The Wake County Public School System has published its guidelines for planning and design of functional, cost effective, and durable educational facilities that are attractive and enhance the students' educational experience. The guidelines present basic planning requirement and design criteria for the entire construction process, including: codes and standards; site development; construction materials; thermal and moisture protection; doors and windows; finishes; equipment and furnishings; plumbing; electrical and mechanical systems; and specialty areas such as toilet facilities, lockers, fire extinguishers and cabinets, and operable partitions. Attachments cover detailed installation and construction specifications for such items as wiring, landscaping, fencing, stage equipment, cable installation, and laminate casework. (GR)
WAKE COUNTY PUBLIC SCHOOL SYSTEM
DESIGN GUIDELINES

March, 1999

Available at:
http://www.wcpss.net/Auxiliary/Facilities/
design_guidelines.html

DEFINITIONS AND ABBREVIATIONS - 01000 -1
INTRODUCTION

These Guidelines have been developed to assist the Architect-Engineer in the planning and design of functional, cost effective and durable educational facilities that are attractive and enhance the educational experience for their students. Designers are encouraged to develop the attractiveness in a straightforward manner by utilizing standard building materials and details with a minimum of ornamentation and special treatments. Highest priority should be placed on the development of the interior learning environment with full attention given to the development of appropriate casework, outlets, lighting, etc.

The Guidelines incorporate experiences and lessons learned from past building improvement programs and have been organized in accordance with CSI's format. They are not intended to limit or control opportunities for innovative design but rather to assist the Designers in understanding certain planning requirements, design criteria, and concern regarding reduction of energy consumption. Nevertheless, whenever the design of facilities varies from the requirements and considerations of the Guidelines, the Designer shall obtain prior approval in writing from the Owner.

Please note that separate Educational Specifications and Building Programs listing detailed space and equipment requirements will be issued for each building project. In event of any conflict between the two, the Education Specifications shall supersede the requirements of the Guidelines.

These Guidelines should be of great benefit to Designers as well as the Owner. The entire design and construction process will be strengthened and less complicated if all concerned utilize the Guidelines at each phase of project design and approval. As the Guidelines will continue to evolve through the Owner's experience and desire to improve projects, your comments and recommendations are invited for future revisions.
ACKNOWLEDGMENTS

These Guidelines have been prepared and revised by the Wake County Public School System Department of Facilities Planning and Construction under the direction of Ray Massey, Jr., Associate Superintendent for Auxiliary Services and Christina Lighthall, Senior Director of Facilities Planning and Construction.

Acknowledgement is made to the various staff members of the Wake County Public School System and to several outside design and technical consultants who reviewed various drafts of the document. The advice and help of all of these sources is greatly appreciated.

Particular thanks are also extended to the staff and consultants of WCPSS who met several times to review each draft copy of the guide in its formative stages and made many valuable contributions.
WAKE COUNTY PUBLIC SCHOOL SYSTEM
DESIGN GUIDELINES
6 May 1992

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SECTION 01000 - DEFINITIONS AND ABBREVIATIONS

DEFINITIONS
Throughout this guide, mandated requirements are differentiated from recommendations or commentary as follows:

Mandates: Indicated by use of “shall”, “will”, “use”, or “shall not”, “do not” (in bold type)

Recommendations or commentary: Indicated by words or phrases such as “should”, “may”, “it is recommended” and the like. Any such words or phrases indicate an option that is to be decided by the Designer.

ABBREVIATIONS
Owner: Wake County Public School System

WCPSS: Wake County Public School System

Designer: Design professional registered to practice in North Carolina. This shall be an architect for the design of all-new structures, additions, and renovations or alterations to existing structures. The scope of the architect’s services shall include the services of professional engineers to design the structural, plumbing, mechanical and electrical portion of the project. The services of the architect may be deleted and comparable services of an engineer or landscape architect may be substituted in lieu of where a project is almost entirely with the design realm of such professionals.

ADA: The American’s with Disabilities Act
AHERA: Asbestos Hazard Emergency Response Act of 1987
ASHRAE: American Society Heating, Refrigeration, and Air Conditioning Engineers
ASTM: American Society for Testing Materials
BOCA: Building Officials and Code Administrators International
HVAC: Heating, Ventilation and Air Conditioning
ICBO: International Conference of Building Officials
NEMA: National Electrical Manufacturer’s Association
NFPA: National Fire Protection Association
NRCA: National Roofing Contractors Association
OSHA: U.S. Occupational Safety and Health Administration
SBCCI: Southern Building Code Congress International
SMACNA: Sheet Metal and Air Conditioning Contractors National Association, Inc.
UL: United Laboratories, Inc.

END OF SECTION
SECTION 01010 - CODES AND STANDARDS

Project design and construction shall meet all governing codes, standards and regulations. These codes and standards shall supersede the WCPSS Design Guidelines in event of a conflict. Among the codes and standards to be complied with are the following:

North Carolina State Building Code including the General, Mechanical, Electrical, Handicap and Gas Volumes.

ADA Requirements

NEMA Standards

ASHRAE Guide (latest edition) including ASHRAE 90 and ASHRAE Standard for Energy Conservation in new buildings. UL Standards (or compatible accepted standards by NCSBC)

NFPA Guide including the following:

NFPA 17 Range Hood Fire Extinguishing Equipment
NFPA 31 Oil Burning Equipment
NFPA 72A Local Protection Signaling Systems
NFPA 90A Ducts, Fire Dampers, Air Conditioning and Ventilation Systems

NFPA 91 Blower and Exhaust Systems
NFPA 96 Removal of Smoke and Grease-Laden Vapors from Commercial Cooking Equipment
NFPA 101 Life Safety Code

Code for Energy Conservation in new building construction (Jointly prepared by BOCA, ICBO, and SBCCI Codes)

Local Zoning Ordinances

WCPSS Project Educational Specifications

END OF SECTION
SECTION 01020 - ASBESTOS NOTE

☐ No asbestos containing building materials shall be used in the construction of the project. The design consultant will be required to submit a signed statement that “no asbestos containing building material was specified as a building material in any construction document for the project, or to the best of the consultant’s knowledge, was used in the building.

☐ If any materials suspected to contain asbestos are encountered in addition or renovation work, the Owner’s “AHERA DESIGNEE” shall be immediately contacted to arrange an investigation and testing of these materials. The Owner shall supervise the removal of any asbestos containing material by an independent contractor hired and paid by the Owner. A statement to this effect shall be included in the General Requirements of the project specifications.

☐ All projects occurring on existing campuses are required to include in specifications the notice to contractors, subcontractors and short-term workers regarding asbestos containing building materials that may be present in the existing buildings. (See Attachment 01020-A) It shall also be required that all contractors and subcontractors return the completed certification form (included in Attachment 01020-B) prior to beginning work.

END OF SECTION
ATTACHMENT 01020-A

NOTICE TO CONTRACTORS, SUBCONTRACTORS, & SHORT-TERM WORKERS

RE: ASBESTOS-CONTAINING BUILDING MATERIALS IN SCHOOLS/FACILITIES

DATE: November 29, 1994

This notice is to advise you that asbestos-containing building materials must not be disturbed if encountered during repairs, renovations, and other construction and installation activities in buildings owned by the Wake County Public School System. A management plan manual is located in the main office of each facility which specifies the location(s), if any, of asbestos-containing building materials. Copies of the manuals are also available for reference in Raleigh at the school system’s Operations Department at 1551 Rock Quarry Road and the Department of Environmental Management (Facilities Building) 1551 Rock Quarry Road. Contractors shall review the appropriate manual prior to beginning any construction activity in order to determine if that activity has the potential for disturbing asbestos-containing building material.

If disturbance of these materials cannot be reasonably avoided, no work shall begin until the AHERA Designee of the Wake County Public School System has been notified and has issued specific instructions on the proper procedures for the activity in accordance with federal, state and local regulation. The attached Contractor Certification Form must be signed and returned to the AHERA Designee prior to the start of work.

Contractors, subcontractors, and short-term workers shall also be responsible for determining, prior to the start of work, the location(s) of any areas of restricted or prohibited access on the site where the work is to be performed. Such areas shall not be entered, for any reason, without prior authorization of the AHERA Designee. The Wake County Public School System will not be responsible for claims of any kind from contractors, subcontractors or short-term workers who fail to comply with provisions of this notice.

Sincerely,

[Signature]

Frank Koontz, AHERA Designee
Wake County Public School System
Environmental Management
1551 Rock Quarry Road, Facilities Building
Raleigh, North Carolina 27610
Phone (919) 856-8286
ATTACHMENT 01020-B

CONTRACTOR CERTIFICATION FORM
Wake County Public School System – Environmental Management

The undersigned certify that they have received and read the “Notice to Contractors, Subcontractors and Short-Term Workers” issued by the Wake County Public School System regarding asbestos-containing building materials that may be present in school buildings.

The Undersigned further certify the following:

• That they have informed their workers and/or subcontractors of this notice and the proper procedures to follow

• That they will contact the AHERA Designee for the Wake County Public School System to determine if there are restricted access areas at the facility where work is planned and, if there are such areas, that they will notify their workers and subcontractors accordingly

• That they will be responsible for proper notification of these conditions to all subcontractors and for obtaining the signature(s) of the authorized representatives of those subcontractors in the spaces provided below

• That this form will be properly completed, signed, and returned to the AHERA Designee for the Wake County Public School System prior to the start of work

Project/School/Facility: ____________________________

Project Number: ____________________________

Prime Contractor: ____________________________ Date: ________________
President/Manager/Owner

Subcontractor: ____________________________ Date: ________________
President/Manager/Owner

Subcontractor: ____________________________ Date: ________________
President/Manager/Owner

Subcontractor: ____________________________ Date: ________________
President/Manager/Owner

Subcontractor: ____________________________ Date: ________________
President/Manager/Owner

Remit To: Frank Koontz, AHERA Designee
Wake County Public School System
Environmental Management/Facilities Building
1551 Rock Quarry Road
Raleigh, NC 27610

DEFINITIONS AND ABBREVIATIONS- 01000 -12
ENERGY CONSERVATION

The requirements of ASHRAE Standard “Energy Conservation in New Building Design” and Volume X of the North Carolina State Building Code shall be complied with in the design of all new and renovated facilities, except that the following considerations shall take precedence over the ASHRAE standard and Volume X:

1. The roof/ceiling “U” factor shall not exceed .05.
2. Wall “U” factor shall not exceed .10.
3. Exceptions may be made for these two (2) items noted above on special designs where the roof structure is utilized for solar collection or natural lighting.

The Design Team shall make every effort to provide a system design with maximum utilization of energy conservation measures, consistent with functional requirements of the building. Close coordination between the Mechanical Engineer, Electrical Engineer and Architect in the interest of energy conservation shall be required.

The following design items shall be performed by or complied with by the Design Teams for all work, both new and renovation.

1. Review building insulation strategies with Energy Management department of WCPSS during design development phase. Insulation levels shall be maximized to enhance long term benefits and comfort. Considerable care shall be taken to minimize infiltration in building shell. Major areas of concern are windows, ceiling/roof assemblies and entry areas.
2. Natural day lighting shall be thoroughly examined and it is strongly recommended that it be utilized in all appropriate spaces.
3. Specify water savings features on all water consuming devices such as water closets, etc.

Other guidelines related to energy conservation are found in specific sections of this document.

END OF SECTION
SECTION 01040 - DRAWING, SPECIFICATION & BID ALT. REQUIREMENTS

SPECIFICATIONS
- The Advertisement for Bids, Information for Bidders, Form of Proposal, Bid Bond, Sample Agreement, Minority Business Enterprises, MBE Contractor Database, General Conditions, Supplementary Conditions, Temporary Facilities, Unit Cost/Allowance Definitions, and Construction Schedules and Reports sections of the specifications will be furnished by the Owner to the Designer.
- The Design Consultant shall submit to owner at 100% CD's, square foot take off quantities for grass area, landscape planted area, each type of asphalt paving and each type of floor finish.
- The General Requirements section of the specifications will be written by the Designer. It shall address coordination of Prime Contractors' work, project meetings, temporary heating, operation of HVAC system (use of filters to be required during construction), shop drawing review, specific site use requirements, the asbestos statement noted in Section 01020 and project close-out requirements. Design Consultant shall obtain current close-out requirements from WCPSS Project Manager.

DRAWINGS
- The title sheet of working drawings shall include site data, building data and building energy performance data as shown on Attachments 01040-A, 01040-B, and 01040-C. Copies of all UL Designs utilized for fire rated wall, column, floor, roof construction and wall penetrations shall be included on drawings. Any approved modifications (by North Carolina Department of Insurance or local building inspector) to the UL Designs shall be noted and evidence provided for permit review.
- The working drawings shall also include a separate set of floor plans showing all code required fire rated walls, occupancy calculations, toilet fixture calculations, and egress travel distances. The landscape-planting plan shall designate which plants and planted areas are required by local zoning ordinances and those which are not required.

BID ALTERNATES
- Project bid alternates shall include add alternates as described in various sections of these guidelines.

ALLOWANCES
- Use of allowances is discouraged, though not prohibited. If the designer uses allowances, provide a section in the specifications that summarizes all allowances. Contractors shall be required to show allowances as line items on the Schedule of Values.

END OF SECTION

DEFINITIONS AND ABBREVIATIONS - 01000 -14
SECTIONS 01050 - WARRANTIES AND MAINTENANCE AGREEMENTS

WARRANTIES

☐ All work shall be fully warranted for one year from the date of substantial completion by
the contractor who shall replace any defective materials and repair any defective
workmanship. In addition, written warranties shall be provided for the following
products and time periods. These warranties shall include any material and labor cost to
repair defective materials and correct defective workmanship.

5 YEAR WARRANTY
- Soil Termiticide Treatment
- Wood Doors
- HVAC Compressors including Refrigeration

10 YEAR WARRANTY
- Glass and Glazing Materials

20 YEAR WARRANTY
- Sheet Metal Roofing (this shall include finish cracking, peeling or color fading)

20 YEAR NO DOLLAR LIMIT “SYSTEM” WARRANTY
- Single Ply Membrane Roofing
- Modified Bitumen Roofing

30 YEAR WARRANTY
- Asphalt Shingle Roofing

END OF SECTION
SECTION 01060 - PROJECT CLOSE-OUT

OPERATION AND MAINTENANCE MANUALS

The Contractors shall deliver four complete sets of all operation and maintenance manuals to the Owner through the Designer, two (2) weeks before the pre-final inspection is held. The manuals shall be installed in 3 ring notebooks with the name of the project and the words “Operation and Maintenance” manuals on the cover and spline. The manuals shall contain the following items as a minimum:

- Index and page numbers.
- Complete start-up, operation, and shutdown procedures for each system including sequence of events, locations of switches, emergency procedures and any other critical items.
- Lubrication schedules and types of lubricates.
- Complete set of current shop drawings and equipment description showing all capacities and other operation conditions.

See Section 15000 for additional requirements.

FINAL INSPECTIONS

Each project shall have both a pre-final and final inspection made before it is finally accepted by the Owner. A complete and thorough training shall be conducted by the design consultant(s), contractors and subcontractors for the WCPSS Maintenance Department after the pre-final inspection.

The pre-final inspection shall be held after all systems are in place and in operation. All contractors shall demonstrate to the Designer that all systems in the building are properly installed, balanced, and performing as designed and specified. All Contractors and Subcontractors shall attend this inspection including the HVAC air and water balance subcontractor.

The final inspection shall be held with the Owner, Designer, all Contractors and Subcontractors to demonstrate to the Owner that all systems in the building are operating as designed and to their satisfaction. The final HVAC inspection results shall be certified by design professionals.

POST INSPECTIONS

Two post construction inspections shall be held by the Designer with the Contractors and Owner to assure that the building is continuing to operate in accordance with the plans and specifications and that no unusual problems are occurring in the building systems. The first post construction inspection will be held approximately six months after substantial completion. This inspection will address Plumbing, HVAC and electrical work. The second post construction inspection shall be held prior to expiration of the 1 year warranty period. It shall address general construction as well as plumbing, HVAC and electrical work. All problems discovered during these inspections that relate to defective materials or defective workmanship shall be corrected by the Contractor at no additional cost to the Owner.

RECORD DRAWINGS (AS-BUILTS)

The Designer shall specify that during construction operations the Contractor shall faithfully record all changes from the contract drawings, including accurate dimensions.

DEFINITIONS AND ABBREVIATIONS- 01000 -16
where applicable including invert elevations for all below-grade outside utilities with
reference to permanent above-grade objects.

☐ The Designer shall also specify that at completion of the work all such changes shall be
recorded neatly with red ink by the contractor on an unused set of the contract drawing
prints supplied by the Designer. The red line changes shall be reviewed by the Designer
who shall modify all contract drawings to reflect and incorporate all field changes.

☐ The resulting Record Drawings shall be turned over to the Owner in hard copy Mylar
form and on CD in AutoCAD format. In addition, the Designer shall provide the Owner
with a half-size set of Record Drawings on either bond or blueprint paper.

SCHOOL SITE STORAGE OF DRAWINGS AND MANUALS

☐ The Design shall provide space in either the main HVAC equipment room or electrical
equipment room for a 36" wide x 18" x 72" high metal storage cabinet supplied by the
Owner. This will be used to store the school's copy of record drawings, project
specifications and operation and maintenance manuals.

SUBSTANTIAL COMPLETION

☐ Substantial Completion is the date that the Owner and Designer determine the project is
complete enough for the Owner to achieve beneficial occupancy. It is also the date that
begins the warranty periods. Please refer to the General Conditions Section of the
Specifications, which will be furnished by the Owner for detailed listing of Substantial
Completion requirements.

FINAL COMPLETION

☐ Please refer to the General Conditions Section of the Specifications for a detailed listing
of documentation, certification and submittals required for Final Completion and Final
Payment.

END OF SECTION
SECTION 02001 - SITE DEVELOPMENT DESIGN CONSIDERATIONS

GENERAL

There are various issues, which need to be addressed in the site design of a school. These considerations include:

1) the allowance for future building expansion and accommodation of future re-locatable classrooms.
2) the development of circulation patterns that separate pedestrian from vehicular traffic, the bus drop/parking from the parent drop off and staff parking from student parking.
3) main building entrances which are readily identifiable;
4) building orientations and configurations which conserve energy and allow for natural day-lighting and ventilation
5) the utilization of exterior terraces/patios for outdoor learning areas.
6) providing handicap accessibility to all buildings and play areas as per Building Code and ADA requirements.
7) the identification and preservation of natural site features such as rock outcroppings and wooded areas to be used to enhance the science program.
8) minimize the building’s environmental impact on the site, i.e.:
   - run-off control (watershed issue)
   - minimize excavation
   - protect trees
   - minimize grounds maintenance
   - protect wetlands

Projects within the City of Raleigh shall be required to comply with City of Raleigh Stormwater Management Policy.

EXECUTION

BUILDING EXPANSION AND RE-LOCATABLE CLASSROOMS: The planning for future building expansion and re-locatable classrooms shall consider grading, circulation patterns and utility stub outs.

BUS DROP OFF, PARENT DROP OFF AND PARKING TRAFFIC: These three functions shall be separated as much as possible. At all drop off areas the discharge or pick-up of students at the loading-unloading zones shall be from the side of the vehicle opposite the driver and towards the building.

Parking bays for full-service buses shall be a minimum of 15 ft. wide.

Back up of buses shall not be permitted.

A minimum turning radius of 7 ft. shall be provided at bus driveways and parking areas.

Linear sidewalks shall be provided at each loading/unloading area.

All primary building entrances used for students shall be protected from weather by overhead cover or soffit. It is recommended that each loading/unloading area have a covered canopy and covered walkway leading into the building. At larger schools it is recommended the bus drop canopy be a minimum of 12 ft. wide and 50 ft. long and walkway canopy to the building be a minimum of 8 ft. wide. Bottom of canopy soffits shall be a minimum of 10 ft. above finish grade at bus drops. Columns supporting canopies shall be set back from curbs a minimum of 4 ft. to allow car or bus doors to open. Canopies shall be designed to avoid roosting of birds.

SERVICE DOCKS: It is recommended service docks be covered or partially covered. Dock height should be at 48 in. Use concrete and not asphalt for dock surface.
ENERGY CONSERVATION: Designers shall consider building orientations and configurations that minimize heat loss and facilitate beneficial solar gain during heating season, allow for natural ventilation and promote natural day-lighting of building interior. South facing window surfaces, particularly at large glazed areas, should be protected by horizontal overhangs, which maximize solar heat gain during the heating season and minimize it during the cooling season.

Also recommended is the use of deciduous trees for summer sun shading, winter sun penetration and use of conifer trees for summer sun shading and winter wind breaks.

Enclosed courtyards often present maintenance problems and should be used with great discretion. If used, provide for maintenance access and do not install large tree plantings. Provide hose bibbs and adequate sized storm drain structures.

RETAINING WALLS: All retaining walls with a height of 5 ft. or greater or walls subjected to surcharge loading (i.e., vehicle traffic, sloping backfill, or point loads) shall be designed by a professional engineer and drawings shall be signed and sealed accordingly.

PLAYGROUNDS: shall be provided as per program requirements. Playground equipment to be supplied and installed by the Contractor.

Playground equipment to be installed on a poured in place, ADA compliant, soft rubber surface, installed over a concrete pad. Size of surface shall be determined from equipment manufacturer’s requirements. Access to playground equipment shall meet ADA requirements.

STORAGE BUILDING: shall be provided as per program requirements. Designers are encouraged to use finish materials and colors to match adjacent buildings.

EXTERIOR MECHANICAL AREAS: shall be enclosed with security fencing as noted in Section 02830. Provide reinforced concrete slab with fenced area with proper sized pads/curbs for equipment mounting. Slope slab away from building.

BOILER ROOMS: shall have exterior door only.

MAIN MECHANICAL EQUIPMENT ROOMS: shall have exterior doors where possible.

BIKE RACKS: Two (2) bike racks capable of holding 8 bikes each shall be supplied and installed by Contractor.
SECTION 02050 - DEMOLITION

EXECUTION

☐ EQUIPMENT REMOVAL: The Designer and Project Manager shall schedule time for Owner to remove material and equipment to be saved.

END OF SECTION
SECTION 02270 - SLOPE PROTECTION AND EROSION CONTROL

EXECUTION

- GRADING: shall allow for storm drainage away from building, parking areas and driveways. Consider flow of concentrated storm drainage, design to slow down velocity. Concentrated drainage across walks shall not be allowed, nor will ponding be allowed.
- Discharge from canopies shall be directed away from walks and tied into underground storm drain line system. All drainage shall be directed into underground storm drains.
- Top of finish grade next to exterior walls shall be set a minimum of 8 in. below top of finish floor except at building entrance locations.
- All slopes shall be less than 1 in 3.
- The recommended slope for paving is between 1% and 2%. Slopes in excess of 5% will not be permitted except in special circumstances where the Owner’s prior approval will be required.
- Do not stockpile excavations permanently on site.
- All cleaned topsoil shall be stockpiled for site use or other use by WCPSS.

END OF SECTION
SECTION 02280 - TERMITE CONTROL

GENERAL

☐ RE-TREATMENT AND REPAIR: If subterranean termite activity is discovered during warranty period, Contractor will re-treat soil and repair or replace damage caused by termite infestation, without cost to the Owner.

☐ The Pest Control Subcontractor shall pay the entire cost of re-treatment if required by the North Carolina Department of Agriculture or if required to comply with these specifications including the costs of providing access to the soil, repair of resulting damage to concrete, and project delays.

PRODUCTS

☐ SOIL TREATMENT SOLUTION: Use an emulsible concentrate termiticide for dilution with water, specially formulated to prevent infestation by termites. Provide a solution recommended by Applicator and acceptable to Architect and approved for intended application by the manufacturer and registered and approved by EPA and the N. C. Department of Agriculture, Structural Pest Control Division. Use only soil treatment solutions which are not injurious to planting.

EXECUTION

☐ SURFACE PREPARATION: Remove foreign matter which could decrease effectiveness of treatment on areas to be treated. Loosen, rake, and level soil to be treated, except previously compacted areas under slabs and foundations. Toxicants may be applied before placement of compacted fill under slabs, if recommended by toxicant manufacturer.

☐ Mixing: Mix emulsible concentrate termiticide into solution on site with confirmation by the Owner’s testing laboratory.

☐ Apply according to manufacturer’s recommendations as approved by the Designer. All Wake County Public Schools shall be treated at labeled rates.

☐ After application, the contractor shall request soil samples be taken by the North Carolina Department of Agriculture Structural Pest Control Division (919.733.6100). The pesticide recovery level must meet their minimum requirements prior to proceeding with construction.

☐ Reapply soil treatment solution to areas disturbed by subsequent excavation or other construction activities following application.

END OF SECTION
SECTION 02510 - WALKWAY, ROAD AND PARKING PAVING

PRODUCTS

☐ CONCRETE WALKWAYS: shall be minimum of 4 in. thick and 5 ft. wide with a broom finish. Use Fiber Reinforcement and install construction joints at a maximum of 5 ft. on center and expansion joints at a maximum of 30 ft. on center. Use wider walkways at entrances and bus and parent drop off areas.

☐ CONCRETE PAVING: shall be made of reinforced concrete and a minimum of 6 in. thick on a compacted sub-grade. Where sidewalks are used for maintenance access they shall be reinforced/thickened to meet vehicular load requirements.

☐ ASPHALT PAVING: shall be a minimum of 1-1/2 in. Type I-1 surfacing with reflective aggregate on 2 in. of binder on 6 in. compacted ABC base course at driveways, heavy truck access and bus parking areas. At car parking areas paving shall be a minimum of 2 in. Type I-1 surfacing on 6 in. compacted ABC base course. All work shall be in accordance with the NC Department of Transportation “Standard Specifications for Roads and Structures” and the Asphalt Handbook Manual Series No. 4 (MS-4) 1989 Edition. Compliance to these standards shall be verified with density testing by either core samples or nuclear density gauge at all paved areas, with particular attention given to bus driveways and parking areas. The testing shall be done by the Contractor and overseen by the Designer as required for reimbursement by the state.

☐ All pavements located in Triassic soils shall be designed in accordance with these specifications by a Professional Engineer with expertise in geotechnical engineering. These areas are shown on Attachment 02510-A which includes all areas located west of the line designated as A-A.

☐ All materials, mixes and construction techniques shall comply with Section 1008, Aggregate Base Course for Stabilization, Section 640, Asphalt Concrete Binder Course and Section 645, Asphalt Concrete Surface Course, of the North Carolina Department Of Transportation Standard Specifications for Road and Structures (1995). A job mix formula shall be furnished prior to the application of the asphalt.

☐ CONCRETE CURB AND GUTTER: shall be integral, one-piece curb and gutter with a broom finish. Height of curb shall be six inches and width of curb and gutter shall be a minimum of 24 in. Install construction joints at a maximum of 5 ft. on center and expansion joints at a maximum of 30 ft. on center. Extruded curb is acceptable; however, it shall be properly installed and back-filled. Use of extruded curbs installed on the surface of the roadway is unacceptable. Eliminate Curb and Gutter when possible to permit natural drainage.

☐ FIRE DEPARTMENT ACCESS ROADS: shall be constructed of a masonry paver system which allows for turf to in-fill between and among the units. Coordinate location with authorities and with WCPSS maintenance departments

EXECUTION

☐ CONCRETE WALKS: Top of walks shall be flush with ground. Flare out walk surfaces at intersections.

☐ CONCRETE PAVING: shall be provided in front of dumpster pad locations and service docks for a minimum distance of 16 ft. and minimum thickness of 8 in. with fiber reinforcement.

☐ CONCRETE CURB & GUTTER: shall be provided at all concrete and asphalt paved areas. The grade of driveway shoulders shall be flush with top of curb.

☐ GRAVEL SERVICE ROADS: Use of gravel surfaced roads is discouraged and requires prior written approval from the owner.
END OF SECTION
ATTACHMENT 02510-A – TRIASSIC BOUNDARY MAP

LIMITS OF THE TRIASSIC AREA:

ALL DEVELOPMENTS WEST OF THIS LINE MUST

Submit for Evaluation

DEFINITIONS AND ABBREVIATIONS - 01000 -25
SECTION 02530 - ATHLETIC PAVING AND SURFACE

GENERAL
Grading and marking of athletic paving and surfaces shall be in compliance with National Federation High School Association Standards as adopted by the North Carolina High School Athletic Association. Copies of the standards are available by contacting the NCHSAA at 919-962-2345 or PO Box 3216, Chapel Hill, NC 27515.

PRODUCTS
- TRACK AND TENNIS COURT SURFACING: shall be 1 in. SASC F-1, (60 lb./sq. yd.) on 2 in. 1-2 asphalt surfacing on 6 inches of compacted stone base course.
- BASKETBALL COURTS AND HARD SURFACE PLAY AREAS: 4 in. fiber reinforced concrete on compacted sub-grade is acceptable.
- Provide oval 220 yd. track with screenings for surface at elementary sites.
- PLAYGROUND SURFACE MATERIALS: Surface materials for use under and around playground equipment shall be Unitary synthetic materials, such as Carlisle’s Playguard, Vitricon’s Vitriturf VPS, or Surface America’s Playbound (poured in place). These surfaces assist in making playgrounds accessible in compliance with the Americans with Disabilities Act (ADA).

EXECUTION
- TRACK SURFACING: It is recommended that track-surfacing slope 2% towards in-field. This will require installation of curbs and underground drainage systems. At existing sites where such drainage systems do not exist, it is acceptable to slope 2% away from in-field. Two (2) 4 in. diameter empty conduits shall be provided under track installations for future water and power lines. Swells should be installed to divert water away from these areas.

END OF SECTION
SECTION 02605 - MANHOLES

EXECUTION

☐ MANHOLES: Covers of storm drainage manholes shall be set flush with top of surrounding paving or finish grade. Where required by local zoning ordinances mount covers of sanitary sewer manholes 12 in. above finish grade at lawn or planted areas.

☐ CLEANOUTS: A concrete pad shall be provided around all cleanouts. Size of pad to be 24 in. x 24 in. x 4 in. thick. Top of pad to be flush with finished grade. Cleanouts shall be installed within 10 ft. of building wall or downspout location at all underground storm drainage lines.

END OF SECTION
SECTION 02610 - STORM DRAINAGE PIPE & FITTINGS

GENERAL

☐ A magnetic locator tape shall be installed at all underground non-metallic pipe installations. This tape shall be buried at a depth of 12 in. below top surface of earth and 12 in. below top of subgrade at pavements and walks.

PRODUCTS

☐ REINFORCED CONCRETE PIPE: shall be ASTM C 76 Class III.

☐ POLYVINYL CHLORIDE (PVC) PIPE: shall be ASTM D 3033, Type PSP SDR 35 or ASTM D 3034, Type PSM, SDR 35.

EXECUTION

☐ Reinforced concrete is recommended for all pipes 12 inches and larger under paving and for all pipes over 24 inches in dia. Proper bedding and compaction details for larger diameter PVC pipe shall be included in construction documents. PVC is recommended for smaller pipe.

END OF SECTION
SECTION 02830 - FENCING

GENERAL

- Fencing is required for security around exterior mechanical equipment areas and for security and sport function at tennis courts, high school baseball and softball fields. Where equipment enclosure fencing is adjacent to main buildings it is desirable for fence construction to match building construction.

PRODUCTS

- CHAIN LINK FENCING: Galvanized steel chain link fence and gates with all accessories, fittings, and fastenings to be obtained from the fence manufacturer. Fabric of fence shall have knuckled selvage at both top and bottom. Do not extend fabric above top rail. See Attachment 02830-A for fence specification and installation detail.

EXECUTION

- MECHANICAL EQUIPMENT AREAS: shall be enclosed with fence construction a minimum of 6 ft. high. Provide clearance around equipment as required for service and operation. Gates shall be a minimum of 4 ft. wide. Enclosures shall meet local ordinance requirements.

- TENNIS COURTS: Shall be enclosed with a 10 ft. high chain link fence with 4 ft. wide gates.

- HIGH SCHOOL BASEBALL AND SOFTBALL FIELDS: shall be enclosed with a 6 ft. high chain link fence with 14 ft. wide service and 4 ft. wide player gates. Crowd separation fences only need to be 4 ft. high. A 12 ft. high chain link backstop with a 5 ft. high foul ball screen set at 45 deg. shall also be provided at softball fields. At baseball fields the backstop shall be 18 ft. high and the foul ball screen shall be 6 ft. high. Dugouts shall be a minimum of 8 ft. high and the fencing between the backstop wing and the dugouts shall be a minimum of 10 ft. high. All framework on backstops and hoods shall be welded.

- MIDDLE SCHOOL SOFTBALL FIELDS: No enclosure fence is required; however, a 10 ft. high chain link backstop with a 5 ft. high foul ball screen set at 45 deg. shall be provided.

END OF SECTION
ATTACHMENT 02830-A - CHAIN LINK FENCING
SPECIFICATION AND INSTALLATION DETAIL

GENERAL NOTES
- Provide chain link fences and gates as complete units obtained from a single source including necessary erection accessories, fittings and fastenings. Dimensions indicated for pipe, roll-formed, and H-sections are outside dimensions, exclusive of coatings.
- MANUFACTURERS: Subject to compliance with requirements, the following manufacturers are acceptable for use:
  - Allied Tube and Conduit Corp.
  - American Fence Corp.
  - Anchor Fence, Inc.
  - Page Fence Div/Page-Wilson Corp.
  - Cyclone Fence/United States Steel Corp.

MATERIALS
- FABRIC: shall typically be No. 9 gauge (0.148 in.) finished size steel wires, 2 in. woven mesh, with knuckled salvage at both top and bottom. Do not extend fabric above top rail. At baseball and softball backstops use No. 6 gauge wire. Furnish one-piece fabric widths for fencing up to 12 ft. high. Fabric finish shall be galvanized, ASTM A 392, Class II, with not less than 2.0 oz. Zinc per sq. ft. of surface or aluminum, ASTM A 491, Class II, with not less than 0.40 oz. aluminum per sq. ft. of surface.
- FITTINGS AND ACCESSORIES: galvanized, ASTM A 153, with zinc weights per Table I.
- FRAMING AND ACCESSORIES: manufacture framing of galvanized steel, ASTM A 120 or ASTM A 123, with not less than 1.8 oz. Zinc per sq. ft. of surface.
- END, CORNER AND PULL POSTS shall have minimum sizes and weights as follows:
  - Up to 6 ft. fabric height, 2.375in. OD steel pipe, 3.65 lbs./lin. ft., or 3.5in. x 3.5 in. roll-formed sections, 4.85 lbs./lin. ft.
  - Over 6 ft. fabric height, 2.875 in. OD steel pipe, 5.79 lbs./lin. ft. or 3.5 in. x 3.5 in. roll-formed sections, 4.85 lbs./lin. ft.
- LINE POSTS: Space line posts 10 ft. on center maximum, unless otherwise indicated of following minimum sizes and weights:
  - Up to 6 ft. fabric height, 1.90 in. OD steel pipe, 2.70 lbs./lin. ft. or 1.875 in. x 1.625 in. C-sections, 2.28 lbs./lin. ft.
  - 6 ft. to 8 ft. fabric height, 2.375 in. OD steel pipe, 3.65 lbs./lin. ft. or 2.25 in. x 1.875 in. H-sections, 2.64 lbs./lin. ft.
  - Over 8 ft. fabric height, 2.875 in. OD steel pipe, 5.79 lbs./lin. ft. or 2.25 in. x 1.875 in. H-sections, 3.26 lbs./lin. ft.
- BASEBALL AND SOFTBALL BACKSTOP POSTS: 4.000 in. OD pipe, 9.11 lbs./lin. ft. Connecting joints of all framework at backstops shall be welded.
GATE POSTS: Furnish gate posts for supporting single gate leaf, or one leaf of a double gate installation, for nominal gate widths as follows:

<table>
<thead>
<tr>
<th>Leaf Width</th>
<th>Gate Post</th>
<th>Lbs./Lin. Ft.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 6 ft.</td>
<td>3.5 in. x 3.5 in. roll-formed section</td>
<td>4.85</td>
</tr>
<tr>
<td></td>
<td>or 2.875 in. OD pipe</td>
<td>5.79</td>
</tr>
<tr>
<td>Over 6 ft. to 13 ft.</td>
<td>4.000 in. OD pipe</td>
<td>9.11</td>
</tr>
<tr>
<td>Over 13 ft. to 18 ft.</td>
<td>6.625 in. OD pipe</td>
<td>18.97</td>
</tr>
<tr>
<td>Over 18 ft.</td>
<td>8.625 in. OD pipe</td>
<td>28.55</td>
</tr>
</tbody>
</table>

TOP RAILS: Top rail pipe sections shall not be less than 18 ft. long and shall be fitted with couplings for connected lengths into a continuous run. The couplings shall not be less than 6 in. long, with 0.070-in. minimum wall thickness, and shall allow for expansion and contraction of the rail. Open seam outside sleeves shall be permitted only with a minimum wall thickness of 0.100 in. Top rail shall pass through the line post tops. Top rail shall be securely fastened to terminal posts by either pressed steel or malleable steel galvanized connections.

TENSION WIRE: Provide 7 gauge, coated coil spring tension wire (metal and finish to match fabric) and locate at bottom and top of fabric.

POST BRACE ASSEMBLY: Provide manufacturer's standard adjustable brace at end and gate posts and at both sides of corner and pull posts, with horizontal brace located at mid-height of fabric. Use 1.66 OD pipe, 2.27 lbs./lin. ft. or equal, for brace, and truss to line posts with 0.375 dia. rod and adjustable tightner.

POST TOPS: Provide weathertight closure cap with loop to receive tension wire or top rail; one cap for each post.

STRETCHER BARS: Use one-piece lengths equal to full height of fabric, with minimum cross-section of 3/16 in. x 3/4 in.. Provide one (1) stretcher bar for each gate and end post, and two (2) for each corner and pull post, except where fabric is integrally woven into post. Do not space stretcher bar bands over 15 in. on center, to secure stretcher bars to end, corner, pull and gate posts.

GATES: Fabricate perimeter frames of gates from minimum 1.90 in. OD pipe with finish to match fence providing security against removal or breakage connections. Provide horizontal and vertical members to ensure proper gate operation and attachment of fabric, hardware and accessories. Space frame members' a maximum of 8 ft. apart unless otherwise indicated. Provide same fabric as for fence, unless otherwise indicated. Install fabric with stretcher bars at vertical edges and at top and bottom edges. Attach stretcher bars to gate frame at not more than 15 in. on center. Install diagonal cross bracing consisting of 3/8 in. dia. adjustable length truss rods on gates to ensure frame rigidity without sag or twist.

GATE HARDWARE: Provide hardware and accessories for each gate, galvanized per ASTM A 153. Hinges shall be of a size and material to suit gate size, non-lift-off type, offset to permit 180 deg. gate opening. Provide 1-1/2 pair of hinges for each leaf over 6 ft. nominal height. Latch shall be forklift type of plunger-bar type to permit operation from either side of gate, with padlock eye as integral part of latch. Provide keeper for vehicle gates, which automatically engages gate leaf and holds it in open position until manually released. For double gates, provide gate stops consisting of mushroom type flush plate with anchors, set in concrete, and designed to engage center drop rod or plunger-bar. Include locking device and padlock eyes as integral part of latch, permitting both gate leaves to be locked with single padlock.
SLIDING GATES: Provide manufacturer's standard heavy duty inverted channel track, ball-bearing hanger sheaves, overhead framing and supports, guides, stays, bracing, hardware, and accessories as required.

WIRE TIES: For tying fabric to line posts, use wire ties spaced 12 in. on center. For tying fabric to rails and braces, use wire ties spaced 24 in. on center. For tying fabric to tension wire, use hog rings spaced 24 in. on center. Manufacturer's standard procedure will be accepted if of equal strength and durability.

CONCRETE: Provide concrete consisting of Portland Cement, ASTM C 150, aggregates ASTM C 33 and clean water. Mix materials to obtain concrete with a minimum 28-day compressive strength of 2500-psi using at least four (4) sacks of cement per cubic yard, 1 in. maximum size aggregate and maximum 3 in. slump.

INSTALLATION

Install chain link fence in accordance with ASTM F 567 and written installation instructions of fencing manufacturer to provide secure, aligned installation. If not shown on drawings, excavate postholes to minimum depth and diameter as recommended by fence manufacturer. Fill holes with concrete and set posts plumb, in line, and at proper spacing. Specify that no concrete is to be exposed above finished grade at fence posts.

Equipment enclosures made of chain link shall have posts set within perimeter of concrete pad. Concrete pad to be sloped to allow for proper drainage. Chain link equipment enclosures to have top, middle and bottom rails.

All gates to be secured with padlock furnished by Owner.
SECTION 02900 - GRASS SEEDING

GENERAL
- The Designer shall require the contractor to stage construction so all playground and athletic field grass seeding occurs early enough to allow grass to develop through one growing season prior to substantial completion. When substantial completion is scheduled for June through December, grass seeding shall occur prior to April 15. It will be the contractor's responsibility to fertilize, irrigate and cut the maturing grass until substantial completion. The areas of playground and athletic grass seeding along with scheduled seeding date shall be shown on Designer's Landscape Planting Plans.
- At renovation/addition projects, the Designer shall require the Contractor to isolate and protect existing lawn areas not involved in the new construction.
- Irrigation should be provided for front of school and athletic playing fields.

PRODUCTS
- LAWN GRASS SEEDING: shall be 5 lbs. of Kentucky 31 Tall Fescue and 1 lb. of Kentucky Bluegrass/1,000 sq. ft. from September 15 through March 30. From April 1 through June 15 seeding shall be Hullied Common Bermuda at a rate of 2 lbs./1000 sq. ft.
- ATHLETIC FIELD GRASS SEEDING: shall be composed of sod forming grasses. The best variety for the Wake County area is Bermuda. The first preference is hybrid Bermuda Tifton 419. Sodding has given best results with sprigging being satisfactory when given enough time to establish. Hullied Common Bermuda is next and should be seeded at 2 lbs./1,000 sq. ft. This seeding needs the entire growing season from April 15 through August 30 to develop. Annual Rye Grass can be planted during fall and winter months for temporary cover.

EXECUTION
- SEEDBED PREPARATION: After weed eradication, rough grading and seedbed cleaning is done; limestone, basic fertilizers and any soil improving additions shall be well mixed into the top 4 to 6 in. of soil. This can be accomplished with a rotary tiller, disking, plowing or even spading. Amount of limestone application should be determined through soil testing. Following rate of basic inorganic fertilizers are recommended for seedbed preparation.
- WCPSS shall review, test, and approve seedbed preparation and seeding methods prior to and during seeding.

NOTE
- Establishment of an acceptable lawn has been a dismal failure in most projects before yours. Accordingly, this area requires added attention in contract documents and project administration and supervision. It is essential that a well-established stand of grass is present when school first begins.
Application Rate in Pounds Per:

<table>
<thead>
<tr>
<th>Fertilizer</th>
<th>1000 SF</th>
<th>Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-20-10</td>
<td>25-40</td>
<td>1000-1750</td>
</tr>
<tr>
<td>5-10-5</td>
<td>50-80</td>
<td>2000-3500</td>
</tr>
<tr>
<td>10-10-10 and</td>
<td>25</td>
<td>1000</td>
</tr>
<tr>
<td>20% super phosphate</td>
<td>12-25</td>
<td>500-1000</td>
</tr>
<tr>
<td>5-10-10 and</td>
<td>40</td>
<td>1750</td>
</tr>
<tr>
<td>20% super phosphate</td>
<td>5-20</td>
<td>220-880</td>
</tr>
<tr>
<td>6-10-4</td>
<td>50-80</td>
<td>2000-3500</td>
</tr>
<tr>
<td>10-20-20</td>
<td>25</td>
<td>1000</td>
</tr>
</tbody>
</table>

- **FINAL GRADING AND STARTER FERTILIZER:** Check slope, remove all foreign materials and stones larger than 1/2 in. Level soil and roll with heavy (250-300 lbs.) roller. Keep soil damp, not dry or wet, when it is worked. Alternately rake and roll area until foot marks cannot be seen readily or they are less than 1/4 in. deep.

- Apply starter fertilizer at a rate that will provide 1 to 1-1/2 lbs. of actual nitrogen/1000 sq. ft. Rake starter fertilizers into soil surface about 1 in. deep and proceed with grass seeding.

- **IRRIGATION:** From time of seeding to substantial completion the Contractor shall keep maturing grass irrigated on a regular basis. This shall be a minimum of once a day until two (2) weeks after date of seeding. Thereafter, irrigation shall be done a minimum of once every week.

END OF SECTION
SECTION 02910 - LANDSCAPE PLANTING

GENERAL

☐ Landscape planting offers a cost effective means to enhance overall project appearance, provide privacy at outdoor learning areas and provide summer sun shading and winter wind breaks. All species should be of hearty, durable variety and require minimum maintenance. Do not use plants with thorns, thistles or toxic foliage, flowers or fruit.

☐ At renovation/addition projects, the Design shall require the Contractor to isolate and protect existing planting not involved in the new construction.

PRODUCTS

☐ TREE, SHRUB AND GROUND COVER PLANTING: Drought-tolerant species shall be specified where possible. See Attachment 2910-A for preferred species and species to avoid.

☐ IMPORTED FIRE ANT CONTROL: In order to limit importation of Fire Ants, WCPSS prefers that local plants be used. However, whether local or imported from outside the area, plants shall be accompanied by a certificate stating “certified under all applicable state and federal quarantines.” In addition, the specifications shall require that the Design Consultant shall inspect each shipment of plant materials for the presence of imported fire ants.

☐ See section 02900-1

EXECUTION

☐ TREE, SHRUB, AND GROUND COVER PLANTING: shall have 8 in. minimum deep plant beds with incorporation of 2 in. of decomposed organic matter. All plant beds shall receive an application of pre-emergent “herbicide” before area is mulched. All trees and shrubs shall be mulched with a minimum of 3 in. of pine bark mulch. Islands in parking lots should be mulched in their entirety. They shall not be planted with grass.

☐ Where slopes exceed 1 in 5 it is recommended ground cover such as Parson or Blue Pacific Juniper be planted and mulched with a minimum of 3 in. (after compaction) of pine bark, hardwood mulch or pine straw.

☐ All trees and shrubs shall be mulched with a minimum of 3 in. (after compaction) of pine bark, hardwood mulch, or pine straw.

☐ All shade trees shall be placed in a manner so that mature size limbs will not overhang buildings or power lines. At driveway and parking areas all trees shall be at height at installation that they will not obstruct motorists’ line of sight.

☐ All shrubs placed near buildings shall be selected from varieties so that at mature height the planting will not overgrow or obstruct vision from windows. At driveway and parking areas shrubs shall be selected from varieties so that at mature height the planting will stay below the motorists’ line of sight.

END OF SECTION
ATTACHMENT 02910-A PREFERRED TREE, SHRUB, & GROUND COVER PLANT LIST

TREES
Acer Ginnala - Amur Maple
Acer Palmatum - Japanese Maple (protected location)
Acer Platanoides - Norway Maple
Acer Rubrum - Red Maple (all varieties)
Betula Nigra - River birch
Cedrus Deodata - Deodatra cedar
Carpinus spp. - Hornbeam
Cercis Canadensis - Redbud
Cornus Kousa - Dogwood (all varieties-can use Cornus Florida but concern has been raised because of susceptibility to anthracnose - prefer Cornus Kousa)
Cryptomeria Japonica - Japanese Cedar
Fagus spp. - Beech
GinkoBiloba - Ginko-males only due to smell of fruit
Gleditsia Triacanthos Inermis - Thornless Locust
Juniperus Virginiana - Eastern Red Cedar
Koelreuteria Paniculata - Golden-Rain Tree
Lagerstomia Indica - Crepe Myrtle (mildew-resistant var.)
Magnolia Grandiflora - Southern Magnolia
Magnolia Stellata - Star Magnolia
Magnolia Virginiana - Bay Magnolia
Metaseqouia Glyptostroboidees - Dawn Redwood
Platanus spp. - Sycamore - do not use near buildings or parking lots
Pinus Taeda - Loblolly Pine (Avoid planting near building or paredarcans)
Pinus Thunbergiana - Japanese Black Pine
Prunus Caroliniana - Carolina Cherry Laurel
Prunus Calleryana - (Aristocrat & Bradford only)
Prunus Cerastifera - Purple Leaf
Prunus X’yedoensis - Yoshino Cherry
Prunus X’okame - Okame Cherry
Quercus spp. - Oak (prefer Sawtooth, Pin and Willow)
Quercus Virginiana
Taxodium distichum - Bald Cypress
Tsuga canadensis - Canadadian Hemlock
Ulmus Parviffolia - Chinese
Zelkova Serrata - Japanese Elm

SHRUBS
Abelia Grandiflora - (Sherwood & Goucher var. only) - do not use on Elementary campuses, near windows, on or around playgrounds anywhere, or near parked cars due to bees.
Acuba Japonica (shaded locations only)
Barberry Thumbergii - Crimson Barberry (dwarf variety only) - do not use on Elementary campuses or near widows or playgrounds anywhere. Do not plant near parking lot medians.
Camellia spp. - shaded protected locations
Chaenomoles Japonica - where pruning is not needed
Chamaecyparis spp. - false Cypress (all var.)

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Cleyera Japonica - where pruning is not needed
Cupressocyparis Leylandii - Leyland Cypress
Euonymus Alatus - Dwarf Burning Bush
Forsythia spp. - where pruning is not needed
Hibiscus Syriacus - Althea
Ilex spp. - Holly - (All var. - Var. w/berries placed away from windows) -dwarf variety
preferred due to no pruning needed.
Illicium Parvifolium - Anise Bush
Jasminum spp - (all var except climbers)
Kumoniensis Chinensis spp. - Avoid planting near or under windows.
Juniperus Virginiana - Eastern Red Cedar
Lagerstromia Indica - Dwarf Crepe Myrtle (mildew resistant variety)
Leucothoe spp (shaded location only)
Ligustrum spp. - all var. where pruning is not needed
Mahonia spp (Holly grape all var.) -do not use on Elementary campuses or near windows or
playgrounds at other campuses or near parking areas due to bees.
Myrica Cerifera - Wax Myrtle -where pruning is not needed
Nandina Domestica - (prefer dwarf var.)
Osmanthus spp. - Tea Olive (all var.) -do not use near any windows or playgrounds
Pieris Japonica - Andromeda - (shaded location)
Pinus Mugo - Dwarf Pine
Prunus L. Schipkaensis - Skiplaurel
Rhododendron - (shaded location only)
Sarcococca spp. (shaded location only)
Spirea spp. (all var.)
Thuja spp. (dwarf var. only)
Viburnum spp. (all var. dwarf is preferred)
Weigela Florida (all var) -do not use on Elementary campuses or near windows or
playgrounds at other campuses or near parking areas due to bees.

GROUND COVER
Ajuga reptans - (shade only)
Hemerocallis spp - Daylilly
Hosta spp - (shade only)
Juniperus - (prefer Blue Pacific, Procumbens and Parson varieties; do not use Shore, Blue
Rug Andorra and
Liriopoe - (Big Blue or Variegata only)
Mondo Grass
Ophiopogon Jap. - Nana Dwarf
Pachasandra-(shade only)
Phlox Subulata -(where spreading is not a problem)
Vinca Minor - (shade only)

PLANTS TO AVOID
Acer Saccharinum - Silver Maple
Acer Saccharum - Sugar Maple
Albizia Julibrissin - Mimosa
Amelanchier Canadensis - Service Berry
Berberis Julianne - Wintergreen Barberry
Buxus spp. - Boxwood
Cotoneaster spp - (all var.)
Cunninghamia Lanceolata - China Fir

DEFINITIONS AND ABBREVIATIONS - 01000 -37
<table>
<thead>
<tr>
<th></th>
<th>Scientific Name</th>
<th>Common Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Crataegus spp.</td>
<td>Hawthorne</td>
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<tr>
<td>2</td>
<td>Elaeagnus Pungens</td>
<td>Thorny Elaeagnus</td>
</tr>
<tr>
<td>3</td>
<td>Evonymus Fortuni</td>
<td>Wintercreeper</td>
</tr>
<tr>
<td>4</td>
<td>Fraxinus spp.</td>
<td>Ash</td>
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<tr>
<td>5</td>
<td>Gardenia spp.</td>
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<tr>
<td>6</td>
<td>Hedera Helix</td>
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<tr>
<td>7</td>
<td>Liquidambar Straraciflua</td>
<td>Sweetgum</td>
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<tr>
<td>8</td>
<td>Liriodendron Tulipifera</td>
<td>Tulip Poplar</td>
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<td>9</td>
<td>Lonicera spp.</td>
<td>Honeysuckle</td>
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<td>10</td>
<td>Magnolia Virginiana</td>
<td>Bay Magnolia</td>
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<tr>
<td>11</td>
<td>Malus spp. all apple &amp; crabapple</td>
<td></td>
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<tr>
<td>12</td>
<td>Nerium Oleander</td>
<td>Oleander</td>
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<tr>
<td>13</td>
<td>Photinia Fraseri</td>
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<tr>
<td>14</td>
<td>Phyllostachys spp. and all bamboo spp.</td>
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<tr>
<td>15</td>
<td>Populus spp. (all var.)</td>
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<td>16</td>
<td>Pyracantha spp. Firethorn (all var.)</td>
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</tr>
<tr>
<td>17</td>
<td>Rosea Rose (all var.)</td>
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<td>18</td>
<td>Salix spp. Willow</td>
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</tr>
<tr>
<td>19</td>
<td>Sophora spp. Pagoda tree</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Yucca spp (all var)</td>
<td></td>
</tr>
</tbody>
</table>

END OF SECTION
SECTION 03300 - CAST-IN-PLACE CONCRETE

GENERAL

☐ CODES AND STANDARDS: Comply with applicable provisions of ACI 301
“Specifications for Structural Concrete for Buildings”, ACI 318, “Building Code
Requirements for Reinforced Concrete”, and ACI 347, “Recommended Practice for
Concrete Formwork”.

☐ TESTING: Owner’s testing laboratory will perform sampling and testing as indicated in
Field Quality Control paragraph.

☐ FIELD QUALITY CONTROL: During placement of concrete the following tests and
sampling shall be made:
- Sampling: ASTM C 172.
- Slump: ASTM C 143.
- Air Content: ASTM C 173.
- Compressive Strength: ASTM C 39; one specimen tested at seven (7) days, and one
specimen tested at twenty-eight (28) days, and one retained for later testing if
required.

☐ CONCRETE MIXES: Contractor shall employ an acceptable testing laboratory to
perform materials evaluation and testing, and to design concrete mixes.

☐ RECYCLED MATERIALS: The use of 20% fly ash and/or 30% slag is permissible.

PRODUCTS

☐ CONCRETE: Use air-entraining admixture in all concrete, providing not less than 4%
or more than 6% entrained air for concrete exposed to freezing and thawing, and from
2% to 4% for other concrete. Unless otherwise noted, all concrete shall have a twenty-
eight (28) day strength of at least 3000 psi. When placed, concrete shall have a slump
between 3 and 5 inches.

☐ VAPOR BARRIER: shall be a reinforced material such as “Moistop II by Fortifiber
Corporation.

☐ WATER REDUCING or ANTI-FREEZE admixtures shall not be permitted.

☐ Use Chemical Hardener or Surface Sealer on all interior concrete slabs to remain exposed.

☐ At exposed concrete floors use clear epoxy seal. Allow concrete to cure for 30 days
prior to application of seal. Follow manufacturer’s recommendation for surface
preparation. Apply two (2) coats of clear solvent base epoxy seal. In the event that
North Carolina changes its ambient air quality standard preventing the use of a solvent
base, a water base epoxy seal should be used.

EXECUTION

☐ COLD WEATHER CONCRETING: All concrete placed when temperature is below 40
deg. F. shall be placed in strict accordance with “Cold Weather Concreting” (ACI-306).
CONTROL JOINTS: Construct using pre-molded key joints, inserts, tooled joints or sawcut joints. Minimum depth of control joints shall be one-fourth (1/4) of the slab thickness. Maximum spacing of joints shall be 40 ft. by 40 ft. Isolate all slabs from exterior walls.

REINFORCEMENT: Position support and secure reinforcement against displacement.

PLACEMENT: Comply with ACI 318.

CURING: shall begin within eight (8) hours after placing, by moisture retaining covering (curing sheets) weighted down with sand.

SURFACE TOLERANCE: Not to exceed 1/8 in. under a 10 ft. straightedge.

Contractor shall be responsible to control rinse water run off.

END OF SECTION
SECTION 04200 - MASONRY

GENERAL

☐ Cavity wall (masonry veneer on concrete masonry unit back-up) and veneer wall (masonry veneer on steel stud back-up with cavity space) construction is strongly recommended at exterior masonry walls. Control joints, expansion joints and flashing shall be located and installed as per the recommendations of the Brick Institute of America and National Concrete Masonry Association.

☐ Use of load bearing wall construction is discouraged.

☐ Where masonry walls supported by elevated floor construction meet ground supported walls, control joints shall be installed.

☐ All concrete masonry units shall be kept free from coal cinder aggregate, waste products, organic impurities, and any other deleterious substance that will cause rusting, staining or pop outs. Blended and light weight concrete masonry units free from the above impurities and substances are acceptable for use.

EXECUTION

☐ MASONRY: Particular attention shall be given to workmanship.

☐ Rinse water run-off shall be controlled during clean up.

☐ Any enclosed planters must have minimum 1 in. weep holes every 6 ft.

☐ If any wall of planted area encloses a heated space, waterproofing shall be used from footing to finished grade.

☐ Cavities shall be kept clean of mortar drippings.

☐ Do not use raked mortar joints.

☐ Flush masonry wall construction is preferred. Special shape (sloping) units shall be used at projecting courses. No horizontal ledges will be allowed.

☐ Direct particular attention to the design and installation of through-wall flashing.

☐ Areas of exterior masonry where through-wall flashing is not required should have “clear waterproofing sealant” applied.

☐ Special shape bullnose units shall be provided at corners of interior CMU wall construction in high traffic areas.

☐ At all interior and at exterior expansion joints adjacent to high traffic areas vandal resistant metal covers shall be provided.
COLD WEATHER MASONRY: Masonry may be laid when the temperature of the outside air is below 40 deg. F. if protection requirements are in compliance with "Recommended Practices for Cold Weather Masonry Construction", as published by the International Masonry Industry All-Weather Council. Accelerator or water-reducing admixtures are not recommended for cold weather masonry work.
SECTION 05500 - METAL FABRICATIONS

GENERAL


PRODUCTS

☐ RAILS: Exterior rails shall be aluminum or galvanized steel.

☐ INTERIOR METAL STAIRS: Stair stringers shall be steel channels or tubing.

☐ LADDERS: Provide metal ladder to roof with locked scuttle or ladder guard. Provide stair for roof access, if feasible. Ladders shall be attached or anchored in solid building materials. Anchoring in drywall is unsafe and will not be acceptable.

END OF SECTION
SECTION 06100 - ROUGH CARPENTRY

GENERAL

☐ GRADING AND INSPECTION AGENCIES: Each piece of lumber or plywood shall be grade stamped by one of the following agencies:
   APA - American Plywood Association
   CRA - California Redwood Association
   SPIB- Southern Forest Products Association
   WWPA- Western Wood Products Association

PRODUCTS

☐ LUMBER, GENERAL: Provide seasoned lumber 19 percent moisture content. Provide preservative treated lumber for cants, nailers, blocking, furring, grounds, stripping and similar items in connection with roofing, flashing and waterproofing or in direct contact with concrete or masonry.

☐ BUILDING PAPER: Asphalt saturated organic felt, or polyethylene sheet.

☐ PRESERVATIVE TREATED WOOD: All preservative treated lumber and plywood shall be pressure treated with water-borne preservatives to comply with AWPA C2 and C9.

EXECUTION

☐ Store lumber and plywood materials off the ground and under cover which has been vented to prevent condensation.

END OF SECTION
SECTION 06200 - FINISH CARPENTRY

GENERAL

Grading and inspection agencies: Each piece of lumber or plywood shall be grade stamped by one of the following agencies:

- APA - American Plywood Association
- CRA - California Redwood Association
- SPIB - Southern Forest Products Association
- WWPA - Western Wood Products Association
- WMMP - Wood Molding and Millwork Producers

PRODUCTS

Lumber standards: Comply with PS 20 “American Softwood Lumber Standard”.

Plywood standards: Comply with PS 1 “U. S. Product Standard for Construction and Industrial Plywood” for plywood and for products manufactured under PS 1, with APA PRP-108. Formaldehydes in adhesives and binders shall not be permitted.

EXECUTION

- Store lumber and plywood materials off the ground and under cover which has been vented to prevent condensation.
- Cope at returns and miter at corners to produce tight fitting joints. Use scarf joints for end-to-end joints.
- Repair damaged or defective finish carpentry where possible to eliminate functional or visual defects. Where not possible to repair, replace finish carpentry. Adjust joinery for uniform appearance.

END OF SECTION
SECTION 06200 - FINISH CARPENTRY

GENERAL

☐ GRADE STAMPING AGENCIES: Each piece of lumber or plywood shall be grade stamped by one of the following agencies:

- APA - American Plywood Association
- CRA - California Redwood Association
- SPIB- Southern Forest Products Association
- WWPA- Western Wood Products Association
- WMMP- Wood Molding and Millwork Producers

PRODUCTS

☐ LUMBER STANDARDS: Comply with PS 20 “American Softwood Lumber Standard”.

☐ PLYWOOD STANDARDS: Comply with PS 1 “U. S. Product Standard for Construction and Industrial Plywood” for plywood and for products manufactured under PS 1, with APA PRP-108. Formaldehydes in adhesives and binders shall not be permitted.

EXECUTION

☐ Store lumber and plywood materials off the ground and under cover which has been vented to prevent condensation.

☐ Cope at returns and miter at corners to produce tight fitting joints. Use scarf joints for end-to-end joints.

☐ Repair damaged or defective finish carpentry where possible to eliminate functional or visual defects. Where not possible to repair, replace finish carpentry. Adjust joinery for uniform appearance.

END OF SECTION

DEFINITIONS AND ABBREVIATIONS - 01000 -45
SECTION 06410 - INTERIOR ARCHITECTURAL WOODWORK

GENERAL


☐ SAMPLES: Contractors should be required to submit samples of transparent finishes which show the extremes in color variation.

PRODUCTS

☐ TRANSPARENT FINISHED CASEWORK: Casework shall be of a heavy-duty construction. It is suggested that Campbell Rhea be used as a standard. In the past, Colledale and Kewanee have been considered equals. See Section 12304 for detailed information on laminate clad casework.

☐ DOORS: Construction and thickness shall be “as required” to prevent warpage.

☐ SHELVES: Do not exceed spans of 3 ft. for 3/4 in. thick shelves and 4 ft. for 1 in. thick shelves.

☐ COUNTERTOP: Plastic laminate surface. Base material for countertops may be dense particleboard (no formaldehydes permitted), except that marine grade plywood shall be used in wet locations.

☐ CABINET HARDWARE:

- Drawer and Door Pulls: Heavy duty, 4 in. rod pull
- Drawer Slides: 60 lb. capacity wheeled slides with self-closing feature
- Door Hinges: Concealed hinges, European Style, self-closing with built-in horizontal and vertical adjustment.
- Door Silencers: shall be provided at all cabinet doors

☐ MILLWORK/CASEWORK PLANNING DATA: See Attachment 06410-A.

EXECUTION

☐ PRECAUTIONS: Do not install architectural woodwork until the building is enclosed, the permanent heating and cooling system is in operation, and residual moisture from plaster, concrete, masonry or terrazzo has dissipated.
ADDITIONAL REQUIREMENTS: Use French Dovetail mortise and tenon to attach drawer sides to drawer fronts.

Where transparent finish is shown, cut doors and drawer fronts of each run of cabinets from one “Counterfront” sheet of plywood (with particleboard or lumber core) and install them in the same position so that the grain runs vertically and grain matches between adjacent doors and/or drawers.

END OF SECTION
ATTACHMENT 06410-A - MILLWORK/CASEWORK PLANNING
DATA

(Use the following standards unless noted otherwise by Project Building
Program requirements)

RECOMMENDED HEIGHTS

Tables:
Pre-Kindergarten  25 in.
Elementary  25 in., 27.5 in., and 29 in.
Middle  29 in.
High  29 in.

Chairs and other seating:
Pre-Kindergarten  13.5 in. classroom, 14 in. media center
Elementary  13.5 in., 15.5 in., and 17.5 in. classroom;
               14 in., 16 in., and 18 in. media center
Middle  17.5 in. classroom, 18 in. media center
High  17.5 in. classroom, 18 in. media center

Perimeter Shelving:
shall be 82 in. high except at window locations where 42 in. high shelving is
recommended.

Freestanding Shelving:
None over 42 in. high

Depth of Shelves:

DEFINITIONS AND ABBREVIATIONS- 01000-48
2. Picture Books 12 in. to 14 in.
4. Print & Non-print 12 in.
5. Kits & Oversize Books 16 in.

6.

7. **Shelf Capacities per 3 ft. Unit:**
8. Average Hard Books 30
9. Reference Books 18
10. Picture Books 60

11.

12. **Access Space:**
13. At least 42 in. between rows of shelves
14. At least 60 in. between rows of shelves and furniture involving seating or traffic
15. At least 60 in. between two parallel tables with back-to-back seating
16. At least 36 in. between tables and wall or between a row of shelves and other furniture not involving seating or traffic

19.

20. **END OF SECTION**
SECTION 07000 - THERMAL & MOISTURE PROTECTION DESIGN

CONSIDERATIONS

GENERAL

☐ Architectural firms shall be required to use a Registered Roof Consultant (RRC) if their contract involves any roofing at all. All roofing plans to be sealed by the registered roof consultant. The RRC is to pre-qualify bidders 30 days prior to bid dates.

☐ MEDIUM SLOPED ROOFS: The Wake County Public School System strongly recommends high pitched roofs (slopes 3 in 12 or greater) be considered for use. Standing seam roofing is preferred. Dimensional, asphalt shingle roofing weighing 250 lbs./square or greater is acceptable.

☐ LOW SLOPE ROOFS: Low slope roof systems (Built-Up and Modified Bitumen) are preferred but (Single Ply) is acceptable. Minimum slope to point of discharge shall be 1/4 in /foot. 4 Ply built-up roof is acceptable.

☐ CANOPIES AND COVERED WALKWAYS: Provide overhead canopies at primary building entrances as per Section 02001. Sheet metal panel systems are recommended for soffit construction. Stucco and drywall soffits shall not be used. Gutters and downspouts may be used at covered walkways as long as run-off is directed away from walks or is discharged into underground storm drain lines.

☐ WALL AND ROOF INSULATION: The maximum U-value shall be .10 for wall construction and .05 for roof construction. Designers are encouraged to consider lower U-values based on life-cycle cost analysis. In new construction, insulation shall not be used as the primary method to assure proper drainage, rather the use of sloped steel members is preferred.

☐ SKYLIGHTS: Overhead sloping glazing shall be used only with the special consent of the Owner. Where day-lighting of interior spaces is desired, vertical clerestory glazing is recommended for use. Where practical the clerestory glazing shall face north or face south with vertical overhang solar protection.

PRODUCTS

☐ ROOF INSULATION: shall require certification that insulation meets Thermal Warranty. Warranty states that roof insulation's actual thermal resistance will not vary by more than 10% from the published R-Value for a period of fifteen (15) years.

☐ All roof insulation shall be CFC free.

☐ Registered Roof Consultant shall be responsible for review and acceptance of all shop drawings and submittals pertaining to roof construction.

EXECUTION

☐ Registered Roof Consultant shall be responsible for monitoring roof construction and final acceptance. Weekly inspection reports are required.

END OF SECTION
SECTION 07100 - WATERPROOFING

GENERAL

☐ All below grade wall construction of interior spaces and elevated floor construction at toilet rooms and showers shall be waterproofed.

PRODUCTS

☐ WATERPROOFING: 3-Ply bituminous waterproofing using either coal-tar pitch or asphalt bitumen and felt is recommended for use. Sheet membrane and fluid-applied waterproofing shall be used only with the Owners approval.

☐ PROTECTION COURSE: Where exposed to earth and crushed stone backfill, provide a protection course over completed waterproofing. For bituminous waterproofing this shall be 1/2 in. asphalt saturated and coated fiber insulation board or 1/8 in. premolded, asphaltic-laminated, semi-rigid composition board.

EXECUTION

☐ BELOW GRADE WALL WATERPROOFING: Drainage tile shall be installed with coarse crushed stone backfill at wall foundation. Connect tile drain lines to grade or storm drain lines.

☐ ELEVATED FLOOR WATERPROOFING: Turn up membrane 4 in. at walls. Prior to installation of finish flooring, flood entire waterproofed area for 24 hours with water at least 2 in. deep at shallowest point. Repair any leaks and retest.

END OF SECTION
SECTION 07310- ASPHALT SHINGLE ROOFING

GENERAL

☐ Where required by project budget constraints, asphalt shingle roofing is acceptable for use on medium pitched roofs, 4/12 minimum slope.

PRODUCTS

☐ ASPHALT SHINGLE ROOFING: shall be dimensional, laminated strip shingle of mineral surfaced, self sealing, laminated multi-ply overlay construction, bearing UL Class “A” external fire exposure label and UL “Wind Resistant” label, weighing not less than 250 lbs. per square.

☐ ROOFING FELT: shall be No. 15 asphalt-saturated unperforated organic roofing felt complying with ASTM D226, 36 in. wide, approximate weight 18 lbs. per square.

☐ ICE AND WATER BARRIER: recommended for use at roof eaves. Use polymer modified asphalt reinforced ice and water barrier with a fiberglass mat and self-adhesive backing for bonding to roof deck substrate.

☐ FLASHING AND SHEET METAL: See Section 07620.

EXECUTION

☐ ASPHALT SHINGLE ROOFING: shall be installed along with underlayment according to the recommendations of shingle manufacturer and details and recommendations of NRCA Steep Roofing Manual. Install valleys using a closed cut or closed woven valley.

☐ ROOFING FELT: shall be installed as noted above. Lap felt 6 in. over top edge of ice and water barrier at roof eaves.

☐ SNOW GUARDS: shall be installed at roof eaves over entrances and walkways.

☐ WARRANTY: Products must meet 25 year warranty requirements

END OF SECTION
SECTION 07420 - SHEET METAL ROOFING

GENERAL

Standing seam roofing is the preferred roof system for medium pitched roofs.

PRODUCTS

- SHEET METAL ROOFING: shall be a pre-fabricated, pre-finished metal panel roofing system. The system shall include the metal panels, sliding clips and other attachments, flashing to adjacent construction and other accessories. The complete systems shall meet the requirements of FM I-90 and Class I A and UL Class A. The complete system installation (flashing, deck, etc.), shall be warranted by the manufacturer for 20 years (20 year weathertight and 20 year finish). Finish of all roofing panels, trim and accessory elements shall be shop-applied, Kynar 500, Versacor PF or Fluruthane IV coating. Any exposed fasteners shall be minimal and of stainless steel construction and shall match color of roofing by means of plastic caps or factory-applied coating.

Acceptable manufacturers include:

- American Buildings
- MM Systems Corp Series 300
- Merchant & Owens Zip Rib
- Moran 2-1/2 in. SSR
- Steel Tite SRS
- Steelox

Other materials and types of metal panel roof systems shall be used only with the approval of the Owner.

EXECUTION

- SHEET METAL ROOFING: shall be installed by manufacturer authorized installers according to the recommendations of the manufacturer and the requirements of the above noted UL and FM designs. It is recommended that the roof panels be installed on 30 lb. asphalt felt or rubberized modified asphalt over a solid substrate. Provide rosin sized sheathing paper under asphalt felt where recommended by manufacturer or SMACNA.

- SNOW GUARDS: shall be installed at roof eaves over entrances and walkways.

END OF SECTION
SECTION 07500 - MEMBRANE ROOFING

GENERAL

Minimum slope to point of discharge shall be 1/4 in. per foot.

PRODUCTS

SINGLE PLY MEMBRANE ROOFING: shall be either mechanically fastened or fully adhered type. Minimum thickness of the membrane shall be as required by manufacturer to achieve warranty. A 20 year, no dollar limit warranty is required. The complete roofing system including membrane, insulation and attachments shall meet requirements of FMI-90 and Class 1A and UL Class A. Owner must approve system manufacturer and type. Acceptable manufacturers include:

- Carlisle Syntec Systems
- Fibertite
- Firestone
- Manville
- Stevens

MODIFIED BITUMEN ROOFING: shall be either self adhered or hot asphalt mopped type with a minimum of two plies and shall have a factory-applied surface. Modifiers and reinforcements shall be as recommended by the Design Consultant, however no organic products shall be specified. A 20 year, no dollar limit warranty is required. Acceptable manufacturers include:

- Firestone
- Siplast, Inc.
- Soprema
- Tamko Asphalt Products, Inc.

Use of any other Membrane systems or manufacturers must be approved by the Owner.

ROOF INSULATION: Provide insulation thickness as required to meet specified thermal resistance. Type of insulation must be approved for use by membrane manufacturer and also meet requirements of the above noted UL and FM designs.

FLASHING: Base flashing shall be type recommended by membrane manufacturer. See Section 07620 for cap and other sheet metal flashing.
EXECUTION

MEMBRANE ROOFING: Install entire roof system according to recommendations of membrane manufacturer and requirements of the above noted UL and FM designs. Roof drain grates shall be metal and anchored.

END OF SECTION
SECTION 07600 - FLASHING AND SHEET METAL

GENERAL

☐ Materials and details used for through-wall flashing, gravel stops, gutters and downspouts shall be permanent and require low maintenance. Details shall be in accordance with the NRCA Roofing Manual and the Architectural Sheet Metal Manual by SMACNA.

☐ Where roofs discharge at eaves it is recommended gutters and perimeter downspouts be installed. Built-in gutters and downspouts shall not be used. Scuppers shall not be used for primary discharge.

PRODUCTS

☐ CONCEALED THRU-WALL MASONRY FLASHING: 3 oz./sq. ft. copper bonded with asphalt to waterproofed Kraft paper masonry flashing is recommended for use. (See Section 04200-1, Line 27)

☐ EXPOSED THRU-WALL FLASHING: 16 oz. copper; 17 oz. lead-coated copper; 28 gauge stainless steel; 20 gauge aluminum with anodized or paint "grip" finish; and 26 gauge galvanized steel with Kynar 500 coating are recommended for use.

☐ CAP FLASHING, PARAPET CAPS, DRIP EDGES, GUTTERS AND DOWNSPOUTS: Same materials as recommended above for exposed through-wall flashing. At copper and lead-coated copper valley installations, the minimum thickness shall be 20 oz. and 21 oz. respectively. At sheet metal roof installations, it is recommended material and finish of gutters and downspouts match roof panels.

EXECUTION

☐ Downspouts shall be protected with heavy-duty covers (22 gauge minimum) or be schedule 10 steel or schedule 40 PVC between finished grade and 8 ft. above finished grade. Covers or pipes are to be painted to match adjacent surface.

☐ Provide clean-out flush with finish grade within 10 ft. of building wall or downspout location at all underground storm drainage lines.

END OF SECTION
SECTION 08100 - HOLLOW METAL DOORS AND FRAMES

GENERAL

Heavy-duty hollow metal door and frames are required for school usage especially at high traffic areas. Particular attention needs to be given to the preparation and reinforcement of doors and frames for finish hardware. Doors shall be 1-3/4 in. thick and 7 ft. in height. Generally door design will be full flush. Entrance doors shall have large vision panels or be hollow metal framed glass doors. INTERIOR stair/corridor doors shall have vision lights as allowed by the NC State Building Code. Swinging exterior and interior “A” label and “B” label double doors shall be hollow metal unless otherwise approved by Owner. All doors and sidelight frames shall be hollow metal unless otherwise approved by Owner.

PRODUCTS

EXTERIOR HOLLOW METAL DOORS AND FRAMES: shall be SDI Grade III, extra heavy model 2A (seamless) which requires face sheets of 16 gauge minimum. Also, exterior doors and frames shall be of galvanized steel construction including reinforcement, louvers and other accessories. Top of exterior doors shall be closed flush and welded watertight. Frames shall be fabricated from 14 gauge cold rolled steel.

INTERIOR HOLLOW METAL DOORS AND FRAMES: shall be SDI Grade III, extra heavy duty, Model 2 (seamless) which requires face sheets of 16 gauge minimum. Interior frames shall be fabricated from 16 gauge cold rolled steel.

HOLLOW METAL GLAZING FRAMES: Shall be fabricated from 14 gauge cold rolled steel. Where used on the exterior both frame and glazing stops shall be made from galvanized sheet metal and glazing stops shall be prime coated prior to assembly.

FRAME ANCHORAGE: Jamb anchors at masonry wall openings shall be standard wire anchors. Frames at masonry walls shall be filled with grout. Jamb anchors for plaster and gypsum wallboard partition openings shall be a minimum of 18 gauge steel. Provide floor anchors at all frames.

FINISH HARDWARE REINFORCEMENT: Door reinforcement shall be a minimum of 12 gauge for hinges and be a continuous channel for the full height of door, 12 gauge for closers and be a continuous channel for the full length of the header and 14 gauge for strikes and be a continuous channel for the full height of the door. 7 gauge reinforcements shall be used for hinges on frames. 26 gauge steel plaster guards or mortar boxes welded to the frame shall be provided at hardware cutouts where installed in concrete, masonry or plaster openings.

VISION LIGHTS: shall be provided at stairs/corridor doors, except at 3 hour labeled openings. Glaze with 1/4 in. UL labeled wire glass at fire rated doors and 1/4 in. tempered glass at other doors. Light size shall be 3 in. x 33 in. at fire-rated doors with light located 10 in. from strike side of door and bottom of light 3-4 ft. above finish floor. Glazing kits shall be (concealed type) flush with door surface.
LOUVERS: shall be sightproof louvers constructed of 24 gauge steel V or Y shaped blades set in 20 gauge frame. A galvanized wire mesh 1/2 in. x 1/2 in. screen shall be provided at the inside face of exterior door louvers.

FINISH PREPARATION: The exposed surfaces of door and frame units including galvanized surfaces shall be cleaned, bonderized and shop primed using manufacturer’s standard baked-on rust inhibitive primer.

EXECUTION

DOOR AND FRAME LAYOUT: It is recommended for exterior, main entrance doors to be multiple single doors swinging in the same direction. Do not use double doors.

Frames shall be installed in compliance with DHI pamphlet "The Installation of Commercial Steel Doors and Steel Frames, Insulated Steel Doors in Wood Frames and Builder’s Hardware". Particular attention shall be paid to Squareness, Plumbness and Spreaders. Caution: Angle iron braces shipped with frames at bottom does not qualify as a "spreader".

DOOR AND FRAME STORAGE: Contractor shall store doors and frames properly at job site off ground and protected from moisture.

BOILER ROOMS: shall have exterior doors only.

MAIN MECHANICAL EQUIPMENT ROOMS: shall have exterior doors where possible.

END OF SECTION
SECTION 08200 - WOOD DOORS

GENERAL

- Solid staved core wood doors with transparent finish in hollow metal frames shall be used at most interior doors including 20 minute constructed fire doors. Fire Doors with ratings of 60 and 90 minutes (labeled) are preferred to be hollow metal. Wood “B” labeled doors may be used only with Owner’s approval. Doors shall be pre-fitted and pre-machined at factory for finish hardware. Wood blocking reinforcement shall be provided at hinge, closer and strike locations. Doors shall be 1-3/4 in. thick and 7 ft. high. Generally, door design will be full flush.

PRODUCTS

- WOOD DOORS: shall be solid core doors complying with requirements of NWWDA I.S.1 and Section 1300 of AWI “Architectural Woodwork Quality Standards”. Cores shall be solid particle board except for fire-rated doors, which shall have solid core as required to meet rating requirements. Labeled wood doors over 20 minutes requiring flush bolts, surface bolts, and exit devices, are to receive proper blocking for attachment of hardware. At high traffic doorways in Middle and High Schools, use metal doors.

- INTERIOR WOOD DOORS WITH TRANSPARENT FINISH: shall be AWI premium grade with hardwood veneer face, pre-finished at factory utilizing low VOC finishes.

- Specify doors which do not use formaldehyde based glue in the manufacturing process.

- Only domestic species of wood should be used.

- Specify only those manufacturers who practice sustainable harvesting methods.

- Two coat hooks shall be installed by contractor on the back of all office doors in new schools and renovated spaces.

- LOUVERS: shall be metal, sight-proof louvers constructed of 24 gauge steel V or Y shaped blades in 20 gauge frame.

- VISION LIGHTS: All doors at instructional areas shall have vision lights. Glaze with 1/4 in. UL labeled wire glass at fire rated doors and 1/4 in. tempered glass at other doors. Set wire glass in steel frame. Light size shall be 3 in. x 33 in. at fire-rated doors and 6 in. x 33 in. at other doors. Locate light 10 in. from strike side of door and bottom of light 3-4 ft. above finish floor. Glazing kits shall be (concealed type) flush with door surface.

EXECUTION

- DOOR LAYOUT: It is recommended for exterior, main entrance doors to be multiple single doors swinging in the same direction. Do not use double doors.
WOOD DOORS: Do not hang doors until the building is enclosed, the permanent heating and cooling systems are in operation and residual moisture from plaster, concrete, masonry or terrazzo work has dissipated.

END OF SECTION
SECTION 08300 - SPECIAL DOORS

GENERAL

☐ Overhead roll-up doors and grilles are acceptable to limit access to certain areas of the facility but shall not interfere with required egress from occupied spaces. All overhead doors and grilles shall be of metal construction.

☐ Dish return at cafeterias shall be stainless steel overhead roll-up door.

☐ Exterior sliding glass doors shall not be used.

END OF SECTION
SECTION 08400 - ALUMINUM ENTRANCES

GENERAL

☐ Aluminum entrance systems shall not be used.

END OF SECTION
SECTION 08500 - METAL WINDOWS

GENERAL

- Exterior window and window-wall construction shall be insulating glass in aluminum frames with the exception of sidelights and transoms adjacent to entrance doors where hollow metal frames may be used. Windows at classrooms and other occupied spaces shall include operable sections. Single hung is the preferred operable window type. Sliding windows are acceptable. Do not use casement or projecting windows. Crank or gear driven operable sash windows shall not be used.

- Sill height and window size should consider size of students. Large sizes of glass are discouraged. There shall not be any special, complex glass designs.

- A horizontal frame approximately 30 in. above finish floor shall be provided at sidelights to guard students against walking into glass.

- Vandal resistant systems shall be used. (See Section 08800-1 line 8)

PRODUCTS

- WINDOWS: shall be commercial grade type fabricated from aluminum extrusions of not less than 0.062 in. thickness for main frame and sash thickness. Thermal break construction shall be used. Single hung windows shall have tilt-in sash with cam latch lock. Use aluminum, non-magnetic stainless steel or epoxy adhesive fasteners. Frame finish shall be either natural satin anodized finish, color-anodized finish or fluoropolymer Kynar 500 color coating. Finish of flashing, trim and exposed fasteners shall match frame finish.

- GLAZING: See Section 08800.

- STOOLS: A non-absorbent, easily cleanable surface shall be provided at windowsills. Mechanically anchored slate and polymer stools are acceptable. Wood, plastic laminate, metal and concrete masonry unit stools shall not be used.

EXECUTION

- WINDOWS: Use interior glazing stops.

- Install according to manufacturer’s recommendations.
SECTION 08710 - FINISH HARDWARE

GENERAL

Occupant life safety and durable low maintenance product quality and installation are key considerations to be used in the design and selection of Finish Hardware. In this regard, Wake County Public School System has decided to require use of heavy-duty hardware such as mortise locksets, the installation of magnetic holders at interior high traffic fire doors and the use of multiple single doors in lieu of double exterior doors. Also, in order to standardize and better maintain installation on a school system basis, a single manufacturer is preferred for lock cylinders, panic devices, door closers and key cabinets.

An add alternate for single source manufacturers for Best Cylinders, LCN Door Closers, Lund Key Cabinets, and Von Duprin Exit Devices, shall be incorporated on the bid form for each project.

Hardware schedule must be prepared and included in the specifications. Hardware shall not be included in documents as an allowance. The specifications shall include a cross-index showing numerical listing of door numbers and the associated hardware sets. The contractor shall include a similar cross-index in their submittal.

Design Consultant to certify that the correct hardware is installed properly.

At wood doors, through bolts shall be used for attachment of closers, overhead holders and exit devices.

Hardware supplier shall have a permanent office staffed with permanent employees located within 120 miles of Wake County Public School's Rock Quarry Road Service Center.

PRODUCTS

MATERIALS AND FINISHES: Generally finish hardware shall be of non-ferrous construction with plated finish; interior door hinges shall be steel with plated finish except at areas subject to excessive moisture or chemical corrosion such as shower rooms or laboratories where stainless steel hinges are required. Exterior doors shall have stainless steel hinges (US32D). Standard finish for all hardware shall be US26D (dull chrome).

PANIC DEVICES: Preferred device shall be Von-Duprin #99 series rim. At exterior doors, devices shall be “dogged-in” for push-pull door operation during school hours with ANSI 03NL “night latch” operation for night time entrance doors and 02 lockset operation at night time “exit only” doors. Dogging device shall be operated by an Allen wrench not a key. Function of device at fire-rated doors shall be 08L with dogging feature omitted and supplied with break-away trim #994L. Fire rated double doors with smoke closers shall be equipped with concealed vertical rod exit devices. Preferred device is the Von Duprin #9948 series. Other acceptable bids from manufacturers are Sargent exit devices #19-HC8804 series and (labeled) 12-19-HC8843 series; and Precision exit devices #DL-1103 X 17 X 1123-38 X 810-84 and (labeled) DL1108 X V39L X 1123-38 X 810-84.

At exterior doors to single classrooms, it is preferred that the Von Duprin #22NL series rim device be used in lieu of the #99 series.
The centercase on all exit devices must be through bolted to the outside trim (pull) and the hinge end **shall** be through bolted.

**LOCK AND LATCH SETS:** **shall** be heavy-duty mortise locksets at all areas predominantly used by students. Exposed screws in knobs and/or rose are not acceptable.

**LOCK CYLINDERS:** It is preferred that cylinders be manufactured by “Best” on new projects. Other acceptable manufacturers are “Falcon” and “Sargent”. Match existing cylinders on renovation/addition projects. The same manufacturer **shall** supply both cores and cylinders.

**DOOR KEYING:** **shall** be grandmaster keyed. Key to existing system on renovation/addition projects. All keying must be approved by the Owner before cylinders/locks are ordered during a keying conference. The contractor **shall** furnish the Owner with final bitting list on all projects. Use only one keyway per school and each keyway must be exhausted before using another. On new projects, locksets **shall** be provided with construction keying. Owner **shall** install permanent cores at substantial completion. All keys **shall** be stamped with appropriate key symbols and “DO NOT DUPLICATE.” No bitting numbers are to be stamped on the key.

**KEY CABINET:** It is preferred that cabinets be Lund. Other acceptable manufacturers are MMF Industries, Tel-Kee and P.O. Moore Company. Size of cabinet **shall** provide for 50% expansion capacity.

**KEY BOX:** Each facility **shall** have a Knox Series 4400RDL Key Lock Box installed on the exterior of the building near the main mechanical room. This box **shall** be keyed to the Wake County Public School System standard maintained by The Knox Company, 17672 Armstrong, Irvine, California, 92714. Phone 1-800-552-5669. In addition, a “Lock Box” **shall** be provided at the front entrance as required by the various fire departments in the county.

**SURFACE CLOSERS:** At interior doors, use overhead surface mounted closers, LCN 4040 Super Smoothee series are preferred. Closers **shall** be mounted on inside of building. Provide parallel arm, EDA type, and/or hold open type where use dictates. Where “stop” is part of arm bracket, use “spring cush” arm mounted at maximum possible swing. The only acceptable bid from another manufacturer is Sargent closer #250 X HD Forged Arm X SRI.

**OVERHEAD CONCEALED CLOSERS:** Where required to be concealed on main exterior doors, use heavy duty concealed LCN 2010 series closers. Attach arm to door with through-bolts.

**SMOKE CLOSERS:** At interior high-traffic fire doors such as stairwells, horizontal exit door and corridor smoke doors, use wall mounted magnetic hold open device which release upon detection of smoke. Chains or other extension devices **shall not** be used.

**HINGES:** **shall** be full mortise, 5-knuckle type with ball bearings. Use heavy-duty hinges with non-removable pins at exterior doors.

**FLUSH BOLTS:** are recommended for use at foot and head of inactive leaf of double doors to unoccupied areas such as storage and equipment rooms. Bolts **shall** be mortise type **not** surface mounted.

**FLOOR AND WALL STOPS:** Use concealed fasteners. Wall stops are preferred wherever feasible. Reinforce gypsum wallboard partitions with wood blocking at wall stop locations.

**OVERHEAD HOLDERS:** When necessary holders should be surface mounted type with shock absorber.

**KICK PLATES:** High pressure plastic laminate plates with beveled edges are recommended for the push sides of all high traffic doors with closers, except for plates at kitchen areas which **shall** be stainless steel and be extended to half door height. Be sure
door manufacturer specification is approved for use of armor plates over 16 in. high if labeled opening. Door must be tested for half door height plates.

○ DOOR SILENCERS: shall be gray rubber and suitable for wood or metal jamb.

EXECUTION

○ LOCKSETS: Privacy locksets shall be provided at individual faculty and student toilet rooms. These locksets shall release upon turn of knob from inside and have an emergency release feature on outside, except doors opening into traffic corridors. These doors require hotel function with indicator button.

○ ROOM NUMBERING: For new school projects, the architect shall provide permanent room numbering system for door keying and signage. At renovation/addition projects the Owner shall provide the room numbering system.

○ CLOSERS: shall be provided at fire doors (unless otherwise excepted by code requirements), exterior doors, general office doors to lobby/corridor areas, and kitchen toilet doors.

○ MULLIONS: Use removable mullions where required to provide 6 ft. wide service access to a building's lobby corridor system.

○ STOPS: Detail doors and frames to swing doors maximum degree possible. Heavy duty wall stops and floor stops (where they are not a tripping hazard) are preferred. Where possible, set stops to provide a minimum 105 deg. door swing. The minimum door swing opening shall be 95 deg.. Floor and wall stops shall be located a minimum of 3/4 width of door from hinge side.

○ KICK PLATES: shall be installed only at push side of doors with closers. At cafeteria service doors the stainless steel kickplate shall be extended to half door height and installed at both sides. If labeled door, be sure door manufacturer is approved for half-door height armor plate.

○ DOOR SILENCERS: shall be provided at each door. Install three (3) at single doors up to 7 ft.-2 in. high, four (4) at single doors over 7 ft.-2 in. and two (2) at each pair of doors.

END OF SECTION

DEFINITIONS AND ABBREVIATIONS- 01000 -66
SECTION 08800 - GLAZING

**general**

- Insulating glass **shall** be installed at exterior windows. It is recommended solar tinted or low "E" glass be used at exterior glass at east, west, and unprotected south facing windows.
- Tempered or wire glass **shall** be installed at and adjacent to doors as required by the NC State Building Code. It is recommended interior glazing 6 ft. or less above the finish floor and exterior glazing 6 ft. or less above walkway surfaces be tempered or wire glass. The use of polycarbonate in lieu of glass for the exterior pane should be explored.

**END OF SECTION**
SECTION 09200 - GYPSUM PLASTER

GENERAL

☐ STANDARDS: Comply with ASTM C 841 and C 842.

☐ Do not use exterior portland cement/plaster or stucco.

☐ Toilet room ceilings shall be gypsum board or plaster, unless directed otherwise.

EXECUTION

☐ PRECAUTIONS: Maintain a temperature of at least 55 deg. F. in all spaces to be plastered for seven (7) days before start of plastering and until the gypsum plaster is dry.

END OF SECTION
SECTION 09250 - GYPSUM WALLBOARD

GENERAL

☐ GYPSUM BOARD STANDARD: Comply with applicable requirements of ANSI/ASTM C 840 for application and finishing of gypsum board, unless otherwise indicated.

☐ STEEL FRAMING STANDARD: Comply with applicable requirements of ASTM C 754 for installation of steel framing for gypsum board.

☐ Confine use of gypsum board faced partitions to administration and Student Support areas. All gypsum board partitions in these areas shall be covered with a vinyl wallcovering (See Section 09720-1) Principals', Assistant Principals', Student Support Services' offices and all conference rooms shall be constructed to minimize sound transmission.

PRODUCTS

☐ STEEL FRAMING: Partitions and ceilings shall comply with ASTM C 754.

☐ GYPSUM BOARD: Provide gypsum board of types indicated in maximum lengths available to minimize end joints:

EXECUTION

☐ PRECAUTIONS: In cold weather and during gypsum wallboard joint finishing, maintain temperature within the range of 55 to 70 deg. F. Adequate ventilation shall be provided to carry off excess moisture.

☐ INSTALLATION: Install steel framing to comply with ASTM C 754 and ASTM C 840.

☐ GYPSUM BOARD INSTALLATION: Install and finish gypsum board to comply with ASTM C 840.

END OF SECTION
SECTION 09300 - TILE WORK

GENERAL


PRODUCTS

☐ GROUT: For ceramic and quarry tile flooring, dark color grout is required.

☐ MARBLE THRESHOLDS: shall be provided at doorways of toilet rooms.

☐ QUARRY TILE: Flash color ranges are recommended. A medium color such as Putty or Sand is preferred over darker colors such as Red or Brick. Slip resistance is of utmost importance in cafeteria kitchens. The use of tile with raised treads to achieve this slip resistance has been used in the past with minimal negative side effects. The Owner is willing to consider any product that will provide the necessary safety while providing for easy cleaning.

☐ VCT: Do not use solid colors nor very light or dark colors for floor installations.

☐ Metal transition strips that are mechanically fastened to the sub-floor are required at all tile/VCT transitions to carpet except where there is a marble threshold. Glue down transition strips shall not be allowed.

EXECUTION

☐ COLD WEATHER PROTECTION: Maintain a minimum temperature of 50 degrees F. in all spaces where tile will be installed for 7 days before beginning installation of setting bed or tile and until at least a week after setting tile.

☐ Comply with ANSI A108.1 and A108.4 through A108.10.

☐ Locate expansion, control, contraction, and isolation joints to comply with recommendations of TCA “Handbook for Ceramic Tile Installation”.

☐ Cover tile flooring until final inspection with heavy Kraft paper or other heavy protective covering to prevent surface damage.

END OF SECTION
SECTION 09510 - ACOUSTICAL PANEL CEILINGS

GENERAL


☐ SURFACE BURNING CHARACTERISTICS: 25 or less for flame spread and 50 or less for smoke developed, per ASTM E 84.

☐ MAINTENANCE STOCK: At time of completing installation, deliver stock of maintenance material to Owner. Furnish amount equal to 2% of acoustical units installed.

PRODUCTS

☐ ACOUSTICAL PANELS: Provide manufacturer’s standard lay-in panels, 24 in. x 24 in. grid-size panels, with white finish. 24 in. x 48 in. panels shall not be used.

☐ HUMIDITY RESISTANT PANELS: Provide for high humidity areas such as Kitchens, Dishwashing areas, etc.

☒ ABUSE RESISTANT PANELS: Provide (along with hold down clips) at areas where damage might be expected, such as Elementary School Multi-Purpose Rooms.

☐ PANELS: 3/4 in. thickness cane or wood fiber panels are acceptable in corridors and multi-purpose rooms. Do not use soft acoustical panels at low ceiling installations.

☐ Specify 65% recycled materials in ceiling panels where possible.

☐ Specify products free of formaldehyde in binders.

EXECUTION

☒ PRECAUTIONS: Do not install acoustical tile or panels until the building is enclosed, the permanent heating and cooling equipment is in operation and residual moisture from plaster, concrete, or terrazzo work has dissipated.

☐ INSTALLATION: Install acoustical ceiling systems in accordance with CISCA “Ceiling Systems Handbook”.

☐ Do not support fixtures or equipment such as exit lights, speakers, etc. from the ceiling system.

END OF SECTION
SECTION 09550 - WOOD FLOORING

PRODUCTS

- STAGE FLOORING: Manufacturer's standard straight edge, tongue and groove and end-matched solid wood flooring, 1 in. thick x 2-1/8 in. or 2-1/4 in. strips in standard random lengths. At high and middle schools use Southern Pine, C and Better Flooring, near-rift grain with flat black, exterior grade latex paint finish. At elementary schools use plain sawn No. 1 common Red Oak or plain sawn, MFMA certified second and better grade, Northern Hard Maple with transparent polyurethane finish.

- ATHLETIC FLOORING: At high and middle schools use manufacturer's standard straight edge tongue and groove end matched solid wood flooring. The strips should measure 25/32 in. thick x 2-1/4 in. wide x 2 ft. minimum length and averaging 4 ft.-6 in. long. Specify either double channeled base, plain sawn No. 1 common Red Oak, or plain sawn, MFMA certified second and better grade, Northern Hard Maple with transparent polyurethane finish. Floor to be DIN approved.

- TRANSPARENT POLYURETHANE FINISH: shall be a polyurethane co-polymer with the following characteristics:
  - Solids 42%
  - Volatile Contents 58%
  - Carrier: De-sulfurized Aliphatic solvent
  - Application rate: 350 - 400 square feet per gallon.

EXECUTION

- PRECAUTIONS: Do not install wood flooring until the building is enclosed, the permanent heating and cooling system is in operation, and residual moisture from plaster, concrete, masonry or terrazzo has dissipated.

- PROTECTION: Protect completed wood flooring during remainder of construction period with heavy Kraft paper or other suitable covering, so that flooring and finish will be without damage or deterioration at time of acceptance.

- TRANSPARENT POLYURETHANE FINISH: shall be installed in the following manner:
  1. Prepare floor
  2. Apply one (1) coat floor seal
  3. Paint all lines using oil base quick dry enamel (2 coats)
  4. Apply one (1) coat floor seal
  5. Cut floor w/#3 steel wool
  6. Apply one (1) coat floor seal
  7. Cut floor w/#3 steel wool
  8. Buff

END OF SECTION
SECTION 09650 - RESILIENT FLOORING

GENERAL

☐ This section includes information for specifying resilient tile flooring and wall base.

☐ Preferred type of tile flooring is Vinyl Composition Tile (VCT). Other acceptable types of tile flooring are Asphalt Tile, Rubber Tile and Vinyl Tile.

☐ Acceptable types of wall base are Rubber Cove or Straight Base or Vinyl Cove or Straight Base. Cove base is to be used with resilient tile flooring and straight base is to be used with carpet. Installer shall use maximum lengths available to minimize joints and shall install preformed or molded corner units at 90 deg. intersections.

☐ For each type of product required, including adhesives, cleaning compounds, and other accessories, provide the same product by one manufacturer throughout the project and specify that all products have low VOC’s.

PRODUCTS

☐ For vinyl composition tile, premium product lines of the following manufacturers, provided they comply with requirements of the contract documents and have a low VOC, will be considered acceptable:

1. Armstrong World Industries, Inc.
2. Mannington Commercial
3. Tarkett
4. Equal as approved by Architect.

☐ Any tile specified shall be free of asbestos and 1/8 in. gage.

☐ For wall base, products of the following manufacturers, provided they comply with requirements of the contract documents and have a low VOC, will be considered acceptable:

1. Burke Industries, Inc.
2. Flexco Company
3. Johnsonite, Inc.
4. The R.C. Musson Rubber Company
5. Roppe Corporation

EXECUTION

☐ A manufacturer’s recommended moisture test shall be performed prior to installation of resilient flooring, to verify that concrete surfaces have cured sufficiently for proper adhesive bond to be achieved between the sub floor and the resilient tile.

☐ Ventilate areas thoroughly during and after installation prior to occupancy.

☐ Resilient edge strips shall be used in locations shown on drawings, or where otherwise required, to protect edge of resilient flooring. Install resilient edge strips securely with recommended adhesive to achieve a tightly butted joint.

☐ When an edge strip is needed at a transition between carpet and tile flooring, it shall be specified as a metal edge strip and installed per manufacturers specification, securing it to the sub floor using mechanical fasteners and not adhesives.

☐ When using floor tile on a ramp within a building, a non-skid tile should be used and shall meet all handicap codes.

END OF SECTION
SECTION 09680 - CARPET

GENERAL
- Manufacturer's Certification: Carpet materials shall comply with "Use of Materials Bulletin UM-44C" published by US Department of Housing and Urban Development (HUD) and are currently listed in HUD "Certified Products Directory" and so identified by imprint on back of carpet.
- A seaming diagram for carpet installation should be submitted for approval by Wake County Public System when finishes are submitted.

PRODUCTS
- CARPET: Class III, tufted, commercial carpet, type 6.6 nylon, face weight: 28 oz./yd., minimum total weight: 61 oz./yd., unitary backing, 20 pound tuft bind, multi-level loop pile, permanent anti-static control, solution dyed, tweed pattern and bacteria protection preferred. Use of "pattern match" should be avoided.
- ATHLETIC CARPET: shall be Collins & Aikman "PROGYM" or equal and used for athletic flooring at elementary schools.
- WALL BASE-RUBBER: Acceptable manufacturer's list in Section 09650
- COMPOUNDS AND ADHESIVES: Formulated specifically for the application of the specified floor covering and shall be applied according to manufacturer's recommendations. Environmentally safe, low odor adhesives required.
- Metal reducer strips that are mechanically fastened to the sub floor are required at all tile/VCT transitions to carpet except where there is a marble threshold. Glue down reducer strips shall not be allowed.

EXECUTION
- PRECAUTIONS: Do not install carpet until the building is enclosed, permanent heating and cooling systems are in operation and residual moisture from plaster, concrete, or terrazzo work has dissipated.
- Specifications shall require moisture test prior to installation of adhesives and reference manufacturer's recommendations regarding moisture content.
- Require submittal and approval of seaming diagram by Wake County Public School System when finishes are submitted.
- Seam sealer is required at all seams.
- No saddle or T-seams shall be allowed in doorways or high traffic areas.
- Ventilate thoroughly all areas during and after installation, prior to occupancy.

END OF SECTION
SECTION 09720 – WALLCOVERING

GENERAL
- Wall covering shall be treated with mildew inhibitor and germicide, with minimum total weight and minimum coating weight specified in FS CCC-W-408A for vinyl wall covering type indicated, and complying with FS CCC-W-408C for other requirements. It shall also be required to carry a Class A fire rating. Provide materials bearing UL label and marking, indicating compliance with fire hazard classification requirements.
- Type II wall-covering which has a total weight of not less than 13 oz./sq. yd. and a vinyl coating of not less than 7 oz./sq. yd. shall be specified where wall covering is required.
- Provide 54 in. wide material with Onasburg backing.
- Colors and patterns for wall coverings will be selected from manufacturers’ standards after contract award.
- An installer specializing in wall covering work with not less than 5 years of experience in installing wall coverings similar to those specified on project shall be required.

PRODUCTS
- The following manufacturers, provided they comply with requirements of the contract documents and manufacture using low VOC’s, will be among those considered acceptable:
  1. Koroseal Wall Covering Division/RFG International
  2. The Arton Group
  3. Genon Wallcovering Division
  4. Equal as approved by Architect.
- Provide low VOC adhesives and sealers recommended specifically by manufacturer of wall covering specified for use on scheduled substrates and certified to be mildew resistant and nonstaining to wall covering.
- Surface sealer for gypsum wallboard substrates, formulated to permit removal of wall covering without damage to wallboard, shall be used on all gypsum wallboard substrates scheduled to receive vinyl wall covering. Specify only those products that emit low VOC’s.

EXECUTION
- Materials shall be stored under cover in original undamaged packages or containers. Do not store rolled goods in upright position. Maintain temperature in storage area above 40 deg. F. and below 90 deg. F. It shall be required that wall-covering materials be removed from packaging and placed in area of installation not less than 24 hours before commencing installation to climatize product to the environment in which it is to be installed.
- Electrical cover plates and other surface-mounted fixtures in areas to receive wall coverings shall be removed temporarily during wall covering and reinstalled when wall covering is complete.
- Nicks, scratches, and other surface irregularities shall be patched in gypsum wallboard substrates with latex filler before wall covering is installed. Sand filler smooth and flush with substrate and wipe with tack cloth.
- Require substrates to be primed and sealed in accordance with wall covering manufacturer’s recommendations and apply release coat.
- Substrates shall be tested with electronic moisture meter to verify that moisture content does not exceed limits recommended by manufacturer of wall covering.
Wall covering shall be installed in accordance with manufacturer's instructions, except where more stringent requirements are shown or specified, and except where project conditions require extra precautions or provisions to ensure satisfactory performance of work.

Seams shall not occur within 4 in. of corners or major openings. Trim wall covering carefully at electrical boxes and other interruptions to avoid gaps and necessity for patches.

Outside corners of wall covering shall be designed with protective trim moldings where exposed to medium or heavy traffic patterns.

END OF SCHEDULE

SECTION 09900 - PAINTING

GENERAL

SINGLE SOURCE RESPONSIBILITY: Provide primers and undercoat paint produced by the same manufacturer as the finish coats.

PRODUCTS

PAINT: shall have a reflective value of 60-80%. At wall surfaces use semi-gloss paint. Provide finish in high traffic areas that can be scrubbed.

Except in toilet areas, specify waterbased solvent and mercury free paint with low or zero VOC's.

Provide epoxy finishes in toilet areas.

Limit number of paint colors to available standards. Avoid blends and coordinate colors to enhance school spirit.

BLOCK FILLER: shall be applied to all exposed masonry block. Specify products with low or zero VOC's.

Filler in Kitchen and Dishwasher areas shall completely fill block pours to eliminate pinholes in painted finish and shall be approved by Health Department inspector before application of finish paint.

EXECUTION

COLOR SCHEMES: Avoid sophisticated color schemes. Limit paint colors to two (2) per wall surface.

STORAGE: Store unused materials in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg. F. Protect from freezing.

PROJECT CONDITIONS: DO NOT apply paint in snow, rain, fog or mist, nor if air, surface, or paint material temperatures are below 50 deg. F. nor when relative humidity exceeds 85% nor when temperature is less than 5 deg. F. above the dew point. DO NOT apply paint to damp or wet surfaces. Maintain a temperature of 50 deg. F. for a period of 24 hours before beginning interior painting and for at least 24 hours after last application.

END OF SCHEDULE

SECTION 10110 - DRY ERASE BOARDS & TACKBOARDS

GENERAL

Dry erase boards and tackboards shall be provided in accordance with the building program for each specific project. Attention to the constraints of applicable codes governing the use of combustible materials is required. Please see Appendix 10110-A.

DEFINITIONS AND ABBREVIATIONS- 01000 -76
PRODUCTS

☐ DRY ERASE BOARDS: shall have 24 gauge porcelain enamel steel face with backer board in extruded aluminum frame with marker tray and head tackstrip. Finish shall be manufacturer's standard glossy white. Core shall be at least 7/16 in. thick particleboard material backed by either foil or aluminum for moisture seal.

☐ TACKBOARDS: shall be 1/4 in. thick composition cork mounted to 1/4 in. hardboard in extruded aluminum frame. The composition corkboard shall be made of pure cork material compounded with linseed oil and pigment on a burlap back.

☐ TACKSTRIPS: shall be 1/4 in. thick composition cork in extruded aluminum frame. Width of tackstrip shall be 1 in. at dry erase board installations and 2 in. elsewhere. Map hooks and flag holders shall be provided at all tackstrip installations including at head of dry erase boards. Provide two (2) flag holders per room. At art rooms, hooks shall also be provided.

☐ PEGBOARDS: shall be 1/4 in. hardboard with 9/32 in. diameter holes on 1 in. centers in extruded aluminum frame.

☐ ACCESSORIES: Furnish standard continuous box-type aluminum marker tray with slanted front and cast aluminum end closures for each dry erase board. Where specified in program, furnish map rail complete with 1 in. to 2 in. wide display rail, end stops, and 2 map hooks for each 4 feet of rail.

☐ All products shall have a 50 year warranty.

EXECUTION

☐ All dry erase board, tackboard, tackstrip and pegboard units shall be factory assembled.

☐ Size, location and mounting height of dry erase boards, tackboards and tackstrips shall be according to building program requirements. Bottom of boards shall be no more than 34 in. from finished floor.

☐ At physical activity spaces such as dance studios, gyms, and multi-purpose rooms, do not provide protruding chalk trays at dry erase board installations. Instead, provide recessed holders for markers and erasers.

END OF SECTION
ATTACHMENT 10110-A - DRY ERASE BOARD AND TACKBOARD

PRODUCTS

- Porcelain Steel Dry Erase Board
- Tackboard

ACCEPTABLE MANUFACTURERS

1. American Chalkboard Co.
2. Best Rite
3. Claridge
4. Lemco, Inc.
5. Nelson/Adams (NACO)

WARRANTY

- Lifetime Guarantee under conditions of normal use. Should not exhibit excessive fading of color, crazing, cracking or flaking.

MATERIALS

- Porcelain Steel Dry Erase Board: Provide balanced, high pressure-laminated porcelain enamel dry erase boards of 3-ply construction consisting of face sheet, core material and backing.

  1. Face sheet: shall be 24 or 28 gauge porcelain, enamel steel with magnetic, non-porous surface. Should wipe clean with an eraser or dry cloth. Also:
     - Deposition coat of 2.0 to 2.5 mils on front of steel.
     - Deposition coat of 1.5 to 2.0 mils on back of steel.
     - Porcelain enamel steel writing and erasing coat system, totaling 3.5 to 4.5 mils over front surface.
     - Firing temperature must be no less than 1500 deg. F.
     - Hardness of writing surface shall be uniform in color and texture.
     - Reflectance factor shall be no more than 20% or less than 15%, nor vary as a result of wear.
     - Writing surface shall be no less than 6.5 MOH’s scale.
     - Color: White

  2. Core: Provide 1/2 in. thick, industrial grade, particle-board or fiberboard core material with zero VOC’s. (Fiberboard is lighter in weight and preferable.)

  3. Backing Sheet: (.015 in. aluminum sheet vapor barrier.) Moisture retardant, laminated with suitable, low VOC emitting adhesive to prevent delamination. Lamination of all materials to be factory type only, with special formulated adhesives. Hand lamination is not acceptable.

- Tackboard: Seamless sheet, 1/4 in. thick ground natural cork compressed with linseed oil and integral color throughout, laminated to burlap backing. Factory laminate cork face sheet under pressure to 1/4 in. thick hardboard in extruded aluminum frame.

ACCESSORIES

- Metal Trim and Accessories: Fabricate frames and trim of not less than 0.062 in. thick aluminum alloy, size and shape as indicated, to suite type of installation. Provide straight
factory-applied trim, single-length units whenever possible. Keep joints to a minimum. Miter corners to a neat, hairline closure.

1. Markertray: Furnish manufacturer's standard snap-on, continuous box-type, extruded aluminum chalktray with end caps and angled bottom support. 1-3/4 in. to 2 in. frame.

2. Map Rail: Where specified on drawings furnish map rail at top of each unit, complete with the following accessories:
   a. Display Rail: Provide continuous cork display rail approximately 1 to 2 in. wide, integral with map rail at top of board.
   b. End Stops: Provide one end stop at each end of map rail.
   c. Map Hooks: Provide two (2) map hooks with flexible metal clips for each 4 ft. of map rail or fraction thereof.
   d. Flag Holders: Provide two (2) per room.

END OF SECTION
SECTION 10155 - TOILET PARTITIONS

GENERAL
- Durable, low maintenance product quality and installation is the primary consideration in the design of toilet room partitions. In this regard, the Wake County Public School has decided to require the use of floor mounted, overhead braced compartments with heavy duty, institutional hardware.

PRODUCTS
- TOILET PARTITIONS: shall be of floor mounted, overhead braced, solid polymer resin partitions at all group toilet installations. Doors shall match compartment construction. Use light, not dark colors. Small patterned finish is preferred. Metal toilet partitions shall not be used.
- HARDWARE AND FITTINGS: shall be heavy-duty extruded aluminum construction with bright finish. Door hinges shall be self closing (integral) at all locations. Continuous wall brackets shall be used at group toilets. Use “through-bolts” (threaded insert with vandal resistant bolt at both sides) to secure hinges, brackets, stops and latches to doors and partitions. Provide vinyl bumper strip to absorb impact at doorstops and latch. Use of polymer hinges, wall brackets, and base at solid polymer resin partitions are acceptable.

INSTALLATION
- TOILET PARTITIONS: shall be secured with vandal resistant stainless steel machine screws with expansion anchors at masonry and tile walls and with toggle bolts at hollow walls and expansion anchors at other walls. Pilasters shall be secured to floor with a minimum of two #14-1.5 in. Stainless Steel screws with expansion anchors. Provide stainless steel or polymer resin base trim to conceal floor anchorage and leveling devices.
- COMPARTMENT DOORS: shall be provided at all compartments.
- URINAL SCREENS: If required, shall be provided between adjacent urinals and where located next to lavatories. These screens shall be of the same construction as the toilet partitions and be attached to the wall with solid polymer resin brackets.

END OF SECTION
SECTION 10426 - IDENTIFYING DEVICES

GENERAL
- An exterior sign shall be required at main site entrance and main building entrance.
- Interior signs shall be required at all doors and spaces. Final room names and numbers will be furnished by the Owner.

PRODUCTS
- INTERIOR SIGNS: shall be manufactured from 1/16 in. clear matte acrylic that is sub-surface printed with a background color and laminated to a 1/16 in. opaque white or black acrylic base and has 1/16 in. raised acrylic letters, Andco Series 850-16 or equal. All signage shall comply with Section 4.11, “Signage and Identification” of the NC State Building Code for Handicapped Accessibility & ADA Standards.

EXECUTION
- INTERIOR SIGNS: Signage shall be sized to accommodate copy. No abbreviations shall be permitted at elementary schools. Abbreviations are strongly discouraged at middle and high schools.

END OF SECTION
SECTION 10500 - LOCKERS

GENERAL

- Lockers shall be recessed in wall construction or have sloping tops and masonry end walls. Bases shall be provided by manufacturer. Use closed "kitchen style" base unless noted otherwise.

PRODUCTS

- STUDENT LOCKERS: shall be of steel construction with baked enamel finish. Doors shall be louvered. Hinges shall be steel, full loop, 5 knuckle, tight pin, welded to frame, screwed to door. Provide a minimum of 3 hinges per door over 42 in. high and 2 hinges for doors 42 in. high and less. Minimum size for student locker compartments shall be 12 in. x 36 in.

- ATHLETIC LOCKERS: Similar to student lockers except provide perforated doors at compartments for gym and athletic clothes.

- STAFF LOCKERS: Similar to student lockers except minimum size shall be 12 in. x 60 in.

- Provide one (1) master-keyed combination padlock for each locker. Also provide 5% spare locks.

END OF SECTION
SECTION 10520 - FIRE EXTINGUISHERS AND CABINETS

GENERAL

Fire Extinguishers shall be located as per Project Building Program, as required by local code officials, and in accordance with the recommendations of NFPA 10, "Standard for Portable Fire Extinguishers". In areas accessible to students where Fire Extinguishers are required, cabinets shall be provided.

PRODUCTS

CABINETS: shall be 12 in. x 27 in. x 8 in. for semi-recessed or recessed installation. Breakable transparent glazing shall be scored Plexiglas.

Specify recessed cabinets for all corridor locations. Maintain integrity of all rated walls.

FIRE EXTINGUISHERS: shall be supplied by the Owner.

EXECUTION

Install cabinets at the heights required by local code officials.

END OF SECTION
SECTION 10650 - OPERABLE PARTITIONS

GENERAL

☐ Avoid use of operable partitions wherever possible.

PRODUCTS

☐ PARTITIONS: **shall** be manually operated type, 20-lb. maximum pull, where size permits.

☐ SOUND SEAL: **shall** be provided, with an STC rating of 38 or greater.

☐ Avoid the use of sound insulation or coverings that emit VOC’s or use formaldehydes in the manufacturing process.

☐ For operable partitions, premium product lines of the following manufacturers, provided they comply with requirements of the contract documents and have a low VOC, **will** be considered acceptable:

1. Hufcore
2. Panelfold
3. Curtition
4. Modernfold

EXECUTION

☐ Partitions **shall** be suspended from the structure overhead. Coordinate with structure and partition manufacturer. **Do not** use floor tracks.

☐ Comply with “Standard Recommended Practice for Architectural Application and Installation of Operable Partitions”.

END OF SECTION
SECTION 10700 - WINDOW TREATMENTS, STAGE CURTAINS, AND BANNERS

GENERAL

- Window treatments shall be provided by the Owner. Allow adequate space at window heads for installation of blinds.
- Curtains/Draperies must be tested in accordance with the large scale tests of NFPA701.
- Banners, signs, and other decorative items must be tested in accordance with the small scale tests of NFPA701. In addition to a written certificate, all items must have a label permanently attached noting the certification.

END OF SECTION
SECTION 10800 - TOILET ACCESSORIES

GENERAL

TOILET ACCESSORIES will be surface mounted type unless noted otherwise. Most accessories will be supplied by the Owner to the Contractor for installation.

PRODUCTS

- PAPER TOWEL DISPENSERS: shall be supplied by the Owner and installed by the Contractor.
- SOAP DISPENSERS: shall be supplied by the Owner and installed by the Contractor.
- TOILET PAPER HOLDERS: For non-handicapped accessible toilets and stalls shall be supplied by the Owner and installed by the Contractor. These units are “Scott” Model 09672 Jumbo.
- TOILET PAPER HOLDERS: For handicapped accessible toilets and stalls shall be 2-roll, heavy duty, controlled delivery type and shall be furnished and installed by the Contractor.
- WASTE RECEPTACLE: shall be free standing units provided by the Owner.
- MIRRORS: shall be polished stainless steel at middle & high school student toilet rooms and framed mirror glass elsewhere.
- ROBE HOOK: shall be stainless steel with #4 satin finish and concealed attachment.
- SANITARY NAPKIN DISPOSAL: shall be of stainless steel construction with #4 satin finish. Provide type for mounting into toilet partitions and for recessed wall mounting. Contractor to furnish and install.

EXECUTION

- PAPER TOWEL DISPENSERS: Install one (1) dispenser for every two (2) lavatories; locate immediately adjacent to lavatories for ease of use.
- SOAP DISPENSERS: Locate directly over lavatories.
- MIRRORS: Size of mirrors at student toilet rooms to be approximately 18 in. wide x 24 in. high at elementary student toilet rooms and 18 in. wide x 30 in. high elsewhere. Mirrors shall be located on walls away from lavatories. Mirrors at staff toilets may be located over lavatories. It is desirable to have one 20 in. x 60 in. full-length mirror at the women's staff toilet rooms.
- SANITARY NAPKIN DISPOSAL: shall be provided at all women's staff and girl's middle and high school toilet rooms. Install at each compartment of gang toilet rooms.
- ROBE HOOKS: shall be provided at individual toilet rooms and at door of all toilet partition compartments.
- Contractor to mechanically fasten paper towel, toilet paper and soap dispensers in place.

END OF SECTION
SECTION 11000 - MISCELLANEOUS EQUIPMENT

GENERAL

TV BRACKETS: Brackets shall be wall-mounted type. Electrical power and cable to TV shall be extended and connected to nearby outlets mounted in the ceiling tile by the Electrical Contractor. Cable and connectors to be furnished by Contractor.

TELEVISIONS: are furnished and installed by the Owner.

INCINERATORS: shall not be used without approval from owner.

DUST COLLECTOR: shall be provided for woodworking shop.

SOLID WASTE HANDLING EQUIPMENT with discharge into sewage system shall not be used.

KILN: Kiln room shall have one (1) hour rated walls. Locate room adjacent to exterior wall. Provide kiln hood and roof mounted exhaust fan. Provide 6 in. deep stationary drainable aluminum louver with motorized damper for make-up air source. Louver to have 1/2 in. x 1/2 in. screen. Fan and damper to be controlled by wall mounted thermostat.

END OF SECTION
WAKE COUNTY PUBLIC SCHOOL SYSTEM
DESIGN GUIDELINES
6 May 1992

SECTION 11400 - FOOD-SERVICE EQUIPMENT

GENERAL
- Food-service equipment shall be designed to be bid as a part of the prime general construction contract.
- INSPECTIONS: Pressure vessels for cooking shall be inspected by the N.C. Boiler Bureau. Refrigeration and air conditioning equipment shall be inspected by qualified inspectors. Contractors shall provide certificates of the above inspections.

PRODUCTS
- WALK-IN COOLERS AND FREEZERS: Floors shall be approximately the same level as the Kitchen floor for food cart operation. Provide floor drains near and outside the cooler and freezer door(s) and run copper drain from evaporator unit to this floor drain. Locate temperature controls and thermometers on the outside near the cooler and freezer doors. Temperature setting for the cooler shall be 35 deg. F. and temperature for freezer shall be 10 deg. F.
- Provide electrical heat strip around freezer door to prevent freeze up of door.
- Architect shall specify proper shelving, additional lighting and non-slip floor strips to be provided for all walk-in coolers and freezers.
- FLY FAN: Provide at all exterior doors from Kitchen area with automatic operation controlled by a jamb mounted switch.
- FUEL SHUT-OFF: Provide automatic type, as required by code. Locate valve a maximum of 6 ft. above finish floor.
- FIRE EXTINGUISHING SYSTEM: Provide under hood system, as required by code. Coordinate with mechanical for shutdown of HVAC systems when hood system is activated and with electrical for notification of fire alarm when hood system is activated. Locate remote ansul pull station near exterior egress from kitchen. Show location of pull station on plans.

END OF SECTION
SECTION 11480 - ATHLETIC EQUIPMENT

GENERAL

☐ GYMNASIUMS: shall be sized according to the building program. Ceiling heights shall be 25 ft. clear inside to the bottom of any and all obstructions at high schools and middle schools.

☐ BASKETBALL COURTS: shall be the following size:

<table>
<thead>
<tr>
<th></th>
<th>Main Courts</th>
<th>Cross Courts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Middle Schools</td>
<td>42 ft. x 84 ft.</td>
<td>42 ft. x 74 ft.</td>
</tr>
<tr>
<td>High Schools</td>
<td>50 ft. x 94 ft.</td>
<td>50 ft. x 94 ft.</td>
</tr>
</tbody>
</table>

Provide 10 ft. overrun on all sides of main court.

PRODUCTS

☐ ACOUSTICAL TREATMENT: Provide suitable wall and/or ceiling acoustical treatment at gymnasiums.

☐ BASKETBALL BACKSTOPS: shall be glass for main court, solid for cross-courts. Rims shall be "breakaway" type. Backstops shall be electrically operated.

☐ CEILING CONSTRUCTION: Exposed structure ceiling is recommended for use.

☐ SCOREBOARD: Wall mounted electronic type, with time-clock, team scores, period, bonus, jump ball, next possession, and possession. Time clock shall be bi-directional with ability to directly set any number of minutes and seconds.

☐ SOCCER AND FOOTBALL GOAL POSTS: shall be supplied and installed by Contractor.

☐ VOLLEYBALL AND BADMINTON FLOOR SLEEVES: Provide floor sleeves for volleyball at high school and middle school gymnasiums. Sleeves shall be recessed steel with hinged floor plate. Top of floor plate must be completely encapsulated and shall be flush with wood floor. Floor plates shall be either solid brass or steel with chrome plated finish.

☐ WALL PADS: 2 in. thick, polyurethane foam, mounted on 3/8 in. plywood and covered with heavy duty vinyl covering. Permanently mounted at end walls of basketball courts. In Auxiliary Gyms, end walls of side courts should also be padded.

END OF SECTION
SECTION 11600 - LABORATORY EQUIPMENT AND CASEWORK

GENERAL
(Refer to Section 06410, "Interior Architectural Woodwork" for detailed construction requirements.)
Contractors shall be required to submit samples of transparent wood casework finishes which indicate range of color variation to be expected in finishes.

PRODUCTS
Both built-in and portable casework shall work together as a system and shall be by the same manufacturer.
CASEWORK: shall be Oak hardwood.
COUNTERTOPS: shall be acid resistant phenolic material similar to lab grade “Trespa.”
Sinks shall be of the same material.
STUDENT TABLES: Science room two-student desks shall have a 1 in. thick top composed of acid resistant phenolic material similar to lab grade “Trespa.”
FITTINGS: shall be vandal-resistant.
HARDWARE: shall be heavy-duty, stainless steel.

END OF SECTION
SECTION 11970 - STAGE EQUIPMENT

GENERAL

☐ Pipe grid system for lighting shall be furnished and installed by the General Contractor.
☐ Maintain adequate clearances between pipe grid and ductwork.

PRODUCTS

☐ See Attachment 11970-A for Elementary School stage curtain requirements.
☐ See Attachment 11970-B for Middle School stage curtain requirements.
☐ See Attachment 11970-C for High School stage curtain requirements.

☐ PIPE BATTENS: shall be 1-1/2 in. dia., schedule 40 pipe. Provide in Educational Theaters and in Video Studios.

☐ CURTAINS: In the theater shall be “dead hung” from the structure. All curtain fabric shall be 25/50 flame/smoke rated.

END OF SECTION
ATTACHMENT 11970-A - STAGE EQUIPMENT
GUIDE SPECIFICATIONS FOR ELEMENTARY SCHOOLS

☐ FRONT STAGE CURTAIN AND VALANCE: Flame resistant 25 oz. Velour (color to be selected). Curtains to be manufactured with 50% fullness. Panel headings shall be box-pleated and constructed with 2 in. heavy jute webbing with a pleat control system consisting of 16 gauge flame resistant virgin vinyl pleat control strips with 4 in. brass grommets placed every 12 in. on center.

☐ Front curtain panels shall have 12 in. leading and 2 in. trailing hems. Bottom hems of the front curtain panel shall be 6 in. Valance hems shall be 2 in. on the sides and 3 in. on the bottom.

☐ Valance shall be constructed with hidden vertical seams i.e. the seams are to fall behind the pleats.

☐ CYCLORAMA SYSTEM: shall consist of two (2) rear curtain panels, four (4) side curtain panels and two (2), three (3) or four (4) overhead borders, depending on stage depth and sight line situation. Curtains shall be manufactured with 50% fullness from flame retardant Atlas Oxford fabric (color to be selected).

☐ Panel headings shall be box-pleated and constructed with 2 in. heavy jute webbing with a pleat control system as noted in specification for Front Stage Curtain above.

☐ Side and rear panels shall have 2 in. side hems and 4 in. bottom hems. Overhead borders shall have 2 in. side hems and 3 in. bottom hems.

☐ Borders shall be constructed with hidden vertical seams as noted in specification for valance above.

☐ FRONT CURTAIN TRACK: ADC 170, or approved equal.

☐ SIDE CURTAIN TRACKS: Sturdi-Bilt 390 (Walk-Draw), or approved equal.

☐ VALANCE PIPE: If required, shall be 3/4 in. I.D. black steel TC pipe.

☐ OVERHEAD BORDER PIPES: shall be 3/4 in. I.D. black steel TC pipe.

☐ TRACK AND PIPE HARDWARE: shall be supported from structure and of adequate design and strength to support curtains. All track and pipe hardware shall be installed by the General Contractor.

END OF SECTION
ATTACHMENT 11970-B - STAGE EQUIPMENT

GUIDE SPECIFICATIONS FOR MIDDLE SCHOOLS

- FRONT STAGE CURTAIN AND VALANCE: Flame resistant 25 oz. Velour (color to be selected). Curtains to be manufactured with 60% fullness. Panel headings shall be box-pleated and constructed with 2 in. heavy jute webbing with a pleat control system consisting of 16 gauge flame resistant virgin vinyl pleat control strips with 4 in. brass grommets placed every 12 in. on center.

- Front curtain panels shall have 12 in. leading and 2 in. trailing hems. Only full widths shall be allowed. Bottom hems of the front curtain panels shall be 6 in., with #8 jack chain encased in flame resistant Repp chain pockets. Valance hems shall be 2 in. on the sides and 3 in. on the bottom, with Kirsch #1602 weighted tape in the bottom hem.

- Valance shall be constructed with hidden vertical seams i.e. the seams are to fall behind the pleats.

- STAGE CURTAIN SYSTEM: shall consist of back traveler, two (2) rear curtain panels, two (2), four (4) or six (6) side leg panels and two (2), three (3) or four (4) overhead borders, depending on stage depth and sight-line situation. Curtains shall be manufactured with 60% fullness from flame-retardant, black Atlas Oxford fabric or similar fabric by another approved manufacturer.

- Borders shall be box-pleated and constructed with 2 in. heavy jute webbing with a pleat control system as noted in specification for Front Stage Curtain above.

- Side legs and rear curtain panels shall have 2 in. side hems and 4 in. bottom hems with #8 jack chain encased in flame resistant Repp chain pockets.

- Overhead borders shall be constructed with hidden vertical seams as noted in specification for valance above.

- MID-STAGE CURTAIN: shall consist of two (2) panels manufactured with 60% fullness from flame retardant, black Atlas Oxford fabric or similar fabric by another approved manufacturer.

- Panel headings shall be box-pleated and constructed with 2 in. heavy jute webbing with a pleat control system as noted in specification for Front Stage Curtain above.

- Side legs and rear curtain panels shall have 2 in. side hems and 4 in. bottom hems with #8 jack chain encased in flame resistant Repp chain pockets.

- FRONT CURTAIN TRACK: ADC 170, or approved equal.

- SIDE LEG TRACKS: Rotodraper Pivot Arms #17 with #400 clamp, or approved equal.

- REAR CURTAIN TRACK: Sturdi-Bilt 390 (Walk-Draw), or ADC 170 (Rope-Operated), or approved equal.

- MID-STAGE CURTAIN TRACK: ADC 170, or approved equal.

- VALANCE PIPE: If required, shall be 3/4 in. I.D. black steel TC pipe.

- OVERHEAD BORDER PIPES: shall be 3/4 in. I.D. black steel TC pipe.

- TRACK AND PIPE HARDWARE: shall be supported from structure and of adequate design and strength to support curtains. All track and pipe hardware shall be installed by the General Contractor,

END OF SECTION
ATTACHMENT 11970-C - STAGE EQUIPMENT

GUIDE SPECIFICATIONS FOR HIGH SCHOOLS

Size, design and use of High School stage prevents provision of specifics as to quantity of any type of curtain to be used. Therefore, these guide specifications provide for each type of curtain that might be used.

☐ FRONT STAGE CURTAIN AND VALANCE: Flame resistant 25 oz. Velour (color to be selected). Curtains to be manufactured with 60% fullness. Panel headings shall be box-pleated and constructed with 2 in. heavy jute webbing with a pleat control system consisting of 16 gauge flame resistant virgin vinyl pleat control strips with 4 in. brass grommets placed every 12 in. on center.

Front curtain panels shall have 12 in. leading and 2 in. trailing hems. Only full widths shall be allowed. Bottom hems of the front curtain panels shall be 6 in., with #8 jack chain encased in flame resistant Repp chain pockets. Valance hems shall be 2 in. on the sides and 3 in. on the bottom, with Kirsch #1602 weighted tape in the bottom hem.

Valance shall be constructed with hidden vertical seams i.e. the seams are to fall behind the pleats.

☐ STAGE CURTAIN SYSTEM: shall consist of back traveler, midstage traveler, two (2) rear curtain panels two (2), four (4) or six (6) side leg panels and two (2), three (3) or four (4) overhead borders, depending on stage depth and sight-line situation. Curtains shall be manufactured with 60% fullness from flame retardant, black Atlas Oxford fabric or similar fabric by another approved manufacturer.

Borders shall be box-pleated and constructed with 2 in. heavy jute webbing with a pleat control system as noted in specification for Front Stage Curtain above.

Legs and panels shall have 2 in. side hems and 4 in. bottom hems with #8 jack chain encased in flame resistant Repp chain pockets. Overhead borders shall have 2 in. side hems. Bottom hems shall be 3 in. with Kirsch #1602 weighted tape inside the hems.

Overhead borders shall be constructed with hidden vertical seams as noted in specification for valance above.

Back and midstage travelers shall consist of two (2) panels manufactured with 60% fullness from flame retardant, black color Atlas Oxford fabric or similar fabric by another approved manufacturer.

Panel headings shall be box-pleated and constructed with 2 in. heavy jute webbing with a pleat control system as noted in specification for Front Stage Curtain above.

Panels shall have 2 in. side hems and 4 in. bottom hems with #8 jack chain encased in flame resistant Repp chain pockets.

CYCLORAMA: shall be manufactured from flame resistant seamless Muslin fabric (color to be white or gray). There shall be no fullness to this curtain.

Panels shall have a heading constructed with 2 in. heavy jute webbing with 16 gauge flame resistant virgin vinyl control strips with #2 brass grommets placed every 12 in. on center. The side hems shall be 2 in. and the bottom hem shall be 4 in. with 2 in. heavy jute webbing attached at the top of this hem on the back side of the panel. This webbing to have #2 brass grommets and tie lines at approximately every 12 in. on center used to fasten a 3/4 in. I.D. black steel TC pipe to the bottom of the panel.

FRONT CURTAIN TRACK: ADC 280A, or approved equal.

BACK AND MID-STAGE TRAVELER TRACKS: ADC 170 or ADC 280A, depending on width and height of panels, or approved equal.

LEG TRACKS: Rotordraper pivot arm #17 with #400C clamp or approved equal.


TRACK AND PIPE HARDWARE: Shall be supported from structure, and installed by the General Contractor, of adequate design and strength to support curtains.

END OF SECTION
SECTION 12304 - LAMINATE CLAD CASEWORK

GENERAL

1. Manufacturers products shall be publicly cataloged. Manufacturer shall show evidence of a minimum of five (5) years experience in providing manufactured casework systems for similar types of projects, produce evidence of financial stability, bonding capacity, and adequate facilities and personnel required to perform on this project.

2. Samples:
   1. Submit samples of casework manufacturer's standard decorative laminate colors, patterns and textures for exposed and semi-exposed materials for architect's selection. Samples of other materials or hardware shall be made available if requested.
   2. Architect may request representative full-size samples for evaluation prior to approval. Samples may be impounded by architect/owner until completion of project to ensure compliance with specifications.

3. Production Drawings:
   1. Submit CAD production drawings for casework systems and countertops showing plan view layout of units with relation to surrounding walls, doors, windows, and other building components, elevations, ends, cross-sections, service run spaces and location of services.
   2. Coordinate production drawings with other work involved. Casework manufacturer to provide shop drawings for all trades involved in installation of casework.

4. Deliver completed laminate clad casework and countertops only after wet operations in building are completed, stored in a ventilated place, protected from the weather, with relative humidity range of 20% to 50%

5. Protect finished surfaces from soiling and damage during handling and installation with a protective covering.

6. Humidity and Temperature Controls:
   1. Advise contractor of requirements for maintaining heating, cooling, and ventilation in installation areas as required to reach relative humidity necessary to maintain optimum moisture content. (See Product Handling).

7. All materials and workmanship covered by this section shall carry a three (3) year warranty from date of substantial completion. This warranty is a warranty of replacement and repair only, whereby the manufacturer will correct defects in material and or workmanship without charge. It does not warrant any products that have been abused, exposed to excessive loads or left in unconditioned air after occupancy.

8. Work in this section shall be performed by a manufacturer certified by the Architectural Woodwork Institute(AWI) Quality Certification Program. The owner or architect shall have the option to require AWI certification on casework at the manufacturers expense.

9. See Attachment 12304-A for Laminate Casework Features.

PRODUCTS

1. Manufacturer and Product Type:
   1. For purpose of determining minimum performance and quality standards this specification is based upon TMI fixed modular casework as manufactured by TMI SYSTEMS DESIGN CORPORATION, 50 South Third Avenue West, Dickinson, North Dakota, 58601, a member of the Architectural Woodwork Institute (membership #8913) and Approved Quality Certification Program.
   2. Casework Manufacturers listed below are acceptable subject to compliance with requirements:

DEFINITIONS AND ABBREVIATIONS- 01000-96
Interiors Wood Specialties, NC
Stevens Cabinet Company, Teutopolis, IL.

Substitutions:
1. Where specific materials, finish options, construction details, modularity, hardware and test data are specified herein, the casework will be held in strict compliance. Substitutions will be considered prior to bid date provided request is submitted to the architect, in writing, no later than ten (10) days prior to bid date; substitution request shall list any and all deviations from the specified product. Acceptable substitutions are to be identified in addenda before bid date. Any manufacturer bidding without prior approval can be rejected solely for this reason.

DEFINITIONS AND MATERIALS

Listed are definitions and materials commonly used in defining decorative laminate clad casework. Refer to FABRICATION section for those items selected for use on this project.

Definitions: Identification of casework components by surface visibility.
1. Open Interiors: Any open storage unit without solid door or drawer fronts and units with full glass insert doors and/or acrylic doors.
2. Closed Interiors: Any closed storage unit behind solid door or drawer fronts, sliding solid doors.
3. Exposed Ends: Any storage unit exterior side surface that is visible after installation.
4. Other Exposed Surfaces: Faces of doors and drawers when closed, tops of cabinets less than 72 in. above finish floor.
5. Semi-Exposed Surfaces: Interior surfaces which are visible, bottoms of wall cabinets and tops of cabinets 72 in. or more above finish floor.

Core Materials:
1. Particleboard: Medium density 45-50 pound industrial grade particleboard of fir or pine meeting or exceeding ANSI A 208.1-1993, M-3 requirements. Thicknesses used are 1/4 in., 1/2 in., 3/4 in., and 1 in.
2. Hardboard: Prefinished hardboard in 1/4 in. thickness meeting or exceeding commercial standards CS-251.

Decorative Laminates/Veneer Where Applicable:
1. High pressure decorative laminate GP28 (.028), NEMA Test LD-3-1995.
2. High pressure decorative laminate GP50 (.050), NEMA Test LD-3-1995.
3. High pressure cabinet liner CL20 (.020), NEMA Test LD-3-1995.
4. Thermally Fused Melamine laminate tested to meet NEMA Test LD-3-1995.
5. High pressure backer BK20 (.020).

Edging Materials / Colors:
1. 1mm PVC banding, machine applied with waterproof hot melt adhesive.
2. 3mm PVC banding, machine applied with waterproof hot melt adhesive with external edges and outside corners of door and drawer fronts, and countertops, machine profiled to 1/8 in. radius for safety.
3. PVC banding shall be available in standard current solid colors. All selections color matched to Wilsonart, Nevemar, Formica and Pionite laminates of the same name.
4. Barbed T-edging or laminate self edge on cabinet components will not be acceptable.

Glass:
1. Full sliding glass doors shall be 1/4 at plate glass.
2. Glass insert doors - hinged or sliding wall cabinets shall be 1/8 at D.S. Glass.
3. Glass insert doors - hinged or sliding tall or base cabinets shall be 1/4 at laminate safety glass. Sliding doors mounted in aluminum track.
4. Provide extruded rigid PVC of design to hold and trim glass inserts in framed doors. Available in dove grey, frosty white or light beige to match basic cabinet body, or in contrasting slate grey or black color.
5. All glass shall be tempered.

SPECIALTY ITEMS
- Countertop support brackets, undercounter support frames, legs and miscellaneous metal parts shall be furniture steel, welded, degreased, cleaned, treated and epoxy powder painted.
- Structural assembly will provide for mounting of closure panels, removable access panels, and field connection of services within.
- Tote trays shall be heavy-duty vacuum formed polypropylene plastic with full top rim and pull. Trays shall be ivory color, equipped with a label holder.
- Tote tray/supply cabinets equipped with injection molded polycarbonate, continuous side rail support glide. Clear color to blend with selected interior finish. Each side rail support glide shall have integral support pins to interface 32mm (approximately 1-1/4") pre-drilled holes, making the supports readily adjustable.

CABINET HARDWARE
- Hinges shall be five knuckle, institutional grade, 2-3/4" overlay type with hospital tip. Steel shall be minimum .095" thick and have minimum of nine (9) edge and leaf fastenings. Hinges shall pass ANSI-BHMA standard A156.9, Grade 1 requirement for both vertical and horizontal set and sag (pair of hinges will hold minimum of 310 pounds); copy of test result shall be provided upon request. Casework manufacturer shall use specifically engineered screws for attachment of hinges; wood screws shall not be permitted. Doors 48" and over in height shall have three (3) hinges per door. Provide magnetic door catch with minimum seven (7) pound pull, attached with screws and slotted for adjustment. Color to be brushed chrome.
- Door and drawer front pulls shall be epoxy finished metal wire style, 96mm spacing on fasteners. Pull design shall be compatible with Americans with Disability Act (ADA), Federal Register Volume 56, No. 144, specifically paragraph 4.27.4. Other pulls may be acceptable pending architect approval. Color to be brushed chrome.
- Drawer Slides: Standard use and kneespace drawers shall be Blum Style No. BS230M with epoxy finish. Slides will have a 100 pound load rating at full extension and a built-in, positive stop both directions, with self closing feature. Slides shall have a lifetime warranty as offered by the slide manufacturer.
- File drawer slides shall be full extension. Slides shall have a lifetime warranty as offered by the slide manufacturer.
- Pencil drawers shall be equipped with Blum No. 320 for undercounter or support frame mounting.
- Adjustable Shelf Supports: shall be injection molded polycarbonate, clear color to blend with selected interior finish, friction fit into cabinet end panels and vertical dividers, readily adjustable on 32mm (approximately 1-1/4 in.) centers. Each shelf support shall have two (2) integral support pins, 5mm diameter, to interface pre-drilled holes, and to prevent accidental rotation of support. The supports shall be automatically adaptable to 3/4 in. or 1 in. thick shelving and shall provide non-tip feature for shelving. Supports

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are designed to readily permit field fixing of shelf if desired. Structural load testing shall show loading to 1,040 pounds (260 pounds per support) without failure.

Locks: for doors and drawers as shown on drawings shall be National Lock #M4-7054C, removable core, disc tumbler, cam style lock with strike. Each lock shall be furnished with two (2)keys.

Chain bolts shall be 3 in. long, shall have a 18 in. pull and an angle strike to secure inactive door on cabinets over 72 in. in height. Elbow catches shall be used on inactive doors up to and including 72 in. in height.

All locks in individual rooms to be keyed alike.

Sliding Door Track: for both glass and wood sliding doors shall be anodized aluminum double channel.

Coat Rods: shall be 1-1/4 in. diameter, 14 gauge chrome plated steel installed in captive mounting hardware.

Hanging File Suspension Rails: All file drawers shall include a pair of 14 gauge steel hanging file suspension rails, epoxy coated. File followers, or other split bottom hardware, shall not be acceptable.

Mirrors: shall be 1/4 in. thick polished mirror plate.

Undercounter Support Frame: Welded steel countertop support frames shall be provided at all kneespaces where indicated on drawings. Frames shall be available in 3 in. increments to clear span 24 in. to 60 in. width. Frames shall readily accept pencil and kneespaces drawers, and shall be designed to interface undercounter support brackets.

Fabricate casework to dimensions, profiles, and details shown.

Cabinet Body Construction: Tops and bottoms shall be joined to cabinet ends and internal cabinet components such as fixed horizontals, rails and verticals using 10mm diameter industrial grade hardwood dowels, laterally fluted with chamfered ends, securely glued and clamped under pressure during assembly to secure joints and cabinet squareness. Use minimum of six (6) dowels at each joint for 24 in. deep cabinets and minimum of four (4) dowels at each joint for 12 in. deep cabinets.

Core shall be 3/4 in. thick particleboard.

Unit backs shall be 1/4 in. thick prefinished hardboard or 1/2 in. thermoset melamine particleboard inset, color matched to cabinet interior. Exposed back on fixed or movable cabinets to be 3/4 in. particleboard, color matched to cabinet interior, exterior surface GP28 laminate as selected.

All fixed undercounter and tall units shall have a separate plywood base. This base should be 96mm or approximately 4 in. high.

All undercounter units except sink base units, shall be provided with full sub-top. Sink base units shall be provided with open top, front welded steel/epoxy painted sink rail full width at top front edge concealed behind face rail/doors, split back removable access panels and bottom panel to have CL20 high pressure cabinet liner both faces, color to match interior color. Exceptions will not be permitted.

All end panels and vertical dividers, except sink base units, shall be prepared to receive adjustable shelf hardware at 32mm (approximately 1-1/4 in.) centers. Door hinges, drawer slides and pull-out shelves shall mount on line boring to maintain vertical alignment of components and provide for future relocation of doors, drawers, shelves and/or pull-out shelves.

All exposed and semi exposed edges of basic cabinet components are factory edged with PVC banding, machine applied with waterproof hot melt adhesive.

1. Edging shall be 3mm PVC available in a minimum of 10 standard colors.
Adjustable shelf core shall be 3/4 in. thick particleboard up to 30 in. wide, 1 in. thick particleboard over 30 in. wide.

1. Front edge shall have factory applied 3mm PVC, color to match shelf color.
2. Any shelving over 30 in. wide shall have a mid shelf support or steel shelf stiffener.

Interior Finish, Units with Open Interiors:
1. Sides, top, bottom, horizontal, and vertical members, and adjustable shelving faced with thermally fused melamine laminate with matching prefinished back.

Interior Finish, Units with Closed Interiors:
1. Sides, top, bottom, horizontal, and vertical members, and adjustable shelving faced with thermally fused melamine laminate, from manufacturers standard color options, with matching prefinished back.

Exposed Ends:
1. Shall be faced with high pressure decorative laminate GP28 (.028) color from casework manufacturer's full range offering of at least 120 colors.

Wall Unit Bottom:
1. Shall be faced with thermally fused melamine laminate.

Wall and Tall Unit Tops:
1. Top surface will be laminated with thermally fused melamine.

Balanced construction of all laminated panels is mandatory. Unfinished core stock surfaces, even on concealed surfaces (excluding edges), will not be permitted. No exceptions.

Drawers: Sides, back and sub front shall be particleboard, 1/2 in. thick, laminated with thermally fused melamine. The back and sub front are doweled and glued into the sides. Dowels shall be fluted, with chamfered ends and a minimum diameter of 8mm. Top edge is banded with 1mm PVC edging in a matching color.

Drawer bottom shall be particleboard, 1/2 in. thick, laminated with thermally fused melamine. The bottom shall be screwed directly to the bottom edges of the drawer box. Drawer bottom less than 1/2 in. thick.

Paper storage drawers are constructed similar except retaining hood shall be included at the rear of each drawer.

Painted finishes on drawer sides and/or bottom will not be permitted.

Bottoms constructed of minimum 1/4 in. tempered hardboard, surfaced to match drawer sides, inset and glued to four sides is also acceptable.

Door/Drawer Fronts: Core for all doors and applied drawer fronts shall be 3/4 in. thick particleboard. All edges shall be finished as indicated herein.

Double doors shall be used on all cabinets in excess of 24 in. wide.

Exterior faces shall be laminated with high pressure decorative laminate GP28, color as selected. Interior face shall be high pressure cabinet liner CL20.

All edges shall be finished with 3mm PVC available in standard offerings from manufacturer. A minimum of 50 solid colors available. External edges and outside corners shall be machine profiled to 1/8 in. radius.

DECORATIVE LAMINATE COUNTERTOPS: All nominal 1 in. thick laminate clad countertops shown on drawings shall be constructed with 1 in. particleboard core laminated top face with GP50 (.050) high pressure decorative laminate, with BK20 backer or GP28 laminate underside for balanced construction. Provide tight joint fasteners where needed. All exposed edges, including edges of backsplash where used, shall have 3mm PVC banding, machine applied with waterproof hot melt adhesive. Exposed edges and corners shall be machine profiled to 1/8 in. radius for safety. All tops in wet areas to have MR board or plywood cores.
EXECUTION

☑ INSPECTION: The installer must examine the job site and the conditions under which the work under this section is to be performed, and notify the contractor in writing of unsatisfactory conditions. Do not proceed with work under this section until unsatisfactory conditions have been corrected in a manner acceptable to the installer.

☐ Condition casework to average prevailing humidity conditions in installation areas prior to installing.

☐ Install casework with factory-trained supervision authorized by manufacturer. Erect casework; plumb, level, true and straight with no distortions. Shim as required. Where laminate clad casework abuts other finished work, scribe and cut to accurate fit.

☐ Adjust casework and hardware so that doors and drawers operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer. Use filler as necessary for ease of operation.

☐ Repair or remove and replace defective work as directed upon completion of installation.

☐ Clean plastic surfaces, repair minor damage per plastic laminate manufacturer's recommendations. Replace other damaged parts or units.

☐ Advise contractor of procedures and precautions for protection of casework and tops from damage by other trades until acceptance of the work by the owner.

END OF SECTION
### ATTACHMENT 12304-A - LAMINATE CASEWORK FEATURES

<table>
<thead>
<tr>
<th></th>
<th>CORE</th>
<th>SURFACE</th>
<th>EDGE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cabinet Boxes - Base &amp; Wall</strong> (Maximum width: 36&quot;)</td>
<td>All front &amp; sides: 3/4&quot; Base bottom: 3/4&quot;</td>
<td>GP28</td>
<td>Finish all exposed edges (including wall cabinet top and bottom). 3mm PVC.</td>
</tr>
<tr>
<td><strong>Exposed vertical surfaces</strong></td>
<td>Wall top &amp; bottom: 1&quot; Back: entrapped - 1/4&quot; Back: onset - 1/2&quot;</td>
<td>CL20 or melamine</td>
<td></td>
</tr>
<tr>
<td><strong>Semi-exposed parts (interior of open cabinets, not including drawer bodies)</strong></td>
<td>Full sub-top</td>
<td>CL20 or melamine</td>
<td>GP28</td>
</tr>
<tr>
<td><strong>Concealed surfaces</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Panel ends</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Countertops &amp; Backsplash (wet areas)</strong></td>
<td>1&quot; exterior grade veneer core plywood or phenolic resin particleboard</td>
<td>GP50 balanced with backing sheet</td>
<td>3mm PVC</td>
</tr>
<tr>
<td><strong>Countertops &amp; Backsplash</strong></td>
<td>1&quot; particleboard</td>
<td>GP50 balanced with backing sheet</td>
<td>3mm PVC</td>
</tr>
<tr>
<td><strong>Cabinet Doors</strong></td>
<td>3/4&quot; particleboard</td>
<td>GP28 with CL20 liner on back.</td>
<td>3mm PVC</td>
</tr>
<tr>
<td><strong>Drawer Fronts</strong></td>
<td>3/4&quot; particleboard</td>
<td>GP28 with CL20 liner on back.</td>
<td>3mm PVC</td>
</tr>
<tr>
<td><strong>Drawer Sides and Backs</strong></td>
<td>1/2&quot; particleboard or 5/8&quot; medium density fiberboard</td>
<td>Melamine on all visible surfaces with drawer in normal open position.</td>
<td></td>
</tr>
<tr>
<td><strong>Drawer Bottoms</strong></td>
<td>Fully captured construction - minimum thickness: 1/4&quot; Platform construction minimum thickness: 1/2&quot;</td>
<td>Melamine panel product or particleboard.</td>
<td></td>
</tr>
<tr>
<td><strong>Shelves (Maximum span: 36&quot;, except for 48&quot; span above K-5 cubby units). (Any span over 30&quot; should have additional support).</strong></td>
<td>3/4&quot; particleboard ≤ 30&quot;W. 1&quot; particleboard &gt; 30&quot;W.</td>
<td>GP28 or melamine</td>
<td>3mm PVC</td>
</tr>
</tbody>
</table>

**NOTES:**

1 – Dimensions given are minimum and actual (not nominal).
2 – Balanced construction is required on all components.
3 – All hardware (latches, hinges and pulls) must be ADA compliant.
4 – All PVC edges must be machine applied with hot melt adhesive. All PVC edges must be machine radiused.
5 – Toe kick should be separate, and of plywood construction.
6 – Warranty should be 3 years.
7 – At the owner/architect’s request, AWI certification may be required, paid for by the manufacturer.
8 – Reference AWI 7th edition, Section 1600 as guide for engineered product. Do not reference Section 400.
9 – Pre-approved manufacturers are: TMI, Interior Wood Specialties and Stevens. All others must be approved by addenda.
10 – All particleboard is to be medium density, 45 – 50 lb. industrial grade fir or pine, meeting or exceeding ANSI A 208.1-1993, M-3 requirements.

SECTION 15000 – GENERAL PLUMBING & MECHANICAL REQUIREMENTS

GENERAL

☐ The following Design Criteria are general items that shall apply to the design of all Plumbing and HVAC Systems in the buildings.

DESIGN REQUIREMENTS

☐ In any building where future expansion is definitely planned, as conveyed by the WCPSS, the Engineer shall provide adequate additional capacity and connection points in the Mechanical Systems as directed by the WCPSS. The additional capacity shall be clearly noted on the front sheet of the drawings.
☐ Show on drawings and specify that all water piping shall be located a minimum of 10 ft. from electrical switchboards and panel boards.
☐ The electrical contractor shall provide all power wiring to each piece of mechanical equipment. The mechanical contractors shall be required to furnish all starters and disconnects and turn over to the electrical contractor for installation and also to make final connections from slack wire left by electrical contractor to each piece of equipment. Show detail on drawing to avoid confusion. See attachment 16142-A.
☐ All points for future connections shall also be clearly shown and labeled on the drawings with the capacity (GPM, Tons, kW, etc.) that is available for future at each connection point.
☐ Do not locate pumps, motors, or other equipment requiring routine maintenance overhead.
☐ Do not use in-line exhaust fans located above ceiling.
☐ See section 15500-4, Lines 4 & 5 for location of fresh air intakes.

ENERGY CONSERVATION – See Section 01000-General Data

DRAWING REQUIREMENTS

☐ All text and numbers shall be a minimum of 3/32 in. high to allow for a 1/2 reduction of the drawing size and still be readable.
☐ Provide key plan for all sheets.
☐ Provide Volume 10 Building Energy Data on cover sheet to drawings.
☐ Show details of all pipe, duct, conduit and wiring penetration details on the drawings for all fire rated walls to meet UL and Local Code Requirements.
☐ Show all fire rated walls on all drawings for all trades with the rating spelled out or show different wall symbol for each rating (1HR, 2HR, or 4HR).
☐ Show location of all supply air, return air, outdoor air and exhaust air balancing devices on plans.
☐ All air handling equipment, pumps, motors, valves etc., shall be mounted in areas easily accessible for routine maintenance. Provide 3 ft. clearance, minimum, around equipment for access to motors, compressors, bearings, controls, filters, valves, etc. Provide filter change space and coil pull space. The access door for the filters should be one that does not require maintenance personnel to use tools to open. (See Section 15500-5, Line 18)
Locate relative equipment together, i.e. in the same room and on the same floor. Do not layout equipment rooms such that equipment, piping and/or duct work must be removed to perform maintenance. Do not locate equipment overhead.

☐ Provide permanently fixed access to ceiling mounted air handling units for auditoriums, gymnasiums or other large volume areas, i.e. catwalk, stairs etc. Maintenance on these units shall not require a boom, lift or extension ladder.

☐ Engineer shall provide standard electrical connection detail (see Attachment 16142-A) on plumbing and mechanical plans.

☐ Show dotted lines on floor plans of all mechanical rooms and all other heavily concentrated areas to designate pull spaces for equipment, (coils, motors, etc.) and maintenance space for equipment (filter change out, lubrication, belt replacement, bearing replacement, compressor replacement, valve maintenance, etc.). Also show minimum of three (3) ft. of clearance around all mechanical and electrical equipment including wall clearances. Show greater clearance where recommended by manufacturer.

☐ Show a complete legend and symbol list on the first sheet for all trades (Plumbing, HVAC, Electrical, etc.).

☐ Where terminal units and/or piping is to be installed exposed in classrooms, media centers, cafeterias, kitchens, administrative areas or other finished areas of the building, a detailed isometric scaled typical detail shall be shown of the equipment and/or piping and the walls, ceiling and floor of the room.

☐ Show complete piping schematic drawings for all piping systems.

☐ Isometric piping diagrams shall be shown for all mechanical equipment used in the building showing all fittings, valves, thermometers, gauges, and other devices required for proper operations and isolation.

☐ All mechanical and boiler rooms shall be blown up to a scale of a minimum of 1/4 in. = 1 ft. and all equipment in the room including piping shall be drawn to scale with all clearances shown. Show all trades on the blow up drawings. Show a minimum of two (2) sections through the rooms or show the room in a full isometric drawing. Show all door swings. Do not block access for any item of equipment with another.

☐ Access to mezzanine mechanical rooms shall be stairwell (not a ships ladder) leading up to the mezzanine mechanical room with a minimum width of 4 ft. Design insulated walls around the mezzanine mechanical rooms with a waterproof membrane and floor drains in the floor. Provide hoist where necessary to install and service equipment. Coordinate this between Architect/Engineer.

☐ All building heating loads (MBH), cooling loads (tons), domestic hot and cold water demand (GPM), waste load (fixture units), connected electrical loads (kW), gas loads (cfh), list of "U" valves and estimated maximum electrical demand (kW) shall be clearly shown in tabular form on the front sheet of the P/M/E drawings for all trades.

☐ All capacities provided for future building additions shall also be shown in this table.

☐ Show all mechanical and electrical equipment to scale including panelboards, fire alarm panels, sound panels, water heaters etc.

SPECIFICATIONS

☐ Show a list of acceptable manufacturers for all items of equipment specified. Refer to this document or if uncertain, consult with the WCPSS.

☐ Specify maximum noise levels for each type of equipment specified. Note: Do not locate noisy equipment near noise sensitive areas of the building. Room noise levels shall not exceed NC level 35. Equipment decibel levels inside building shall not exceed 50 dB.

☐ Engineer shall not locate noisy outdoor equipment (i.e. chillers, cooling towers, etc.) in locations that will result in complaints from adjacent property owners.
1. Specify minimum energy efficiency for each item of mechanical and electrical equipment based on its operating conditions. For a water chiller specify the minimum efficiency at the 25, 50, 75 and 100% operating conditions.

2. Specify that the Mechanical Contractor shall balance all air and water systems. Once the Contractor certifies to the Owner that the systems are balanced, and the Engineer has approved the report, the Owner will have an AABC or NEEB Certified Test and Balancing Contractor confirm that the systems are balanced. If the Owner’s Test and Balancing Contractor discovers discrepancies of more than 10% than the values called for on the construction documents, the Mechanical Contractor will rebalance the system and the Owner’s Test and Balancing Contractor will re-test the system. The specifications shall further state that any re-test by the Owner’s Test and Balancing Contractor will be paid for by the Mechanical Contractor.

3. Specify five (5)-year warranty for all compressors.

4. Specify all filters for AHU’s to be pre-cut type and that the Mechanical Contractor shall be responsible for a complete change of filters at final completion and leaving an additional set of pre-cut filters at the school for the next change.

5. Specify that all belt driven equipment shall be provided with a spare belt to be turned over to the Maintenance Department.

6. Specify that all warranties shall commence from the date of Substantial Completion, not from the start-up date of the equipment.

OPERATING AND MAINTENANCE MANUALS (See Section 01000-General Data)

7. Specify that four (4) complete sets of operation and maintenance manuals shall be delivered to the owner through the A/E two (2) weeks before the pre-final inspection is held.

8. The O&M manuals shall be installed in 3 ring heavy back note books with the name of the building and the words “Operations and Maintenance Manuals” permanently affixed to the cover and spine.

9. The manuals shall contain the following items as a minimum:
   - Index and page numbers
   - Certificate of substantial completion
   - A summary sheet of warranties with the dates noted and a copy of all warranties
   - List of all subcontractors and suppliers with names, addresses and phone numbers
   - Certified testing and balancing report
   - Complete start-up operation, and shut-down procedures for each system including sequence of events, locations of switches, emergency procedures and any other critical items
   - Lubrication schedules and types of lubricants
   - Complete set of current shop drawings and equipment description showing all capacities and other operation conditions
   - Equipment summary showing all capacities and ratings (HP, Tons, kW, Filter size, etc.)
   - All submittal data and shop drawings

FINAL INSPECTIONS (See Section 01000-General Data)

POST INSPECTION (See Section 01000-General Data)

END OF SECTION
SECTION 15050 - PLUMBING SYSTEM, GENERAL

GENERAL

All provisions of the “General Plumbing & Mechanical Requirements Section 15000” shall apply to this section.

All water consuming devices shall be the water saving type.

Provide positive freeze protection on all water lines subject to freezing conditions.

Provide a ball valve in branch piping to all exterior hose bibs. Where suitable, locate hose bibs adjacent to exterior mechanical rooms, dropping branch piping exposed in mechanical room and locating ball valve a maximum of 6 ft. above finish floor.

Contractor shall be required to completely rod and flush out all sanitary waste lines both new and existing after a building is completed.

Tempered water shall be provided at all locations.

Specify copper fin tube water heater with a separate lined storage tank for domestic water heaters.

Provide chrome escutcheon rings at all exposed ceiling and wall penetrations.

Provide isolation valves in cold water and hot water piping so that water can be shut off to each classroom wing, administration area, group toilets and science classrooms.

Engineer shall specify plaster type P-traps for all art room sinks.

Provide floor drain with deep seal P-trap and indirect type trap primer at science eye wash station.

END OF SECTION
SECTION 15100 - PLUMBING VALVES

GENERAL

☐ Use one valve manufacturer throughout job.

PRODUCTS

☐ Where insulation is required, provide extended valve stems.

☐ Domestic hot water and cold water - Ball valves, 2 in. and smaller - class 125, 200 WOG cast bronze, soldered ends. 2-1/2 in. and larger - class 125 iron body.

☐ Compressed air - ball valves, 400 WOG, two-piece construction, full size port.

☐ Natural gas - plug valves 2 in. and smaller, 150 WOG bronze body, square head, threaded ends, 2-1/2 in. and larger, 175 WOG lubricated plug type, semi steel body, flanged ends.

☐ Globe valves (bypass only) 2 in. and smaller, class 125 cast bronze solder ends, 2-1/2 in. and larger, class 125 iron body, flanged ends.

☐ Swing check valves, 2 in. and smaller, class 125 cast bronze, threaded ends, 2-1/2 in. and larger, class 125, cast iron body, flanged ends.

END OF SECTION
PRIVATE WATER SUPPLY

- Well (6 in. minimum) will be located and bored by WCPSS.
- Plumbing contractor shall provide submersible pump, hydropneumatic storage tank, chlorinator & filters.
- Pump house by general contractor.
- No meters required.

PRODUCTS

- Locate meter at property line and/or right of way line in non-traffic area.
- Provide second water only meter for irrigation, cooling tower, and other non-sewer services. This will be on separate water line from main building service.
- Water tap, meter & vault costs provided by plumbing contractor.
- Meter deposit paid by WCPSS.
- WCPSS is exempt from paying acreage fees.
- Underground water service; 2-1/2 in. and less - type “K” copper w/silver solder joints; 3 in. and above; cement lined ductile iron ASTM C151 with mechanical joints except straight sections may be push - on joints.
- Minimum 18 in. cover to top of pipe for 2-1/2 in. and smaller.
- Minimum 48 in. cover to top of pipe for 3 in. and larger.
- Backflow preventer (Watts 909 DDC) for fire line.
- Backflow preventer (Watts 909S) for irrigation.
- Backflow preventer for fire loop or irrigation shall be located above ground in a vault or insulated cover.
- Fire loop around building shall be 8 in. minimum with fire hydrants spaced no greater than 300 ft. and no parts of the building no more than 300 ft. from a hydrant.
- Fire hydrants and valves shall be approved by local inspectors.
- Provide profile of water distribution lines to site from nearest source of municipal water with all interference.
- Engineer shall require contractor to dimension actual location of all underground water lines on as-built drawings. A minimum of two (2) dimensions from building reference points shall be provided and a bury depth indicated.

END OF SECTION
SECTION 15120 - SEWAGE DISPOSAL

PUBLIC SANITARY SEWER LINES

- Manholes spaced no more than 300 ft.
- Provide manhole to make tie-in to 6 in. and larger sewer.
- Use 4 ft. diameter precast eccentric manholes with steps 15 in. on center.
- Minimum cover in non-traffic areas 3 ft.
- Minimum cover in traffic area - 5 ft. for pvc, 3 ft. for ductile iron on Class I bedding.
- Materials:
  - a. Ductile iron class 50 with push on joints - ASTM C-150 (8 in. and larger)
  - b. PVC ASTM D-3034 SDR 35 on Class I bedding (8 in. and larger)
  - c. PVC schedule 40 ASTM, D2665 (4 in. and 6 in.)
  - d. Cast iron ASTM A74 hub and spigot service weight (4 in. and 6 in.)
- Provide profiles of sanitary sewer lines between manholes.
- Use laser instrument to install all exterior sanitary sewer lines.
- Use drop manhole if elevation of sewer line exceeds 24 in. above manhole invert.
- Minimum slope of sewer lines:
  - 4 in. - 1.00%
  - 6 in. - .60%
  - 8 in. - .50%
  - 10 in. - .28%
  - 12 in. - .22%
- Minimum flow velocity - 2 FPS
- Sewer lines shall be straight with uniform slope between manholes.
- Maximum slope is 10%.
- Show new and existing grade contours on plan.
- Install metal identification tapes over PVC sewer lines.
- Engineer shall require contractor to dimension actual location of all sewer lines on as-built drawings. A minimum of two (2) dimensions from building reference points shall be provided and a bury depth indicated at a maximum spacing of 100 ft.
- Provide a minimum of a 6 inch sewer waste line from all group toilet restrooms.

END OF SECTION
SECTION 15125 - IRRIGATION SYSTEM

GENERAL

☐ Use backflow preventer - Watts No. 909S.

☐ Use metered water supply so the amount of water used for irrigation can be subtracted from main meter to save sewage charges. (See Section 15110)

☐ Use Toro heads and control panel as an alternate if not used for base bid.

☐ Use triple elbow swing joints at all heads.

☐ Use hydraulic valve in head gear driven rotor pop-up adjustable nozzle Toro heads.

☐ Irrigation supply line - PVC SDR 21/PR200 type 1, grade 1 with PVC schedule 40 solvent weld fittings.

☐ Install metal identification tapes over PVC lines.

☐ Minimum 24 in. cover to top of irrigation piping.

☐ Engineer shall require contractor to dimension actual location of all irrigation lines on as built drawings. A minimum of two (2) dimensions from building reference point shall be provided and a bury depth indicated.

END OF SECTION
SECTION 15131 - KITCHEN PLUMBING

Use stainless steel 12 in. x 12 in. x 10 in. ZURN Z-1752-KC-Y-2 floor sink for indirect waste from prep and pot sinks & steamer.

Use 7 in. round recessed strainer floor drain for indirect waste from ice machine, serving line equipment and cooler/freezer.

Use stainless steel floor troughs for wastes from cutter mixer, tilting skillet, and area in front of steamer and steam kettle. Use stainless steel strainers built-in as a component of trough.

Use hand sinks with wrist blade handles.

Supply 120 deg. F. water to hand sink.

Use cleaning faucet - American Standard or similar and mount under hand sink 12 in. above finish floor.

Use floor drain under cleaning faucet.

Add adequate quantity of general area floor drains to kitchen so entire floor can be hosed down.

Use utility raceway to serve equipment under hood. Use flexible hoses to serve equipment. Length of hoses shall be adjusted or shortened to prevent hoses from lying on floor.

Kitchen equipment shall utilize natural gas where available. Do not use LP gas.

Hood manufacturer shall furnish solenoid gas shut off valve to Plumbing Contractor for installation.

Add electric water cooler in kitchen area.

Supply 140 deg. F. to dishwasher, prep and pot sinks, can wash and mop receptor.

Circulate hot water for 140 deg. F. and 120 deg. F. loops.

Use American Standard freeze proof mixing faucet for can wash.

Use non-clog floor drain for can wash.

Do not connect disposals to grease interceptor.

Use fill faucet for cutter mixer.

Use copper pipe for prep and pot sink continuous waste.

Use backflow preventer - Watts No. 909 for cold water and hot water Kitchen supply.

Use shock absorbers for all solenoid operated equipment.

Use Wake County Health Dept. water heater sizing chart to check for adequate kitchen hot water.

All final connections to kitchen equipment shall be done by Plumbing Contractor except items connected to utility raceway.

Kitchen equipment contractor shall furnish and install faucets for prep and pot sinks.

Kitchen equipment contractor shall furnish to Plumbing Contractor for installation in water piping items such as solenoid valves, thermometers, etc.

Provide water filter at kitchen icemaker connection.

END OF SECTION

DEFINITIONS AND ABBREVIATIONS - 01000 -111
SECTION 15140 - PLUMBING SUPPORTS AND ANCHORS

GENERAL
Use one hanger manufacturer throughout job.

PRODUCTS
- Horizontal piping hangers - insulated piping shall have hanger around insulation with rigid insulation above shield. Use adjustable steel clevis hangers.
- Vertical piping clamps - size to fit bare pipe, copper plated for copper piping.
- Building attachments - use beam clamp with retaining strap or concrete inserts.

EXECUTION
- Use trapeze hangers where possible to rack piping together.
- Do not support piping from bar joist bridging and/or roof deck.
- Support all piping so as to prevent excessive movement.

END OF SECTION
SECTION 15190 - PLUMBING IDENTIFICATION

GENERAL
Use same identification system throughout project.

PRODUCTS
- Pipe markers and flow arrows: Stencil paint type
- Underground plastic pipe marker: 6 in. wide x 4 mils thick multi-ply tape, solid aluminum foil core between two (2) layers of plastic tape.
- Valve tags: 19 gauge polished brass valve tags. Contractor to furnish valve schedule mounted behind glass in a frame located in main mechanical room.
- Above ceiling valve markers: 1/2 in. dia. self-adhesive color coded circle. Color code as noted below.
- Engraved plastic-laminate sign: 1/16 in. thick, fastened with self-tapping stainless steel screws

EXECUTION
- Locate pipe markers and flow arrows as follows:
  - maximum of 25 ft. and closer if congested
  - near each valve
  - near each branch
  - near equipment
  - near origination & termination points
  - near where pipe passes through walls (both sides of wall)
  - near access doors
- Paint and color code all exposed piping in mechanical and boiler rooms. Piping shall have flow arrows and labels located at 10 ft. intervals, at all turns and at each floor or wall penetration and be color coded as follows:
  - Cold Water - Dark Blue
  - Hot Water - Dark Red
  - Gas Lines - Yellow
- Provide brass valve tag on all valves.
- Provide ceiling valve marker for valves located above lay-in ceilings. Attach valve marker to adjacent ceiling grid.
- Provide plastic laminated signs on all equipment. Include equipment identification, capacity, substantial completion date and warranty information.

END OF SECTION
SECTION 15250 - PLUMBING INSULATION

GENERAL
- Flame/smoke ratings: flame-spread index of 25 or less and smoke-developed index of 50 or less, as tested by ASTM E84 (NFPA 255) method.

PRODUCTS
- Fiberglass insulation: ASTM C 547 Class I with Type I all service jacket.
- Exposed insulation - 8 oz. canvas rosin sized cloth jacket.
- Fittings: one-piece pre-molded PVC fitting covers.

EXECUTION
- Insulate all domestic water piping with 1 in. thick minimum insulation except for recirculation hot water which needs to be insulated with 1-1/2 in. thick insulation. Insulate roof leader horizontal piping with 1 in. thick insulation to include roof drain pan and vertical piping from roof drain.
- Install 20 gauge galvanized metal jackets on all exposed insulated lines within 8 ft. above floor in occupied spaces. Prime metal jacket with paint grip finish.
- Provide sheet metal saddle at all pipe hangers.
- Provide rigid insulation at pipe hangers for all insulated piping 2 in. and larger.

END OF SECTION
SECTION 15411 - DOMESTIC WATER PIPING

GENERAL
- Covers domestic hot water and cold water piping within building to a point 5 ft. outside building.

