

# *Yavapai* COLLEGE **Campus Design Standards**

Purpose: Yavapai College Facilities Division created the Campus Design Standards to guide design and construction professionals to complete lasting, high-quality additions to the campus-built environment. These Standards, along with applicable codes, ensure that new construction and renovation projects at Yavapai College integrate industry best practices and experience with existing campus buildings, infrastructure, grounds, and maintenance issues. All projects shall comply with applicable State of Arizona fire and life safety regulations, including the International Fire Code (IFC) and referenced NFPA standards, as adopted and enforced by the State Fire Marshal’s Office. The Campus Design Standards were developed by Facilities Services. They apply to all Yavapai College construction projects. These standards use the Construction Standards Institute’s 2016 MasterFormat. Where a division is not listed in this document, there are no current campus standards and current applicable code shall prevail.

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## DIVISION 1: GENERAL

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### LIGHTING GUIDELINES

The objectives of good lighting design are to provide light than enhances the comfort of the occupant, adds interest to the space and serves the functional requirements for the occupant. By meeting these objectives, the lighting will become an integral part of the learning environment.

### GENERAL REQUIREMENTS

1. Supplemental lighting should not produce “hot spots” or glare.
2. Display surfaces should have even lighting with no “scalped” effects.
3. Each lighting source type (general, supplemental) should have its own control so only those needed by the instructor will be on.
4. Room surfaces should be light, but minimize reflectance of room light onto screen surfaces.
5. Lighting levels should be consistent with acceptable classroom lighting levels as established by the I.E.S. lighting standards.
6. Provide supplementary task lighting for surfaces such as whiteboards, lecterns and demonstration areas.
7. Yavapai College uses Acuity brand lighting control for classrooms, lecture halls, corridors and restrooms.

### DURING PROJECTION OF IMAGES

8. Projection screens and student tablet areas should be of equal brightness with all other room surfaces less but not less than one-tenth as bright (perceptions are based upon relative brightness, not absolute).
9. When other task areas are used (such as whiteboards), they should be as bright as the screen. When not used, they should blend into the background.
10. Light striking the student desk should not cast distracting shadows.
11. Lighting sources should not be within normal lines of vision.
12. Lighting should be directed so that it does not fall on screen either directly or indirectly.
13. Lighting should be adjustable to correspond to the brightness of the projection type used, type of screen and other room conditions.
14. Exit lights for the classrooms and buildings should be provided in compliance with NFPA Type 101.

### LIGHTING SOURCES

Lighting fixtures and lamps should be specified for minimum light spillage to projection screens, Energy efficiency, low heat generation and easy maintenance. LED is preferred. Specification of fluorescent fixtures shall only be allowed when specifically authorized in writing by the FMD.

Lamps shall be Acuity compliant. Lithonia is the preferred manufacturer. General Electric, Voss, Westinghouse, Sylvania, Green or equal may be considered by the FMD.

F/C Level

System

<u>Academic Unit</u>	<u>Lab Type</u>	<u>Light</u>	<u>Medium</u>	<u>Direct</u>	<u>Indirect</u>	<u>Special</u>
	Public Programs					
	Writing	100	150	x		Task
	Social Work Editing	150	200		x	Task
	Interview	30	50			
	Adjacent View Room	100	150			
Liberal Arts & Sciences						
	Microscopic Chemistry	75	100	x		Task
	Biology	75	100	x		Task
	Geology	75	100	x		Task
	Physics	75	100	x		Task
	Language	75	100	x		Task
	Task Fine Arts	75	100	x		Task
	Drawing/ Painting	150	200	x		Task
	3D Art	150	200	x	x	Task
	Computer Graphics	15	20		x	Task
	Photography Dark Room	75	100			Task
	Movement	100	150	x		
	Voice	75	100	x		
	Design (theater)	100	150	x		Task
	Make-up	100	150	x		Task
	Video/Technology	150	200	x		Spot
	Music	100	150	x		
	Organ	100	150	x		
	Dance	15	20	x		Safe
Engineering & Applied Sciences						
	Aeronautical	75	100	x		Task
	Computer CRT	15	20		x	
	Drafting Computer Lecture	150	200	x		Task
		100	150	x	x	
Architecture & Environmental Design						
	Drawing	150	200			Task
	Design	100	120			Task
	Interior Architecture Incl. Task	150	200	x	x	
Law						
	Fluorescent					
	Moot Court	100	150		x	Accent
	Nursing					
	Health Assessment	75	100	x		
	Skills	100	150	x	x	
	Education					
	Education	75	100	x	x	

## ACOUSTICS

### GUIDELINES

1. The sending side of the room, i.e., the side on which the sound source is located, should have hard, sound reflecting surfaces to provide useful reflections to the audience.
2. All surfaces of rooms intended for speech that do not provide useful reflections should be covered with absorptive material.
3. Seating in large learning spaces should be upholstered to reduce the effect of occupied seating on the overall absorption of the room.
4. Hard reflective parallel wall surfaces should be avoided to prevent flutter echoes between these surfaces.
5. Generally, the reverberation time for learning spaces should not exceed 1.5 seconds at 100 Hz. Optimum reverberation time for learning spaces with a capacity under 100 people – 0.5 to 1.0 seconds. For learning spaces with a capacity over 100 people 0.8 to 1.5 seconds.

### BACKGROUND NOISE

The background noise criteria are measures of the noise levels that should not be exceeded by mechanical, electrical, plumbing and other noise sources in a space in order to achieve acceptable sound levels for various space users. The Preferred Noise Criteria (PNC) is used to describe acceptable noise environments for a variety of functional areas. Relatively high PNC noise levels, above PNC 30-35, create a masking effect that is prominent in the speech frequency range of 500 Hz to 2000 Hz. Rooms intended for good speech intelligibility should have relatively low background noise levels.

### REFLECTION/ABSORPTION CHART

Room Type	Reflective	Absorptive	Non Parallel	Reverberation Time	Padded Seats for Sound
	Sending Wall	Rear Wall	Side Walls	(Seconds)	Absorption
Seminar 1				0.5-1.0	
Seminar 2				0.5-1.0	
Classroom 1				0.5-1.0	
Classroom 2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	0.5-1.0	
Lecture 1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	0.8-1.5	<input type="checkbox"/>
Lecture 2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	0.8-1.5	<input type="checkbox"/>
Auditorium 1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	0.8-1.5	<input type="checkbox"/>
Auditorium 2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	0.8-1.5	<input type="checkbox"/>
Preferred	<input type="checkbox"/>				

### PREFERRED NOISE CRITERIA

Academic Unit      Lab Type      25-30    30-35    35-40    40-45    45-50

General		25-30	30-35	35-40	40-45	45-50
Seminar				X		o
Classroom				x		o
Lecture		x		o		
Auditorium		x		o		
Public Programs						
Writing				x		o
Editing				x		o
Social						
Work						
Interview		x		o		
Liberal Arts & Sciences						
				x		o
Microscopic				x		o
Chemistry				x		o
Biology				x		o
Geology				x		o
Physics				x		o
Language	x		o			
Task Fine						
		x		o		
Drawing/ Painting					x	o
3D Art		x		o		
Computer Graphics		x		o		
Dark Room						
Movement					x	o
Voice	x		o			
Design (theater)					x	o
Make-up				x		o
Video/Technology				x		o
Music		x		o		
Organ	x		o			
Dance	x		o			
Engineering & Applied Sciences						
					x	o
Aeronautical					x	o
Computer CRT			x		o	
Drafting			x		o	
Architecture & Environmental Design						
Drawing			□		□	
Design			□		□	
Interior Architecture					□	□
Law						

Moot Court		x	o		
Nursing					
Health Assessment		x	o		
Skills		x	o		
Education					
Education	x	o			

Preferred      x      Acceptable      o

## SPEECH INTELLIGIBILITY

Speech Intelligibility (SI) is a function of signal level, background noise and reverberation time. In rooms intended for speech, the signal levels should be at least 25 dB higher than the background noise level. Background noise has no effect upon intelligibility when noise is 25 dB below the speech level.

Speech Intelligibility is quantified by the percent syllable articulation and percent articulation loss of consonants (% ALCONS). Syllable articulation is directly measured in the space while % ALCON is calculated by the following formula:

$$\% \text{ ALCON} = 656 (D2)(RT2)/VQ$$

D = Distance between talker and listener

RT = Reverberation in seconds

V = Volume in cubic feet

Q = Directionality of source – 2.5 for human voice

### Intelligibility Guidelines:

1. Syllable articulation – 80 % minimum
2. Articulation Loss of Consonants – 15 %

## INTRUSIVE NOISE

Different levels of privacy and freedom from distractions due to intrusive noise are desired for various space uses.

Normal privacy exists when intrusive speech is audible, but only partially intelligible and not disturbing.

Confidential privacy exists when intrusive speech is audible but intelligible, or inaudible.

Since acceptable levels of sound are somewhat subjectively based, the Speech Privacy Potential (SPP) is used to quantify the sound isolation expected from different partition/room systems in the learning spaces. The SPP is the sum of the background noise level in the room (PNC) and the composite Sound Transmission Class (STC) of the partition separating the space from adjacent spaces.

Intrusive noise, which is clearly audible, corresponds to a SPP below 65, a low level of privacy. Intrusive noise, which is audible with effort, generally corresponds to a SPP of 70, a normal level of privacy. Intrusive noise, which is noted as inaudible, corresponds to a SPP of 80 or higher, a confidential level of privacy.

### Intrusive Noise Guidelines:

1. The learning spaces should have a normal level of privacy, which corresponds to SPP of 70.
2. The STC values for the wall partitions of learning spaces should range between STC 50 to 55 for large lecture halls with low background noise to STC 25 to 30 for laboratories with high background noise levels. The recommended value of STC is slightly higher than required to meet normal privacy requirements to allow for field construction deficiencies of the partitions.
3. Walls between learning spaces, and between learning spaces and corridors, should go to the underside of the structure.
4. HVAC ducting supply and return shall have sound deadening equipment used when passing between spaces when zoned multiply.

## DETAILED SPACE CRITERIA

### STANDARDS

The following are the normative space standards used in this analysis to establish the “Required Area” for the various functions and departments.

	NSF	NOTES
<b>OFFICES</b>		
Private Faculty Office	115	1
Chair’s Office	150	2
PT Faculty Office Station	40	3
Administration Director/Coordinator	150	
Dean’s Office	200	2
President’s Office	250	2
Professional Staff Office	115	
Professional/Clerical Staff Work Station	90	4
PT Professional Staff Station	60	5
Secretary Station/Office	120	6
Student Worker	40	7
Waiting Chair Station	20	
Office Equipment/Kitchenette (large)	150	8
Office Equipment/Kitchenette (small)	100	9
Conference Room Station	20	
<b>CLASSROOMS/LABORATORIES/STUDIOS</b>		
Classroom Station: 1 – 59 seats	20	10
Lecture Room Station: 50 – 99 seats	15	
Lecture Room Station: 100+ seats	14	
Computer/Language Lab Station	40	11
Learning Center Station	25	12
Distance Learning Classroom Station	25	
Physical/Life Sciences Lab	50	13
Physical/Life Sciences Lab Support	25% of total lab area	
Physical Geography Lab	40	14
Auto Shop Bay	1,500	
Drafting/CAD Lab	60	15
Nursing Skills Lab	125	16
Art Studios – 3D	100	
Art Studios – Crafts	70	
Art Studios – 2D	60	
Photography Dark Room Station	50	
Art Department Locker	10	
Music Practice Room	70	17
Music Listening Lab Station	20	18
Piano Lab Station	20	19
<b>DINING/LOUNGES</b>		
Snack Bar Seat	20	20
Cafeteria Seat	15	
Lounge Seat	20	
<b>LIBRARY</b>		
For library standards, see Appendix B		

**NOTES:**

- 1 110 NSF is the base standard used in community colleges.
- 2 Allows for meeting area/table in office.
- 3 Allows for desk, usually to be shared with one other PT faculty.
- 4 Standard low partitioned workstation. 5 Minimum low partitioned workstation.
- 6 Allows for files/records area.
- 7 Assumes basic open workstation.
- 8 Allows for work table (collating, etc...) for academic and larger administrative departments.
- 9 No worktable.
- 10 Assumes flexible classroom with potential for seats at tables.
- 11 Allows for computer support (peripherals, lab monitor, technician area, etc...).
- 12 Assumes basic computer station.
- 13 Allows for distance learning equipment in classroom.
- 14 Allows for wall counters and some storage area.
- 15 Allows for layout space adjoining computer/drafting table.
- 16 Simulation hospital bed.
- 17 Assumes upright piano in room. 18 Assumes headphones/CD player 19 Assumes MIDI keyboard.
- 20 Allows for informal seating arrangements.



	Drawing/ Painting	72-78	68-74	35	30
	3D Art	72-78	68-74	25	30
	Computer Graphics	72-78	68-74	35	30
	Dark Room	72-78	68-74	40	30
	Movement	72-78	68-74	25	35
	Voice	72-78	68-74	25	35
	Design (theater)	72-78	68-74	45	35
	Make-up	72-78	68-74	25	35
	Video/Technology	72-78	68-74	35	30
	Music	72-78	68-74	35	30
	Organ	72-78	68-74	35	30
	Dance	72-78	68-74	45	35
<b>Engineering &amp; Applied Sciences</b>		72-78	68-74	50	35
		72-78	68-74	25	40
		72-78	68-74	35	30
		72-78	68-74	35	30
		72-78	68-74	35	30
	Aeronautical				
	Computer CRT				
	Drafting				
<b>Architecture &amp; Environmental Design</b>		72-78	68-74	35	30
		72-78	68-74	35	30
		72-78	68-74	30	25
	Drawing				
	Design				
	Interior Architecture				
<b>Law</b>		72-78	68-74	35	30
		72-78	68-74	35	35
	Moot Court	72-78	68-74	35	35
<b>Nursing</b>					
	Health Assessment	72-78	68-74	35	30
	Skills				
<b>Education</b>					
	Education				

## FURNITURE

### WORK SURFACES

Tables or continuous work surfaces with fixed or movable seating are preferred over tablet-arm chairs. To allow for note taking and reference materials, the minimum work surface area should be 2.5 square feet (a typical tablet-arm chair provides approximately 0.7 square feet). The work surface should be continuous across the front of the student with access from the back.

Tablet arms should be considered when student capacity is an important criterion. When tablet-arm chairs are required in a classroom, the provided tablet size should be equal to or larger than 12" x 15" (1.25 square feet). 10% of the tablet work surfaces should have a left-handed orientation. The tablet arm and control mechanism should be constructed of heavy-duty materials and should not have non-metallic components.

All work surfaces should be constructed of high-pressure plastic laminate applied to solid wood or hard plywood. Particleboard construction should be avoided.

### SEATING

Several aspects must be considered when selecting seating in order to achieve minimum standards of comfort.

#### **Width of seat:**

Seating width for minimum comfort will range from 18" minimum to 22" maximum. The selection of seating width should be based upon the criteria set forth for the type of seating utilization described in the width selection matrix.

#### **Type of lumbar support in back:**

All seating should have proper lumbar support. The back should have a slope ranging from 12 to 30 degrees for classroom seating. The height of the back should not exceed 34" from the floor level.

#### **Appearance:**

The appearance should be coordinated with the interior of the classroom and should meet the acoustical requirements for the space. Soft coverings should be used in large auditoriums or lecture halls where reverberation of sound is a problem. The construction and materials should be selected so that their color and surface are consistent with the other furnishings within the classroom.

#### **Versatility of seating:**

Fixed seating should be provided in all large lecture halls and should be constructed of cast iron or steel frames. Auditorium seating should have retractable tablet arms. In lecture rooms where programs will typically exceed 2 hours, padded seats and backs should be selected.

Classrooms that anticipate heavy usage by handicapped students in wheelchairs should consider special writing surfaces that are available at a lower floor height than 30". White marker boards can be extended to within 1'-0" of the floor level. A 1'-0" floor heights should be maintained in order to prevent housekeeping materials and methods from damaging the writing surface.

Sight lines to vertical writing surfaces should be such that in auditoriums or large classrooms, a 30-degree line of sight is to apply for spacing between the front row and the vertical writing surface.

#### **Surface area required:**

A standard vertical writing surface area for all room types should be 64 to 80 square feet of writing surface. Smaller or larger amounts of writing surface are dependent on the function of the room. A minimum surface area per room should never be less than 64 square feet and the maximum area should not have to exceed 288 square feet.

## CLASSROOM FURNITURE

Teaching classrooms should be equipped with proper lecterns, podiums and tables. In providing this equipment, attempts should be made to maintain the aesthetic and functional compatibility with the overall décor of the room. General assignment teaching classrooms have an identifiable instructional area. This area should be arranged so that it is visible from any perspective in the room. If this area is not visible, special modifications should be made including selection of alternative lecterns, podiums and construction of teaching platforms.

#### **Classrooms:**

A control panel for a smart podium should be accessible to the instructor at the front of the classroom. Availability of a table and chairs should be present.

**Teaching Labs:**

Rooms that are teaching labs have special requirements. The requirements for instructional furniture should be discussed with the faculty that will be utilizing the teaching lab.

**FURNITURE SELECTION CHART**

Room Type	Fixed Seats	Fixed Tables	Movable Chairs	Movable Tables	Tablet Arms
Seminar 1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	N/A
Seminar 2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	N/A
Classroom 1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Classroom 2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Lecture 1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Lecture 2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Auditorium 1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Auditorium 2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	N/A	<input type="checkbox"/>	N/A	<input type="checkbox"/>

## DIVISION 2: SITE CONSTRUCTION

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### 02000 SITE PREPARATION

This section applies to all new buildings, building expansions, utility expansions, parking structures, surface parking lots, campus mall amenities or any other design/construction activity that materially changes or affects the current features found on campus. Areas incorporated in this section are civil surveys, archaeological studies and utility mapping.

All existing built site features shall be noted as to their disposition during and after construction, i.e., removed, relocated, demolished, stored, etc... Contractor is to provide photo survey of conditions prior to the start of construction, documenting the condition of site features to remain.

All landscape material (trees, shrubs, etc...) and irrigation supply devices shall be noted as to remain, stored, relocated or demolished. If existing plant material is to remain or be stored for future project use, it shall be noted as the GC's responsibility to maintain such plant material for the duration of construction. Unless noted otherwise, all existing landscaping shall be returned to original or better condition.

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

### 02010 SUBSURFACE INVESTIGATION

Any project requiring subsurface investigation work shall be coordinated through the FMD. Such work shall be performed by an independent testing agency. A/E to provide list of testing required. Identify the type of test, # of tests, frequency of tests, requirements of tests, etc...

### 02050 DEMOLITION

The Contractor shall ensure that all applicable notifications are completed and submitted to the Arizona Department of Environmental Quality (ADEQ) as outlined in 40 CFR 61.145(b), EPA's asbestos National Emission Standard for Hazardous Air Pollutants (NESHAP) regulation. Notification(s) must be completed prior to all demolition or renovation work as a result of construction activities that impact asbestos-containing materials (ACM). All demolition and renovation construction activities involving ACM must be in compliance with all applicable NESHAP regulations. The current State of Arizona NESHAP coordinator located at ADEQ is Jon Marting and can be reached at (602) 207-2333.

A/E to include provisions for dust and noise control, protection of adjacent buildings, rooms, roofs, site improvements, structures and finishes. Identify access and egress path from the building and/or site.

Contractor to restore or repair any damaged sidewalks, curbs, utilities or plant material. The Owner to review repair work and photo records with the Contractor and approve prior to final acceptance and payment.

### 02110 SITE CLEARING

Contractor to restore or repair any damaged sidewalks, curbs, utilities or plant material. The Owner to review repair work and photo records with the Contractor and approve prior to final acceptance and payment.

### 02140 POSITIVE DRAINAGE

The A/E is responsible for specifying and the Contractor is responsible for maintaining positive drainage away from structures, around all foundation elements within the project boundary. Contractor assumes all liability if positive drainage is not maintained.

## 02200 EARTHWORK

### General:

This section defines earthwork, as rough and finish grading required to grades to design grades for proper site drainage, lawns, shrub and ground cover beds. This section also includes criteria for building and site storm water retention, which shall be confined on site in retention areas, ponds or drywells.

### Fill:

Foundation wall waterproofing must be backfilled within 3 days of placement.

Conceptual grade elevations shall be considered and noted on the schematic site plan and soil fill material shall comply with the following:

- Soil material shall comply with ASTM D 2487 soil classification groups GW, GP, GM, SM, SW, and SP;
- Sub-base material shall be specified as naturally or artificially graded mixtures of crushed gravel, stone, slag or sand;
- Base coarse material shall be specified as naturally or artificially graded mixtures of crushed gravel or stone, conforming to MAG and YAG specification 702, Type B;
- Backfill and fill materials shall be specified as soil free of clay, rock, gravel larger than 4", debris, waste or other deleterious material;
- Top soil shall be specified as natural, friable, loamy soil, which produces heavy vegetative growth, free from subsoil, weeds, sods, stiff clay and stones larger than ¾", with a soil Ph not exceeding 8.00 nor less than 6.5, total soluble salts in saturation not exceeding 2,000 parts per million; and
- All compaction requirements shall conform to applicable MAG and YAG specifications

### Grading and Retention:

Calculation and design of site retention and flows shall conform to the most recent Yavapai County standards and MAG specifications.

All surface areas shall be graded to drain by natural gravity flow.

Site grades shall direct site water away from all portions of the building, parking lots and walks at slopes that disperse the run-off at a rate that will not allow pooling or ponding.

The use of drywells should only be used as a back-up means of site water retention, and should not be relied upon to satisfy total storm water requirements. YC does not have a maintenance program to clean and inspect drywells for proper design percolation and sediment removal.

The use of sump type pumps for exterior surface drainage is not allowable.

All grading shall be such that all surface areas will drain by natural gravity flow. Sumps shall not be used for exterior surface drainage disposal. The general guidelines for the amount of slope shall be as follows:

	Grade	Ratio
Maximum unsupported cut	100%	1:1
Maximum unsupported fill	50%	2:1
Maximum practical landscape	40%	2.5:1
Maximum lawn slope	33%	3:1
Maximum walk ramp	15%	
Maximum handicap ramp	12%	
Maximum drive slope	12%	
Maximum/minimum large flat areas	2% to 1%	
Minimum landscape or paved areas	1%	

All areas to be planted with grass or ground cover shall receive a minimum of 4" topsoil. All finish grades shall be a minimum of ½" below adjacent walks, drives, curbs, mow strips and paving. Any existing site area affected by rough or finish grading activity shall be restored to its original existing condition. Special care should be exercised in design to evaluate any effects new site work or building will impose on existing site features, retention, travel or aesthetics.

## 02220 EXCAVATING, BACKFILLING AND COMPACTING

### General:

This section includes consideration for any anticipated excavation support systems, including all underpinning, sheeting and tiebacks necessary to protect existing structures, workmen, general public, utilities, pavement, etc... during future project development and the construction process.

### Design Standard:

All excavation and shoring shall be done in conformance with OSHA Construction Standards for Excavation (29CFR Part 1926.650-652 subpart P) requirements and any other applicable law, rule or statute governing construction excavation and shoring activities on the State of Arizona property.

Any excavation or shoring occurring in close proximity to pedestrian or vehicular circulation; depth and widths greater than 4' or remaining open longer than 30 calendar days, must be clearly identified on the plans and brought to the attention of the Project Manager by the A/E prior to the start of construction, for appropriate action. The Contractor shall notify the CPM who, in turn, shall notify FMD, Blue Stake and the Local Government Agency (if applicable) no later than 48 hours prior to any excavation activity.

Any area to be excavated or shored extending six feet or greater below adjacent natural grade must be barricaded or fenced (if appropriate) from pedestrian or vehicular traffic.

Excavated material not used for backfill of the project shall be transported off-site at the time it is excavated. Material used for backfilling may be stockpiled within the construction staging area (or other area deemed feasible by YC).

The General Contractor shall be responsible for dust control measures during excavation, stockpiling or transport of material on campus. All compaction requirements shall conform to applicable MAG and YAG specifications.

## 02280 SOIL TREATMENT

### Termite Control:

Termite control is required on all new construction and renovation-building projects where there is structure to ground contact. Certificates of treatment application by a licensed professional are required. Submittal required: Record of Treatment that includes the date, time, and location of treatment, weather conditions and product used. Payment for services shall not be approved until documentation has been submitted and approved, including warranty.

## 02510 ASPHALTIC CONCRETE PAVING

### General:

This section defines general design parameters for paving, curbs and traffic markings. The A/E is required to obtain all information regarding parking stall layout, flow and stall dimensioning from Yavapai College Master Plan along with formal written approvals of the design concept. All handicapped parking stall dimensioning shall be according to "Universal" design, 11' plus 5' access aisle.

### Design Standard:

In areas where asphalt concrete paving is being proposed for vehicle parking, patching of existing parking areas and new roadways or drives, the design specification shall comply with the following: Existing roads, parking and sidewalks; concrete milled to MAG Specifications.

- The aggregate base coarse to be 6" minimum in depth, (more as defined on a project-specific basis) 100% crushed rock conforming to MAG and YAG Specification 702, Type B, compacted per ASTM D1557-78.
- Bituminous binder course shall be 2" thick, conforming to MAG and YAG Specifications Section 710.
- Painted traffic markings to be 4" wide with reflective beads.
- No asphaltic concrete curbing or driveway aprons are allowable.
- Sealer coat shall be applied after completion of laying of asphalt. A/E to specify time frame and procedures.
- Asphaltic concrete pedestrian walkways shall conform to the same MAG, YAG and ASTM specification sections cited above, with a 4" aggregate base coarse, 1" bituminous binder coarse and 1" surface coarse.
- Dead end driveways are highly discouraged, but if site restrictions mandate this design approach, there shall be a minimum of 20' of unobstructed pull in length; width equal to the driveway.

## 02525 CURBS

### **Pre-cast Concrete Curbs:**

Parking bumpers shall be specified for all pavement installations within 2' of existing structures or fences.

## 02545 SURFACING

### **Aggregate Surfacing – Chipseal:**

Quick-setting and emulsified asphalt per MAG Specification Type CRS-2.

Aggregate gradation shall conform to MAG Specification Table 716-1 for moderate traffic areas and MAG Specification Table 716-2 for high traffic areas. ADOT Specification CM 11 will be considered as an alternate subject to availability of MAG Specification material and credit price.

Submit chip sample for testing prior to application.

The Contractor shall be responsible for providing barricades and appropriate signage for all parking lot entrances. Signs shall read:

“Parking Lot Closed from \_\_\_\_\_ to \_\_\_\_\_. Use Lot # \_\_\_\_\_.”

Loose chips shall be swept and removed within a 24-hour period and again at a later date if required.

Contractor is responsible for protection of all manholes and valve covers. All manholes and valve covers shall be marked with non-permanent orange paint and protected with cardboard (or equally effective material) prior to chip sealing.

### **Bituminous Surface Coarse:**

Bituminous surfacing shall be used only in exceptional cases. Chipseal is the preferred preservation method.

## 02600 PIPED UTILITY MATERIALS

All electric, data, water, sewer and gas subsurface utility pipes shall be buried with high strength reinforced tracer wire. Detector tape shall be buried a minimum of 12” and a maximum of 16” below grade. If multi pipes are buried in a trench a single tracer wire is to be used.

## 02660 WATER DISTRIBUTION

All water systems shall be protected from main Municipal supply by backflow preventers. All backflow preventer installations shall be inspected by the CPM.

## 02665 DOMESTIC WATER SYSTEMS

### **Fire Water Systems:**

Fire hydrant flow tests are required with written test results submitted, prior to payment. Tests shall be paid for by the Contractor, performed and witnessed by the Fire Marshal and CPM.

## 02685 GAS DISTRIBUTION SYSTEM

### **All underground pipe shall be:**

Schedule 40 black iron steel, factory coated and protected with cathodic protection – U.S. domestic-made pipe.

All gas lines into building need to have insulating unions installed to isolate building pipe from underground piping.

All underground pipe shall be buried a minimum of 24” deep with alternate shading and with metal detector tape.

Tape shall be installed a maximum of 6” below grade.

Any abandoned gas line shall be removed or purged by the Contractor. Any such removal must be noted and dated on the as-builts. The Contractor shall submit a dated, written statement of purging.

### **Submittals:**

Mandatory: 30 days prior notice of any construction (in writing) involving gas pipeline main distribution systems with proposed plans involving gas distribution system.

Installer of gas system must provide to the Arizona Corporation Commission (ACC) and the College, paperwork showing the welder's certification, the welding procedures to be used on installation and verification that the welder has used these procedures within the past six months, and test results confirming the procedures to be used. All pressure tests on lines, shading of ditches, coating of pipes, cathodic protection, tracer lines and open ditches must not be removed or covered until the ACC has been notified and performed visual inspection. As-built prints shall be provided showing the accurate location of all utilities.

## 02695 STEAM DISTRIBUTION SYSTEM

YC maintains one central plant on campus, supplying chilled water and 250o HTHW (High Temperature Hot Water) to the campus buildings. In addition, there are several buildings with natural gas fired furnaces or hot water boilers.

## 02720 STORM SEWAGE SYSTEMS

The design and capacity flows shall be shown on the storm drain profile for each reach of the system.

The minimum size for drainpipe shall be 18" or equivalent arch pipe.

All storm drains shall be designed to have a self-cleaning minimum velocity of 3fps at the design storm.

Horizontal and vertical pipe separation shall be per manufacturer's specification with a minimum of \_\_\_ feet. The minimum cover for storm drains shall be one foot as measured to sub grade, or to finish grade if no sub grade is involved.

Trench details for storm drains shall comply with MAG specifications.

Manhole spacing shall be at a maximum of 500 feet and at horizontal deflections per the table below:

Manhole Required	Pipe Size	Deflection
No	18" to 42"	0° to 22 1/2°
Yes	18" to 42"	> 22 1/2°
No	> 42"	0° to 45°
Yes	> 42"	> 45°

Any vertical deflections will require manholes. Manholes will be placed as close as possible to the point of deflection, with allowance for manufactured bends, etc. If the manhole cannot be placed at the point of deflection, then it should be located immediately upstream from the deflection.

## 02810 IRRIGATION SYSTEMS

### Trenching:

All pipe and wire under pavement

Pressurized lines

Non-pressurized lines

Non-pressurized drip laterals

Control wire

### Cover Requirements:

24"

18"

12"

8"

18"

Designed for future effluent use and YC EMS controls.

Lines bordering curbs and sidewalks shall be held 12" away to allow for maintenance and access to the lines.

Backfill around and over pipes shall be with sandy soil free from rocks over 1/8" in diameter. Where existing soil does not meet this requirement, sandy soil shall be imported for backfilling.

Pipe and control wiring and tubing under walks, roads and other hard surfaces shall be installed in schedule 40 sleeves that are two times the size of the pipe. Sleeves shall extend a minimum of 12" beyond the hard surface.

Sleeve locations shall be identified on as-built drawings. Heads, bubblers and drip lines shall maintain a minimum of 2' 0" setback from walks, drives or building faces. Special care shall be utilized in design to avoid the possibility of wind-driven mist from wetting paving and building surfaces.

All main lines shall be looped whenever possible so as to improve pressure and flow.

All pipe used for main lines and auxiliary lines shall be schedule 40 PVC pipe with ratings printed on pipe.

All fittings shall be schedule 40, pressure rated, PVC fittings.

Fittings between the auxiliary (lateral) line and any sprinkler head or hose bib shall consist of a rigid PVC full circle swing joint, "Lasco" brand or pre-approved equal.

Specifications for piping shall include standards that all piping shall be free from cracks, holes, foreign materials, blisters, inside bubbles, wrinkles and dents.

If pipe is stored outside, it shall be protected from direct sunlight.

No galvanized nipples, elbows or other fittings shall be used with PVC pipe installations.

PVC joints shall be glued according to manufacturer's recommendations.

Glued joints shall set for 24 hours before pressure is applied to lines.

### **Control Wires:**

Electronic controller cable to be solid copper wire, UL approved for direct burial, minimum gauge 14 UV for runs under 1000 L.F., 12 UF for runs over 1000 L.F. Control wires must be buried at least 18" below finish grade.

Electric control wires shall be color coded so that neutrals are white, grass areas are red, shrub areas are blue, flower beds are green and drip irrigated areas are brown.

Lawn, shrub, flowerbeds, desert and drip areas shall be valved separately and have separate stations on the time clock.

All connections to valves and all splices shall be made with "SNAP-TITE" connectors and PT-55 sealer (RAINBIRD), or equal.

All splices shall be made in valve boxes.

### **Valves:**

Avoid locating valves in areas where curbs and walks come together.

Main valves should be located, when possible, in a grassed area, five feet from sidewalks, curbs or other traffic areas.

Valves shall have a minimum size of 1".

All valves shall be placed in valve boxes so to allow access for servicing. Valve boxes shall be set at finished grade with valve stems 4" below top of the box. Each valve box or group of valve boxes shall have a hose bib on the pressure side of the valve. 3" of gravel shall be placed under all valves (electric, gate and sectional).

When possible, control valves shall be manifolded together.

### **Clocks: Controlled by YC EMS:**

Clocks shall be RAINBIRD "MAXI" computer control compatible and shall be capable of maxi-operation.

Rainbird, ISC or SBM 1230 electro-mechanical system.

Clocks shall be mounted outside the buildings or any other proximate built structure.

### **Heads: Controlled by YC EMS:**

Heads for lawn areas less than 25 feet wide shall be Hunter I 10 or Hunter I 20 or equal.

Heads for strips and shrubs shall be Rainbird 1800 series, Rainbird 1400/1500 bubblers or equal.

Heads for open areas 25 feet or wider shall be Hunter I 25 or equal.

Heads for large areas with few trees shall be RAINBIRD SAMS or Hunter I 40.

Placement of heads shall be influenced by prevailing wind direction, location of mounds, and placement and location of trees.

Provide diagrams for all head installation.

All lines shall be flushed before the heads are installed.

A non-fading, weather-resistant copy of the irrigation diagram and controller name-label shall be affixed to the inside of the controller cabinet door. The irrigation diagram shall show all valves operated by the controller, valve sizes and type of plantings irrigated.

### **Backflow Prevention:**

Backflow preventers shall be reduced pressure type and shall be installed at all connections to water distribution mains. Preferred manufacturers are FEBCO, WATTS or pre-approved equal.

All backflow preventers shall be assembled with pipefittings and risers of galvanized steel. Valves and drains shall be placed so the entire system may be winterized.

## 02900 LANDSCAPING

### General:

All plantings shall be guaranteed by the Contractor for a minimum of one year after substantial completion. All specified planting materials shall be of species that has a proven history of resilience in this specific county locale. Preference shall be given to designs that center around a xeriscape approach and utilize drip irrigation. All trees and shrubs shall be container grown, not balled and burlap, unless otherwise approved by the FMD.

## 02920 SOIL PREPARATION

### Topsoil:

Topsoil shall be friable, loam topsoil, free from sticks, stones over 1" in diameter, roots, refuse, noxious weeds or any other material toxic to plant growth.

### Shall have:

Loam and soil texture (USDA classification)

30% to 50% sand

10% to 25% clay

30% to 50% silt Ph

– 6.0 to 7.5

Electrical conductivity (ec) – 4.0 milliohms or less per centimeter as measured on the saturation extract

Sodium absorption ratio of less than 5 as measured on the saturation extract

Prior to the delivery, the Contractor shall furnish the College, at no additional cost, a numerical analysis and test from a soils laboratory, which will include:

- Nitrogen
- Phosphorus
- Potassium
- Electrical conductivity (ec)
- Sodium absorption
- Ph
- Percentage of sand, silt, clay, organic matter, water holding capacity

Landscape or planting areas shall not be cultivated when they are so wet as to cause excessive compaction or so dry as to cause excessive dust or the formation of large clods. If imported soil is specified, the existing soil shall be sacrificed to a minimum depth of 8" prior to placing topsoil. All clods and rocks over 1" in diameter, within 6" of the surface, shall be removed and disposed of offsite. The thickness of the topsoil shall be at least 4".

All in-place soil and topsoil shall be free from nut grass, refuse, roots, noxious weeds or any material toxic or a hindrance to plant growth.

Unless otherwise specified, all in-place and/or imported soil will be prepared and conditioned as topsoil to meet the following minimum specifications:

### Ph shall not exceed 7.5 or be lower than 6.0

Electrical conductivity (ec) shall be less than 4.0 milliohms per centimeter as measured on the saturation extract

Sodium absorption ratio of less than 5 as measured on the saturation extract

Shall contain approximately 1.5% by dry weight, organic matter, either natural or added

Soil gradation shall be in accordance with section 795.2 of the Uniform Standard Specifications for Public Works Construction, Maricopa Association of Governments, 1979 edition

### Any use of manure as a soil conditioner is not acceptable

All planted areas shall be conditioned by spreading evenly, over the areas, and thoroughly incorporating (roto-tilled) into the soil to a depth of 6" the following material, per 1000 square feet:

### 20 lbs of 6-20-20 commercial fertilizer

3 cubic yards of nitrogen stabilized amendment derived from redwood sawdust, fir sawdust or finely ground bark

## 02930 LAWNS, GRASSES AND WILDFLOWERS

No more than 10% of the area around newly constructed facility shall be turf or other type of water-intensive vegetation.

Lawns shall be specified only where maintainable with full normal access (no inner courtyards not directly accessible from outside) for irrigation, mowing, fertilizing and pest control operations.

Lawn areas shall be designed open and clutter free, as far as practical, shrubs and ground cover areas shall be separated by concrete, exposed aggregate, 6" x 6" or greater timbers or occasionally brick headers, their tops being ½" above sod/soil level.

Lawn grass shall not be used in any planting strip less than 36" wide unless it has an extension of a continuous larger area.

Lawn soil surfaces shall be constructed ½" below walks, curbs, mow strips or other adjacent paving. Any valve boxes installed in turfed areas shall be made flush with the finish grade, not turf height.

Lawns may be established cut sod or by hydro seeding. In either case, the soil shall be thoroughly roto-tilled and leveled to receive the grass.

Single isolated posts in lawn areas shall be fitted with a concrete mow strip at least 6" wide around the post.

### **Hydro seeding:**

The preferred grass seed mix is a perennial rye/bluegrass mix. Submit species for approval.

Any wildflower seed mix shall be submitted to the FMD prior to specifying. All specified hydro seeding must be in place prior to August 1.

### **Sodding:**

Sod will be a bluegrass/perennial rye mix. It will come from an area with similar climate and soil conditions to the College. Sod grown on a sandy loam soil will not be accepted.

All sod must be in place prior to September 1.

## 02950 TREES, PLANT AND GROUND COVERS

### **Temporary Protection:**

Provide temporary fencing, barricades or guards to protect from damage existing trees, lawn and other plants, which are designed to remain on site.

Protect root systems by not storing construction materials, debris or excavated material within five (5) feet of the drip line of the tree (outer perimeter of the branches). Do not permit vehicle traffic within stated area and restrict foot traffic to prevent excessive compaction of the soil over root systems.

### **Repair and Replacement of Trees, Shrubs and Lawns:**

The removal of trees, shrubs, and ground cover shall not occur without the consent and/or coordination with the FMD.

Repair trees, shrubs and lawns damaged by construction in a manner acceptable to the Landscape Architect and/or the FMD. Make repairs promptly after damage occurs to prevent progressive deterioration of damaged trees, shrubs and lawns.

Remove and replace dead and damaged trees, shrubs and lawns, which are determined by the FMD to be incapable of restoration to normal growth patterns.

Provide new trees of same size and species, unless such plant is on the "DO NOT PLANT" list. Plant and maintain as specified under landscaping section of the specifications.

### **Trees and Shrubs:**

All specified tree and shrub plant material must be in place prior to August 1. All plant materials used shall be of types proven hardy for the area and situation. New, novel or "different" plants shall be restricted to a bare minimum. All plants shall be healthy, true to name and full size of specifications (no recent shifts to larger container).

Trees planted in lawns shall be provided with 24" of bare, sod-free soil beyond and around the full circle of the tree. This area shall also be depressed (dish shaped) to help deep watering of the tree.

Deciduous trees shall be planted no closer than 8' from any walk or drive and evergreen trees planted no closer than 2' greater than the anticipated mature radius of branching. Trees planted in rows shall be uniform in size and shape.

Trees and shrubs shall not be planted until all construction working the area has been completed, final grades established, the planting areas properly graded and prepared as specified.

Dig plant pocket for trees a minimum of 24" wider and 6" deeper than root ball, unless otherwise specified. Loosen subsoil to a depth of 4". Loosen earth on sides of pocket to break the glaze caused by digging.

Set plants at finished grade.

Fill prepared soil to ½ the depth of the ball, pack firmly and settle with water.

If balled and burlapped, loosen and remove burlap and all lacing from upper two-thirds of ball. Backfill with prepared soil, which, after compaction, is flush with ground level.

Cover plant pocket area with 3" to 4" of mulch. Prune, wrap and brace as specified.

## 02970 LANDSCAPE MAINTENANCE

The watering, fertilizing and treating of all existing trees, lawns, shrubs and other plant materials located within the contract limit line or construction fence of the project, will be

The responsibility of the Contractor for the duration of the maintenance period. Specifications and notes on the landscape drawings shall require the contractor to maintain and accept responsibility for all plant material for a minimum of 90 days or through to final acceptance of the work, whichever is longer.

Maintenance shall begin immediately after each portion of lawn and each plant is planted and shall continue in accordance with the following requirements:

- Lawns that have been planted shall be protected and intensively maintained by watering, mowing, fertilizing and re-planting as necessary through a minimum of 90 calendar days or longer if necessary to establish a uniform stand of the specified grasses and until acceptable.
- New planting and groundcovers shall be protected and maintained until the end of the lawn maintenance period or until final acceptance, whichever is longer. Maintenance shall include water, fertilizing, weeding, cultivating, mulching, tightening and repairing guys, removal of dead materials and resetting plants to proper grades.

The Warranty period for all plant materials shall be a minimum of one calendar year.

## DIVISION 3: CONCRETE

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### 03000 CONCRETE, GENERAL

All concrete work shall meet the minimum requirements outlined in U.B.C. Chapter 19 and ACI Standards 301 & 318. Any non-conforming work shall be removed and replaced at the Contractor's expense.

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

Foundation wall waterproofing must be backfilled within 3 days. Inspection required prior to backfill.

All exterior flatwork that may be exposed to salt/ice melt chemicals shall be a minimum of 4500 psi.

Concrete curb cuts, ramps, etc... to allow for handicapped accessibility shall meet the requirements outlined in The Americans with Disabilities Act Accessibility Guidelines (ADAAG). A copy of this law, with design details on file at:

[www.access-board.gov/adaag/html/adaag.htm](http://www.access-board.gov/adaag/html/adaag.htm)

### 03130 PERMANENT OR TEMPORARY FORMS

Contractor shall supply all formwork, complete with necessary shoring, bracing and anchorage.

Architect's or Engineer's (A/E's) or CPM review and inspection shall be required prior to use of earth forms. When using earth forms, sides shall be hand-trimmed and bottoms shall be swept clean of all loose dirt prior to placement of concrete.

Forms shall remain in place throughout any required curing period. All portions or pieces of any wood forms shall be removed completely after the cure period has been completed and prior to Owner possession.

### 03210 REINFORCING STEEL

Reinforcing steel shall be a minimum of 60-ksi-yield grade, deformed. Exceptions to this shall require A/E approval.

### 03240 FIBROUS REINFORCING

Fiber mesh reinforcement is an allowable substitute for wire mesh with A/E's written approval.

### 03250 CONCRETE ACCESSORIES

#### **Anchors and Inserts:**

All anchors and inserts in exterior work exposed to weather shall be inset and/or protected to prevent rusting.

### 03300 CAST-IN-PLACE CONCRETE

1. Under-slab Vapor Retarder Barrier: Provide beneath all slabs on grade.
  - A. Minimum Type: 10-mil thick polyethylene sheeting complying with ASTM D4397-10, "Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications."
  - B. Provide Class A retarder conforming to ASTM E1745-11, "Specification for Plastic Water Vapor Retarders used in Contact with Soil or Granular fill Under Concrete Slabs," where slabs are to receive resilient, wood, and carpet flooring and where recommended by the Project's Geotechnical Engineer for existing and anticipated below grade hydrostatic water conditions at the Project site.
  - C. Install over prepared aggregate base material.
  - D. Joints in the barrier shall be lapped and taped.
2. Curing materials, surface texture, flatness and levelness for concrete flatwork shall be selected for compatibility with finish floor materials. Where surface is to remain unfinished, an appropriate curing agent shall be applied.
3. Floor and slab construction shall conform to the following:
  - A. Flatwork tolerances shall be determined using flatness and levelness F-numbers measured in accordance with ASTM E1155-14, "Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers".

B. Use "Alpha" Class designations where the scope of work is limited or less than 3,000 square feet.

4. Completed exposed concrete flatwork shall maintain a surface coefficient of friction of more than 0.05 percent for slip resistance. Field tests indicating compliance are required and shall be in accordance with ASTM D2047, "Test Method for Static Coefficient of Friction of Polish-Coated Floor Surfaces as Measured by the James Machine." Where sealers are to be used, field tests shall be taken after application of the sealer.

### 03340 CONCRETE FINISHING

In general, exterior concrete traffic surfaces shall be designed with a heavy broom finish.

All stoops, porches, steps and any other exterior concrete shall be finished so as to slope a minimum of ¼" per foot to drainage. Ponding or puddling resulting from finish work that does not address this requirement shall be repaired at the Contractor's expense.

#### **Concrete Finished Floors:**

Generally, concrete finished floors are to receive a hardener with colorant. Positive protection shall be provided to prevent staining and chipping during construction work.

All slabs required to slope to floor drains shall have a minimum ¼" per foot slope to the drain with no ponding areas.

A suitable sealant shall be specified for interior exposed concrete.

All concrete must be cured. Compounds, water curing or blanket protection is acceptable as applicable. The Contractor is solely responsible for protection of all concrete products throughout the curing period. Any damage to partially cured concrete shall require removal and replacement at no cost.

Structural concrete must be cured a minimum of three days. Normal concrete in structures and pavement shall be cured a minimum of seven days.

On formed concrete, forms shall remain in place until work has reached 90% of its design strength.

### 03430 STRUCTURAL PRE-CAST CONCRETE

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

### 03480 PRE-CAST CONCRETE SPECIALTIES

#### **Utility Boxes:**

Utility boxes shall be traffic rated regardless of installation location. Minimum sizes shall be pre-approved by affected departments.

#### **Manholes:**

Manhole design, installation and repair shall conform to the standards and details based on the most current edition of MAG and YAG specifications, which have been adopted by the City of Prescott.

### 03520 LIGHTWEIGHT INSULATING CONCRETE DECK

Lightweight concrete insulating fill roof decks shall not be used in conjunction with urethane roof systems.

Lightweight structural concrete shall be allowed.

## DIVISION 4: MASONRY

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### 04000 MASONRY, GENERAL

In general, when the ambient temperature is less than 40oF, masonry work shall not be constructed without heat, heated materials and/or protection.

Every effort should be taken by the A/E to properly specify and detail masonry veneers, applications, joints and fastening systems to protect against moisture infiltration, efflorescence, cracking caused by improper structural back-up materials and excessive maintenance. The A/E should pay special attention to the fact that the intent of YC is to construct buildings that are permanent structures, i.e., have a useful lifetime of 50 years. A low cost design approach in areas that cannot be “seen” undermines the philosophy of building at YC and, in the end, are usually much more costly in remedial corrective action.

### 04100 MORTAR

**Mortar:**

Portland cement, ASTM C150, normal Type 11, low alkali. Hydrated lime: ASTM C207, Type S. Sand to conform to ASTM C144.

Mortar mix design shall be based on an alkali-free or low-alkali cement (no more than 0.1 percent) in order to reduce the potential of efflorescence. **Mortar Coloring Materials:**

Mortar colorants may be used as desired. Final color selection shall be determined from review of a selection of mock-up panels to be constructed by the Contractor. Mock-up panels shall remain on site for job duration.

### 04150 MASONRY ACCESSORIES

**Anchors and Tie Systems:**

Any anchors or ties embedded within masonry systems shall be coated or of corrosion resistant materials.

**Control Joints:**

Control joints shall be incorporated into straight-wall masonry construction, which exceeds forty feet. Spacing of control joints shall be at the discretion of the Design Professional.

**Joint Reinforcement:**

Joint reinforcement is required and shall meet the zone-specific seismic requirement detailed in the Uniform Building Code.

Horizontal wire reinforcing: No. 9 gauge wire, Class 1 mil galvanized.

Veneer back up: 8” wide concrete masonry units or structural steel studs with a ¾” substrate (equal to or better than “Wonderboard”).

**Flashing:**

Through-wall concealed flashing at all shelf angles, lintels, ledges and other obstructions to downward flow of moisture within the wall. Inspection required prior to covering over flashing.

Flashing above doors, mechanical room louvers and windows to be seamed and end dammed. Detail all throughwall flashing to prevent contact with sealant.

**Weep holes:**

Polyethylene plastic tubing, ¼” dia. x 4” long.

Caulking and sealants:

**Sealer:**

Waterproofing sealer, guaranteed performance minimum 5 years from UV breakdown.

Control & expansion joints: 20’ minimum in run.

All joints that require a caulking should receive special attention during construction. To be filled as soon as possible and maintenance program established within four years of completion of project.

**Admixtures:**

Most admixtures compositions are not disclosed. Unknown composition may cause mortar breakdown and possible efflorescence.

## 04200 UNIT MASONRY

**General:**

In all cases, severe weather (SW) brick or waterproofed concrete masonry units shall be specified for new construction. The A/E shall specify certain precautions to ensure that finished unit masonry is, and shall remain, free from efflorescence and discoloration. These precautions shall include: sealants or mortar mixes, washing and waterproofing of finished water panels and specification of ASTM Test E-67 (efflorescence test) on large projects. A/E shall specify that brick and concrete unit installations shall carry a 2-year warranty against efflorescence.

**Design:**

Provide cavity or airspace behind exterior masonry walls.  
Direct water away from wall tops and horizontal surfaces.  
Special attention to workmanship, detailing, flashing, drips and weepholes.

**Workmanship:**

All mortar joints should be full joints.  
Partially completed walls should be covered at the end of each working day, or when work is not in progress, with a strong weather-resistant material to prevent contamination.  
Cold weather construction shall comply with UBC requirements 2104.3. Covers shall drape over both sides and be securely fastened.

## 04210 BRICK MASONRY

All brick walls, parapets, etc... shall have metal caps or caps of approved materials.  
Each project utilizing brick masonry as an architectural finish material shall include a requirement in the specifications for a sample panel to be constructed as specified. Such panel shall be a minimum of 36 square feet and shall be constructed at and remain on the jobsite until project completion. The panel shall be representative of both brick and mortar type and color.

**Brick:** conforming to ASTM C216-75a, Grade SW, (for new buildings) Type FBX. ASTM C67-85, compressive strength 3000 psi, no efflorescence.  
A/E shall specify an appropriate amount of product extra of each color to be turned over to Owner for future repairs prior to job closeout.

## 04220 CONCRETE UNIT MASONRY

Concrete unit masonry is an accepted method of construction.  
Concrete products contain two to seven times as much soluble materials as the fired clay units so efflorescence potential shall be mitigated in all ways possible.  
An alkali-free cement should be specified. No more than a 0.1 percent alkali.  
All materials should be stored in a dry area. To prevent ground water contamination, masonry units, cements, limes and sand should not be stored on the ground.  
A/E shall specify an appropriate amount of product extra to be turned over at job completion.

## 04255 MASONRY VENEER

A 2" minimum air space shall be maintained between face brick and cavity insulation. Cavity shall be unobstructed, free from mortar drippings.

## 04400 CUT STONE

**General:**

The same care in design and specification should be exercised by the A/E as with brick masonry.

**Mortar:**

Portland cement, ASTM C150, Type I, low-alkali, staining requirements conforming to ASTM C91. Masonry cement: conforming to ASTM C91.H.

**Sand:**

Conforming to ASTM C144.

**Anchors:** conforming to latest edition of the UBC. All anchors shall be mechanically set, stainless steel. Veneer back up: 8" concrete masonry units where possible.

**Type:** designer option, although native materials are encouraged. Pavers: 1/2" minimum thickness, thickset. A material should be chosen that is relatively impervious to moisture absorption and has a high degree of slip coefficient. Polished or honed finishes as a major field finish is not acceptable.

## 04510 MASONRY CLEANING

**Cleaning:**

All masonry work shall be cleaned and sealed before final inspection and acceptance. Acid wash is not usually an acceptable method of cleaning; Contractor shall be required to submit proposed procedures.

## DIVISION 5: METALS

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### 05110 METAL STUDS

In general, 25 gauge studs are acceptable at 16" centers for walls not exceeding 10' in height. Specification of 25 gauge studs is preferred on smaller "task order" type jobs due to availability and cost issues.

### 05500 METAL FABRICATIONS

#### **General:**

This section applies to all metal fabrications that will be used by the A/E that have a visual aesthetic impact, both interior and exterior. Great care should always be exercised by the A/E in the design and detailing of metal fabrication in that they strictly comply to all applicable codes, are relatively easy to construct and maintain (finishes) and do not create potential hazards due to inconsistent heights, surface textures, harsh protrusions or "blend" too well with adjacent surfaces or finishes that could create a special hazard to the visually impaired and physically handicapped.

#### **Design Standard:**

Applicable Items: Rough Hardware, Ladders, Nosings, Trim, Pipe Railings, Stairs, Bollards and Architectural Features. Welds should be smoothly ground to match surface texture of parent metal. All gaps, holes and gouges should be filled with a permanent material (solder or brazing). Design limitations of grinders, files, etc., dictate that adjoining metal tubing pieces at angles less than 125° generally need a minimum of ¼" radius butt weld in order to grind smooth. Adjoining railing splices shall be fully concealed in runs that appear constant. At elbow bends, the design should facilitate metered joints. The use of expansion bolts to secure railing assemblies to vertical or horizontal surfaces is not allowable. Anchorage systems should consist of direct imbeds (sleeved or plates) and/or welding. Exterior exposed metal fabrications shall have a spray-applied epoxy-polyamide type primer paint and spray applied finish paint-epoxy based and/or electrostatically applied. A color should be chosen that does not easily fade when exposed to direct sunlight and hides handprints. Ladders shall be a minimum width of 18", ¾" diameter rungs spaced 12" o.c., braced a minimum of 5' o.c. All stair nosings shall have a permanently applied non-slip surface, either integral or imbedded, 2" wide minimum the width of the tread. Where metal stair risers are exposed (not covered), they shall have spray applied epoxy-polymide type primer paint and spray applied finish paint-epoxy based and/or electrostatically applied. A color should be chosen that does not easily fade when exposed to direct sunlight and hides the shoe-scuff marks. At the top and bottom of stair landings, a contrasting color and texture to the normal stair treads shall be used to facilitate the blind and visually impaired. Expansion joints should be provided in continuous runs at a minimum interval of 40 feet. All exposed to public fabrications with right angle corners shall be radiused a minimum of 1/8". Metal bollards shall be a minimum of 6" square or 4" diameter round and be directly or sleeve set a minimum of 1/3 the exposed height below the finished adjacent surface. Metal trim in continuous runs shall have concealed splices and be of sufficient gauge that natural distortions are not visually apparent. All exposed edges to the public shall be radiused or sharp edges eased.

### 05510 METAL STAIRS

Provide colored safety edge at the top and bottom steps, color as selected by the Owner. All stair nosings shall have a permanently applied non-slip surface, either integral or imbedded, 2" wide minimum the width of the tread. Metal pan stairways shall not be specified for unprotected exterior locations.

### 05520 HANDRAILS AND RAILINGS

In general, handrails shall be specified for both sides of all stairs, ramps, etc... Handrail design shall conform to the latest edition of the UBC and all designs shall be cross-referenced to the Americans with Disabilities Act Accessibility Guidelines (ADAAG) latest edition.

## DIVISION 6: WOOD & PLASTICS

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### 06200 FINISH CARPENTRY

**General:**

Formaldehyde containing particleboard and similar composition products are not allowable.

### 06240 PLASTIC LAMINATE

Synthetic counter tops shall be high-pressure laminate, or, in extra heavy-duty use applications, equal to “Corian” 5/8” minimum thickness.

Guides for plastic laminate finishing are as follows: min. .050” exposed horizontal surfaces; min. .028” exposed vertical surfaces; min. .020” cabinet linings and concealed backing.

The use of plastic laminate tops and splashes is not recommended for high-moisture areas such as lavatory tops, coffee bar tops or work surfaces that are repeatedly subjected to spillage, water cleaning or subject to chemical substances. In lavatory countertops, lighter colors are preferred.

### 06400 ARCHITECTURAL WOODWORK

**General:**

This section applies to architectural mill and casework. In general, the design and specification of items normally contained in this section must be considered to last the lifetime of the building. Flexibility, years of heavy use and misuse, limited maintenance, high impact, occasional overloading and initial cost-effectiveness should be the criteria in the design and finish. Endangered or limited tree species used as veneers or solid stock (mahogany, teak, etc...) are not allowable. Soft species used for face veneers, tops, kick plates, bases or any other high impact or abrasion related uses are not allowable.

### 06420 CUSTOM CASEWORK

Case or millwork that will be specified as receiving a painted finish should be limited to lower cost species (birch, poplar, etc...).

All cabinet and millwork tops, sides, dividers, shelving, etc., shall be ¾” minimum stock. Stained veneer materials shall conform to AWI custom grade, minimum thickness 1/16”.

Unexposed framing shall be nominal 1 x 2 hardwood, AWI custom grade.

Doors and drawer fronts shall be ¾” minimum core stock.

Drawer boxes shall be ½” minimum with minimum ¼” plywood bottoms.

Cabinet tops should be of sufficient height to comply with minimum disabled accessibility requirements.

Most shelving should be designed as fully adjustable, ¾” minimum thickness.

“Line bore and pin” method of shelving adjustment (either in cabinets or standing shelving) is desired. Shelf standards mortised in with brackets is also acceptable.

All millwork and accessory hardware shall comply with ANSI A156.9, minimum quality level Type 2 (institutional). Hinges, guides, slides, etc., shall utilize bearings complying with BHMA 201.

All cabinet hinges should be self-closing. YC standard Amerock spring loaded or approved equal.

Drawer slides should allow full extension (1” longer than total drawer depth) and be specified as heavy duty (100 lb. minimum), Blum or approved alternate.

The use of painted particleboard as the finish for cabinets and tops is not acceptable. Particleboard is allowable as core stock in low/no moisture areas when receiving a high-pressure plastic laminate finish. Particleboard is not an acceptable material for shelving with greater than a 2 foot unsupported span.

The use of melamine or other similar low mill finishes (less than .020”) as interior cabinet lining or underside of shelving is not acceptable. Melamine thermo fused ¾” is acceptable for interior finish of cabinets only.

All exposed cabinet hardware should be specified with a permanent, durable finish that is easily cleanable.

All countertops designed as work surfaces shall be of an appropriate height to accommodate the physically disabled.

All millwork designed to support electrical equipment (computers, phones, clocks, etc...) shall have grommet openings allowing cords, interconnect cables, etc., to be concealed or routed internally. Grommets shall be 2-1/2” minimum diameter plastic, color to match adjacent finish.

## DIVISION 7: THERMAL & MOISTURE PROTECTION

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### 07100 WATERPROOFING

**General:**

This section applies to sheet waterproofing of building components that receive or are in and around areas to receive such treatment. Proper architectural design and detailing of areas exposed to moisture should not rely solely on such treatments as the only barrier to moisture, but rather as a “guarantee” or “second line of defense”, in other words, the design and specification of appropriate materials should in itself greatly mitigate a majority of moisture infiltration problems.

Inspection of waterproofing is required prior to covering over the membrane. A/E to specify proper notification time.

**Design Standard:**

The A/E should attempt to specify primary waterproofing materials of each type from a single manufacturer. Cross-reference with requirements of Division 2, exterior grades shall be specified to slope away from buildings. The A/E should review foreseeable methods and procedures relating to waterproofing materials early on (design development) with a considered manufacture of the product(s) for insights and suggestions that could alter the approach in mind.

The A/E should select a manufacturer(s) capable of providing a 5-year warranty on the material(s) being specified. The A/E should specify that before membranes on horizontal surfaces are covered by protection course(s) or other work, test for leaks with a 2” depth of water maintained for 48 hours be conducted by the Contractor or Subcontractor.

### 07200 INSULATION

**General:**

This section applies to all constructed building vertical and horizontal surfaces that are thermal barriers to the environment and also inclusive of demising partitioning acting as acoustical barriers. YC’s goals for all new and renovation projects is a substantial reduction in energy usage, both campus-wide and building-specific. All effort should be focused to mitigate thermal and acoustical factors through proper architectural design, detailing, orientation and adjacencies, and utilize applied insulating materials as a further enhancement to the composite performance of the design rather than the sole means of obtaining the desired performance. **Design Standard:** Roofing systems in conjunction with proposed insulation or other exposed horizontal surfaces shall attain a minimum composite R-value of 38.

Walls or other exposed vertical surfaces shall attain a minimum composite R-value of 20.

A/E to specify by type and manufacturer, stating performance characteristics of density, aged average R-value per inch, flame spread and fire rating.

Generally (unless noted otherwise), all corridor, restroom, classroom, laboratory, conference, meeting, lobby and office walls and ceilings shall be fully sound attenuated.

Where blanket type insulation or sound attenuation material is being utilized in open plenum areas, it should be specified as being “kraft” or foil faced and backed (depending on installation).

### 07500 MEMBRANE ROOFING

**General:**

This section applies specifically to membrane roofs, but also pertains to other methods of roofing or those areas effectively acting as “roofs” (decks, overhangs, balconies, etc...). To aid in attaining both the written specification and warranties called for by YC, the A/E should design and detail appropriate roof slopes, drainage system(s), cants, flashing, protection devices or materials and utilize good common sense. Roofing techniques, systems and materials should be utilized that are “time proven” (+5 years) and be designed as “composite” systems instead of appliques. Roofing shall be done only by a roofer who is approved by the manufacturer whose materials are used.

**Design Standard:**

Specify primary products, including roofing sheets, as produced and supplied from a single manufacturer, which has produced that product successfully for not less than 5 years.

Specify that a single installer shall perform the work, and have not less than 5 years of successful experience in the installation of built-up systems (or others if a different system is designed).

The A/E should review the proposed roofing system early on (design development) with a considered manufacturer or installer of the system(s) for insights and suggestions that could alter the approach in mind.

YC requires a 20-year limited service warranty on all membrane roofing systems along with a 10-year full value warranty. Only manufacturers that can comply with this warranty should be specified.

Roofing systems should be designed and/or specified that will allow occasional foot traffic by maintenance personnel. In areas where there is more frequent foot traffic, additional built-up walk or elevated pads should be designed and demarcated (TRAFBLOC material).

Exterior insulation systems on top of membrane or built-up layers should be avoided due to the extreme difficulty in tracing and repairing roof leaks.

### 07510 BUILT-UP BITUMINOUS ROOFING

In general, built-up roofing systems with asphalt bitumen, glass-fiber plies should be laid-up as follows: Base sheets on concrete should be heavyweight venting, consisting of asphalt-coated fiberglass and spaced large mineral aggregate on bottom to allow vapor transmission. For base sheets on rigid insulation, a single ply of asphalt-impregnated glass-fiber mat, complying with ASTM D2178, Type IV;

4 plies of asphalt-impregnated glass-fiber mats, complying with ASTM D2178, Type IV;

White elastometric or approved by FMD;

Fibrated asphalt/clay emulsion coating, complying with ASTM D1227, Type I, inorganic;

Fibrated reflective coating with asphalt cut back base, inorganic reinforcement and leafing type, complying with ASTM D2824, Type II;

Plastic or fiberglass roof drains and/or guards are not acceptable. Non-ferrous metal(s) shall be specified.

### 07800 SKYLIGHTS

All skylights shall be insulated glass and warranted against leakage for 10 years.

## DIVISION 8: DOORS & WINDOWS

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### 08000 GENERAL INFORMATION

Doors and door hardware are to be installed only by qualified persons and all work must meet appropriate codes. No exceptions will be made to the hardware listed below for use in any College construction without prior testing, evaluation and approval by the FMD.

All doors, hardware, openers, etc., shall be specified as institutional grade throughout.

Final acceptance of any hardware installations shall be subject to approval by the FMD.

All hardware submittals shall be routed through the CPM for review and approval prior to purchase.

### 08100 METAL DOORS AND FRAMES

This section applies to both interior and exterior applications. In general, hollow metal doors should be designed and specified for areas of heavy use and potential abuse. Commercial heavy-duty hollow metal frames should be utilized regardless of whether the door be hollow metal, glass or wood. Aluminum Store Front style doors may be permitted in certain applications with approval of the FMD.

#### 08110 STEEL DOORS AND FRAMES

##### **General:**

Doors and frames shall be specified as commercial heavy-duty quality. Minimum door thickness shall be 1-3/4" thick. Interior doors shall comply with SD1-100, Grade II, and heavy-duty, minimum 16-gauge faces. Exterior doors shall comply with SD1-100, Grade III, and extra heavy-duty, minimum 16-gauge faces.

All exterior doors shall have thresholds, closures, weather-stripping and padded stops.

##### **Door Frames:**

All frames shall be specified as welded. Knockdowns are not acceptable. An inspection of anchoring method must be made prior to drywall or closing up of walls.

Frames shall have wall anchors a maximum of 16" o.c. per jamb. All doorframes will be steel. Exterior doorframes will be 14-gauge and protected from rust; internal frames may be no lighter than 14-gauge steel.

Doorframes shall be factory pre-assembled with mitered, fully welded joints ground smooth and delivered to the job site with spreaders. If knockdown and two-piece frames are unavoidable, specification must require quality standards for securing and finishing these frames. Shop priming is required.

All frames shall be delivered prior to masonry construction. All frames in masonry walls shall be grouted full with Portland cement grout. Gypsum grout is not permitted.

Specify seamless end channel closure pieces at door heads.

##### **Doors:**

All external doors will be 16-gauge steel with vertical steel rib stiffeners and reinforced for all door hardware.

Internal doors shall be 16-gauge, or may be solid core wood.

Where doors are to be used as part of an acoustical barrier assembly, they shall be rated a minimum of STC 33.

Doors used as a normal means of ingress and egress shall have either vision panels or adjacent sidelights (where allowable by fire ratings).

Doors shall have a minimum of 3 heavy-duty industrial type hinges per door.

Doors and frames shall have a spray applied finish.

A/E shall specify doorstops on all installations, closures if doors open into a rated space.

### 08200 WOOD AND PLASTIC DOORS & FRAMES

##### **General:**

This section applies to interior applications. Endangered or limited tree species are not allowable for wood door veneers. Doors receiving painted finishes should be limited to low cost species (birch, maple, etc...). Welded hollow metal frames should be utilized.

Wooden doors are acceptable only for interior usage, must be solid core, and have adhesives that are 100% waterproof. Hollow core doors shall not be re-used.

All doors shall be solid core flush with veneer faces, commercial heavy-duty minimum grade, and 1-3/4" thick. Minimum width to be 3'0". Maximum height to be 7'0". 3'0" x 7'0" doors are the standard. Exceptions must be approved by the President's Management Team.

**All doors should be specified from a single manufacturer.**

Specify formaldehyde off-gassing rates to be less than .03 milligrams per square foot of surface/hr in accordance with ASTM D5116-90.

Doors shall carry a life of installation warranty from the manufacturer. All doors that are warped, after installation, shall be replaced prior to substantial completion.

Where doors are to be used as part of an acoustical barrier assembly, they shall be rated a minimum of STC 33.

Doors receiving a stained finish shall be specified as having premium quality face veneers, minimum thickness 1/16".

Doors used as a normal means of ingress and egress shall have either vision panels or adjacent sidelights (where allowable by code) in metal frames.

Doors shall have a minimum of 3 heavy-duty type hinges per door.

Doors and frames shall have a spray applied finish where specified.

## 08410 ALUMINUM ENTRANCES AND STOREFRONTS

All exterior glass shall be insulating glass, except vestibule doors and windows.

Thermally Broken Construction: Provide systems that isolate aluminum exposed to exterior from aluminum exposed to interior with a material of low thermal conductance. No slotted systems will be acceptable

Glass manufacturer shall provide a written warranty that shall guarantee insulating glass units for a period of 10 years.

Aluminum entrance section hardware shall meet all requirements in Section 08700. Weather-stripping for exterior doors shall be continuous at head, jambs and door bottoms.

## 08420 STEEL ENTRANCES AND STOREFRONTS

Steel entrances and storefronts shall pass water leak testing prior to substantial completion and prior to payment for materials and labor. Test area shall include perimeter caulk joint. All retesting and associated costs shall be paid for by the Contractor, via deduct change order.

Glass manufacturer shall provide a written warranty that shall guarantee insulating glass for a period of 10 years.

Steel entrance section hardware shall meet all requirements in Section 08700. Weather-stripping for exterior doors shall be continuous at head, jambs and door bottoms.

## 08460 AUTOMATIC ENTRANCE DOORS

Automatic entrance doors must be approved by the CPM during design.

Entrance doors shall pass water leak testing prior to substantial completion and prior to payment for materials and labor. Test area shall include perimeter caulk joint. All retesting and associated costs shall be paid for by the Contractor, via deduct change order.

Glass manufacturer shall provide a written warranty that shall guarantee insulating glass units for a period of 10 years.

Hardware shall meet all requirements in Section 08700. Weather-stripping for exterior doors shall be continuous at head, jambs and door bottoms.

## 08500 METAL WINDOWS

Glass manufacturer shall provide a written warranty that shall guarantee insulating glass units for a period of 10 years.

All windows shall pass water leak testing prior to substantial completion and prior to payment for materials and labor. Test area shall include perimeter caulk joint. All failed windows shall be retested until they pass. All retesting and associated costs shall be paid for by the Contractor, via deduct change order.

## 08600 WOOD AND PLASTIC WINDOWS

Vinyl-clad wooden windows are the preferred specified product. All exterior glass shall be insulating glass. Glass manufacturer shall provide a written warranty that shall guarantee insulating glass for a period of 10 years. All windows shall pass water leak testing prior to substantial completion and prior to payment for materials and labor. Test area shall include perimeter caulk joint. All failed windows shall be retested until they pass. All retesting and associated costs shall be paid for by the Contractor, via deduct change order.

## 08700 HARDWARE

### General:

There is a YC standard for cylindrical locksets with lever handles. Best 9K series is proprietary. All new construction shall require lever handles. 626 finish and full escutcheon plates are preferred. Lever designs shall be 15D or style to match existing locksets and must comply with all appropriate codes.

Hardware schedule shall be submitted to the architect and FMD for approval prior to ordering.

### Cylindrical Locksets:

Cylindrical locksets, Best 9K series are required for new construction and may be used in renovation projects. Rose design and finish should match the building's existing hardware. Heavy-duty line shall be specified. Mortise

### Locksets:

Mortise locksets may be specified when justified or to match surrounding installations.

Approved model is Best 45H series or to match existing locksets.

### Electronic Locks:

YC requires at least one high traffic door per building to have card access capabilities. Exact location of card access door to be reviewed by FMD. Card access door shall have, at a minimum, the following installed by the contractor: Electric Strike Plates.

- ASSA ABLOY: HES 5200C, HES 8000C, HES 9600
- 110 volt power and data connection at controller installation location.
- 1/2" conduit from control box location to a flush mount box for the card reader on exterior side of door.
- 1/2" conduit from control box location to the electric strike.

If the design requires owner provide and installation of the equipment it is critical that the placement of the conduit for the electric strike hardware be accurate.

We prefer that the operators and installation be part of the project.

### YC access control hardware/cabling:

- **Mercury Security Controls:** LP Intelligent, MR-SIO-S3
- **Access Control Management Software:** Avigilon ACM
- **Allegion/Schlage Multi-tech OSDP Readers:** MT15-485 (single gang), MT11-485 (mini-mullion)
- **Access Control cabling:** *Indoor:* Plenum Cat 6, *Outdoor:* shielded Cat 6, *Panel/Door:* Windy City Smartwire

All electronic systems will be in compliance with ADA requirements and presented for review and approval prior to proposal acceptance.

**Exit Devices:**

All exit devices will be VonDuprin 33, 99, 33-OEL, 99-OEL. Finish to match other building door hardware.

**Door Closers:**

All door closers will have extra heavy-duty arms and be mounted with thru bolts.

Approved model: LCN 4040XP, EDA, TB Auto

Operator: LCN Electric Auto Equalizer Door

**Hold Open Devices:**

All hold open devices on self-closing doors will release the doors automatically upon the detection of smoke or heat, max 165o.

**Cylinders and Cores:**

All new construction will match the YC Best keying system. The FMD will specify which system and the keyway to be used. Only original Best cylinders and interchangeable cores shall be used.

**Hinges:**

All doors will be mounted with three 4-1/2" x 4-1/2" full mortise hinges. Doors larger than 3' x 7' will be mounted with four hinges that are the same size as above.

**Approved Models:**

- Hager BB1168
- McKinney TA2714
- Stanley FBB168
- Roton continuous hinge or equal continuous hinge for high traffic exterior doors

## 08710 FINISH HARDWARE

### GENERAL

**SUMMARY:**

- A. Section Includes: Finish hardware except as otherwise specified or specifically omitted herein.
- B. Related Sections:
  1. Section 06200 - Finish Carpentry: Installation of finish hardware.
  2. Section 08100 - