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ABSTRACT

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

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.

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

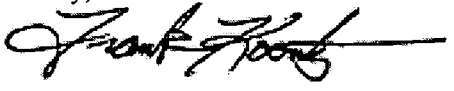
DATE: November 29, 1994

This notice is to advise you that asbestos-containing building materials must not be disturbed if encountered during repairs, renovations, and other construciton 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 distrubing 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,



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 Conty 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: _____
President/Manager/Owner _____ Date:_____

Subcontractor: _____
President/Manager/Owner _____ Date:_____

Subcontractor: _____
President/Manager/Owner _____ Date:_____

Subcontractor: _____
President/Manager/Owner _____ Date:_____

Subcontractor: _____
President/Manager/Owner _____ Date:_____

Subcontractor: _____
President/Manager/Owner _____ Date:_____

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

SECTION 01030 - ENERGY CONSERVATION

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

SECTION 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

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.
- ❑ Backing 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.

END OF SECTION

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

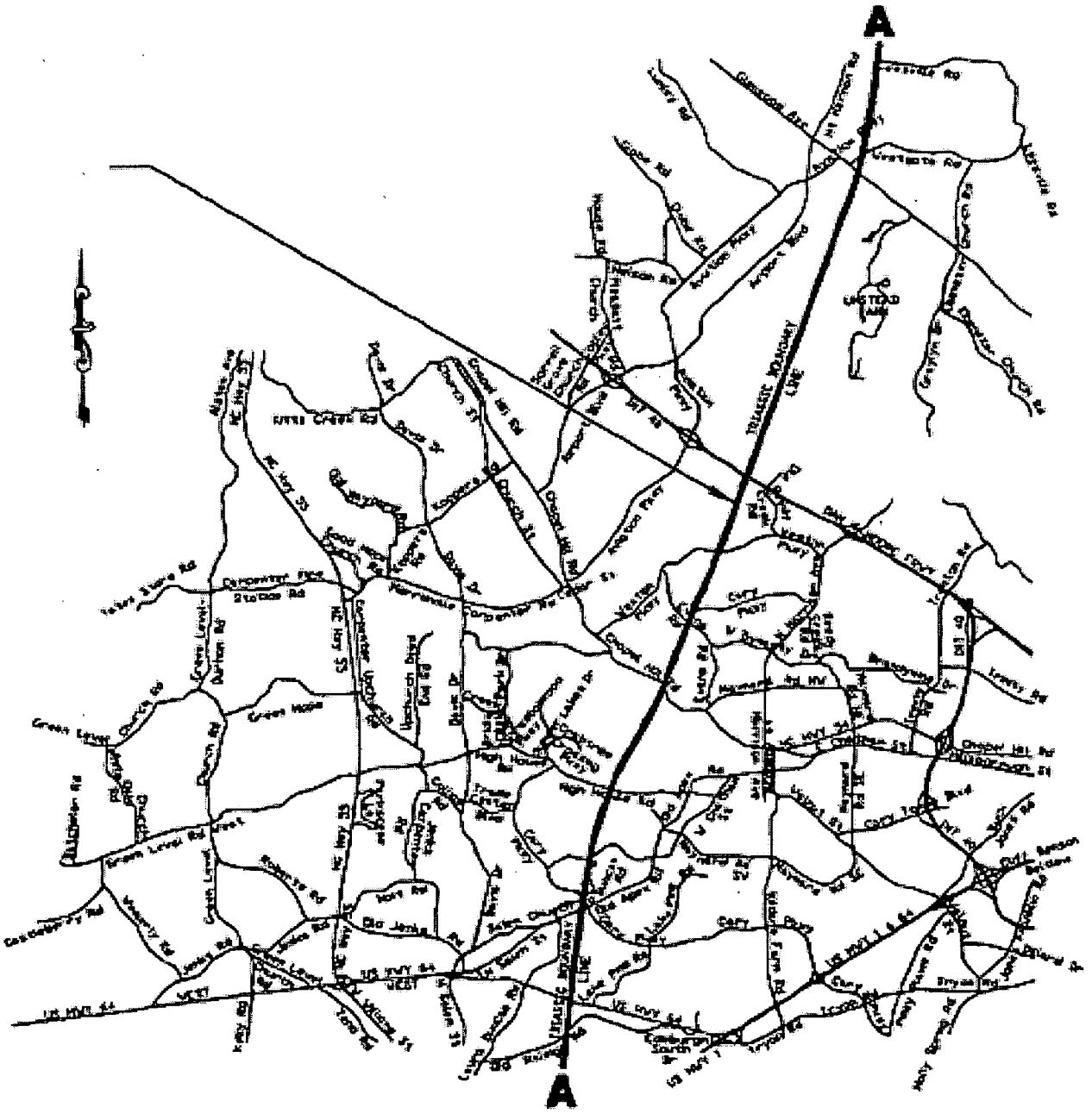
PRODUCTS

- ❑ 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.

1
2 **END OF SECTION**



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2 **ATTACHMENT 02510-A – TRIASSIC BOUNDARY MAP** **Y MAP**

3 LIMITS OF THE TRIASSIC AREA: **ERN WAKE COUNTY**

4 ALL DEVELOPMENTS DEPT. OF AGRICULTURE SOIL SURVEY MANUAL – NOV. 1970

5 WEST OF THIS LINE MUST

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. I-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:

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

- ❑ 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 forked 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 with-in 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.

END OF SECTION

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 Hulled 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. Hulled 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:

Fertilizer	1000 SF	Acre
10-20-10	25-40	1000-1750
5-10-5	50-80	2000-3500
10-10-10 and	25	1000
20% super phosphate	12-25	500-1000
5-10-10 and	40	1750
20% super phosphate	5-20	220-880
6-10-4	50-80	2000-3500
10-20-20	25	1000

- ❑ 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 susceptablity 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 Virgimana - Eastern Red Cedar
Koelreuteria Paniculata - Golden-Rain Tree
Lagerstromia Indica - Crepe Myrtle (mildew-resistant var.)
Magnolia Grandiflora - Southern Magnolia
Magnolia Stellata - Star Magnolia
Magnolia Virginiana - Bay Magnolia
Metasequoia Glyptostroboides - 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 Cerasifera - Puple Leaf
Prunus X'yedoensis - Yoshino Cherry
Prunus X'okame - Okame Cherry
Quercus spp. Oak (prefer Sawtooth, Pin and Willow)
QuercusVirginiana
Taxodium distichum - Bald Cypress
Tsuga canadensis - Canaadian 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.)