PRODUCTS
- Underground piping: type “K” copper with silver soldered joints. Do not locate joints below slab of building.
- Above ground piping: type “L” copper with silver soldered joints.
- Backflow preventer located in building - reduced pressure principle assembly with strainer, Watts No. 909S. Locate between 12 in. and 60 in. above finish floor. Pipe discharge around room to floor drains. Provide pressure gauges on entering and leaving sides of assembly.
- Pressure regulating valve: Provide for all installations. Include strainer, bypass and pressure gauge.

END OF SECTION
SECTION 15420 - DRAINAGE AND VENT SYSTEMS

GENERAL

Includes sanitary, acid and storm drainage and vent piping systems inside building to a point 5 ft. outside building. Roof drains are to be furnished and installed by General Contractor. Plumbing Contractor connects to roof drain outlet.

PRODUCTS

- Underground Sanitary and Storm Drainage and Vent Piping:
  1. Schedule 40 PVC.
- Aboveground Sanitary and Storm Drainage Piping:
  1. Schedule 40 PVC.
- Aboveground Sanitary Vent Piping:
  1. Schedule 40 PVC.
- Joints:
  1. Cemented Joints.
- Underground Acid Waste and Vent Piping:
  1. Acid resistant Polypropylene pipe schedule 40 flame retardant with socket fittings. Electrical fusion or heat fusion joints.
- Aboveground Acid Waste and Vent Piping:
  1. Acid resistant polypropylene pipe, schedule 40, flame retardant with socket fittings. Electrical fusion or heat fusion joints.
- Cleanouts - Josam:
  1. Do not install cleanouts in carpet or gym floors
  2. Floor cleanouts:
     a. Exposed rim type, with recess to receive 1/8 in. thick resilient floor finish.
     b. Exposed flush type, standard non-slip scored or abrasive finish
  3. Wall cleanouts: Cast iron body with cast-bronze cleanout plug, stainless steel cover.
  4. Cleanouts at finish grade: Cast brass plug with recessed slot in fitting or in caulked cast iron ferrule. Set in center of 24 in. x 24 in. x 8 in. thick concrete pad flush with grade.
- Flashing Materials:
  1. Vent flashing - 16 oz per square ft. sheet copper or 4 lbs./square ft. sheet lead shop fabricated into one-piece base flashing and separate counter (cap) flashing.
  2. Single ply (rubber roof) flashing will be furnished and installed by General Contractor.
- Use PVC piping with proper flame/smoke rating in return air plenums or wrap with insulation to provide proper protection.

EXECUTION

- Install underground drainage mains with the laser beam alignment system.
- Pipe sleeves - schedule 40 black steel.
- Install all V.T.R. a minimum of 15 ft. from fresh air intake.
- Depress floor drains below room perimeter minimum of 1/2 in.
- Route waste piping from science classrooms to acid dilution tank and tie into sanitary sewer.

END OF SECTION

DEFINITIONS AND ABBREVIATIONS- 01000-116
SECTION 15440 - PLUMBING FIXTURES

GENERAL

☑ Specify all vandal-proof options for all fixtures used by students. This includes handle screws, aerators and showerheads.

☑ American Standard, Eljer or Kohler are acceptable manufacturers for cast-iron and vitreous china fixtures. All fixtures shall be white.

☑ Elkay and Just are acceptable manufacturers for stainless steel sinks. Sinks shall be 18 gauge.

☑ Specify Carriers for all wall hung fixtures including urinals and lavatories.

☑ Specify all water closets to be floor mounted.

☑ Specify chrome plated rigid supplies with angle I.P.S. loose key stops for all gang toilet lavatories - such as McQuire No. 158 LK. Wheel handle stops may be used for K-5 School and all administration areas.

☑ Specify chrome plated cast brass p-trap and wall nipple for all lavatories - such as McQuire No. 8090 with No. 2127 nipple.

☑ Specify chrome plated semi-cast 17 gage brass p-traps for all sinks and water coolers - such as McQuire No. 8902 or 8912.

☑ Specify separate stops for all fixtures unless integral stops.

☑ Sloan or Delany are acceptable manufacturers of flush valves with solid ring supports.

☑ Specify chase for multiple lavatory installations (minimum 6 in. clear).

☑ A walk-in plumbing chase shall not be specified at group toilets.

☑ Specify plaster p-trap for all art room sinks.

☑ Specify primer valves and/or deep seal p-traps for floor drains in mechanical rooms. Locate primer valve inside mechanical room.

☑ Specify floor drain with indirect style trap primer at emergency eye wash stations (new construction only).

☑ Connect circulating pumps to DDC system.

☑ Specify separate flue for water heater.

☑ Specify separate fuel oil lines from fuel oil tank for water heater.

☑ Use gas water heaters for kitchens and gym areas. Use small tank type electric water heaters for remote uses. Do not use instantaneous water heaters.

☑ Specify key operated chrome plated box type hose bibb flush with wall for group toilets - such as Woodford No. B24.

☑ Specify key operated box type automatic draining non-freeze wall hydrants around exterior of building so that 100 feet of hose will reach all windows - such as Woodford No. B65, Josam or Zurn. Provide ball valve in branch piping for isolation purposes.

☑ Dimension all floor drain locations on drawings.

☑ Specify washer box for all residential type washing machines with cold water, hot water and drain for both commercial and residential use.

☑ Specify tempered water to student group showers - single handle control. Locate thermostatic mixing valve in lockable cabinet in coach’s office.

☑ Specify cast-iron wall hung lavatories, 4 in. centers, 20 in. x 18 in. grid drain - such as American Standard “Regalyn” 4869.020 for lavatories served by both hot and cold water.

☑ Provide both cold and hot water to all lavatories.

☑ Specify single lever centerset lavatory fitting for administrative toilets.

☑ Branch piping to custodial closets: Provide check valves in cold and hot water piping.

☑ Specify metered faucets (laser is preferred) on lavatories at group toilet rooms. Ease of operation is a must for small children (no push buttons). Note: Engineer shall check
with local code officials to see if this requirement can be omitted on elementary campuses
for the K-1 wing.

☐ Specify single bowl sinks for classrooms and workrooms. Provide double bowl sinks for
teacher's lounge and Exceptional Children areas.

☐ Specify pre-cast mop receptor with stainless steel wall protector.

☐ Specify cold water for all refrigerator icemakers.

☐ Specify floor mounted elongated bowl water closets

☐ Specify institutional grade water closet seats with self-sustaining check hinge. Church
No. 9500.NSSC.

☐ Specify flush valve for all water closets with handle 39 in. above finish floor. Coordinate
water closet flush valve height with grab bars.

☐ Specify thermostatic mixing valves to provide 120 °F hot water temperature from water
heater that serves kitchen with 140°F water.

☐ Specify wall-mounted drinking fountain - enameled cast iron - Haws Model 1310. Use
for K-1 classroom not supplied with lavatories and 6-12 locker rooms.

☐ Specify wall mounted wheel chair type electric water cooler, electric push button on front
colored vinyl covered steel skirt, flexible safety bubbler spout, Oasis or Halsy-Taylor.
Use for all K-12 applications.

☐ Specify ASME expansion tanks for water heaters larger than 80 gallons.

☐ Do not connect oil/gas water heaters to DDC system due to thermal shock of tank.

☐ Provide key operated solenoid water valves for each science lab. Do not allow fork type
keys to be used. Key switch to be labeled “CW” for cold water and “HW” for hot water
and show “ON” and “OFF” position. Label to be engraved plastic laminate. Valve to be
normally closed.

☐ PLUMBING FIXTURES MOUNTING HEIGHTS

<table>
<thead>
<tr>
<th>WATER CLOSETS</th>
<th>REGULAR</th>
<th>HANDICAPPED</th>
<th>REMARKS</th>
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</thead>
<tbody>
<tr>
<td>Pre K</td>
<td>10 in.</td>
<td>10 in.</td>
<td>Top of Seat</td>
</tr>
<tr>
<td>K-5</td>
<td>15 in.</td>
<td>15 in.</td>
<td>Top of Seat</td>
</tr>
<tr>
<td>6-8</td>
<td>15 in.</td>
<td>16-1/2 in.-19-1/2 in.</td>
<td>Top of Seat</td>
</tr>
<tr>
<td>9-12</td>
<td>15 in.</td>
<td>16-1/2 in.-19-1/2 in.</td>
<td>Top of Seat</td>
</tr>
<tr>
<td>Adult</td>
<td>15 in.</td>
<td>16-1/2 in.-19-1/2 in.</td>
<td>Top of Seat</td>
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<table>
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<th>REMARKS</th>
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<tbody>
<tr>
<td>K-5</td>
<td>20 in.</td>
<td>14 in.</td>
<td>To Rim</td>
</tr>
<tr>
<td>6-8</td>
<td>20 in.</td>
<td>17 in.</td>
<td>To Rim</td>
</tr>
<tr>
<td>9-12</td>
<td>24 in.</td>
<td>17 in.</td>
<td>To Rim</td>
</tr>
<tr>
<td>Adult</td>
<td>24 in.</td>
<td>17 in.</td>
<td>To Rim</td>
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</tbody>
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<table>
<thead>
<tr>
<th>LAVATORIES</th>
<th>REGULAR</th>
<th>HANDICAPPED</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre K</td>
<td>23 in.</td>
<td>23 in.</td>
<td>To Rim</td>
</tr>
<tr>
<td>K-5</td>
<td>27 in.</td>
<td>30 in.</td>
<td>To Rim</td>
</tr>
<tr>
<td>6-8</td>
<td>31 in.</td>
<td>34 in.</td>
<td>To Rim</td>
</tr>
<tr>
<td>9-12</td>
<td>31 in.</td>
<td>34 in.</td>
<td>To Rim</td>
</tr>
<tr>
<td>Adult</td>
<td>31 in.</td>
<td>34 in.</td>
<td>To Rim</td>
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</tbody>
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<table>
<thead>
<tr>
<th>WATER COOLERS</th>
<th>REGULAR</th>
<th>HANDICAPPED</th>
<th>REMARKS</th>
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</thead>
<tbody>
<tr>
<td>Pre K-3</td>
<td>24 in.</td>
<td>30 in.</td>
<td>To Rim</td>
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DEFINITIONS AND ABBREVIATIONS-
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<th></th>
<th>SHOWERS</th>
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<tr>
<td>1</td>
<td>4-5</td>
<td>28 in.</td>
<td>30 in.</td>
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<tr>
<td>2</td>
<td>6-8</td>
<td>34 in.</td>
<td>34 in.</td>
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<tr>
<td>3</td>
<td>9-12</td>
<td>34 in.</td>
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<tr>
<td>4</td>
<td>Adult</td>
<td>34 in.</td>
<td>34 in.</td>
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<tr>
<td>5</td>
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<td></td>
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<tr>
<td>6</td>
<td>SHOWERS</td>
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<tr>
<td>7</td>
<td>6-8 boys</td>
<td>72 in.</td>
<td>see note 2</td>
</tr>
<tr>
<td>8</td>
<td>6-8 girls</td>
<td>66 in.</td>
<td>see note 2</td>
</tr>
<tr>
<td>9</td>
<td>9-12 boys</td>
<td>72 in.</td>
<td>see note 2</td>
</tr>
<tr>
<td>10</td>
<td>9-12 girls</td>
<td>66 in.</td>
<td>see note 2</td>
</tr>
<tr>
<td>11</td>
<td>Adult</td>
<td>72 in.</td>
<td>see note 2</td>
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<tr>
<td>12</td>
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<tr>
<td>13</td>
<td>NOTES:</td>
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<tr>
<td>14</td>
<td>1. Handicapped heights shall comply with the NC Building Code and all ADA requirements.</td>
<td></td>
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<tr>
<td>15</td>
<td>2. Top of shower controls not more than 48 in.</td>
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<tr>
<td>16</td>
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<td>17</td>
<td>END OF SECTION</td>
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</tr>
</tbody>
</table>
SECTION 15488 - NATURAL GAS SYSTEMS

GENERAL

Engineer and Contractor shall coordinate with gas company and have high pressure gas line routed to gas meter. WCPSS will pay any cost incurred. Plumbing contractor shall connect to load side of meter and extend inside building.

PRODUCTS

Provide main gas valve above ground prior to entrance to building. Use ball valves on all gas lines inside the buildings.

- Piping - Black steel pipe schedule 40 ASTM A 120.
- Fittings - malleable - iron threaded fittings, Class 150.
- Joints - threaded joints for 2 in. and smaller, welded joints for 2-1/2 in. and larger.

EXECUTION

- Gas piping may be installed above accessible (lay-in) ceiling. Do not locate gas piping under floor slab and inside solid partitions including CMU. Provide accessible chases for concealed gas piping. I.E. floor trench. Route gas piping exposed where possible.
- Provide gas shut off valves at each piece of equipment.
- Provide key operated solenoid gas valve for each science lab. Do not allow fork type keys to be used. Key switch to be labeled “GAS” and show “ON” and “OFF” position. Label to be engraved plastic laminate. Valve to be normally closed.
- Final connections to equipment shall be made with flexible connectors.
- Provide 6 in. dirt leg at each vertical rise and prior to each equipment connection.
- Contractor shall be required to paint all exposed exterior gas piping with one primer coat and (2) two coats of oil based paint.
- All gas piping shall be tested at a test pressure of 100-psi minimum for a period of not less than (8) eight hours. Test to be conducted using a chart recorder. Chart size to be 8 in., range to be 0 to 150-psi with a 24 hour recording time. Pressure measuring elements to be heat-treated to prevent hysteresis-related inaccuracies. Engineer to witness all tests. Contractor to turn over chart in close-out documents to Owner.
SECTION 15500 - HEATING, VENTILATING AND AIR CONDITIONING, GENERAL

GENERAL

☐ The selection of all HVAC systems and other systems shall be approved by the responsible WCPSS authority at the schematic phase of design.

☐ The use of Lockinvar Boilers is prohibited.

☐ A computerized 30 year Life-cycle-cost analysis shall be made for all school buildings over 20,000 SF and submitted to the Wake County Public School Systems, Energy Management Department at the schematic stage of design with a final recommendation of type of HVAC system to be used.

☐ Such an analysis shall include at least three (3) alternates along with integrated studies of construction costs, the effects of building construction materials, building orientation, lighting, usage schedules, fuels, HVAC equipment, maintenance costs, and other factors that relate to the initial capital cost of the building versus the annual operating costs. Contact responsible WCPSS authority for which three (3) alternates are to be studied.

☐ The life cycle costs study shall include (but not necessarily be limited to) the following estimates for each alternate study.

1. The initial cost of the mechanical system, including electrical work and miscellaneous building costs related to the mechanical system.

2. First year utility costs for the following:

   Heating Energy
   Cooling Energy
   Interior Building Lighting
   Domestic Hot Water
   All other energy sources

The requirements for balancing have been modified and moved to Section 15000 for greater clarity.

☐ Air side economizer cycles shall be used where possible, for the energy savings and the effect on health through the reduction of airborne bacteria count. Contact the responsible WCPSS authority when a water side economizer is being considered.

☐ Low-leakage type outdoor air dampers shall be used to minimize air infiltration during off hours. Max. leakage of 1/2 of 1% at pressure differentials under 4 in. WG.

☐ Electric resistance heaters should only be used for comfort heating where indicated by a life cycle cost study to be most economical. However, electric heaters shall be used in all exterior mechanical rooms, which have hydronic piping.

☐ Engineer shall specify engraved plastic laminated labels on all equipment. Labels shall include equipment number, area(s) served (use actual room numbers used at the facility-not architectural room numbers), substantial completion date (S.C.), extended warranty period, number and size of filters and capacity.
The following are examples of labeling to be used:

Air Handling Units: AHU #1 (Classrooms 10 & 12)
S.C.: 11/16/94
Filters: 2 @ 24 in. x 24 in. x 1 in.
Capacity: 2000 CFM @ 0.5” ESP

Boilers: Boiler #1 (Buildings 100 & 200)
S.C.: 11/16/9
Input: 1,000 MBH
Output: .900 MBH

Chillers: Chiller #1 (Buildings 100 & 200)
S.C.: 11/16/94 (5 year Comp. Warranty)
Capacity: 190 Tons

Condensing Units: CU #1 (Classrooms 10 & 12)
S.C.: 11/16/94 (5 Year Warranty)
Capacity: 5 Tons

Cooling Towers CT #1 (Chiller #1)
S.C.: 11/16/94
Capacity: 190 Tons

Fans: EF #1 (Toilets 110 & 112)
S.C.: 11/16/94
Capacity: 500 CFM @ 0.3” ESP

Pumps: BP #1 (Boiler #1)
S.C.: 11/16/94
Capacity: 200 GPM @ 50 FT.

Water Source Heat Pumps: WSHP #1 (Classrooms 10 & 12)
S.C.: 11/16/94 (5 year Comp. Warranty)
Filters: 1 @ 24 in. x 24 in. x 1 in.
Capacity: 5 Tons

TYPE OF HVAC SYSTEMS
NOTE: The requirement of a unit for every two classrooms has been changed. WCPSS will now permit similar spaces with like exposures to be grouped into one zone served by one unit. A maximum of four (4) classrooms per zone will be permitted. All designers shall be required to meet with the responsible WCPSS authority prior to the Schematic Design Submittal to discuss and approve the zoning for each project.

There are seven (7) approved systems for school buildings:
1. Four (4) pipe constant speed pumping system with chiller boiler and single-zone central station air handling units.
2. Four (4) pipe variable speed pumping system with chiller boiler and single-zone central station air handling units.
3. Closed loop water source heat pump system.
4. Two (2) pipe, dual temperature, constant speed pump system with chiller boiler and single-zone central station air handling units.
5. Two (2) pipe, dual temperature, variable speed pump system with chiller/boiler and single-zone central station air handling units.

6. Split system heat pump systems with a central station AHU in building and heat pump unit outdoors. This system should only be used for a small isolated building or for special zones, such as administrative area, or media center.

7. Geothermal heat pump system.

- Packaged air cooled chillers are preferred.
- Engineers are encouraged to investigate the use of thermal storage and alternative cooling sources as a means to reduce building energy consumption.
- Do not use roof top units
- Do not use variable air volume systems.
- Designate areas as 10 and 12 month for zoning purposes. 12 month areas shall be served by separate HVAC Systems not requiring central plant operation unless their combined loads indicate efficient and economical operating of central plant during normally unoccupied periods. Administrative Areas and Media Centers are normally 12 month areas.

FUEL SOURCES

- Cooling
  1. Electricity shall be used for all cooling equipment and heat pumps.

- Heating
  1. Natural gas shall be used in all cases where available.
  2. LP gas shall be used when natural gas in not available.

DESIGN CONDITIONS AND ENERGY USAGE

SUMMER DESIGN CONDITIONS

Indoor: 75°F, 50% RH
Outdoor: 92°F dB, 75°F WB
Load Calculation Safety Factor = 0%

Note: Locker rooms shall be designed for an indoor summer space temperature of 80°F and 60% relative humidity.

WINTER DESIGN CONDITIONS

Indoor: 72°F
Outdoor: 10°F
Load Calculation Safety Factor = 10%

Engineer shall design the HVAC system so as to provide building relative humidity levels less than 60% during all occupied periods, except for Media Centers which should keep the relative humidity at less than 60% at all times.

HVAC system shall be designed so as to pretreat classroom outdoor ventilation air to prevent humidity problems.

Provide a copy of all load and energy calculations to WCPSS at each design phase submittal.

All new work shall comply with Volume X of the NC State Building Code. For new buildings, provide estimates of monthly energy use in BTU per SF and cost per SF by fuel type, using current unit fuel cost, at the design development and working drawing phases of the design to the WCPSS Energy Management Department.
VENTILATION

1. Each building or portion thereof shall be provided with the capability to provide ventilation in accordance with ASHRAE 62, based on building classification and occupant load.

2. Fresh air intakes shall be located a minimum of 15 ft. away from sanitary sewer vent outlets, exhaust outlets and truck and bus loading areas.

3. Thermostatically controlled ventilation should be provided in main electrical room to prevent excessively high temperatures.

4. All spaces, which produce dust (cabinetry labs, etc.), shall be negatively pressurized to assist in reducing the infiltration of dust to adjacent spaces. Also, the mechanical systems for these spaces should have easily replaceable filtration systems. In addition, for those spaces programmed to have a dust collection system, the controls shall be designed to halt air conditioning when the dust collection system is engaged.

5. The heating of make-up air for welding shops is not recommended from an economical standpoint.

6. Work areas for internal combustion engines shall have provisions so that exhaust gases can be exhausted directly to the outside by a carbon monoxide exhaust system.

7. Paint spray rooms shall have special treatment with respect to ventilation and safety requirements. Paint spray booths, commercial type, are recommended. If the booth is not to be used and a paint spray room is desired, the engineer and the architect shall investigate thoroughly with respect to codes and standards. See Standard Building Code, Section 407, Standard Fire Prevention Code, Chapter 19.

8. The storage of flammable or combustible liquids shall be in UL-labeled cabinets with mechanical ventilation, or in storage rooms designed for the purpose. If a flammable or chemical storage room is needed, the engineer and the architect shall investigate thoroughly with respect to codes and standards. For flammable or combustible storage, see SBC, Section 407; Standard Fire Prevention Code, Chapter 20; NFPA 30; and NFPA 70. For hazardous chemical data and reactions, see NFPA 49 and NFPA 491M.

9. A separate exhaust fan shall be provided for each chemistry or physics science laboratory and be of such capacity as to be able to quickly remove objectionable odors. Specify number of air changes on drawings. A fan is also desirable in a biology lab, but not needed as critically as in the former two areas; a fan would not be needed in a separate physics lab. A roof mounted exhaust fan with a hood and fresh air intake lover with motorized damper shall be provided at all KILN locations. Provide interlock switch between KILN and exhaust fan. Damper to open when fan operates. In addition to this, provide a 4 in. dia. metal dryer vent to exterior.

10. A separate HVAC System shall be provided for all gymnasium locker/dressing rooms. The system should provide 100% outside air during occupied hours. Use exhaust fans to remove make-up air. Air shall be re-circulated during unoccupied hours. Room temperature shall be controlled by the room sensor. The system shall be controlled by the BAS.

11. Mechanical ventilation shall be provided for all toilet rooms, janitor’s closets, and storage rooms where odors could become a problem. Group toilets shall have 2 CFM per square foot minimum ventilation.

12. Provision shall be made to prevent sound transmission through any common duct system serving more than one area, such as between adjoining classrooms and toilet rooms.

KITCHEN

13. Automatic dry-type fire-extinguishing systems shall be installed in all hoods. Ansul is an acceptable system. Upon activation of the extinguishing system, all fuel shall be shut
off, whether gas or electric, and will include fuel to all equipment under the hood, including fryers, broilers, griddles, and ranges. Make-up air shall be shut off, but exhaust fans shall continue exhausting. Exhaust fans shall have an adjustable high limit shutdown switch normally set at 350°. The fire-extinguishing system shall be designed in accordance with the Standard Mechanical Code, Section 307, NFPA 96 and NFPA 17. Connect into the Central Fire Alarm System. Locate a manual pull station at nearest exit.

- Range hood roof exhaust fans shall be designed to prevent air from being discharged down toward the roof.
- All kitchen hoods shall have 80% minimum outside make up air delivered at perimeter of hoods. Do not heat make up air.
- Exterior entrances to kitchens shall be equipped with a fly fan with automatic switch geared to opening and closing of door. Location of fan on interior of building with air directed down and outward is preferred.

**MISCELLANEOUS HVAC ITEMS**

- Install one-shot chemical feed system in all closed loop water systems.
- Install a “Ernest Gauge Co.” visual site flow indicator in all closed loop systems in line with the one-shot chemical feed systems.
- Electric unit heaters with built-in thermostats shall be installed in all exterior mechanical rooms in lieu of hot water unit heaters.
- Provide dehumidification control in all media centers.
- All chilled water coils shall be selected based on a chilled water temperature of 2° F higher than that leaving the chiller. Show all selection data in a coil schedule on drawings.
- All HVAC equipment shall be selected for low noise levels that do not interfere with instructional activity. The noise levels in classrooms shall not exceed NC Level 35.
- The HVAC systems shall be provided with a complete labeling systems for all equipment, starters, piping, valves, control panels and devices, dampers rotation, valve movements, and any other system components. The equipment labels shall be screwed on laminated plastic with the name, (hot water pump no. 1, etc.), number, model number, capacity and any sequence of operation that is applicable.
- Specify fencing around all outdoor air cooled chillers, cooling towers and condensing units. Gates shall be large enough for service vehicles to remove equipment if necessary. Specify drains for all cooling tower locations. Area inside fence shall be concrete properly sloped, with fence posts located within perimeter of pad.
- Specify that all refrigeration compressors have five (5) years material warranties.
- Locate all cooler and freezer condensers outside building on reinforced concrete pad on ground, protected and for maximum ventilation. (Condensers shall not be located on roof)
- All heat pumps shall be factory wired down with 24 VAC control interface, NOT 24 VDC.
- There shall be no open-flame heaters, open-coil electric heaters, or spark-producing electric components in areas likely to be used for spray painting or where there will be open containers of gasoline or other explosive vapors or dust.
- Boilers and pressure vessels shall be ASME-labeled and installed in accordance with the American Society of Mechanical Engineers “ASME Boiler and Pressure Vessel Code.” Boiler rooms and installation of boilers shall conform to Section 806 of Standard Building Code.

DEFINITIONS AND ABBREVIATIONS - 01000 -125
Each hot water boiler shall have a low-water cutoff and each steam boiler shall have an extra-low-water cutoff. Low-water cutoff should be manually reset type.

Combustion controls shall meet the requirements of improved Risk Mutual Insurance Corporation, IRM Spec. 205.

Equipment shall be ASME Code-stamped, AGA-labeled, or UL-labeled as and when applicable.

Hot water relief valves, refrigerant relief devices, and steam pop-off safety valves must be piped to a location to minimize danger to personnel or students upon relief. Hot water relief valves should be piped to exterior or to funnel-type floor drains located near the equipment.

Filters for all air handling equipment shall be mounted in 2 in. thick permanent metal frames with 1 in. thick polyester media. Filter access must be readily accessible and require no tools to change. Specify that any questionable means of access shall be replaced at no additional cost to owner.

All major items of mechanical equipment that employ any solid state electronic components shall be fully protected from electrical surges and lighting.

For all hydronic heating/cooling systems, provide manual shut off valves at point where main supply and return lines leave the central mechanical room, where piping leaves and/or enters a building and in mains such that classroom wings can be isolated.

Do not locate AHU's in same room as boilers.

Provide permanently fixed access to ceiling mounted air handling units in Gyms and Auditoriums for maintenance use. Maintenance on these units shall not require a boom, lift or extension ladder.

The use of outdoor boilers shall be prohibited.

END OF SECTION
SECTION 15550 - HVAC PIPING SYSTEMS

GENERAL

- All piping systems for HVAC systems in buildings shall be schedule 40, black steel with
  - either welded, screwed or victaulic joints except as follows in Products below.

PRODUCT

- Condensate drains from AHU's and fan coil units shall be type "L" copper. PVC drain
  - lines shall not be permitted.
- Insulate all drain lines.
- Provide unions on both sides of p-trap.
- Cold water lines and chilled water/hot water run outs (1 in. and smaller) may be type “K”
  - copper with soldered joints. Use 95-5 solder.
- Use “Ric-Wil” or similar conduit system for all underground hot water piping system.

EXECUTION

- Engineer shall specify and show on plans expansion loops on all hot water piping runs
  - over 200 feet in length.
- Support piping as recommended in ASME Handbook. Do not support piping from bar
  - joist bridging.
- Paint and color-code all exposed piping system.
  - All exposed piping, both insulated and uninsulated shall be painted and labeled.
  - Piping shall be color coded as follows with flow arrows and labels located at 10
    - foot intervals at all turns and at each floor or wall partition:
      - Chilled water - Light Blue
      - Hot water - Light Red
      - Dual Temperature - Orange
      - Make up water - Dark Blue
      - Condenser water - Green
      - Gas Lines - Yellow
  - All underground lines shall be marked with a bright colored continuous - printed
    - plastic tape on top of the line.
- Provide positive freeze protection for all water systems subject to freezing conditions
  - such as air-cooled outdoor chillers, cooling towers, outdoor piping (above ground) etc.
- All piping systems shall be thoroughly flushed out before placing in operation. This is
  - especially critical for all hydronic systems. Hydronic systems shall be connected so as
    - to by-pass the units before flushing begins and then flushed and the filters cleaned out at
      - least three (3) times before the units are connected to the system and placed in
        - operation. All cooling towers shall be completely cleaned and flushed after all systems
          - are in operation and the site work has been completed. (Engineer to be present).
- Provide additional bulb wells in central plant piping for electronic sensors. Coordinate
  - with the Energy Management Department for locations of additional wells. Show detail
    - of wells on drawings.
- Provide shut-off valves for all hydronic mains at all take-offs to mechanical rooms and
  - pump rooms.
- Also provide shut-off valves at the supply and return side of all equipment to provide for
  - removal and repair.
- Provide Pete’s Plugs at each hydronic heat pump and/or fan-coil units and 2 test kits
  - containing thermometers and pressure gauges for each building. Have test kits turned
    - over to Energy Management Department.

DEFINITIONS AND ABBREVIATIONS - 01000 -127
All chilled water piping shall have 2 in. thick fiberglass insulation all with a vapor-proof jacket.

Specify canvas jacket lagged in place for painting on all exposed piping in occupied spaces and mechanical rooms.

Provide section on pressure testing of all piping systems.

Insulate all hot water and domestic hot and cold water with 1 in. thick fiberglass insulation.

All water make-up assemblies shall be provided with a backflow preventer.

Specify an aluminum jacket on all outdoor piping.

Provide automatic chemical feed systems to all “open” systems such as cooling towers. Coordinate with the WCPSS Physical Plant Department concerning the type system, the water test, chemicals and water management program.

Pipes venting gas from appliances or other devices shall terminate outside the building 2 ft. above any roof line within 10 ft. Keep away from louvers and overhangs.

Specify all pipe supports to have saddles and blocking and all exposed piping, hangers, saddles and supports to be painted with two (2) coats.

Specify all exposed piping in occupied spaces below eight feet to be covered with a 20 gauge metal jacket.

Provide chrome escutcheon rings at all exposed ceiling and wall pipe penetrations.

Show by-pass piping for all heat exchangers.

Show why strainers in inlet piping to heat exchanger and cooling tower outlet (unless strainer is built-in basin).

Specify all damper operators, control and service valves to be installed such that they can be serviced by personnel standing on the floor of the Mechanical Room.

Engineer shall require contractor to dimension actual location of all underground piping on as-built drawings. A minimum of two (2) dimensions from building reference points shall be provided and a bury depth indicated.

END OF SECTION
SECTION 15760 - COOLING TOWERS

GENERAL
Wake County Public School System standardized on induced-draft propeller fan cooling towers for all school buildings using centrifugal chillers or hydronic heat pump systems. This decision was based on the maintenance requirements of these towers.

PRODUCTS
- The cooling tower shall be factory fabricated Baltimore Air Coil Co., Inc. Series 3000 or equal by Marley and Evapco.
- All steel components shall be provided with a corrosion protection system G-210.
- The tower shall be equipped with an electric basin heater sized to maintain 40 deg. F. pan water with a 10 deg. F. outdoor air temperature. Basin heater shall have built-in thermostatic control and low water cut-off.
- The tower shall have a water level control utilizing a large diameter plastic float with brass shut-off valve. Provide additional pressure reducing valve on cold water feed.
- The tower shall be selected on 79 deg. F. entering air wet bulb temperature.
- The cold water basin shall be constructed stainless steel.
- Tower accessories shall include: hinged access doors on the tower end walls, large area lift-out steel strainers with perforated openings sized smaller than water distribution nozzle orifices, integral anti-vortexing hood, 3 in. flush connection, internal walkway, and exterior access ladder.
- Inlet louvers shall be Waved Form Fiberglass Reinforced Polyester (FRP).
- Hot water distribution basins shall be open gravity type with corrosion protection system G-210 and pan covers. Distribution weirs and plastic metering orifices shall be provided to insure even distribution of water over the wet deck surface.
- Integral flow balancing valves shall be factory-installed in the hot water basin to distribute flow evenly between the basins.
- The wet deck surface and integral drift eliminator shall be formed from Polyvinyl Chloride.
- Fans shall be fixed pitch, heavy duty, cast aluminum, axial flow. Fan and shaft shall be supported by heavy duty, re-lubricated ball bearings with special moisture-proof seals, grease packed, self-aligning and integral slinger rings. All bearings shall be designed for a minimum life of 40,000 hours. Fan sheave shall be cast nylon and motor sheave shall be protected from moist discharge air by a vented enclosure.
- Fan motor shall be totally enclosed air-over (TEAO), 1800 rpm, reversible, squirrel cage, ball bearing type. Motor shall be furnished with special moisture protection on windings, shafts and bearings. A heavy gauge, hot-dip galvanized wire fan guard shall be provided over each fan cylinder.

EXECUTION
- The tower shall be installed on two (2) reinforced concrete piers with the suction outlet located above the centerline of the condenser water pump of sufficient height to provide proper NPSH to the pump.
- The overflow/drain shall be piped full size to the storm drainage system or sewage system as code or municipal rules dictated.
- Proper clearance shall be provided around the tower for proper air flow and service requirements.
Cooling Towers shall be completely flushed and cleaned before system is placed in operation and every (4) four weeks until all site work is completed.
SECTION 15855 - AIR HANDLING UNITS AND FAN COIL UNITS

GENERAL

☐ All air handling units and fan-coil units shall be equipped with a heavy metal casing, (18 gauge min.) fans, heating and/or cooling coils and a disposable media type filters.

PRODUCTS

☐ Approved air handling units shall be Trane, Carrier, or McQuay, Central Station Equipment.

☐ Carrier Model 39L is permitted only when unit airflow requirement is less than 2,000 cfm.

☐ Approved fan-coil units shall be American Air Filter, Air Therm, Carrier and Trane when required for renovation projects only. All control valves, speed switches shall be factory supplied and installed inside the units. Thermostats shall be wall mounted. Use direct drive models only.

☐ All air handling units and fan coils shall have factory-fabricated filter access assemblies complete with metal frames and disposable media. Tools shall not be required to access and change filters on air handling units (use hinged access doors with cam locks). Mechanical contractor shall submit, upon final walk-through, a summary of all HVAC equipment indicating filter media size and numbers of filters (this shall also be part of the Operation & Maintenance manual). The following is an example of this information which is to be provided on all projects:

WAKE COUNTY PUBLIC SCHOOL SYSTEM
NEW SCHOOLS/RENOVATIONS
FILTER LIST FOR
ENERGY AND PHYSICAL PLANT

SCHOOL NAME: 

MECH. ROOM #: FILTER SIZE: 

AIR HANDLER #: QUANTITY: 

MECH. ROOM #: FILTER SIZE: 

AIR HANDLER #: QUANTITY: 

MECH. ROOM #: FILTER SIZE: 

AIR HANDLER #: QUANTITY: 

☐ Contractor shall also be required to provide an engraved plastic laminated label on the exterior of each AHU. See Section 15500 for further information on label.

☐ Contractor shall install new set of filters before final inspection and provide spare set of filters to the Owner.

☐ Use low-leakage, outside air intake dampers for all air handling units and fan coil units. Maximum leakage of 1/2 of 1% at pressure differentials under 4 in. WG.

☐ Provide spare belt for each belt driven piece of equipment.

END OF SECTION

DEFINITIONS AND ABBREVIATIONS - 01000 -131
SECTION 15860 - DUCTWORK

GENERAL
All ductwork, supply, return and outside air shall be constructed in accordance with SMACNA standards.

PRODUCTS
- All ductwork except kitchen hood and certain other hood exhaust shall be galvanized sheet metal with zinc coating complying with ASTM A527 and SMACNA standards.
- Exposed ductwork shall be mill phosphatized for painting.
- Use stainless steel ductwork with welded, water tight joints for kitchen dish washer hood.
- Low-pressure ductwork shall be rectangular. Medium and high-pressure ductwork shall be spiral round duct.
- Insulate all ductwork, except exhaust ductwork, by wrapping with minimum 2 in. thick fiberglass insulation with vapor proof jacket.
- Exposed ductwork shall be double wall insulated spiral duct with paint grip finish. Discuss with WCPSS the use of exposed ductwork prior to incorporating it into any design.
- Flexible ducts may be used for above ceiling lay-in system. Flexible ducts to be UL Class 1 insulated type with foil wrapper.

EXECUTION
- Seal all ductwork joints, seams and take-offs airtight with non-hardening mastic or liquid elastic sealant. Engineer to witness ducts have been sealed before ducts can be insulated.
- Do not support ductwork from bar joist bridging.
- Support all flexible ducts a maximum of 5 ft. on center and at all changes in direction so as to prevent sagging and crimping from occurring. Note: All flex duct to receive a minimum of one (1) duct hanger.

END OF SECTION
SECTION 15865 - DIFFUSERS AND GRILLES

GENERAL
- A complete system of ceiling and sidewall diffusers and grilles for supply, return and exhaust air shall be provided throughout the building.
- Perforated diffusers shall not be permitted.

PRODUCTS
- The diffusers and grilles shall be constructed of steel with painted surfaces.
- Aluminum diffusers and grilles shall be specified for moist and humid locations (ie: Locker rooms, showers and training rooms).
- In general provide 4-way adjustable stamped louver faced diffusers and double deflection registers.
- Provide heavy duty steel return air grilles located in gymnasiums, multi-purpose rooms and in all locations where the grille is within 8 ft. of the floor. Grilles shall be all welded construction with 1/8 in. thick grille blades, 14 gauge blade mullions on 6 in. centers with 18 gauge frame reinforced at the corners.
- Engineer shall show location of all balancing dampers on plans.
- Engineer shall select air distribution so as to insure heat can be delivered to floor level.

END OF SECTION
SECTION 15900 - BUILDING AUTOMATION AND CONTROL SYSTEM (BAS)

PRODUCTS
- The Building Control and Automation System shall be a Direct Digital Control System and shall be a completely compatible system in all respects to the Barber-Colman Network 8000 System currently in use by the Energy Management Department of the WCPSS. See Attachment 15900-A for detailed specifications. Contact the Energy Management Department of WCPSS for guidance and questions.

EXECUTION
- All control sequences shall be discussed with Energy Management and agreeable to both the Engineer and Energy Management. A clear written sequence of operation shall be an integral part of the specification. Sequence of operation shall follow equipment manufacturer's recommendations.
- Engineer to show a complete control sequence and a control diagram on the drawings.
- All sensor and EMS panel locations shall be discussed with Energy Management and clearly shown on drawing. Any field modifications must be approved by Engineer and Energy Management. Acceptable height of GCM's, LCM's and GCS's is 60 in. above finish floor.
- Specify lightning and surge protection on all building automation system panels and telephone modems associated with these systems.
- Specify momentary contact push button for night override in a flush mounted panel located in the administrative area corresponding to zones in plans and specifications.
- All temperature sensors shall be flush mount, stainless steel PreCon 10k thermistor or equivalent.
- Eliminate any reference to time clocks. Perform all time of day control functions through the Building Automation (DDC) system.
- Provide space for owner provided cabinet in main mechanical room for placement of reduced sized drawings, specifications, Operations and Maintenance manuals etc. Coordinate between Architect/Engineer.
- Mechanical Contractor shall provide input from each walk-in cooler and freezer to building automation system for system alarm.
- Engineer shall be responsible for completely testing Control System for proper operations including each control device and also running system through the entire control sequence. An Owner Representative should also be present.
- Electrical Contractor to provide conduit from demand meter to main Mechanical Room. Electrical contractor shall be responsible for all costs associated with demand meter.
- Send complete copies of each design phase submittal plans and specifications to Diversified Control Systems, Inc., 5400 S. Miami Blvd., Suite 140, Creekstone Crossings, Morrisville, NC 27560.

END OF SECTION

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DEFINITIONS AND ABBREVIATIONS- 01000-134
ATTACHMENT 15900-A - BUILDING LEVEL DIRECT DIGITAL CONTROL SYSTEM

RELATED DOCUMENTS
- Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specifications sections, apply to the work of this section.

DEFINITIONS
- Algorithm: A logical procedure for solving a recurrent mathematical problem. A prescribed set of well-defined rules or processes for the solution of a problem in a finite number of steps.
- Analog: A continuously varying signal value (e.g. temperature, current, velocity).
- Auxiliary Control Units (ACU): The ACU's shall be functionally a part of an RCU, but may be located remotely from the RCU, and shall communicate over a dedicated communication circuit (RS232 or equivalent bus). ACU's shall be used to connect remote inputs and outputs to a supervisory RCU and shall contain all necessary I/O functions to connect to field sensors and control devices. ACU operation shall be fully supervised by the connected RCU.
- Baud: A Baud is a signal change in a communication link. One signal change can represent one or more bits of information depending on type of transmission scheme. Simple peripheral communication is normally one bit per Baud. (e.g., Baud Rate = 1200 Baud/sec is 1200 bits/sec if one signal change = 1 bit).
- Binary: A two-state system where an "on" condition is represented by a high signal level and an "off" condition is represented by a low signal level.
- Control Unit (CU): The CU is the microprocessor-based device(s) by which the direct digital control algorithms are processed. The CU may also include the input and output data processing function.
- Control Wiring: Includes conduit, wire and wiring devices to install complete HVAC control systems including motor control circuits, interlocks, thermostats, PE and EP switches and like devices. Includes all wiring from a DDC cabinet to all sensors and points defined and/or required to execute the sequence of operation.
- DCP (Distributed Control Panel): Panels which house the CU, input and output functions, power supplies, relays, transducers and other required hardware.
- DDC (Direct Digital Control): A control loop in which a digital controller periodically updates the process as a function of a set of measured control variables and a given set of control algorithms.
- Deadband: A temperature range over which no heating or cooling is supplied (i.e., 72-78 deg. F., as opposed to single point changeover or overlap).
- Diagnostic Program: Machine-executable instructions used to detect and isolate system and component malfunctions.
- Distributed Control System: A system whereby control processing is decentralized and independent of a central computer. Operational control, processing and data are distributed to computers throughout the system. Little functionality is lost in any processor on the network if communication is lost with other processors. Distributed control implies distributed processing and distributed data.
- Downline Load: The electronic transfer of programs and data files from the Global Control Supervisory Station to the building level DDC system or building operator workstation with secondary memory devices, to remote, distributed CU's.
- Input/Output (I/O): Input and output functions of the DDC control unit (CU).
Man-Machine Interface (MMI): The proprietary hardware/software system (Siebe "Ulti
Vist"), located at the WCPSS central office, for providing a method for an operator to
communicate with any building DDC system in any school. The MMI allows the
operator to command, monitor, and program any DDC system in any school.

Network: A data communications system connecting information-processing equipment.

Operator Workstation: Personal Computer (PC) based Terminal and Cathode Ray Tube
(CRT), which performs the primary man-machine functions of the building ECC.

Operating System (OS): Software which controls the execution of computer programs and
which proves scheduling, debugging, input/output controls, accounting, compilation,
storage assignment, data management, and related services.

Peripheral: Input/output equipment used to communicate with the computer and make
copies of system outputs. Peripherals include CRT, printer, tape deck, and diskette.

Remote Control Units (RCU): As "master" level CU's, the RCU's shall communicate
with other RCU's (and with the ECC) over a peer-to-peer local area network or over the
EMCS Ethernet 10BaseT LAN, and shall provide general purpose control functions,
global control functions, and history recording functions.

Unitary Control Units (UCU): The UCU's shall be microprocessor based, dedicated
purpose devices, designed and programmed to accomplish a specific purpose.

GENERAL REQUIREMENTS

Control Sub-Contractor: The Mechanical Contractor shall employ the services of a
control subcontractor to furnish and install a complete DDC control system for
automatic environmental control and energy management.

Network Interface Module: The control subcontractor shall be responsible for providing
a Network Interface Module (NIM), including hardware and/or software, to provide a
100% complete and 100% compatible interface between the Owner's MMI and this DDC
system in order for all functions to be performed and defined at the MMI and downline
loaded to the building level system via a telephone link at a baud rate of not less than
9600 bps. The NIM shall interface to the building level DDC system through a building
level RCU. If additional interface "gateways" are required, they shall be provided by the
control subcontractor. The cost to provide this interface shall be part of the system bid
price.

Interface Demonstration: The control subcontractor shall contact the Owner, at least
fourteen (14) working days prior to bidding, and provide complete documentation of the
entire specification herein and a demonstration of the following operational interfaces
and requirements between the Owner's MMI and the proposed system:
1. Graphic screen monitoring
2. Alarm reporting
3. Full programmability (on-line and off-line)
4. Trend reporting
5. Energy usage and monitoring
6. Maintenance Management
7. Dynamic run time monitoring
8. Programming all building level controllers via modem and the MMI
9. "Terminal" mode programming of all building level controllers via modem
10. Database uploads/downloads to building controllers to and from the MMI
11. Automated reporting to the MMI of system diagnostics/status diagnostics
12. Ability to modify all point configuration data via the MMI and in terminal mode

Configuration: The control subcontractor shall provide an IBM OS/2-compatible version
of the RCU's operating system so that the building system database can be configured/
reconfigured through the MMI and then downloaded to the building level system.
Likewise, the RCU shall upload its database to the MMI upon command or at operator-defined intervals for archiving and backup. Database changes made at the building level shall automatically modify the MMI master level database during the next dial-up session or automatically after log off occurs on site, as selected by the operator.

QUALITY ASSURANCE

1. Control subcontractor shall meet the following criteria:
   1. Be a factory branch or authorized representative of a national firm having a minimum of five years experience in the design and installation of computerized building systems similar in performance to that specified. Provide evidence of experience by submitting resumes of the project manager, the local manager, project engineer, the application engineering staff, and the electronic technicians to be involved with the supervision, the engineering, and the installation of the system. Information concerning the amount of training and experience shall be included in each resume.
   3. Use only factory trained and certified personnel to perform programming, final DCP connections, system start-up, diagnostics and warranty service. Maintain a 24-hour per day service organization within two hours auto travel time from the project.

2. Codes and Standards: The components of the DDC system shall comply with the latest editions of the following codes and standards, as applicable:
   1. Instrument Society of America (ISA):
      - 57.3 Quality Standard for Instrument Air (R1981)
   2. National Fire Protection Association (NFPA):
      - 70 National Electrical Code
   3. Federal Communications Commission (FCC):
   4. Underwriters Laboratories (UL):
      - UL 864 Sub-categories UUKL, UOXX, UDTZ; Fire Signaling and Smoke Control Systems
      - UL 873 Temperature Indication and Regulating Equipment
      - UL 916 Energy Management Systems
   5. For electrical equipment and products, comply with applicable NEMA standards, and refer to NEMA standards for definitions of terminology herein. Comply with National Electrical Code (NFPA 70) for workmanship and installation requirements.
   6. Labeling: All products shall be labeled with the appropriate approval markings.

3. Performance Tests:
   1. Demonstrate that all controls are installed, adjusted, and can perform all functions required by the drawings and specifications. When coordinated with the Owner, this demonstration may be performed in conjunction with instructions to the Owner's operations personnel.
   2. Individual Building Final Operational Tests:
      a. Performance Test Period: Not less than 336 consecutive hours to demonstrate proper functioning of the complete system. Continue test on a day to day basis until the performance standard is met.
      b. Acceptance Performance Standard: Operation at an average effectiveness level (AEL) of at least 95 percent for the performance test period. Whenever downtime occurs, correct defects before resuming test. Failure, due to an individual sensor or controller, shall not count as system downtime provided that:
         - The system records the fault.
The AEL for all sensors and controllers together is at least 99 percent of the test period.

**SUBMITTALS**

**GENERAL**

- Submittals shall demonstrate compliance with technical requirements by reference to each subsection of this specification. Where a specific item does not comply with specification requirements, the deviation shall be presented to the Owner and A-E a minimum of 14 working days prior to bid, along with information as to how the intent of the specification requirement is to be satisfied, for approval. It is the Contractor's responsibility to demonstrate compliance. The Wake County Public School System shall have the right to reject any substitutions with deviate from this specification.

- Owner meetings: The control subcontractor shall schedule a minimum of two meetings with Owner to review control drawings, software, and strategies before proceeding with the installation. The A/E, upon receipt of initial submittals, shall schedule the first meeting. The second meeting shall be scheduled following the first meeting.

- Manufacturer's literature and data for all components including the following shall be submitted:
  1. One-line schematics of control piping and wiring of sensors and actuators to DCP cabinets.
  2. Schematic of all termination points within each cabinet.
  3. Catalog cut sheets of all equipment used. This includes, but is not limited to DCP's, peripherals, sensors, actuators, etc.
  4. Detailed descriptions of specified DDC algorithms.
  5. Flow charts for each sequence of operation or control strategy.
  6. Define a preliminary scope and sequence of field tests that will be executed to demonstrate that the system performs all specified functions. Include in the scope the method by which system accuracy will be demonstrated.
  7. FCC Part 15 listing certificates for all equipment.
  8. UL 864 and UL 873 and/or UL 916 listing certificates for all equipment.
  9. Details of communications wiring, electrical isolation, surge and lightning protection, etc.

- Control Drawings: Integrate with HVAC drawings on one-line control diagrams. Show and identify all HVAC equipment and control devices for all air, water and steam systems. Equipment and control labels shall correspond to those shown on the drawings.

- As-Built Control Drawings: Provide as part of project closeout. See Division 1.
  1. One complete set of prints.
  2. One set of applicable systems prints wall mounted in each mechanical room.
  3. One set of drawings in electronic media storage, AutoCAD V12.DWG format or fully compatible .DXF format.

- Operation and Maintenance (O/M) Manuals: Provide detailed product information on all control hardware, including but not limited to relays, sensors, transducers, actuators, etc. Any custom control programs shall be documented and explained in English and step-by-step instructions on how to change parameters and create additional custom control programs provided. Coordinate documentation format(s) with Wake County Public School System prior to creating O/M Manuals.

- Final Control Algorithms Documentation: Provide final version of all control software at completion of construction. Provide, for each control algorithm, a flowchart with

DEFINITIONS AND ABBREVIATIONS- 01000-28
TRAINING

The controls subcontractor shall provide the Owner's system operators complete instructions for proper control of the system under all modes of operation. These modes shall include, but not be limited to, summer/winter, occupied/unoccupied, energy management, alarm event sequences, etc. Provide on the job training during start-up, checkout, and performance test period. On the job training shall consist of facilities personnel working with the Control System Supplier's installation and test personnel on a daily basis. During the performance test period, provide five 8-hour periods of instruction.

**********SPEC WRITER: IF OWNER DESIRES FORMAL INSTRUCTION, INCLUDE THE FOLLOWING PARAGRAPH AND INCLUDE A BID ALTERNATE FOR IT.**********

Additional Instruction: Formal instruction, for a total of 24 classroom hours for up to 10 persons, conducted prior to the performance test period, at a time mutually agreeable to the Control System Supplier and the Owner. The instructions shall be conducted during normal working hours, Monday through Friday at the job site and at the Energy Management Office, as directed by Owner.

The O/M Manuals shall contain approved submittals as outlined above. In addition, provide diagrammatic layouts of the DDC systems specified. The layouts shall show all DDC cabinets, all connected mechanical systems, location and function of each sensor, actuator, and equipment cut sheets of the entire system. O/M Manual shall contain a detailed description of the systems and a complete listing of all software programs required to perform the sequence of operation. O/M Manual shall describe all commands, operating and trouble shooting instructions, and routine maintenance procedures to be used with the systems. Three (3) copies shall be supplied and utilized in operator's training curriculum.

WARRANTY SERVICE

Provide all labor, material and equipment necessary to maintain beneficial performance of the entire control system for a period of one (1) year after acceptance of the system or parts thereof, by an authorized representative of the owner. Any defects in workmanship or material during the warranty period shall be promptly corrected by the contractor at no charge to the owner. All work shall be accomplished during normal working hours, Monday through Friday excluding legal holidays. Precaution shall be taken to minimize disruption of facility operations.

Owner's involvement in modifications to hardware and/or software or the addition of panels and points shall not void warranty.

PART 2 - CONTROL UNITS
GENERAL DESCRIPTION

The Building Level DDC system shall be configured as a distributed processing network of direct digital control units connected to the existing MMI via a network interface module and dial-up telephone interface. The system shall be completely modular and stand-alone in both hardware and software and allow for expansion in both function and capacity. Systems requiring a host processor or ECC for any of the systems control operations are not acceptable.
1. The DCP's and all associated equipment shall be designed to operate in ambient conditions of 35 to 120 degrees F at a relative humidity of 0 to 95 percent non-condensing.

2. CU's shall operate properly with power fluctuations of plus 15 percent to minus 10 percent of nominal supply voltage.

3. Sensors and controlling devices shall be designed to operate in the environment which they are sensing or controlling but not less severe than for DCP's.

All DCP equipment shall be properly mounted and organized in a grounded UL-listed NEMA 1 cabinet (panel). Cabinet shall protect DCP equipment from dust, liquids or accidental blows. Cabinets with strong and framed transparent laminated plastic doors or windows are acceptable.

CONTROL UNITS

GENERAL

Control Units (CU): Multiple digital CU's shall be provided. Failure of any single controller shall have no effect on other controllers, except where a global control strategy is involved. All control functions shall be resident in the CU's, including those involved in building-wide strategies. There may be up to three types of CU's:

1. Remote Control Units (RCU): The RCU's shall communicate with other RCU's (and with the ECC) over a peer-to-peer local area network (Level 1 LAN) and shall provide general purpose control functions, global control functions, and history recording functions. The RCU's shall be provided as a networking stand-alone energy management panel enclosed in a sturdy metal enclosure containing a 16 bit microcomputer with nonvolatile memory, peripheral ports for CRT, printer and auto answer/auto dial modem(s), network communications, battery back-up, onboard keypad and display, and utilize a multi-tasking, multi-user operating system.

2. Auxiliary Control Units (ACU): The ACU's shall be functionally a part of an RCU, but may be located remotely from the RCU, and shall communicate over a dedicated communication circuit (Level 2 LAN, an RS232 or equivalent bus). ACU's shall be used to connect remote inputs and outputs to a supervisory RCU and shall contain all necessary I/O functions to connect to field sensors and control devices. ACU operation shall be fully supervised by the connected RCU.

3. Unitary Control Units (UCU): The UCU's shall be microprocessor based dedicated purpose devices, designed and programmed to accomplish a specific purpose. UCU's shall communicate with RCU's/ACU's over the Level 2 LAN.

CU's shall be microprocessor-based with all hardware, software, and communication interfaces. CU's shall have access to data within the network as needed in order to accomplish required global control strategies. If communication between RCU's or between an RCU and the ECC is disrupted, each CU shall continue to operate in standalone mode. Likewise, if communication between an ACU and its connected RCU, or between a UCU and its connected RCU, is disrupted, each CU shall continue to operate in standalone mode. The controllers shall each be either 32 bit, 16 bit, or 8 bit microprocessors as required to meet individual requirements. Controllers shall be configured in a true distributed manner where input-output processing is a function of the DDC controller.

Controllers shall be modular and wired in a grounded UL-listed NEMA 1 enclosed Distributed Control Panel (DCP) complete with all relays, digital to analog converters and terminal strips.

Controllers shall utilize Programmable Read-Only Memory (PROM) for application software storage and may utilize Random Access Memory (RAM) for general operation.
requirement. All DDC algorithms and parameters shall be RAM-based for ready access for modification and adjustment. RAM shall be provided with minimum 72 hours battery backup. (Controllers that are downloaded automatically following power fail/restart or that have non-volatile RAM need not have battery backup.)

Diagnostic Devices: Each CU shall be supplied with connections to which maintenance personnel can connect portable diagnostic operators terminals (PDOT’s) for data display, setpoint modification, and reloading and modification of controller programs. Unless the owner has other control systems in place which are identical to that proposed for this project and already has a portable diagnostic operator's terminal(s) (PDOT) which can be used to troubleshoot local HVAC equipment, provide a PDOT as part of this project. It shall be possible for the user to completely operate the controller via the PDOT and completely exercise all valves and dampers via the PDOT, display values in complete engineering units for setting analog control values, reading digital status, setting control parameters, commanding digital loads, and setting analog alarm limits. Full read-write capability shall be provided.

1. The full English display shall provide easy to read visual display of system parameters and data. These displays shall accommodate all operating conditions of the RCU as well as the values and status of the sensors and contacts being monitored or controlled. Time and day and other pertinent program values may be displayed.

2. Displayed data and values are accompanied by full English descriptors for ease of interpretation. The RCU shall utilize the English display to provide the operator with a self-prompting technique of entering data into the system. This prompting program shall automatically step the operator through the data entry procedure.

3. In addition to the self-prompting programmability, the full English display may be set up in a mode to automatically scan either analog inputs, digital inputs, analog outputs, or relay (digital) outputs, displaying the value or status of each in sequence. For example, the operator can set the system up to provide a continual display/summary of all or a portion of all of the input sensors, displaying for a few seconds at a time, each value, and then advancing to the next sensor. This display mode will continue, uninterrupted until manually stopped by an authorized operator. With the full English display and the automatic scan any operator can tell at a glance what conditions are.

Spare Equipment: Provide spare control unit (CU) board and spare I/O board. It shall be possible for trained operations personnel to replace CU boards and load software via the PDOT. Provide one spare control unit board. If power supplies are separate, supply separate power supplies and other parts to make one complete set of DDC control equipment spares. If I/O boards are separate from the CU boards, provide two spare I/O boards for each spare CU board provided above. Deliver spares to WCPSS Energy Management Office and provide A/E with written confirmation of delivery.

SYSTEM SIGNAL TRANSMISSION

1. Communications between RCU’s and between the RCU’s shall utilize a peer-to-peer local area network (Level 1 LAN). Peer-to-peer networks shall be commercially-available peer-to-peer LAN, which operates at 2.5 megabaud or faster. The LAN shall be capable of operating at distances of at least 4000 feet between most distant nodes. The system shall automatically reconfigure the LAN upon failure and restoration of breaks in the communication lines.
Communication between RCU's and ACU's, and between RCU's and UCU's, shall be via commercially available network modems, which operate at 9600 baud or faster (Level 2 LAN).

2. Transmission lines shall be electrically isolated from the CUs by optical couplers at each interface to prevent any voltages in the transmission lines from damaging any of the electronic circuits.

**INPUT/OUTPUT**

- Each point shall be discrete. No multiplexing to a single input or output shall be acceptable.
- Input/output points include sensors, two-state commands, binary counters or analog outputs. The system shall have easily accessible terminal strips for connection of input/output wiring. I/O voltages shall not exceed 24 volts AC or DC and current shall not exceed 1.0 ampere.
- RCU's shall contain functions as required to meet the capacity of the project.

1. The digital outputs shall be used for two state commands to loads, such as stop/start. The digital outputs shall provide a normally closed or open dry contact output with a minimum contact rating of 1 amp at 24 volts.
2. The digital inputs shall accept 2-state dry contacts for alarm or status monitoring or can count pulses from an energy demand generator.
3. Each RCU shall provide 1-11 volt DC analog outputs or 4-20 ma signals, not to exceed 80 ma output total. The analog signals must be software scaled to read-out in actual engineering units. Pulse width modulation will not be acceptable.
4. The analog inputs shall accommodate a wide range of industry standard sensors including resistive copper RTDs, 1 to 11 volts or 4 to 20 ma DC. Analog inputs will be scaled to read-out in engineering units, as appropriate.

**PART 3 - SYSTEM SOFTWARE**

**GENERAL REQUIREMENTS:**

- Each RCU shall be programmable through the integral keypad, PDOT, and/or MMI.
- Software architecture shall allow set-up of points types, EMS programs, loops and custom programs. In addition, the RCU shall allow the building operator a means of interrogating input/output sensor conditions via the keypad and display unit, PDOT, or through the MMI.
- Each RCU keypad will allow access to and programming of each of the other units on the Level 1 LAN. (As an example: the operator shall be able to address all the discharge temperatures from any RCU in the entire complex). Each RCU on the network shall have a separate access code. Each UCU, via the PDOT, shall allow access to each of the other UCU's connected to the Level 2 LAN.
- The RCU shall be capable of parenthetical, mathematical calculations and logic decisions as programmed by an operator. Totalizations, optimizations and internal formatting of data shall be independent of the MMI.
- The RCU shall format all data for recall via the MMI. Formats shall include such items as engineering units (kwh, F, C, PSI, etc.), function descriptions, times, dates and other information relating to point types.
- The Level 1 LAN shall have defined object registers for transferring values or state commands at at least 9600 baud every second. Each of the RCUS on the Level 1 LAN shall be able to transmit and receive global information. Such information (such as outside air temperature, demand-shed commands, enthalpy changeover and related

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1. Level 1 LAN status shall be monitored through status objects. Loss of data transfer will trigger alarms, as well as default sequences to maintain system integrity and continued data transfer between all other RCU’s on the Level 1 LAN.

2. Building alarm monitoring and reporting shall be user definable based upon the presence of abnormal alarm conditions such as high/low temperature input or abnormal change of state such as freezestats, firestats, filter alarm switches, etc. Printed reports upon alarm condition shall be assignable and generated at the locations specified. Up to three (3) different telephone numbers may be assigned for alarms or trend reports as defined by the owner to alarm at up to three (3) separate locations. (Example - Maintenance alarms to Physical Plant and Energy related alarms to the Energy Management Office.) ALL ALARMS MUST USE THE EXISTING PHONE LINES AND NUMBERS IN THE ENERGY MANAGEMENT OFFICE.

3. One master clock shall provide automatic clock synchronization for all panels on the network. In case of master clock failure, each RCU shall resume stand alone clock operation. Additionally, daylight savings time adjustments shall be automatic based on the current year format or programmable.

DDC CONTROL UNIT SOFTWARE

4. The DDC system shall be a network of independent standalone CU’s. Each CU shall be capable of full control of its assigned functions as a completely independent unit. The RCU’s shall include standalone capability of direct digital control with integrated energy management programs including duty cycling, time scheduling, optimum start and stop and load reset programs. ACU’s and UCU’s, if provided, shall perform dedicated functions as assigned.

5. The CU operating system software shall be PROM resident. The operating system shall provide alarm monitoring and reporting, provide control application packages, and contain built-in automatic diagnostic routines. In addition, RCU’s shall maintain supervisory control over all ACU’s and UCU’s to which they are connected.

6. Each CU shall contain self-diagnostics that continuously monitor the integrity of the system. Any malfunction of the system will be reported to the MMI to inform the operator of the nature of the malfunction of the CU’s affected. The controllers shall have memory error checking. Upon detection of a memory error, the CU shall correct the error or halt to prevent erroneous operation. All halts shall be reported.

7. After a power failure and upon a power restoration, the system shall provide automatic sequential restart of equipment based on current program time and program requirements without operator invention.

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(When disabled, control outputs shall stay in the same state or position as
commanded from the central or until they are manually set to automatic.)

3. To eliminate integral windup, all PID programs shall automatically invoke
integral windup prevention routines whenever the controlled unit is off, under
manual control or under control of an EMS or time initiated program.

☐ Default Value Operation: All CU's shall be capable of being programmed to utilize stored
default values for assured fail-safe operation of critical processes. Default values shall be
invoked upon sensor failure or, if the primary value is normally provided by the central
or another CU, by loss of bus communication. Individual application software packages
shall be structured to assume a fail-safe condition upon loss of input sensors. Loss of an
input sensor shall result in output of a sensor failed message at the central control and
command station. Each CU shall have capability for local readouts of all functions.

☐ Control Loops Shall be able to Utilize any of the Following Control Modes:
- Two position (on-off, slow-fast, etc.)
- Proportional (P)
- Proportional plus integral (PI)
- Proportional plus integral plus derivative (PID)

☐ System Diagnostics: System diagnostic software and hardware diagnostic software stored
in non-volatile memory shall be provided for the central computer and each remote
DCP CU. Each board within each remote DCP shall independently execute its own
cold-start initialization diagnostic routines. These tests shall assure that the board
circuitry is operating properly and that the individual boards within the system
communicate with each other properly. If any test within the system detects a problem, a
message shall be output to the peripheral devices provided the failure is not within the
peripheral devices themselves or within the peripheral communication circuitry.
Additionally, LED indicators, which are visible while the board is operating, shall be
provided to localize the fault. The LED indicators shall operate in addition to the
peripheral device reporting. Cold-start initialization diagnostics shall be initiated by
power-up and operator request. Additional hardware and software shall be provided to
continuously monitor on-line system operation and detect system faults.

☐ Software Documentation: Provide software to automatically graphically document all
DDC control points and software directly from control software code and providing a
graphic output compatible with AutoCAD DWG or DXF format(s). This software shall
effectively "reverse engineer" the control programs code to provide the Owner with a
graphic representation of the control algorithm, control points, and control variables.

☐ Application Software: All application software programs shall be distributed throughout
the CU's in the system. Distributed software resident in the CU's shall be provided for
standalone operation. All CU's shall contain OS software as necessary for scheduling and
controlling resident programs, and for data file management. All sensor failures shall be
immediately reported as an alarm.

1. Timed Programmed Commands (TPC): The RCU shall be capable of
automatic start-up and/or shutdown of selected remote equipment and automatic
adjustment of setpoint data according to preset schedules stored in the computer.

All remote fans, pumps, motors, lights, HVAC systems, boilers, chillers, etc., or any
device which operates on a preset time basis can be assigned to this program. TPC
shall operate in accordance with a yearly calendar with automatic adjustment for
daylight savings time and leap year.

TPC shall operate a holiday schedule capability, which will automatically bring up a
pre-defined holiday schedule of operation. Holidays can be scheduled up to one year
in advance and shall be capable of any number of holidays per year. The technique

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for scheduling holiday operation shall be to specify the date of the beginning day of
the holiday and the date of the ending day of the holiday. For each of those days
specified as a holiday, each timeclock will follow its unique holiday schedule.

In addition to the time dependent two state control, TPC also provides time
dependent setpoint control. This control provides the capability of outputting
assignable, proportional setpoint values in accordance with the time of day and day of
week. This program shall be used to accomplish night setback, morning warm-up,
and normal daily operation setpoints of all control system loops controlled by the
RCU. As with the two state control, time dependent setpoint control shall be
subject to the holiday schedule.

The setpoints desired shall be user definable at the keypad and display. The operator
shall be capable of reading and/or altering all stored data pertaining to time of day,
day of week, on/off times, setpoint values and holiday designation.

2. Optimum Start Program (OS): The optimum start-up time of assigned
equipment shall be determined based on a software calculation, which takes into
consideration outdoor air conditions and space conditions. Any or all zones and their
associated loop control shall be capable of being optimized by the optimum start
program.

The software program shall be capable of determining the ideal start-up time in the
heating and cooling system. Each zone being optimized may have its own unique set
of variables, such as temperature and occupancy time. The optimum start program
shall control the start-up of the HVAC cooling and heating equipment to achieve
the target occupancy space temperature at the precise time of building occupancy. By
use of the onboard keypad, the operator shall have the ability to program the
occupancy time and target temperature for each zone to be optimized.

Provide a built-in "learning" technique that allows the RCU to automatically adjust
itself to the most effective time to start equipment in order to achieve the desired
occupancy target temperature. Each zone being optimized shall have its own
learning curve. However, it shall be possible for the operator to input values into
the program and disable the "learning" function.

3. Enthalpy Optimization (EO): The enthalpy optimization program shall
reduce system cooling requirements when the total heat of the O.A. is less than that
of return air. The total heat, which is a combination of the latent heat and sensible
heat, will be calculated for outdoor air and compared against that of the return air
and a decision made as to which source would provide the most economical operation.
Dampers will be automatically adjusted in accordance with this decision. Dry bulb
sensor inputs in conjunction with relative humidity input will be used to calculate the
enthalpy in both air streams.

4. Custom Control Programs (CCP): The RCU shall be capable of providing
operator programmable custom event/response routines. A user programmable
language will provide the ability for the user to compose unique programs for
handling building requirements, which are not covered, by the available standard
programs of the system. The custom control program can provide an output in
response to any combination of the logical input functions AND, OR, NAND, NOR
and XOR.
In addition, the custom control program must also have the ability to perform mathematical operation, including ADD, SUBTRACT, SQUARE ROOT, MULTIPLY, DIVIDE, AVERAGE, MAXIMUM (highest signal select) separate from or in combination with logical functions. The program must accommodate separate and unique custom control programs.

5. Direct Digital Control (DDC): DDC capability using a custom control program, manual command or time program initiated commands shall be provided as a standard feature of this system. It shall be possible to input sensor or group of sensors to the RCU, process the data using the features of a loop control program, and output and analog control signal or setpoint directly to a controlled device. It shall not be necessary to provide intermediate controllers to condition the signal. The output signal shall be scaled in software to be compatible with industry standard control signal variables, such as 3 to 6 volts or 6 to 9 volts. Integral to the direct digital control capability shall be industry standard control types, e.g., hysteresis (floating control), proportional control/direct or reverse acting, proportional and integral (PID)/direct acting or reverse acting. The units of control will be in engineering units, such as degrees Fahrenheit, kilowatt hours or percent relative humidity. In the case of hysteresis control, dead band shall be entered in engineering units, such as degrees Fahrenheit. For proportional control, throttling range shall be specified in engineering units. For proportional and integral and PID control, reset time in quarter minutes or differential rate in units per minute shall be an operator entered constant. Any software loop output in the RCU shall have the ability to control staged control or provide analog direct digital control. All loop parameters shall be user definable and shall include "Minimum On-Time", "Minimum Off-Time" and "Optimum Cycle Time" for each stage of control.

6. Trend Analysis Reporting: Trended points may be digital inputs or outputs, analog inputs or outputs or calculated values. Time interval between samples shall be operator selectable. Trend logs shall be capable of providing history of facility condition and shall continue uninterrupted until the program is manually stopped or altered by an authorized operator. The trend function shall:
   • Monitor the same point or points according to an interval and store each value.
   • Monitor a point or points when directed by an alarm condition.
   • Store the time at which the data was taken for each point.
   • Point data according to an interval (length determined by user) or during an alarm condition.
   • Print a column header with point designation and engineering units for each point.
   • Print the time and point data information in its respective column for all values for that point.

PART 5 - VARIABLE AIR VOLUME DIGITAL CONTROLS
GENERAL
☐ Controls shall be microprocessor based pressure independent or pressure dependent Variable Air Volume Digital Controllers (VAVDC), as indicated on the drawings.
☐ The VAVDC shall consist of a UCU, power supply, enclosure, actuator (when required), differential pressure transducer, field terminations, field adjustments and operating/application system software in a single integrated package.
☐ All input/output signals shall be directly hardwired to the VAV DDC controller.
Troubleshooting of input/output signals shall be easily executed with a PDOT connected at the wall sensor location.

- The VAVDC shall have a room sensor with integral room setpoint adjustment. The room sensor/setpoint shall be capable of being shared by up to four VAVDC's to provide coordinated control of zones containing multiple VAVDC's. The sharing of the sensor/setpoint shall be through hardwire connection. Systems sharing data through communications shall not be acceptable. The room sensor shall contain a pushbutton for override of unoccupied conditions and a plug-in communications jack for connection of the PDOT.

- VAVDC control algorithms shall be designed to limit the frequency of damper repositioning, to assure a minimum 10 year life from all components of the VAVDC. The VAVDC shall provide zone control accuracy of not more than +/- 1 Deg. F.

- All control sequences programmed in the VAVDC shall be stored in non-volatile memory, which is not dependent upon the presence of a battery to be retained. Power failures shall, therefore, not cause the VAVDC memory to be lost, nor shall there be any need for batteries to be recharged or replaced.

- The VAV terminal unit manufacturer shall provide a multi-point, averaging, differential pressure sensor mounted on the inlet to each VAV terminal unit and shall adjust the unit for airflow's indicated on the drawings.

**********SPEC WRITER: COORDINATE THE REQUIREMENTS FOR MOUNTING CONTROL DEVICES WITH THE VAV TERMINAL UNIT SPECIFICATION.**********

- The VAV terminal unit manufacturer shall mount actuators, controllers, etc., provided by the control subcontractor. The control subcontractor shall ship actuators, controllers, etc. to the VAV terminal unit manufacturer for installation. The control subcontractor shall provide all reheat control valves to the mechanical contractor for mounting and piping. The control subcontractor shall provide and install all wiring between the valve and VAVDC and between the room sensor and the VAVDC.

FAN ASSISTED, INDUCTION, REHEAT UNITS

- In addition to the inputs and output points described above, VAVDC for terminal units which are fan assisted of induction or of reheat configurations shall provide the following additional control points:
  - Up to 4 digital outputs for fan control, up to 4 stages of electric reheat, floating valve actuator control of occupancy control of blinds, lights, etc.
  - A 4-20mA (0-10 VDC) true proportioned analog output signal for control of a proportioning hydronic reheat valve.

PART 6 - FIELD SENSORS AND DEVICES

GENERAL

- Provide all remote sensing points and instrumentation as required for the systems. All sensors shall have accuracies as stated hereinafter.

- Field Wiring for each digital device shall be two or three conductor No. 18 AWG, or larger twisted sets of cooper conductors 300 volts, thermoplastic. When line voltage is present in conduits or wiring trays the insulation on all conductors shall be 600 volts. For multiconductor wire having four or more conductors, wire size shall be not less than No. 20 AWG solid copper.

SAFETY/STATUS SWITCHES

- Differential liquid pressure switches shall be piped in parallel across all water circuits for positive indication of flow - Example: Heat pump loop, cooling tower loop, heat
exchangers and storage tanks. Snap action SPDT switches shall operate from a neoprene slack diaphragm, corrosion-resistant stainless steel diaphragm or copper diaphragm capable of being adjusted through the total pressure range.

Switches shall withstand at least twice the working pressure of the system including any standing head, and have a temperature range exceeding the worst case liquid and ambient temperature range conditions. Provide a NEMA 4 enclosure for the switch assembly. For ease of service and maintenance, install the switch with a 3 valve manifold piped in copper to pressure taps in the liquid lines.

Current sensing relay shall be used for pump and/or fan motor status. The current sensing relay shall be adjustable within three ranges; .1-6amps, 6-40amps and 40-200amps. Contact rating shall be .15amps at 30VDC.

Differential air pressure switches shall be piped in parallel across fans for positive indication of flow. Static pressure sensing tips shall be used for both high and low inputs. Pressure range shall be adjustable between .07 and 1.0" W.C. Snap acting contact shall be rated at 300 VA at 120 VAC.

SENSOR ACCURACY

Sensors are only one element in the overall system accuracy to which the CU can respond. That response includes alarm decision, value display, value calculation on which analog values must be multiplied, subtracted, square rooted, etc. As such, the system end-to-end accuracies are herein stated. Sensors that have a tendency to drift with age shall be supplied with self-correcting circuits. The following range/ accuracies are required:

- For the air temperatures: +/- .5
- For water temperatures: +/- 1.0
- For water temperatures in the range 40 - 55 F.: +/- 0.1
- KWH and KW monitoring: +/-.20 psig for water or steam pressure in the range of 0 - 200 psig.
- +/- 1.0% of full scale value for potential or current transducers.
- +/- 2.0% for 0-80% RH, +/- 3.0% for 80-100% RH

Sensors for differential temperature readings to be used in BTU calculations shall be a matched pair with a differential accuracy of plus or minus 0.1 deg. F.

Space Temperature Sensors shall have a temperature range of -40 to 160 deg. F. The sensor shall be stainless steel plate with a 10k thermistor thermally bonded to back with fully insulated gasket and nylon mounting screws.

Duct Temperature Sensors shall have an insertion measuring probe 6 inches long with a temperature range of -40 to 250 deg. F. The sensor shall include a utility box and gasket to prevent air leakage and vibration noise. For all mixed air and preheat air applications, install bendable averaging duct sensors with a minimum 5 ft. long sensor element.

Liquid Immersion Temperature Sensors shall have a temperature range of -40 to 250 deg. F.

Outside Air Temperature Sensor shall be mounted in the outdoors where natural air flow occurs, away from any artificial affect from mechanical sources. The temperature range shall be -40 to 220 deg. F. Provide a sun shield and weatherproof assembly for mounting to 1/2 in. rigid conduit.

Duct Relative Humidity Sensors shall be duct mounted devices that produce a linear output over the complete range of 0-100% RH. A thin film polymer sensing element shall respond quickly to changes in humidity and shall be protected from contamination by a sintered filter. The sensor shall be factory calibrated with periodic field recalibration capability. The sensor shall be mounted in a duct probe assembly and be installed only after the construction or renovation area is free of contamination.

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Space Relative Humidity Sensors: The sensor shall be an analog precision capacitance type relative humidity detector. Sensing element shall be rated for the relative humidity range 0-80%.

TEMPERATURE AND HUMIDITY SENSORS
- Temperature Sensors: The following shall apply to temperature sensors:
  - Stem or tip sensitive types.
  - Sensing elements shall be hermetically sealed.
  - Stem and tip construction shall be 304 stainless steel.
  - All external trim material shall be corrosion resistant designed for the intended application.
  - Thermometer wells shall be stainless steel. Heat transfer compounds shall be compatible with the sensors.

PRESSURE
- Air pressure transmitter shall universally measure very low static or differential pressure using a variable capacitance technique. Static pressure shall measure in ranges from 0 to 10 inches water column. Differential air pressure shall have a range of 0 to +/-0.5 inches. Transmitter accuracy, including non-linearity, hysteresis and non-repeatability shall be within 1% of full scale.
- Dirty Filter Indication: Dirty filter shall be indicated as an alarm. Sensor shall be Dwyer 1823-0 or 1823-1 which ever is required.

POWER METERING
- Electrical demand shall be from pulsing dry contacts provided by owner and installed by the Utility Company at the power meter. The DDC system shall be capable of measuring and scaling any pulse rate provided by the utility company.

SURGE AND LIGHTNING PROTECTION
- Line voltage protection: The CU's shall be powered by 120 VAC circuits provided with surge protection. This protection is in addition to any internal protection provided by the manufacturer. The protection shall be a LA302RUL manufactured by Delta Lightning Arresters Inc. or an approved equal. For all DCP locations with telephone modem, an MP11 (as manufactured by GSI or equal) shall be used to provide AC line and telephone line protection. A grounding conductor, (minimum 12 awg), shall be brought to each control panel from either a driven ground rod or the ground bus in a breaker panel. Conduit grounds will not be acceptable.
- Inter-unit Communications: All panel to panel data networks that are routed outside or between buildings shall be protected by a SPR 422E or approved equal. The protection device shall match the voltage levels of the inter-unit communications network.

FIBER OPTIC DEVICES AND CABLE
- Fiber Optic Repeaters: The repeaters shall be provided as required and shall convert RS-485 to Fiber Optics. The repeaters shall also extend communication distance up to 3 miles (16,000 ft.) All Repeater Modules shall have Light Emitting Diode (LED) diagnostic indication. The LEDs indicate when power is applied and show the communications activity. Each Repeater shall be installed in a Nema one (1) enclosure and be surge tested to comply with IEEE-587 (ANSI/IEEE std. C62.41) transient suppression withstand test for category A and B type devices.
Fiber Optic Cable: The Fiber Optic Cable shall be as manufactured by Ensign-Bickford, Avon, CT. Part #HCP-M0200T-A-02E-B07 or approved equal.

**FINAL CONTROL ELEMENTS AND OPERATORS**

- **Fail Safe Operation:** Design and install control valves and dampers to activate "closed" upon a loss of control signal.

- **Valves:** Controls subcontractor shall be responsible for selection of the proper control valves including line size, pressure rating, flow-coefficient, shutoff rating and allowable leakage factor. Valves 2-1/2 in. and larger shall have minimum 125 psig cast-iron body and shall have stainless steel stems and flanged connections with field replaceable packings. Valves smaller than 2-1/2 in. shall be constructed of brass with screwed connections, stainless steel stems and field replaceable packings. All valves 1-1/2 in. and larger shall have gear train heavy duty actuators.

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**Maximum Pressure Drop through Valve:**

- **Two Position Steam Control:** 20% of inlet gauge pressure.
- **Modulating Steam Control:** 80% of inlet gauge pressure (acoustic velocity limitation).
- **Modulating Water Flow Control:** Greater of 10 ft. of water or the pressure drop through the apparatus.

- Two position water valves shall be line size.

- **Valve Positioning:** All control valves 2-1/2 in. or larger shall have position indication. Modulating valves shall have an analog input to the DDC system. End switches shall provide a digital input for 2-position valves. Voltage output indications are not acceptable. Feed-back shall be provided by slide-wire potentiometer or equal.

- **Dampers:** Control dampers shall be opposed blade (except where two-position action is indicated) with interlocking gasketed edges, jamb seals and ball type oilite bearings. Blades and frames shall have galvanized finish. Frames shall not be less than 5 in. X 1/2 in. X 16 gauge channel iron and shall be reinforced to form a rigid assembly. Blades shall be 16 gauge with maximum blade width of 10 in. Dampers over four feet high or wide, or over 16 sq.ft. shall be built in two or more sections with interconnections on every other blade. Gasket material shall be molded neoprene or approved equal. Damper leakage shall not exceed 6.0 CFM/SF at 1in. SP, fully closed.

- **Damper Operator:** Operators shall be heavy duty electric gear train type for modulating automatic dampers in response to a varying signal. Motor shall be of sufficient size to operate damper positively and smoothly to obtain correct sequence as indicated. Provide NC operator with spring return on 2-position dampers.

- **All applications requiring proportional operation shall utilize truly proportional electric actuators. Pulsed positioning of actuators/operators will not be acceptable.**

- **Computer generated mylar labels shall be provided so as to properly identify all control components.**

- **A telephone line shall be supplied and wired from the telephone board to the DDC system.**

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**PART 7 - SEQUENCE OF OPERATION**

**GENERAL**

- **AHU's shall each have an RCU. Additional RCU's shall be provided as indicated or required.**

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**SPEC WRITER:** **EDIT THIS PARAGRAPH TO PREVENT REQUIRING EXCESS CONTROL PANELS.**

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- **Each RCU or ACU shall be provided with 2 spare universal I/O points to allow for future**

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modifications. (If more than one panel exists in an equipment room or closet only 2
points are required in this situation. Systems not providing universal I/O's shall provide
4 additional points, i.e. one of each (A/I, A/O, D/I and D/O), at each panel.

AHU CONTROL
☐ Each AHU is a zone that can be individually assigned an operation schedule or operate in
conjunction with other zones as defined by the Owner. Each zone shall have a
push-button override located in the Administration area to provide for a programmable
amount of time for override. If the button is pushed during normally occupied times, no
change in operation will occur. If the button is pushed during normally unoccupied
times, both the AHU and central heating and cooling source will operate in the occupied
mode for the programmed time duration. Each AHU transmitter shall have adjustable
heating and cooling setpoints which can be operator adjusted.

☐ During night setback operation, both the AHU and central heating source will be cycled
on/off to maintain a minimum 55 deg F. space temperature. Actual minimum
temperature shall be adjustable, through software, with a 4 deg. F. differential (also
adjustable) to prevent frequent cycling. Any required water pumps shall also be
commanded on if an AHU is required to operate during unoccupied times. The outside air
damper for each AHU shall open only during occupied times and shall remain closed
during morning warm-up/cool down and night setback operation.

☐ The AHU fan shall be started and stopped based on a pre-programmed, adjustable time
schedule.

☐ The supply air temperature shall be reset from 55 deg F. to 65 deg F. as required by the
zone demand, as measured by the zone sensors. Supply air temperature shall be
maintained by modulation of outside/return/relief dampers if the O.A. temperature is
below supply air temperature setpoint and 3-way chilled water valve on the cooling coil if
O.A. temperature is at or above supply air temperature setpoint.

☐ DDC system shall modulate the inlet vane actuator on the Supply Fan as required to
maintain the minimum duct static pressure setpoint.

☐ A space mounted static pressure sensor/transmitter, acting through the DDC system,
shall modulate the vaneaxial operator on the Return Fan as required to maintain the
minimum building static pressure setpoint.

☐ A software freezestat shall shut down the unit if the mixed air temperature should fall
below 34 deg F.

☐ Each AHU shall initialize a morning warm-up cycle. The outside air damper shall close
to minimum position and return air shall open to its minimum position. The cycle
shall continue until the return air temperature reaches 70 deg F., at which time the
system shall switch back to its normal operating mode.

VAV TERMINAL CONTROL
☐ A wall mounted temperature sensor, acting through the VAVDC, shall modulate the VAV
terminal and the proportional hot water reheat valve in sequence as required to maintain
the space temperature setpoint. During AHU warm-up, the VAV terminal control action
shall be reversed to allow the terminals to operate at their controlled maximum CFM
and the reheat valves shall open to full flow.

CENTRAL PLANT CONTROL
☐ The DDC system shall start/stop the pumps and central equipment whenever an AHU or
fan coil unit (FCU) zone is indexed to occupied and the outside air is above/below the
appropriate setpoint. Upon command from the DDC system, and when the outside air
temperature is above 60 deg F. (adjustable) the chilled water pump shall start. When the
chilled water pump is started, and when the chilled water flow is proven by a flow switch
and a current sensing relay on the pump, the chiller shall be enabled and shall operate
under control of its integral operating and safety controls. Upon command from the

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DDC system, when the outside air temperature is below 55 deg F. (adjustable), and when required to maintain the HWS setpoint, the hot water pump shall start. When the hot water pump is started, and when the hot water flow is proven by a current sensing relay on the pump, the boiler shall be enabled and shall operate under control of its integral operating and safety.

SEQUENCE EXISTING BUILDING(S)/OVERRIDES

The Equipment shall be grouped into building zones as directed. Each zone will be addressable for "on/off" and optimum start/stop operation and temperature monitoring (one temperature sensor per zone). Timed override switches (panel mounted) located in the office area will allow manual override of the schedule for up to two hours. Each timed override switch status shall be an input to the DDC system.

FAN COIL UNIT CONTROL (FCU)

For each power circuit serving fan coil units, the control subcontractor shall provide a contactor that will close on a signal from the DDC system. The control subcontractor shall provide the control wiring to the contactors. All power wiring shall be by the Electrical Contractor. DX FCU's shall be started and stopped by relays breaking the control voltage and not the power circuits.

