Optic Connecting Hardware
   All fiber optic connecting hardware will be by Leviton and will be identified in the scope of work. (Refer to Hardware and Material specifications) Example: WCH, CCH, PCH etc.

5. Tagging and Labeling
   Fiber cables entering a building or entering a Communication Closet will be tagged and labeled. Cables placed in the underground will be tagged and labeled in each Man-hole or Hand-hole through which it passes. The tag shall contain such information as cable designation and count. The tags are to be yellow and shall read in bold letters "FIBER OPTIC CABLE".

6. Testing & Acceptance

   MULTIMODE BACKBONE FIBER
   Unidirectional insertion loss (Power Meter) attenuation test; @ 850 nm and 1330 nm wavelength and unidirectional OTDR test @ 850 nm and 1330 nm wavelength on each Multimode fiber. Each fiber shall not exceed 3.5 dB per km and must provide a minimum of 160 MHz of bandwidth per km @ 850 nm. Also, each fiber shall not exceed 1.5 dB per km and must provide a minimum of 500 MHz of bandwidth per km @ 1330 nm.

   SINGLEMODE BACKBONE FIBER
   Unidirectional insertion loss (Power Meter) attenuation test; @ 1300 nm and 1550 nm wavelength and unidirectional OTDR test @ 1300 nm and 1550 nm wavelength on each Single mode fiber. Each fiber shall not exceed 1.5 dB per km @ 1300 nm. Also each fiber shall not exceed 1.25 dB per km @ 1550 nm.

   Premises optical fiber links should be tested bidirectional and at their two corresponding wavelengths (multimode at 850 nm and 1300 nm; single-mode at 1310 and 1550nm). Because length and potential number of connections and splices vary depending on site conditions, an attenuation equation is used to determine worst-case acceptance values based on standard component requirements at applicable wavelength.

7. Performed test results are to be furnished to Nova Southeastern University Department of Telecommunications in spread sheet form.

8. Fiber optic cable will be Berk Tek. If any deviation is intended. Nova Southeastern University Department of Telecommunications will be notified prior and any other manufacturer and the installing contractor must be able to provide an manufacturer extended warranty if approved by Nova Southeastern University.

27.6.3 Horizontal Station Wiring

1. Voice Cable:

   All voice station wiring shall be Cat 6 four pair with plenum jacket and conform to EIA / TIA 568 "Commercial Building Wiring Standard". In the Fort Lauderdale Campus the jacket must be green in color.

2. Voice Cable Termination:

   Voice station cables are to be terminated in the communications closet on 66M1-50 blocks, the termination blocks are to be mounted to 183-A-1 or 183-B-1 (Blue) back boards. Cables are to be neatly routed with the use of D Rings. Wire management shall be provided above and/or below the termination field.

   The station end of the cable will be terminated on an "Information Outlet" in compliance with the 568B wiring standard using the hardware specified in the scope of work. (Refer to NSU Division 08 “Openings” Hardware and Material Specifications.).

3. Voice Cable Testing & Acceptance:

   Voice cables are to be tested end-to-end for continuity and compliance to 568B wiring pin configuration standard.

4. Data Cat 6 Cable:

   All Data Cat 6 cables shall have a plenum jacket, blue in color for Fort Lauderdale Campus and blue in color for other applicable campuses as needed and comply with and be installed in accordance with EIA/TIA 568 "Commercial Building Wiring Standard" and EIA/TIA TBS 36 "Telecommunications Systems Bulletin-Additional Transmission Specifications for Unshielded Twisted Pair Connecting Hardware.

5. Data CAT 6 Cable Termination:

   Data cables are to be terminated in the communication closet onto a CAT 6 patch panel, angled High Density (HD) patch panels on the station side they are to be terminated in an "Information Outlet" equipped with Cat 6 RJ45 Outlet using the 568B wiring standard and black RJ45 jacks.

   PATCH PANELS:

   Cat 6 patch panels shall be equipped with 8 pin RJ45 CAT 6 modular jacks and comply with EIA/TIA 568 "Commercial Building Wiring Standard" and EIA/TIA TBS 36 "Telecommunications Systems Bulletin-Additional Transmission Specifications for Unshielded Twisted Pair Connecting Hardware." The wiring scheme is to be 568 B. Angled High density patch panels are required.

   INFORMATION OUTLETS:

   “Information Outlets” will use 8 pin RJ45 non-keyed modular jacks for voice cables and CATEGORY 6, 8 pin RJ45 non keyed modular jacks for data cables. Only twelve inches of slack should exist at the Information Outlet with no more than 2.5 inches of sheath (jacket) removed for termination. The individual cable pairs must not be untwisted more than 1/2 inch from termination block. If ICONS are used, blue will designate voice and red will designate data. The wiring scheme is to be 568 B.

6. Data Cat 6 Cable Testing & Acceptance

   Category 6 cables are to be tested end-to-end for continuity and compliance with EIA/TIA specifications and to 568-A standards. Category 6 must meet the Basic Link Test. at a length of 90 meters, cable attenuation, using 1 mw, should not exceed the dB loss table:

ATTENUATION	
Frequency	**Loss**
1.0	2.1
4.0	4.0
8.0	5.7
10.0	6.3

NEXT (worst Pair to	
Frequency	**Loss**
1.0	60.0
4.0	51.8
8.0	47.1
10.0	45.5

16.0	8.2
20.0	9.2
25.0	10.3
31.25	11.5
62.5	16.7
100.0	21.6

16.0	42.3
20.0	40.7
25.0	39.1
31.25	37.6
62.5	32.7
100.0	29.3

7. Data Multimode Fiber to the Station

   a) Data Multimode Fiber Optic Cable:

   Data fiber cable to the station is to be a manufacturered Berk Tek cable with plenum jacket contain two 125 micron Multimode fibers.

   b) Data Multimode Fiber Optic Cable Termination: Terminations will be made with LC-type or LC-type connectors. In the communication closet connectors are to be terminated onto a fiber optic patch panel. The station end connectors are to be terminated onto an IO (information outlet). Fiber termination's are to be done with Leviton, LC-type connectors.

   c) Data Multimode Fiber Optic Cable Testing & Acceptance:

   Unidirectional insertion loss (Power Meter) attenuation test; @ 850 nm. Each fiber shall not exceed 3.5 dB per km and must provide a minimum of 160 MHz of bandwidth per km @ 850 nm. Only a dB loss of 0.75 or less per connector or 1.5 dB per connector pair will be acceptable.

   Test results are to be furnished to The Nova Southeastern University Department of Telecommunications in spread sheet form.

8. Tagging and Labeling

   All Voice and Data cables shall be tagged and labeled within 6 inches of each end. Labeling must conform to the Nova Southeastern University labeling scheme which allows importation into Facilities Management module.

JACK FIELD POSITION DEFINITION

POSITIONS: 1 - 4 Building Code

Standard building abbreviations will be used. If a building's abbreviation is only three digits then an X will be added to the building abbreviation.

5 - 9 Building Room Number

All rooms will be entered as five digits. If a building uses a three digit numbering scheme then leading zeroes will be added to the room number.

10 a hyphen "-"

11 Jack Type Code

"V" - Voice

"K" - Key Systems

"D" - Data

12 - 17 VARY DEPENDING OF JACK TYPE CODE (AS DEFINED IN POSITION 11)

VOICE (V):

- The first, second and third position contain the jack number.
- The three digit number will be assigned to the jack by the technicians.
- Positions four, five and six currently not used.

Example: ASHE00235-V017

Building: ASHE

Room: 00235

Jack Type: V

Jack Number: 17

KEY (K): Five digit alphanumeric code that will be assigned to the jack by the technicians.

- The first and second digits will indicate the 620 panel number.
- The third digit will be the 620 panels quadrant identifier.
- Each 620 panel in a phone closet has four quadrants.
- Each quadrant is labeled from left to right; top to bottom.
- Top Left (A), Bottom Left (B), Top Right (C), Bottom Right (D).
- The fourth digit will indicate line appearance.
- There are up to two lines in each quadrant.
- The fifth and sixth positions are currently not used.

Example: NSUC3033A-K05C1

Building: Nova Southeastern University Clinics (NSUC)

Room: 3033A

Jack Type: K

Panel Number: 05

Quadrant: C

Line Appear: 1

DATA (D): Five digit alphanumeric codes will be assigned to the jack by the technicians.

- The first digit will define the type of service being fed to the jack.
  F fiber

  T twisted pair

- The second digit will define the type of device connected to or being fed by the data circuit.
  P patch panel

  C controller

  X other

- The third and fourth digits will contain the two digit number assigned to the patch panel or controller by the technician.

- The fifth and sixth digit is the two digit jack number.

  Example: HABA00235-DFP0294

  Building: Horvitz Administration Building Ancillary

  Room: 00235

  Jack Type: D

  Service Type: F

  Data Device: P

  Patch Panel #: 02

  Jack Number: 94

  Proper labeling is required on Information Outlets (Jacks), Voice termination blocks and Data termination hardware.

Any non-compliant cables and hardware will be replaced at no cost to the Nova Southeastern University.

27.7 Nova Southeastern University Telecommunication Wiring Standards-Firestopping

27.7.1 Riser Cables

1. Riser Cables
   All riser cables are required to be fire stopped using mineral or ceramic fiber and fire clay or putty. A cementitious material may also be used.

2. Entrance Cable
   All entrance cables are required to be fire stopped using mineral or ceramic fiber and fire clay or putty. A cementitious material may also be used.

3. Firewall Penetrations
   All firewall penetrations must be done in accordance with practices as not to violate the rating of the wall.

4. All Fire-stop material must be UL classified, and installed in compliance with NEC, NFPA and any applicable building codes.

27.8 Design Criteria

Refer to specific requirements under each section included herein.

27.9 Specific requirements (organized by CSI Master Format® 2013 Numbers & Titles)

27 05 28	Interior Communication Pathways
27 05 43	Exterior Communication Pathways
27 08 00	Testing, Identification and Administration
27 11 00	Telecommunication Rooms
27 11 13	Equipment Rooms and Service Entrances
27 13 00	Communication Backbone Cabling
27 15 00	Communication Horizontal Cabling

27 05 28 Interior Communications Pathways

Design Standards

1. The intent of these standards is to provide general guidelines on the design and provision for electronic communication components of the site, building scope. These standards shall not supersede code and regulations nor relieve the Architects from their professional responsibility. This section includes minimum requirements for the following:
   a) Interior Horizontal Cabling Communication Pathways.
   b) Interior Backbone Cabling Communication Pathways.

Component Standards-Minimum

1. Minimum composition requirements and installation methods for the following pathways:
    a) Conduit
    b) Innerduct
    c) Sleeves
    d) Cable tray
    e) Cable hangers
    f) Wireways and wire troughs
    g) Power/communication poles
    h) Under floor duct
    i) Floor Boxes and Poke Through
    j) Surface Raceways – Metallic
    k) Surface Raceways – Non-Metallic
    l) Outlet Boxes
    m) Related Sections include the following:
        1) 17150 Backbone Cabling Requirements
        2) 17160 Horizontal Cabling Requirements

Performance Standards- Minimum

1. All pathways and associated equipment shall be installed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of The Nova Southeastern University Department of Telecommunications. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based upon the acceptable manufacturers listed. Where "approved equal" is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval.

2. Materials and work specified herein shall comply with the applicable requirements of:
    a) National Electric Code (NFPA 70) including the following Articles:
    b) 318 - Cable Trays
    c) 331 - Electrical Nonmetallic tubing
    d) 348 - Electrical metallic tubing
    e) 349 - Flexible metallic tubing
    f) 350 - Flexible metal conduit
    g) 351 – Liquid-Tight Flexible metal conduit and Liquid-Tight flexible nonmetallic conduit.
    h) 352A - Surface Metal Raceways
    i) 352B - Surface Nonmetallic raceways
    j) 353 – Multi-outlet Assembly
    k) 354 - Under floor raceways
    l) 362 - Metal Wire ways and nonmetallic Wire ways
    m) 370 - Outlet, Device, Pull and Junction Boxes, Conduit Bodies and Fittings

n) 645 - Information Technology Equipment
o) 770 - Optical Fiber Cables and Raceways
p) 800 - Communications Circuits

1. The following American National Standards Institute (ANSI) standards:
    a) ANSI-C80.3 Specification for Electrical Metallic Tubing, Zinc-coated.
2. The following Telecommunication Industry Association (TIA) standards.
    a) ANSI/TIA/EIA current release, Commercial Building Telecommunications Cabling Standard.
    b) ANSI/TIA/EIA current release, Commercial Building Standard for Telecommunications Pathway and Spaces.
    c) EIA/TIA current release, Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.
    d) EIA/TIA-607 Commercial Building Grounding and Bonding requirements for Telecommunications.
3. The following BICSI guidelines
    a) BICSI Telecommunications Distribution Design Manual current published edition.
    b) BICSI Customer Owned Outside Plant Design Manual current published edition.
    c) BICSI Telecommunications Cabling Installation Manual current published edition.
4. The following UL Standards:
    a) UL 1, 2000Flexible Metal Electrical Conduit.
    b) UL 3, 1999 Flexible Nonmetallic Tubing for Electric Wiring.
    c) UL 5, 1996 Surface Metal Electrical Raceways and
    d) Fittings.
    e) UL 360, 1996 Liquid-Tight Flexible Steel Conduit, Electrical.
    f) UL 514B, 1996 Fittings for Conduit and Outlet Boxes.
    g) UL 797, 1997 Electrical Metallic Tubing.
    h) UL 870, 1995 Electrical Wireways, Auxiliary Gutters and Associated Fittings.

Submittal Requirements

1. Provide product data for the following:
    a) Conduit
    b) Sleeves
    c) Cable tray
    d) Cable hangers
    e) Wireways and wire troughs
    f) Power/communication poles

g) Under floor duct
h) Floor Boxes and Poke Troughs
i) Surface Raceways – Metallic
j) Surface Raceways – Non-Metallic
k) Outlet Boxes

Product Standards-Minimum

1. CONDUIT

a) Rigid Galvanized Steel Conduit
   1. Shall be hot-dipped galvanized steel, including threads.

b) Electrical Metallic Tubing
   1. Electrical Metallic Tubing shall be electro-galvanized steel.

c) Rigid Non-Metallic PVC Conduit
   1. Extra-Heavy wall conduit: Schedule 80, constructed of polyvinyl chloride, rated for use with 90 degree C conductors, and UL listed for direct burial and normal above ground use.
   2. Heavy wall conduit: Schedule 40, constructed of polyvinyl chloride, rated for use with 90 degree C conductors, and UL listed for direct burial and concrete encasement.

d) Fittings
   1. Rigid galvanized steel fittings shall be fully threaded and shall be of the same material as the respective raceway system.
   2. Fittings for electrical metallic tubing shall be single screw indenter fittings for conduits up to 2" and double screw indenter fittings for conduits 2" and larger.
   3. Fittings for rigid non-metallic conduit shall be solvent cemented in accordance with the manufacturer's instructions.
   4. Connectors shall have insulated throat up to and including 1" size. For sizes 1-1/4" and larger, provide plastic insulating bushing.
   5. Die-cast or pressure cast fittings are not permitted.
   6. Provide conduit body types, shapes and sizes as required to suit application and NEC requirements. Provide matching gasketed covers secured with corrosion-resistant screws.

e) Expansion Fittings
   1. Provide expansion fittings with external grounding straps at building expansion joints.
   2. Galvanized steel expansion joints for RGS or EMT conduit, PVC for PVC conduit.
   3. Minimum 4” movement in either direction.
   4. Weatherproof for outdoor applications.

5. At expansion joints in concrete pours, provide Deflection/Expansion fittings capable of movement of ¾" in all directions from the normal.

f) Waterproofing Seals
   1. Provide watertight expanding link-type seals for installation between the conduit and the sleeve or core drilled hole.
   2. Design Make: Link Seal, or approved equal.

g) Pull and Junction Boxes
   1. Shall be constructed of not less than 14 gauge galvanized steel with trim for flush or surface mounting in accordance with the location to be installed. Provide screw-on type cover boxes installed in damp or wet locations shall be of rain-tight construction with gasketed cover and threaded conduit hubs. In no case shall boxes be sized smaller than as indicated in Article 370 of the National Electrical Code for conduit and conductor sizes installed. Boxes shall be NEMA approved for the environmental condition of the location where they will be installed.

h) Flush floor junction boxes
   1. Flush floor junction boxes shall be recessed cover boxes designed for flush mounting in masonry. (Approved by Nova Southeastern Department of Telecommunications.)

3. CABLE TRAY

a) Trough Bottom Cable Trays shall be aluminum construction including accessories. Maximum rung spacing 8 in. on centers is welded to side rails with flanges in 4-in. wide channel rungs. Aluminum alloy side rails and rungs. Standard lengths 12 ft. - 0 in. long. Cover required where called for. Provide divider strip where called for. Minimum radius of horizontal elbows shall be 12 in. Provide special radius elbows where required for field conditions.

Loading Data:

Usable Tray Width	Load Depth	NEMA Depth	Std.	Span	Lbs/Ft	Deflection
6”	4”					
8”	4”					
12”	4”	3”	12A	10’	81	1.20”
12”	6”	5”	12B	10’	112	0.59”
18”	4”	3”	12A	10’	81	1.20”
18”	6”	5”	12B	9’	112	0.59”
24”	4”	3”	12A	10’	81	1.20”
24”	6”	5”	12B	10’	112	0.59”

b) Provide a safety-loading factory of 1.5 for uniformly distributed loads when supported as a simple span in accordance with the NEMA standard listed.

4. CABLE HANGERS

a) Provide prefabricated, zinc coated, carbon steel hangers designed specifically for UTP and Optical Fiber cable installations.

b) Hangers shall have open top, rolled edges and a 3” or 4” minimum diameter loop.

c) Provide beam clamps, rod fasteners, flange clips and brackets as job conditions require.

d) Use of ERICO cable hangers as described in 270528-17

e) Hangers must be approved by Nova Southeastern University Department of Telecommunications.

5. WIREWAYS AND WIRE TROUGH

a) Wireway shall be steel, enclosed type. Provide hinged, JIC sectional NEMA dust resistant, oil tight type where subjected to moisture, in Pump Rooms, Mechanical, Electric and Fan Rooms, exterior walls, Maintenance Shops, and similar locations. Size to meet NEC fill requirements or larger as noted on Contract Documents. Provide knockouts along runs. Provide all elbows, tees, pull-boxes, fittings, hangers, reducers, supports, etc., to meet installation requirements.

b) Cover: Hinged Screw cover with full gasketing

c) Connector: Slip-in or Flanged.

d) Fittings: Lay-in type with removable top.

e) Finish: Electro-coated ASA-49 Gray Epoxy Paint over Phosphate Primer.

f) Approved by Nova Southeastern University Department of Telecommunications.

6. POWER/COMUNICATION POLES

a) Poles shall contain a communication and power divider and be nominally 2-1/4" square by height required.

b) Constructed of a minimum of .070" thick, anodized aluminum extrusion, with removable trim plate and cover.

c) Unit shall be furnished with top plate mounting assembly for easy installation to accessible ceiling; bushings need to be installed.

d) Approved by Nova Southeastern University Department of Telecommunications.

7. FLOOR BOXES

a) Flush Floor Box:
   1. Boxes shall be fully adjustable constructed of cast iron, nominally 4.38”L x 3.19” w x 3.19”D (single gang) 4.38”L x 6.38”w x 3.19”D (two gang)
   2. Boxes shall house leveling screws for adjusting box to accept floor flange after pour.
   3. Boxes shall have 1” conduit hubs on each end and 3/4” conduit hubs on each side.
   4. Provide Brass floor rings and brass cover-plate with duplex flaps.

b) Acceptable manufacturer: Wire mold
   a) Raised Floor Box (mfg # AC8850, AC8105, AC8840, AC104)
   b) Concrete Floor Box (mfg # RFB4-SS with RAKMII cover (ss shallow steel)
   c) Concrete Floor Box (mfg # RFB4-4DB with RAKMII cover)

8. SURFACE METALLIC RACEWAY

a) Single channel suitable for up to (10) 0.2” O.D. Cables
   1. Two piece raceway with single compartment, length as indicated on the drawings. Nominal 1-9/32” x ¾” with snap on cover. Color shall be ivory.
   2. Approved by Nova Southeastern University Department of Telecommunications.

b) Single channel suitable for up to (50) 0.2" O.D. Cables
   1. Two piece raceway with single compartment, length as indicated on the drawings. Nominal 2-3/4" x 1-7/16" with flush snap on cover. Color shall be ivory. Provide devices in the raceway as indicated on plans.
   2. Approved by Nova Southeastern University Department of Telecommunications.

c) Two channel with devices suitable for up to (48) #12 AWG conductors or (50) 0.2" O.D. Cables.
   1. Two piece raceway with divider for power and communications, length as indicated on the drawings. Nominal 4-3/4" x 1-3/4" with flush snap on cover. Color shall be gray. Provide devices in the raceway as shown on plans.

      Approved by Nova Southeastern University Department of Telecommunications.

d) One-piece raceway
   1. Shall have Ivory finish
   2. Size race way as required based on the following:
      a) 025" steel suitable for (2) 0.2" O.D. cables
      b) .040" steel suitable for (3) 0.2" O.D. cables
      c) .040" steel suitable for (5) 0.2" O.D. cables\.
   3. Approved by Nova Southeastern University Department of Telecommunications.

e) Provide miscellaneous boxes, fittings and supports designed and manufactured by the raceway manufacturer as required to make a complete job.

f) Approved by Nova Southeastern University Department of Telecommunications.

9. SURFACE NON-METALLIC RACEWAY

a) Manufactured of rigid UV stabilized PVC compound with matte texture with "office white" finish. Provide the manufacturers standard fittings as required for the installation. All system components shall meet UL 94 requirements for nonflammable, self-extinguishing characteristics.

b) Shall have a voltage rating of 300 V AC maximum.

c) Shall be UL listed.

d) Fitting shall comply with EIA/TIA UTP/Optical Fiber bend radii requirements.

e) Raceways shall have the following wiring capacities:
   1. One Piece, Single Channel - .32 sq. in. suitable for (5) 0.18" O.D. cables
   2. One Piece, Dual Channel - .97 sq. in. suitable for (6) 0.18" O.D. cables
   3. Two Piece, Single Channel - .29 sq. in. or .87 sq. in. suitable for (4) 0.18" O.D. cables or .87 sq. in. suitable for (13) 0.18" O.D. cables
   4. Two Piece, Triple Channel – 1.514 sq. in. per channel suitable for(24) 0.18"

O.D. cables per channel without devices.

f) Design Make:
   1. One-Piece Raceway.
   2. Two-Piece Raceways, Single Channel Raceway.
   3. Two-Piece Raceway, Triple Channel Raceway:
      a) Provide Communication devices as specified in wiring devices and indicated on the drawings.
      b) Provide divider in raceways utilized for power and communications.

g) Approved by Nova Southeastern University Department of Telecommunications.

10. OUTLET BOXES

a) Outlet Boxes and Covers
   1. Shall be galvanized steel, not less than 2 ¾" deep X 4" square or octagonal, with knockouts.
   2. Outlet boxes exposed to moisture, exterior, wet or damp locations shall be cadmium cast alloy complete with threaded hubs and gasketed screw fastened covers.
   3. Boxes shall be approved for the environmental condition of the location where they will be installed.
   4. Install with mud ring where possible.
   5. Approved by Nova Southern University Department of Telecommunications.

b) Non Metallic Surface Outlet Boxes
   1. Shall be Manufactured of rigid UV stabilized PVC compound with matte texture with "office white" finish. Provide the manufacturers standard fittings as required for the installation. All system components shall meet UL 94 requirements for nonflammable, self-extinguishing characteristics.
   2. Shall have a voltage rating of 300 V AC maximum.
   3. Shall be UL listed.
   4. Shall be of size indicated drawings.
   5. Shall be of sufficient depth to maintain CAT 6 bend radii requirements.
   6. Approved by Nova Southeastern University Department of Telecommunications.

c) Low Voltage Mounting Brackets
   1. Shall mount to any wall thickness from ¼" – 1".
   2. Shall be constructed of a non-metallic material.
   3. Approved by Nova Southeastern University Department of Telecommunications.

11. SUPPORTING DEVICES

a) Supports, support hardware and fasteners shall be protected with zinc coating or treatment of equivalent corrosion resistance using approved alternative treatment, finish or inherent material characteristic. Products used fin outdoor applications shall be hot dipped galvanized.

b) Provide clevis hangers, riser clamps, conduit straps, threaded c clamps with retainers, ceiling trapeze hangers, wall brackets and spring steel clamps as applicable.

c) 14 gauge U-Channel systems with 9/16 inch diameter holes at a minimum of 1 7/8 inches on center in the top surface. Provide fittings and accessories that match and mate channel.

d) Provide carbon steel or wedge or sleeve type expansion anchors, steel springhead toggle bolts and heat-treated steel power driven threaded stud fastening equipment as required by construction types.

e) Provided field fabricated supporting devices such as angles, channels, pipe supports, etc. All fabricated supports shall be of metal construction as called for in 2.1.

f) Approved by Nova Southern University Department of Telecommunications.

Field Quality Control

1. CONDUIT

a) Electrical Metallic Tubing, Rigid Metal Conduit and Rigid PVC are allowed conduit types. Flexible metal conduit is not permitted.
b) Install with a minimum of bends and offsets. Bends shall not kink or destroying the interior cross section of the raceway. Factory made bends shall be used for raceway's 1" trade size and larger. Bends radius shall be 6 times the internal diameter for conduit sizes up to 2 inches. A conduit greater than 2 inch shall have bend radius at least 10 times the diameter of the conduit.
c) Runs exceeding 100 feet or 180 degrees total bends shall be broken with suitable sized pull or splice boxes. (LB or similar conduit fittings are not acceptable for runs of riser cables. Approval required by Nova Southeastern University Department of Telecommunications.
d) Do not locate riser pull boxes at bends without prior review and approval by Nova Southeastern University Department of Telecommunications. Do not make changes in direction using "pull boxes"
e) Conduit runs to work areas shall serve no more than one (1) communication outlet.
f) Conduits shall be sized to accept 40% future growth; sizing shall account for fire code capacity restrictions.
g) Plug the ends of each roughed-in raceway with an approved cap or disc to prevent the entrance of foreign materials during construction.

h) Secure within three feet of each outlet box, junction box, cabinet or fitting.
i) Provide a #14 AWG fish wire in all "Spare" or "Empty" conduit runs to facilitate future installation of cables.
j) Install raceways in concrete floor slabs as follows:
    a) All conduits in concrete floor slabs shall be rigid galvanized steel with concrete tight threaded fittings.
    b) Provide expansion fittings where conduits cross building expansion joints.
    c) Install conduit below the reinforcing mesh.
    d) Locate conduits to provide a minimum of 2" of concrete around conduit.
    e) Obtain approval from the Nova Southeastern University Department of Telecommunications prior to installing conduit larger than 1" trade size in concrete slabs.
    f) Wherever a cluster of four-(4) or more conduits rise out of floor exposed, provide neatly formed 4-in. high concrete envelope, with chamfered edges, around raceways.

k) Provide conduit supports based on the following table:

Conduit Trade Size	Type of Run	Horizontal Spacing in Feet	Vertical Spacing in Feet
1", 1 ¼"	Concealed	8	10
1 ½", & LARGER	Concealed	10	10
½", ¾"	Exposed	5	7
1", 1 ¼"	Exposed	7	8
1 ½" & larger	Exposed	10	10

l) Where conduits puncture roof, install approved roof flashings as required in order that the roof warranty is maintained.
m) Conduit System Installation:
    a) Cable in exterior, above grade locations: Rigid Galvanized Steel
    b) Interior locations: Electrical Metallic Tubing
    c) Cable below grade: PVC Schedule 40
n) Identification: Clearly label conduit at exposed ends indicating closet or outlet where conduit terminates and the length of the conduit. Label pulls boxes indicating destination of conduits entering and exiting.
o) Include intra- and inter-building raceways. Including conduits, sleeves and trays for the placement of cables from the communications center to communications rooms, from the communications center to the entrance room or space and from communication center to communication center in different building in a campus environment.

1. Conduit fill shall be as follows:

Trade Size	Area of Conduit (Square Inches)	1 Cable 53% Fill (sq. in.)	2 Cables 31% Fill (sq. in.)	3 Cables & Over 40% Fill (sq. in.)
1”	0.87	0.46	0.27	0.35
1 ¼”	1.51	0.80	0.47	0.60
1 ½”	2.05	1.09	0.64	0.82
2”	3.39	1.80	1.05	1.36
2 ½”	4.82	2.56	1.49	1.93
3”	7.45	3.95	2.31	2.98
3 ½”	9.96	5.28	3.09	3.98
4”	12.83	6.80	3.98	5.13
5”	20.15	10.68	6.25	8.06

2. Backbone pathways shall be in the form of 4” conduits or sleeves between the main communication equipment rooms and spaces and closets shall be provided as shown on drawings:

3. Fires stop all pathways as called for in section 25010 of this document. This includes using rated pathways by Hilti Fire Stop Systems.

4. All backbone conduits shall be marked with 1” reflective tape every 25 feet. Coordinate color with The Nova Southeastern University Department of Telecommunications.

5. Pull boxes shall be marked with 1” wide reflective tape.

6. Stub out conduits into closets only enough to attach connector and bushings, except conduits shall rise a minimum of 6 inches above the finished floor.

7. Bush all conduit ends.

8. Conduits shall be concealed except in the following areas:
    1. Mechanical Rooms
    2. Electric Rooms
    3. Manufacturing areas
    4. Garage or maintenance areas
    5. Unfinished basements or crawl spaces

9. Do not install raceways adjacent to hot surfaces or in wet areas.

10. Install conduits to edges of access boxes so as to maximize the total number of conduits that can be routed through the pull box.

11. Provide expansion fittings with external grounding straps at building expansion joints.

12. Do not install conduit horizontally in concrete or block partitions.

13. Arrange neatly to permit access to the raceway, outlet, pull, and junction boxes, and work installed by other trades.

14. If it is necessary to burn holes through webs of beams or girders, call such points to the attention of The Nova Southeastern University Department of Telecommunications and receive written approval both as to location and size of hole before proceeding with work. All holes shall be burned no larger than absolutely necessary.

15. Core drill, sleeve, and fire stop all penetrations through existing floors.

16. Support all raceways with malleable iron pipe clamps or other approved method. In exterior or wet locations, provide minimum ¼" air space between raceway and wall. Secure raceway within 3 ft. of each outlet box, junction box, cabinet or fitting.

17. Install junction and pull boxes in readily accessible locations. Equipment, piping, ducts and the like shall not block access to boxes. Provide all necessary junction or pull boxes required due to field conditions and size as required by the National Electrical Code.

2. SLEEVES

a) Use appropriate Hilti Firestop Systems fire rated pathways by HIlti, Inc. or approved equal. Follow manufacturer's installation requirements.

3. CABLE TRAYS

a) Hang Cable tray using threaded, galvanized rod hangers, with rods extended through support steel and double nutted; implementing Quick- Support Center Rod PVC Sheath(Cat. No. WBCR SHEATH : for protecting cables from threaded rod when hanging WB Series Cable Tray from center rod hangers). Size support member within load rating of member section; and without visible deflection. Install cable tray level and straight.

b) A minimum of 12" headroom shall be provided above all cable trays.

c) Provide aluminum body expansion connectors at building expansion joints. Minimum 4-in. movements, greater if expansion movement conditions warrant.

d) Provide external grounding strap at expansion joints, sleeves, crossovers and at other

locations where tray continuity is interrupted.

e) Provide necessary elbows, tees, crosses, risers, offsets, fittings, reducers, connectors, clamps, rod suspension, trapeze hangers, etc., as required to make a complete job, coordinate with The Nova Southeastern University Department of Telecommunications.

f) Provide conduit to tray fitting at each conduit entrance to tray.

g) Install divider in trays where cables of different systems are carried in the same tray.

h) Provide (1) 6" long piece of ½" EMT conduit on each threaded rod hanger to prevent scoring of cable insulation when cable is pulled in.

i) Install fire stop wall frames around cable tray at penetrations through fire rated walls, and where called for. Seal these openings with pliable fire resistant sealant.

j) Cable Trays shall not pass through any firewall or fire-rated soffits. Cable tray shall end before the firewall and transition to a minimum of two (2) 4" EMT sleeves with connectors and insulated bushings as called for is this specification section.

4. CABLE HANGERS

a) Provide cable hangers a maximum of 3' on center wherever cable tray or conduit is not present.

b) Ceiling ties and rods shall not be used to hang cable or cable supports without the approval of The Nova Southeastern University Department of Telecommunications.

c) Load hangers as recommended by the manufacturer. Provide hangers side by side on a common bracket where cable quantities require.

d) Do not install cables loose above lock-in type, drywall or plaster ceilings.

e) Cables shall be installed at least 3 in. above the ceiling tiles and shall not touch the ceiling.

f) Do not support cable from ceiling system tie wires or grid in fire rated systems.

g) Provide a minimum of 2 spare bracket mounted hangers in new construction.

h) Utilize ERICO CADDY CABLECAT adjustable Cable Support when cables trays are not needed; determine with Nova Southeastern University Department of

Telecommunications management prior to installation

Part numbers:
Adjustable Cable Support:

- CAT425WM - wall mount – vertical surface
- CAT425 - 1/4" Threaded rod or horizontal surface mount
- CAT425A6 - 3/8" Threaded rod or horizontal surface mount

Hammer-On Flange Clips:

- CAT42524SM – Hammer-on 1/8" – ¼" flange
- CAT42558SM - Hammer-on 5/16" – ½" flange
- CAT425912SM – Hammer-on 9/16" – ¾" flange

Beam Clamp:

- CAT425BC – Screw-on 1/8" – ½" flange (rotates 360 degrees)
- CAT425BC200 – Screw-on 1/8" – 5/8" flange (rotates 360 degrees)

Purlins:

- CAT425AF14 – Hammer-on 1/16" – ¼" Z purlins
- CAT425VF14 – Hammer-on 1/16" – ¼" vertical flange
- CAT425WMCD18 – under floor pedestal

5. WIREWAYS AND TROUGHS

a) Use appropriate Cable Management Solutions (Snake tray) product or approve equal, using manufacturer's installation requirements.