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)
Kumo[eris 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 prefered)
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 Sargent varieties)
Liriope - (Big Blue or Variegata only)
Mondo Grass
Ophiopogen 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

Crataegus spp. - Hawthorne
Elaeagnus Pungens -Thorny Elaeagnus
Evonymus Fortuni - Wintercreeper
Fraxinus spp. - Ash
Gardenia spp.
Hedera Helix
Liquidambar Straraciflua - Sweetgum
Liriodendron Tulipifera - Tulip Poplar
Lonicera spp. - Honeysuckle
Magnolia Virginiana - Bay Magnolia
Malus spp. - all apple & crabapple
Nerium Oleander - Oleander
Photinia Fraseri
Phyllostachys spp - and all bamboo spp.
Poplus spp. - (all var.)
Pyrancantha spp. - Firethorn (all var.)
Rosea - Rose (all var.)
Salix spp. - (Willow)
Sophora spp - Pagoda tree
Yucca spp - (all var)

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 permissable.

PRODUCTS

- ❑ CONCRETE: **Use** air-entraining admixture in all concrete, providing not less than 4% nor 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.

END OF SECTION

SECTION 05500 - METAL FABRICATIONS

GENERAL

- ❑ CODES AND STANDARDS: Comply with applicable provisions of AISC "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings" and AWS "Structural Welding Code", unless otherwise indicated.

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

- ❑ 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 06410 - INTERIOR ARCHITECTURAL WOODWORK

GENERAL

- ❑ STANDARDS: Comply with "Architectural Woodwork Quality Standards" published by Architectural Woodwork Institute (AWI).

- ❑ 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, Collegedale 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:

Books, regular	12 in.
Picture Books	12 in. to 14 in.
Reference Books	12 in.
Print & Non-print	12 in.
Kits & Oversize Books	16 in.

Shelf Capacities per 3 ft. Unit:

Average Hard Books	30
Reference Books	18
Picture Books	60

Access Space:

At least 42 in. between rows of shelves

At least 60 in. between rows of shelves and furniture involving seating or traffic

At least 60 in. between two parallel tables with back-to-back seating

At least 36 in. between tables and wall or between a row of shelves and other furniture not involving seating or traffic

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 1A 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.

1 **EXECUTION**

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

5

6 **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 fluoropolymar 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.

END OF SECTION

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 suplied 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

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

- ❑ STANDARDS: Comply with ANSI A13.1 Standard Specification for Ceramic Tile and ANSI 108 series of tile installation standards included under "American National Standard Specifications for the Installation of Ceramic Tile".

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: Flashed 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

- ❑ STANDARDS: Acoustical Ceiling Units: ASTM E 1264. Acoustical Suspension System: ASTM C 635 for materials.
- ❑ 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-sulferized 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 Compostion 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
  6. Equal as approved by Architect.

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.

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 markertray 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.
- ❑ Locate all toilet paper dispensers so that toilet stall doors **will not** hit dispensers when door is opened.

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

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:

	Main Courts	Cross Courts
Middle Schools	42 ft. x 84 ft.	42 ft. x 74 ft.
High Schools	50 ft. x 94 ft.	50 ft. x 94 ft.

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 retardent, 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 retardent, 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.

- ❑ LEGS: Install on 3/4 in. I.D. black TC pipe.
- ❑ VALANCE AND OVERHEAD BORDERS: Install on 3/4 in. I.D. black steel TC pipe.
- ❑ CYCLORAMA: Install on 3/4 in. I.D.black TC pipe.
- ❑ 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

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SECTION 12304 - LAMINATE CLAD CASEWORK

GENERAL

- ❑ 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.
- ❑ 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.
- ❑ 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.
- ❑ Deliver completed laminate clad casework and countertops only after wet operations in building are completed, store in a ventilated place, protected from the weather, with relative humidity range of 20% to 50%
- ❑ Protect finished surfaces from soiling and damage during handling and installation with a protective covering.
- ❑ 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).
- ❑ 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.
- ❑ 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.
- ❑ See Attachment 12304-A for Laminate Casework Features.

PRODUCTS

- ❑ 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:

Interior 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.
    6. Concealed Surfaces: Any surface not visible after installation.
  - ❑ 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

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 kneespace drawers, and **shall** be designed to interface undercounter support brackets.

FABRICATION

- ❑ 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 stiffiner.
- ❑ 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

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

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 suply 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.

- ❑ 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.
- ❑ 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.
- ❑ Specify five (5)-year warranty for all compressors.
- ❑ 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.
- ❑ Specify that all belt driven equipment **shall** be provided with a spare belt to be turned over to the Maintenance Department.
- ❑ 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)

- ❑ 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.
- ❑ 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.
- ❑ 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 mumbers
  - 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 bibbs. Where suitable, locate hose bibbs 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

SECTION 15110 - POTABLE WATER & FIRE WATER SYSTEMS

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 interferenceís.
- ❑ 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 add 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 freezeproof mixing faucet for can wash.
- ❑ **Use** non-clog floor drain for can wash.
- ❑ **Use** manual hose reel in dishwashing area for wash down.
- ❑ **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

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 re-circulation 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

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 ^{O}F hot water temperature from water heater that serves kitchen with 140^{O}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

WATER CLOSETS

FIXTURE	REGULAR	HANDICAPPED	REMARKS
Pre K	10 in.	10 in.	Top of Seat
K-5	15 in.	15 in.	Top of Seat
6-8	15 in.	16-1/2 in.-19-1/2 in.	Top of Seat
9-12	15 in.	16-1/2 in.-19-1/2 in.	Top of Seat
Adult	15 in.	16-1/2 in.-19-1/2 in.	Top of Seat

URINALS

K-5	20 in.	14 in.	To Rim
6-8	20 in.	17 in.	To Rim
9-12	24 in.	17 in.	To Rim
Adult	24 in.	17 in.	To Rim

LAVATORIES

Pre K	23 in.	23 in.	To Rim
K-5	27 in.	30 in.	To Rim
6-8	31 in.	34 in.	To Rim
9-12	31 in.	34 in.	To Rim
Adult	31 in.	34 in.	To Rim

WATER COOLERS

Pre K-3	24 in.	30 in.	To Rim

4-5	28 in.	30 in.	To Rim
6-8	34 in.	34 in.	To Rim
9-12	34 in.	34 in.	To Rim
Adult	34 in.	34 in.	To Rim
SHOWERS			
6-8 boys	72 in.	see note 2	Bottom of Showerhead
6-8 girls	66 in.	see note 2	Bottom of Showerhead
9-12 boys	72 in.	see note 2	Bottom of Showerhead
9-12 girls	66 in.	see note 2	Bottom of Showerhead
Adult	72 in.	see note 2	Bottom of Showerhead

NOTES:

1. Handicapped heights **shall** comply with the NC Building Code and all ADA requirements.
2. Top of shower controls not more than 48 in.

END OF SECTION

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

END OF SECTION

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°FWB

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

- ❑ 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.
- ❑ 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.
- ❑ Thermostatically controlled ventilation should be provided in main electrical room to prevent excessively high temperatures.
- ❑ 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.
- ❑ The heating of make-up air for welding shops is not recommended from an economical standpoint.
- ❑ 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.
- ❑ 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.
- ❑ 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.
- ❑ 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.
- ❑ 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.
- ❑ 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.
- ❑ 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

- ❑ 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.

- ❑ 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 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.
- ❑ **Use** of pneumatic controls is not acceptable.
- ❑ **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.
  a. All exposed piping, both insulated and uninsulated **shall** be painted and labeled.
  b. 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

  c. 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.

- ❑ 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.

END OF SECTION

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

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

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

❑ 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.
2. Be in compliance with ISO-9001 (Model for Quality Assurance in Design/ Development, Production, Installation and Servicing) as issued by the International Organization for Standardization.
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.

❑ 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):
   Rules and Regulations Volume II (July 1986) Part 15, Subpart J, Class A, Radio Frequency Devices
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.

❑ 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

English language descriptions of all variables, functions, decisions, etc.

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.**
- ❑ Job Conditions (Environmental Conditions of Operation)

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

- ❑ CU input signal circuits **shall** be in metal conduit where exposed or subject to mechanical damage and be approved shielded cable.
    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 RCU'S 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

routines) **shall** be shared by all RCU's on the Level 1 LAN.

- ❑ 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.
- ❑ 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.
- ❑ 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

- ❑ 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.
    1. 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.
    2. 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.
    3. 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.
- ❑ All control functions **shall** execute within the standalone control units via DDC algorithms. The Owner **shall** be able to customize control strategies and sequences of operations defining the appropriate control loop algorithms and choosing the optimum loop parameters. Each CU **shall** include the following standalone functions:
    1. Direct Digital Control algorithms and control sequences are to be CU resident and be capable of standalone operation. All DDC programs **shall** be custom written as required to meet the performance criteria spelled out in the sequence of operation paragraphs on the drawings for each controlled mechanical system. PID algorithm **shall** be employed as appropriate to the application and per sequences or operation.
    2. All CU resident DDC programs **shall** be capable of being enabled or disabled from the MMI or PDOT. In the enable mode all DDC loops **shall** be active and output signals **shall** be routed to the final control elements. In the disable mode all DDC loop calculations **shall** continue but outputs to actuators **shall** be suppressed.

(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

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 copper 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:

  +/- .5 for the air temperatures.
  +/- 1.0 for water temperatures.
  +/- 0.1 for water temperatures in the range 40 - 55 F.
  KWH and KW monitoring within 1.0% of full scale value.
  +/- 2.0 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.

- ❑ 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.

**************SPEC WRITER: DELETE THIS SUBSECTION IF FIBER OPTIC CABLING IS NOT UTILIZED.***

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 LED's 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-BO7 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.
- ❑ 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.

PART 7 - SEQUENCE OF OPERATION

GENERAL

- ❑ AHU's **shall** each have an RCU. Additional RCU's **shall** be provided as indicated or required.

****************SPEC WRITER: EDIT THIS PARAGRAPH TO PREVENT REQUIRING EXCESS CONTROL PANELS.*****************************

- ❑ Each RCU or ACU **shall** be provided with 2 spare universal I/O points to allow for future

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

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 breech is alarmed the lights **will** be activated.
- ❑ The control subcontractor **shall** provide all wiring between the DDC system and the light

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 annunciate 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:

1. Sensors and Controls: Permanently mark terminal blocks for identification. 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.

- ❑ 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

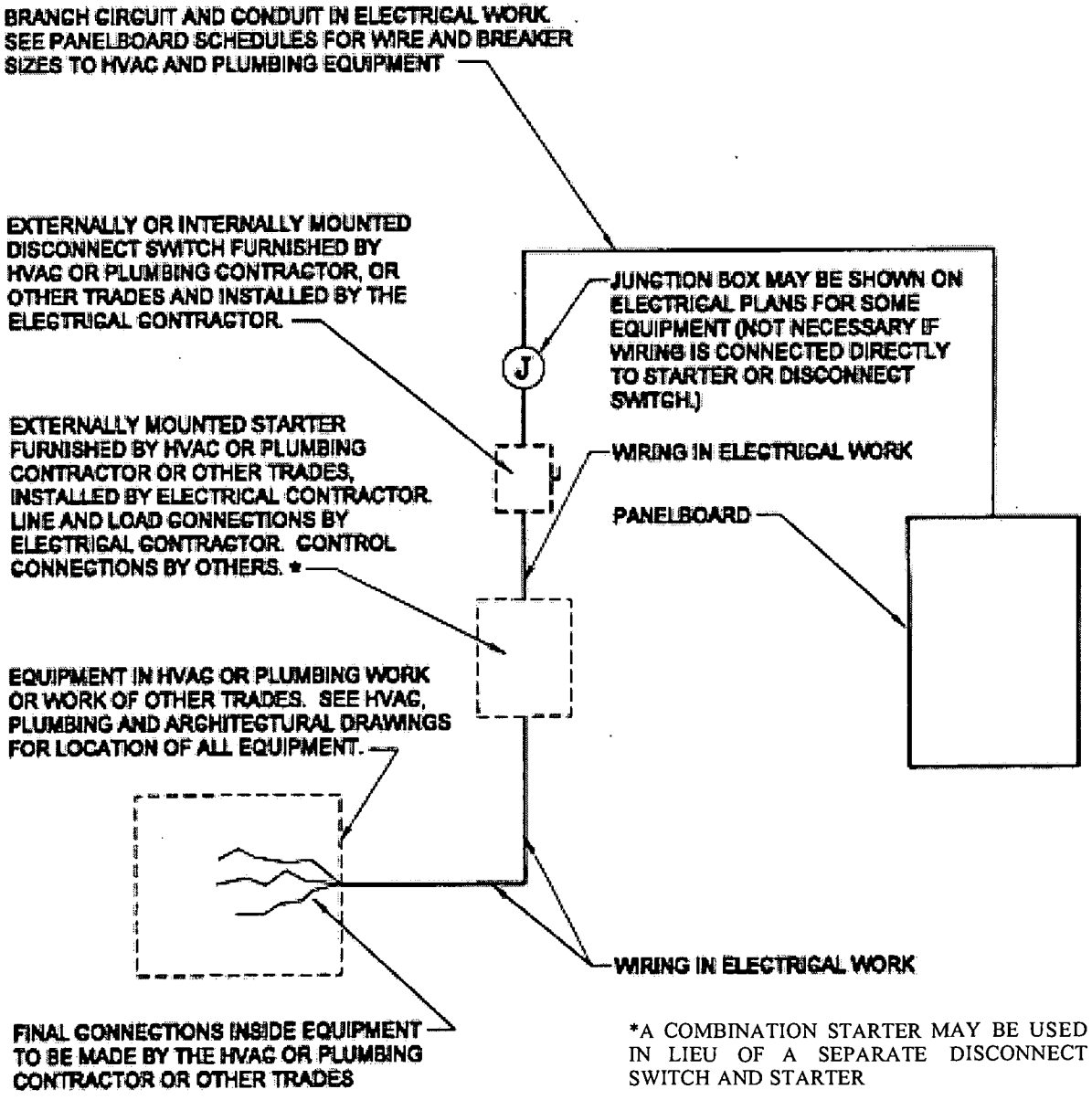
SECTION 16142 - ELECTRICAL CONNECTIONS TO EQUIPMENT

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.

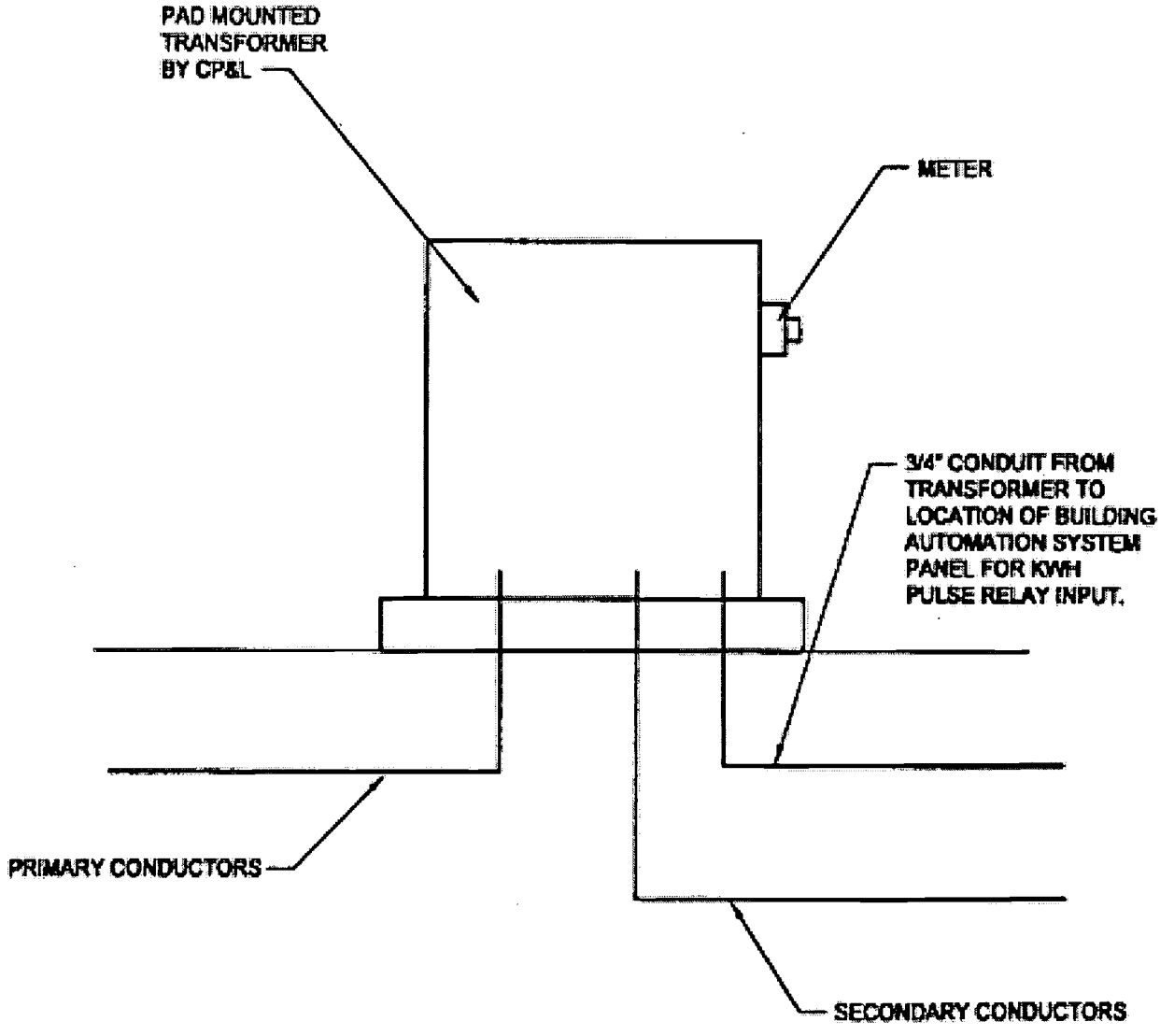
END OF SECTION

ATTACHMENT 16142-A – STANDARD ELECTRICAL CONNECTIONS TO EQUIPMENT



*A COMBINATION STARTER MAY BE USED IN LIEU OF A SEPARATE DISCONNECT SWITCH AND STARTER

ATTACHMENT 16142-B – STANDARD PULSE RELAY CONDUIT DETAIL



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

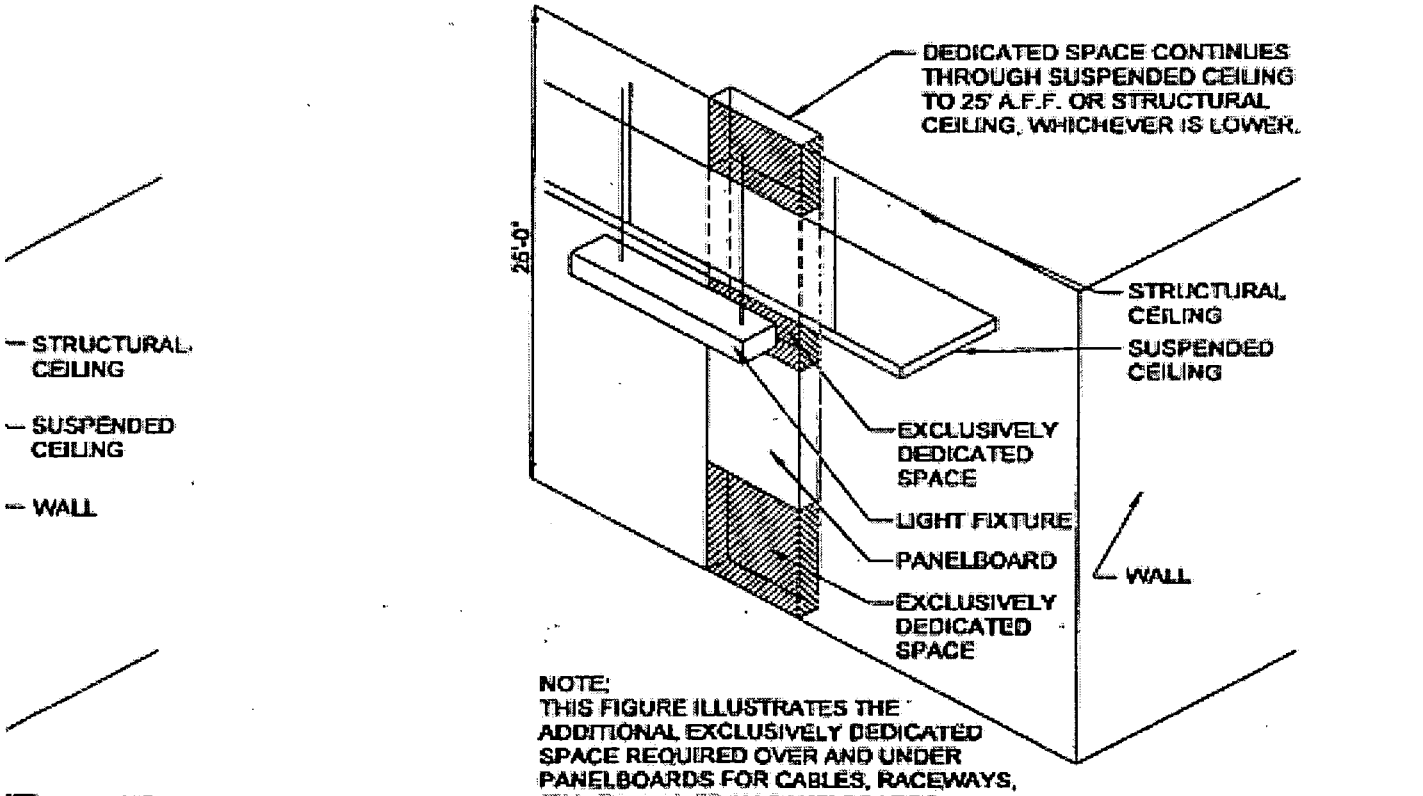
- ❑ All panelboards **shall** have copper bus with bolt-in breakers. All panelboards **shall** be provided with main breakers, even for sub-panelboards that are served from another panelboard except where sub-panelboards are located in the same room as the panelboard serving them.

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

1
2 **ATTACHMENT 16470-A – PANELBOARD WORKING SPACE REQUIREMENTS**
3



PANELBOARDS

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.
- ❑ Incandescent 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

-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

Type of Interior Areas	Recommended Minimum Initial Design Level	Remarks
All interior areas other than listed below	70 foot-candles	Multipurpose rooms and auditorium stages need 70 foot-candles at full bright dimmer setting
Industrial art, prevocational or trade and industrial shops, laboratory and lecture room demonstration areas, and task lighting areas	100 foot candles	
Gymnasiums	50 foot candles	
Cafeterias and commons, stairways, and auditorium seating areas	30 foot candles	Auditorium seating areas need 30 foot-candles at full bright dimmer setting
Corridors, toilet areas, dressing rooms, storage rooms and boiler, mechanical or electrical rooms	25 foot candles	

SECTION 16721 FIRE ALARM SYSTEMS

PART 1 - GENERAL

- ❑ //Spec writers notes: Search on "//" to locate commonly deleted items, items which are usually modified, or locations which require information to be input. Delete all items **not** required for the specific project being written then correct page breaks as required.

RELATED DOCUMENTS

❑ Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

SCOPE

❑ This section of the specifications includes the furnishing, installation, and connection of the microprocessor controlled, intelligent reporting fire alarm equipment required to form a complete coordinated system ready for operation. It **shall** include, but **not** be limited to, alarm initiating devices, alarm notification appliances, control panels, auxiliary control devices, annunciators, power supplies, and wiring as shown on the Drawings and specified herein.

- ❑ //Spec writers note: If system is being installed to replace an existing system verify that the Drawings detail the scope of any demolition that may be required. Pay particular attention to items that may be reused in the new system.

QUALITY ASSURANCE

❑ Manufacturer's Qualifications: Firms regularly engaged in manufacture of fire alarm systems of types, sizes, and electrical characteristics required, and whose products are Listed and Labeled. Products of firms that **do not** maintain factory authorized service organization and spare parts stock are **not** acceptable for use on this project.

❑ Codes and Standards:

- NFPA Compliance: Comply with applicable requirements of NFPA-72, National Fire Alarm Code.
- NEC Compliance: Comply with applicable requirements of NFPA-70, National Electrical Code (NEC) standards pertaining to fire alarm systems.
- Testing Laboratory Compliance: Comply with provisions of UL safety standards pertaining to fire alarm systems. Provide products and components which are Listed and Labeled.
- FM Compliance: Provide fire alarm systems and accessories which are FM approved.

SUBMITTALS - GENERAL

❑ Submittals **shall** demonstrate compliance with technical requirements by reference to each subsection of this specification. Where a submitted item **does not** comply fully with each and every requirement of the specifications, the submittal **shall** clearly indicate such deviations. Identification requirements for non-complying features of items are very specific. See Section //01 //, SUBMITTALS, for exact requirements.

- Product Data: Submit Manufacturer's technical product data, including specifications and installation instructions, for each type of fire alarm system equipment.
- Shop Drawings: Submit shop drawings showing equipment, device locations, and connecting wiring of entire fire alarm system. Include wiring and riser diagrams. Copies of Project Construction Documents or details therefrom may **not** be a part of the shop drawing submittal.

- 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, and 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

	Alarm Verification with Tally	Drift Compensation	
	Automatic Day/Night Sensitivity Adjust	Device Blink Control	
	Pre-alarm Control Panel Indication	Trouble Reminder	
	NFPA 72 Smoke Detector Sensitivity Test	Walk Test	
	System Status Reports	Periodic Detector Test	
	Alarm Verification, by device, with tally	Multiple Printer Interface	
	Multiple CRT Display Interface	Security Monitor Points	
	Non-Alarm Module Reporting	Block Acknowledge	
	Smoke Detector Maintenance Alert	Control-By-Time	
	Ability to interface to Motorola Alert Central		

- ❑ 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 FACP **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.

INITIATING DEVICES

❑ Addressable Devices - General: Unless otherwise indicated on the Drawings all initiating devices **shall** be individually addressable. Addressable devices **shall** comply with the following requirements:

- 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-mount 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 indicated 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 contract 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

- ❑ 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.

- 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: Levition 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 arrestor, typically a gas tube, a series impedance of 1 mH or more, and a fast acting secondary arrestor 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.

- ❑ 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:

//	Initiating Circuits, General	Red (+)/White (-)
//	Initiating Circuits, Smoke Only	Violet (+)/Gray (-)
	Signal Line Circuit cable	Red jacket with Red (+)/Black(-)
	Alarm Indicating Appliance Circuits	Blue (+)/Black (-)
	AHU Shutdown Circuits	Yellow (+)/Brown (-)
	Door Control Circuits	Orange
	Elevator Capture Circuits	Brown

//Spec writers note: Some of the above colors are **not** relevant to addressable systems and apply only to extension of existing zoned systems.

- ❑ 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 leads 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.
  - //Spec writers note: The following section deals with fire alarm system raceway. Always provide RACEWAYS section in the Division 16 specifications. For fire alarm systems in existing structures be sure RACEWAY section details the conditions under which surface metal raceway is required, how it is to be installed, and how it is to be painted.
- ❑ 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 Mõ), 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:

Fuses	2 of each size used in the system
Manual Stations	2% of installed quantity
Indoor Horns/Strobes	4% of installed quantity
Spot Smoke Detectors, Bases	6% of installed quantity

-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.
    2. Measured sensitivity of each smoke detector.
    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.

END OF SECTION

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 frame(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

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).

❑ Subclosets 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

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5 **ATTACHMENT 16740-1A – MDF CABLE SCHEDULE**
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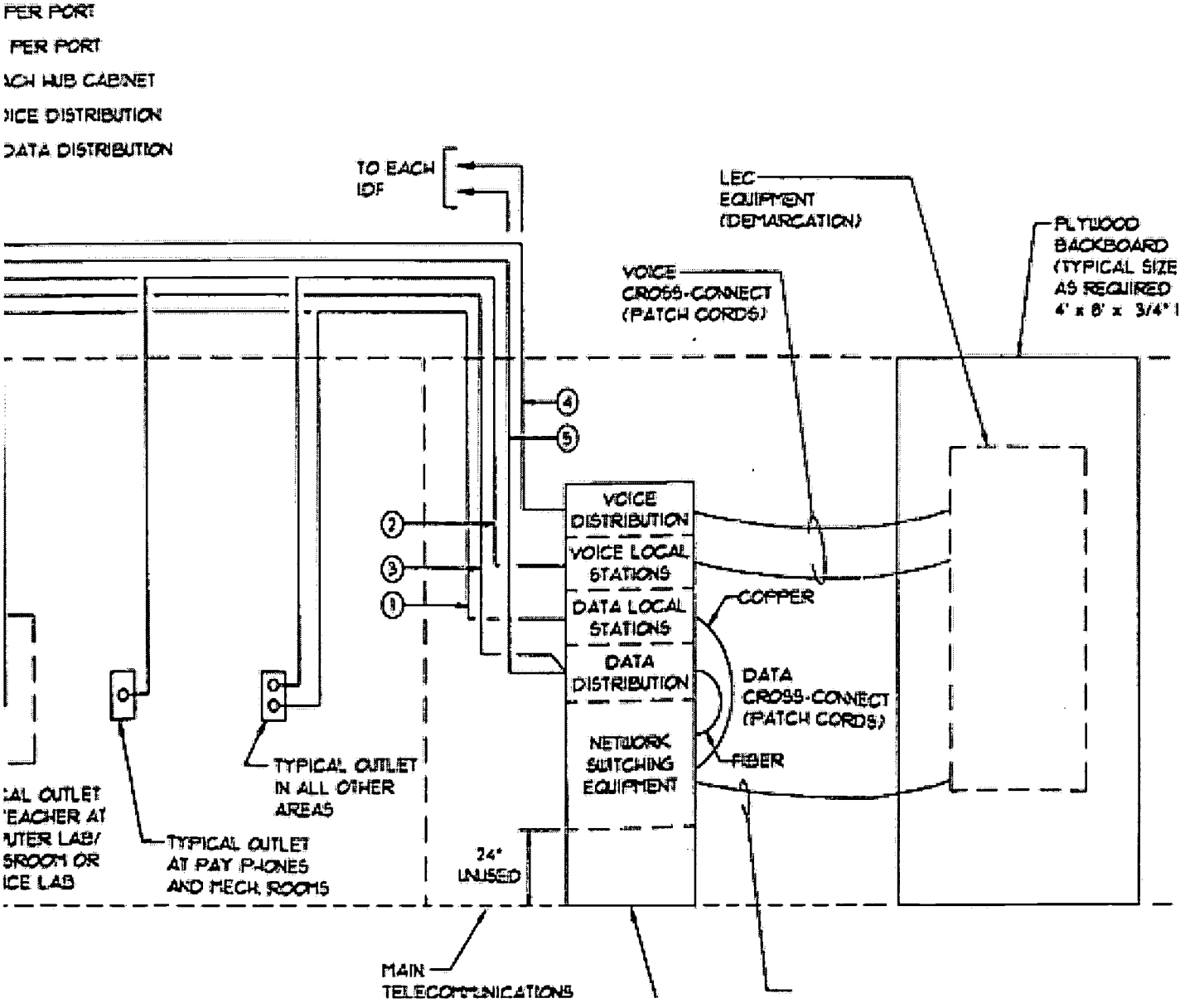

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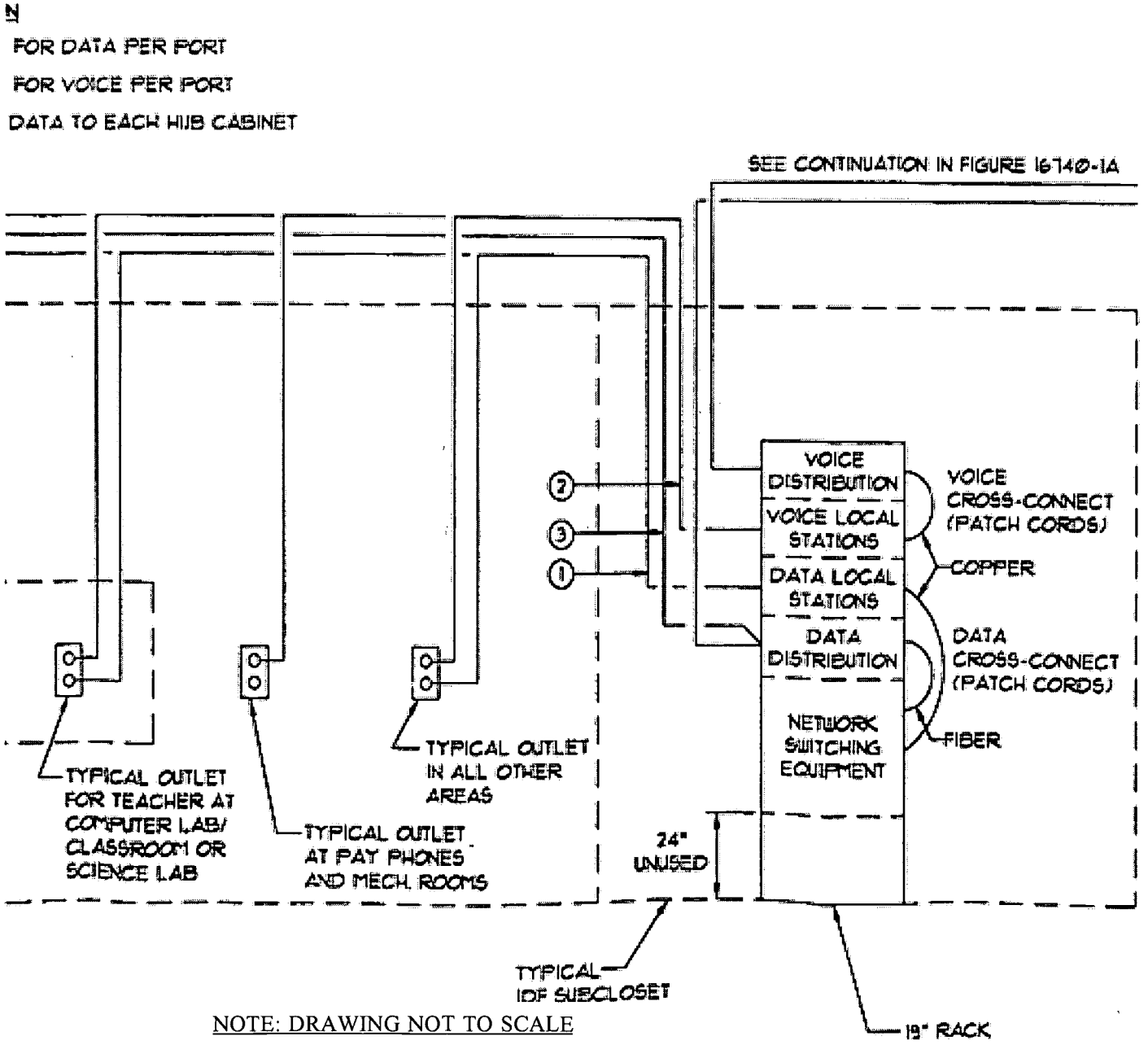
1
2 **ATTACHMENT 16740-1B - IDF CABLE SCHEDULE**



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□ ATTACHMENT 16740-2 – HUB CABINET DETAIL
□

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

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1 ATTACHMENT 16740-3A – DESCRIPTION OF TELEPHONE/DATA SYSTEM

LABEL EACH BACKBONE(DISTRIBUTION) COPPER CABLE AS FOLLOWS:

LABEL DISTRIBUTION PATCH PANEL AT IDF - "FEEDER CABLE TO X -RMAAA"

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 - RM AAA".

WHERE AAA IS THE TELECOM CLOSET/ROOM NUMBER WHERE THE IDF IS LOCATED.

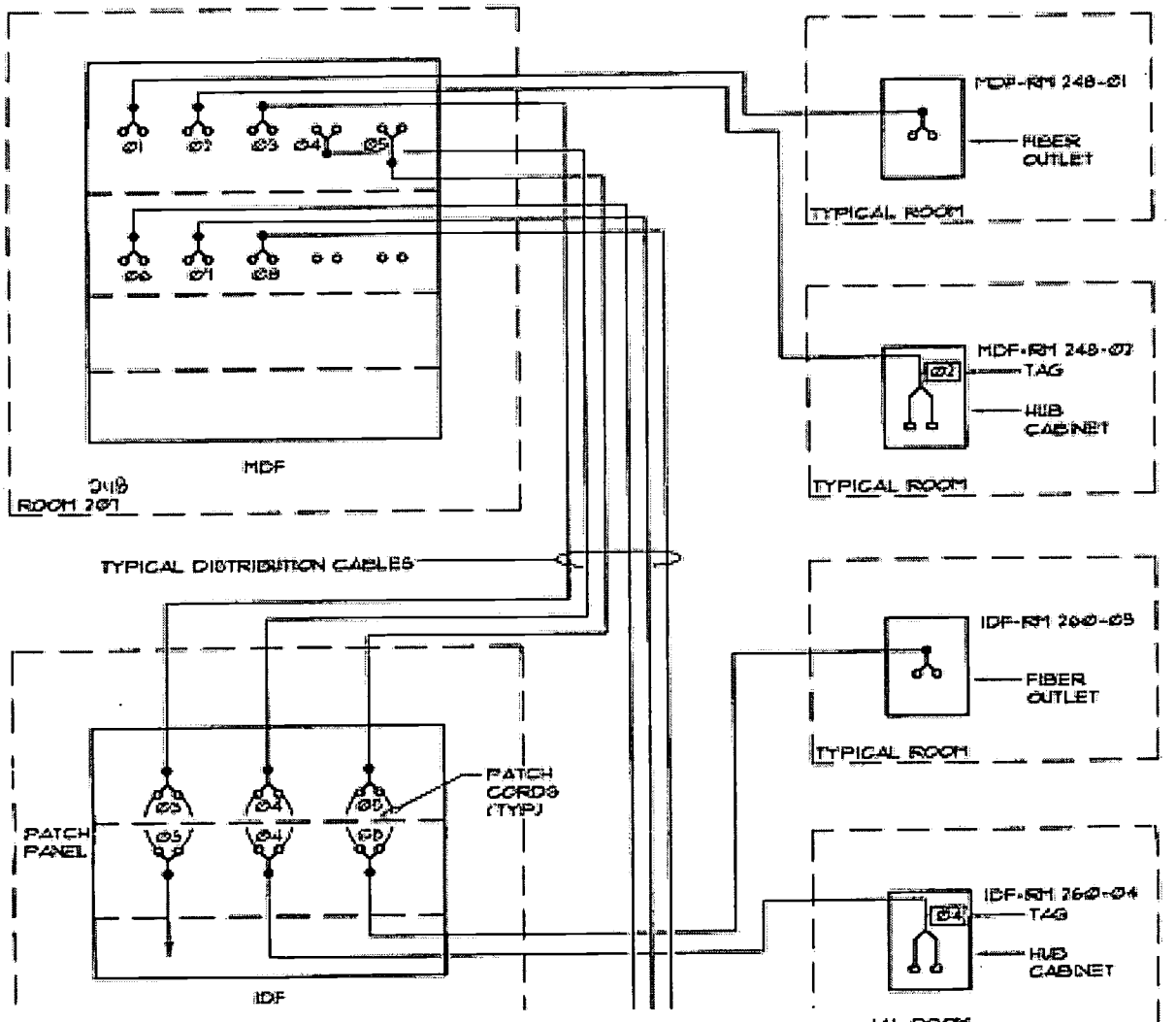
JACK NUMBERS SHALL MATCH EXACTLY AT BOTH ENDS OF ALL COPPER DISTRIBUTION CABLES.

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 CABINET 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.

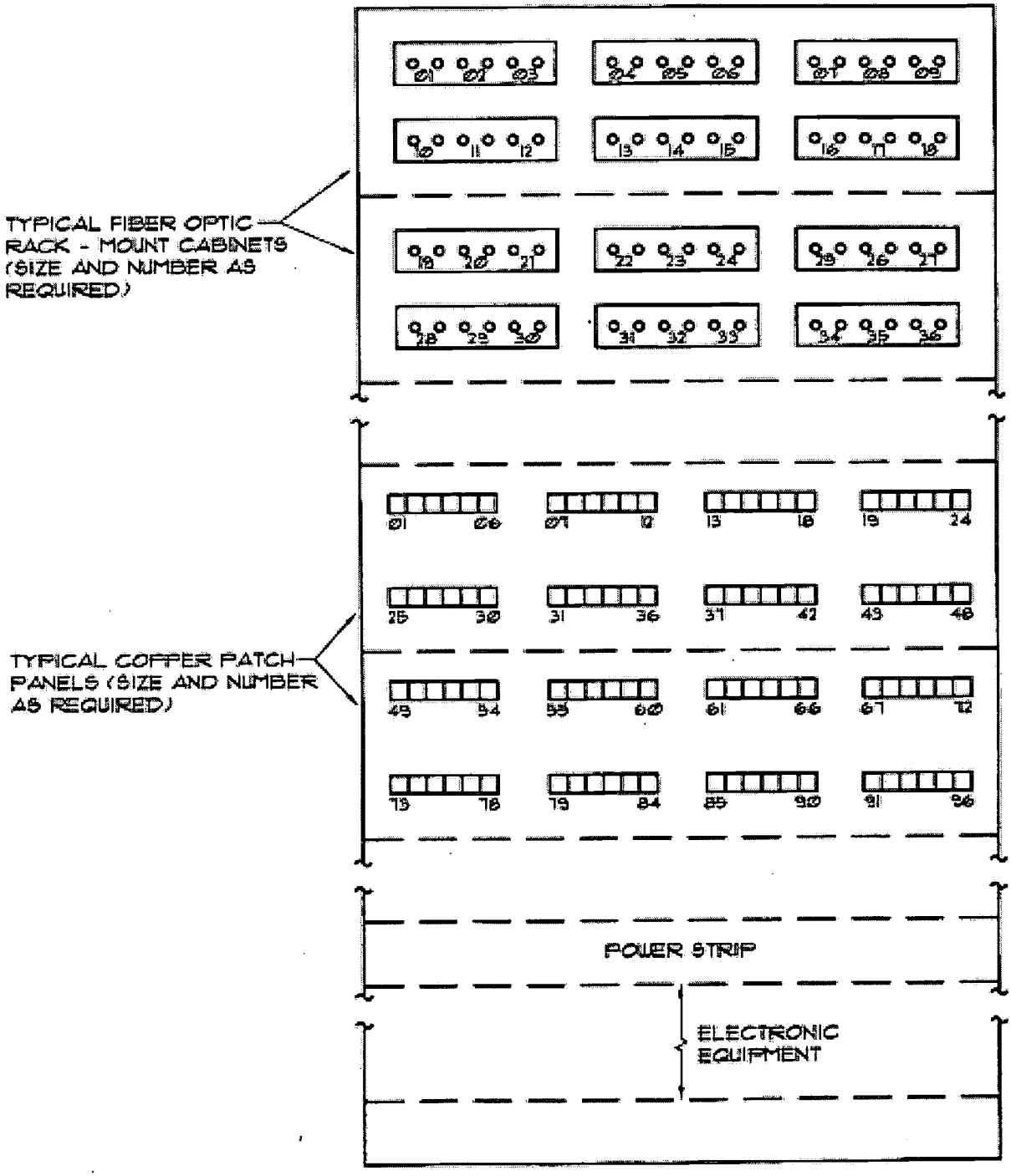
1 LABELING
2 **ATTACHMENT 16740-3B – TYPICAL LABELING ON HUB CABINET W/ COPPER**
3 **OUTLETS**



ATTACHMENT 16740-3E – HUB CABINET FEEDS AND FIBER OUTLETS

ATTACHMENT 16740-3E – TYPICAL MDF OR IDF RACK ELEVATION

SECTION



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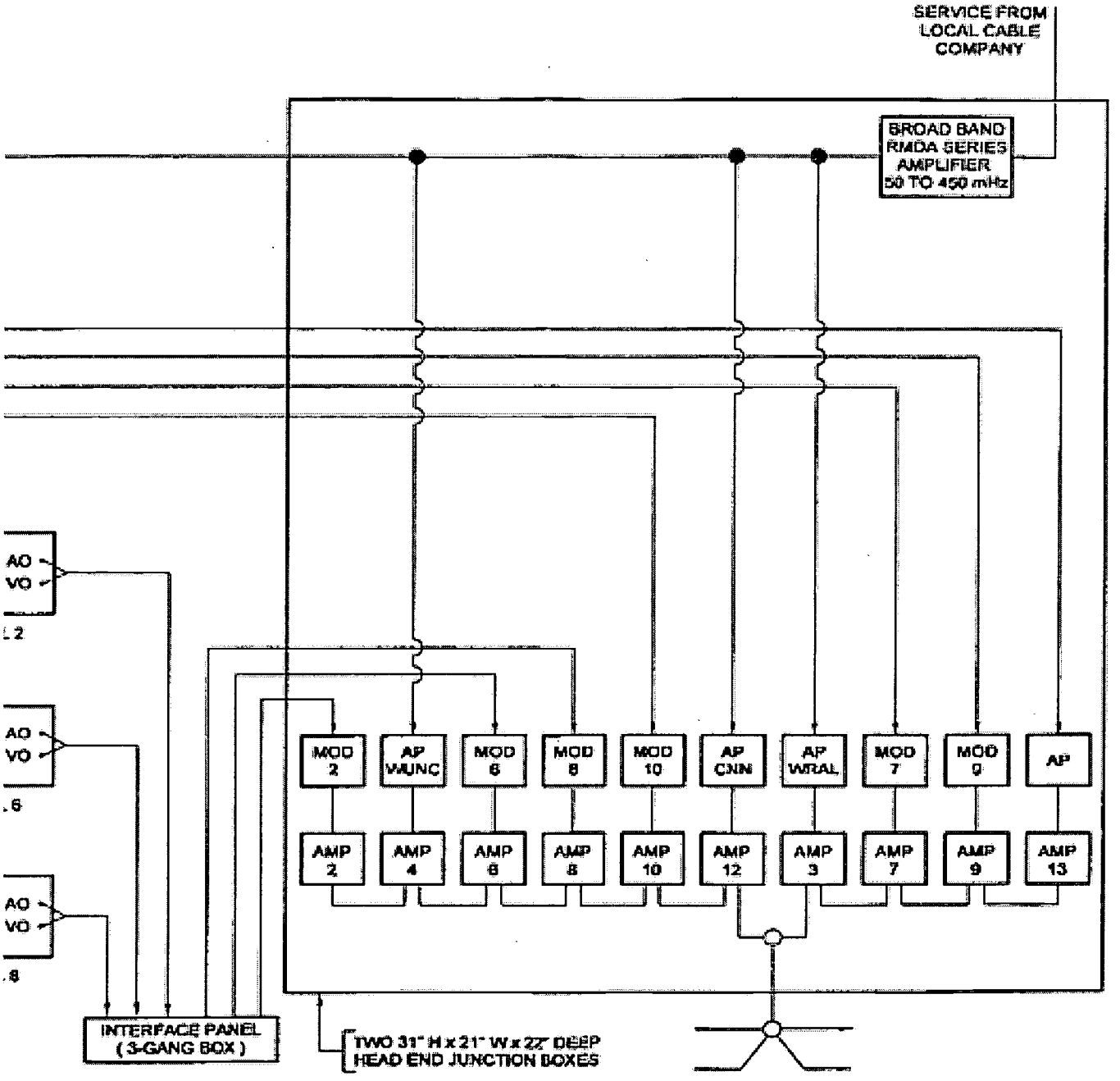
ATTACHMENT 16780-A – STANDRD CABLE TV DIAGRAM



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