In the occupied mode, when the FCU's are indexed for operation through the contactors, the fans shall run continuously at the speed previously selected on the 3-speed fan switch and the return air thermostat shall control the chilled water valve to maintain desired space conditions. Each FCU will have a factory supplied and wired return air thermostat, 3-way valve and 3-speed fan switch. Note: The FCU's shall be locked out whenever the outside air temperature is below 65 deg F. (adjustable).

ELECTRICAL DEMAND LIMITING

The DDC system shall limit electric demand to a value specified by the Owner.

1. First stage of demand limiting shall be by shifting heating and cooling setpoints.

2. Second stage shall be to turn off exhaust fans and close outside air dampers to reduce building load.

The DDC system shall measure and record building electrical demand and building electrical consumption. Program trend logs to record:

1. Maximum demand and consumption per hour on hourly intervals.

2. Building demand and consumption on a daily interval.

3. Building demand and consumption on a monthly interval.

SECURITY SYSTEM INTERFACE

The DDC system shall connect to the school's security system and when that system is "armed" the DDC system shall switch all of the equipment in the complex to the night/unoccupied mode and stop all mechanical equipment unless a night setback/setup or freeze condition is in effect.

KITCHEN EQUIPMENT FREEZER AND COOLER CONTROL

Provide wall mounted refrigerator/freezer temperature sensors to monitor both the freezer and cooler areas. Each sensor shall be an input to the DDC system for indication and alarm.

LIGHTING CONTROL

The control subcontractor shall provide the number of outputs for lighting control as indicated on the drawings. These loads will be controlled based on time-of-day and special scheduling supplied by owner. The control subcontractor shall also connect to a dry contact point in the school's security system such that when a security breach is alarmed the lights will be activated.

The control subcontractor shall provide all wiring between the DDC system and the light fixtures.
and security contact. All power wiring to lighting contacts shall be by the Electrical contractor. Lighting and security contact are supplied by others.

- Provide push button override located above or near security keypad as D/I into DDC system for unoccupied use of lights.

SMOKE DETECTORS

- Smoke detectors are supplied and wired by Electrical Contractor. The control subcontractor shall mount detectors. Electrical Contractor shall supply and install a relay near the motor controller to shut down the unit. Central fire alarm panel shall be provided with one contact output to the DDC system to indicate activation or failure of any smoke detector. Wiring required for alarm points shall be provided by the control subcontractor.

MAINTENANCE MANAGEMENT

- The DDC system shall measure and record run time for all start/stop points in the system. Based upon the accumulated run time provide maintenance messages on the interval recommended by the equipment manufacturers.
- Any digital input point that is used for maintenance purposes (i.e. Dirty Filter) shall also generate a maintenance message.
- All maintenance messages are to be sent via LAN or Modem to the MMI.

TROUBLE ALARMS

- The control subcontractor shall establish a trouble high and trouble low alarm limit for each analog input and announce a corresponding alarm message at the MMI.

MODIFICATION

- All software setpoints, limits, alarms, messages, schedules, sequences, etc., as specified herein are to provide an initial setup of the control system. The control subcontractor shall provide software modifications that may be required to "tune" the DDC system to accurately respond to actual building parameters. Further, these software functions shall be readily modifiable by the Owner's personnel as changes in building operation dictate.

DOMESTIC HOT WATER

- Provide one temperature sensor for each kitchen and/or gym domestic water heater.
- Provide single digital output for water heater start/stop control. Recirculating pump(s) may be controlled by separate digital output or same output controlling water heater, depending upon application.

DATATALK INTERFACE

- The DDC system shall be capable of utilizing DATATALK. WCPSS already owns DATATALK software and hardware and therefore will only require additional site software for this job. All alarms, overrides, etc. required shall report and run in complete compatibility with the existing software package.
- New CU's shall have the ability to report to the existing software such that setpoints, schedules, analog values and digital values can be interrogated and changed from any remote touch tone telephone. Appropriate alarms shall contact personnel via telephone. Maintenance personnel can dial into system from remote touch tone telephone to interrogate problem.

PART 8 - EXECUTION

INSTALLATION-GENERAL

- Work schedule shall be in accordance with Division 1.
- Existing facilities shall remain in use during all phases of construction under this Contract.
- The Contractor shall cooperate with the Owner in every way possible to keep interruption of, and interference with, normal functions, activities, and operations to a minimum. Where construction or attendant work interrupts normal functions in any
area, a schedule of work shall be submitted for approval of the Owner and after
approval, strictly followed.
☐ Modification to existing work shall be done as required.
☐ All work shall be performed in such a manner as to prevent any interruption of any
service or utility.
☐ Where it is necessary to interrupt service for cut-in or changeover, the work shall be
scheduled well in advance of the interruption and the interruption approved by the
Owner. If required by Owner, change-over work shall be done during night, weekends,
holidays, or other off peak period as approved.
☐ No equipment shall be disconnected without approval of the Owner's Representative.
☐ Existing material which is removed may be reused if specifically approved by the Owner's
Representative.
☐ All temporary wiring and/or other control components required for temporary operation
of the facility shall be provided.
☐ Wiring: The term wiring is construed to include furnishing of wire, conduit, miscellaneous
material and labor to install a working system. Outdoor installations shall be of
weatherproof construction or in NEMA 3R or 4 enclosures.
☐ Routing: Except for short apparatus connections, run conduit parallel to or at right
angles to the building structure. Conceal conduit in finished spaces. Do not run conduit
concealed under insulation or inside ducts. Mount control devices, and conduit located on
ducts or apparatus with external insulation on stand-off support to avoid interference
with insulation.
☐ Run wire connecting devices on or in control cabinets parallel with the sides of the
cabinet neatly racked to permit tracing. Rack connections bridging a cabinet door along
the hinge side and protect from damage.

D. Field Materials:

   Protect all circuits to avoid interruption of service due to short-circuiting or other
   conditions. Line-protect all wiring that comes from external sources to the site from
   lightning and static electricity. Label or code each field wire at each end.
   Permanently label or code each point of all field terminal strips to show the
   instrument or item served. Color-coded cable with cable diagrams may be used to
   accomplish cable identification.

   a. Temperature sensors: Temperature sensors shall be readily accessible and
      adaptable to each type of application in such a manner as to permit for quick,
      easy replacement and servicing without special tools or skills.

      Mount duct sensors in locations to sense the correct temperature of the air
      only, within the vibration and velocity limits of the sensing element. Mount
      extended surface element, when used, securely within the duct and position to
      measure the best average temperature. Thermally isolate elements from
      brackets and supports to respond to air temperature only. Securely seal duct
      penetrations.

      Install pipe sensors in top of pipe for horizontal runs and at a positive slope
      on vertical runs to prevent condensation from flowing to sensor head.

   b. Temperature sensing elements installed in liquid systems shall be installed
in thermowells.

c. Relative humidity sensors **shall** have air guards when installed in air flows of more than 15 meters per minute across the sensor element.

d. Pressure Instruments:

Pressure sensors (all types) installed on liquid lines **shall** have drains. Pressure sensors installed on steam lines **shall** have drains and siphons. All pressure sensors **shall** have valves for isolation, venting, and taps for calibration. Pressure sensors **shall** be verified by calibration. Differential pressure sensors **shall** have nulling valves.

Pressure switches (all types) installed on liquid lines **shall** have drains. Pressure switches installed on steam lines **shall** have drains and siphons. All pressure switched **shall** have valves for isolation, and taps for calibration. Pressure switches **shall** be adjusted to proper setpoint, and **shall** be verified by calibration. Differential pressure switches **shall** have nulling valves. Switch contact ratings and duty **shall** be selected for the application.

The duct static-pressure sensing element, (tap or pitot tube), **shall** be located approximately two-thirds of the distance from the supply fan to the end of the duct with the greatest pressure drop. Provide taps for transmitter calibration.

e. Install potential and current transformers in NEMA enclosures. Current transformer leads **shall** be shorted when they are not connected to the measurement circuits.

f. Install relays and contactors in NEMA enclosures. H-O-A switches and override switches **shall** be installed so that controls function through the automatic position. Safety and fire or life safety interlocks **shall** function through both hand and automatic switch positions.

g. Damper Actuators:

Actuators **shall not** be mounted in the air stream.

Outside air, return air, and relief dampers **shall** have individual actuators.

Actuators **shall** be installed so that their action **shall** seal the damper to the extent required to maintain leakage at or below the specified rate and **shall** move the blades smoothly.

2. DCP's: Install in accordance with manufacturer's published instructions and requirements.

E. Signal Transmission System Equipment:

1. General: Install all system components in accordance with the National Electrical Code and the manufacturer's recommendations; fuse and ground them properly.
a. Splices: Splices in shielded and coaxial cables **shall** consist of terminations and the use of shielded cable couplers. Terminations **shall** be in accessible locations. Cables **shall** be harnessed with cable ties.

b. Equipment: Fit all equipment contained in cabinets or panels with service loops, each loop being at least 12 inches long. Equipment for fiber optics system **shall** be rack mounted, as applicable, in ventilated, self-supporting, code gauge steel enclosure. Cables **shall** be supported for minimum sag.

c. Cable Runs: Keep cable runs as short as possible, connecting to the terminal board. **Do not** bend flexible coaxial cables in a radius less than ten times the cable outside diameter. **Use** vinyl tape, sleeves, or grommets to protect cables from abrasion or damage. Allow extra length for vibration at points where they pass around sharp corners, through walls, and panel cabinets.

d. Grounding: Ground system per manufacturer's requirements for proper and safe operation.

F. Field Test and Inspections

1. System Equipment: Upon completion of installation of each piece of equipment, field inspect and mechanically and electrically test equipment for proper function.

2. Field Materials: Upon completion of installation of each piece of equipment, field inspect and mechanically and electrically test equipment for proper function.

3. Signal Transmission System Equipment:
   a. Ground Rod Tests: Before any wire is connected to the ground rods, **use** a portable ground testing instrument to test each ground or group of grounds.
   b. Coaxial Cable Tests: Implement NEMA WC41 as a minimum.

4. Inspections: Inspection of the electrical work **shall** be done by the N.C. Department of Insurance "State Electrical Inspector" and by a representative of the State Construction Office.

END OF SECTION
SECTION 16000 - ELECTRICAL WORK

GENERAL

DESIGN REQUIREMENTS

□ Engineer shall be required to incorporate the EPA “Green Lights” program and “Energy Star” program requirements for all designs.

□ All electrical systems main service equipment and panelboards shall be designed with 25% minimum spare capacity, both physically and electrically, for future growth capabilities.

□ In any building where future expansion is definitely planned, as conveyed by the WCPSS, the Engineer shall provide adequate capacity and connection points in the electrical systems as directed by the WCPSS. The additional capacity shall be clearly noted on the front of the electrical drawings.

□ Provide ten (10) 3/4 in. spare conduits for all recessed panelboards to stub out above lay-in ceilings.

□ Provide sufficient electrical service, transformer, spare panelboard space and 2 in. conduits to a junction box located on exterior face of building for four (4) future portable classrooms. Assume each portable classroom will require 200 amp, 240 volt single phase service.

□ Provide lightning and surge suppression on all security, intercom, Building Automation System (BAS), MATV and fire alarm systems.

□ Provide phase loss protection at electrical panels serving HVAC motors and compressors.

□ Electrical Contractor shall provide conduit and pull string from demand meter to main Mechanical Room.

□ Electrical Contractor shall be responsible for all costs associated with demand meter.

□ Electrical Contractor shall provide dedicated and protected 120V power to all HVAC control panels and damper operators. Provide junction box and on/off service switch directly over control panel.

□ Electrical Contractor shall provide a telephone jack in each mechanical room.

□ Engineer shall require contractor to dimension actual location of all underground conduits on as-built drawings. A minimum of two dimensions from building reference points shall be provided and a bury depth indicated.

□ Provide a 120 V receptacle adjacent to kiln to provide power to kiln downdraft exhaust fan. Locate this receptacle a maximum of 4 ft. away from kiln. Kiln room shall also have a high temperature heat detector tied into the fire alarm panel.

DRAWING REQUIREMENTS

□ All text and numbers shall be a minimum of 3/32 in. high to allow for a 1/2 reduction of the drawing size and still be readable.

□ Provide key plan for all sheets.

□ Show details of all conduit penetration details on the drawings for all fire rated walls to meet UL and Local Code Requirements.

□ Show all fire rated walls on all drawings for all trades with the rating spelled out or show different wall symbol for each rating, (1HR, 2HR, or 4HR).

□ Show dotted lines on floor plans to designate clearance requirements for electrical equipment.

□ Show a complete legend and symbol list on the first electrical sheet.

□ All building connected electrical loads (kW) and estimated maximum electrical demand (kW) shall be clearly shown on the first electrical sheet.

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DEFINITIONS AND ABBREVIATIONS - 01000 -157
All capacities provided for future building additions shall also be shown on the first electrical sheet.

Draw all electrical equipment to scale including panelboards, fire alarm panels, sound panels, etc.

OPERATING AND MAINTENANCE MANUALS (See Section 01000-General Data)

Specify that four (4) complete set of operation and maintenance manuals shall be delivered to the owner through the A/E two (2) weeks before the pre-final inspection is held.

The O&M manuals shall be installed in three (3) ring heavy back note books with the name of the building and the words "Operations and Maintenance Manuals" permanently affixed to the cover and spine. The manuals shall contain the following items as a minimum:

1. Index and page numbers
2. Certificate of Substantial Completion
3. Summary sheet of warranties with dates noted and a copy of all warranties
4. List of all subcontractors and suppliers with names, addresses and phone numbers
5. All submittal data and shop drawings

FINAL INSPECTIONS - see section 01000-General Data.

POST INSPECTIONS - see section 01000-General Data.

END OF SECTION
SECTION 16110 - CONDUIT

PRODUCTS

☐ Conduit types shall be rigid steel, IMC, schedule 40 (or heavier) PVC or EMT.

☐ Fittings shall be all steel. Cast, pot metal, set-screw or crimp type fittings shall not be permitted.

☐ EMT connectors shall be insulated throat. Plastic bushings may be used in lieu of insulated throat.

☐ EMT couplings shall be compression type.

EXECUTION

☐ Conduit Uses:

1. Rigid steel conduit or IMC may be used for underground branch circuit wiring without concrete encasement. All rigid steel and IMC feeder conduits shall be encased with 3 in. of concrete on all sides. All branch circuits exposed less than 8 ft. above finish floor and all feeder conduits run above grade shall be in rigid steel conduit or IMC.

2. PVC conduit may be used without concrete encasement for branch circuits directly under concrete slabs and when turning up out of the slab inside walls to the first junction box. All PVC conduit outside the building slab and all PVC feeder conduits shall be encased in 3 in. of concrete on all sides.

3. EMT may be used inside walls, in ceilings and exposed above 8 ft. above finish floor.

☐ Plastic bushings or insulated throat connectors shall be used in all conduit terminations.

☐ Conduit shall be used in walls, from the outlet to the ceiling, for public address, intercom and MATV wiring. Conduit is not required in ceilings for public address, intercom or MATV wiring. Provide plenum rated cable where necessary.

END OF SECTION
SECTION 16120 - WIRES AND CABLES

GENERAL

☐ All conductor material shall be copper. Aluminum conductors are prohibited.

END OF SECTION
SECTION 16142 - ELECTRICAL CONNECTIONS TO EQUIPMENT

GENERAL

- Power wiring to all Plumbing or HVAC equipment shall be provided by the Electrical Contractor. The Plumbing or HVAC Contractors will be required to make final connections inside the equipment from slack wire left by Electrical Contractor for system check out. All disconnect switches and starters shall be supplied by the Plumbing or HVAC Contractors and turned over to the Electrical Contractor for mounting and wiring. All fuses and heaters shall be furnished by the Plumbing or HVAC Contractors. Show detailed drawing to avoid confusion. See Attachment 16142-A.

- Provide dedicated 120 volt, 20 AMP circuits to all Building Automation System (BAS) panel locations and in all mechanical rooms or other mechanical equipment locations requiring 120 volt control power.

- Provide a dedicated 120 volt, 20 amp circuit at the Fire Alarm Control Panel location.

- A $1,000.00 allowance shall be provided in the electrical contract for demand meter pulse relay installation by the power company. A 3/4 in. empty conduit with pull wire shall be run by the Electrical Contractor from the pulse relay location to a BAS panel location, usually in the main mechanical room. See Attachment 16142-B.

END OF SECTION
ATTACHMENT 16142-A – STANDARD ELECTRICAL CONNECTIONS TO EQUIPMENT

BRANCH CIRCUIT AND CONDUIT IN ELECTRICAL WORK. SEE PANELBOARD SCHEDULES FOR WIRE AND BREAKER SIZES TO HVAC AND PLUMBING EQUIPMENT.

EXTERNALLY OR INTERNALLY MOUNTED DISCONNECT SWITCH FURNISHED BY HVAC OR PLUMBING CONTRACTOR, OR OTHER TRades AND INSTALLED BY THE ELECTRICAL CONTRACTOR.

EXTERNALLY MOUNTED STARTER FURNISHED BY HVAC OR PLUMBING CONTRACTOR OR OTHER TRADES, INSTALLED BY ELECTRICAL CONTRACTOR. LINE AND LOAD CONNECTIONS BY ELECTRICAL CONTRACTOR. CONTROL CONNECTIONS BY OTHERS.

EQUIPMENT IN HVAC OR PLUMBING WORK OR WORK OF OTHER TRADES. SEE HVAC, PLUMBING AND ARCHITECTURAL DRAWINGS FOR LOCATION OF ALL EQUIPMENT.

FINAL CONNECTIONS INSIDE EQUIPMENT TO BE MADE BY THE HVAC OR PLUMBING CONTRACTOR OR OTHER TRades.

JUNCTION BOX MAY BE SHOWN ON ELECTRICAL PLANS FOR SOME EQUIPMENT (NOT NECESSARY IF WIRING IS CONNECTED DIRECTLY TO STARTER OR DISCONNECT SWITCH.)

WIRING IN ELECTRICAL WORK

PANELBOARD

WIRING IN ELECTRICAL WORK

*A COMBINATION STARTER MAY BE USED IN LIEU OF A SEPARATE DISCONNECT SWITCH AND STARTER.
ATTACHMENT 16142-B – STANDARD PULSE RELAY CONDUIT DETAIL

- Pad mounted transformer by CP&L
- Meter
- ¾" Conduit from transformer to location of building automation system panel for kWh pulse relay input.
- Primary conductors
- Secondary conductors
SECTION 16143 - WIRING DEVICES

PRODUCTS
- All receptacles and switches shall be minimum 20 amp. rated, heavy duty, specification grade.
- Two-level lighting switches shall be 20 amp., double-pole, double throw, center off. See Attachment 16515-A for two-level lighting wiring scheme.

EXECUTION
- Receptacles (Convenience Outlets)
  1. Receptacles should be properly located throughout the building for cleaning equipment and other similar uses.
  2. A minimum of one duplex receptacle shall be provided on the interior near the top of the ladder serving the scuttle to the roof area and at each exterior mechanical equipment location.
  3. All receptacles over counters near sinks shall be either GFCI type or on a GFCI protected circuit.
  4. Provide a duplex receptacle and work light in all crawl spaces, open chases and attic spaces.
- Switches
  1. All room switches should be placed in the most convenient location, preferably on the strike side of the entrance door to the area served, 48 in. above finish floor.
  2. Building light switching and control methods are noted in Section 16515.

END OF SECTION
SECTION 16420 - SERVICE ENTRANCE

GENERAL

The engineer shall coordinate with power supplier and indicate and/or specify all requirements for:

a. Point of service
b. Division of work (contractor and power company)
c. Fault current: Overcurrent device(s) shall have interrupting capacity in excess of available fault current throughout system.

END OF SECTION
SECTION 16470 - PANELBOARDS

PRODUCTS
- All panelboards shall have copper bus with bolt-in breakers. All panelboards shall be provided with main breakers, even for sub-panelboards that are served from another panelboard except where sub-panelboards are located in the same room as the panelboard serving them.

EXECUTION
- NEC required clearances shall be required around all panelboards. Show a clearance detail on drawings for clarification. See Attachment 16470-A.
- Provide dedicated surge protected circuits serving computers.
- Lighting panelboards shall only contain lighting circuits. All other loads such as receptacles, mechanical/plumbing equipment, etc. shall be served from separate panelboard(s).
- All panelboards shall be selected for 25% minimum spare electrical and physical capacity above the anticipated demand load.
- Specify typed directories in all panelboards. Room names and numbers in directories shall match final signage used at the site.
- Specify screwed on laminated plastic identification labels on cover of all panelboards.

END OF SECTION
ATTACHMENT 16470-A – PANELBOARD WORKING SPACE REQUIREMENTS

NOTE: THIS FIGURE ILLUSTRATES THE ADDITIONAL EXCLUSIVELY DEDICATED SPACE REQUIRED OVER AND UNDER PANELBOARDS FOR CABLES, RACEWAYS, ETC. TO AND FROM PANELBOARDS REQUIRED BY SECTION 364-4 OF THE NATIONAL ELECTRICAL CODE.

DEDICATED SPACE CONTINUES THROUGH SUSPENDED CEILING TO 25' A.F.F. OR STRUCTURAL CEILING, WHICHEVER IS LOWER.

NOTE: NO PIPING, DUCTS OR EQUIPMENT FOREIGN TO THE ELECTRICAL EQUIPMENT OR ARCHITECTURAL APPURTENANCES SHALL BE PERMITTED TO BE INSTALLED IN, ENTER OR PASS THROUGH THE DEDICATED SPACES SHOWN ABOVE.
SECTION 16515 - LIGHTING

GENERAL

These requirements pertain to all interior, exterior canopy and exterior building lighting. Generally site lighting, such as for parking lots, is provided by the Power Company or others and is not a requirement of the building work. Coordinate with the WCPSS concerning the outdoor lighting requirements.

All lighting systems shall be designed based on IES and ANSI schoolhouse lighting standards.

Discuss lighting ideas and control strategies with WCPSS Energy Management and Physical Plant offices before design and layout of lighting systems.

Fluorescent light fixtures shall be T-8 lamps with electronic ballasts.

Area lighting shall be designed and provided by CP&L. Engineer to send set of plans to CP&L at the Design Development stage. Area lights to be “cobra heads” on 30 foot metal poles.

CP&L area lighting shall be shown on site plan prior to 100% C.D. submittal. Electrical contractor to provide conduit from area lights located in paved areas to adjacent non-paved surface.

Engineer shall review CP&L area lights and provide additional exterior building lighting (wall packs) as needed to insure that all exterior entrances and first floor windows are illuminated.

Do not locate light fixtures over stairwells. Use wall mounted light fixtures to light stairwells.

PRODUCTS

Four (4) lamp prismatic fluorescent fixtures shall be used.

The use of indirect lighting or parabolic fixtures in areas of high computer concentration is acceptable.

Metal halide fixtures with color corrected lamps and automatic restrike may be used in gyms, multi-purpose rooms, high corridors and high library ceilings. High-pressure sodium fixtures shall be used for exterior corridors, walkways and on the building facade. Standard lamps shall be used in all fixtures.

Inandescent lighting shall not be used except for stage or special utility lighting, as approved by the WCPSS.

“U”tube fluorescent fixtures shall not be used.

No high-pressure sodium lamps under 100 watts are to be specified.

Do not specify “Emergency Light” brand emergency light fixtures.

Ballast manufacturers for fluorescent fixtures shall be Sylvania, Advance or Magna-Tech.

Lamp manufacturers for fluorescent fixtures shall be Sylvania, GE or Phillips.

EXECUTION

Fluorescent lighting shall be laid out so that long dimensions are parallel with dry erase boards on primary wall. If no dry erase boards are present then fixtures should be parallel to cabinets and shelves.

All interior corridors and group toilet lights shall be controlled with key operated light switches and the use of lighting contactors. Provide Hand-Off-Auto (HOA) switch for each lighting contactor. Location of all lighting contactors to be clearly identified on plans.

Provide minimal night lighting in corridors and stairs.
All classrooms, labs, and other rooms greater than 100 sq. ft. shall have two level lighting with two (2) circuits per fixture controlled by a three (3)-position switch. See the accompanying drawing, Attachment 16515-A, for switching scheme.

When fixtures are used which require a warm-up, switches need to be located to assure against accidental or malicious switching. If the switches can not be located in a secure location, then locking switches are required.

Exterior lighting shall be provided for building entrances, outdoor storage areas, loading docks, bus ports, covered walkways, exterior mechanical room doors and other outdoor areas where in the judgment of the engineer or WCPSS, lighting is required for night functions, security, or safety.

Provide exterior floodlighting as required for present and future mobile classrooms.

Illumination Levels: Use Illuminating Engineering Society handbook as a guide.

Lighting calculations: shall be based on room surface reflectance for interior finishes selected by the architect, which in all cases shall not be less than the following for instructional areas. Ceiling Cavity - 80%, Walls - 50%, Floor Cavity - 20%.

Lighting calculations: The illumination levels shown in Attachment 16515-B are recommended minimum initial design levels.

Engineer shall furnish a copy of all lighting calculations to the Owner for review.

Fixture selection and placement shall provide the minimum practical amount of brightness and glare.

Due to constantly changing lighting technology, special designs not strictly adhering to the preceding recommended light levels, but still meeting the lighting needs in the engineer's opinion, will not be prohibited but should have prior approval of the WCPSS.

EXIT SIGNS

Exit signs and directional signs related thereto shall be provided with power from two sources.

The primary source may be connected at any point within the normal lighting system. The secondary source shall operate automatically upon interruption of the primary source and shall be self-contained batteries unless a building emergency generator is provided.

Exit signs and directional signs related thereto shall be provided at all exit doors and as required to mark egress routes.

All exit signs shall be “LED” type with long-life light emitting diodes as manufactured by Exitronix, Lithonia (Signature Series) or equal.

EMERGENCY LIGHTING

Emergency lighting shall be provided with power from two sources.

The primary source may be connected at any point within the normal lighting system. The secondary source shall operate automatically upon interruption of the primary source and shall be self-contained batteries unless a building emergency generator is provided.

The following areas shall have emergency illumination, whether having natural lighting or not:
- Exits and exit access corridors
- Small and large assembly areas
- Areas occupied by over 50 persons
- Gymnasium dressing rooms
- Band and choral rooms
- Industrial arts, prevocational and shops
- Administration or other building control centers
WAKE COUNTY PUBLIC SCHOOL SYSTEM
DESIGN GUIDELINES
6 May 1992

- Kitchens
- Group toilets
- Main electrical service disconnect location
- Main mechanical/boiler room
- Mechanical mezzanines
- Mechanical rooms
- Emergency power equipment location

LIGHTING SYSTEM SECURITY

☐ All practical measures should be taken to provide protection for lighting fixtures and equipment.
☐ Vandal-resistant materials or metal guards shall be used for fixtures within reach of floors and all outdoor locations.
☐ Mounting heights should be specified to afford protection, consistent with ease of maintenance. Mount light fixtures in stairwells 10 ft. above landing floors.
☐ Exit signs and directional signs related thereto should be wall-mounted where possible in lieu of ceiling-mounted, as ceiling-mounted signs are subject to a much greater degree of abuse. Signs must be visible from anywhere within the length of an exit access corridor or directional signs shall be provided.
☐ Certify foot-candle levels at job completion documents and provide report to Owner as part of closeout.

END OF SECTION
## ATTACHMENT 16515-B LIGHTING LEVEL TABLE

<table>
<thead>
<tr>
<th>Type of Interior Areas</th>
<th>Recommended Minimum Initial Design Level</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>All interior areas other than listed below</td>
<td>70 foot-candles</td>
<td>Multipurpose rooms and auditorium stages need 70 foot-candles at full bright dimmer setting</td>
</tr>
<tr>
<td>Industrial art, prevocational or trade and industrial shops, laboratory and lecture room demonstration areas, and task lighting areas</td>
<td>100 foot candles</td>
<td></td>
</tr>
<tr>
<td>Gymnasiums</td>
<td>50 foot candles</td>
<td></td>
</tr>
<tr>
<td>Cafeterias and commons, stairways, and auditorium seating areas</td>
<td>30 foot candles</td>
<td>Auditorium seating areas need 30 foot-candles at full bright dimmer setting</td>
</tr>
<tr>
<td>Corridors, toilet areas, dressing rooms, storage rooms and boiler, mechanical or electrical rooms</td>
<td>25 foot candles</td>
<td></td>
</tr>
</tbody>
</table>
SECTION 16721 FIRE ALARM SYSTEMS

PART 1 - GENERAL

RELATED DOCUMENTS

SCOPE

QUALITY ASSURANCE

SUBMITTALS - GENERAL

DEFINITIONS AND ABBREVIATIONS- 01000 -172
- Installation Instructions: Submit Manufacturer's detailed installation instruction for all duct mounted smoke detectors, flow switches, tamper switches, supervisory switches, and similar items which require mechanical installation.

- Maintenance Data: Submit maintenance data and parts lists for each type of fire alarm equipment installed, including furnished specialties and accessories. Include this data, product data, and shop drawings in maintenance manual.

- Maintenance Contract: Submit a quote for a maintenance contract to provide all maintenance, test, and repair described below and/or in accordance with NFPA-72, "Guide for Testing Protection Signaling Systems". Include also a quote of unscheduled maintenance/repair, including hourly rates for technicians trained on this equipment, and response travel costs. Submittals that do not identify all post contract maintenance costs will not be accepted. Rates and costs shall be valid for the period of five (5) years after expiration of the guaranty. Maintenance and testing shall be on a semiannual basis (or as required by the local AHJ). A preventive maintenance schedule shall be provided by the Contractor that shall describe the protocol for preventive maintenance. The schedule shall include:
  1. Semiannual systematic examination, adjustment and cleaning of all detectors, manual fire alarm stations, control panels, power supplies, relays, water flow switches and all accessories of the fire alarm system.
  2. Semiannual testing of each circuit in the fire alarm system.
  3. Semiannual testing of each smoke detector in accordance with the requirements of NFPA 72, Chapter 7.

- Post-Contract Expansion: If requested in writing by the A/E, the Contractor shall furnish as a part of the submittal package the cost of providing proposed system modifications and/or expansion.

- Certifications: Submit a certification from the major equipment manufacturer indicating that the proposed supervisor of installation and the proposed performer of contract maintenance is an authorized representative of the major equipment manufacturer. Include names and addresses, and telephone numbers in the certification.

PART 2 - PRODUCTS

MANUFACTURERS

☐ Sample manufacturers are as follows:
  Simplex
  Fire Control Instruments
  Cerebus Pyrotronics

FIRE ALARM CONTROL PANEL (FACP)

☐ FACP - General: The FACP shall meet the following general requirements:
  - Signal Line Circuits: Alarm, trouble and supervisory signals from all intelligent reporting devices shall be encoded onto an NFPA Style 6 (Class A) Signaling Line Circuit (SLC).
  - Initiation Device Circuits: Initiation Device Circuits (IDC) shall be wired Class A (NFPA Style D).
  - Notification Appliance Circuits: Notification appliance circuits shall be wired Class B (NFPA Style Y).
  - Digitized electronic signals shall employ check digits or multiple polling. In general a single ground or open on any system signaling line circuit, initiating device circuit, or notification appliance circuit shall not cause system malfunction, loss of operating power or the ability to report an alarm.
- Loss of Power: Alarm signals arriving at the main FACP shall not be lost following a power failure (or outage) until the alarm signal is processed and recorded.

- System Response to an Alarm Condition: When a fire alarm condition is detected and reported by one of the system initiating devices or appliances, the following functions shall immediately occur:
  1. The system alarm LED shall flash.
  2. A local piezo-electric signal in the control panel shall sound.
  3. The 80-character LCD display shall indicate all information associated with the fire alarm condition, including the type of alarm point and its location within the protected premises.
  4. On systems equipped with a printer, printing and history storage equipment shall log the information associated each new fire alarm control panel condition, along with time and date of occurrence.
  5. All system output programs assigned via control-by-event equations to be activated by the particular point in alarm shall be executed, and the associated system outputs (alarm notification appliances and/or relays) shall be activated. Exact programming shall be provided by the Contractor to meet the Owners requirements.

//Spec writers note: T-taps are prohibited elsewhere. Retain the following section if is desired to have the ability to add future T-taps to the system.

//The Fire Alarm Control panel shall be capable of T-Tapping Class B (NFPA Style 4) Signaling Line Circuits. Systems which do not allow, have restrictions to, for example, the amount of T-Taps, length of T-Taps etc., are not acceptable.

FACP - Minimum Requirements: The FACP shall contain a microprocessor based Central Processing Unit (CPU). The CPU shall communicate with and control the following types of equipment used to make up the system: intelligent detectors, addressable modules, local and remote operator terminals, printers, annunciators, and other system controlled devices. The main FACP shall perform the following functions:
  1. Supervise and monitor all intelligent addressable detectors and monitor modules connected to the system for normal, trouble and alarm conditions.
  2. Supervise all initiating, signaling, and notification circuits throughout the facility by way of connection to monitor and control modules.
  3. Detect the activation of any initiating device and the location of the alarm condition. Operate all notification appliances and auxiliary devices as programmed.
  4. Visually and audibly annunciate any trouble, supervisory or alarm condition on operator's terminals, panel display, and annunciators.

System Capacity and General Operation: The system shall have the following capacities and general operation modes:
  1. The FACP shall provide, or be capable of expansion to 198 intelligent/addressable devices per SLC and 2048 annunciation points per system. The number of SLCs provided shall be as indicated on the Drawings.
  2. The FACP shall include a full featured operator interface control and annunciation panel that shall include a backlit, 80 character liquid crystal display, individual, color coded system status LEDs, an alphanumeric keypad for the field programming and control of the fire alarm system.
  3. All programming or editing of the existing program in the system shall be achieved without special equipment and without interrupting the alarm monitoring functions of the fire alarm control panel.
  4. The FACP shall be able to provide the following features:

Upload/Download to PC Computer  Charger Rate Control

DEFINITIONS AND ABBREVIATIONS- 01000 -174
Central Processing Unit: The Central Processing Unit (CPU) shall communicate with, monitor, and control all other modules within the control panel. Removal, disconnection or failure of any control panel module shall be detected and reported to the system display by the CPU.

- The CPU shall contain and execute all control-by-event (including ANDing, ORing, NOTing, CROSSZONEing) programs for specific action to be taken if an alarm condition is detected by the system. Such control-by-event programs shall be held in non-volatile programmable memory, and shall not be lost with system primary and secondary power failure. The CPU shall also provide a real-time clock for time annotation of all system displays. The Time-of-Day and date shall not be lost if system primary and secondary power supplies fail.
- The CPU shall be capable of being programmed on site without requiring the use of any external programming equipment. Systems that require the use of external programmers or change of EPROMs are not acceptable.
- The CPU and associated equipment are to be protected so that they will not be affected by voltage surges or line transients consistent with UL standard 864.

Display: The system display shall provide all the controls and indicators used by the system operator and may also be used to program all system operational parameters. The display assembly shall contain, and display as required, custom alphanumeric labels for all intelligent detectors, addressable modules, and software zones.

- The system display shall provide an 80-character back-lit alphanumeric Liquid Crystal Display (LCD). It shall also provide five Light-Emitting-Diodes (LEDs), that will indicate the status of the following system parameters: AC POWER, SYSTEM ALARM, SYSTEM TROUBLE, DISPLAY TROUBLE, and SIGNAL SILENCE.
- The system display shall provide a 25-key touch key-pad with control capability to command all system functions, entry of any alphabetic or numeric information, and field programming. Two different password levels shall be accessible through the display interface assembly to prevent unauthorized system control or programming.
- The system display shall include the following operator control switches: SIGNAL SILENCE, LAMP TEST, RESET, and ACKNOWLEDGE.

Signaling Line Circuit (SLC) Interface Board: The FACP shall contain SLC interface boards as required to communicate with the SLC loops as shown on the Drawings. Each SLC board shall monitor and control a minimum of 198 intelligent addressable devices. This includes 99 analog detectors (Ionization, Photoelectric, or Thermal) and 99 monitor or control modules.

- Each SLC interface board shall contain its own microprocessor, and shall be capable of operating in a local mode (any SLC input activates all or specific SLC outputs) in the event of a failure in the main CPU of the control panel. The SLC interface board shall not require any jumper cuts or address switch settings to initialize SLC Loop operations. SLC interface boards shall provide power and communicate with all intelligent addressable detectors and modules connected to
it's SLC Loop on a single pair of wires. This SLC Loop shall be capable of
operation as NFPA Style 4, Style 6, or Style 7.

- Each SLC interface board shall receive analog information from all intelligent
detectors and shall process this information to determine whether normal,
alarm, or trouble conditions exist for that particular detector. The SLC interface
board software shall include software to automatically maintain the detector's
desired sensitivity level by adjusting for the effects of environmental factors,
including the accumulation of dust in each detector. The analog information may
also be used for automatic detector testing and for the automatic determination of
detector maintenance requirements.

Serial Interface Board: The FACP shall contain a serial interface board to provide an
EIA-232 interface between the fire alarm control panel and the UL Listed Electronic
Data Processing (EDP) peripherals. The serial interface board shall allow the use of
multiple printers, CRT monitors, and other peripherals connected to the EIA-232 ports.
In addition, the serial interface board shall provide one EIA-485 port for the serial
connection to annunciation and control subsystem components; LEDs shall be provided
to show operational status. All serial interface input/outputs shall be optically isolated
to provide protection from surges and/or earth grounds.

//The serial interface shall be compatible to Motorola's Alert Central software
package. This interface shall be used to communicate the complete fire alarm
control panel 80 character message to pocket pagers.

Operators Terminal: Provide an operators terminal which allows the following
minimum functions. In addition, the operators terminal shall support any other
functions required for system control and/or operation:
1. Acknowledge (ACK/STEP) Switch
2. Signal Silence Switch
3. System Reset Switch
4. System Test Switch
5. Lamp Test Switch

Video Display Terminal: Where indicated on the Drawings provide a video display
terminal with detachable keyboard to provide a visual display and an audible alert of all
changes in status of the system and shall annotate such displays with the current time-of-day and date.

Printer: Where indicated on the Drawings provide a printer to provide hard-copy
printout of all changes in status of the system. The printer shall time-stamp such
printouts with the current time-of-day and date. The printer shall be standard carriage
with 80-characters per line and shall use standard pin-feed paper. Thermal printers are
not acceptable. The printer shall operate from a 120 VAC, 60 Hz power source.

//The system shall have a strip printer capable of being mounted directly in the
system enclosure. Alarms shall be printed in easy to read RED, other messages,
such as troubles, shall be printed in black. This printer shall receive power from
the system power supply and shall operate via battery back-up in the event that
AC power is are lost. The strip printer shall be UL-864 listed.

Remote Transmissions: The FACP shall be interfaced to a separate Digital Alarm
Communications Transmitter (DACT) as indicated on the Drawings. Systems which
contain built-in DACTs shall be acceptable on the condition of total compatibility with
the Owner's receiving station equipment.

Power Supply: The FACP power supply(ies) shall operate on 120 VAC, 60 Hz and
shall have a continuous rating adequate to power all equipment and functions in full
alarm continuously. All modules and drivers must be able to withstand prolonged short
circuits in the field wiring, either line-to-line or line-to-ground, without damage. Further,
the power supply shall be expandable for additional notification appliance power in 3.0 Ampere increments.
- The power supply shall provide a battery charger for 24 hours of standby using dual-rate charging techniques for fast battery recharge.

- Enclosures: The FACPs shall be housed in a UL listed cabinet suitable for surface or semi-flush mounting. Cabinet and front shall be corrosion protected, given a rust-resistant prime coat, and manufacturer's standard finish. The door shall provide a key lock and shall include a glass or other transparent opening for viewing of all indicators. For convenience, the door may be hinged on either the right or left side (field selectable).

ALARM APPLIANCES
- Programmable Electronic Sounders shall be located as shown on the Drawings; sounders located outdoors shall be listed for use in wet locations. Electric sounders shall have the following specifications:
  - Voltage: Programmable electronic sounders shall operate on 24 VDC nominal.
  - Programming: Electronic Sounders shall be field programmable without the use of special tools, to provide slow whoop, continuous, or interrupted tones with an output sound level of at least 90 dBA measured at 10 feet from the device.
  - Mounting: Provide flush mounting devices suitable for mounting in a standard single gang device box unless otherwise indicated on the Drawings. Unless otherwise indicated on the Drawings, electronic sounders shall be mounted at 7'-6" (2.3 M) Above Finished Floor (AFF) or 6" (15.3 Cm) Below Finished Ceiling (BFC), whichever is lower.

- Strobe Lights shall be located as shown on the Drawings. Strobe lights indicated for use at exterior of the building shall be mounted at the indicated elevation and listed for use in wet locations. Strobe lights shall have the following specifications:
  - Voltage: Strobe lights shall operate on 24 VDC nominal.
  - Maximum pulse duration: 2/10ths of one second.
  - Mounting: Provide flush mounting devices suitable for mounting in a standard single gang device box unless otherwise indicated on the Drawings. Unless otherwise indicated on the Drawings, strobe lights shall be mounted at 7'-6" (2.3 M) Above Finished Floor (AFF) or 6" (15.3 Cm) Below Finished Ceiling (BFC), whichever is lower.
  - Strobe intensity and flash rate: Must meet minimum requirements of UL 1971. Provide strobe lights with specific intensity Candela (Cd) rating if such is indicated adjacent to the device symbol on the Drawings.

- Audible/Visual Combination Devices shall be located as shown on the Drawings and shall comply with all applicable requirements for both Programmable Electronic Sounders and Strobe Lights. Unless otherwise indicated on the Drawings, combination A/V devices shall be mounted at 7'-6" (2.3 M) Above Finished Floor (AFF) or 6" (15.3 Cm) Below Finished Ceiling (BFC), whichever is lower.
  - Bells shall be 10" diameter vibrating type located as shown on the Drawings; bells located outdoors shall be listed for use in wet locations. Bells shall have the following specifications:
    - Voltage: Bells shall operate on 24 VDC nominal.
    - Mounting: Provide flush mounting devices suitable for mounting in a standard single gang device box unless otherwise indicated on the Drawings. Bell mounting elevation shall be as described on the Drawings.
- Address Setting: Addressable devices shall provide an address-setting means that use rotary decimal switches configured to provide decade (numbered 1 to 10) type addresses. Devices which use a binary address setting method, such as a dip switch, are not acceptable.

- Connections: Addressable devices shall be connected to a Signaling Line Circuit (SLC) with two (2) wires. Signaling Line Circuits shall originate as indicated on the Riser Diagram shown in the Drawings.

- Operational Indications: Addressable initiation devices shall provide dual alarm and power LEDs. Both LEDs shall flash under normal conditions, indicating that the device is operational and in regular communication with the control panel. Both LEDs shall be placed into steady illumination by the FACP to indicate that an alarm condition has been detected. The flashing mode operation of the detector LEDs shall be optional through the system field program. An output connection shall also be provided in the device base to connect an external remote alarm LED.

- Intelligent Initiation Devices: All smoke detectors shall be the "intelligent" in that smoke detector sensitivity shall be set through the FACP and shall be adjustable in the field through the field programming of the system. Sensitivity shall be capable of being automatically adjusted by the FACP on a time-of-day basis. Using software in the FACP, detectors shall be capable of automatically compensating for dust accumulation and other slow environmental changes that may affect performance. The detectors shall be listed by UL as meeting the calibrated sensitivity test requirements of NFPA Standard 72, Chapter 7.

- Device mounting Base: Unless otherwise specified all detectors shall be ceiling-mounted and shall include a separate twist-lock base with tamper proof feature.

- Sounder Base: Where indicated on the Drawings, provide bases with a built-in (local) sounder rated at 85 dBA minimum. Configure sounder bases such that sounders are activated under conditions as described or otherwise indicated on the Drawings.

- Test Means: The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a magnetic switch) or initiated remotely on command from the control panel when in the "test" condition.

- Device Identification: Detectors shall store an internal identifying type code that the control panel shall use to identify the type of device. Device identifications shall be either PHOTO or THERMAL.

- Addressable Pull Stations - General: Addressable pull stations shall, on command from the Control Panel, send data to the panel representing the state of the manual switch. They shall use a key operated test-reset lock, and shall be designed so that after actual emergency operation, they cannot be restored to normal use except by the use of a key. Pull stations that employ a glass break rod are not acceptable.

- All pull stations shall have a positive, visual indication of operation and utilize a key type reset.

- Construction: Pull stations shall be constructed of Lexan or other material suitable to the installation environment with clearly visible operating instructions provided on the cover. The word FIRE shall appear on the front of the stations in raised letters, 1.75 inches or larger. Stations shall be suitable for surface mounting or semiflush mounting as shown on the plans. Unless otherwise indicated on the Drawings pull stations shall be mounted at 48" Above Finished Floor.

- Photoelectric Smoke Detectors: Photoelectric smoke detectors shall use the photoelectric (light-scattering) principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the analog level of smoke density. Unless otherwise indicated on the Drawings all smoke detectors shall be photoelectric type.
Thermal Detectors: Thermal Detectors shall be intelligent addressable devices rated at 200°F. (93° C.) and unless otherwise indicated on the Drawings shall have a rate-of-rise element rated at 15° F. (9.4° C.) per minute. It shall connect via two wires to the Fire Alarm Control Panel Signaling Line Circuit. Up to 99 intelligent heat detectors may connect to one SLC loop. Thermal detectors shall use an electronic sensor to measure thermal conditions caused by a fire and shall, on command from the control panel, send data to the panel representing the analog level of such thermal measurements.

Non-Rate-of-Rise Detectors: Where indicated on the Drawings provide thermal detectors with non-rate of rise thermal elements. Non-rate of rise detectors are identified by NRR adjacent to the thermal detector symbol.

Duct Smoke Detector: In-Duct Smoke Detector Housings shall accommodate either an intelligent ionization sensor or an intelligent photoelectric sensor as described elsewhere. The device, independent of the type used, shall provide continuous analog monitoring and alarm verification from the panel. When sufficient smoke is sensed, an alarm signal shall be initiated at the FACP.

Installation: Duct detectors and related items shall be furnished and connected by the Division 16 (Electrical) Contractor but installed by the Division 15 (Mechanical) Contractor.

MISCELLANEOUS SYSTEM ITEMS

Addressable Dry Contact Monitor Module: Addressable Monitor Modules shall be provided to connect one supervised IDC zone (either Style D or Style B) of conventional Alarm Initiating Devices (any Normally Open [N.O.] dry contact device) to one of the Fire Alarm Control Panel Signaling Line Circuit Loops. Monitor modules shall be installed as required by the system configuration. All required monitor modules may not be shown on the Drawings.

Indication of Operation: Unless otherwise indicated on the Drawings an LED shall be provided that shall flash under normal conditions, indicating that the Monitor Module is operational and in regular communication with the control panel.

Mounting Requirements: Monitor Modules shall mount in a standard 4-inch square, 2-1/8" deep electrical boxes.

Two Wire Detector Monitor Module: Addressable Monitor Modules shall be provided to connect one supervised IDC zone, either Class A or B (Style D or Style B operation) of conventional 2-wire smoke detectors or alarm initiating devices (any N.O. dry contact device) to one of the Fire Alarm Control Panel Signaling Line Circuit Loops. Monitor modules shall be installed as required by the system configuration. All required monitor modules may not be shown on the Drawings.

Indication of Operation: Unless otherwise indicated on the Drawings an LED shall be provided that shall flash under normal conditions, indicating that the Monitor Module is operational and in regular communication with the control panel.

Mounting Requirements: Monitor Modules shall mount in a standard 4-inch square, 2-1/8" deep electrical boxes.

Addressable Control Module: Addressable Control Modules shall be provided to supervise and control the operation of one conventional Notification Appliance Circuit (NAC) of compatible, 24 VDC powered, polarized Audio/Visual (A/V) Notification Appliances. For fan shutdown and other auxiliary control functions, the control module may be set to operate as a dry contact relay. The control module shall provide address-setting means using decimal switches and shall also store an internal identifying code that the control panel shall use to identify the type of device. An LED shall be provided that shall flash under normal conditions, indicating that the control module is operational and is in regular communication with the control panel.

Mounting Requirements: Control Modules shall mount in a standard 4-inch square, 2-1/8" deep electrical boxes.

Configuration: The control module NAC circuit may be wired for Style Z or Style Y (Class A/B) with up to 1 Amp of inductive A/V signal, or 2 Amps of resistive
A/V signal operation, or as a dry contact (Form C) relay. The control module shall be suitable for pilot duty applications and rated for a minimum of 0.6 amps at 30 VDC. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to insure that 100% of all auxiliary relay or NACs may be energized at the same time on the same pair of wires.

- Power Source: Audio/visual power shall be provided by a separate supervised power loop from the main fire alarm control panel or from a supervised, UL listed remote power supply. A/V power sources and connections are not shown on the Drawings.
- Test Switch: A magnetic test switch shall be provided to test the module without opening or shorting its NAC wiring.
- Isolator Module: Isolator Modules shall be provided to automatically isolate wire-to-wire short circuits on an SLC loop. The Isolator Module shall limit the number of modules or detectors that may be rendered inoperative by a short circuit fault on the SLC Loop.

- Operation: Isolator Modules shall operate such that if a wire-to-wire short occurs, the Isolator module shall automatically open-circuit (disconnect) the SLC loop. When the short circuit condition is corrected, the Isolator Module shall automatically reconnect the isolated section. The Isolator Module shall not require any address-setting, and its operations shall be totally automatic. It shall not be necessary to replace or reset an Isolator Module after its normal operation.
- Mounting: The Isolator Module shall mount in standard 4-inch square, 2-1/8" deep electrical boxes. It shall provide a single LED that shall flash to indicate that the Isolator is operational and shall illuminate steadily to indicate that a short circuit condition has been detected and isolated.

//DELETE THE FOLLOWING TWO ITEMS FOR BUILDINGS WITHOUT SPRINKLER SYSTEMS

- Water Flow Switch: Flow switches shall be integral, mechanical, non-coded, non-accumulative retard type. Flow switches shall have an alarm transmission delay time that is conveniently adjustable from 0 to 60 seconds. Initial settings shall be 30-45 seconds. Flow switches shall be located a minimum of one (1) foot from a fitting that changes the direction of the flow and a minimum of three (3) feet from a valve.
- Location: Locations shown on the Drawings for water flow switches are approximate. Coordinate exact location with the sprinkler system installer.
- Installation: Water Flow Switches shall be furnished and installed by the Division 15 (Mechanical) Contractor and electrically connected by the Division 16 (Electrical) Contractor.

- Sprinkler and Standpipe Valve Supervisory Switch: Supervisory switch mechanisms shall be contained in a weatherproof aluminum housings that shall provide a 3/4 inch tapped conduit entrance and shall incorporate the necessary facilities for attachment to the valves. Switch housing shall be finished in red baked enamel.
- Installation: Mount switch so as not to interfere with the normal operation of the valve and adjust to operate within two revolutions toward the closed position of the valve control, or when the stem has moved no more than one-fifth of the distance from its normal position. The entire installed assembly shall be tamper resistant and shall be arranged to cause a switch operation if the housing cover is removed or if the unit is removed from its mounting.
- Installation: Supervisory switches shall be furnished and installed by the Division 15 (Mechanical) Contractor and electrically connected by the Division 16 (Electrical) Contractor.

//DELETE THE PROCEEDING TWO ITEMS FOR BUILDINGS WITHOUT SPRINKLER SYSTEMS

DEFINITIONS AND ABBREVIATIONS- 01000-180
Serially Connected LED Annunciator: Annunciator shall communicate with the fire alarm control panel via an EIA-485 communications loop (four-wire) and shall individually annunciate all zones in the system. System zones shall be as indicated on the Drawings. Up to 10 annunciators may be connected to the EIA-485 communications loop.

- Annunciator Indicators: The annunciator shall provide a red Alarm LED per zone, and a yellow Trouble LED per zone. The annunciator shall also have an "ON-LINE" LED, local piezo sounder, local acknowledge/lamp test switch, and custom zone/function identification labels. All annunciator switches and indicators shall be software programmable.

LCD Alphanumeric Display Annunciator: The Alphanumeric display annunciator shall be a supervised, remotely located back-lit LCD display containing a minimum of eighty (80) characters for alarm annunciation in clear English text. The LCD annunciator shall display all alarm and trouble conditions in the system.

- System Capacity: The system shall allow a minimum of four LCD annunciators. In addition to annunciation functions, each LCD annunciator shall be capable of the following software programmed system functions: Acknowledge, Signal Silence and Reset.
- Connections: The annunciator shall connect to a two-wire EIA-485 interface. The two-wire connection shall be capable operation at distances of 6,000 feet. Provide interface to fiber optic cable systems and/or repeater units where such are indicated on the Drawings.

Batteries: Shall be completely maintenance free and shall not require liquids, fluid level checks, refilling, and shall not be capable of producing spills and/or leaks. Battery voltage shall be as required by the FACP and related equipment. Battery shall have sufficient capacity to power the fire alarm system for not less than twenty-four hours plus 5 minutes of alarm upon a normal AC power failure.

Remote Annunciator Indicator Lights (RAIL): Remote annunciator indicator lights shall be provided in locations where indicated on the Drawings. RAILs shall be provided with a key type switch for testing of the annunciated device. In addition, RAILs shall have the following features:

- Voltage: RAILs shall operate on 24 VDC nominal.
- Mounting: Provide flush mounting devices suitable for mounting in a standard single gang device box unless otherwise indicated on the Drawings. Unless otherwise indicated on the Drawings, RAILs shall be mounted as described for electronic sounders above.

Door Hold-Open Magnets: Door hold open magnets shall be suitable for mounting in a single gang electrical device box. Door hold open magnets shall be furnished with keepers, door chains, and other accessories as required to properly hold open doors as indicated on the Drawings. Holding force of the magnet shall be appropriate for the door to be held open. Proper attachment of door magnet hardware to doors is the responsibility of the Division 16 contractor. Door hold open magnets shall operate in a fail safe manner, i.e., the door shall release in event of a failure of voltage to the device.

- Door hold open magnets: Door hold open magnets shall be configured to operate from a nominal 24 VDC system as supplied by the FACP. All hold open magnet supply sources shall be supervised.
- Device box support: Door hold open magnet device boxes shall be securely attached to the building structure by means of wood blocking or other equally effective means. Boxes attached directly to only one metal stud or boxes supported by means of expansion type fasteners are not acceptable.

PART 3 - SYSTEM REQUIREMENTS

Fire and smoke detection and alarm systems shall comply with the following system requirements with regard to operation and installation.

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DEFINITIONS AND ABBREVIATIONS - 01000 -181
- All equipment and components shall be installed in strict compliance with manufacturers' recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation. Refer to the Riser/Connection diagram for all specific system installation/termination/wiring data.

- All system components shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load. Adhesives are not permitted to mount fire alarm system components to building surfaces or structure.

☐ The system shall be new and furnished with a warranty (parts & labor) of at least one year from the date of final inspection and acceptance by the Owner. Equipment, initiating devices, and alarm appliances shall be arranged as described in the Drawings; annunciator zones shall be configured as described in the Drawings.

☐ The system shall be equipped with the following protective devices to prevent damage or nuisance alarms by nearby lightning strikes, stray currents, or voltage transients. The devices are to be provided by the fire alarm equipment supplier:

- On AC Input: Leviton 51010-WM, Square-D Q02175SB or equivalent Listed device. Install at panelboard and trim excess lead lengths. Wind small coil in branch circuit conductor, within panelboard, downstream of the suppressor connection. Coil is to be about 1" diameter, 5 to 7 turns, and tie-wrapped.

- On DC Circuits Extending Outside Building: Near the point of entry to or exit from each building, provide a "pi" filter on each leg. The filter shall consist of a primary arrester, typically a gas tube, a series impedance of 1 mH or more, and a fast acting secondary arrester which clamps between 30 and 40 Volts. Acceptable models include Simplex 2081-9027 and 2081-9028, Transtector FSP4002, and TSP9002, Citel America B280-24V, Edco P264 and P642, or equivalent by Innovative Technology or other supplier.

☐ Both audible and visible alarm signals shall be provided. Visible signals must be the strobe (flash discharge) type, with white or clear lens, and shall comply with current ADA requirements for intensity and placement.

☐ The FACP must have an Alarm Silence switch, and be equipped with the Subsequent Alarm (alarm resound) feature. Any remote annunciators or graphic displays located away from the alarm area must also include an audible signal with alarm resound feature.

☐ If the system includes AHU shutdown or smoke removal startup, silencing the alarm (without resetting) must not reverse them. A supervised "AHU Shutdown Defeat" switch must be provided in the FACP. The switch must be labeled and its "Normal" position indicated. Provide supervised Hand-Off-Auto switch(es) at the FACP for any building smoke control equipment (pressurization or exhaust fans).

☐ The coverage of each fire alarm zone as described in the Drawings shall be indicated on the FACP and any remote annunciator. This may be accomplished by engraved labels, framed directories, and/or graphic displays. Label tape or handwritten labels are not acceptable.

☐ Detectors used for elevator capture are identified on the Drawings by the designation EL adjacent to the detector. Primary and/or alternate recall points are indicated by the designation PRI or ALT respectively. Elevator capture or control signals must come from the FACP as relayed by control modules. Use of detector auxiliary contacts for elevator capture is not acceptable.

☐ Systems are to be provided with a separate and independent source of emergency power. Switching to emergency power during alarm shall not cause signal drop-out. Batteries must meet the appropriate NFPA capacity requirements, with a 25% safety factor. This requirement is in effect even if generator power is supplied to the Fire Alarm Control Panel.

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Style 6 Circuits Required: Systems with one or more addressable sub-panels that (1) have an integral addressable loop controller, or (2) monitor multiple conventional initiation zones, shall comply with the NFPA 72 requirements for Style 6 circuits.

All wiring shall be color coded in accordance with the following scheme, which shall be maintained throughout the system, without color change in any wire run:

<table>
<thead>
<tr>
<th>Circuit Type</th>
<th>Color Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initiating Circuits, General</td>
<td>Red (+)/White (-)</td>
</tr>
<tr>
<td>Initiating Circuits, Smoke Only</td>
<td>Violet (+)/Gray (-)</td>
</tr>
<tr>
<td>Signal Line Circuit</td>
<td>Red jacket with Red (+)/Black (-)</td>
</tr>
<tr>
<td>Alarm Indicating Appliance Circuits</td>
<td>Blue (+)/Black (-)</td>
</tr>
<tr>
<td>AHU Shutdown Circuits</td>
<td>Yellow (+)/Brown (-)</td>
</tr>
<tr>
<td>Door Control Circuits</td>
<td>Orange</td>
</tr>
<tr>
<td>Elevator Capture Circuits</td>
<td>Brown</td>
</tr>
</tbody>
</table>

For splices, use markers or other means to indicate which conductors lead to the FACP. All junction boxes and covers shall be painted red, unless in finished areas.

There shall be NO splices in the system other than at terminal blocks. "Wire nuts," crimp splices, or insulation piercing type connectors are not acceptable. All terminal block screws shall have pressure wire connectors of the self-lifting or box lug type.

Permanent wire markers shall be used to identify all splices and terminations for each circuit. For splices, use markers or other means to indicate which conductors lead to the FACP. All junction boxes and covers shall be painted red, unless in finished areas.

In multistory buildings, all circuits leaving the riser on each floor shall feed through a labeled terminal block in a hinged enclosure, located for convenient access.

All wiring and cable must be in EMT, 3/4" minimum diameter, unless indicated otherwise on the Drawings or elsewhere in the Specifications. All fire alarm system raceway, couplers, and connectors must meet the performance and installation requirements of Section //16// "RACEWAYS".

The exterior of all junction boxes containing fire alarm conductors shall be painted red; box interiors shall not be painted. Box covers for junction boxes containing fire alarm conductors shall be painted red on both sides. All painting of junction boxes and junction box covers shall be accomplished prior to installation of the boxes to avoid possible problems with overspray.

Box covers shall be labeled to indicate the circuit(s) or function of the conductors contained therein. Labels shall be neatly applied black lettering on a clear background. Handwritten labels or labels made from embossed tape are not acceptable.

Wire shall be new AWG #14 minimum stranded copper, type THHN/THWN. Wiring for electronic communications between system components where individual conductors are not judged appropriate by the equipment manufacturer may be routed in multi-conductor cable Listed for the purpose. Minimum cable conductor size is AWG #16 stranded copper conductors.

Detection or alarm circuits must not be included in raceways containing AC power or AC control wiring. Within the FACP, any 120 VAC control wiring or other circuits with an externally supplied AC/DC voltage above the nominal 24 VDC system power must be properly separated from other circuits and the enclosure must have an appropriate warning label to alert service personnel to the potential hazard.

Provide an engraved label in FACP identifying its 120 VAC power source. This label shall include panelboard location, identification, and circuit number.

All wiring shall be checked for grounds, opens, and shorts, prior to termination at panels and installation of detector heads. The minimum resistance to ground or between any
two conductors shall be ten megohms (10 MΩ), as verified with a megger. Provide
advance notice to the A/E of these tests.
☐ All connections at the FACP must be made by the Manufacturer's authorized, factory
trained representative (rather than by the electrical contractor).
☐ The system shall be electrically supervised for open or (+/-) ground fault conditions in
SLC, alarm circuits, and control circuits. Removal of any detection device, alarm
appliance, plug-in relay, system module, or standby battery connection shall also result
in a trouble signal. Fire alarm signal shall override trouble signals, but any pre-alarm
trouble signal shall reappear when the panel is reset.
☐ Sprinkler system supervisory circuits for monitoring valve position, air pressure, water
temperature, pump status, etc., must cause distinct audible and visible indications at the
FACP. The audible supervisory signal shall either be a 4" diameter bell or a pulsing
piezo-electric alarm. Provide the following engraved label adjacent to the bell/alarm:
"SPRINKLER STATUS ABNORMAL". If only valve position is supervised, provide an
engraved label reading: "SPRINKLER VALVE CLOSED".
☐ Spare Parts: Provide the following spare parts with the system, each individually
packaged and labeled. For multi-building projects, calculate separately for each building:

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuses</td>
<td>2 of each size used in the system</td>
</tr>
<tr>
<td>Manual Stations</td>
<td>2% of installed quantity</td>
</tr>
<tr>
<td>Indoor Horns/Strobes</td>
<td>4% of installed quantity</td>
</tr>
<tr>
<td>Spot Smoke Detectors, Bases</td>
<td>6% of installed quantity</td>
</tr>
</tbody>
</table>

-Increase decimal quantities of spare parts to the next higher whole number. For
example if a system has 20 spot-type smoke detectors provide 2 spare detectors with
bases.

SMOKE DETECTORS
☐ Detectors must be the plug-in type, each having a separate base, to facilitate replacement
and maintenance. When installed in a room, detectors shall be oriented so their alarm
light is visible from the nearest door to the corridor, unless Remote Alarm Indicator
Light (RAIL) equipped.
☐ Spot type smoke detectors mounted within 12 feet of a walking surface shall have their
built-in locking device activated.
☐ Unless suitably protected against dust, paint, etc., detectors shall not be installed until
the final construction clean-up has been completed. Contaminated detectors must be
REPLACED by the Contractor at no additional cost to the Owner.
☐ Identification of individual detectors is required, by the unique number indicated on the
Drawings. These device numbers, which must also be shown on the shop drawings, shall
be permanently affixed to the detector base. Device labels may not be affixed to the
device. Identification labels must be printed labels with black lettering on a clear
background. Handwritten labels or labels made from embossed tape are not acceptable.
☐ Where shown on the Drawings air duct/plenum detectors must have a RAIL located in
the nearest corridor or public area and identified by an engraved label affixed to the wall
or ceiling. These detectors shall be installed in a manner that provides suitable access
for required periodic cleaning and calibration.
☐ Duct detector sampling tubes shall extend the full width of the duct. Those over 36
inches long must be provided with rear support. The preferred method for doing this is to
have the tube go through the far side of the duct, with the point of penetration tightly
sealed to prevent air leakage around the tube. This facilitates smoke testing and tube
cleaning. Duct smoke detector mounting position and air sampling tube orientation, are
critical for proper operation. The Manufacturer's detailed installation instructions must
be followed. The contractor shall mark the direction of air flow on the duct at each duct
detector location.
☐ Smoke detector guards, where indicated on the Drawings shall be Listed for use with the
specific model of smoke detector being protected. All smoke detector guards are to have
a separate base which must be very securely anchored to wall or ceiling. The cover must
be readily removable by the Owner for periodic detector cleaning and servicing but, to
prevent unauthorized entry, must be secured to the base by a lock or tamper resistant screws approved by the A/E. Metal guards must be 16 gauge or heavier steel.

**AUTOMATIC SMOKE DOOR HOLD OPEN MAGNET REQUIREMENTS**
- Wall-mounted magnetic door holders and separate heavy-duty closers shall be used, instead of combination door control units.
- The electromagnets shall be controlled by the building's smoke detection system FACP.
- Individual smoke detector auxiliary contacts shall not be used to release door holders.

**SPRINKLER SYSTEM MONITORING**
- The following sprinkler system alarm and supervisory functions shall be provided as a part of the fire alarm system:
  1. Waterflow alarm, by sprinkler zone (not to exceed one floor).
  2. Supervision of each control valve.
  3. Supervision of air pressure, if used (both high and low).
  4. Supervision of fire pump.
- Sprinkler supervisory monitoring of flow switches, tamper switches, and similar functions shall be accomplished with a separate system address for each activity monitored.

**KITCHEN EXHAUST HOOD EXTINGUISHING SYSTEMS**
- Installation shall comply with the current edition of NFPA Standard for the type of system installed.
- System(s) shall be interconnected with the fire alarm system as a separate system address.
- The following operational requirements are generally provided directly by the extinguishing system. The Contractor shall verify that the means for providing the following operation sequence is in place:
  - The exhaust fan must continue running after the system has been discharged, (except on carbon dioxide systems) to remove smoke; the supply fan should stop.
  - All sources of heat for appliances served by the extinguishing system (both electric and/or gas) must be turned off.

**FIRE ALARM SYSTEM INSTALLATION AND CONFIGURATION**
- In addition to other requirements of these Specifications the fire alarm system must comply with the following:
  - The addressable fire alarm system shall be connected, programmed, and tested only by the Manufacturer or by an authorized distributor who stocks a full compliment of spare parts for the system.
  - Technicians performing this service shall be trained and individually certified by the Manufacturer for the model of system being installed.
  - Copies of installer certification must be included with the Contractor's submittal.
- Any Personal Computer (PC), laptop, or other similar items or equipment necessary to program the fire alarm system shall be furnished by the Contractor as required to accomplish programming at no additional cost to the Owner. It is not the intention of this section to require the Contractor to provide a PC to the Owner as a part of the fire alarm system.
- The complete configuration data (site-specific programming) for the system must be permanently stored on a computer disk or diskette and archived by the manufacturer or authorized distributor. A diskette copy of this data must be submitted to the A/E for transmission to the Owner when the system is commissioned.
- The Manufacturer or authorized distributor must maintain software version (VER) records on the system installed. The system software shall be upgraded free of charge if a new VER is released for any reason during the warranty period. For any new VER to correct problems, free upgrade shall apply during the entire life of the system.
All addressable loop controller circuits must be "Class A" and shall have a minimum of 20% spare addresses for future use. "T-taps" from the loop are not permitted. To minimize the impact of a wiring fault on the system, isolation modules must be provided as follows:

1. After each 30 devices/control points on any addressable circuit.
2. For each circuit extending outside the building.
3. At the FACP, at each end of the loop.

Supervision required: The connection between individual addressable modules and their contract type initiating device(s) must be supervised.

The Fire Alarm System shall have multiple access levels which permit the Owner's authorized personnel to make temporary changes in the system alarm response matrix without actually changing the system programming. This must include the ability to override selected alarm inputs or system responses to alarms without affecting the remaining portions of the system.

The fire alarm system shall have a self-contained modem with a minimum speed of 9,600 baud for external communications purposes. All system functions and programming features must be available through the modem port. The modem port shall be password protected with multiple access levels as described above. Telephone lines and connections to the modem will be furnished and installed by the Owner.

Where indicated on the Drawings, a Graphic Annunciator (GA) with separate Light Emitting Diodes (LED) indication for each alarm and supervisory signal initiating device shall be included. Multiple initiating devices of the same type within a single room may be permitted to share a common LED. The GA must show all major building features such as corridors, elevators, stairs, exits, and "YOU ARE HERE". GA layout must be submitted for approval.

In addition to the system tests and certification described elsewhere, the Manufacturer or authorized distributor must 100% test all site-specific software functions for the system and provide a written test report or detailed check list. This documentation must include a system operation matrix showing the actual FACP response for each initiating device input.

**PART 3 - SYSTEM TESTING & CERTIFICATION**

Upon completion of the installation the Division 16 Contractor and the Manufacturer's authorized representative together shall test each and every alarm initiating device for proper response and annunciation, every alarm signaling appliance for effectiveness, and all other functions such as elevator capture, control of smoke doors/dampers, proper operation of HVAC systems, and pressurization fans. ALL supervised circuits must also be tested to verify proper supervision. (Control circuits and remote annunciation lines are among those required to be supervised.)

The A/E must be given 7 days advance notice of the tests.

The contractor must submit the following test documentation:

1. Written verification that this 100% system test was done.
3. NFPA-72 "Fire Alarm System Certification and Description".

After completion of the 100% system test and submission of the above documentation, the contractor will request in writing that the A/E to set up a final inspection with the Owner and the Authority Having Jurisdiction. The system must operate for at least two days prior to this inspection. The system will be inspected and functionally tested on a sample basis. Equipment intended for open area protection or releasing device service.
may be subjected to simulated or actual test fires, in accordance with ANSI/UL guidelines and sound engineering practice, to verify proper response.

If the initial inspection determines that the required 100% system test was not reasonably done, or if a reinspection of the project is requested without the punch list being nearly completed, the Contractor may be required to reimburse the Owner for inspection costs as defined in the Supplementary General Conditions of the Contract.

After successful completion of inspections and tests, the warranty period begins. In the event of malfunctions or excessive nuisance alarms, the Contractor must take prompt corrective action. The Owner may require a repeat of the Contractor's 100% system test, or other inspections. Continued improper performance during the warranty period shall be cause to require the Contractor to remove the system.

SYSTEM DOCUMENTATION, TRAINING, AND MAINTENANCE

The contractor shall provide the A/E with three copies of the following:

1. As-built wiring and conduit layout diagrams, including wire color code and/or label numbers, and showing all interconnections in the system.
2. Electronic circuit diagrams of all control panels, modules, annunciators, communications panels, etc.
3. Technical literature on all major parts of the system, including control panels, batteries, detectors, manual stations, alarm indicating appliances, power supplies, and remote alarm transmission means.

The contractor shall provide the A/E with one copy of the following:

1. All software required, both for the installed fire alarm system and for any personal computer (PC) necessary to access the fire alarm system for trouble shooting, programming, modifications, monitoring, de-bugging, or similar functions.
2. Complete documentation for all software for both the installed fire alarm system and for any interface PC software necessary for system functions as described in (1) above.

The Contractor shall provide the A/E with one each interconnection cable where such is required to connect the fire alarm system to a PC.

The Manufacturer's authorized representative shall provide training for the Owner's designated employees in proper operation of the system and in all required periodic maintenance.

Scheduling of training must be arranged to meet the Owner's schedule.

A maximum of 20 hours of training shall be provided at no additional cost to the Owner with additional training available at a cost to be mutually agreed upon by the Owner and the Contractor.

The instruction shall include a minimum of two copies of a written, bound training summary, for future reference.

Basic operating instructions shall be framed and mounted at the FACP.
SECTION 16740 - TELEPHONE/DATA SYSTEMS

GENERAL

Overview
The telephone voice/data system shall consist of a main telecommunications room, telecommunications subclosets, service entrance conduits, main telephone/data distribution frames (MDF), intermediate distribution frames (IDF's), hub cabinets (HC's), local exchange carrier (LEC) demarcation, voice and data cross-connects and interconnecting hardware, voice and data backbone pathways and cables, voice and data horizontal pathways and cables, and telephone and/or data outlets (TCO's). The system shall have a 5 year warranty for material and labor.

Industry Standards
The system shall in general comply with the requirements of EIA/TIA-568A (Commercial Building Standard for Telecommunications Wiring), EIA/TIA-569 (Commercial Building Standard for Telecommunications Pathways and Spaces), EIA/TIA-607 (Commercial Building Telecommunications Grounding/Bonding Requirements), EIA/TIA TSB 67 (Transmission Performance Specification for Field Testing of Unshielded Twisted-Pair Cabling Systems), and EIA/TIA TSB 72 (Centralized Optical Fiber Cabling Guidelines).

System Configuration: The system shall be configured in a star topology.

1. Main Telecommunications Room (Location of LEC and MDF)
The MDF will be located in this room and shall consist of the required number 3/4" plywood backboards and 19" racks. The LEC shall provide service to the main telecommunications room for both voice and wide area network (WAN) services. LEC equipment shall be mounted on a dedicated section of the backboard. Central network switching equipment will be mounted in the racks. All fiber optic and copper terminating hardware shall be rack mounted. Main voice and data cross-connects will be made at the MDF. Interconnection between the LAN and the WAN will be made at the MDF.

2. Telecommunications Subclosets (Location of IDF's)
Additional telecommunications subclosets shall be provided as required to insure that no TCO or HC requires a single run of cable from the closet in excess of 295 feet. IDF's shall consist of fiber and copper terminating hardware. All fiber optic cables shall be terminated in wall mounted fiber distribution enclosures (FDE's) mounted directly to wall. All copper cables shall be terminated on patch panels attached directly to wall.

Services shall be provided for each type of area as outlined in the following sections. Other special type areas may arise on a particular project and will be addressed individually during the design process. Refer to Attachments 16740-1A and 16740-1B.

General Purpose Classrooms, Computer Labs/Classrooms, Business Labs with Computers, Science Classrooms and Modular Classrooms:

shall contain a cabinet (Hub Cabinet - HC) for housing electronic switching equipment such as Ethernet hubs. Refer to Attachment 16740-2 for HC details. Hub cabinets shall be mounted 36" AFF to center of cabinet whenever possible.

shall have two strands of fiber extended back to the MDF. The fiber will extend directly back to the MDF in a single cable when the classroom is located in the area of the MDF. When the classroom is located in the area of an IDF the 2

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strand fiber cable will terminate at a FDE at the IDF and be extended in a multiple strand fiber distribution cable on to the MDF.

☐ shall contain multiple TCO's for data as required by the school program. TCO's shall contain an 8-position modular female connector per port. Each port shall have a 4 pair cat.5 cable extended to the HC. The cables in the HC shall be terminated on 8-position modular male plugs.

☐ shall contain one(1) 2-port TCO for the teacher for voice/data. The data port of the TCO shall be extended to the HC just like the data TCO's above. The voice port of the TCO shall have a 4 pair cat. 5 cable extended back to the MDF or an IDF, if applicable. Voice cables terminated at an IDF will be cross-connected with patch cords to a voice distribution cable which in turn extends to the MDF.

☐ Typical Mechanical Room, Pay Phone Location or other Phone Only Location:

☐ shall contain one(1) 1-port outlet for voice. The voice port shall have a 4 pair cat. 5 cable extended back to the MDF or an IDF, as applicable. Voice cables terminated at an IDF will be cross-connected with patch cords to a voice distribution cable which in turn extends to the MDF.

☐ Typical Outlets in All Other Areas:

☐ shall contain one (1) or more 2-port TCO's for voice/data. There are two (2) types of TCO's. One (1) type contains both 8-position modular female connectors for voice and data. The other type of TCO contains one (1) 8-position modular female connector for voice and one (1) ST fiber optic connector for data. The copper only TCO's are used for outlets that terminate at the MDF. The copper/fiber TCO's are used for outlets that terminate at IDF's. Voice cables terminated at an IDF will be cross-connected with patch cords to a voice distribution cable which in turn extends to the MDF. Data cables terminated at an IDF will be cross-connected to a fiber distribution cable and extended to the MDF.

DESIGN CRITERIA

☐ The main telecommunications room for the MDF should be ideally located near both the administrative area and the media center.

☐ This room shall be dedicated to the functions outlined below.

☐ The room should be sized to accommodate:

- the LEC demarcation
- 19 in. racks for terminating all backbone cables
- individual outlet cables
- all electronic equipment, and accessories including rack mounted power strips and cable management hardware
- the public address system controller (refer to other section of Design Guidelines for system requirements)
- the security system control panel (refer to other section of Design Guidelines for system requirements)
- the MATV headend unit(refer to other section of Design Guidelines for system requirements)
- the energy management system Global Control Module (coordinate this with the mechanical engineer).

☐ Subclossets for IDF's should be strategically located in each major area of a building.
These subclosets may be incorporated as space in non-plenum mechanical and/or electrical rooms.

- All above telecommunications rooms shall be provided with dedicated electrical power circuits as required to meet equipment loads.
- Provide multiple outlets located about the space for convenience. Specify power strips with NEMA 5-20R receptacles for 19 in. racks.
- Provide individual split DX cooling system for main telecommunications room.
- The system shall be designed with surge suppression on all copper distribution cables from building-to-building and all horizontal voice cables from building-to-modular classroom.
- Provide protection on both ends of cables where entering buildings. Protection shall comply with NEC 800.
- Drawing requirements: The drawings shall contain as a minimum the following:
  - all TCO’s shown on plans.
  - all HC’s in classrooms shown on plans.
  - MDF and IDF’s shown on plans. Use enlarged plans where necessary for clarity.
  - all routing of raceways shown where required to be exposed in existing buildings.
  - all TCO’s scheduled showing room numbers, number of ports, termination point (IEMDF or IDF #), type of cabling, and number of cables.
  - a riser diagram showing the LEC Demarcation, the MDF, each IDF, and all distribution/backbone cables and also showing a typical arrangement for each type of station/outlet or hub cabinet connection.
  - details of racks, cabinets, and outlets.

PRODUCTS

- The telephone backboards shall be 4 ft. x 8 ft. x 3/4 in. minimum, painted on both sides with fire-resistant paint.

- All copper TCO’s shall be EIA/TIA 568 Type B configuration and category 5 compliant. TCO’s designated as two (2) port for voice and data shall consist of two (2) 8-position modular jacks mounted in a single gang box with stainless coverplate. See Attachments 16740-3A through E for labeling details.

- All fiber optic connections shall be type ST.

- Cables intended for voice shall have different colored sheaths than cables intended for data.

- All racks shall be 19 in. with EIA standard hole configurations. Use floor mounted racks for MDF.

- All copper station cables shall be category 5 compliant.

- All copper distribution cables shall be category 5 compliant when available for application.

- All fiber optical cable shall be 62.5/125 micrometer multimode type cable.

- The above cable types shall be general, riser, or plenum rated as required in accordance with the NEC and shall be UL listed.

- Distribution cables shall be suitable for use( indoor, outdoor, distribution type, breakout type, etc.). Use of tight-buffered indoor/outdoor cable is preferred for exterior applications.

- All copper cables shall be terminated on patch panels located in racks (at MDF) or wall brackets (at IDF’s).

- Patch panels shall match cables regarding category classification.

- All fiber optic cables shall be terminated on fiber optic interconnection units located in racks at the MDF and terminated in FDE’s at IDF’s.
Surge protection shall be Lucent Technologies 110ANA1-25 Multipair Protector Panels or approved equal.

EXECUTION

Provide a minimum of 120% of the required strands for fiber optic and pairs for copper distribution cables.

Install a #6 copper ground wire from the main building ground to the MDF. Install a #6 copper ground wire from the MDF to each IDF.

Install #6 copper ground wire from MDF and each IDF to the building steel, if applicable.

Use a grounding bus bar mounted to the plywood backboard at the MDF and at each IDF to make all grounding connections.

Install all cables in raceway within walls and inaccessible spaces.

Use nylon bushings at top of conduit where stubbed into accessible ceiling spaces.

Support all cables in accessible ceilings with cable tray or "J" type hooks where cable tray is not available. Cables shall be supported directly by the building structure.

Route all cables underground between buildings. All fiber optic cable shall be routed in raceway everywhere except in cable tray. Use of listed optical fiber raceway is preferred in concealed spaces. Maintain proper bending radius for fiber optic cables.

Copper distribution cables shall be punched down in a 1 pair per port configuration. The cable shall be terminated on the WHT/BLU and BLU/WHT 110 connectors at patch panels. This corresponds to pair #1. Install surge suppressors as required by the NEC.

Specify labeling of all system components in accordance with Wake County Public School System - Technology Department and all applicable industry standards. Refer to attached figures 16740-3A through E. All labeling shall be approved by the school system prior to installation.

Provide testing in accordance with industry standards.

END OF SECTION
ATTACHMENT 16740-1A - MDF CABLE SCHEDULE

NOTE: DRAWING NOT TO SCALE

BEST COPY AVAILABLE
ATTACHMENT 16740-1B - IDF CABLE SCHEDULE

FOR DATA PER PORT
FOR VOICE PER PORT
DATA TO EACH HUB CABINET

NOTE: DRAWING NOT TO SCALE
NOTES (HUB CABINET):

1. CABINET SHALL BE CONSTRUCTED FROM 16 GAUGE COLD ROLLED STEEL. HINGES SHALL BE FORMED STEEL TYPE OR EQUIVALENT AND SWING FROM SIDE OR BOTTOM. FRONT PANEL TO HAVE LOUVERS TO AID IN THE DISSIPATION OF HEAT. UNIT SHALL HAVE KEYLOCK DEVICE. ALL HUB CABINETS IN GROUP TO BE KEYED ALIKE. UNIT SHALL HAVE A POLYESTER POWDER ENAMEL, OR EQUIVALENT TYPE FINISH.

2. CABINET SHALL HAVE 1/2" PLYWOOD BACKBOARD TO MOUNT EQUIPMENT. CABINET TO CONTAIN FIBER RADIUS HOOPS FOR CABLE MANAGEMENT. CABINET SHALL HAVE SEALED RUBBER CABLE ENTRY GROMMETS WHERE REQUIRED. OWNER TO SUPPLY AND INSTALL HUB, FIBER TRANSCEIVER, POWER SUPPLY AND CAT. 5 CABLES TO WORKSTATIONS.

3. CONTRACTOR TO SUPPLY CABLE MANAGEMENT DEVICE AS SHOWN AND PROVIDE A MINIMUM OF 6' OF SLACK FIBER. CONTRACTOR TO TERMINATE FIBER WITH ST CONNECTORS.

4. CABINET SHALL BE MOUNTED TO WALL WITH FOUR (4) 1/4" BOLTS IN WALL ANCHORS. USE TOGGLE BOLTS FOR HOLLOW PARTITIONS AND LEAD ANCHORS FOR SOLID MASONRY WALLS. BOLTS SHALL PASS THROUGH THE 1/2" PLYWOOD CABINET BACKBOARD, THE CABINET AND INTO THE WALL ANCHOR.

5. CABLE SHALL BE ROUTED TO CABINET AS FOLLOWS:
   NEW CONSTRUCTION: 3/4" EMT ROUGHED IN WALL TO A SINGLE GANG OUTLET BOX. CABINET SHALL HAVE A 1-1/2" DIA. OPENING IN BACK AND BE MOUNTED DIRECTLY OVER OUTLET BOX.
   EXISTING WALL - HOLLOW PARTITION: CABINET SHALL HAVE A 1-1/2" DIA. OPENING IN BACK AND BE MOUNTED DIRECTLY OVER A 1-1/2" DIA. OPENING IN WALL. CABLE TO BE ROUTED IN WALL AS STATED IN SPECIFICATIONS.
   EXISTING WALL - SURFACE MOUNT: ROUTE CABLE DOWN WALL IN SURFACE METAL RACEWAY MECHANICALLY FASTENED TO WALL INTO TOP OF CABINET. USE A SURFACE METAL RACEWAY TYPE
LABEL EACH BACKBONE (DISTRIBUTION) COPPER CABLE AS FOLLOWS:

LABEL DISTRIBUTION PATCH PANEL AT IDF - "FEEDER CABLE TO X - ROOM AAA"

WHERE X IS THE 'MDF' OR 'DEMARC' AS APPLICABLE.

AAA IS THE TELECOM CLOSET/ROOM NUMBER WHERE THE MDF OR DEMARC IS LOCATED.

LABEL DISTRIBUTION PATCH PANEL AT DEMARC OR MDF - "FEEDER CABLE TO IDF - ROOM AAA".

WHERE AAA IS THE TELECOM CLOSET/ROOM NUMBER WHERE THE IDF IS LOCATED.

JACK NUMBERS SHALL MATCH EXACTLY AT BOTH ENDS OF ALL COPPER DISTRIBUTION CABLES.

LABEL BACKBONE (DISTRIBUTION) FIBER CABLES AS FOLLOWS:

AT THE MDF LABEL ALL FIBER CONNECTOR PAIRS SEQUENTIALLY FROM LEFT TO RIGHT FROM TOP TO BOTTOM. CARRY THIS NUMBER ALL THE WAY TO THE HUB CABLE OR FIBER OUTLET. NUMBER SHALL MATCH AT ALL INTERMEDIATE IDF'S OR FDE'S. TAG CABLE AT ALL CONNECTIONS, IDENTIFY DISTRIBUTION SIDE AT ALL IDF'S AND FDE'S WITH - "FEEDER CABLE TO MDF - ROOM AAA".

WHERE AAA IS THE TELECOM CLOSET/ROOM NUMBER WHERE THE MDF IS LOCATED. IDENTIFY FEEDER DISTRIBUTION AT MDF WITH - "FEEDER CABLE TO X - ROOM AAA".

WHERE X IS 'FDE' OR 'IDF' AS APPLICABLE, AAA IS THE TELECOM CLOSET/ROOM NUMBER, WHERE THE MDF IS LOCATED.
LABELING

ATTACHMENT 16740-3B – TYPICAL LABELING ON HUB CABINET W/ COPPER OUTLETS

ATTACHMENT 16740-3E – HUB CABINET FEEDS AND FIBER OUTLETS

NOTE:
ATTACHMENT 16740-3E – TYPICAL MDF OR IDF RACK ELEVATION

NOTE: DRAWING NOT TO SCALE

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