6. POWER/COMMUNICATION POLES

a) Use aluminum or steel poles. Finish color to be approved by client, if dual purpose, electrical and communications services must be properly separated for entire run. Provide appropriate product from Wire mold or approved equal. Securely fasten to structure at floor and ceiling.

7. UNDERFLOOR DUCT

a) The method of pour and depth of concrete shall determine the positioning of the duct as follows (Verify floor structure prior to submitting layout drawings):
    a) Monolithic pour - installed at the midpoint of the slab.
    b) Slab on grade - midpoint of slab.
    c) Double pour floor - installed in structural slab, Second pour buries the duct system.
    d) Post tensioned pour - preset inserts shall be used.
    e) Prefabricated concrete - buried in concrete topping.

b) Location: Locate runs parallel to outside wall five foot on center with final runs two feet from walls. Provide cross runs as indicated on drawings.
c) Provide conduit access to cross runs as indicated on drawings.
d) Perform cutting, hole sawing and drilling necessary for installation of wiring to

devices, through service fitting, from under floor raceway. Provide devices and service fittings at points of use indicated. Install raceway aligned, level, and parallel or perpendicular to building walls or as indicated. Underfloor raceways shall be free from burrs, sharp edges, dents and mechanical defects. Provide caps or plugs on open raceway ends and on boxes and openings.

e) Provide flush service boxes with trim rings and carpet or tile flanges as indicated on the plans.
f) Seal raceways, cells, inserts and trenches to prevent the entrance of water, concrete or foreign matter into the raceway system, before and during pouring of slab or placing of fill. Provide tape or sealing compound at joints, as recommended by the duct manufacturer.
g) Install all products in accordance with manufacturer's instructions.
h) Provide expansion fittings with bonding jumper where duct crosses building expansion joints.
i) Securely hold junction boxes and raceways in place during concrete pours to avoid floating or other movement.
j) Install under-floor duct with tops of preset inserts 1/8" below finished floor line. Locate raceways as indicated on Drawings.
k) Place schedule on the inside of cover-plate of each junction box indicating distance to first insert in each direction, measured from the center of the box. Also, include the pane-board and circuit number of each circuit located in the junction box. Use self- adhesive labels for schedule.
l) Support Couplers and Supports: Join raceway lengths using combination support couplers where practical. Provide additional supports at intervals of not over 5 feet (1.5 m), within 30 inches (750 mm) each side of junction boxes, and as close as practical to elbows, bends, and terminations.
m) Install insert within 12 inches (30 mm) of edge of junction box. Align inserts on same centers for all services.
n) Do not extend inserts into special floor finishes, such as terrazzo, marble, or wood.
o) Install a duct marker in each insert adjacent to junction box, at end of each duct run, on both sides of permanent partitions, and on both sides of change of direction of duct. Install markers flush with finished floor material. In carpeted areas, install marker screws level with carpet backing.
p) Install surface service fittings after installation of floor finishes. Cut floors as necessary. Following duct manufacturers recommendations. Replace damaged floor construction and finish.
q) Install trench duct trim flush with cover-plates; maintain covering of factory-applied tape for protection.

8. FLOOR BOXES AND POKE THROUGHS

a) Floor outlet boxes shall be installed flush with finished floor, adjust level and tilt as required. Where finished floor is terrazzo, provide boxes specifically designed for installation in terrazzo. Where floors are to receive carpet, provide floor outlet with carpet flange.

b) Coordinate the location of flush floor boxes with furniture layout. Provide

coordination drawings for approval.

9. CONCEAL RACEWAY – METALLIC

a) Provide raceway as shown on the drawings. Leave a tagged nylon pull tape in each raceway (including raceways in use). Bush ends of all stubbed out raceways.
b) Cut raceways square, ream ends to remove burrs, and bush where necessary.
c) Install raceways parallel or perpendicular to building walls, floors and ceilings.
d) Surface mounted only to be used with prior approval.

10. CONCEAL RACEWAYS – NON METALLIC

a) Support with expansion anchors, concrete inserts, masonry inserts or toggle bolts as field conditions require. Provide supports every 4 foot on center.
b) Provide all fittings, connectors, elbows, tees, boxes etc. as required for the installation.
c) Surface raceway shall be filled to 40% maximum.
d) Surface mounted only to be used with prior approval.

11. BOXES AND CABINETS

a) Consider location of outlets shown on drawings as approximate only. Study architectural, electrical, process piping, mechanical, plumbing, structural, roughing-in, etc., drawings and note surrounding areas in which each outlet is to be located. Locate outlet so that when fixtures, motors, cabinets, equipment, etc., are placed in position, outlet will serve its desired purpose. Where conflicts are noted between drawings, contact Nova Southeastern University Department of Telecommunications for decision prior to installation.
b) Outlet boxes in separate rooms shall not be installed "back-to-back" without the approval of The Nova Southeastern University Department of Telecommunications.
c) Outlet boxes shall be sized to accommodate the wiring device(s) to be installed.
d) Outlet boxes installed in plaster, gypsum board or wood paneled walls shall be installed with raised plaster covers or raised tile covers.
e) Outlet boxes installed in tile, brick or concrete block walls shall be installed with extra-deep type raised tile covers or shall be 3-1/2" deep boxes with square corners and dimensions to accommodate conductors installed.
f) Surface ceiling mounted outlet boxes shall be minimum 4" square, 1-1/2" deep, galvanized sheet metal.
g) Surface wall mounted metallic outlet boxes shall be cast type boxes having threaded or compression type thread-less hubs. Exterior boxes shall be cast type with threaded hubs and gasketed cover plates secured by non-ferrous screws.
h) Unless otherwise noted, mount devices and equipment at heights measured from finished floor to device/equipment centerline as follows:

1. Desktop telephone outlets 18"
2. Data outlets 18"

3. Data or desktop telephone outlets, above hot water or steam baseboard heaters. Do not install receptacle outlets above electric baseboard heaters. 30"
4. Television outlet 18”
5. Wall Mounted 48”
6. Bracket Mounted Television 96”

i) Where structural or other interference prevent compliance with mounting heights listed above, consult Nova Southeastern University Department of Telecommunications for approval to change location before installation.

j) Where communications outlets are shown on, behind, below or above furniture or millwork. Verify the exact location and mounting height with the project coordinator. The communications contractor shall be responsible for moving all communications outlets that are in conflict with furniture or millwork, including cutting, patching and painting, at no cost to the Nova Southeastern University Department of Telecommunications..

k) Pull boxes used for angle or U pulls shall have a distance between each raceway entry inside the box and the opposite wall of the box of at least 6 times the trade-size diameter of the largest raceway. This distance being increased by the sum of the trade size diameters of the other raceways on the same wall of the box and have a distance between the nearest edges of each raceway enclosing the same conductor of at least 6 times the trade size diameter of the raceway or 6 times the trade size diameter of the larger raceway if they are of different sizes.

l) Install outlet boxes as per sizes indicated on the drawings.

m) Install Low Voltage Mounting Brackets for fishable wall installation location that does not have an available outlet box.

12. SUPPORTING DEVICES

a) Hangers and Supports:
   1. Provide steel angles, channels and other materials necessary for the proper support of wall-mounted cabinets, racks, panels, etc.
   2. Cabinets, large pull boxes, and cable support boxes shall be secured to ceiling and floor slab and not supported from conduits. Small equipment boxes, etc., as approved by Nova Southeastern University Department of Telecommunications may be supported on walls. Racks for support of conduit and heavy equipment shall be secured to building construction by substantial structural supports.

13. FURNITURE RACEWAYS

a) Furniture Pathways - Shall comply with UL 1286 and NEC Article 605.

b) It shall be the contractors’ responsibility to verify the furniture layout and communication outlet with respect to the furniture. Obtain approved shop drawings from the architect detailing furniture heights, cable openings etc. Prior to roughing in the outlet box, verify height and location for all communication outlets near furniture or cabinetry. Boxes roughed in the wrong location shall be relocated at the contractors’ expense.

c) Provide a concealed transition from outlet box to furniture.

14. GENERAL

a) Support raceways from building construction. Do not support raceways from ductwork, piping, or equipment hangers.
b) Support outlet, pull, and junction boxes independently from building construction. Do not support from raceways.
c) Coordinate all raceway runs with other trades.
d) All open raceways shall be installed a minimum of 6 in. away from any light fixture or other source of EMI (Electro-magnetic interference).
e) All horizontal pathways shall be bonded and grounded per the NEC Article 250. In all cases, horizontal pathways shall be sized for a minimum of 50% future growth.

27 05 43 Exterior Communication Pathways

Design Standards

1. The intent of these Design Professional standards is to provide general guidelines on the design and provision for electronic communication components of the site and building scope. These standards shall not supersede code and regulations nor do they relieve the Design Professional from their professional responsibility. This section includes minimum requirements for the following:

A. SCOPE
1. Minimum composition requirements and/or installation methods for the following materials and work are included in this section:
a) Trenching and Excavation.
b) Underground Duct.
c) Inner duct.
d) Aerial Installations.
e) Manholes, Vaults and Hand holes.

Submittal Requirements

1. Product data for:
a) Precast manholes, hand holes.
b) Duct bank materials.
c) Aerial hardware.

Performance Standards-Minimum

A. The contractor shall engage the services of a qualified installer and Nova Southeastern University for all excavation and concrete work.
B. All work shall be done in a professional neat and workmanlike manner. All

methods of construction, details of workmanship, that is not specifically described or indicated in the contract documents, shall be subject to the control and approval by The Nova Southeastern University Department of Telecommunications. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based upon the acceptable manufacturers listed. Where "approved equal" is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval.

C. Materials and work specified herein shall comply with the applicable requirements of:

1. The following Articles of the National Electric Code (NFPA 70)
    a) 343 - Nonmetallic underground conduit with conductors
    b) 346 – Rigid metal conduit
    c) 347 – Rigid nonmetallic conduit

2. The following National Electrical Manufacturers Association (NEMA) Standards
    a) NEMA, RN1, 1998 PVC Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
    b) NEMA, TC3, 1999 PVC fittings for use with Rigid PVC Conduit and tubing.
    c) NEMA. TC 6. 1999 PVC and ABS Plastic Utilities Duct for Underground Installation
    d) NEMA, TC8, 1999 Extra strength PVC Plastic Utilities Duct for Underground Installation
    e) NEMA, TC9, 1999 Fittings for ABS and OVC Plastic Utilities Duct and Fittings for Underground Installation
    f) NEMA, TC 10, 1999 PVC and ABS Plastic Communications Duct and Fittings for Underground Installation
3. The following American National Standards Institute (ANSI) standards:
    a) ANSI-C80.2 Specification for Rigid Steel Conduit, Enameled
4. The following Telecommunications Industry Association (TIA):
    a) ANSI/TIA/EIA, current release Commercial Building Telecommunications Cabling Standard.
    b) ANSI/TIA/EIA , current release Commercial Building Standard for Telecommunications Pathway and Spaces.
    c) EIA/TIA, current release Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.
    d) EIA/TIA current release Commercial Building Grounding and Bonding requirements for Telecommunications.
5. The following BICSI guidelines
    a) BICSI Telecommunications Distribution Design Manual, current published edition.

b) BICSI Customer Owned Outside Plant Design Manual, current published edition.
c) BICSI Telecommunications Cabling Installation Manual, current published edition.

6. The following U.L. Standards:
   a) U.L. 6, 2000 Rigid Metal Electrical Conduit.
   b) U.L. 651, 1995 Schedule 40 and 80 PVC Conduit.

Project Conditions-Minimum

1. The following conditions apply to excavation scope performed:
   a) Identify maintain and protect existing building services which are within the construction/ contract limits of the excavation area.
   b) Protect utilities, sidewalks, structures, pavements and other facilities from damage caused by settling, lateral movements, undermining, washouts and other hazards created by excavation work.
   c) Locate and verify existing underground utilities in excavation areas. If utilities are indicated to remain, support and protect services during excavation operations.
   d) Verify subsurface conditions prior to excavation work.

Product Standards

1. TRENCHING AND EXCAVATION FILL

a) Sand: Clean, coarse, and free of organic matter.
b) Crushed Stone: Crushed stone or gravel, washed, graded, free of organic materials, 1 in. to No. 4 size. Graduation per ASTM C33, Table II, Size 57, as follows:

PERCENT PASSING

Sieve No.	Maximum	Minimum
1-1/2 in		100
1 in	100	95
½ in	60	25
#4	10	0
#8	5	0

c) Gravel Fill: Well-graded natural inorganic sand and gravel conforming to following graduations:

PERCENT PASSING

Sieve No.	Maximum	Minimum
4 in		100
1 in	100	60
#4	85	25
#16	60	10

#50	30	4
#200	5	0

d) Pea Gravel: Rounded stone, 3/4 in. maximum diameter, and 1/8 in. minimum diameter. Stone crushing of 1/8 in. to 1/2 in. meeting ASTM C33, Paragraph 9.1 may also be used.

e) Ordinary Fill: Well-graded, natural inorganic soil, meeting the following requirements:

1. Free of organic and other compressible materials, debris and frozen materials, and of stones larger than 4 in. maximum dimension.
2. Be of such nature and character that it can be compacted to the specified densities.
3. Free of highly plastic clays, of materials subject to decay, decomposition, or dissolution, and of cinders, ash and other corrosive materials.
4. Maximum dry density of not less than 115 lbs. per cu. ft.
5. Material from excavation on the site may be used as ordinary fill if it meets the above requirements.

2. MANHOLES, VAULTS AND HANDHOLES

a) Provide pre-cast or cast-in-place reinforced concrete designed for H-20 loading.

b) Shall have angled corners, cut on 45 degrees for optimum cable racking.

c) Covers and frames shall be cast iron, with a minimum opening of 27" suitable for H-20 loading. Covers shall have open pick holes and have “Telephone”, “Communications”, "Signal" or “CATV” cast in 2” high lettering on the cover, per Nova Southeastern University Department of Telecommunications directive.

d) Floors shall be 6 inches thick with a 12” diameter sump hole. In wet soil, reinforced floor with 5/8” bars, 8 inches on center.

e) Adjust frame to grade by providing a minimum two courses of bricks with all joints fully filled with mortar both inside and outside the collar. Provide layer of mortar on top course for bricks.

f) Provide cable racks with “T” slots for attaching support hooks. Provide two per wall.

Provide pulling irons on each wall 12” below duct.

3. DUCTBANKS

a) Ordinary Fill: Well-graded, natural inorganic soil, meeting the following requirements:

b) Concrete for encapsulating ducts shall be 3/8” aggregate with a nominal compressive strength of 3000 pounds per square inch unless otherwise indicated.

c) Provide a minimum of four #5 continuous reinforcement bars the entire length of the duct bank.

d) Concrete shall be 3” thick at the top, bottom and sides of ducts.

e) Where duct banks penetrate foundation, footings or outside walls, rigid metallic conduits with expandable rubber shields shall be used.

f) Provide a 6" wide warning marker tape above duct 18" below grade.

4. AERIAL INSTALLATIONS

a) Messenger Strand System
   1. Provide 3/16" diameter 7-wire galvanized "6M" steel messenger strand as noted on the drawings. Messenger strand to be manufactured to ASTM A475 specifications and be accepted by both REA and Bell Telephone standards. Strand to be at least a utilities grade, have a minimum breaking strength of 5,500 pounds, have a left lay and have at least an "A" rated galvanized coating weight.
   2. Strand Attachments:
      a) Provide and install the appropriate S guy bolts, B beam clamps, wall straps, brackets, etc., as necessary to adequately support the strand as typically indicated.
      b) S guy bolts (or commonly called anchor rods or "thimbleye" bolts) shall be a minimum 5/8" diameter with a straight shank and be designed for attaching messenger strand dead ends. The bolt length shall be at least 4" longer than the width of the structural steel flange it will be attached to.
      c) B beam clamps, or approved equivalent, shall be designed to be used for dead-ending strand on the flange of structural steel members (columns and beams). B beam clamp shall be designed to be used with a 5/8" S guy bolt.
   3. Strand Connectors:
      a) Provide and install all B strand connector's suspension/cable clamps, grounding tap clamps, hangers, 1-bolt and 3-bolt clamps to adequately support the strand as typically indicated.
      b) For strand runs in excess of 15' between structural columns, additional ½" rod supports and appropriate strand clamps (either 3-hole clamps or Kindorf C-708 supports) shall be provided and installed on minimum 25' centers, per the project manager's direction.
   4. Strand Cable Rings:
      a) Provide and install cable rings, or equivalent, to all strand runs after strand is installed. Rings shall be spaced on maximum 16" centers with the latching ring oriented in the same direction. Ring size required for each strand run shall be identified on the drawings.

Field Quality Control Standards

1. EXCAVATION AND TRENCHING

a) Preparatory Work
   1. Build lines to grade and elevations shown. Provide stakes, grade boards, cleats, nails, instruments. Locate and stake each new run for its entire length. Verify elevations given. Start excavation at low point. Notify Engineer of elevation discrepancies. Protect marks and stations. Before

excavating work, coordinate with Nova Southeastern University Department of Telecommunications. Furnish schedule of operations to Nova Southeastern University Department of Telecommunications. Provide and maintain temporary bridges, walks and bridges over excavations where underground utility lines, sewers, water lines, etc., cross access roads, walks, and streets. Make necessary arrangement with authorities having jurisdiction.

2. Examine substrates, areas and conditions, with the installer present, for compliance with requirements for installation tolerances and other conditions affecting installation. Do not proceed with installation until unsatisfactory conditions have been corrected.

b) Protection

1. Provide bracing, shoring, sheathing and other work for: protection of personnel, the contract work, excavations, trees, shrubs, existing structures, and surrounding properties. Slope sides of excavations to comply with local codes and ordinances. Provide, erect, and maintain barricades, warning signs, flags, and lights to provide protection for work, workmen, public, and property. Plank walks, pavements, and curbs to be crossed by equipment.
   Protect adjacent property, existing fences, trees, shrubs, roads, curbs, sidewalks, manholes, hydrants, and other items:
2. Restore, repair, rebuild or replace any such items damaged or destroyed to condition equal to that existing before such damage occurred.
3. Establish conditions, before starting work, by taking photographs to determine state to which existing conditions must be restored. Submit such photographs notarized, identified and dated for record.

c) Existing Utilities

1. Every attempt has been made to indicate existing utilities as accurately as possible from existing drawings, surveys, and data. Report immediately other utility lines encountered, but not shown on the drawings. Notify Town of Davie, Verify exact location of existing utility lines where work crosses existing utilities and where connections are to be made by test hole before starting work. Notify utility companies, municipalities, organizations, and other involved jurisdictions when excavation occurs within vicinity of existing underground service such as sewers, water, electric, gas, telephone, including such services owned by Nova Southeastern University If existing service lines, utilities and utility structures which are to remain in service are uncovered or encountered during this excavation, they shall be protected from damage, and securely supported as directed and approved by the involved jurisdiction. Comply with regulatory requirements with regard to work in vicinity of combustible gas piping. Immediately report damage or injury to utility lines to Town of Davie Fire Department, Police Department and appropriate utility company (e.g. FPL). Repair or replace utility lines damaged or injured as directed and approved by the involved jurisdiction. Excavate by hand in proximity to existing underground utility lines; take extreme care when

excavating around duct banks carrying energized cable. Remove plug or cap inactive or abandoned utilities encountered during construction operations. The location of such utilities shall be noted on the record drawings. Verify "inactivity" of services with involved jurisdiction before start of work.

d) Cutting and Patching

1. Before starting work, obtain necessary permits and pay fees and charges for same. Cut paved areas as called for, perpendicular to surface and in straight saw-cut lines. Replace pavements, roadways, streets, and blacktop areas, walks, disturbed by excavating operations with materials equal to adjacent pavements.

e) Methods

1. Provide for buried work in contract both inside and outside of building. Excavate to proper depth and width for installation work as called for and comply with rules set forth by the State Florida Department of Labor. Remove materials including masonry work, rubble, earth, brickwork, concrete, sand, debris, abandoned pipe lines, drains and sewers, rocks, boulders, and concrete, all of which is considered "earth excavation." Provide for legal disposition of excess excavated materials. Make allowance for gravel fill, sand bases, form work, floor slabs, manholes, anchor and thrust blocks, sheet piping, drainage pumps, and work space. Start excavation at rough grade and provide form work and sheet piling where required.
2. Trench excavation:
    a) By open cut, to proper depth and grade no wider than required for placement of work and not more than 100 ft. in advance of utility being installed.
    b) Should trench bottom be wet, unstable, and/or otherwise incapable of supporting the contract work, immediately report it to Nova Southeastern University Department of Telecommunications representative. Should it be deemed unsuitable, excavate to depth as directed and back fill with gravel to trench depth, or provide concrete cradling.
    c) Should rock be encountered, excavate 6 in. deeper and fill space between trench bottom and pipe with coarse sand, well tamped to form firm bed.

f) Shoring, bracing, sheathing:

1. In addition to governing codes, protect sides of excavations with sheeting and bracing where necessary to prevent sliding or caving of banks and to protect adjacent structures. Remove as back fill is placed.
2. Provide at locations adjacent to existing manholes, hydrants, and similar items.

g) General excavation:

1. As required for all buried work. This shall include, but not be limited to, piping, tanks, duct banks, conduits, footings, manholes, anchors, concrete pads, thrust blocks, fixture bases, and other work in contract.

h) Backfill

1. Provide bedding around piping with coarse sand from 6 in. below to 8 in. above. Apply by hand and compact under and at sides by mechanical means
2. Piping, jackets and sand bed must be inspected and tested prior to backfill of any nature. Provide necessary anchors, thrust blocks, for testing.
3. Fill remainder of trench in 12 in. layers, use ordinary fill material, except as otherwise specified. Do not use frozen material. Remove boulders, stones, broken rock, wood, bricks, blocks, and debris from fill material before backfill operation.
4. Under roadways, manholes, drives, parking areas, walks, slabs, on grade and at utility entrance to building provide backfill in 6 in. layers with gravel or crushed stone, free from organic or other unsuitable material, to grade. Thoroughly compact each layer.
5. Compaction to not less than 95% density compared to maximum laboratory tests by weight, per modified ASTM D1557-64T, latest editions, method "A" under slab on grade, roadways, drives, and other paved areas and 85% for general grading. Submit certified results of tests by an approved soil testing laboratory.

i) Removal of water

1. Provide pumps, hoses, pipe, labor and fuel, necessary to keep excavations free of water accumulation. Maintain and operate equipment. Discharge water in manner not interfering with any trade's work and not to undermine or disturb existing or adjacent structures or land. Grade to prevent surface water from flowing into all excavations and trenches. Do not discharge dirt, backfill, debris, into sanitary or storm drainage systems.

j) Rock Excavation

1. Rock Excavation defined as:
    a) Ledge rock requiring blasting or air hammer for removal.
    b) Boulders in excess of 1-1/2 cu. yds. in size. Demonstrate that material in question cannot be removed with a 1-1/2 yd. backhoe or shovel.
    c) Procedure: Should rock be encountered, remove only upon written order of the Nova Southeastern University Department of Telecommunications representative**.**

2. Measurement of rock excavation, for purpose of payment to Contractor, will be taken 1 ft. wider than duct bank, manhole, pipe or conduit being installed. No allowance made for additional rock taken out accidentally or for convenience of Contractor beyond amount required for installation of work. Rock excavation claimed must be measured each day and verified by Nova Southeastern University Department of Telecommunications. representative. Maintain daily accounting. No claim for extra compensation honored except through procedures outlined above.
    a) Blasting: NOT ALLOWED ON CAMPUS

k) Job completion
   1. On completion of the work, clean the entire site; remove surplus earth, large stones and debris, to off-site legal disposal. Remove tools and equipment and leave the entire area in a neat condition.
   2. Rough grade to 6 in. below finished grade. Scarify subsoil to depth of 2 In. to achieve bond between topsoil and subsoil.
   3. Repave, reseed and completely restore the area to the condition prior to the start of excavation and trenching work

2. MANHOLES, VAULTS AND HANDHOLES

a) Locate to avoid unnecessary hazards and cause minimum interference with normal traffic flow. Locate outside traveled parts of road wherever possible.
b) Seal all conduits watertight after conduits or duct banks are complete.
c) Coordinate the installation with the Division 16 contractor's work.

3. DUCTBANKS

a) Where duct banks enter manholes they shall be centered as nearly as possible to the center between roof and floor and end walls.
b) Where possible, the trench walls shall act as forms for concrete encasement. Provide wood forms where soil conditions require it.
c) Securely tie raceways in place to prevent floating.
d) Clean raceway to remove any concrete, dirt or other obstructions, by drawing cylindrical brushes through duct [with prior approval from the Nova Southeastern University Department of Telecommunications..
e) Provide metallic elbows where conduits rise out of ground.
f) Seal all conduits watertight prior to pour.
g) Provide bushings or bell ends at each conduit termination.

4. AERIAL INSTALLATION

a) Fasten cable messenger strand to buildings and poles using galvanized steel wall straps, suspension clamps, etc.
b) Use an approved cable guide and lashing device to secure the cable to messenger strand.
c) Clamp cable to exterior of building with approved galvanized steel cable clamps.

27 08 00 Testing, Identification and Administration

Design Standards

1. This section includes the minimum requirements for the testing, certification administration and identification of backbone and horizontal cabling

2. This section includes minimum requirements for the following:
   a) UTP testing and testers

b) Fiber optic testing and testers
c) Labels and Labeling
d) Documentation

Performance Standards

1. All testing procedures and testers shall comply with applicable requirements of:
    1. ANSI/TIA/EIA 568- B.1 Commercial Building Telecommunications. Cabling Standard, Part 1: General Requirements.
    2. ANSI/TIA/EIA 526-7 Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant..
    3. ANSI/TIA/EIA 526-14A Measurement of Optical Power Loss of Installed Multimode Fiber Cable Plant..

2. Identification and administration work specified herein shall comply with the applicable requirements of:
    1. ANSI/TIA/EIA , current release Administration Standards.
    2. ANSI/TIA/EIA, current release Pathway and Spaces.
    3. ANSI/TIA/EIA , current release Telecommunications Cabling Standard.
    4. ANSI/TIA/EIA, current release Customer Owned Outside Plant Telecommunications Cabling Standard.
    5. BICSI Telecommunications Cabling Installation Manual
    6. BICSI Telecommunications Distribution Methods Manual

Submittal Requirements

1. Manufacturers catalog sheets and specifications for fiber and copper cable testers.

2. Test reports

Product Standards

1. OPTICAL FIBER CABLE TESTERS

a) Multimode optical fiber light source
    1) Shall be capable of testing to TIA 568-B.1 and ANSI/TIA/EIA 526-14A criteria.
    2) Shall meet the launch requirements of ANSI/EIA/TIA-455-50B.
    3) Provide 850nm and 1300nm +/- 20 nm wavelength LED light sources.
    4) Spectral width of sources shall be </= 50nm for 850nm wavelengths and </= 140nm for 1300nm wavelengths.
    5) The output of the light source shall be 8 MW for 62.5um core optical fiber.
    6) Output Stability +/- 0.40 dB from 0 to 50 degrees C.
    7) Long Term output stability +/- 0.10dB at 25 degrees C.
    8) Power shall be from rechargeable Ni-Cad batteries.

9) Connector types shall include: MTRJ, ST and SC.
10) Acceptable Manufacturers: Fluke ; mfg# DPS2000 + Fiber Test Kit (or better)

b) Single mode optical fiber light source
   1. Shall be capable of testing to TIA 568-B.1 criteria.
   2. Shall meet the requirements of ANSI/TIA/EIA 526-7.
   3. Provide 1300nm and 1500nm +/- 20 nm wavelength Laser light sources.
   4. Output Stability +/- 0.40 dB from 0 to 50 degrees C.
   5. Long Term output stability +/- 0.10dB at 25 degrees C.
   6. Power shall be from rechargeable Ni-Cad batteries.
   7. Connector types shall include: MTRJ, ST and SC.
   8. Acceptable Manufacturers: Fluke – DPS2000 (or better).

c) Power Meter
   1. Shall be capable of testing to TIA 568-B.1 criteria.
   2. Provide 850nm, 1300nm and 1500nm +/- 20 nm wavelength test capability.
   3. Measurement range shall be from 10 to -60 dBm.
   4. Accuracy shall be +/- 5% at 0 to -50dBm and +/- 10% 10 to 0dBm and -50 to-60 dBm.
   5. Resolution shall be 0.1 dB.
   6. Connector types shall include: LC.
   7. Acceptable Manufacturers:
      a) Fluke - Model 43 B (or better).

d) Optical Time Domain Reflectometer (OTDR)
   1. Shall be capable of testing to TIA 568-B.1 criteria.
   2. Shall have a front CRT display
   3. Connector types shall include: LC.
   4. Design Make: Fluke or approved equal.

2. 100 OHM UTP TESTER

a) Shall be capable of testing to TIA 568-B.1 criteria.
b) Physical interface shall be modular RJ-45 connector and a serial port with DB-9 connector.
c) Shall have auto-testing to determine if cable meets the requirements of TIA/EIA 568-B.1, ISO Class C, D, 10 Base-T, Token Ring, Fast Ethernet and ATM standards
d) Acceptable Manufacturers: Fluke or approved equal.

3. LABELS

a) Shall meet the legibility, defacement, exposure and adhesion requirements of UL 969.
b) Shall be preprinted or laser printed type.
c) Where used for cable marking provide vinyl substrate with a white printing area and a clear “tail” that self laminates the printed area when wrapped around the cable. If cable jacket is white, provide cable label with printing area that is any other color than white, preferably orange or yellow – so that the labels are easily

distinguishable.

d) Where insert type labels are used provide clear plastic cover over label.

e) Provide plastic warning tape 6 inches wide continuously printed and bright colored 18" above all direct buried services, underground conduits and duct-banks.

Acceptable Manufacturers: Brothers or approved equal.

Field Quality Control Standards

1. OPTICAL FIBER CABLE TESTING

a) Test all fibers with launch and far end cable of sufficient length for the OTDR to be able to see through all installed connectors.

b) Localized attenuation shall not exceed 0.50 dB at any point.

c) Backbone multimode fiber shall be tested at both 850nm and 1300 nm in accordance with ANSI/EIA/TIA-526-14A method B.

d) Backbone single mode fiber shall be tested in at both 1310nm and 1550 nm in accordance with ANSI/EIA/TIA-526-14A method A.1.

e) Multimode fiber shall conform to the following:

Length (meters)	**Attenuation (dB)**
500	3.25
1000	5.0
1500	6.5
2000	8.5

1300 nm:

Length (meters)	**Attenuation (dB)**
500	2.2
1000	3.0
1500	3.8
2000	4.5

f) Single Mode Fiber shall conform to the following (note: taken at 1550nm)

Length (meters)	**Attenuation (dB)**
500	2.0

1000	2.5
1500	3.0
2000	3.5
2500	4.0
3000	4.5

Outside:

Length (meters)	**Attenuation (dB)**
500	1.8
1000	2.0
1500	2.2
2000	2.5
2500	2.8
3000	3.0

2. 100 OHM UTP CABLE TESTING

a) The testing parameters called for in this section shall include the horizontal Link/ channel for all installed drop locations.

b) Test cable with test set to match the NVP for the cable as stated by the cable manufacturer of the cable being installed.

c) The test parameters shall include Wire Map, Length, Attenuation, PS- NEXT, PS-ACR, PS-ELFEXT and Return-Loss.

d) Wire Map

1. The wire map test shall verify pair to pin termination at each end and check for connectivity errors. The wire map shall indicate the following for each of the eight conductors:
    a) Continuity to the remote end.
    b) Shorts between any two or more conductors.
    c) Crossed pairs.
    d) Reversed Pairs.
    e) Split Pairs.
    f) Any other missing wiring.

e) The wire map test shall verify pair to pin termination at each end and check for connectivity errors. The wire map shall indicate the following for each of the eight conductors:
   1. Must meet the minimum acceptable values as indicated in TIA/EIA 568B.1 Category6 (TIA/EIA 568B.2-1) requirements.

f) Cable Performance.

g) Must meet the minimum acceptable values as indicated in TIA/EIA 568B.1 Category 6 (TIA/EIA 568B.2-1) requirements.

3. IDENTIFICATION & LABELING

a) Confirm specific labeling requirements with customer's project coordinator prior cable installation or termination.

b) Cables
   1. Backbone cables shall be marked at each endpoint and at all intermediate pull/ access points or junction boxes. Label shall indicate origination and destination TR ID, sheath ID and strand or pair range.
   2. Horizontal cables shall be marked at each end, on the sheath indicating the TR, patch panel and panel port to which the cable is wired. Faceplates and Patch Panels.

c) Faceplates and Patch Panels
   1. Optical Fiber Patch Panels
      a) Fiber patch panels shall be marked using adhesive labels indicating the range of circuits installed to it.
      b) Each port shall be labeled with the origination and destination with the individual strand ID.
   2. Faceplates
      a) Shall be labeled to indicate the room number and panel port A thru Z to which the cable is wired for each cable that it houses.

4. RECORD COPY AND AS - BUILT DRAWINGS

a) Provide record copy drawings periodically throughout the project as per requirements under 25030 or as requested by the project manager and at end of the project. Record copy drawings shall include notations reflecting the as built conditions of any additions to or variation from the original contract drawings provided.

5. TEST RESULTS

   a) Horizontal Copper Cabling
      a) The Contractor shall test all cables and submit all horizontal copper cable test result data in electronic format, with the resulting file formatted with one test result per 8.5"x 11" page.

b) To provide the test results in an acceptable format:
1) Export or Download the test results from the cable tester to a *.txt format.
2) Then open the *.txt file in Microsoft WORD 6.0 and save the file as a *.doc file.

b) Fiber Optic Cables
a) The Contractor shall test all fiber optic cables and submit all fiber test result data in an electronic format and provide one (1) hard copy of the test results showing graphically, the entire length of the fiber.
1) Reports shall show circuit ID, cursor marks, total attenuation, date of installation and test used.
b) Contractor shall submit (1) copy of software capable of viewing the electronic test result files.

c) High Pair Count Copper Cables
a) The Contractor shall test all high count copper cables and submit test result information in an electronic format. Minimal acceptable formats are Word 6.0 or Excel 95/97.
b) See project coordinator for required format for test report documentation.

27 11 00 Telecommunication Rooms

Design Standards

1. This section includes the minimum installation requirements for equipment and cabling infrastructure in Telecommunication Rooms.

Minimum composition requirements and installation methods for the following:
1) Floor Mounted Racks
2) Wall Mounted Racks and Brackets
3) Wall Mounted Cabinets
4) Floor Mounted Cabinets
5) Cable Management Hardware
6) Cable Supports/Ladder Rack
7) Category 6 Patch Panels
8) Fiber Patch Panels
9) Back Boards
10) Punch down Blocks
11) Cross Connect Wire
12) Grounding Bars
13) Power Strips
14) Rack Mounted Shelves
15) Network Electronics
16) Optical Fiber Patch Cords
17) UPS Backup Power

1. Related Sections include the following:

a) 17150 Backbone Cabling Requirements

Performance Standards-Minimum

1. All Telecommunications Room (TR) equipment shall be installed in a neat and professional workmanlike manner. All methods of construction that are not specifically described or indicated in the Contract Documents shall be subject to the control and approval of the Nova Southeastern University Department of Telecommunications. Equipment and materials shall be of the quality and manufacturer indicated. The equipment specified is based on the acceptable manufacturers listed. Where "acceptable manufacturers" is stated, equipment shall be equivalent in every way to that of the equipment specified, and subject to approval.
2. Materials and work specified herein shall comply with the requirements of:
    1. ANSI/TIA/EIA, current release Commercial Building Telecommunications Cabling Standard.
    2. ANSI/TIA/EIA, current release Commercial Building Standard for Telecommunications Pathway and Spaces.
    3. EIA/TIA, current release Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.
    4. EIA/TIA, current release Commercial Building Grounding and Bonding requirements for Telecommunications
    5. NEMA – 250
    6. Federal Communications Commission 47 CFR 68.
    7. BICSI Telecommunications Distribution Design Manual, current published edition.
    8. BICSI Customer Owned Outside Plant Design Manual, current published edition.
    9. BICSI Telecommunications Cabling Installation Manual, current published edition.
    10. ANSI/NECA/BICSI, current release Standard for Installing Commercial Building Telecommunications Cabling.
    11. ADA - Americans with Disabilities Act.
    12. NFPA 70 - 2002, including:
        a) NEC - Article 770
        b) NEC - Article 800
    13. Underwriters Laboratory.

Submittal Requirements

a) Provide product data with bid for the following:
    1. Floor Mounted Racks
    2. Wall Mounted Racks and Brackets
    3. Wall Mounted Cabinets
    4. Floor Mounted Cabinets
    5. Cable Management Hardware
    6. Cable Supports/Ladder Rack
    7. Category 6 Patch Panels
    8. Fiber Patch Panels

9. Punch down Blocks
10. Grounding Bars
11. Power Strips
12. Rack Mounted Shelves

Product Standards

1. FLOOR MOUNTED RACKS

a) Racks shall meet the following physical specifications:
   1. 19" rack mounting space.
   2. 7 foot high.
   3. Lightweight aluminum construction.
   4. Black polyurethane finish.
   5. 15" deep base with four (4) ¾" bolt down holes.
   6. Have double sided 12/24 tapped holes and 5/8" to 5/8"- ½" standard EIA hole pattern.

2. WALL MOUNTED RACKS

a) Wall mounted racks shall meet the following physical specifications:
   1. 19" rack mounting space.
   2. 38.5" high with 19 mounting spaces.
   3. Lightweight aluminum construction.
   4. Black polyurethane finish.
   5. Stationary mounting with 21" deep 14 gauge mounting brackets and 200 lb. capacity.
   6. Racks shall have double sides 12/24 tapped holes and 5/8", 5/8" ½" standard EIA hole pattern.

b) Acceptable Manufacturers:
   1. Chatsworth mfg # 11961-718

3. WALL MOUNTED CABINETS

a) Wall mounted cabinets shall meet the following specifications:
   1. 19" equipment mounting space.
   2. 38.5" high with 20 rack mount spaces.
   3. Universal mounting rails with 10/32 and 12/24 tapped holes-5/8", 5/8", ½". EIA standard hole pattern.
   4. Black polyurethane finish.

b) Racks shall:
   1. Have a two hinge design for front access.
   2. Have louvered sides for ventilation.
   3. Have knockouts in top and bottom for cable access.
   4. Have front access.
   5. Be lockable.

c) Acceptable Manufacturers
   1. Chatsworth mfg# 12324-722 or mfg # 12325-722.

4. FLOOR MOUNTED CABINET AND FRAME

a) Floor mounted cabinets shall meet the following specifications:
   1. Universal mounting rails with 10/32 and 12/24 tapped holes-5/8", 5/8", ½" EIA standard hole pattern.
   2. 16 gauge Aluminum (maximum strength) construction.
   3. Nominal 78"x19"x30".
   4. Lockable plexiglass® hinged door on front and steel hinged door in rear.
   5. Vented roof.
   6. Removable side panels.
   7. Leveling feet.

b) Acceptable Manufacturers:
   1. Chatsworth mfg# M-1130-71x; x refers to shipping method.
   2. APC mfg # AR2800BLK (non-plexiglass, 16 gauge).

5. CABLE MANAGEMENT

a) Cable management panels shall be plastic with integral wire retaining fingers.
b) Cable management panels shall have front and back channels.
c) Cable management panels shall have removable front and back covers. D. Horizontal Cable managers shall be 3"wide x 3"deep on front channel and.2"x 4" on rear channel.
d) Vertical managers shall be 3"wide x3"deep on front channel and 2"w x4"d on rear channel 4"w x 5"d on front channel and 4"w x 4"d on rear channel.
e) Design Make: Panduit
   1. Horizontal - mfg # WMPF1; Vertical – mfg # WMPV20.

6. LADDER RACK

a) Provide a 12" ladder rack in TR as shown on drawings for horizontal cable support
b) Include connecting and support hardware to suit installation. Including but not limited to:
   1. Rack to runway mount plate.
   2. Wall angle support bracket.
   3. Butt splice swivel.
   4. Connect junction.
   5. Grounding Kit. (Metallic ladder racks must be grounded).
c) Rack shall be a hollow or solid side bar nominally 3/8" thick by 1 ½" high with rungs 9" on center.
d) Ladder racks shall be painted black.

7. CATEGORY 6 UTP PATCH PANELS

a) Shall meet the following specifications:
   1. Shall meet or exceed all Category 6 component performance standards as specified in TIA 568-B.2-1.
   2. Provide 48 ports per panel.
   3. Paired punch down sequence to allow pair twists within ½" of the termination.
   4. Shall be UL listed.
   5. Shall have 110 IDC terminations.
   6. Sized for standard 19" equipment rack and shall in all cases have 48 ports.
   7. Shall be equipped with rear cable support bars.

b) Design Make: Leviton.

8. FIBER OPTIC PATCH PANELS

a) Shall meet or exceed all TIA 568-B.3 requirements.
b) Provide 36/48 port or 72/96 port panels as called for on drawing.
c) Shall be rack mounted.
d) Shall accept 6 and 8 Pack SC adapter panels.
e) Multimode fiber shall be connected to orange bulkheads and Single mode fiber shall be connected to yellow bulkheads.
f) Design Makes: Siecor LANScape
   1. CCH-03U : 36 fiber total capacity ; using six 6 fiber panels
      48 fiber total capacity; using six 8 fiber panels
   2. CCH-04U : 72 fiber total capacity; using twelve 6 fiber panels
      96 fiber total capacity; using twelve 8 fiber panels

9. BACKBOARDS

a) Shall be 4 x 8 x ¾" BCX, fire rated plywood
b) Shall be painted – Black, acrylic, interior, fire retardant paint

10. PUNCHDOWN BLOCKS

a) Shall be 110 IDC style blocks.
b) Shall be 300 pair blocks.
c) Blocks shall include means to identify cables per ANSI/TIA/EIA-606-A
   1. Provide connecting clip, designation strip, plastic covers and retaining clip necessary to terminate cables.
d) Acceptable manufacturers
   1. Siemens mfg # S110AB2-300.

11. UTP CROSS CONNECT

a) Provide modular 110 cross connect blocks for all backbone UTP terminations
b) Cross-connects shall be made with wire of equal gauge to that of the feed cable, which it is being connected to:
c) Shall be UL listed.
d) Provide (1) roll of 1 pair and (1) roll of 2 pair per TR
e) Acceptable manufacturers
    1. Berk Tek:
        a) 1 pair description: wh/bl-bl/wh
        b) 2 pair description: wh/bl-bl/wh, o/wh-wh/o

12. GROUNDING BARS

a) Provide telecommunication grounding bar (TGB) assembly as shown on drawings and #6 grounding wire from ground bar telecommunications grounding system.
b) Grounding wire shall be appropriately bonded to the telecommunications main grounding bar (TMGB). The TMGB shall be grounded to the main electrical service grounding electrode system.
c) NEMA approved Ground Bar Assembly to be constructed with following materials (See drawing details for additional information):
    1. Copper Ground Bar (1/4”x4”x10”) with 9/32” holes spaced 1 1/8” apart.
    2. Insulators.
    3. 5/8” Lock washers.
    4. Wall Mounting Brackets.
    5. 5/8-11”x1” HHCS bolts

13. POWER STRIP

a) Shall be 30 amp, 115V.
b) Shall be Rack mounted.
c) Shall be Non-switched.
d) Shall be Surge suppressed.
e) Must have 20 amp twist lock plug.
f) Power cord shall be 10' in length.
g) Must meet UL 1363 and 1449 requirements.
h) Design Make.
i) Acceptable Manufacturers.
    1. Eaton mfg # PW105MI1U165 (switchless).
    2. Eaton Power mfg #PW105MI1U165.

14. EQUIPMENT SHELVES

a) Equipment shelves shall be made of .090 aluminum
b) Color shall be black.
c) Shall be 19” rack mountable.
d) Acceptable Manufacturers:

1. Chatsworth mfg # 40117-719

15. NETWORK ELECTRONICS

a) Network Switches: Juniper Network switches shall be used exclusively unless otherwise specified by The Nova Southeastern University Department of Telecommunications.
b) Media converters: Transition Networks and Allied Telesyn media converters shall be used exclusively unless otherwise specified by The Nova Southeastern University Department of Telecommunications.

16. OPTICAL FIBER PATCH CORDS

a) Shall be a duplex fiber cable meeting the transmission characteristics of the optical fiber horizontal cable.
b) Cables shall be orange in color for multi-mode connections and yellow for single mode connections.
c) The following configurations may be required:
    1. LC/LC.
d) Acceptable Manufacturers:
    1. Compulink

(Note: Must be 100% Leviton Fiber).

17. UPS BACKUP POWER

A. High Performance, uninterruptible power system, designed to prevent blackouts, brownouts, sags and surges from reaching network electronics and other sensitive electronic equipment.
B. Provide a minimum of 30 minutes uptime in the event of an electrical outage situation.
C. Network Management card to provide web/snmp remote management.
D. Acceptable Manufacturers: (UPS Backup Power):

* EATON:
    1. 220 Volt Specifications
        a) 9PX5K UPS.
        b) 9PXXEBM180RT Additional Battery.
    2. 110 Volt Specifications
        a) 5PX2200RT
        b) 5PX3000RT2U UPS.

Installation Quality Control Standards

1. FLOOR MOUNTED RACKS

a) All racks shall be anchored to the floor securely.

b) Provide vertical and horizontal cable as shown on drawings.
c) Mount with a minimum of 36" feet clear access behind and front of rack from the wall to a rack.
d) Ground the rack to the equipment ground bar with a #6 copper wire.

2. WALL MOUNTED RACKS

a) Secure wall mounted racks to building structure with approved anchoring means.
b) Verify all existing wall construction and submit proposed anchoring methods for approval.
c) Provide vertical and horizontal cable management both front and rear.

3. LADDER RACK

a) Install as shown on the drawings.
b) Ladder Rack to be secured to walls and top of equipment rack. Must be grounded for all metallic ladder racks.

4. CABLE MANAGEMENT

a) Provide (1) racked mounted cable manager at TOP OF EACH RACK INSTALLED. ALSO, provide 2 vertical cable managers for each rack installed. If two or more racks are installed side by side, install cable manager between the racks and cable managers on the outside or ends of racks.
b) Provide one 3.5" horizontal cable manager above each 48 UTP port panel and fiber patch panel installed.
c) Provide two 3.5" horizontal cable managers, one (1) above and one (1) below electronics, as shown on drawings.

5. PATCH PANELS

1. Install and label as shown on drawings.
2. Install per manufacturer's recommendations.

6. OPTICAL FIBER PATCH PANELS

1. Install as shown on drawings.
2. Furnish and Install labels for each strand, as per Nova Southeastern University Department of Telecommunications. Management instruction in the field or as shown on drawings.
3. Install blank adapter panels in all positions not used at time of installation for fiber terminations.

7. VIDEO PATCH PANELS

a) Load all panels with one coax insert.
b) Position the panel as indicated on drawings.

8. CABLE SUPPORTS

a) Provide 8 inch “J” hooks 2 ft. on center for all exposed wall mounted vertical cable runs.
b) Keep horizontal wall mounted cable runs to a minimum. In general, horizontal runs shall be on wall mounted ladder rack.
c) Provide category 6 cable brackets 3’ on center supported to building structure for all cable runs not supported by cable tray.

9. BACKBOARDS

a) Linear wall space used for anchoring equipment shall be lined for the full closet width with fire treated BCX grade exterior plywood 3/4" and 8' high.
b) Plywood for mounting termination equipment on shall be installed vertically side by side a minimum of 6" above finished floor. Mounting of said plywood shall be sufficient to support the equipment.
c) Plywood for supporting riser cables shall be installed vertically resting directly on the finished floor. Anchoring and mounting techniques of plywood used to support backbone riser cables shall be sufficient to support a minimum of 1500 pounds of weight.
d) In no cases shall the heads of mounting screws protrude past the face of the plywood.
e) Contractor shall install distribution rings for the cross-connect fields above all wall mounted blocks. Two rings per vertical row of blocks. Mount rings with two hex head screws per ring.

10. MISCELLANEOUS REQUIREMENTS

a) All cables shall be neatly “dressed out” in equipment rooms
b) Fire stop all sleeves and conduit openings after the cable installation is complete
c) Cable pathways shall incorporate the fire rated pathway :

Manufacturer: Hilti Fire Safety Systems, Inc.

Product: Hilti p r o d u c t line

(Discuss with Nova Southeastern University Department of Telecommunications. Manager to determine specific products to be used).

11. PUNCH DOWN BLOCKS

a) Installed on plywood backboard so that top of 300 pair block is 5’6” AFF,
b) Mount Blocks with steel, zinc plated 5/16" slotted hex head #10 x 3/4" drill screws.

c) Install Designation Strips color-coded with industry standard coded field as follows:

Description	Color
Horizontal Wiring	Blue
Data	Light Blue
Wireless Data	Orange
Security / Public Safety	Yellow
Miscellaneous	Dark Gray

d) Install Red Insulator Clips on all special circuits in the TR and at the MDF. See section 271113 for circuit count information.

12. GROUNDING AND BONDING

a) Copper bus provided in each Telecommunication Room.
b) Bond metallic equipment racks, conduits, cable tray, ladder racks to the ground bar.
c) All connectors and clamps shall be mechanical type made of silicon bronze.
d) Terminals shall be solder less compression type, copper long-barrel NEMA two bolt.
e) Bond the shield of shielded cable to the ground bar in communications rooms and spaces.

13. CROSS CONNECT

a) Cross connects shall be made with 1 pair and 2 pair wire as required by circuit being connected. Coordinate cross connect colors

Typical Cable Management Photograph Example 001

Typical Cable Management Photograph Example 002

Typical Cable Management Photograph Example 003

Typical Cable Management Photograph Example 004

Typical Cable Management Photograph Example 005

27 11 13 Equipment Rooms and Service Entrances

Design Standards

1. This section includes the minimum requirements for equipment and materials at the Main Distribution Frame (MDF) and at the Building Entrance.
    a) Minimum composition requirements and installation methods for the following:
        1. Building Entrance Terminals
        2. Surge Protection Modules
        3. Floor Mounted Distribution Frames
        4. Wall Mounted Distribution Frames
        5. Steel Ladder Racking
        6. Grounding and Bonding
        7. Backboards
        8. Frame Mounted Termination Blocks
        9. Frame Mounted Ring
        10. UTP Cross Connects
        11. Utility Coordination

Performance Standards-Minimum

1. All methods of construction that are not specifically described or indicated in the Contract Documents shall be subject to the control and approval of the Nova Southeastern University Department of Telecommunications. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based on the acceptable manufacturers listed. Where "approved equal" is stated, equipment shall be equivalent in every way to that of the equipment specified, and subject to approval.

2. Materials and work specified herein shall comply with the applicable requirements of:
    1. ANSI/TIA/EIA, current release Commercial Building Telecommunications Cabling Standard
    2. ANSI/TIA/EIA , current release Commercial Building Standard for Telecommunications Pathway and Spaces
    3. EIA/TIA, current release Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
    4. EIA/TIA, current release Commercial Building Grounding and Bonding requirements for Telecommunications
    5. NFPA 70 - 2002, including:
        a) NEC - Article 770
        b) NEC - Article 800
    6. Underwriters Laboratory
    7. NEMA -250
    8. Federal Communications Commission 47 CFR 68.
    9. BICSI Telecommunications Distribution Design Manual, current published edition.
    10. BICSI Customer Owned Outside Plant Design Manual, current published edition
    11. BICSI Telecommunications Cabling Installation Manual , current published edition
        edition)
    12. ANSI/NECA/BICSI, current release Standard for Installing Commercial Building Telecommunications Cabling
    13. ADA - Americans with Disabilities Act

Submittal Requirements

1. Provide product data for the following:
    a) Building Entrance Terminals
    b) Surge Protection Modules
    c) Distribution Frames
    d) Steel Ladder Racking
    e) Termination Blocks

Product Standards-Minimum

1. BUILDING ENTRANCE TERMINALS

a) Building Entrance Terminal shall protect up to 100 lines (pairs).
b) Dimensions shall be 4.0"W x 2.0' H x 3.95" D.
c) Input stub (tip) cable shall be 26AWG shielded cable. Contractor shall field verify actual stub length in field.
d) Input stub shall serve as internal fuse link.
e) Input stub shall be equipped with a heavy duty strain relief and encapsulated cable connector.
f) Output stub cable shall be 24 AWG shield cable. Contractor shall field verify actual stub length in field.
g) Shall be wall or frame mountable.
h) Shall accommodate industry standard 5 pin protection modules.
i) Plastic components shall meet exceeded specifications set for in U.L. 497

2. SURGE PROTECTION MODULES

a) Shall be 5 pin, 3 element gas type protection modules.
b) Module shall provide true balanced operation.
c) Over voltage on either side shall cause the entire tube to ionize to provide a simultaneous path to ground for both sides of the circuit.
d) Shall be UL 497 listed.
e) Ground pin shall be tin.
f) Tip and Ring pins shall be gold alloy.
g) The module color shall be black.
h) The module color shall be green for spare pair modules.
i) The nominal DC Breakdown shall be 350V @ 100V/µsec.
j) The impulse breakdown voltage shall be 700A @ 100V/usec and 150A @1KV/usec.
k) The DC holding current shall be 135V for <150ms.
l) The Surge life (min. operations) shall be as follows:
    1. @ 10A, 10 x 1000µsec >3000
    2. @ 100A, 10 x 1000µsec>300
    3. @ 10kA, 8 x 20µsec >10
    4. @ 20kA, 8 x 20µsec >1
    5. @ 65Arms, 11 cycles, 130A total >1
    6. @ 10Arms, 1sec, 20 A total >10

m) The capacitance shall be <1pf for 1 Vrms @ 1Khz, 50 DCV.
n) The insulation Resistance shall be >100M ohms @ 50 VDC.
o) The fail safe operation shall be as follows:
    1. @1.0A <50sec
    2. @5.0A <15sec
    3. @20 A <10sec
    4. @60A <3sec

p) The current limiters shall be as follows:
   1. hold current (ma) @ 20 C = 145
   2. R min / max ohms = 3 / 6.

3. FLOOR MOUNTED FRAMES FOR PROTECTION TERMINALS

a) Provide 84"H Frames suitable for single side mounting of Protection Terminals.
b) Overall width of frame shall be 35.5" and Depth shall be 15".
c) Frame shall be supplied with 12" cable runway support, junctioning bolts, aluminum bond bars, grounding screws and screw for installing the blocks.
d) The frame shall support three (3) Protector modules. Each module shall support eight (8) Protection Terminals for a total of 2400 Pairs per frame.
e) Rack shall have 6" vertical channel to feed cables to blocks.
f) Lowest installed block shall be 6" A.F.F.

4. FLOOR MOUNTED DISTRIBUTION FRAMES

a) Provide 84"H Frames suitable for single side mounting of 110D Termination Blocks
b) Frame shall be configured to support either 3600 on 12 110D blocks or 4500 pairs on 15 110D blocks as per drawing.
c) Overall width of frame shall be 37.5" and Depth shall be 16.13".
d) Frame shall be supplied with 12" cable runway support, junctioning bolts, bond bars, grounding screws and screw for installing the blocks.
e) The frame shall be divided into two modules. The top module shall support 6 110D block and the bottom module shall support 9 110D block.
f) Lowest installed block shall be 18" A.F.F.
g) Rack shall have 6" vertical channel to feed cables to blocks.

5. STE LADDER RACKING

a) Provide ladder rack in CER as shown on drawings for backbone cable support.
b) Include connecting and support hardware to suit installation. Including but not limited to, racks runway mount plates, wall angle support brackets, butt splice swivels, connection junctions and grounding kit. Note: All metallic ladder racks must be grounded.
c) Rack shall be a solid side bar nominally 3/8" thick by 1 ½" high with rungs 9" on center.
d) Finish shall be telco gray.
e) 13/32" holes shall be provided in solid bar for seismic applications.
f) Rungs shall be welded to stringer.

6. COMPUTER FLOOR BASES

a) Shall be adjustable in 2" increments from 8-12" or 16"-24" as required for installation environment.
b) Shall include all mounting hardware.

7. GROUNDING AND BONDING

a) Provide a #6 AWG wire suitable for grounding application.

8. BACKBOARDS

a) Shall be 4 x 8 x ¾" BCX, fire rated plywood.
b) Shall be painted – Black, acrylic, interior, fire retardant paint.

9. WALL MOUNTED DISTRIBUTING "J" HOOKS

a) Contractor shall install open ended distribution rings for wall mounted cross-connect fields above all wall mounted blocks. Two rings per vertical row.
b) Design Make:
    1. Caddy (wall mount) (mfg # CAT32).
    2. Caddy (rod mount) (mfg # CAT12BC).

10. TERMINATION BLOCKS ON FRAME

a) Shall be 110D style blocks.
b) Shall be 300 pair blocks.
    1. Provide connecting clip, designation strip, plastic covers and retaining clip necessary to terminate cables.

11. UTP CROSS CONNECTS

a) Cross connect wire shall be of same gauge (22AWG and 24 AWG) as the feed cable to which it is being connected to, typically cross connect wire will be 24 AWG single twisted pair and dual twisted pair wire as required for circuit being connected.
b) Cross connect wire colors shall be:
    1. White-Blue for voice circuits.
    2. White-Orange for Ethernet.

12. BUILDING ENTRANCE TERMINALS

a) Shall be frame mounted.
b) Field verify actual length required for the input and output stubs.
c) If scope of work does not include splicing of the tip cable to the feed cable, provide clear labeling at the splice end of the tip cable referencing; rack, row and block information. Coordinate with Nova Southeastern University Department of Telecommunications.
d) Terminate output stub to appropriate block on distribution frame. Coordinate with Nova Southeastern Department of Telecommunications.
e) Install #6 Grounding wire as straight as possible from terminal to Grounding Bar.

13. SURGE PROTECTION MODULES

a) Contractor shall fully protect all pairs entering a building.
b) Include unit cost per module in bill of materials.

14. FLOOR MOUNTED DISTRIBUTION FRAMES

a) Install frames as indicated on drawings.
b) Install as per manufacturer's instructions.

15. COMPUTER FLOOR BASES

a) Install as per manufacturer's instructions.

16. STE LADDER RACKING

a) Install all ladder rack and associated mounting hardware in a manner that will allow it to support its maximum rated load.
b) Secure ladder rack to rack when the ladder rack and the top of the rack are at the same height and as additionally required by drawings and field conditions.
c) Install as per manufacturer instructions. Must be grounded.

17. GROUNDING AND BONDING

a) If required, install grounding bar as per the drawings and connect a #4 or#6 copper ground cable to the electrical service ground or independently driven ground rod.
b) If there is no electrical service ground available, install a ½" diameter, 5 ft. grounding rod at least 6 ft. away from other existing electrodes. Installation of any grounding rod shall be in compliance with NEC Section 800 and its subsections and ANSI TIA/EIA 607.
c) Bond equipment to grounding bar as required with #6 AWG copper ground cable.

18. BACKBOARDS

a) Linear wall space used for anchoring equipment shall be lined for the full closet width with fire treated BCX grade exterior plywood 3/4" with certification grade stamp visible after installation and 8' high.
b) Plywood for mounting termination equipment on shall be installed vertically side by side a minimum of 0" above finished floor. Mounting of plywood shall be sufficient to support the equipment.
c) Plywood for supporting riser cables shall be installed vertically resting directly on the finished floor. Anchoring and mounting techniques of plywood used to support backbone riser cables shall be sufficient to support a minimum of 1500 pounds of weight.
d) In no cases shall the heads of mounting screws protrude past the face of the plywood.

19. TERMINATION BLOCKS ON FRAME

a) Install color Designation strips as follows:

Descriptions	Color
Horizontal Wiring	Blue
Data	Light Blue
Wireless Data	Orange
Security / Public Safety	Yellow
Miscellaneous	Dark Gray

b) Install Red Insulator Clips on all special circuit in the MDF.

20. GROUNDING AND BONDING

a) Provide pre-drilled tin plated copper bus bar, with standard NEMA bolt hole sizing and spacing for connectors being used, in all communication equipment rooms.
b) All connectors and clamps shall be mechanical type and made of silicon bronze.
c) Terminals shall be solder less compression type, copper long-barrel NEMA two bolt.
d) Provide #6 AWG conductors from the bus bar to the electrical system equipment ground.
e) Bond the ground bar in the main communication equipment room to dedicated communications equipment panel board where applicable
f) Bond metallic equipment racks to the ground bar.
g) Bond the shield of shielded cable to the ground bar in communications rooms and spaces.

27 13 00 Communication Backbone Cabling

Design Standards

2. The intent of these standards is to provide general guidelines on the design and provision for electronic communication components of the site, building scope. These standards shall not supersede code and regulations nor relieve the Design Professional from their professional responsibility. The section includes the copper and fiber backbone cable and the termination requirements from a switch room / MDF to a BDF to a ER or TR and from ER to TR and from TR to another TR.

3. This section includes minimum requirements for the following:

a. Outside plant (OSP)
    1) Outdoor related optical fiber cables.
    2) Heavy wall inner ducts.
    3) Optical fiber connectors – SM / MM.

4) Optical fiber splicing trays for exterior enclosures.
5) Optical fiber splices enclosures.
6) 24 AWG underground rated copper cables (PE89).
7) Vault enclosures.
8) End caps.
9) Plugs.
10) Bushings.
11) Lubricants
12) Sealing kits.
13) Clamps.
14) Bonding harnesses.
15) Dome Enclosures.
16) Encapsulated Enclosures
17) Encapsulants
18) Splice Tapes.
19) Splicing Modules – Filled.
20) De-Gel Stripper
21) Installation, termination and Splicing methods.

b. Inside plant (ISP)
1) Plenum and riser rated optical fiber cables.
2) Riser and plenum rated inner ducts.
3) Optical fiber connectors – SM / MM
4) ARMM / CMR copper cables
5) Splicing tapes
6) Clamps.
7) Split riser splice cases
8) Bonding Connectors
9) Grounding braid.

Inside Plant – Fiber Optic Cables

1. Plenum and Riser rated Optical Fiber Cables
A. Multimode Fiber:
a) Shall be graded-index optical fiber waveguide with nominal OM3 50 micron-core/cladding diameter. The primary coating diameter of 900um UV cured acrylate buffer material.
b) The fiber shall comply with ANSI/EIA/TIA-492AAAA
c) Transmission Characteristics for Multimode Fiber Optic Cable: Each cabled fiber shall meet the graded performance Specifications below. Attenuation shall be measured in Accordance with ANSI/EIA/TIA-455-46, 53 or 61. Information transmission capacity shall be measured in accordance with ANSI/EIA/TIA-455-51 or 30. The measurements shall be Performed at 23 degrees C +/- 5 degrees.
1.) Maximum attenuation dB/Km @ 850/1300 nm: 3.25/1.0
2.) Bandwidth 200 MHz-km @ 850nm
3.) Bandwidth 500 MHz-km @ 1300nm

4.) Distance vs. bandwidth using a LED transmitter operating at a 1300nm wave length.

B. Single Mode:

a) Class Iva dispersion un-shifted single mode optical fibers complying with ANSI / EIA/ TIA-492BAAA. Primary coating diameter of 250 um UV cured acrylate buffer material.
b) The zero dispersion wavelengths shall between 1300 nm and 1324 nm. The ANSI/ EIA/ TIA-455-168 maximum value of the dispersion slope shall be no greater than 0.093 ps/km-nm².
c) Dispersion measurements shall be made in accordance with ANSI/ EIA/ TIA-455-169 or ANSI/ EIA/ TIA-455-175.
d) The nominal mode field diameter shall be 8.7 um to 10.0 um with a tolerance of +/- 0.5 um at 1300 nm when measured in accordance with ANSI/ EIA/ TIA-455-164 or ANSI/ EIA/ TIA-455-167.
e) Transmission Characteristics:
   1) Maximum attenuation dB/Km @ 1310/1550 nm: 1.0 / 1.0.
   2) The maximum cut-off wavelength shall be <1279 nm when measured in accordance with ANSI/ EIA/ TIA-455-170.
   3) Distance vs. bandwidth using a laser transmitter operating at a 1310 nm.

C. Physical Characteristics:

a) 900 um tight buffers.
b) 2.0 mm sub-unit diameter.
c) OFNR/ OFN flame rated meeting U.L. 1666.
d) Suitable for indoor or interior installations.
e) Strength members shall be FGE/ Aramid yarn with extruded PVC sub cable jacket.
f) Secondary thermoplastic type buffer over each fiber.
g) Suitable for underground or above ground conduits.
h) Shall have individual fiber tube colors per TIA? EIA-598 and overall orange jacket.
i) Provide stiff central member with cables stranded around center.
j) Provide ripcord for overall jacket.
k) Suitable for -40° to 80°C.
l) Suitable for lashing.
m) Must be UV rated for exterior installation.

Optical Fiber Connectors – SM / MM

A. Physical Characteristics

1. All fiber connectors shall meet ANSI/EIA/TIA-604-3 standards.
2. Multimode connectors shall be orange colored, Single Mode connectors shall be yellow colored.
3. The connector shall have an optical axial pull strength of 33 N at 0 degree angle and an optical off axial pull strength of 2.2 N at a 90

degree angle, with a maximum 0.5 dB increase in attenuation for both tests when tested in accordance with ANSI/EIA/TIA-455-6B.

4. Connectors must be fusion-spliced, factory polished pigtails. Refer to Nova Southeastern University Department of Telecommunications management for part number.

B. Transmission Characteristics:

1. The maximum optical attenuation per each mated field installed fiber connector pair shall not exceed 0.5 dB.
2. The total optical attenuation through the cross-connect from any terminated optical fiber to any other terminated fiber shall not exceed 1.0 dB.
3. Shall have a return loss greater than or equal to 20 dB for Multimode fiber and greater than or equal to 26 dB for single mode fiber.
4. The connectors shall sustain a minimum of 500 mating cycles without degrading this performance.

1 Inside Plant-Copper:

1. Backbone UTP cables shall consist of 24 AWG, groups of 50/100 pair thermoplastic insulated copper conductors following the ANSI/ICEA S-80-576 color code. The 50/100 pair groups shall be bound together and covered by a protective sheath consisting of an overall thermoplastic jacket an underlying metallic shield and one layer of dielectric material applied over the core.
2. Provide plenum rated cable.
3. Transmission Characteristics:

a). The resistance of any conductor, measured in accordance with ASTM D 4566 shall not exceed 9.38 ohms per 100m at 20 degrees C.

b) The resistance unbalance between the two conductors of any pair shall not exceed 5%.

c) The mutual capacitance of any pair shall not exceed 6.6 nF per 100m.

d). The capacitance unbalance to ground at 1 kHz of any pair shall not exceed 330 pF per 100m.

e) The characteristic impedance shall be 100 ohm +/- 15% from 1 kHz to 16 MHz

f). The attenuation shall meet the requirements of the horizontal cable specified in section 271500.

g) The insulation between each conductor and the core shield shall be capable of withstanding a minimum dc potential of 5 kV for 3 seconds.

h). The propagation delay of any pair at 10 MHz should not exceed 5.7 ns/m.

i). The Power Sum NEXT loss shall meet the following:

Frequency (MHz)	NEXT loss (dB)
0.772	43
1.0	41
4.0	32
8.0	27
10.0	26
16.0	23

2. ARMM-Copper Cables

a) Shall be of size indicated on the drawings.
b) Shall consist of a core of 24 AWG solid annealed copper conductors, color coded in accordance with telephone industry standards.
c) Transmission Characteristics:
   1) The nominal resistance of any conductor shall not exceed 27.3 ohms per 1000 feet at 20 degrees C.
   2) The mutual capacitance of any pair shall not exceed 15.7 nF per 1000 feet at 1 kHz.
   3) The maximum attenuation at 1.0 MHz shall not exceed 6.8 dB per 1000 feet.
d) Conductors shall be twisted to form pairs. Cable having more that 25 pairs shall be assembled in units, each individually identified by color coded unit binders.
e) The core shall be covered with a plastic tape.
f) The core and tape shall be overlaid with a corrugated shield applied longitudinally with overlap using the following materials:
   1. .008 inch coated aluminum
   2. .005 inch copper
   3. Shall be bonded to outer jacket to form an ALVYN sheath.
g) The outer jacket shall consist of a fire retardant sheath that meets NEC low flame requirements.
h) Cable shall be suitable, listed and marked for use in a riser application. (CMR).
i) Manufacturer's cable code, pair size, manufacturing plant location, month and year or manufacture shall be marked on cable every two feet.

3. VAULT AND RISER CLOSURES

a) Closure shall consist of a black solid or split PVC sleeve as indicated on the drawings.
b) Minimum inside diameter shall be 5" (127mm).
c) Minimum inside length shall be 26" (660mm).
d) Actual sizes shall be indicated on the drawings. Otherwise, closure to be sized to accommodate the maximum number of cable pairs to be spliced and the type of connector to be used for splicing.
e) Closure shall be flame retardant.
f) Closure shall be re-enterable.

g) When assembled with properly sized end caps, bushing, plugs and clamps, the closure shall be air and water tight.

4. VAULT CLOSURE END CAPS

a) At MDF and BDF locations, multiple End caps shall be sized precisely to fit the diameter of the tip cables entering the closure.
b) Number of openings in the multiple end caps shall be determined by dividing the number pairs in the feed cable by 100 and doubling that number. (i.e. 1200 pair cable would have 24 openings for tip cables.
c) Collared Cap opening can be up to 6.35mm (1/4") larger than the feed cable diameter.
d) Actual end cap to be provided shall be based on the diameter of the feed cable to be spliced.

5. PLUGS

a) At MDF and BDF locations, multiple End caps shall be sized precisely to fit the diameter of the tip cables entering the closure.
b) Number of openings in the multiple end caps shall be determined by dividing the number pairs in the feed cable by 100 and doubling that number. (i.e. 1200 pair cable would have 24 openings for tip cables.
c) Collared Cap opening can be up to 6.35mm (1/4") larger than the feed cable diameter.
d) Actual end cap to be provided shall be based on the diameter of the feed cable to be spliced.

6. BUSHINGS

a) Use tapered or collared plugs as required to fill extra opening in end caps.
b) Use sealant to seal if inside diameter of hole is less than 6.35mm (.25").

7. LUBRICANTS

a) Lubricant shall evaporate are use and shall not damage closure elements in any way.

8. SEALING KITS

a) Shall consist of a urethane adhesive designed for sealing split vault sleeves and split end caps.

9. CLAMPS

a) Provide Sleeve and Collared clamps as required to complete work.
b) Adhere to all manufacturer installation guidelines.

10. BONDING HARNESSES

a) Shall be used to ground the shields of the spliced cables.
b) Bonding harness shall be 14 AWG and sized according to closure.

Adhere to all manufacturer installation guidelines

11. SPLICING MODULES

a) All splicing modules shall have an integrated encapsulate in all environments. (ISP and OSP).
b) Crimping process shall strip the installation from the wire and trim the excess wire.
c) The module shall create a gas tight connection.
d) All modules shall have test entry ports on the front side of the module.
e) Straight splicing modules shall have a yellow cover and body top and the base and body bottom shall be dark gold.
f) Pluggable/Bridge splicing modules shall have a transparent cover, the body top and bottom shall be blue and the insulator shall be red.
g) Design Make:
    1. Straight Splicing Modules
        a) Pluggable/Bridge Splicing Modules
        b) Wire connectors may be used for small pair count splices, pending Nova Southeastern University Department of Telecommunications approval.

12. SPLICING TAPES

a) Shall be all weather, Vinyl Plastic material.
b) Shall resist:
    1. Water
    2. Acids
    3. Alkalis
c) Shall be flame retardant
d) Shall not be affected by sunlight.
e) Shall release smoothly in zero weather and will not ooze adhesive in hot climates.

13. BONDING CONNECTORS

a) Shall consist of a base and upper member, two securing nuts and a plastic shoe to aid connector installation and protect the conductors.

b) Base and upper members shall be made of tin plated tempered brass, slightly curved so as to exert a continuous spring form on sheath and shield after clamping.

14. GROUNDING BRAID

a) Shall be a flat tin plated copper braid conductor.
b) Shall have eyelets at regular intervals.

c) Eyelets shall fit shield connector studs up to 6 mm (1/4") in diameter.

OUTSIDE PLANT:

1. OUTDOOR RATED OPTICAL FIBER CABLES

1. Multimode OM3 50 Micron Fiber
   a) Shall be graded-index optical fiber waveguide with nominal 62.5/125um-core/cladding diameter. The primary coating diameter of 900um UV cured acrylate buffer material.
   b) The fiber shall comply with ANSI/EIA/TIA-492AAAA
   c) Transmission Characteristics for Multimode Fiber Optic Cable: Each cabled fiber shall meet the graded performance specifications below. Attenuation shall be measured in accordance with ANSI/EIA/TIA-455-46, 53 or 61. Information transmission capacity shall be measured in accordance with ANSI/EIA/TIA-455-51 or 30. The measurements shall be performed at 23 degrees C +/- 5 degrees.
      a) Maximum attenuation dB/Km @ 850/1300 nm: 3.25/1.0
      b) Bandwidth 200 Mhz-km @ 850nm
      c) Bandwidth 500 Mhz-km @ 1300nm

2. Single Mode
   a) Class IVa dispersion – un-shifted single mode optical fibers complying with ANSI/EIA/TIA-492BAAA. Primary coating diameter of 250um UV cured acrylate buffer material.
   b) The zero dispersion wavelength shall be between 1300 nm and 1324 nm. The ANSI/EIA/TIA-455-168 maximum value of the dispersion slope shall be no greater than 0.093 ps/km-nm^2. Dispersion measurements shall be made in accordance with ANSI/EIA/TIA-455-169 or ANSI/EIA/TIA-455-175.
   c) The nominal mode field diameter shall be 8.7 um to 10.0 um with a tolerance of +/- 0.5 um at 1300 nm when measured in accordance with ANSI/EIA/TIA-455-164 or ANSI/EIA/TIA-455-167.
   d) Transmission Characteristics:
      a) Maximum attenuation dB/Km @ 1310/1550 nm: 1.0/1.0
      b) The cutoff wavelength shall <1279 nm when measured in accordance with ANSI/EIA/TIA-455-170
      c) Distance vs. bandwidth using a Laser transmitter operating at a 1310 nm wavelength:

3. Physical Characteristics:
   a) OFNR/OFN Flame Rated meeting U.L. 1666.
   b) Shall be gel-filled.
   c) Strength members shall be FGE/Aramid yarn with extruded PVC Sub-cable jacket.
   d) Secondary thermoplastic type buffer over each fiber.
   e) Suitable for underground or aboveground conduits.
   f) Shall have individual fiber tube colors per TIA/EIA-606 and overall orange or black jacket.

g) Provide stiff central member with cables stranded around center.
h) Provide ripcord for overall jacket.
i) Suitable for -40^{o} to +75^{o} C.
j) Suitable for lashing.
k) Must be UV rated when used for exterior/aerial installations.

2. HEAVY WALL INNERDUCT

a) Shall be 1" heavy wall construction.

3. OPTICAL FIBER CONNECTORS

a) See inside plant category for same, this section.

OUTSIDE PLANT-COPPER

4. UNDERGOUND RATED BACK BONE COPPER CABLES

a) Shall be of size indicated on the drawings.
b) Shall consist of a core of 24 AWG solid annealed copper conductors, color coded in accordance with telephone industry standards.
c) Transmission Characteristics:
    1. The nominal resistance of any conductor shall not exceed 135.5 ohms per mile at 20 degrees C.
    2. The resistance unbalance between the two conductors of any pair shall not exceed 4%.
    3. The mutual capacitance of any pair shall not exceed 83 +/- 4 nF per mile at 1000 Hz.
    4. The capacitance unbalance pair to ground at 1000 Hz of any pair shall not exceed 800 pF per 1000 feet.
    5. The capacitance unbalance pair to pair at 1000 Hz of any pair shall not exceed 80 pF per 1000 feet.
    6. The dielectric strength of the insulation shall be capable of withstanding a conductor to conductor minimum dc potential of:
    7. The dielectric strength of the insulation shall be capable of withstanding a conductor to shield, minimum dc potential of:
        a) 15 kV for 3 seconds (single jacket) and 20 kV for 3 seconds (double jacket).
    8. The maximum attenuation at 772 kHz at 20 degrees C shall not exceed:
        a) 5.6 dB per 1000 feet for PE-89
        b) 4.9 dB per 1000 feet for PE-39

d) Conductors shall be twisted to form pairs. Cable having more that 25 pairs shall be assemble in units, each individually identified by color coded unit binders.
e) The core shall be covered with a non-hygroscopic tape.
f) The cable shall be filled with a filling material that seals air spaces in the cable core, meeting of exceeding REA compound flow tests.
g) The core and tape shall be overlaid with a corrugated shield applied longitudinally with

overlap using the following materials:

1. .008 inch coated aluminum
2. .005 inch copper
3. Gopher resistant types shall use 0.10 inch copper, .006 inch bimetallic alloy 194 (copper/stainless or steel/copper) or .008 inch coated aluminum/.006inch coated steel (CACSP).
4. Shall be bonded to outer jacket to form an ALVYN sheath.

h) The outer jacket shall consist of a high molecular weight polyethylene.
i) Cable shall be suitable, listed and marked for use in a duct application.
j) Manufacturer's cable code, pair size, manufacturing plant location, month and year or manufacture shall be marked on cable every two feet.

5. ENCAPSULATED CLOSURE

a) Minimum inside diameter shall be 5" (127mm).
b) Minimum inside length shall be 26" (660mm).
c) Actual sizes shall be indicated on the drawings. Otherwise, closure to be sized to accommodate the maximum number of cable pairs to be spliced and the type of connector to be used for splicing.
d) Closure shall be re-enterable.
e) When assembled the closure shall be air and water tight.

6. END CAPS AND CLOSURE EXTENSION SLEEVES FOR ECAPSULATED CLOSURE

a) Actual end caps and closure extension sleeves to be provided shall be based on the quantity and diameter of the feed cables to be spliced.

7. SPLICING TAPES

a) See inside plant category for same, this section.

8. BONDING HARNESSES

a) See inside plant category for same, this section.

9. ENCAPSULANTS

a) Encapsulant shall be transparent.
b) Encapsulant shall be on low viscosity to allow it to penetrate around connectors and wires.
c) When splice is re-entered, the encapsulant must easily come off hands.
d) Must possess sufficient tack to adhere well to the splice components during expansion and contraction caused by temperature changes.
e) When new gel is poured, it must bond thoroughly to existing gel in the closure.
f) Shall be compatible with the cable insulation.
g) Shall not be corrosive to copper and must not support fungi or mold growth.
h) Shall cure quickly. (20- 30 minutes).

10. SPLICING MODULES – FILLED

a) See inside plant category for same, this section.

11. DE-GEL STRIPPER

a) Shall be non toxic.
b) Shall be compatible with the cable insulation.
c) Shall not be corrosive to copper.

Field Quality Control Standards

OUTSIDE PLANT-FIBER:

1. OUTDOOR RATED OPTICAL FIBER CABLES

a) Shall be composite fiber optic cable for all ER to TR connections.
b) Install cable inside of an Innerduct.
c) Adhere to all manufacturer installation guidelines.
d) A service loop of 15 feet shall be maintained at all points of termination.
Service loops shall not exceed manufacturer's recommended bend radius and shall be neatly dressed and shall not interfere with other cables and termination equipment.
e) Pulling tensions shall not exceed those recommended by the fiber optic cable manufacturer.
f) Manufacturer's minimum specified bend radius shall not be exceeded.
g) In the event that cabling is totally dielectric (nonmetallic) and installed in a nonmetallic duct, a #6 copper wire shall be placed in the conduit with the cable to be used as tracer for cable locating purposes.

2. HEAVY WALL INNERDUCT

a) Install 1/8" polypropylene monofilament utility rope with a minimum pull tensile strength of 200 pounds. This rope shall have footage marked printed on it.

3. OPTICAL FIBER CONNECTORS

a) See inside plant category for same, this section.

OUTSIDEPLANT-COPPER:

4. UNDERGROUND RATED COPPER CABLES

a) All underground cable shall have been manufactured within 6 months of purchase date.
b) All open ends of the cable shall have sealing caps installed at the factory prior to shipping so that infiltration of moisture between shipment and installation is prevented.

c) Contractor shall provide notice 2 days advance notice prior to pulling any cable greater that 400 pairs in size or when a winch is planned for use.
   1. Nova Southeastern University Department of Telecommunications shall be present to observe all pulling activities of cable greater than 400 pair or when a winch is planned for use.

d) Cable bend radius shall be at least 10 times the diameter of the cable.

e) Contractor shall be responsible for verifying that ducts are ready for occupancy prior to cable placement.

f) Contractor shall assume responsibility for any difficulties or damage to the cable during placement.

g) Cable feeder guides shall be used between the cable reel and the face of the duct.

h) Cable shall be watched and inspected for sheath defects, as it is payed off the reel. Pulling operation shall be stopped and Nova Southeastern University Department of Telecommunications shall be notified if a defect or any other irregularity is found.

i) Cable shall be peeled off from the top of the reel.

j) Adhere to all manufacturers requirements regarding pulling tension allowable lubricants and bending radius.

k) Use Line Tension meter during cable pull to provide accurate measurement of the force exerted on a cable as it is installed. The meter shall have a programmable overload set point with an audible and visual indication of an overload condition. The meter shall have controls to disengage the cable puller if an overload condition occurs. Provide chart recorded information of the cable pull for the Nova Southeastern University Department of Telecommunications records.

l) Secure all cables and splice cases as required with heavy duty tie-wraps to T-slot cable racking and steps. See section for 270543 for additional exterior pathway requirements.

m) Cable shield shall be continuous from end to end.

n) Ground and bond all cable at the lightning protection.

o) All cables to be grounded at the MDF end with a minimum #6 solid soft copper ground wire as required by code.

p) All cable pairs shall be terminated.

q) Cables shall be tested and the results documented on Nova Southeastern University Department of Telecommunications provided or approved test sheets as specified in Section 270800.

r) Cables shall be labeled as specified in Section 270800.

5. ENCAPSULATED CLOSURES

a) Adhere to all manufacturer installation guidelines.

b) Support closure at both end via racks and steps.

6. END CAPS AND CLOSURE EXTENSION SLEEVES

a) Adhere to all manufacturer installation guidelines.

7. ENCAPSULANTS

a) Adhere to all manufacturer installation guidelines.

8. SPLICING TAPES

a) Adhere to all manufacturer usage guidelines.

9. DE-GEL STRIPPER

a) Adhere to all manufacturer usage guidelines.

INSIDE PLANT-FIBER:

10. PLENUM AND RISER RATED OPTICAL FIBER CABLES

a) Shall be MM/SM composite fiber optic cable for all ER to TR connections.
b) All fiber optic cable shall be installed in conduit, cable tray or supported from building structure at 3-foot centers.
c) Maintain polarization for entire system as described in ANSI/EIA/TIA-568- B.1
d) Cable shall be continuous from the ER to the ER's and TR's.
e) For ER to TR fiber runs, leave a 15' service loop at the ER end and at the TR end leave a 15' service loop.
f) For ER to ER fiber runs leave a 25' service loop at each end.
g) Adhere to all manufacturers' requirements regarding pulling tension and allowable lubricants.
h) The contractor shall be responsible for verifying the actual footage's and distances identified on the attached prints (i.e. wall-to-wall, pull box-to- pull box and ER to TR).
i) The contractor shall be responsible for verifying that conduits and raceways are "ready for occupancy" before cable placement.
j) The contractor shall assume the responsibility for any difficulties or damage to the cable during placement.
k) Where fiber optic cable passes through a vertical riser closet or TR secure fiber to wall vertically every 48". Review fasteners, strain relief and routing with customer.
l) Test, label and document as per Section 270800.

11. RISER AND PLENUM RATED INNERDUCT

a) Adhere to all manufacturer installation guidelines.
b) Support Inner duct every 36" on center.

12. OPICAL FIBER CONNECTORS-SM/MM

a) Adhere to all manufacturer installation guidelines.
b) Connector shall be installed with less than .50 dB of attenuation.

c) Connectors must be fusion-spliced, factory polished pigtails (Refer to the Nova Southeastern University Department of Telecommunications Management for part numbers).

INSIDE PLANT-COPPER:

13. GENERAL REQUIREMENTS

a) All placements shall conform to industry standards with regard to anchoring, cable support and separation from other facilities.
b) All placements shall conform to industry standards with regard to anchoring, support, etc.
c) Cables and Inner duct shall not sag or droop but should be installed to maintain a flat plane with smooth transitions from one level or direction to another.
d) All cables entering and leaving a splice as well as the splice itself shall be appropriately racked to eliminate stress on the cables and/or connections.
e) All cables shall be sufficiently racked and supported in order to eliminate stress on the cable or splice.

14. CMR/CMP COPPER CABLES

a) UTP backbone cables may be installed in conduit, cable tray, or in cat 6 cable hangers 4’ on center.
b) Cables above drywall ceilings shall be installed in conduit. Cables in exposed areas other than communications equipment rooms shall be installed in conduit or surface raceway.
c) Cables shall not be allowed to lay on ceiling or ceiling support structure.
They must be anchored in such a way as to not interfere with other services or space access.
d) Unless otherwise specified, noted UTP backbone cables shall be sized based on two-pairs/connected voice jack. Round up to the next audible pair sizing when doing calculations.
e) Where UTP backbone cable incorporates a campus system (i.e., multiple buildings connected to the backbone), all cable shall be installed with gas tube or solid state protection devices at both ends.
f) Test, label and document as per Section 270800.

15. ARMM COPPER CABLES

a) Secure all ARMM cables to wall within 12" of all splice enclosures
b) UTP backbone cables may be installed in conduit, cable tray, or in cat 6 cable hangers 4’ on center.
c) Cables above drywall ceilings shall be installed in conduit. Cables in exposed areas other than communications equipment rooms shall be installed in conduit or surface raceway.
d) Cables shall not be allowed to lay on ceiling or ceiling support structure. They must be anchored in such a way as to not interfere with other services or space access.
e) Unless otherwise specified, noted UTP backbone cables shall be sized based on two-pairs/connected voice jack. Round up to the next audible pair sizing when doing calculations.
f) Where UTP backbone cable incorporates a campus system (i.e., multiple buildings

connected to the backbone), all cable shall be installed with gas tube or solid state protection devices at both ends.

g) Test, label and document as per Section 270800.

16. VAULT AND RISER CLOSURES

a) In vault environment or other horizontally installations support splice closure at both end via racks and steps.
b) Secure Riser closures to wall with heavy-duty Panduit tie-wraps.

17. SPLICING

a) Fold back method of splicing is required for all new splices.
b) Ends of unused binder groups shall be staggered, cleared and encapsulated with capping kits.
c) Terminal counts shall be installed as per the drawings and may not be split or multiplied.
d) Binder group and color code integrity shall be maintained.
e) Striped nylon cable ties shall be used to identify binder groups on both sides of the splices and at all other sheath openings.
f) The quantity of bad pairs per sheath of 100 pairs or more shall not exceed 1% of the total pair count.
g) Use Cover Removal Tool to remove bases and covers.
h) Use Separation Tool to separate modules from any other module.
i) All cable pairs shall be free of electrical opens, shorts (within and between pairs), polarity reversals, transpositions, and the presence of AC voltage, from the Communication Equipment Room to the termination hardware at the main cross connect frame. All defects must be corrected.

18. SPLICING TAPES

a) Tape all entries to vault and riser closures to prevent water, insects or rodents from entering enclosure.

19. BONDING CONNECTORS

a) Install Bonding Connectors so as not to damage the conductors in the cable.

20. GROUNDING BRAID

a) Adhere to all manufacturer installation guidelines.

27 15 00 Communication Horizontal Cabling

Design Standards

1. Horizontal cabling is the portion of the cabling system that extends from the work area to the Telecommunications Room or communications center in the case where the communication center serves as a communication closet for an area. The horizontal cabling shall be

configured in a star topology. The horizontal cabling includes the horizontal cables, the mechanically terminated jacks/inserts and the faceplates that the jacks/inserts snap into, in the work area.

2. This section includes minimum requirements for the following:
    a) Category 6 UTP Cable from TR to Workstation
    b) Category 6 Jacks
    c) Category 6 Patch Cables
    d) Faceplates
    e) Installation and Termination Methods

Performance Standards-Minimum

1. All cable shall be installed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the Nova Southeastern University Department of Telecommunications. Equipment and materials shall be of the quality and manufacture indicated. The equipment
Specified is based upon the acceptable manufacturers listed. Where "approved equal" is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval.

2. Strictly adhere to all <<CATEGORY 6>> installation practices when installing UTP data cabling.

3. Materials and work specified herein shall comply with the applicable requirements of:
    a) ANSI/TIA/EIA, current release Commercial Building Telecommunications Cabling Standard.
    b) ANSI/TIA/EIA, current release Commercial Building Standard for Telecommunications Pathway and Spaces
    c) EIA/TIA, current release Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
    d) EIA/TIA, current release Commercial Building Grounding and Bonding requirements for Telecommunications
    e) NEMA – 250
    f) Federal Communications Commission 47 CFR 68.
    g) BICSI Telecommunications Distribution Design Manual, current published edition
    h) BICSI Customer Owned Outside Plant Design Manual, current published edition
    i) BICSI Telecommunications Cabling Installation Manual, current published edition
    j) ANSI/NECA/BICSI, current release Standard for Installing Commercial Building Telecommunications Cabling
    k) ADA - Americans with Disabilities Act
    l) NFPA 70 - 2002, including:
        a) NEC - Article 770
        b) NEC - Article 800
    m) Underwriters Laboratory.

Submittal Requirements

A. Manufacturers catalog sheets, specifications and installation instructions for all cable, <<CATEGORY 6>> inserts, faceplates and jacks.

B. If providing pre-standards manufacturer system solution, submit installer/contractor certification documentation and channel certification information and requirements from manufacturer.

Component Standards

1. 100 OHM UNSHIELDED TWISTED PAIR CABLE (UTP)

a) Physical Characteristics:
1. Shall be plenum/pvc rated and meet applicable requirements of ANSI/ICEA S-80-576. All 4 pairs must be F.E.P. No 2x2 or 3x1 F.E.P. cables will be allowed.
2. The diameter of the insulated conductor shall be .048 in. maximum.
3. Shall consist of (4) 24 AWG Twisted pairs.
4. The color coding of pairs shall be:

Pair 1	W-BL; BL
Pair 2	W-O; O
Pair 3	W-G; G
Pair 4	W-BR; BR

5. The overall diameter of the cable shall be less than 0.25 inches.
6. The ultimate breaking strength measured in accordance with ASTM D 4565 shall be 400 N minimum.
7. Cable shall withstand a bend radius of 1 inch at -20 degrees Celsius without jacket or insulation cracking.
8. Labeled third party "Verified Category 6".
9. Blue cable shall be provided for all cables terminated to patch panels in the TR's that are designated for data services.

b) Transmission Characteristics:
1. Shall meet TIA 568-B.2-1 standard for Category 6 UTP cable.

c) Acceptable Manufacturers:
LEVITON or approved equal.

2. CATEGORY 6 JACKS

a) Physical Characteristics:
1. Shall be functional from -10 degrees F to 140 degrees F.

2. Shall be tested in accordance with ANSI/EIA/TIA-568-B.2-1 for Category 6.
3. Shall be modular RJ45 jacks that snap into user configurable faceplates meeting durability requirements specified in IEC 603-7. Provide impact resistant faceplates nylon with label indicating Room number and patch panel port [A-Z].

b) Shall be 110 IDC, RJ45 type suitable for eight 22-26 AWG wires and be certified Category 6compliant.
c) Conductors shall be separated and aligned internally by jack comb.
d) Wired in accordance with EIA/TIA T568B polarization sequence.
e) Color (s) to be approved by NSU Committee per project. Black Jacks are preferred for all data runs on faceplates.
f) Design Make: LEVITON.

3. FACEPLATES

a) Faceplates installed in office area shall be high impact thermoplastic flush mounted design.
b) Single gang faceplates shall be 2.75" x 4.5".
c) Double gang faceplates shall be 4.5" x 4.5".
d) Faceplates shall be UL listed.
e) Color (s) to be approved by NSU committee per project. Black Jacks are preferred for all data runs on faceplates.
f) Design Make:
    1. Acceptable Styles:
        1) Plastic
            1) LEVITON
            Single Port
            Double Port
        2) Stainless Steel
            1) LEVITON
            Single Port
            Double Port
        3) Modular Furniture Faceplate Assemblies
            1) LEVITON
        4) Surface Mount Boxes
            1) LEVITON
            Single: Port
            Double Port:

4. WALL PHONE WALL JACK ASSEMBLY

a) Shall be constructed of plastic
b) Shall have mounting lugs designed to mate with corresponding telephone base plate or adapter.
c) Shall mount to single gang outlet box.
d) Shall be wired to TIA-568B.
e) Design Make: SPC Technology. Mfg # TA-5-6

5. 100 OHM UTP PATCH CABLES

a) Physical Characteristics.
   1. Shall have stranded conductors and meet Category 6. Performance criteria as defined by TIA 568-B.2-1 for Category 6
   2. Lengths required will range from 4' to 15' as required by customer. See Bid Forms.
   3. Shall be blue in color.
   4. Insulated conductor diameters shall not exceed (0.047 in.).

b) Design Make: LEVITON or approved equal

Field Quality Control Standards

1. INSTALLATION

a) UTP Cable:
   1. All wiring concealed in walls or soffits shall be installed in metal conduits.
   2. All exposed wiring shall be installed in surface raceway.
   3. All wiring above ceilings shall be installed in cable tray or open top cable hangers.
   4. Cable above accessible ceilings shall be supported 3' on center from cable support attached to building structure.
   5. Do not untwist cable pairs more than 0.5 in. when terminating.
   6. The Contractor shall be responsible for replacing all cables that do not pass category 6 requirements.
   7. Maximum length shall be 60 meters.
   8. Cable shall have no physical defects such as cuts, tears or bulges in the outer jacket. Cables with defects shall be replaced.
   9. Install cable in neat and workmanlike manner. Neatly bundle and tie all cable in closets. Leave sufficient cable for 90^{o} sweeps at all vertical drops.
   10. Maintain the following clearances from EMI sources.
       a) Power cable - 6 in.
       b) Fluorescent Lights - 12 in.
       c) Transformers - 36 in.
   11. Do not install category 6 cable with more than 110N (25 lbs) pull force, as specified in EIA/TIA and BICSI practices. Utilize appropriate cable lubricant in sufficient quantity to reduce pulling friction to acceptable levels on: long pulls inside conduit, pulls of multiple cables into a single small bore conduit, on conduit runs greater than 100 lineal feet with bends of opposing directions, and in conduit runs that exceed 180 degrees of accumulated bends. Use of tensile rated cords (i.e. fishing line) should be used for difficult or questionable.
   12. Cables jackets that are chaffed or burned exposing internal conductor insulation or have any bare copper (“shiners”) shall be replaced.
   13. Firestop all opening where cable is installed through a fire barrier.

b) Inserts and Faceplates

1. All cables shall be terminated with high density modular jacks that snap into a faceplate mounted on a wall outlet box, surface raceways or power pole.
2. Outlet boxes shall be secured to building with mechanical fasteners. Adhesive fasteners are not allowed.
3. All extra openings to be filled with blank inserts.
4. Terminate cable per EIA/TIA T568B standard pin assignments.
5. Locate so that combined length of cables and cords from panel to phone or computer does not exceed 3m.

THE END OF DIVISION 27

SECTION 13700

SECURITY SYSTEM

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 DEFINITIONS

A. Definitions: In addition to the definitions outlined in the General Conditions, the following definitions shall apply to this Section:

1. Owner: The Owner is Nova Southeastern University.
2. Security Consultant: The Security Consultant is Kroll Advisory Solutions.
3. Contract Documents

    a. Contract Documents shall consist of:

        1) General Conditions.
        2) This Section.
        3) Applicable Information Technology (IT) Sections.
        4) Security Device Drawings (Drawings).
        5) Appendices
        6) Addenda, change orders, drawings, and associated correspondence as may be authorized in writing and issued by the Owner or its representatives to interpret, clarify, or modify the Contract Documents.

4. Critical Device

    a. A critical device is any device that will significantly impact the system performance and/or operation.
    b. Examples of critical devices and applications include:

        1) Data gathering panel (DGP) motherboards; card reader, input, and output modules, and Network Video Recorders (NVR). Failure of these devices cause many card reader controlled doors, cameras, or critical alarm events to fail.
        2) Power supplies and power distribution modules. Failure of these devices impact many system devices.
        3) Fire alarm interfaces, request to exit devices, and other equipment that impact life safety.
        4) Card reader controlled building primary and secondary entrances and high-security areas including labs and the vivarium.

5) Building perimeter and high-security area door position switches that do not allow the Owner to remotely monitor and control the secure condition of the building.
6) Duress buttons, telephone assistance stations, and other equipment that does not allow the Owner to monitor and respond to duress alarm conditions.

c. Examples of non-critical devices include:

1) Card readers (except as noted).
2) Door position switches (except as noted).
3) Request to exit devices for doors with free egress locking mechanisms.
4) Motion sensors and other typical alarm input devices (except as noted).

5. Provide: Where the term "provide" is used throughout this Section, it shall mean "furnish and install."
6. Security Contractor: The Security Contractor is Siemens Building Technologies, Inc.
7. Security System: The Security System shall refer to Work provided in this Section.
8. Instructions, directions and requirements as specified shall be considered to be followed by the phrase "unless otherwise specified or noted."

1.03 RELATION OF SECTION, APPENDICES, AND SECURITY DRAWINGS

A. This Section, Appendices, and the Drawings shall be of equal authority and priority. The Security System specifications shall consist of this Section (Standard Security System Requirements) and Appendices (project-specific clarifications and specifications). Where Appendices conflict with this Section, Appendices shall supersede requirements in this Section.

B. Refer differences between the requirements to the Security Consultant prior to the submission of bids for clarification by an Addendum issued to bidders. If differences or conflicts are not called to the Security Consultant's attention prior to submission of bids, the Security Consultant shall decide which of the conflicting requirements will govern, and the Contractor shall perform the Work at no additional cost in accordance with the Security Consultant's decision.

C. Should the Drawings disagree in themselves or other Contract Documents provide the greater quantity of Work or materials.

1.04 CONFIDENTIALITY

A. The Work is critical to the security of Nova Southeastern University. Plans, specifications and other documentary material and information about the Work are confidential information and shall remain secure and confidential. Confidential information shall not be deliberately or inadvertently disclosed to anyone other than the Contractor's personnel and subcontractors who require disclosure to perform their

portion of the Work. Track confidential information and ensure that copies are accounted for.

1.05 NOTIFICATIONS

A. Notify the Owner's security operations (954-262-8999) before working on security equipment and after completing work for the day when the Security System is being installed in a new building and it is after substantial completion.

1.06 SUMMARY

A. Scope of Work

1. Provide Security System equipment as indicated the Drawings and Appendices. This Section specifies the Owner’s standard requirements for Security Systems equipment. The Drawings and Appendices identify specific requirements for each project.
2. Connect the Security System equipment to the Owner’s existing systems.
3. Connect the Security System to the Owner's network and telephone lines. Provide patch cables and punch down blocks as required to connect the Security System to the network ports and telephone lines.
4. Provide Security System cables and connectors including device cables, data and voice cables, and patch cables. Data and voice cables, equipment, installation, termination, and testing shall comply with IT Communications requirements.
5. Provide conduit and back-boxes that are not provided under a separate section, as indicated on the Drawings.
6. Provide complete turnkey systems including software, hardware, equipment, peripherals, programming, interfaces with other systems, conduits, boxes, and raceways, power, wire and cable, carpentry, demolition, patching, refinishing, and relocation. Include the cost of other trades necessary to install the complete system, whether specifically mentioned or not.
7. The Drawings indicate approximate locations. Field verify final equipment layouts and exact equipment locations to ensure compliance with the intent of the Contract Documents.

B. Owner's Existing Security System Description

1. The Owner's existing security system consists of:

a. A Software House C-Cure 800 access control and monitoring system.

1) Provides for card read control and alarm monitoring functions.

b. A Genetec Omnicast video management system.

1) Provides for security video surveillance and recording functions.

c. Talk A Phone telephone assistance stations.

1.07 RELATED WORK

A. Coordinate the installation with the following related Sections.

1. Division 08 – Openings.
2. Division 08 - Door Hardware.
3. Division 14 – Elevators.
4. Division 16 – Electrical.
5. Communications and IT.
6. Fire Protection System.

1.08 PERMITS

A. Ensure compliance with and an understanding of local codes and contract conditions and obtain permits necessary pertaining to the Work.

B. Submit to the local authority having jurisdiction (AHJ) the electric lock/electronic lock procedure submittal for permitting as required. The Contractor shall only be responsible for lock permitting of electric locks controlled by the Security System.

1.09 REFERENCES

A. Americans with Disabilities Act - ADA

B. Underwriters Laboratories (U.L.) Applicable Standards.

C. National Fire Protection Association (NFPA) 731: Standard for the Installation of Electronic Premises Security.

D. Factory Mutual (FM).

E. National Electrical Code (NEC).

F. Insulated Cable Engineers Association (ICEA).

G. Institute of Electrical and Electronics Engineers (IEEE).

H. Electronic Industries Alliance (EIA).

I. Telecommunications Industry Association (TIA).

J. ETL Testing Laboratories (ETL).

1.10 SUBMITTALS

A. General

1. Provide submittals in accordance with Division 1 and General Conditions requirements.
2. The Architect, Owner, and Security Consultant will review and approve submittal packages.
3. Submit packages to the Architect and Security Consultant for distribution to reviewers.
4. Submit a letter of transmittal with project submittal form identifying the name of the Project, Contractor's name, date submitted for review, and a list of items transmitted.
5. Produce submittal drawings using the latest version of AutoCAD.
6. Provide printed drawings sized as required to present readable detail including text and symbols (minimum of 18" x 24").
7. Partial Submittals shall not be accepted without prior written approval by the Security Consultant. The Security Consultant cannot verify the Security System design without complete and thorough descriptions of components and installation details.
8. Details, block diagrams, legends, symbols, and other drawing elements prepared by the Architect or Security Consultant are not intended to be complete designs, shall not be considered submittals, and shall not be accepted as submittals for the Work.
9. The review and approval of the Contractor's Submittals shall not relieve the Security Contractor of the obligations to comply with the requirements of the Contract Documents.
10. No portion of the Work shall commence, nor shall equipment be ordered until the Owner and the Security Consultant have approved the Submittals in writing.
11. There shall be no deviation from the approved Submittals unless otherwise stated in the Contract Documents or pre-approved by the Security Consultant prior to the Work being performed.

B. Prefabrication Submittals

1. Provide prefabrication submittals no later than 30 calendar days after award of contract.
2. Prefabrication submittals shall consist of the Security Contractor's construction schedule, product data, shop drawings, and samples.
3. The purpose of the prefabrication submittals is to provide information as noted below. Provide documents necessary to comply with these requirements, demonstrate understanding and compliance with contract requirements, and provide installation details necessary for installation technicians to provide a consistent and compliant installation.

    a. A system description prepared by the Security Contractor that demonstrates comprehension of the Contract Documents and design intent.

b. Equipment schedules necessary to identify products that will be provided for the Project. Schedules shall include description, manufacturer, model, and quantity for each product.
c. Product information necessary to demonstrate compliance with the operational and technical requirements of the Contract Documents. Product information shall identify specific manufacturers, models, and options to be used for the project. Submittals shall also include descriptions, illustrations, diagrams, installation instructions, compliance information for applicable standards, dimensions, electrical characteristics, support requirements, and connection requirements.
d. Product and software descriptions necessary to explain the operation and implementation of custom products.
e. Floor plans necessary to identify specific device locations, cable routes and quantities, cable types, riser locations, and references to installation details and diagrams.
f. Riser diagrams necessary to clearly identify cable routes between floors, closets, rooms, buildings, and other areas that cannot be clearly identified on floor plans.
g. Installation drawings including system block and functional diagrams. Include point to point wiring diagrams for each device type including terminal and connector pin terminations.
h. Device termination details necessary to ensure consistent equipment installation and termination.
i. Head end termination details and schedules necessary to ensure that installation personnel and subcontractors properly connect devices to the DGPs, power supplies, transition equipment, and other head end equipment.
j. Power supply connection details including connected loads and demonstration that loads do not exceed power supply and specification load requirements.
k. Wiring diagrams for fail-safe locking mechanisms necessary to demonstrate that connections comply with contract documents.
l. Wire and cable types and samples necessary to verify cable types and confirm installed wire and cable matches submitted and approved wire and cable.
m. Detailed elevation drawings for each security riser location.
n. Completed programming forms. The Owner will provide blank forms.
o. Color, finish, and other samples necessary for review and approval of product options.
p. Preliminary fabrication drawings for custom equipment necessary to demonstrate compliance with Contract Documents.
q. Product samples as necessary for review and approval of product applications.

4. Construction Schedule

a. Security System Substantial Completion shall coincide with other trades. Coordinate with the General Contractor and other sections to ensure completion of work by other trades necessary for the Security System to operate successfully.

b. Provide a detailed and coordinated construction schedule that identifies milestones and completion dates for the Security Contractor and other work that must be completed by other trades and the Owner necessary to make the Security System operational. The schedule will be used by the Architect, Owner, and Security Consultant to verify progress during construction.
c. Demonstrate integration of the construction schedule into the overall Project construction schedule. Coordinate with the General Contractor to document the impact of overall Project schedule modifications to the security system installation and completion.
d. The construction schedule shall include but not be limited to the following milestones:

    1) Pre-installation meeting.
    2) Coordination meetings with the General Contractor and contractors providing related work.
    3) Security conduit and back box rough-in.
    4) Security wire rough-in.
    5) Security riser closet construction completion.
    6) Network and voice infrastructure and equipment installation.
    7) Door and frame installation.
    8) Door hardware installation.
    9) Door operator installation.
    10) Surrounding walls installation, finishes, and final painting.
    11) Field device installation and wire termination.
    12) Security riser closet equipment installation and wire termination.
    13) Security System programming sheet coordination.
    14) Security System programming.
    15) Security System and field device test.
    16) Substantial Completion test.

e. For work that must be completed by other trades and the Owner, the schedule shall identify time necessary to complete the Security System installation after completion of work by other trades and the Owner.
f. During construction submit an updated construction schedule to the Owner and Security Consultant at least every two weeks. Additional and more frequent submissions may be requested during key construction periods, in preparation for Commissioning, and other times as determined by the Owner and Security Consultant.

5. Product Data

    a. Submit product data in three ring binders divided into separate sections for each portion of the Access Control and Alarm Monitoring, Security Video System, and Security Voice Communications

6. Shop Drawings

    a. Drawings shall comply with the Architect's and Owner's CAD standard requirements.

b. Produce original Submittal drawings using the latest release of AutoCAD®, at the time of production.
c. Title drawings and include the issue name and original date of issue on each drawing.
d. Clearly mark revised original drawings to indicate the date and description of each revision.
e. Drawing submittal and lettering shall permit production of legible, half size copies.

7. Samples

a. Coordinate sample submittal requirements with the Owner and the Security Consultant.

C. Procedure for Resubmitting

1. Make corrections or changes in product data, shop drawings, and samples as required by the reviewer comments and resubmit when the reviewers' stamp requires resubmission.
2. Clearly identify changes on shop drawing re-submittals. Only identified changes will be reviewed when resubmitting.
3. Clearly identify drawing sheets added to the resubmitted shop drawings. Do not change the sheet numbering scheme for previously issued shop drawings.
4. Submit a letter of transmittal with re-submittals identifying the name of the Project, Security Contractor's name, date submitted for review, and a list of items transmitted.
5. The Security Contractor shall be responsible for delays caused by rejected submittals and the resubmission process.

1.11 RECORD DOCUMENTATION

A. Record documentation shall consist of product data, as-built drawings (prefabrication drawings revised to reflect as-installed conditions), and operations and maintenance (O&M) manuals.

B. The Security Contractor shall be responsible for modifying the prefabrication shop drawings to reflect as installed conditions.

C. During systems installation and at times when the Work is actively in progress, maintain up-to-date and accurate as-built drawings. Keep this set of drawings current and neat. The progress set shall provide for reference only and shall not be used for installation purposes.

D. Prior to Commissioning of the Security System, submit two hard copies of the preliminary as-built drawings to the Security Consultant for review and approval. Preliminary as-built drawings may include legible red-line markups of field changes and notes. Upon acceptance of the preliminary as-built drawings and other pre-test requirements, the Security Consultant will schedule a Substantial Completion test.

E. Upon Substantial Completion of the Work, submit three full size hard copies of record documentation within 30 days from the date of Substantial Completion. The submission shall include comments made to the preliminary as-built drawings and modifications made necessary during the Substantial Completion test. Upon acceptance of the record documentation, submit two electronic copies of the approved documents on CD-ROM or similar removable storage media as coordinated with the Owner.

F. Field Equipment Documentation

1. Provide termination documentation within each cabinet. Documentation shall include information necessary to maintain and service the cabinet including, but not limited to cable types and identifiers, cable pathways, device terminations, connected field devices and locations/descriptors, communication connections, and 120 VAC power circuits, breakers, and locations.

G. Operation and Maintenance (O&M) Manuals

1. Record documentation shall include operation and maintenance manuals for devices, equipment and software modules.
2. Bind final copies of O&M Manuals in hardback, loose-leaf binders.
3. Identify each manual's contents on the cover.
4. Furnish a table of contents and tab sheets for each O&M Manual. Furnish tab sheets at the beginning of each chapter or section and at the beginning of each appendix.
5. Manuals shall include the following:

    a. A list of manufacturers, their local representatives and subcontractors that have performed Work on the Project with a detailed description of the Work they performed. The list shall include contact names, telephone numbers, and addresses for each.
    b. Manufacturer product information.
    c. Specific functions of each device. For example, detail camera call-up (in order) and what the expected view for that particular call-up will be.
    d. Final test data.
    e. Installation and service/maintenance manuals for each piece of equipment. Manuals shall include the following minimum information:
    f. List of Owner-associated mechanical locking keys with key codes and tamper-resistant hardware types.
    g. Installation instructions.
    h. Use of the software and programming.
    i. Operator commands.
    j. System start-up and shut-down procedures.
    k. Recovery and restart procedures.
    l. Detailed setup procedures for components.
    m. A statement of warranty from each manufacturer that will be supplying equipment for this Project.
    n. Maintenance schedules for installed components. Schedules shall include inspections, preventive maintenance schedules, and documentation of repaired and replaced equipment.

H. Warranty Letter

1. Provide a signed warranty letter.
2. The letter shall identify the completion date, warranty start date, and warranty completion date.
3. The Security Consultant shall verify the warranty dates to ensure dates begin upon Final acceptance of the system.

1.12 QUALITY ASSURANCE

A. Security Contractor Responsibilities

1. The Security Contractor shall:

   a. Schedule and coordinate their work with the General Contractor.
   b. Manage, schedule, and coordinate conduit and cabling contractors regarding any work that pertains to security equipment and device installation.
   c. Maintain certifications, training, and licenses as required to purchase, install, modify, and service the specified systems.
   d. Maintain factory trained and certified technicians. Certified technicians shall install and terminate security riser closet equipment including DGPs, and power supplies and shall supervise installation, commissioning, and maintenance of the Work. Installing personnel shall be licensed as required by local and state jurisdictions. Maintain certification information for each technician and provide certifications to the Owner and Security Consultant for verification and record.
   e. Ensure compliance with and have a thorough understanding of local codes and contract conditions pertaining to the Work.
   f. Have local in-house engineering and project management capabilities consistent with the requirements of the Work. Provide a team managed by a project manager responsible for submittals, installation, scheduling, manpower, testing, record documents, subcontractors, etc.
   g. Maintain a spare parts inventory to resolve system component failures including:

      1) Data gathering panel boards.
      2) Card readers.
      3) Power supplies.
      4) Door position switches.
      5) Motion sensors.
      6) Telephones assistance stations.

2. In the event the Security Contractor becomes unable to complete the Work in accordance with the Contract Documents or the satisfaction of the Owner or its representatives due to a lack of understanding of the equipment, systems, or services required by the Contract Documents, the Security Contractor shall retain the services of the applicable manufacturer's representatives to expeditiously

complete the Work in accordance with the construction schedule at no additional cost to the Owner.

B. Product Standards

1. Materials included in the completed Security System installation shall be new, compatible with the Owner's existing systems and equipment, and shall comply with the latest published specifications and versions of the manufacturer.
2. Unless otherwise specified, components included in the completed security system shall be standard, unmodified production models.
3. Provide at the time of installation the latest version of equipment and software. Discontinued equipment or software shall not be acceptable.
4. Equipment, components and materials shall meet or exceed the performance characteristics and technical specifications for referenced components.
5. Provide complete and detailed technical information for equipment, components and materials. The Owner or its representatives will reject proposed equipment in the event that submitted technical information is not sufficient to readily confirm that proposed equipment, components, and materials will meet or exceed the performance and technical specifications. The Owner or its representatives shall make the final decision as to whether proposed equipment, components and materials are acceptable. In no case shall acceptance by the Owner or its representatives of proposed equipment, components and materials relieve the Security Contractor of responsibility to produce completed systems which comply with this Section.
6. Within the technical specifications for the system, certain manufacturers may be specified. These manufacturers are preferred by the Owner to ensure compatibility with existing equipment. Unless followed by "no exceptions," the Security Contractor may substitute manufacturers and models that are more cost effective or readily available than those specified. Substitutions shall meet or exceed the minimum functional and technical specifications and shall be compatible with existing equipment. Acceptance of such substitutions is at the discretion of the Owner or its representatives.

1.13 WARRANTY

A. Furnish a one-year warranty for the Work. The Warranty shall begin after Substantial Completion acceptance of the Work by the Owner. Provide manufacturers standard warranties.

B. If, within one year after the date of Substantial Completion of the Work or within such longer period of time as may be prescribed by law, or by the terms of applicable special warranty required by the Contract Documents or provided by a manufacturer, Work and equipment are found to be defective or not in accordance with the Contract Documents, the Security Contractor shall correct it promptly including parts and labor after receipt of notice from the Owner to do so unless the Owner or its representative has previously given the Security Contractor a written acceptance of such condition. This obligation shall survive termination of the Contract. The Owner will give notice of such conditions

promptly after discovery. Owner representatives shall furnish such notice either verbally or in writing.

C. Nothing contained in the Contract Documents shall be construed to establish a shorter period of limitation with respect to other obligations that the Security Contractor might have under the Contract Documents or manufacturer's warranty.

D. The establishment of the time period of one year after the date of Substantial Completion of the Work or such longer period of time as may be prescribed by law or by the terms of Warranty required by the Contract Documents, relates only to the specific obligation of the Security Contractor to correct the Work or equipment, and has no relationship to the time within which its obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Security Contractor's liability with respect to its obligations other than specifically to correct the Work or equipment.

E. Warranty Service

1. In the event that defects in the materials and workmanship are identified during the Warranty period, the Security Contractor shall provide labor and materials as may be required for prompt correction of the defect.
2. Warranty service and repair work shall be performed by personnel who have been trained, certified, and are experienced in the operation and maintenance of the installed system(s).
3. Warranty service shall include replacement of parts and components as required to restore normal system operation within 24 hours, based on a 7-day/24-hour per day week. Critical failures require response within 4 hours. In the event that system parts or components must be removed for repair, it shall be the responsibility of the Security Contractor to furnish and install temporary parts and components as required to restore normal system operation until the repaired parts or components can be repaired and re-installed.
4. Maintain an inventory of spare parts or arrange for manufacturer parts support as required to ensure correction of failures or malfunctions within 24 hours of the Owner's request for service (72 hours when spare parts or loaner equipment must be delivered from the manufacturer).
5. Provide loaner equipment for equipment not field repairable. Such loaner equipment shall be in working order and the functional and technical equivalent of the item replaced.
6. In the event that the Security Contractor determines and successfully demonstrates to the Owner that service or repairs are required as a result of misuse, abuse or abnormal wear and tear, the Security Contractor shall be compensated for such service or repairs at the Security Contractor's hourly rates as listed in the bid proposal for the Project. Similarly, such compensation to the Security Contractor shall apply in the event that repairs are required for devices and equipment not provided by the Security Contractor but incorporated in the completed systems.
7. Immediately following the completion of a Warranty repair or service call, the Security Contractor's service personnel shall submit a written report to the Owner which details the service work performed, the cause of the trouble, and outstanding work which is required to restore complete and normal operation.

F. Preventive Maintenance

1. Perform preventive maintenance during the warranty period. Submit a list of items to be included in the preventive maintenance program. The list shall include maintenance to each item, the frequency of such maintenance, and the amount of time to be spent on each item for maintenance. Semi-annual preventive maintenance shall include, but not be limited to, the following.

    a. Test and adjust system sensors.
    b. Provide workstation and NVR maintenance.
    c. Inspect and clean DGP's.
    d. Inspect, clean and vacuum equipment racks and cabinets (organize and re-strap as necessary).

G. Repair or Replacement Service

1. Provide one service phone number with 24 hour per day, 7 day per week response for Warranty service.
2. Perform repair or replacement service during the warranty period in accordance with the following schedule:

    a. Schedule A - 7 days, 24 hour, 4-hour response time.
    b. Schedule B - 8:00 a.m. - 5:00 p.m. business days, excluding Owner holidays, 8-hour response time.

3. Schedule A shall apply to Critical Devices.
4. Schedule B shall apply for other components and devices.
5. A technician shall be on site within 4 hours after receiving a warranty service request from the Owner in accordance with the schedule. Repairs shall be complete within 24 hours after the technician arrives on the site.
6. Warranty service performed for Schedule B items, but outside of the specified time frame, shall also provide a four-hour response time. Include after hours labor rate for warranty service required during hours not covered under Schedule B. Schedule B service performed outside of specified hours shall be approved in writing by the Owner.

H. Furnish written notice to the Owner documenting Work performed during the warranty period including preventive maintenance Work performed.

I. The Owner reserves the right to expand or add to the system during the warranty period using firm(s) other than the Security Contractor for such expansion without affecting the Security Contractor's responsibilities, provided that the expansion is done by a firm which is an authorized dealer or agent for the equipment or system being expanded. Security Contractor shall not be responsible for maintenance of equipment installed by other companies.

1.14 SEQUENCE AND SCHEDULING

A. Review the construction and completion schedules and coordinate execution of the Work as defined in the Contract Documents with other contractors and service providers engaged by the Owner and their representatives for the Work.

PART 2 - PRODUCTS

2.01 ACCESS CONTROL AND ALARM MONITORING SYSTEM (ACAMS)

A. System Description

1. The ACAMS shall consist of Data Gathering Panels (DGPs), card readers, and alarm input and output devices connected to the Owner's existing Software House CCure 800 access control system as indicated on the Drawings.
2. Card Reader Controlled Doors

    a. Provide card reader, system workstation, and time schedule control of electric locking mechanisms.
    b. Provide one magnetic door position switch for each leaf of card reader controlled doors to monitor door propping/intrusion alarms and open/closed status. In addition, the Security System shall monitor the card reader for invalid card use. The Security System shall annunciate each condition individually.
    c. The Security System shall automatically relock the lock after the door closes after a valid card read access.
    d. Provide normally closed Request to Exit (REX) switch configurations.

3. Card Reader Controlled Doors Utilizing IDH Max Locks with Integral Reader and REX Switch

    a. Typical Application: Single leaf door or double leaf door with fixed leaf. Configuration cannot be implemented with a door operator.
    b. Integral Reader/Lock: 93KM7DDEU14PHS3626H26B - IDH-Max with NSU option and door hardware provided by others
    c. Configure doors with IDH-Max as follows:

        1) Free Exit Side Handle

            a) The integral REX in the handle shall always function.
            b) When pressed, the door handle shall:

                (1) Signal the Security System to shunt the door position switches.
                (2) Manually retract the latch-bolt.

2) Card Reader Bypass Mode

a) The door shall be unlocked and the door position switch shunted.
b) The card reader controlled side door handle shall work the latch-bolt.
c) Pressing the door handle shall open the door.

3) Card Reader Controlled Mode

a) The door shall be locked.
b) The card reader controlled side door handle shall be disabled.
c) Upon a valid card read, the Security System shall:

(1) Unlock the door.
(2) Shunt the door position switch.
(3) Enable the card reader controlled side door handle to operate the latch-bolt

4. Card Reader Controlled Doors with Operators

a. Configure doors with door operators as follows:

1) Free Exit Side Push Plate

a) The push plate shall always function.
b) When pressed, the door operator push plate shall:

(1) Signal the ACAMS to unlock the door and shunt the door position switches.
(2) Signal the door operator to open the door.

c) Provide relays and hardware as required to interface with the door operator push plate.

2) Card Reader Bypass Mode

a) The door shall be unlocked.
b) The card reader controlled side door operator push plate shall be enabled.
c) Pressing the push plate shall signal the door operator to open the door.

3) Card Reader Controlled Mode

a) The door shall be locked.
b) The card reader controlled side door operator push plate shall be disabled.
c) Upon a valid card read, the ACAMS shall:

(1) Unlock the door.

(2) Enable the card reader controlled side door operator push plate.

5. Card Reader Controlled Doors with Delayed Exit Devices

   a. Interface to the delayed exit device provided under a separate section.
   b. Card Reader Control

      1) Upon a valid card read the ACAMS shall signal the delayed exit device to disarm and allow passage through the door. The ACAMS shall not interrupt power to the delayed exit device.
      2) The delayed exit device controller shall disarm the delayed exit device and allow passage.

   c. Free Egress

      1) Interface with the exit device lever set request to exit switch to:

         a) Signal a valid request to exit to the ACAMS.
         b) Signal the delayed exit device to disarm and allow passage through the door.

      2) Provide relays and hardware as required to interface with the lever request to exit switch.

   d. Door Position Switches

      1) Provide double pole double throw door position switches.
      2) Interface one switch to the ACAMS to monitor door position status.
      3) Interface one switch to the delayed exit device. Configure the delayed exit device to rearm the delayed exit device only when the door is closed.

6. Interlocked Doors

   a. Provide a dedicated BASE M2 or approved equal interlock controller for each interlocked door set.
   b. Configure the interlock controller to prevent both interlocked doors from opening simultaneously.
   c. Interface with the interlock controller to provide the following:

      1) Monitor the interlock violation alarm output.
      2) Monitor the interlock fail alarm output.
      3) Provide for remote reset of the interlock controller through ACAMS output.
      4) Provide for remote bypass of the interlock controller through ACAMS output.

7. Card Reader Controlled Pedestrian Gates

    a. Provide card reader controlled entry and exit passage through the pedestrian gate. Provide weatherproof backboxes, mounting hardware, and conduit as required to install the card readers.
    b. Provide a surface mounted switch to monitor gate position.
    c. Interface to the electric locking mechanism provided under a separate section.
    d. Provide power supply for the electric locking mechanism. Field verify and coordinate lock power supply requirements.

8. Card Reader Controlled Vehicle Gates

    a. Provide for card reader controlled entry and exit through the vehicle gate and remote open, close, and stop controls through the ACAMS workstation.
    b. Provide pedestals, gate position switches, gate operators, loop detectors, and safety devices as required to provide for functions as specified. Field verify gate type and provide operator and accessories as required.
    c. Configure the gate operator(s) to automatically close the gate after a vehicle passes over the close loop and after a pre-programmed period of time if a vehicle does not pass over the close loop.
    d. Manual Control

        1) Provide for remote control of open, maintained open (gate shall not automatically close), close, and stop controls for each entrance through the ACAMS workstation.

9. Garage Vehicle Entrances and Exits

    a. Provide for card reader and remote controlled entry to and exit from the garage through traffic control lift gates.
    b. Provide traffic control lift gates
    c. Configure the gate operator(s) to automatically close the gate after a vehicle passes over the close loop and after a pre-programmed period of time if a vehicle does not pass over the close loop.

10. Card Reader Controlled Elevators

    a. Card Reader Controlled Floor Select Buttons

        1) Provide a card reader mounted in the primary return panel in each elevator. Coordinate mounting requirements with the Architect.
        2) The ACAMS shall provide for card reader control of elevators on a time programmable basis allowing access to certain floors and doors to be card reader controlled while allowing free access to other floors and doors at the same time. Selection of time intervals and floors/doors shall be programmable. Coordinate egress floor and door requirements to provide elevator egress as required by local life safety codes.
        3) When an elevator is in the card reader control mode, the floor select buttons shall be disabled. The passenger shall be required to hold their

access card up to a card reader mounted in the elevator return panel. Upon a valid card read, the ACAMS shall enable the floor select buttons for the floor(s) and door(s) the passenger is authorized to access. The passenger must then push the desired select button(s). Once the passenger has pushed the button(s), the elevator control system will illuminate the button(s) and send the elevator to the selected floor(s) and open selected door(s). When an elevator is in the normal mode, floor select buttons shall be enabled.

b. Card Reader Controlled Hall Call Stations

1) Provide card reader, system workstation, and time schedule control of elevator call stations.
2) When the hall call station is in the card reader controlled mode, the station shall be disabled. The passenger shall be required to present their card to the card reader adjacent to the hall call station. Upon a valid card read, the ACAMS shall enable the station call buttons. The passenger must then push the desired call button. Once the passenger has pushed the button, the elevator control system will illuminate the button and call the elevator to the floor.

11. Card Reader Controlled Overhead Doors

a. Interface with overhead door controllers to enable local door controller open and close buttons for a user defined time after a valid card read.

12. Emergency Exit Only Doors

a. Provide door position switches and local alarm units for emergency exit only doors.
b. Local Alarm Units (LAUs)

1) Provide LAUs to provide for local annunciation of door open conditions.
2) Connect one DPDT door position switch output to the LAU door status input.
3) Connect LAU alarm output to DGP alarm input for alarm monitoring.
4) Connect LAU reset / bypass input to DGP control point relay output to provide remote momentary reset and maintained bypass.
5) Configure the LAU as follows:

a) Immediate local alarm activation if the door opens.
b) The local alarm shall reset automatically after the door returns to a closed position.

B. Equipment Requirements

1. Data Gathering Panels (DGP's)

a. Provide Software House CCure iSTAR PRO Data Gathering Panels (DGPs) with 128 MB memory.

b. Provide supervision for each DGP input. Locate end of line resistors at the device to provide supervision for the entire cable connection.
c. For each DGP location, provide one spare card reader input point and 20 percent spare alarm input points and output points after all specified points are initially connected. A "DGP location" shall be defined as a remote location where alarm input devices, control output devices or access control devices are connected to the Security System. Sufficient plug in modules shall be provided to accommodate the number of card readers initially installed, and one spare input as specified.

2. Proximity Card Readers

a. Card Reader Applications

1) Wall Mount: HID ProxPro reader
2) Mullion Mount: HID MiniProx reader
3) Integral Reader/Lock: 93KM7DDEU14PHS3626H26B - IDH-Max with NSU option provided by others.

b. LED Configuration

1) Red: Locked condition
2) Green: Unlocked and valid card read conditions

3. Traffic Control Lift Gate

a. Provide Liftmaster Chamberlain BG790 Parking Barrier gate operators.
b. Provide loop detectors to provide for safety and close operation.
c. Provide an adjustable timer to automatically close the gate if a vehicle does not cross the close loop after a predetermined time.

4. Door Position Switches

a. Concealed Magnetic Door Position Switch

1) Provide Sentrol 1076 Series concealed, normally closed, magnetic door position switch to monitor the open/closed status of doors.

b. Surface Mount Door and Hatch Position Switch

1) Provide Sentrol 2500 Series or approved equal switches.

c. Overhead Door Position Switch

1) Provide Sentrol 2200 Series or approved equal switches.

d. Provide armored cable from the switch to the associated junction box to conceal the wire for surface mount, hatch position, and overhead door position switches.

5. Local Alarm Unit (LAU)

    a. Provide Designed Security Inc. (DSI) ES4200 Series.

6. Emergency Release

    a. Provide Safety Technology International (STI) SS-2411EX with clear STI Bopper Stopper cover.
    b. Provide STI SUB-102722-Blue spacer as required.

7. Tamper Switches

    a. Provide Ademco or approved equal plunger type normally closed tamper switches to monitor the secure status of DGP's, power supplies, terminal cabinets, power distribution units, and other Security System cabinets and enclosures.
    b. Fasten tamper switches within the cabinet to provide no access to the switch and fasteners when the cabinet is closed.
    c. Provide independent monitoring of tamper conditions for each cabinet. Include the number of tamper switches in the total alarm input figures.

8. Duress Alarms

    a. Provide Ademco model 269 desk mounted personnel duress alarms with normally closed alarm output contacts.
    b. Locate desk mounted duress buttons below counter tops or in the knee space of desks in an accessible location. Verify the exact location with the Owner.

9. Magnetic Door Hold & Release Device

    a. Provide Security Door Control (SDC) EH Series magnetic door hold open device with 30lbs. holding force.
    b. Interface door hold open device with access control system relay output to provide for timed scheduled release of door.

10. Tamper Resistant Screws

    a. Provide tamper resistant screws for the following applications:

        1) Junction boxes located above doors.
        2) Junction boxes located below ceiling height and within reach of hatch ladders.
        3) Device cover plates.
        4) Surface mounted door position switches and armored cable.

    b. Provide Torx® fasteners with pins for tamper resistant screw applications.
    c. Provide appropriate screw heads for each application (e.g. countersunk heads for recessed cover plate screws, flat head screws for standard junction box covers, etc.).

11. Power Supplies

    a. Provide power supplies for Security System equipment and electric locking devices.
    b. Power supplies shall provide the following:

        1) 120 VAC input and filtered and conditioned output voltage as required.
        2) U.L. Listed Class II power limited rating.
        3) Four hours of sealed gel battery backup to provide continuous operation during power failure. Provide batteries as required to provide specified battery backup time for a fully loaded power supply, regardless of the connected load. Permanently label each battery with the manufacture date and the installation date (the month and year the battery was placed in the power supply and began charging).
        4) A battery charger to maintain the battery.
        5) Low battery and power fail contacts to monitor the status of the input power and the battery. Connect each power supply power fail alarm as a separate alarm input into Security System.
        6) An on/off power switch and indicator within the cabinet.
        7) Key lockable wall mount metal enclosure with tamper switch. Key cabinets alike and on the same key as other Security System cabinets. Coordinate keying requirements with the Owner.

    c. Additional DGP Power Supply Requirements

        1) The DGP power supply provide power only to DGP's and shall not provide power for locks or other low voltage device.

    d. Additional Electric Locking Mechanism Power Supply Requirements

        1) Provide power supplies for electric locking mechanisms.
        2) Fail secure electric locking mechanisms shall continue to operate normally upon loss of building power.
        3) Connect fail safe locking devices in accordance with applicable life safety codes to unlock automatically under the following conditions:

            a) Loss of power to the power supply.
            b) Failure of the power supply.

        4) Fail secure locks shall remain operational during fire alarm and power failure conditions.
        5) Provide power distribution boards with independently fused outputs and relays.

    e. Additional Card Reader Power Supply Requirements

        1) Power supplies shall provide necessary output voltage to allow the card readers to operate at maximum specified read range.

f. Additional Device Power Supply Requirements

1) Provide device power supplies for other devices requiring power (e.g. card readers, door management units, local alarm units, relays, etc.)
2) Provide power distribution boards with independently fused outputs.

g. Acceptable Manufacturers

1) Altronix / AL Series.
2) Alarm-Saf.
3) Approved equal.

12. Vehicle Gate Operators

a. Provide Hy-Security or approved equal operators for vehicle gates and other gates as indicated on the Drawings.
b. Verify gate types and sizes and provide operators as recommended for the application by the manufacturer.
c. Provide vehicle loop detectors, timers, hardware, software, and safety devices as required to provide for operations as specified.

13. Security Communications System

a. Provide IP Enabled Bi-directional Dual 4” Speakers with embedded IP7-SS8 and POE.
b. Acceptable Manufactures

1) Digital Acoustics SPKR-IP11-BD-P (No exceptions)

C. System Interfaces

1. Door Operators

a. Interface to automatic door operators provided under a separate section. Provide wire and connections as required between the Security System and the automatic door operator.

2. Electric Locking Mechanisms

a. Interface with electric locking mechanisms provided by the door hardware supplier.
b. Provide power supplies for electric locking mechanisms except for exit devices with electric latch retraction and automatic door operators. A separate section will provide power supplies for exit devices with electric latch retraction and automatic door operators. Install power supplies for exit devices (furnished under a separate section) and interface power supplies to the fire alarm system as required.
c. Interface to REX switches within electric locking mechanisms.
d. Provide cabling and electrical connectors between the Security System, power supplies, power transfer device, and the electric locking mechanism.

3. Elevators

   a. Card Reader Controlled Floor Select Buttons

      1) A separate section will provide one pair of terminals per elevator such that a maintained dry contact closure across the terminals by the security system shall place the elevator in the card reader control mode. The elevator shall remain in the card reader control mode as long as the contact is closed and shall return to the normal mode when the contact opens.
      2) A separate section will provide one pair of terminals per floor select button per elevator such that a dry contact closure across the terminals by the security system shall enable the floor select button. The button shall remain enabled for as long as the dry contact is closed.

   b. Card Reader Controlled Hall Call Stations

      1) A separate section will provide one pair of terminals per controlled call button station such that a dry contact closure across the terminals by the security system shall enable the station. The station shall remain enabled for as long as the dry contact is closed.

   c. Traveling Cables

      1) A separate section will provide 4 pairs, 18 gauge stranded cable with an overall braided shield and drain wire traveling cables for each elevator for card reader control and terminate traveling cables to dual screw barrier terminal strips in the interface cabinet.
      2) A separate section will provide and terminate conduit, power, and wiring required for the installation of the traveling cables.

   d. Interface Cabinets

      1) Provide lockable continuous hinge cover enclosures with dual screw barrier terminal strips for each interface point in a readily accessible location in each elevator machine room.
      2) Label the interface cabinet and terminal strips to identify function and responsibility (e.g. to elevator control system, to ACAMS, etc.).

   e. Connections

      1) Provide cables from the interface cabinet to the DGP located at the security riser.
      2) The elevator contractor will provide cables from the elevator interface to the elevator control system.

4. Fire Alarm System

    a. Interface the Security System with the fire alarm system to provide the following:

        1) Automatically unlock fail-safe electric locking mechanisms during a fire alarm condition.
        2) Automatically disarm delayed exit devices during a fire alarm condition.
        3) Automatically bypass elevator access controls during a fire alarm condition.
        4) Monitor the normally closed general fire alarm contacts from the ACAMS.
        5) Monitor the manual unlock key-switch position from the ACAMS.

5. Overhead Doors

    a. Interface to overhead door controllers provided under a separate section. Provide wire and connections as required between the ACAMS and the overhead door controller to enable/disable the local open and close buttons.

6. Mass Notification System

    a. The Sygnal mass notification system is interfaced to AccuWeather, Federal Giant Voice speakers, I.P. based intercoms and/or classroom phones, WEBS Talk-A-Phone assistance stations, Sharktub displays, lobby monitors, Comcast CATV, and lightning strobes.

        1) Provide classroom I.P. based telephone with speaker or I.P. based intercoms to provide audio based mass notification messages. Per NSU specifications.
        2) Provide Federal Giant Voice speakers for outdoor sport facilities, parking lots, and outdoor assembly areas. Per NSU specifications.
        3) Strategically place Talk-A-Phone WEBS assistance station within parking lot/garages, building perimeters, and walkways. Per NSU specifications.
        4) Provide red lightning detection strobes mounted on assistance stations, scoreboards, and building exteriors. To provide visible lightning notification for outdoor sport facilities and assembly locations. Per NSU specifications.
        5) Provide exterior weather proof audio visual programmable I.P. based beacons that activate during mass notification alarms and provide a visual alarm and a programmable audio alpha numeric message. The beacon must interface with NSU’s mass notification systems, Blackboard Connect, Alertus Per NSU specifications.

2.02 SECURITY VIDEO SYSTEM (SVS)

A. System Description

1. The SVS shall consist of: workstations and fixed and pan/tilt/zoom cameras connected to the Owner's existing Genetec Omnicast video management system as indicated on the Drawings.
2. Provide servers, licenses, and software as required to connect the cameras to the existing Genetec Omnicast system.
3. The SVS shall utilize the Owner’s network to provide for communications.
4. Provide patch cables as required to connect the cameras to the structured cabling system and network ports.
5. Configure the SVS equipment in accordance with the Owner’s requirements. Coordinate requirements with the Owner.

B. Equipment Requirements

1. OmniCast Video Archiving System

2. Network Video Cameras

a. Network video cameras shall include:

1) Vandal resistant housings.
2) Camera Power utilizing network switch ports with Power over Ethernet (PoE) in compliance with IEEE 802.3af.
3) Where cameras require High PoE power, provide High PoE midspan power supplies.
4) Day/night mode.
5) Wide dynamic range.
6) Varifocal lenses matched to the camera application.
7) Remote access to camera programmable features and functions through the Genetec Omnicast software.

b. Provide power supplies as required.
c. Field verify camera locations and mounts with the Architect and the Owner prior to backbox installation.
d. Field verify camera views and program requirements with the Owner.
e. Approved Megapixel (MP) Cameras

1) 3 MP: Sony SNCDH280.

f. Approved General Dome Cameras

1) Sony SNCDH280.
2) Or approved equal.

g. Approved 180 and 360 Dome cameras

1) Axis M3007-P

2) Or approved equal.

h. Approved PTZ Cameras

1) Axis Q6045-E Day/Night Series with 20x zoom.
2) Or approved equal.

i. Approved License Plate Recognition Cameras

1) Genetec Sharp VGA (no exceptions) with internal license plate camera and overview camera.
2) Field verify lens requirements.

3. Ethernet to Coaxial Cable Converters

a. Provide NVT NV-EC1701 or approved equal Ethernet to coaxial cable converters to connect elevator cab cameras to the network.

C. Interfaces

1. Elevator

a. A separate section will provide the following traveling cables for each elevator:

1) 2 – RG59/U stranded center conductor coax cables.
2) 2 – twisted pair, 18 gauge stranded cables with a braided shield and drain wire.

b. Provide Ethernet over coaxial cable converters for each elevator. Provide patch cables from the converters to the cameras and to the network interface.
c. Locate network interfaces within the interface cabinet.

2.03 SECURITY VOICE COMMUNICATION SYSTEM (SVCS)

A. System Description

1. The SVCS shall consist of telephone assistance stations and hands free telephones.
2. Provide stations with colors and graphics to match existing stations.
3. Connect SVCS devices to analog telephone lines.
4. Configure SVCS devices to dial the SOC and automatically call up an associated camera when a station call button is pressed.

B. Equipment Requirements

1. Telephone Assistance Stations (TAS)

a. Free Standing Emergency/Information Station with WEBS and Camera

1) Provide Talk-A-Phone WEBS-MT/R Op 4 with the ETP-500EI communications device.

b. Free Standing Emergency/Information Station without WEBS.

1) Provide Talk-A-Phone ETP-MT/R with the ETP-500EI communications device when no camera is required.
2) Provide a Talk-A-Phone ETP-MT/R Op 4 with the ETP-500EI communications device when a camera is required.

c. Wall Mounted Emergency/Information Station

1) Provide Talk-A-Phone ETP-WM/E with the ETP-500EI communications device.

d. Parking Access Assistance Stations

1) Provide Talk-A-Phone ETP-SML-PM/E with an ETP-500E communications device.
2) Provide a custom faceplate fabricated by the manufacturer with an HID Thinline II card reader card reader as indicated on the Drawings.

a) Configure ACAMS contact outputs to activate and call-up an adjacent camera when a card is read by the unit. The output contacts shall be used to call-up an adjacent camera.

e. Wall Mounted Access Assistance Station

1) Provide Talk-A-Phone ETP-SML with an ETP-500E communications device.
2) Provide a custom faceplate fabricated by the manufacturer with an HID Thinline II card reader card reader as indicated on the Drawings.

a) Configure ACAMS contact outputs to activate and call-up an adjacent camera when a card is read by the unit. The output contacts shall be used to call-up an adjacent camera.

2. Direct Dial Telephone

a. Provide Viking E-30-EWP or equal weatherized hands free telephones.
b. Provide custom backbox for the telephone.
c. Provide Viking RC-2A remote control relay for each direct dial telephone. Interface the relay to the telephone line in the security riser location and connect the relay output to a DGP input to provide for remote release of the associated door when the unlock command is received by the relay.

2.04 WIRE AND CABLE

A. Description

1. Provide wire and cable for security system components.
2. Route wire and cable from each device location to the security riser location as indicated on the Drawings.
3. Another section will provide risers and chases for security wiring. Route wire above accessible ceilings and in conduit as provided under separate sections.
4. Where available, use wire trays as follows:

    a. Provide bridle rings, d-rings, or other approved hardware attached to the side of the wire tray. Route security wiring along the side of the tray.
    b. Security wiring shall not be allowed within the wire tray.

5. In areas where wire tray is not available, provide j-hooks, bridle rings, d-rings or other approved wire management hardware to route wire neatly from each device to the security equipment locations.

B. Minimum Requirements

1. Conductors and cable shall be U.L. approved for its intended application and shall meet national, state, and local code requirements for its application.
2. Conductors and cable shall meet individual security system manufacturer specifications.
3. Provide plenum rated conductors and cable as required by code.
4. Provide cable specifically designed for direct burial applications where cable must be run in underground conduit.
5. Conductors and cable shall conform to the minimum requirements of ICEA standards.
6. Conductors and cable shall comply with the applicable requirements of the latest edition of the NEC for construction and usage.
7. Conductors shall be copper and have conductivity in accordance with the standardization rules of the IEEE. Each conductor shall be round and free of kinks and defects.
8. Provide shielded conductors and cable as required by the manufacturer or as required to provide for interference-free signals.
9. Conductor and cable insulators shall be rated for a minimum of 300 volts. Provide higher rated cables where required to comply with NEC application requirements.
10. Color coding shall be accomplished by using solidly colored insulation. Grounding conductors, where insulated, shall be colored sold green or identified with green color as required by NEC.
11. Increase conductor sizes on cables as required to be consistent with circuit current ratings, length of wire runs, and manufacturers' recommendations.
12. Composite cables are not an acceptable alternative.
13. Patch Cables

    a. Provide pre-manufactured patch cables (cable, connectors, boots, etc.) as required to connect security systems.

b. Patch cables shall be certified for their specific use to meet or exceed applicable industry specifications (e.g. EIA/TIA, ETL, U.L., CSA, etc.).
c. Provide cable lengths as necessary to neatly route cables through cable management systems and other cable organization systems.
d. Provide connectors as required for proper termination. Provide boots for connectors where applicable to prevent snagging.
e. Provide Category-6 patch cables as required for the connections of security equipment. Confirm Category-5e cabling specifications and requirements with the Owner.
f. Provide cable jacket colors as follows:

1) Blue for data cables.
2) White for voice cables.
3) White for security cables except for direct burial cables.

C. Minimum Conductor and Cable Types and Sizes

1. Low Voltage Power Cable

a. 18 AWG, twisted, stranded, insulated, and jacketed, multi-conductor (varied by device type) UTP with 5' loops at devices.

2. Card Reader Cable

a. 20 AWG, stranded, individually shielded twisted pairs, insulated, and jacketed, multi-conductor (varied by device type) UTP with 5' loops at devices.

3. Keypad Cable

a. 18 AWG (6 conductors minimum), stranded, insulated, and jacketed, multi-conductor (varied by device type) UTP with 5' loops at devices.

4. Alarm Point Monitoring Cable

a. 20 AWG (4 conductors minimum), stranded, insulated, shielded and jacketed, multi-conductor (varied by device type) UTP with 5' loops at devices.

5. Siren, Speaker, and Control Point Cable

a. 18 AWG, stranded, insulated, and jacketed.

6. Category 6 wire, cable, connectors, outlets, and other components shall fully comply with TIA/EIA Commercial Building Telecommunications Standard.

D. Acceptable Manufacturers

1. Belden.
2. CommScope.
3. West Penn.
4. Approved equal.

PART 3 - EXECUTION

3.01 COORDINATION

A. Coordination

1. At a minimum, coordinate the following through the Architect and Owner:

a. Programming information required to interface systems with the Owner's existing systems.
b. Final device locations and installation and operational requirements.
c. Equipment labeling.
d. Training curriculum, syllabus, and schedule.
e. Equipment finishes and colors. Submit finishes and graphics for equipment in public areas to the Architect for approval prior to installation.
f. Locations of devices prior to installation.

2. Verify that adequate network and telephone connections are provided and properly located.
3. Verify that adequate conduit is provided and that equipment back boxes are adequate for system installation.
4. Verify that adequate power has been provided and properly located for the security system equipment. Coordinate circuit, breaker, and panel locations and identify locations in record documents.
5. Verify that doors and door frames are properly prepared for electric locking hardware and door position switches.

B. Meetings

1. Coordination meetings are essential to the successful completion of the Security System installation. Coordination meetings shall include the following in addition to regular project meetings coordinated by the General Contractor.

a. Project Kickoff Meeting

1) The intent of this meeting is to:

a) Introduce the Owner and design and construction teams.
b) Identify communication channels and process.
c) Establish expectations.
d) Review the Project scope and requirements.
e) Establish schedule for provision and review of submittals.
f) Answer questions and resolve issues.

b. Pre-Installation Meeting

1) The intent of this meeting is to:

a) Review the construction schedule.

b) Coordinate requirements and schedules of other trades related to the Security System.
c) Review issues and problems as necessary.

c. Meetings with Other Trades

1) The intent of these meetings are to coordinate requirements with other trades as required to:

a) Review the details for each interface.
b) Ensure that each trade understands requirements for the interface with the Security System.
c) Verify interface responsibilities and close necessary gaps in scope of work.
d) Resolve issues as required.

d. The initial coordination meeting shall involve trades related to the Security System. Additional meetings will be scheduled as necessary for additional coordination.
e. The General Contractor shall be responsible for scheduling coordination meetings.

3.02 INSTALLATION

A. General

1. Coordinate equipment installation requirements with other trades prior to installation.
2. After installation, protect equipment to prevent damage during the construction period. Close openings in conduits and boxes to prevent the entrance of foreign materials.
3. Make equipment connections in accordance with the approved submittal drawings and manufacturer specifications.
4. Seal exterior devices to protect against weather conditions including heat, cold, moisture, dust, and sand. Comply with Section 07 9200 Joint Sealants and device manufacturer recommendations.
5. Site Observation

a. Continuously verify that the site conditions are in agreement with the Contract Documents. Submit a report to the Owner or its representatives documenting changes to the site or conditions that affect the performance of the system to be installed. For those changes or conditions, which affect system installation or performance, provide (with the report) specification sheets, or written functional requirements to support the findings, and a cost estimate to correct the deficiency. No deficiency shall be corrected without written permission from the Owner or its representatives.
b. The Architect, Owner, and Security Consultant will conduct random site observation visits during the project and prepare reports noting observations.

Correct deficiencies noted on the site visit reports. Work shall comply with the Contract Documents, applicable codes, regulations and local Authorities whether or not a particular deficiency has been noted in a site visit report.

B. Equipment

1. Field-verify specific equipment locations to provide the best fit and function. Verify locations with the Architect as necessary.
2. Install equipment in accordance with manufacturer specifications.
3. Install equipment to allow adequate clearance for testing and maintenance.
4. Locate end of line devices within the device housing.
5. Provide tamper resistant screws and fasteners for equipment located in accessible and public areas.
6. Remove dirt, packaging, wiring scraps, and other debris from equipment, boxes, and cabinets at the end of each work day.
7. Wherever possible, remove contractor and manufacturer equipment logos from security field devices.

3.03 SURGE PROTECTION

A. Provide protection against spikes, surges, noise, and other line problems for system equipment and components.

B. Provide surge protection for power circuits, telephone, network, and other communication circuits, and electronic modules.

3.04 CONDUIT, BOXES AND RACEWAYS

A. Conduit, junction boxes, pull boxes, wire troughs, and wire ways dedicated to security will be provided under a separate section. Provide additional conduit necessary to complete the installation, but not provided.

B. Where required, install conduit, cable and wire parallel and square with building lines. Conduit is to be 3/4" diameter minimum. Do not exceed 40% conduit fill.

C. Vertical wiring and all main trunk/riser wiring shall be installed in a complete raceway/conduit system. Adequately size riser boxes for the number of conductors traversing the respective box and the number of terminations required.

D. Paint junction boxes containing security system wire or cable white.

E. Provide conduit between power sources provided under a separate section and security system low voltage power supplies.

F. Provide conduit from interface terminal cabinets to security pull boxes.

G. Carefully install conduit, properly and adequately support conduit as required to comply with the requirements specified herein and as required by the NEC, and provide a neat,

workmanlike installation. Support horizontal conduit runs with clamps, pipe straps, special brackets, or heavy iron ties secured to building structure.

H. Drill required inserts and saw cut or core drill openings required through concrete or masonry with tools specifically designed for this purpose.

I. Swab out and remove burrs from conduit before pulling wires.

J. Lay out and install conduit runs to avoid proximity to hot pipes. In no case shall a conduit be run within three inches of such pipes, except where crossings are unavoidable, and then the conduit shall be kept at least two inches from the covering of the pipe crossed.

K. Provide fire stops where conduits penetrate fire rated walls and floors.

L. The Architect shall approve a sample conduit installation for each exposed condition prior to installation. No exposed conduit shall be installed unless approved by the Architect.

M. Provide tamper resistant screws or fasteners for junction boxes located in accessible and public areas.

3.05 WIRING TECHNIQUES

A. Wire installation is not specifically detailed in the Contract Documents. Determine conductor requirements for each device in accordance with the Contract Documents and manufacturer requirements.

B. Install cable in accordance with manufacturer's certified installation requirements and NEC.

C. Color code and terminate conductors consistently as follows:

1. Red for positive and black for negative DC power leads.
2. White for positive and green for negative alarm loop conductors.

D. Run wiring within conduit or exposed within walls, above accessible ceilings, and in riser closets.

E. Arrange cables within access panels to allow for removal of the access panel and access to equipment within the panel.

F. Neatly route cables parallel or perpendicular to building lines.

G. Provide J hooks and other cable support systems (spaced at irregular intervals) within accessible ceiling spaces. Fasten cables to the cable support systems and provide strain relief to protect cables and ensure compliance with required cable bends.

H. Keep cable not run in conduit a minimum of 18" from high voltage (120 VAC and above) circuits (e.g. light fixtures, wire run parallel with conduit, transformers, electric panels, etc.).

I. Run cables at least six inches from the communications cable plant, intercom wires, input/output wires, and siren wires.

J. Route wire and cable as required to prevent interference and signal contamination of both Security System cable and cable associated with other systems. Coordinate the routing of wire and cable requiring isolation from power, radio frequency (RF), telephone, etc.

K. Provide sleeves and code compliant fire proofing techniques for penetrations of fire rated partitions, masonry walls, and slabs, where the penetrations are made by or used for installation of Security Systems.

L. Separate high voltage (120 VAC and above) cables from low voltage cables within enclosures to comply with NEC requirements.

M. Fasten approved wire management hardware (bridel rings, j-hooks, etc.) to the building structure or cable tray at least every 10 feet where not in conduit. Do not lay or fasten cables to electrical conduits, light fixtures, piping, mechanical equipment, or ceiling grids.

N. Run wire and cable continuous from device location to the final point of termination. No mid-run cable splices will be allowed except where cables must transition from one type to another (e.g. underground cable to plenum cable). Provide the following where cable transitions are required:

    1. Provide terminal strips inside lockable cabinets at cable transition locations and document locations in the submittals.
    2. Label terminal cabinets and document labels in record documentation.
    3. Provide the same number of conductors and insulator colors for each cable type from the security device to the DGP location.

O. Visually inspect wire and cable for faulty insulation prior to installation.

P. Provide bushings, grommets, and strain relief material where necessary to prevent abrasion of wire and excess tension on wire and cable.

Q. Make solderless device connections mechanically and electrically secure in accordance with the manufacturers' recommendations.

R. Component Connections

    1. Prepare wire ends for attachment to components in accordance with manufacturer recommendations.
    2. Wire nuts shall not be an acceptable means of connecting wire and cable.
    3. Make cable connection for device terminations with crimp type connectors. Connectors shall provide a hermetic seal.

S. Neatly install and terminate wire and cable within DGP's, power distribution cabinets and other security enclosures. Pull cables tight, remove slack, and route in such a way as to allow direct, unimpeded access to the equipment within the enclosure.

T. Bundle and tie wire and cable with Velcro hook & loop type or similar cable ties.

U. Provide heat-shrink to insulate wire connections. The use of electrical tape shall not be acceptable.

V. Cover exposed high voltage (120 VAC and above) power terminations within DGP's, power distribution cabinets and other security enclosures.

3.06 POWER REQUIREMENTS

A. 120 VAC power dedicated to security will be provided by a separate section.

B. Connect to AC power and provide U.L. listed power supplies and transformers to distribute low voltage power to the system components as required.

3.07 GROUNDING

A. Ground equipment and cables in accordance with manufacturer requirements and instructions.

B. Ground cable shields and drain wires as follows:

1. From the field devices, terminate shield drain wires to the terminal cabinet ground bar.
2. Bond the terminal cabinet ground bar to the DGP ground bar with a minimum 12 AWG ground wire.
3. Do not terminate shields and drain wires between the terminal cabinet and DGP.

3.08 LABELED FRAMES AND DOORS

A. In no instance shall a U.L. labeled door or frame be drilled, cut, penetrated, or modified.

B. The Security Contractor shall be responsible for replacing labeled doors or frames that are modified without written approval from the Architect.

3.09 LABELING

A. Mark connectors with common designations for mating connectors. Indicate connector designations on the record drawings.

B. Permanently mark terminals. Terminal and cable markings shall agree with markings shown on as-built drawing.

C. Coil spare conductors in the device back box or panel wireway. Neatly bundle and tag conductors.

D. Label equipment including, but not be limited to DGPs (label to denote DGP address), power supplies and DVR's, and termination cabinets. Coordinate names, fonts, styles, and devices to be labeled with Owner prior to labeling. Provide computer-generated labels; handwritten labels shall not be accepted.

E. Identify power circuits and locations within each power supply cabinet.

F. Label Materials

1. Conductor and Cable Labeling

    a. Provide T&B Shrink-Kon Type HVM or equal labels.
    b. Labels shall be computer generated and fastened to conductors/cables with transparent heat shrink material. Hand-written labels shall not be accepted.

2. Equipment Labeling

    a. Engraved plastic with contrasting letter colors.
    b. Half-inch minimum size lettering
    c. Fasten labels with permanent adhesive.

G. Label wires and cables as follows:

1. Mark wire and cable in common at both ends. Use plenum-rated tags for marking cable runs. Install cable tags (labels) on all cable runs, approximately 2 inches wide and 3 inches high, at both ends of the cable and at 4 foot intervals until the cable enters the ceiling space
2. Install markers to be readable from left to right or top to bottom. Locate labels near termination points.
3. Install labels when wire and cables are installed.
4. Labeling shall agree with record documentation.

H. Cabinet Labeling

1. Label DGPs with Panel numbers: "PANEL: XXXX" where XXXX represents the Owner's four digit account number.
2. Label power supplies with "PANEL XXXX YYYY PS" where XXXX represents the DGP four digit panel number and YYYY represents the type of equipment being powered. For example: "PANEL 1234 LOCK PS" represents the lock power supply for Panel 1234.

I. Cable Labeling Scheme

1. DGP Cables

a. The label shall consist of six fields on two lines:

1) First Line

a) DGP #: Four digit panel number between 0001 and 2000.
b) Board: One digit number representing the board number within the DGP.
c) Address: Two digit number representing the board address.
d) Input/output: Two digits (IN for inputs and OT for outputs).

2) Second Line

a) Device: Two digit number representing the device number.
b) Room/Door Number: Room or door number as labeled by the Owner.

b. Format

1) [DGP #]_[Board]_[Address]_[Input/output]
2) [Device] [Room/Door Number]

c. Examples

1) 1234_2_00_IN
2) CR 1.111

3.10 PROGESS OBSERVATIONS

A. The Owner and Security Consultant will conduct progress observations during construction to verify construction progress and verify the Construction Schedule.

B. The Owner or Security Consultant will conduct the following minimum progress observations:

1. Security Conduit Rough-in and Preliminary Wire and Cable Installation

a. The intent of this observation is to verify that adequate and proper conduit rough-in is installed, verify that wire and cable are being properly installed and labeled, and identify and resolve issues regarding conduit and wire and cable installation.

2. Preliminary Wire Termination Progress

    a. The intent of this observation is to verify that the Security Contractor will install and terminate equipment in accordance with specifications and Owner standards.

C. Coordinate appropriate timing of each observation with the General Contractor, Owner, and Security Consultant as required to meet intended goals.

D. The inspectors will issue reports for each observation to summarize findings and document clarifications noted during the observation.

3.11 PROJECT COMPLETION PROCESS

A. Install the system in accordance with the project schedule. The following schedule includes minimum times necessary to comply with Substantial Completion test requirements. Coordinate detailed schedules with the General Contractor and the Owner to meet the Project Substantial Completion schedule.

B. During Construction

1. Conduct Pre-Functional Tests (PFT) utilizing checklists provided by the Owner.
2. Test and document device connections with a multi-meter to verify termination and operation.

C. Five Weeks Prior To Commissioning

1. Program IP addresses and other basic information necessary to communicate with and complete programming of the system.
2. Submit -programming forms (in electronic format) to the Owner a minimum of four weeks prior to Commissioning.
3. While the systems are being installed, program the information into the security systems in an off-line mode.
4. The Owner and the Security Contractor will review the completed programming worksheets to identify and correct programming and compatibility issues.

D. Four Weeks Prior To Security System Commissioning

1. Provide a two week completion notice to the Architect, Security Consultant, and the Owner.
2. Coordinate system startup schedule with the Owner.
3. Submit preliminary record drawings.
4. Provide notice of the pending Commissioning to the Architect, the Owner, and the Security Consultant.
5. Coordinate final network (ports, IP addresses, programming, etc.) and telephone (ports, extensions, remote control codes, programming, etc. as applicable) requirements with the Owner.

E. Two Weeks Prior To Security System Commissioning

1. Conduct an Operational Field Test (OFT) of the security system devices, communications, and programming with the Owner. The intent of this test is to verify proper system operation and ensure accuracy of system programming prior to Commissioning.
2. Coordinate with the Owner to resolve programming and communication problems that arose during the test.
3. Upon completion of the OFT, the Owner and the Security Consultant will conduct a Substantial Completion test.
4. The Security Consultant will prepare a punch list of items identified during the test that require correction.

F. One Week Prior To Security System Commissioning

1. Complete repairs noted during the OFT and conduct a five day burn-in test. The intent of the burn-in test is to prove the Security System operation and reliability and identify and resolve abnormalities in advance of Commissioning.
2. Provide clean-up and patch work of security system equipment and areas. Security equipment closets and similar areas shall be free of accumulation of waste materials or trash caused by operations under the Contract. At completion of the Work, remove waste materials, trash, the Contractor's and its subcontractors' tools, construction equipment, machinery, and surplus materials.
3. Submit a completion matrix indicating completion or delinquency for each item included on the matrix. Indicate completion of the requirement by the word "Completed" following each paragraph number. Indicate delinquency for the requirement by the words "To Be Completed" following the applicable paragraph number. For work in progress, indicate the extent (or lack thereof) of completion to date and the proposed date of completion.
4. Submit a report to the Owner and the Security Consultant describing the results of the burn-in test, diagnostics, calibrations, corrections, and repairs. The report shall include written certification that the installed complete Security Systems have been calibrated, tested, and is functional. Upon an acceptable review of the report, the Architect will schedule the Substantial Completion test.

3.12 COMMISSIONING

A. The Owner or its representatives and the Security Consultant will conduct Commissioning of the Work.

B. Prior to Commissioning, the Contractor shall submit two sets of preliminary (draft) record drawings to the Owner and Security Consultant. The Owner and Security Consultant will use preliminary record drawings to conduct the system Substantial Completion.

C. During the course of the Substantial Completion test, the Contractor shall demonstrate that the completed and integrated system complies with the Contract Documents, initial training is complete, and the system is operational (including system interfaces).

D. Equipment shall be on and operational during testing procedures. Provide personnel, equipment, and supplies necessary to perform site testing. Provide a minimum of two employees familiar with the system for the Substantial Completion test. One employee shall monitor and verify alarms while the other will demonstrate the function of each device. Supply at least two two-way radios and spare batteries for use during the test. The Contractor shall make no adjustments, repairs, or modifications during the test without the permission of the Owner. Make tools and ladders necessary to access equipment readily available.

E. Upon successful completion of the Substantial Completion test (or subsequent punch list retest) the Security Consultant will issue a letter of acceptance.

F. The Security Consultant retains the right to suspend or terminate testing if the system fails to perform as specified. In the event that it becomes necessary to suspend or repeat the test, of the Owner's, Architect's, and Security Consultant's expenses related to the suspended test will be deducted from the Contractor's retainage.

END OF SECTION 13700

DIVISION 31 EARTHWORK

31.1 General Requirements

This chapter identifies criteria for the design of earthwork scope in Nova Southeastern University buildings with the purpose of establishing minimum standards to be used as a basis of design for Nova Southeastern University (NSU) Buildings at the Main Campus, Fort Lauderdale, Florida. NSU experiences with various materials, products and installations have led to the procedures and practices noted under this Division 31. The thermal and moisture protection systems/products provided under this division must be selected to provide weather tight and thermally efficient building envelope work environment for the occupants in a sustainable and reliable design.

The thermal and moisture protection system products must be designed to comply with the following objectives:

1. Sustainable Design and products under the criteria to meet LEED "silver" standards as a minimum to reduce the total building energy consumption.
2. Reflectivity for energy conservation.
3. Longevity.
4. Easy of maintenance.
5. Compatibility with all adjacent materials both new and existing.
6. Solutions with the best value considering a life cycle cost analysis to account for total project cost.

These objectives are in line with the objectives of all Divisions and should be coordinated with requirements in Division 1 Section "SUSTAINABLE DESIGN REQUIREMENTS."

All work shall be designed by a Professional Civil Engineer licensed in the State of Florida.

The Design Professional shall obtain from the Nova Southeastern University the following information:

1. Site surveys
2. Underground utilities information
3. Geotechnical investigation reports
4. Traffic studies
5. Transportation routes and drop-off locations.

The design of the Earthwork must be implemented so there is minimum impact on adjacent buildings, paved areas, vegetation or existing waterways and aquifer. The Design Professional shall specify that all excavation be implemented safely and in compliance with the Trench Safety Act. The Design Professional shall specify the Termite Control and note that all work shall comply with EPA Regulations. The Design Professional must ensure that design of the Auger Piles shall conform to all applicable codes

The Design Professional shall obtain a copy and become familiar with the Nova Southeastern University Facilities Design and Construction (NSUFDC).

The design of the Earthwork and Auger Piles shall complement other disciplines designs in a sustainable and reliable fashion.

Nova Southeastern University Fort Lauderdale Campus and NSU Buildings Earthwork and Structural Systems must be designed to comply with the following objectives:

1. Sustainable Design

2. Minimum elevations of finished on-site grading and building lowest finished floor elevations shall comply with highest elevation requirements of:
   a. Federal Emergency Management Agency (FEMA)
   b. Federal Standard 44 CFR (National Flood Insurance Program)
   c. Broward County Permitting, Environment and Regulatory Affairs - Natural Resources Regulation & Restoration Division

3. Solutions with the best value considering a life cycle cost analysis to account for total project cost

These objectives are in line with the objectives of all Divisions and should be coordinated with all disciplines in a holistic way.

All designed earthwork scope shall provide whenever possible enough capacity for future additions or renovations and allow modifications to be made in one area without causing major disruptions in other areas of the facility. The flexibility to adjust to alterations easily must be designed into the building and underground systems from the outset. It is the goal of Nova Southeastern University to build facilities equipped with the latest advances in technology. The design of earthwork scope and other building components shall all combine together to produce a building that meets the project's programmed sustainability rating (LEED rating), of the specific project. This intent of the requirements is making this concept a reality requires a comprehensive design for engineering systems that goes beyond the requirements of the immediate building program. Also, the design work shall be done in accordance with all rules, regulations, by-laws and requirements of all authorities having jurisdiction.

31.1.1 Submittals

The Design Professional must ensure that all submittals and shop drawings are coordinated with other disciplines.

31.2 Codes and Standards

31.2.1 Earthwork

Site clearing, dewatering, earthwork, excavation and termite control shall comply with the requirements of the applicable authorities having jurisdiction and with the in-force edition at the time of the project of the following codes and standards:

1. Florida Building Code
2. Trench safety Act - Florida Statutes, Chapter 553, Part VI
3. Occupational Safety and Health Administration (OSHA) - Excavation Safety Standards
4. American Society of Testing and Materials (ASTM) Standards
5. Broward County Permitting, Environment and Regulatory Affairs
6. City of Fort Lauderdale Department of Public Works
7. State of Florida Department of Environmental Protection (FDEP)
8. Environmental Protection Agency (EPA) Regulations

31.2.2 Structural Design Standards

Auger Pile Design shall comply with the requirements of the applicable authorities having jurisdiction and with the in-force edition at the time of the project of following codes and standards:

1. American Society of Civil Engineers– ASCE-705
2. American Concrete Institute – ACI-301 and ACI-318

31.3 Design Criteria

31.3.1 Earthwork

The Design Professional shall specify the Earthwork covered in this section, which include Clearing and Grubbing, Earth Moving, Dewatering and Excavation Support and Protection.

1. Clearing and grubbing should include the following:
   a. Removing from site or transplanting of all required vegetation within the construction area.
   b. Protecting of all vegetation to remain.
   c. Removing from site all undesirable materials.
   d. Stripping and stockpiling for later re-use all clean topsoil encountered.
   e. Capping of all required utilities
   f. Implementing all necessary erosion and sedimentation control measures.

2. Earth Moving should include the following:
   a. Preparing subgrades and sub base curses including cutting or filling and compacting for slabs-on-grade, sidewalks and asphaltic and concrete pavements.
   b. Excavating, backfilling and compacting for buildings foundations, piping and underground structures.
   c. Sub bases for grass areas and planting areas.

d. Subsurface drainage backfill for walls and trenches.

3. Dewatering shall be designed and provided by contractor. Contractor to comply with the regulations of Broward County Permitting, Environment and Regulatory Affairs, The City of Fort Lauderdale Department of Public Works and Town of Davie Public Works.

4. The Contractor shall engage the services of a Professional Engineer licensed in the State of Florida to design the excavation support and protection.

31.3.2 Termite Control

1. The Design Professional shall specify the termicide installation and ensure it complies with all the requirement of the regulations of the Environmental Protection Agency (EPA) .

31.3.3 Auger Pile Design

1. The Design Professional shall design the Auger intrusion mortar cast in place piles. These piles shall be installed under the supervision of a qualified professional geotechnical engineer.

31.4 Specific requirements (organized by CSI MasterFormat® 2013 Numbers & Titles)

31 10 00	Site Clearing
31 20 00	Earth Moving
31 23 19	Dewatering
31 31 16	Termite Control
31 50 00	Excavation Support and Protection
31 62 13	Concrete Piles

31 10 00 Site Clearing

Design Standards

1. The Design Professional shall design the site clearing to include the following:
   a. Protection of all vegetation to remain. If an endangered plant species is found, provide an undisturbed area around it as required by FDEP.
   b. Removal of vegetation as required.
   c. The clearing and grubbing of obstructions, trees, shrubs and other vegetation, including grinding stumps and removing roots and debris.
   d. The stripping and stockpiling of topsoil and the removal of surplus topsoil.
   e. The removal of existing above and below grade site improvements.
   f. The disconnection, capping or sealing, and removal of site utilities.
   g. The installation of temporary erosion and sedimentation control measures.

31 20 00 Earth Moving

Design Standards

1. The Design Professional shall design the Earth Moving as follows:
   a. Design the preparation of subgrades including cutting and filling, as necessary, and compaction for slabs-on-grade, sidewalks, pavements, turf and grasses, and plants.
   b. Specify the methods for excavation, backfill and compaction for buildings and structures.
   c. Design of Sub base course, including compaction for concrete walks and concrete pavements.
   d. Design of Sub base course and base course, including compaction, for asphalt paving.
   e. Design of Subsurface drainage backfill for walls and trenches.
   f. Specify the methods for excavation, backfill and compaction of trenches for utilities and pits for buried utility structures.
   g. Specify that explosives are not allowed.
   h. Geotextiles:
      Design of usage of drainage geotextiles and separation geotextiles wherever are necessary.
   i. Excavation:
      (1) Excavation design shall cause minimal disturbances to adjacent occupied areas.
      (2) Specify hand-excavation in tree and plant protection zones.
      (3) Specify the disposal of Surplus and Waste Materials:
      Satisfactory soil to designated storage areas on Owner's property; waste materials and unsatisfactory soil off Owner's property.

2 Compaction as recommended by the geotechnical report or as follows:
   a. Required compaction of sub base, sub base courses and surfaces as a percentage of maximum density as obtained by test procedures of ASTM D1557.
   b. Compaction shall be as follows:

Under structures and building slabs, except footings, each layer.	95%
Under footings, top one foot of cut each layer of fill.	100%
Under pavements and sidewalk areas, top 12 inches, each layer.	95%
Under pavements and sidewalk areas, below 12 inches, each layer.	90%
Under landscaped areas, each layer.	85%

3. Testing requirements.
   a. Testing: By Owner engaged agency.

31 23 19 Dewatering

Design Standards

1. Dewatering shall be designed by the Contractor as follows:
   a. Contractor to be supplied with a copy of the geotechnical report.
   b. Contractor to survey adjacent construction for settlement before and during dewatering.
   c. Contractor to maintain water level as deep as necessary below bottom of excavation.
   d. Contractor to comply with the regulations of Broward County Permitting, Environment and Regulatory Affairs and the City of Fort Lauderdale Department of Public Works.

31 31 16 Termite Control

Design Standards

1. Termite Control as follows:
   a. The installer shall be licensed according to regulations of authorities having jurisdiction.
   b. Termicide installation shall comply with all required EPA regulations.
   c. The Warranty Period shall be five (5) years.
   d. Maintenance shall continue for twelve (12) months.

31 50 00 Excavation Support and Protection

Design Standards

1. Contractor shall engage a design professional to design excavation support and protection whenever trench depth exceeds five (5) feet as follows:
   a. Contractor to be supplied with a copy of the geotechnical report
   b. Contractor's design professional to specify required materials.
   c. Remove excavation support and protection to a minimum depth of 48 inches below overlying construction.

31 62 13 Concrete Piles

Design Standards

1. Design Professional shall design the auger intrusion mortar cast in place piles as follows:
   a. Design Loads: As required for particular application.
   b. Quality Assurance:
      (1) Grout cubes during construction.
      (2) Evidence auger weight is sufficient to penetrate soil profile.
   c. Materials
      (1) Steel Reinforcement: Deformed reinforcing bars.
      (2) Pile Accessories:
         (a) Sheet metal collars at cut-off.

(b) Spacers to maintain vertical reinforcing in position.

d. Concrete: As required by pile capacity.

e. Installation:
   (1) Static pile tests to verify augering criteria and pile lengths and to confirm allowable load of piles.
   (2) Damaged or defective piles withdrawn.
   (3) Pile installation records compiled by qualified professional geotechnical engineer.

f. Field quality control
   (1) Special Inspections: Pile foundations.
   (2) Testing: By Owner engaged agency.
   (3) Pile installation records compiled by qualified professional geotechnical engineer.

END OF DIVISION 31.

DIVISION 32 EXTERIOR IMPROVEMENTS

32.1 General Requirements

This chapter identifies criteria for the design of exterior improvement scope in Nova Southeastern University buildings with the purpose of establishing minimum standards to be used as a basis of design for Nova Southeastern University (NSU) Buildings at the Main Campus, Fort Lauderdale, Florida. NSU experiences with various materials, products and installations have led to the procedures and practices noted under this Division 32. The exterior improvement systems/products provided under this division must be selected to provide a pleasing work environment for the occupants in a sustainable and reliable design.

These objectives are in line with the objectives of all Divisions and should be coordinated with requirements in Division 1 Section "SUSTAINABLE DESIGN REQUIREMENTS."

All work shall be designed by a Professional Civil Engineer licensed in the State of Florida and a Registered Landscape Architect licensed in the State of Florida as required. Improvements will be constructed in accordance with the expected standard of design professionals within the State of Florida.

The design and of the exterior Improvements shall:

1. The design shall be implemented in such a way so existing structures, hardscape, landscape, or improvements to remain are not damaged.

2. The design shall take into account that access to or the functioning of improvements to remain shall not be hindered during the construction period. Specify that the contractor is responsible for creating a 'maintenance of operations' plan for approval by Nova Southeastern University Facilities Design and Construction prior to the commencement of any demolition or construction activities. This plan will also identify all safety measures proposed to protect pedestrians around and within the construction area as well as maintenance of traffic schedules and plans.

3. The design shall compliment existing improvements in character and scale to enhance the collegiate atmosphere.

4. The design shall comply with the Americans with Disabilities Act as codified within the latest edition of the Florida Building Code, Chapter 11, 'Florida Accessibility Code for Building Construction' to create an inviting and accessible campus.

5. Follow 'Crime Prevention Through Environmental Design' (CPTED) principles to ensure a safe university environment.

6. Coordinate with other disciplines on, adjacent to, or impacted by the proposed improvement project, including but not limited to utility companies.

7. Design shall include sustainable design regarding construction methods and material choices, maintenance required, and water and fertilization requirements.

8. Provide the best value to the University when considering the project's total life cycle cost.

9. Prior to any excavation, locate, mark and ID all existing underground utilities/correlate to GIS data.

10. Prior to covering new and/or exposed existing underground utilities, contact Nova Southeastern University for update of all underground utilities location database.

11. Parking spaces for design purposes shall be calculated using a three (3) parking spaces per 1000 square feet + 1.5/classroom ratio.

12. Sidewalks shall be 6" thick with WWM and edge re-bar reinforcement.

13. Sidewalks and concrete in general shall have fly ash content per LEED Silver criteria, whether or not the project is intended to be LEED certified.

14. For veneer finishes, provide waterproofing prior to application of veneer, compatible with the bonding requirements of the finish system.

15. Concrete pavers to be 4" x 8" or as determined by Nova Southeastern University.

16. Consider recycled materials for walkways.

17. Coordinate all exterior lighting with the University's lighting standards and standard fixtures as outlined in Division 26 Electrical of NSU Criteria Manual of Design and Specifications Standards.

The above objectives are in line with the objectives of all Divisions and should be coordinated with all disciplines in a holistic way.

The design of the Exterior Improvements shall complement other disciplines designs in a sustainable and reliable fashion.

32.1.1 Required Site Information

The Design Professional shall obtain from Nova Southeastern University the following information:

1. Site surveys, current to existing improvements and specific to the site.
2. Tree surveys for all trees over 6 inches diameter breast height (DBH) and arborist reports regarding the health of trees.
3. Utilities information including above and below ground utilities.
4. Geotechnical investigation reports..

32.1.1 Submittals

The Design Professional must ensure that all submittals and shop drawings are coordinated with other disciplines.

32.2 Codes and Standards

32.2.1 Exterior Site Furnishings

The Design Professional shall specify that the Exterior Site Furnishings comply with the requirements of the applicable authorities having jurisdiction and with the in-force edition at the time of the project of the following codes and standards:

1. American Society of Testing and Materials (ASTM)
2. Consumer Product Safety Commission (CPSP)
3. City of Fort Lauderdale Building and Zoning Department
4. Town of Davie Zoning Department.

32.2. Asphalt Pavement, Concrete Paving, Decorative Concrete Paving, Concrete Paving Joint Sealant, Concrete Curbs, Concrete Curbs and Gutters, Unit Paving, Permeable Unit Paving, Parking Bumpers, Pavement Markings and Manufactured Traffic Calming Devices,

The Design Professional shall specify that the Asphalt Pavement, Concrete Paving, Decorative Concrete Paving, Concrete Paving Joint Sealant, Concrete Curb, Concrete Curbs and Gutters, Unit Paving, Permeable Unit Paving, Parking Bumpers, Pavement Markings and Manufactured Traffic Calming Devices comply with the requirements of the applicable authorities having jurisdiction and with the in-force edition at the time of the project of the following codes and standards:

1. American Society of Testing and Materials (ASTM)
2. American Association of State Highway and Transportation Officials (AASHTO)
3. Town of Davie Department of Public Works

4. State of Florida Department of Transportation (FDOT)
5. American Concrete Institute (ACI)
6. Interlocking Concrete Pavement Institute (ICPI)
7. The Master Painters Institute (MPI)
8. Federal Specifications (FS)

32.2.3 Planting Irrigation

The Design Professional shall specify that the Planting Irrigation comply with the requirements of the applicable authorities having jurisdiction and with the in-force edition at the time of the project of the following codes and standards:

1. American Society of Testing and Materials (ASTM)
2. American Society of Mechanical Engineers (ASME)
3. Broward County Water and Sewer Department (BCWASD)
4. American Water Works Association (AWWA)
5. Town of Davie Department of Public Works (TDDPW)
6. State of Florida Department of Transportation (FDOT)

32.2.4 Turf and Grasses, Plants and Transplanting

The Design Professional shall specify that the Planting Irrigation, Turf and Grasses, Plants and Transplanting comply with the requirements of the applicable authorities having jurisdiction and with the in-force edition at the time of the project of the following codes and standards:

1. American Society of Testing and Materials (ASTM)
2. United States Department of Agriculture (USDA)
3. Environmental Protection Agency (EPA)
4. American Society of Civil Engineers (ASCE)
5. Turfgrass Producers International (TPI)
7. American National Standards Institute (ANSI)
8. American Wood Protection Association (AWPA)
9. Grades and Standards Publications, Division of Plant Industries, State of Florida Department of Agriculture
10. Standardized Plant Names, American Joint Committee on Horticultural Nomenclature
11. International Society of Arboriculture (ISA)
12. American Society of Consulting Arborists (ASCA)
13. Americans with Disabilities Act (ADA)
14. City of Fort Lauderdale Planning Department.
15. Town of Davie Zoning Department.
15. State of Florida Department of Transportation (FDOT)

32.2.5 Chain Link Fences and Gates

The Design Professional shall specify that the Chain Link Fences and Gates comply with the requirements of the applicable authorities having jurisdiction and with the in-force edition at the time of the project of the following codes and standards:

1. American Society of Testing and Materials (ASTM)
2. American Society of Civil Engineers (ASCE)

3. Chain Link Fence Manufacturers Institute (CLFMI)
4. National Electrical Manufacturers Association (NEMA)
5. City of Fort Lauderdale Zoning Department
6. Town of Davie Zoning Department

32.2.6 Decorative Fences and Gates

The Design Professional shall specify that the Decorative Fences and Gates comply with the requirements of the applicable authorities having jurisdiction and with the in-force edition at the time of the project of the following codes and standards:

1. American Society of Testing and Materials (ASTM)
2. National Ornamental and Miscellaneous Metal Association (NOMMA)
3. Builders Hardware Manufacturers Association (BHMA)
4. City of Fort Lauderdale Zoning Department
5. Town of Davie Zoning Department

32.3 Design Criteria

32.3.1 Exterior Site Furnishings

The Design Professional shall specify the Exterior Site Furnishings covered in this section.

1. Exterior site furnishing shall be specified to match existing University standard furnishings whenever possible and appropriate.
   a. Preferred Options:
      1) Benches, Manufacturer: Landscape Forms
         Sit Bench (w/ arms) or Austin Bench Cantilevered Back (w/ no arms) with backs with no dividers or alternates approved by Nova Southeastern University.

         a) Austin Bench Cantilevered Back (D x H x W = 23"x33”x 72")
            Austin Bench Weight: 118 lbs each.

         b) Sit Bench (D x H x W = 25"x32”x 74")
            Sit Bench Weight is 210 lbs each

         Color: Powdercoated Silver
         Material: Aluminum
         Support/Mounting: Concrete Base
      2) Chair, Manufacturer: Landscape Forms
         Catena Chair or alternates approved by Nova Southeastern University.
         Size: Frame is 7/8" tubular aluminum with stainless steel spindles
         D x H x W = 23"x30”x21"
         Weight is 15 lbs each
         Stackable by 4 chairs only
         Style: Perforated with no arms

Color: Silver

3) Table, Manufacturer: Landscape Forms - Catena or alternates approved by Nova Southeastern University.
Steelhead Perforated Tabletop w/ surface mount
Steelhead perforated metal table top w/ 1-1/2" diameter tube (umbrella hole)
Table top, 30" diameter
Height is 30"
Weight is 150 lbs each
Support/Mounting: Quad - Surface Mount
Table Top/ Supporting Base Color: Stainless Steel

4) Umbrella, Manufacturer: Landscape Forms- Equinox Umbrella –96 inch. or alternates approved by Nova Southeastern University.
Weight is 40 lbs each
Umbrella will be mounted to table support, not to the ground.
Style: Plain Edge cover
Fabric Color: Natural Color
Powdercoat Color: Titanium
Mounting: Table Mount
Standard Features: 1 ½" diameter pole
Standard Fabric: Sunbrella® marine-grade fabric w/ stain-resistant treatment

5) Trash Receptacle, Manufacturer: Landscape Forms – Petoskey Litter Receptacle or alternates approved by Nova Southeastern University.
Petoskey Litter Receptacle-hinged lid, perforated pattern
D x H x W = 20"x42"x 30 gallons
Receptacle Color: Silver
Weight is 96 lbs each
Support/Mounting: Concrete Base

2. The design of exterior site furnishings that are not standard University furnishings shall complement the existing and proposed character of the campus and landscape design. Site furnishings shall be constructed of durable materials and anchored in place in a concealed manner when appropriate.
3. Preferred Bike Rack: Bicilinea by Landscape Forms 10'-0" in length with a capacity of eight (8) bicycles at a rack mounting 30" on center, the finish shall be polished stainless steel set in concrete foundation beneath concrete pavers on sand, or cored into existing concrete slab with non-shrink epoxy grout. Preferred bike rack area surface is concrete pad.

32.3.2 Asphalt Pavement, Concrete Paving, Decorative Concrete Paving, Concrete Paving Joint Sealant, Concrete Curbs, Concrete Curbs and Gutters, Unit Paving, Permeable Unit Paving, Parking Bumpers, Pavement Markings and Manufactured Traffic Calming Devices.

The Design Professional shall specify the Asphalt Pavement, Concrete Paving, Decorative Concrete Paving, Concrete Paving Joint Sealant, Concrete Curbs, Concrete Curbs and Gutters, Unit Paving, Permeable Unit Paving, Parking Bumpers, Pavement Markings and Manufactured Traffic Calming Devices covered in this section.

1. Asphaltic Pavement should include the following designs:
   a. Design of the subgrade including compaction and stabilization if required by soil conditions. Specify minimum thickness of 12 inches.
   b. Design of lime rock base including compaction as per FDOT Standards and Specifications. Specify minimum thickness of 6 inches for parking stalls and minimum 8" for all others areas.
   c. Design of the asphaltic concrete surface as per FDOT Standards and Specifications. Specify minimum thickness of 2 inches.
   d. Cold milling of existing asphaltic concrete surface when required. Specify depth.
   e. Design of the asphaltic concrete overlay as per FDOT Standards and Specifications. Specify minimum thickness of 1 inch.
   f. Compaction testing requirements.

2. Concrete Paving and Sidewalks should include the following designs:
   a. Includes concrete pavement, curbs, curb and gutter, valley gutter and concrete sidewalks.
      1) Walkways to be designed as per Nova Southeastern University Standards
      2) Standards include concrete pavers with concrete bands are standard for plaza, drop-offs and key pedestrian/ vehicular areas. In special locations natural stone can be used and installed as approved by Nova Southeastern University.
      3) Concrete sidewalks shall be concrete with a light broom finish and a picture framed tooled edge of 4-1/4 inches wide (2-1/8" on each side of the control joint). Pedestrian areas are to be designed to withstand the weight of a golf carts and other lightweight vehicular access. Minimum sidewalk thickness shall be 6 inches.
      3) Provide walkways connecting drop-off zones, reserve parking and other facilities to building entrances.
      4) Where walkways exceed 150 feet in length, provide rest areas adjacent to walkway at convenient intervals with space for bench seats and wheelchair space, a minimum of 48 inches x 72 inches.
      5) Do not place grates or manholes in walkways.
      6) Curbs shall not create barriers for the handicap. Curb height shall not exceed six inches.
      7) Curb ramps shall be installed at all intersections and wherever walkways cross street or drives. When installed at intersections, a consistent pattern of orientation shall be observed to provide repetitive "cueing" to blind people. Locate and align curb ramps to direct pedestrian traffic into crosswalk areas.

8) Curb ramps located adjacent to parking areas shall not be blocked by parked vehicles.
9) Sidewalk slopes and curb cuts shall comply with Broward County Public Works, City of Fort Lauderdale and Town of Davie ordinances and ADA.
10) Provide sidewalks subject to maintenance trucks and other vehicular traffic with welded wire fabric and reinforced edges. Expansion joints shall not exceed fifteen (15) feet on center with a minimum 6 inch thickness.
11) All parking areas shall be fully curbed. Use cast-in-place concrete only. Type "D" curbs shall be 18 inch total curb height with 12 inch bury depth.
12) Extruded curbing is not permitted.

b. Design of the pavement sub-grade including compaction and stabilization if required by soil conditions. Specify minimum thickness.
c. Design of pavement base:
1) Lime rock base as per FDOT Standards and Specifications. Specify minimum thickness.
d. Design of concrete pavement, curbs, curb and gutter, valley gutter and concrete sidewalks, shall include the following:
1) Concrete strength or modulus of rupture.
2) Specification of steel reinforcing if any is required.
3) Pavement thickness as required.
4) Spacing of joints and types of joints.
5) Finishes.
6) Concrete testing requirements as required.

3. Decorative concrete paving shall include the following designs:
a. Design of the subgrade including compaction and stabilization if required by soil conditions. Specify minimum thickness of 12 inches.
b. Design of the base:
1) Lime rock base as per FDOT Standards and Specifications. Specify minimum thickness that is site specific..
c. Design of the concrete pavement shall include the following:
1) Concrete strength or modulus of rupture.
2) Specification of steel reinforcing if any is required.
3) Pavement thickness as required.
4) Spacing of joints and types of joints.
5) Color and finishes.
6) Mockups requirements.
7) Concrete testing requirements as required.

4. Concrete paving joint sealant shall include the following designs:
a. Design and specification of joint sealants should include the following:
1) Joint sealant application and location.
2) Joint sealant manufacturer and product name.
3) Joint sealant color.
4) Surface preparation before joint sealant installation.
5) Testing requirements of joint sealant.

5. Unit paving shall include the following designs:
   a. Design of the subgrade including compaction and stabilization if required by soil conditions. Specify minimum thickness of 12 inches.
   b. Design of the base:
      1) Lime rock base as per FDOT Standards and Specifications. Specify minimum thickness of 6 inches.
   c, Specify setting bed and thickness.
   d. Type of paver unit and color:
      1) Concrete pavers by Belgard Hardscapes or alternates approved by Nova Southeastern University.
      2) Color and unit sizes to match existing or as approved by Nova Southeastern University.
   e. Joint patterns shall be reviewed and approved by Nova Southeastern University.
   f. Mockups requirements shall be 6'-0" x 6'-0" or larger as required by Nova Southeastern University.
   g. Specify testing requirements.

6. Permeable unit paving shall include the following designs:
   a. Design of the subgrade; open graded for stormwater storage. Specify minimum thickness.
   b. Design of the base; well graded. Specify minimum thickness.
   c. Design of leveling course. Specify minimum thickness.
   d. Specify type of permeable paver unit and color as approved per Nova Southeastern University.
   e. Joint patterns shall be reviewed and approved by Nova Southeastern University.
   f. Mockups requirements shall be 6'-0" x 6'-0" or larger as required by Nova Southeastern University.
   g. Specify testing requirements.

7. The Design Professional shall design the type, size and location of parking bumpers and specify the manufacturer.

8. Pavement markings design shall include the following:
   a. Specify paint type:
      1) Alkyd.
      2) Latex.
   b. Specify wet film thickness
   c. Specify color and stripe width.

9. The Design Professional shall design the type, size and location of manufactured traffic calming devices and specify the manufacturer all signage shall meet Broward County minimum standards (latest edition).

32.3.3 Planting Irrigation

The Design Professional shall design the Planting Irrigation as follows:

1. Planting Irrigation should include the following design.
   a. Design of spacing and type of irrigation head.
   b. Design of piping sizes to obtain the required pressures and flows.
   c. Specify irrigation controls.

d. Specify backflow prevention devices if required.
e. Specify wells and pumps if required.

32.3.3 Turf and Grasses, Plants and Transplanting

The Design Professional shall design the Turf and Grasses, Plants and Transplanting as follows:

1. The design professional shall design the landscape to enhance the character of the campus, which is that of a visually pleasing, consistent lush landscape that responds to human and environmental needs, while being responsive to architectural and landscaping precedent and simplified maintenance with an emphasis on drought tolerance and native vegetation. Landscape design shall abide by the Nova Southeastern University Campus Master Plan and shall be carried out in consultation with the campus tree relocation program.

32.3.3 Chain Link Fences and Gates

The Design Professional shall design the chain link fences and gates. Including location, height, gage, hardware, footings and types of gates as follows:

1. PVC coated fence to match existing at Nova Southeastern University as approved by Nova Southeastern University.

2. Chain link fencing shall have top, intermediate and bottom rails.

3. Fence layout and heights to follow Nova Southeastern University requirements.

4. Fence openings to follow Nova Southeastern University requirements.

5. A fencing plan indicating post and fencing locations in relationship to existing to remain and proposed improvements shall be submitted to the Nova Southeastern University for approval prior to installation. The plan shall adhere to the following requirements:
   a. Fencing shall be set a minimum of two (2) feet from any existing to remain or proposed tree trunk.
   b. Fence posts shall be a minimum of two (2) feet from any edge of walk or pedestrian area and a minimum of four (4) feet from any edge of vehicular pavement or access route.
   c. Fencing and posts shall be located outside of sight triangles at roadway intersections.

6.. Nova Southeastern University fencing shall comply with applicable Florida Building Code requirements, City of Fort Lauderdale and Town of Davie zoning requirements and NSU requirements. Fencing Plan shall be coordinated with appropriate agencies.

32.3.4 Decorative Fences and Gates

The Design Professional shall design the decorative fences and gates. Including style, location, height, hardware, footings or foundations, gage and types of gates as follows:

1. Acceptable materials:

a. Wall topped with factory coated aluminum metal picket fence similar to existing at Nova Southeastern University.
b. Masonry wall with painted stucco finish and coping elements similar to existing. Or distinctive design signature approved by Nova Southeastern University.
c. Masonry wall with materials and colors if desired similar to existing.
d. Factory coated aluminum picket fence to match existing at Nova Southeastern University.
e. Blend of perforated and solid aluminum sequence and pattern shall be reviewed and approved by Nova Southeastern University.

2. Fence layout and heights to follow Nova Southeastern University requirements.

3. Fence openings to follow Nova Southeastern University requirements.

4. A fencing plan indicating post and fencing locations in relation to existing to remain and proposed improvements shall be submitted to the Nova Southeastern University for approval prior to installation. The plan shall adhere to the following requirements:
   a. Fencing shall be set a minimum of two (2) feet from any existing to remain or proposed tree trunk. Consult with Nova Southeastern University and Landscape Architect when distant to tree trunk is less than 10 feet.
   b. Fence posts or columns shall be a minimum of two (54) feet from any edge of walk or pedestrian area and a minimum of four (4) feet from any edge of vehicular pavement or access route.
   c. Fencing, posts, and columns shall be located outside of sight triangles at roadway intersections, per Fort Lauderdale Planning and Zoning requirements.

5. Nova Southeastern University fencing shall comply with applicable Florida Building Code requirements, City of Fort Lauderdale zoning requirements and shall be coordinated with appropriate agencies.

32.4 Specific requirements (organized by CSI Master Format® 2013 Numbers & Titles)

32 93 00	Exterior Site Furnishings
32 12 16	Asphalt Paving
32 13 13	Concrete Paving
32 13 16	Decorative Concrete Paving
32 13 73	Concrete Paving Joint Sealant
32 14 00	Unit Paving
32 14 43	Permeable Unit Paving
32 17 13	Parking Bumpers
32 17 23	Pavement Markings
32 17 29	Manufactured Traffic Calming Devices
32 31 13	Chain Link Fences and Gates
32 31 19	Decorative Fences and Gates
32 84 00	Planting Irrigation
32 91 00	Planting Topsoil
32 92 00	Turf and Grasses
32 93 00	Plants
32 96 00	Transplanting
32 97 00	Landscape Stone and Gravel

32 93 00 Exterior Site Furnishings

Design Standards

1. The Design Professional shall design the exterior site furnishings as follows:
   a. LEED submittals
      1) Product Data for Credit MR 4.1 and Credit MR 4.2
   b. General requirements:
      1) At least 50% of the proposed site furnishings for a project shall be handicap accessible, if applicable. If only one of a particular furnishing is proposed, it shall be handicap accessible.
      2) All top-opening receptacles shall have a covered opening, via domed lid or bonnet type design to limit rainwater into the bin.
      3) All receptacles shall be installed with a liner.
      4) Receptacles shall not be located directly adjacent to benches.
      5) Bench pads shall have a clear area for adjacent wheelchair parking.
      6) Movable seating shall be stackable.
      7) If umbrellas are provided, they shall be removable.
      8) Removable bollards shall have a locking mechanism.
      9) Bike racks shall be located to allow a six (6) foot length 'clear zone' for bike parking, centered on rack and in the direction of the rack. This clear zone shall fall outside of walk or building exit and entry areas. Individual racks shall be located no closer than two (2) feet six (6) inches from one another to allow for access between racks.
      10) Bike parking areas shall be lighted.
   c. Products:
      1) Site furnishings shall be selected to be in character and of the same quality of the campus's existing furnishings.
      2) Bike racks shall be selected as those which hold the bike by the frame, making contact at two horizontally separate points, minimum.
   d. Installation:
      1) Site furnishings shall be direct burial installation unless hardship from such method is identified to the Nova Southeastern University prior to the installation.
      2) Utilize tamper-resistant, stainless steel hardware.

32 12 16 Asphalt Paving

Design Standards

1. The Design Professional shall design the asphalt paving as follows:

   a. LEED submittals
      1) Product Data for Credit MR 4.
   b. Asphalt materials:
      1) Asphaltic concrete surface as per FDOT Section 916.
      2) Lime rock base as per FDOT Section 911
   c. Design mixes:
      1) Asphaltic concrete pavement as per FDOT Section 334.

d. Installation:
   1) General construction requirements as per FDOT Section 330.
   2) Milling of existing asphalt pavement as per FDOT Section 327.

32 13 13 Concrete Paving

Design Standards

1. The Design Professional shall design the concrete paving, which includes concrete pavement, curbs, curb and gutter, valley gutter and concrete sidewalks, as follows:

   a. LEED submittals
      1) Product Data for Credit MR 4.

   b. Materials:
      1) Portland cement, water, admixtures and curing materials as per FDOT Sections 921, 923, 924, and 925.
      2) Lime rock base as per FDOT Section 911
   c. Installation:
      1) Portland cement concrete as per FDOT Sections 346, 347 and 350.
      2) Sidewalks within vehicular use areas or subject to vehicular traffic including golf carts:
         a) Six (6) inches thick.
         b) Six (6) feet wide.
         c) Reinforced with welded wire fabric and reinforced edges.
         d) Expansion joints shall not exceed fifteen (15) feet.
      3) Sidewalks pedestrian use only::
         a) Six (6) inches thick.
         b) Six (6) feet wide.
         c) Unreinforced with troweled joints.
         d) Expansion joints shall not exceed forty (40) feet and shall be the full thickness of the walk.
         e) Control joints shall not exceed 5 (5) feet and shall be troweled to a depth of 1/3 that of the thickness of the walk.
      4) Curbing to comply with FDOT Index No. 300.

32 13 16 Decorative Concrete Paving

Design Standards

1. The Design Professional shall design the decorative concrete paving as follows:

   a. LEED submittals
      1) Product Data for Credit MR 4.

   b. Materials:
      1) Portland cement, water, admixtures and curing materials as per FDOT Sections 921, 923, 924, and 925.
      2) Lime rock base as per FDOT Section 911
      3) Colors compatible with Portland cement admixtures and curing materials.
   c. Installation:
      1) Portland cement concrete as per FDOT Sections 346, 347 and 350.

32 13 73 Concrete Paving Joint Sealant

Design Standards

1. The Design Professional shall design the concrete paving joints materials as follows:
   a. Materials and Installation:
      1) Concrete joint sealants as per FDOT Section 932.

32 14 00 Unit Paving

Design Standards

1. The Design Professional shall design the unit paving as follows:

   a. LEED submittal:
      1) Product certificates for Credit MR-5.
   b. Materials:
      1) Standard paver shall be Belgard Hardscapes or approved equal by Nova Southeastern University
         Colors:
         a) As determined and approved by Nova Southeastern University.

         Sizes:
         a) Standard manufacture's square or rectangular sizes, no polygonal allowed.

         Design requirements:
         a) Color mixing allowed in borders, band or geometrical patterns, random mixing is prohibited.
         b) Herringbone pattern 4-1/2" x 4-1/2" x 2-3/8" squares and 4-1/2" x 7" x 2-3/8" rectangular pavers in Flemish bond pattern in harvest blend or rustic bay color without aggregate is preferred where subject to vehicular traffic, paver size as required for best resistance to vehicular loads.
         c) Design layouts to avoid or minimize paver cutting.
         d) A sampler paver must be submitted before work is approved to begin.
   c) Installation:
      1) Per manufacture specifications.
      2) Standard design can be changed only when authorized by Nova Southeastern University. Joints should be broom in using round silica sand for compaction. The sand must be broom sweep into the paver's joints to maintain their position in the hardscape. The pavers and the concrete band will evenly meet with no tolerance greater than an eighth (1/8) of an inch for conformance with ADA.
      3) Provide a one (1) inch sand bed.
      4) Simulate heavy rain conditions to judge uneven settlement, and re-level pavers as necessary. Inspect pavers again 30 days after acceptance by Nova Southeastern University, and make further leveling adjustments if uneven settlement is detected.

32 14 43 Permeable Unit Paving

Design Standards

1. The Design Professional shall design the permeable unit paving as follows:

    a. LEED submittal:
        1) Product certificates for Credit MR-5.
    b. Materials:
        1) Standard paver shall be Belgard Hardscapes or approved equal by Nova Southeastern University.
        Colors:
            a) As determined and approved by Nova Southeastern University.

        Sizes:
            a) Standard manufacture's square or rectangular sizes, no polygonal allowed.

        Design requirements:
            a) Color mixing allowed in borders, band or geometrical patterns, random mixing is prohibited.
            b) Herringbone pattern 4-1/2" x 4-1/2" x 2-3/8" squares and 4-1/2" x 7" x 2-3/8" rectangular pavers in Flemish bond pattern in harvest blend or rustic bay color using pavers without aggregate is preferred where subject to vehicular traffic, paver size as required for best resistance to vehicular loads.
            c) Design layouts to avoid or minimize paver cutting.
            d) A sampler paver must be submitted before work is approved to begin.

    c. Installation:
        1) Per manufacture specifications.
        2) Standard design can be changed only when authorized by Nova Southeastern University. Joints should be broom in using a washed open graded free draining aggregate material (typically a #8, #89 or #9 stone) to fill the spaces (joints or voids) between concrete pavers to create interlock and still maintain filtration for compaction. The aggregate material must be broom sweep into the paver's joints to maintain their position in the hardscape. The pavers and the concrete band will evenly meet with no tolerance greater than an eighth (1/8) of an inch for conformance with ADA.

32 17 13 Parking Bumpers

Design Standards
Nova Southeastern University prefers curb stops in lieu of parking bumpers. Design parking areas considering a 24" vehicular overhang over landscaped parking medians or parking lot edges. This area of overhang shall not contain vegetation, but rather mulch or gravel as approved by the Nova Southeastern University. However, where curbs are not possible.

1. The Design Professional shall specify the parking bumpers as follows:

    a. LEED Submittal:
        1) Product certificate for Credit MR 4.

b. Product: Parking bumpers:
   1) Concrete wheel stops:
      a) 4,000 PSI minimum compressive strength.
      b) 5 inches high by 8 inches wide by 72 inches long.
      c) Provide chamfered corners, transverse drainage slots on the underside and a minimum of two factory-formed or drilled vertical holes through wheel stop for anchoring to substrate.
      d) Units as made by Denmark Cast Stone Co., A. & R. Concrete or accepted equivalent.
      e) Assigned/labeled parking bumpers must be indicated on drawings. Assigned/labeled parking bumpers will include but not limited to "SERVICE", VISITOR", "RESERVED". Coordinate with Nova Southeastern University Public Safety / Parking Department for additional requirements.

c. Installation:
   1) One parking bumper per parking stall.
   2) Five eighth (5/8) inch round reinforcing bars usual 12 inches driven (7) inches into the ground.
   3) Anchor rods shall be recessed ½ inch to 1 inch below the top of the wheel stop.
   4) Wheel stops shall be reinforced with #5 reinforcing rods.

32 17 23 Pavement Markings

Design Standards

1. The Design Professional shall design the pavement markings as follows:

   a. LEED submittal:
      1) Product certificates for Credit IEQ 4.2.
   b. Materials:
      1) Pavement markings paint:
         a) Alkyd-resin type as per AASHTO M248
         b) Alkyd pavement marking paint as per MPI No. 32.
         c) Latex pavement marking paint as per FS TT-P-1952 or MPI No. 97.
      2) Glass beads.
   c. Installation:
      1) Specify color and stripe width.
      2) Pavement to age for 60 days before starting pavement markings.
      3) Provide a minimum wet film thickness of 0.15 mils.

Product Standards:

1. Flint Trading Company or approved equal by Nova Southeastern University.

32 17 29 Manufactured Traffic Calming Devices

Design Standards

1. The Design Professional shall specify the manufactured traffic calming devices as follows:

    a. LEED Submittal:
        1) Product certificate for Credit MR 4.
    b. Product: Traffic calming devices:
        1) Speed bumps and humps Solid, integrally colored, 96 percent postconsumer or commingled post-consumer and pre-consumer recycled rubber or plastic; UV stabilized. Provide factory-formed or drilled vertical holes for anchoring to substrate.
            a) Speed bump: 2 inches high by 10 inches wide by 72 inches with tapered, square, or rounded ends.
            b) Speed hump: Modular assembly 4 inches high by 14 feet in overall width with overall length as dimensioned on drawings; and with tapered, square or rounded ends.
    c. Installation:
        1) Galvanized steel spikes as per manufacturer written recommendation for heavy traffic.
        2) Bed of adhesive for adhesion to pavement with heavy traffic as per manufacturer written recommendation.

32 31 13 Chain Link Fences and Gates

Design Standards

1. The Design Professional shall design the chain link fences and gates as follows:

    a. General requirements:
        1) Wind loading as per ASCE 7 and the Florida Building Code.
        2) Exposure category C.
        3) Fence height to match existing.
    b. Materials:
        1) Fabric shall be in one-piece heights measured between top and bottom of outer edge of selvage knuckle or twist. Comply with CLFMI Product Manual and with requirements indicated below:
            a) Fabric Height shall match existing Nova Southeastern University fencing.
            b) Steel Wire Fabric: Wire with a diameter of 0.148-inch (9-gauge) zinc coated.
            c) Mesh size: Two (2) inches..
            d) Selvage: Knuckled edge to be on top, twist on the bottom.
            e) Fence and gate fabric to be PVC coated class 2b wire (blue in color) as per ASTM F668. Thickness of coating 0.025 inch.
        2) Posts and rails: Strength requirements shall conform to ASTM F-699, and fence manufacturers written recommendations.
            a) Pipe shall be straight, true to section, materials and sizes specified.

b) Post and rail coatings to comply with the heavy-duty industrial fence requirements in ASTM F668. Zinc coating and PVC coating shall be the same type, thickness and color as indicated for fabric.

3) Fittings and accessories: Coating shall be the same as indicated for fence fabric.

4) Gates:
   a) Swing gates: Comply with ASTM F900.
   b) Sliding gates: Comply ASTM F1184.

c. Installation:

1) The contractor shall examine areas and conditions, with installer present, for compliance with requirements for site clearing, earthwork, pavement work, and other conditions affecting the performance of the work.
2) Installation will not begin before final grading is completed.
3) Installation will not commence until unsatisfactory conditions have been corrected.
4) Installation of the chain-link fencing to comply with ASTM F 567.
5) Specify diameters and spacing for drilling or hand-excavation of holes for posts. These holes are to be in firm, undisturbed soil.
6) Specify post setting.
7) Specify concrete fill:
8) Specify terminal posts and line posts: Space line posts uniformly at 10 feet on center maximum. Tension Wire: Install according to ASTM F 567.
9) Chain-link fabric shall be applied to outside of enclosing framework. In addition, specify that 2 inches be left between finish grade and bottom selvage unless otherwise indicated. A bottom pipe is required.
10) Specify gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach hardware using tamper-resistant or concealed means. Specify that ground-set items be in concrete for anchorage. Specify hardware for smooth operation and be lubricated where necessary.
11) Design gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range.
12) Provide a 6” concrete slab for motor operators, sloped and raised above grade sufficiently to prevent storm water ponding.

32 31 19 Decorative Fences and Gates

Design Standards

1. The Design Professional shall design the decorative fences and gates as follows:

a. General requirements:

1) Wind loading as per ASCE 7 and the Florida Building Code.
2) Exposure category C.
3) If fencing exists adjacent to proposed fencing or site, proposed fence design, height, and materials to match existing unless otherwise directed by Nova Southeastern. If existing fencing is not present, the NSU Project

Manager to advise on general requirements for design, height, and materials. The Design Professional is responsible for preparing final design and submitting signed and sealed structural drawings prepared by a structural engineer licensed in the State of Florida for approval prior to ordering of materials or installation of fence.

4) New fencing shall intersect with existing fencing via the use of a column or post. No new fencing shall tie directly into existing fencing material.

5) SPECIAL NOTE: Service Yard Vehicular Gate:
a) Decorative Rolling gate, Decorative blend of perforated and solid aluminum panels with sunburst pattern, Color: RAL 7038, per approval by Nova Southeastern University.

6) Barrier Decorative Railings: Horizontal aluminum tubes, above three smaller horizontal tubes in a wave pattern and supported by aluminum pickets. Aluminum painted with a kynar finish, color RAL 7038.

b. Materials:

1) Picket fences: Factory coated aluminum picket fence, materials, finish, color and design similar to of existing Nova Southeastern University picket fences.
2) Aluminum Fence Panels: Painted and / or coated to match finish of existing fencing.
3) Wall topped with metal picket: Materials, finish, color and design similar to existing Nova Southeastern University fences.
4) Masonry walls:
   a) Masonry wall with painted stucco finish to match existing similar masonry wall fences as determined and approved by Nova Southeastern University..
   b) Masonry wall with similar existing masonry wall fences. As determined and approved by Nova Southeastern University.

c. Installation:

1) Contractor shall examine areas and conditions, with installer present, for compliance with requirements for site clearing, earthwork, pavement work, and other conditions affecting the performance of the work.
2) Installation will not begin before final grading is completed.
3) Installation will not commence until unsatisfactory conditions have been corrected.
4) Design wall topped with metal picket to match materials, finish, color and design of existing Nova Southeastern University fences.
5) Design masonry wall with painted stucco finish and coping to similar existing masonry wall fences as determined and approved by Nova Southeastern University.
6) Design masonry wall to match similar existing masonry wall fences.
7) Specify gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach hardware using tamper-resistant or concealed means. Specify that ground-set items be in concrete for anchorage. Specify hardware for smooth operation and be lubricated where necessary.
8) Design gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment,

misplacement, disruption, or malfunction, throughout entire operational range.

32 84 00 Planting Irrigation

Design Standards

1. The Design Professional shall design the planting irrigation as follows:

   a. General requirements:
      1) Irrigation shall be provided for all proposed landscape and turf areas, unless otherwise directed by Nova Southeastern University.
      2) Water use for irrigation must comply with the Broward County and CBWCD regulatory requirements as well as with the University's water use agreement with the CBWCD.
      2) All efforts should be made to connect irrigation to existing well water sources on the Nova Southeastern University campus. If access to an existing well is not feasible, efforts should be made to drill a new well, which must be tested for water salinity and approved by the Nova Southeastern University.
      3) Potable water may only be used for irrigation with prior authorization by the University.
      4) Reclaimed or reuse water shall be utilized as much as possible for irrigation. If used, follow requirements of Florida Statutes Chapter 62-610, "Reuse of Reclaimed Water and Land Application", including use of purple for pipes, boxes, etc. as well as advisory signs are indicating the use of reclaimed water.
      5) Drip irrigation shall be utilized as much as possible.
      6) The irrigation system shall be regulated by a rain-gauge or a moisture sensor.
      7) Irrigation to provide 100% "head-to-head" coverage.
      8) Turf areas shall be served by different zones than groundcover and shrub irrigation
      9) 'Rotor' type irrigation heads may not be used for groundcover or shrub irrigation.
      10) Rain Bird brand components or equal shall be specified for all irrigation systems unless otherwise authorized by Nova Southeastern University.

   b. Materials as follows:
      1) PVC Pipe: ASTM D 1785, PVC 1120 compound, Schedule 40.
         a) PVC Socket Fittings: ASTM D 2466.
         b) PVC Threaded Fittings: ASTM D 2464.
      2) Corporation Stops: AWWA C800.
         a) NPS 1-1/4 to NPS 2 Minimum pressure rating 150 psig.
         b) Body Material: Brass or bronze with ball or ground-key plug.
         c) End Connections: Matching piping.
         d) Stem: With wide-tee head.
      3) Tapping valves:
         a) Cast Iron body compatible with drilling machine, 150 psig.
      4) Tapping sleeves:
         a) Ductile iron sleeve compatible with drilling machine.
      5) Irrigation water meters:

a) Provided by CBWCD.

6) Irrigation water meter boxes and vaults:
   a) Water meter boxes and covers: Cast Iron.
   b) Vaults: Precast concrete with galvanized steel hatches.

. 7) Backflow preventers:
   a) Reduced Pressure Backflow Preventers.
   b) Pressure Vacuum Breakers.

8) Bronze Automatic Control Valves: Cast-bronze body, normally closed, diaphragm type with manual-flow adjustment, and operated by 24-V ac solenoid.

9) Plastic Automatic Control Valves: Molded-plastic body, normally closed, diaphragm type with manual-flow adjustment, and operated by 24-V ac solenoid.

10) Sprinklers:
   a) Plastic Pop-up, Gear-Drive Rotary Sprinklers: ABS body with pressure compensating fixed or adjustable nozzles, also capable of flow adjustment. Pop-up heights from 4 inches to 12 inches.
   b) Plastic, Spray Sprinklers: ABS body with pressure compensating fixed or adjustable nozzles, also capable of flow adjustment. Pop-up heights from 4 inches to 12 inches.
   c) Plastic, Fixed Spray Sprinklers: ABS body with pressure compensating fixed or adjustable nozzles, also capable of flow adjustment. Sprinkler installed in riser.

11) Drip Irrigation:
   a) Emitters: Polyethylene or vinyl with flow control. They can be singled installed or in manifolds.
   b) Drip tubes.
   c) Pressure regulators.
   d) Filter Units.
   e) Air relief valves.
   f) Vacuum relief valves.

12) Controllers for Automatic Control Valves (Outside installation). 24 volt interior transformer. Adjustable, 24-hour, 14-day clock, with automatic operations to skip operation any day in timer period, to operate every other day, or to operate two or more times daily:
   a) Specify number of stations. Stations can be programmed from approximately 5 to 60 minutes. Included with switch for manual or automatic operation of each station.
   b) Exterior Control Enclosures: NEMA 250, Type 4, weatherproof, with locking cover and matching keys; included with provision for grounding.
   c) Body Material: Enameled-steel sheet metal, stainless-steel sheet metal or molded plastic.
   d) Mounting: Freestanding type for concrete base or surface type for wall installation.

13) Controllers for Automatic Control Valves (Inside installation). 24-volt interior transformer. Adjustable, 24-hour, 14-day clock, with automatic operations to skip operation any day in timer period, to operate every other day, or to operate two or more times daily:

a) Specify number of stations. Stations can be programmed from approximately 5 to 60 minutes. Included with switch for manual or automatic operation of each station.
b) Exterior Control Enclosures: NEMA 250, Type 12, drip-poof, with locking cover and matching keys; included with provision for grounding.
c) Body Material: Enameled-steel sheet metal, stainless-steel sheet metal or molded plastic.
d) Mounting: Wall installation.

14) Moisture Sensor: Adjustable from one to seven days, to shut off water flow during rain.
15) Wiring: As recommended by controller manufacturer.

c. Installation:
1) Piping requirements:
a) Refer to DIVISION 31 EARTHWORK for excavating, trenching and backfilling.
b) Irrigation main piping to be installed with 36-inch cover under pavements and walkways and 24-inch cover under landscaped areas.
c) Irrigation circuit piping (to automatic valves) to be installed with 24-inch cover under pavements and walkways and 18-inch cover under landscaped areas.
d) Piping to be installed as close as possible to the location indicated on the drawings.
e) Warning tape to be installed directly over the piping.
f) Piping to be installed within sleeves under parking lots, roadway and sidewalks.
g) Drip tubes to be installed below ground.
2) Sprinklers requirements:
a) Pop-up sprinklers to be installed flush with proposed grade. Pop-up height will depend on the type of plants being irrigated.
b) Fixed sprinklers to be installed in risers. Riser height will depend on the type of plants being irrigated.
c) Sprinklers to be installed as close as possible to locations shown in drawings. If location adjustments are necessary a 100% coverage will need to be maintained.
3) Emitters shall be installed as shown on plan. Manifold emitters systems to have tubing to each single emitters.
4) Drip irrigation pressure regulators, filter units, air relief valves and vacuum valves shall be installed in control valve boxes.
5) Automatic control valves are be installed as close as possible to the irrigation main and within control valve boxes.
a) Wiring from automatic control valves to controller shall be installed to the side of the irrigation main.

d. Testing:
1) Test entire irrigation system at 100 psi for one hour without any loss of pressure.

e. Connection to existing water mains.
1) Provide backflow preventers and meters as required by BCWAS.

f. Standards for storm water retention for irrigation, verify with Nova Southeastern University requirements.

32 91 00 Planting Topsoil

Design Standards

1. The Design Professional shall design planting topsoil as follows:
   a. General requirements:
      1) All planting topsoil shall be tested by a soil testing laboratory prior to installation or amendment. Conduct soils tests as per standard commercial testing requirements to provide recommendations for soil amendments, organic matter, and fertilizer mix with application rate and frequency for plant species specified.

   b. New planting topsoil:
      1) A mixture of sand, as outlined below, and Everglades Peat conforming to ASTM D 5268. Topsoil shall have a pH range of 5.5 to 7, and have a 4 percent organic material minimum composition. Topsoil shall be free of stones 1 inch or larger in any dimension, debris, salt, and any other extraneous materials harmful to plant growth.
   c. Amendment of existing topsoil for planting:
      1) All existing planting topsoil must be tested prior to amendment by a soil testing laboratory and shall be amended as recommended by the laboratory and as approved by the Nova Southeastern University.
      2) Acceptable soil amendments include the following:
         a) Aluminum Sulfate: Commercial grade, unadulterated.
         b) Sand: Clean, washed, natural or manufactured silica sand, free of salt, debris or other toxic or extraneous materials. "Concrete Sand" or crushed limestone will not be accepted.
         c) Peat Humus: FS Q-P-166. Finely divided or granular texture, with a pH range of 6 to 7.5, composed of partially decomposed moss peat (other than sphagnum), peat humus, or reed-sedge peat.
         d) Sawdust or Ground-Bark Humus: Decomposed, nitrogen-treated, of uniform texture, free of chips, stones, sticks, soil, or toxic materials.
         e) Other Amendments: As recommended by testing agency and approved by the Nova Southeastern University.
   d. Typical planting topsoil mixes:
      1) Planting soil mixtures for trees, palms, and shrubs: 50% Everglades Peat, 50% coarse clean silica sand, by volume. Add amendments as recommended by testing laboratory.
      2) Planting topsoil for lawn areas: 25% Everglades Peat, 75% coarse clean silica sand, by volume. Add amendments as recommended by testing laboratory.
      3) Above mixtures are subject to adjustment based on testing laboratory's recommendations and as approved by the University.
   d. Typical planting topsoil depths:
      1) Turf and grasses: Planting topsoil depth for turf and grasses shall be installed or amended at a minimum depth of 6".
      2) Shrubs: Planting topsoil depth for shrubs shall be installed or amended at a minimum depth of 12"-18".
      3) Trees: Planting topsoil depth for trees shall be installed or amended at a minimum depth of 24"-36" within a minimum radius of 2.5 times the rootball diameter; the radius shall be enlarged to accommodate adequate root volume in areas with highly compacted soil.

f. Compacted soil amendment:
   1) Compacted soil in all planting areas shall be remediated by tilling the soil to decompacting the soil to a depth appropriate to provide suitable soil root volume for the plant material being planted, as outlined in the "Typical planting soil depths" section immediately above.

g) Tree root soil volume systems:
   1) In areas requiring additional soil volume for tree roots under paved areas, the use of a soil volume system is encouraged. Examples of appropriate soil volume systems are "CU-Structural Soil" as manufactured by Amereq, Inc., or approved equal, and the "Silva Cell" system as manufactured by DeepRoot or approved equal.

e. Fertilizer:
   1) Commercial-grade complete balanced fertilizer of neutral character, with 50 percent derived from natural organic sources of nitrogen, phosphorous, and potassium in the following composition, or as otherwise recommended by the testing laboratory and required by the University.
   2) The following forms of fertilizer shall be used. Composition shall be as recommended by testing lab and approved by the University.
      a. Shrubs and ground covers shall receive a granular fertilizer such as Tri-nite or equal.
      b. Palms shall receive a palm special mix containing magnesium, manganese, chelated iron and other minor elements such as that produced by Grace or Atlantic Fertilizer Companies, Miami, Florida or other approved source.
      c. B&B Trees shall receive a time-released fertilizer in the form of packets or briquettes such as Agriform or approved equal.
      d. Sod shall be fertilized with 10-10-10 fertilizer or as otherwise recommended by the soil testing laboratory and approved by Nova Southeastern University.

32 92 00 Turf and Grasses

Design Standards

1. The Design Professional shall design turf and grasses as follows:
   a. General requirements:
      1) All turf shall be provided as sod. Seeding is not acceptable.
      2) Sod shall comply with "Specifications for Turfgrass Sod Materials" in TPI's "Guideline Specifications to Turfgrass Sodding" and be free of pests.
      3) Sod shall be sand grown. Muck grown sod will not be accepted, unless authorized by the Nova Southeastern University in writing prior to installation.
   b. Testing as follows:
      1) Conduct a soils test as per standard commercial testing requirements to provide recommendations for soil amendments, organic matter, and fertilizer mix with application rate and frequency for turf species specified.
   c. Materials as follows:
      1) Sod shall be solid, either as fifteen (15) inch by eighteen (18) inch pieces or a roll.
      2) Acceptable species include the following:

a) St. Augustine grass, Stenotaphrum secundatum, varieties "Floratam", "Palmetto", and "Seville".
b) Bahia grass, Paspalum notatum, varieties "Argentine" and "Pensacola".
c) Bermuda grass for specialty athletic fields. Variety to be approved by Nova Southeastern University prior to installation.

3) Bahia grass to be the only turf species used for non-irrigated areas. All species may be used for irrigated areas.
4) Install planting soil and amendments as outlined in Division 32 91 00 of these Building Standards. Soil amendments and fertilizer shall be used as per the recommendations of the soil testing laboratory.

c. Installation of the works:
1) Lay sod within twenty-four (24) hours of harvesting. Do not lay sod if dormant or if ground is muddy
2) Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod to offset joints in adjacent courses.
3) Water sod immediately after installation.
4) Maintenance: The Contractor shall be responsible for all turf maintenance until Final Acceptance. Such maintenance shall include watering, mowing, weeding, pest treatment, replacement of dead material, and all other operations necessary to provide a viable and thriving landscape at the point of Final Acceptance.

32 93 00 Plants

Design Standards

1. The Design Professional shall design plants and vegetation as follows:
a. General requirements:
1) Plant selection shall strive for use of Florida native or "Florida-Friendly" species as much as possible. The Florida-Friendly plant database can be found at http://www.floridayards.org
2) Do not use category I exotic species, and avoid or use judiciously, category II exotic species, as listed within the Florida Exotic Pest Plant Council's Invasive Plant Species List.
3) Groundcovers or low growing shrubs, shall be used wherever possible to reduce landscape maintenance. Examples include sloped areas, replacement of turf grass in inaccessible or highly shaded areas, erosion prone areas, and areas where mulch washes away or is otherwise difficult to maintain, such as parking lot islands.
4) A minimum tree planting area or island shall be ten (10) feet wide by ten (10) feet long.
5) Trees shall be located a minimum of ten (10) feet from any underground utility to remain and a minimum of fifteen (15) feet from any overhead utility to remain unless it can be demonstrated that the mature size of the tree will not interfere with the utility.

b. Testing as follows:
1) Conduct a soils test as per standard commercial testing requirements to provide recommendations for soil amendments, organic matter, and fertilizer mix with application rate and frequency for plant species specified.

c. Materials:
   1) All plant material to be Florida No. 1 or better as specified within "Florida Grades and Standards for Nursery Plants".
   2) Trees with circling or girdling roots will not be permitted.
   3) Install planting soil and amendments as outlined in Division 32 91 00 of these Criteria Manual of Design and Specification Standards. Soil amendments and fertilizer shall be used as per the recommendations of the soil testing laboratory.
   4) Mulch:
      a) Mulch shall be organic wood mulch, free from deleterious materials and suitable as a top dressing for planting bed areas.
      b) Wood mulch shall be used for planting bed areas, as opposed to gravel or other inorganic mulches, as wood mulch inhibits weed germination and growth, holds in soil moisture, moderates soil-temperature fluctuations (reducing plant stress), improves the soil fertility through the decomposition of organic material, and decomposes at a moderate rate (reducing maintenance).
      b) Mulch shall be installed at a depth of 2"-4" and shall be pulled back a minimum of 3 inches from the trunk of the tree or shrub so that the trunk and root flare are exposed.
      b) Mulch shall be Florimulch by Forestry Resources, Inc. or approved equal Grade A Melaleuca mulch that is clean, bright, and free of weeds, moss, sticks, and other debris.
      c) Other mulches such as pine straw or pine bark "Mini Nuggets" are acceptable if Florimulch is unavailable and if authorized by Nova Southeastern University prior to installation.
      d) Cypress and red color mulch will not be accepted.
   5) Staking and bracing systems:
      a) Design professional shall be responsible for providing staking and bracing details specific to tree and palm sizes and types for review and approval prior to installation.
      b) Braces for palms shall be made of sound, new pressure-preservative-treated softwood, free of knots, holes, cross grain, and other defects, 2 by 4 inches or 4 by 4 inches, and sized appropriately for the size of the palm.
      b) Tree staking systems shall use a polypropylene material in green, Arbor Tie by Deep Root, or other approved equal protective material where in contact with branches.
      c) Staking to occur in area of undisturbed soil surrounding tree.
      d) For narrow planting areas or in areas where staking would be in conflict with access, use "Platipus" brand or equal type below-grade tree staking system. Ensure root ball sizes meet manufacturer's requirement for using such systems.
      e) Staking systems to be removed at one (1) year after Final Acceptance or longer if tree has not established at that point.

d. Installation of the works:
   1) Tree Protection: All existing trees and specimen plants to remain shall be protected during construction activities.
      a) Tree barricades shall be used to protect specimen plants and trees to remain larger than four (4) inches in diameter.
      b) Barricades shall be four feet high, minimum, and constructed of 2" x 4" rails with 4" x 4" posts, minimum.

c) Barricades shall enclose the specimen plant's, tree's, or collective tree group's dripline or a fifteen (15) foot by fifteen (15) foot area, whichever is less.
d) No stockpiling of debris, trash, or materials shall be permitted within the barrier area.
e) No parking of vehicles or vehicular/equipment traffic shall be permitted within the dripline area or within the tree barricade once erected.
f) No grade changes shall occur within the barrier area at any time during construction, and grade changes within the dripline area should be minimized to the greatest extent possible.
g) If trimming of trees to remain is required, trimming shall be performed by a certified and licensed arborist as certified by the International Society of Arboriculture.
h) Penalties shall be charged to the contractor at a rate of $500 per caliper inch for specimen plants and trees that are damaged due to construction activities.

2) General requirements:
a) No landscape planting shall occur prior to a fully functioning irrigation system to support it.

3) Planting of groundcover and shrubs as follows:
a) Planting shall be performed by a licensed contractor to the expected standards of care of landscape contractor professionals within the state of Florida.
(b) Plants shall be planted such that one (1) inch of the rootball is above finished grade.
(c) Mulch all planting areas with a three (3) inch layer of mulch. Do not mulch over rootballs.

4) Planting of trees and palms:
a) Planting shall be performed by a licensed contractor to the expected standards of care of landscape contractor professionals within the State of Florida.
b) Trees and palms shall be planted such that two (2) inches of the rootball is above finished grade.
c) Trees and palms to be planted plumb.
d) Mulch all trees and palms with a three (3) inch layer of mulch. Lightly dust mulch over rootballs such that the depth is no more than one (1) inch. Mulch shall be pulled back a minimum of 3 inches from the trunk of the tree so that the trunk and root flare are exposed.

5) Maintenance:
a) The Contractor shall be responsible for all landscape maintenance until Final Acceptance. Such maintenance shall include watering, trimming, weeding, pest treatment, replacement of dead material, and all other operations necessary to provide a viable and thriving landscape at the point of Final Acceptance.

32 96 00 Transplanting

Design Standards

1. The Design Professional shall design the transplanting procedures as follows:
   a. General requirements:
      1) Each tree proposed for transplanting to be inspected by a certified arborist, as certified by the International Society of Arboriculture, for recommendation of the tree's general heath and expected success rate of transplanting. Arborist to prepare report with recommended preparation and relocation procedures and schedule.
      2) All transplanting and trimming activities to be performed by or directly overseen by a certified and licensed arborist.
      3) Contractor to submit a tree relocation plan and schedule identifying all required activities for the NSU Project Manager's review and approval prior to initiation of any transplanting activities. If utilizing roadways or access ways, a maintenance of traffic plan shall be included within the relocation plan.
      4) Contractor to have experience with previous tree relocation of similar magnitude as proposed.
      5) Contractor responsible for all required permitting and coordination with utilities, FDOT, and City of Fort Lauderdale and Town of Davie as required.
   b. Testing:
      1) A tissue test shall be performed on all trees proposed for relocation.
      2) A soils test shall be conducted at all proposed relocation points of the site.
      3) The testing agency and certified arborist shall be responsible for making recommendations as per soil amendments, fertilizers, and prepared planting soil for each tree as proposed for their specific transplanted location.
      4) Contractor to perform percolation tests at all proposed transplanted locations to ensure good drainage for transplanted trees.
   c. Materials:
      1) Soil amendments, fertilizers, and prepared planting soil as per recommendation of soils and tissue tests.
   d. Installation of the works:
      1) All crown and root pruning shall be conducted as per approved transplanting plan and schedule.
      2) Transplanting activities other than root and crown trimming will not occur within hurricane season, June 1st through November 30th.
      3) Trees to be relocated either directly, within the same day of excavation, or held in a temporary nursery in a container, complete wrap, or temporary planting pit. Relocated trees to be moved a maximum of two times. Contractor is fully responsible for maintaining the health of held trees as per recommendation of certified arborist.
      4) Contractor to warranty relocated trees for a two (2) year period.

32 97 00 Landscape Stone and Gravel

Design Standards

1. The Design Professional shall design the landscape stone and gravel as follows:

    a. Stone and boulders:
        1) Stone and boulders shall be cap rock from the Broward County County region, similar in appearance, after weathering, to the native rock visible on the site. Obtain Nova Southeastern University's approval of samples before obtaining stone.
    a. Acceptable gravel types (3/4" maximum size) include the following:
        1) Crab orchard gravel.
        2) 3/4" Georgia grey granite.
        3) Other gravel types are acceptable if approved by Nova Southeastern University prior to installation.

    END OF DIVISION 32

DIVISION 33 UTILITIES

33.1 General Requirements

This chapter identifies criteria for the design of utilities scope in Nova Southeastern University buildings with the purpose of establishing minimum standards to be used as a basis of design for Nova Southeastern University (NSU) Buildings at the Main Campus, Fort Lauderdale, Florida. NSU experiences with various materials, products and installations have led to the procedures and practices noted under this Division 33. The utilities systems/products provided under this division must be selected to provide a functional work environment for the occupants in a sustainable and reliable design.

These objectives are in line with the objectives of all Divisions and should be coordinated with requirements in Division 1 Section "SUSTAINABLE DESIGN REQUIREMENTS."

The utilities system products must be designed to comply with the following objectives:

1. Sustainable Design and products under the criteria to meet LEED "silver" standards as a minimum to reduce the total building energy consumption.
2. Longevity.
4. Easy of maintenance.
5. Compatibility with all adjacent materials both new and existing.
6. Solutions with the best value considering a life cycle cost analysis to account for total project cost.

The design of the utilities must be implemented so there is minimum impact on adjacent buildings, paved areas, vegetation or existing waterways and aquifer. The Design Professional shall specify that all excavation be implemented safely and in compliance with the Trench Safety Act. The Design Professional shall specify the Termite Control and note that all work shall comply with EPA Regulations. The Design Professional must ensure that design shall conform to all applicable codes.

The Design Professional shall obtain a copy and become familiar with the Nova Southeastern University Facilities Design and Construction (NSUFDC).

All work shall be designed by a Professional Civil Engineer licensed in the State of Florida.

The Design Professional shall obtain from the Nova Southeastern University the following information:

1. Site surveys.
2. Underground utilities information.
3. Geotechnical investigation reports.

The Design Professional shall show in the construction documents plans and profiles of all the storm water systems. Profiles to be drawn at a minimum of 1" = 50' horizontal and 1" = 5' vertical.

1. Prior to any excavation, locate, mark and identify all existing underground utilities, correlate to GIS data.
2. Prior to covering new and/or exposed existing underground utilities, contact Nova Southeastern University for update of underground utilities location database / GIS.

33.1.1 Submittals

The Design Professional must ensure that all submittals and shop drawings are coordinated with other disciplines.

33.2 Codes and Standards

33.2.1 Water Supply Wells for Irrigation, Storm Utility Drainage Piping, and Sub drainage.

The Design Professional shall specify that the Water Supply Wells for irrigation, Storm Utility Drainage Piping, and Sub drainage comply with the requirements of the applicable authorities having jurisdiction and with the in-force edition at the time of the project of the following codes and standards:

1. Trench safety Act - Florida Statutes, Chapter 553, Part VI
2. Occupational Safety and Health Administration (OSHA) - Excavation Safety Standards
3. American Society of Testing and Materials (ASTM) Standards
4. American National Standards Institute (ANSI)
5. Hydraulic Institute (HI)
6. Broward County Permitting, Environment and Regulatory Affairs
7. City of Fort Lauderdale Department of Public Works (FLDPW)
8. State of Florida Department of Environmental Protection (FDEP)
9. Environmental Protection Agency (EPA) Regulations

33.3 Design Criteria

33.3.1 Water Supply Wells for Irrigation, Storm Utility Drainage Piping, and Sub drainage.

The Design Professional shall specify the utilities covered in this section, which includes Water Supply Wells for Irrigation, Storm Utility Drainage Piping and Sub drainage.

1. Water supply wells for irrigation should include the following:
   a. Compute required flow and pressure for irrigation requirements

   b. Well driller qualifications.

   c. Materials for well casing.

   d. Pumps; submersible vertical-turbine pumps or centrifugal pumps.

2. Storm utility drainage piping should include the following:
   a. Design storm water system to comply with authorities having jurisdiction.

   b. Piping materials, depth and location.

   c. Precast concrete catch basins and manholes. Specify location and depth. Coordinate with water and sanitary sewer lines or other utilities.

   d. Trench drains and their connections to the storm water system.

   e. Coordinate storm water piping location and depth with water and sanitary sewer lines or other utilities.

   f. Ensure that the rainwater leaders from the building are routed to catch basins. If they need to be routed to a manhole, then the manhole needs to be provided with a grate and not with a solid cover.

3. Sub drainage should include the following:
   a. Drawings location of sub drainage.

   b. Details of sub drainage.

   c. Geotextile fabric and drainage course.

   d. Locate connection points to storm water system.

33.4 Specific requirements (organized by CSI Master Format® 2013 Numbers & Titles)

33 21 00	Water Supply Wells for Irrigation
33 41 00	Storm Utility Drainage Piping
33 46 00	Subdrainage

33 21 00 Water Supply Wells for Irrigation

Design Standards

1. The Design Professional shall design the water supply wells for irrigation as follows:

   a. Required pressure and flows.

   b. Electrical components devices and accessories as per NFPA 70.

   c. Compliance of water supply well with AWWA A100.

   d. Well casing as follows:
      (1) Steel Casing: AWWA C200, single ply, steel pipe with threaded ends and threaded couplings for threaded joints.

(2) PVC Casing: ASTM F 480 PVC, Schedule 40 bell-and-spigot pipe and couplings for solvent-cemented joints.

e. Well seals: Casing cap, with holes for piping and cables, this fits into top of casing and is removable, waterproof, and vermin proof.

f. Well screens.

g. Pumps and their appurtenances including all electrical equipment.

h. Well location and installation.

i. Well driller is licensed in the State of Florida.

j. Well installation complies with all applicable regulations.

33 41 00 Storm Utility Drainage Piping

Design Standards

1. The Design Professional shall specify the storm utility drainage piping as follows:

a. Piping materials:
(1) PVC Corrugated Sewer Piping:
(a) Pipe: ASTM F 949, PVC, corrugated pipe with bell-and-spigot ends for gasketed joints.
(b) Fittings: ASTM F 949, PVC molded or fabricated, socket type.
(c) Gaskets: ASTM F 477, elastomeric seals.

b. Drainage structures:
(1) Concrete catch basins and curb inlets:
(a) As per ASTM C478, for precast, reinforced concrete, of depth indicated, with provision for sealant joints.
(b) As per ASTM C913, for heavy traffic precast, reinforced concrete, of depth indicated, with provision for sealant joints.
(c) As per ASTM C890, for cast in place, reinforced concrete, of depth indicated, with provision for sealant joints.
(d) Size, wall thickness, top slab, and base section (sized to prevent floatation). Comply with CGDPW specifications.
(e) Steps if depth is more than five (5) feet.
(f) Resilient pipe connectors as per ASTM C923.
(g) Joint sealant as per ASTM C990.
(h) Frame and grate as per ASTM A536 and CGDPW specifications. Grate to be sized according to its tributary area.
(i) Adjusting rings.

(2) Concrete manholes:
(a) As per ASTM C478, for precast, reinforced concrete, of depth indicated, with provision for sealant joints.
(b) As per ASTM C913, for heavy traffic precast, reinforced concrete, of depth indicated, with provision for sealant joints.

(c) As per ASTM C890, for cast in place, reinforced concrete, of depth indicated, with provision for sealant joints.
(d) Size, wall thickness, top slab, base section (sized to prevent floatation). Comply with CGDPW specifications.
(e) Steps if depth is more than five (5) feet.
(f) Resilient pipe connectors as per ASTM C923.
(g) Joint sealant as per ASTM C990.
(h) Frame and cover.
(i) Adjusting rings.

(3) Concrete control structures:
(a) As per ASTM C890, for cast in place, reinforced concrete, of depth indicated, with provision for sealant joints.
(b) Size, wall thickness, top slab, base section (sized to prevent floatation). Comply with CGDPW specifications.
(c) Steps if depth is more than five (5) feet.
(d) Resilient pipe connectors as per ASTM C923.
(e) Joint sealant as per ASTM C990.
(f) Frames and covers.
(g) Adjusting rings.

(5) Sloped invert polymer concrete channel drainage systems:
(a) Include interlocking-joint precast channel sections, medium or heavy-duty grates, covers and locking mechanism.

(6) Wide-with and narrow-width level invert polymer concrete channel drainage systems:
(a) Include interlocking-joint precast channel sections, medium or heavy-duty grates, covers and locking mechanism.

(7) Steel and stainless-steel, wide-width and narrow-width channel drainage systems:
(a) Include trench sections, grates, and vandal proof fasteners.

(8) Plastic channel drainage systems:
(a) Include interlocking-joint precast channel sections, medium or heavy-duty grates, covers and locking mechanism.

c. Concrete:
(1) Cast in place concrete shall be as per ACI 318 and ACI 350R.

(2) Concrete strength 4,000 PSI.

(3) Maximum water cement ratio of 0.45.

(4) Reinforcing fabric shall be as per ASTM A185 steel.

(5) Reinforcing bars shall be as per ASTM 615, Grade 60 deformed steel.

d. Installation:
(1) The installer shall have a minimum of three years experience in the field and a minimum of five projects completed with similar scope. The installer shall be licensed in the State of Florida.

(2) Contractor to examine field conditions prior to proceeding with the work.

(3) Contractor to submit shop drawings and product information as required.

33 46 00 Sub drainage

Design Standards

1. The Design Professional shall specify the sub drainage for retaining walls as follows:

a. Piping materials:
(1) Perforated PE Pipe and Fittings: ASTM F405 or AASHTO M252, Type CP, corrugated, for coupled joints. Specify size.

b. Waterproofing felt:
(1) Comply with ASTM D226, Type I, asphalt or ASTM D227, coal-tar-saturated organic felt.

c. Geotextile filter fabrics:
(1) Description: Fabric of PP or polyester fibers or combination of both, with flow rate range from 110 to 330 gpm/sq. ft when tested according to ASTM D4491.

(2) Structure Type: Nonwoven, needle-punched continuous filament.
(a) Survivability: AASHTO M 288 Class 2.
(b) Styles: Sock or flat style.

d. Installation as required.

e. Connections with stormwater system:
(1) Connect low elevations of subdrainage system to storm drainage system.

f. Test and inspections:
(1) After installing drainage course to top of piping, test drain piping with water to ensure free flow before backfilling.

(2) Remove obstructions, replace damaged components, and repeat test until results are satisfactory.

(3) Drain piping will be considered defective if it does not pass tests and inspections.

END OF DIVISION 33.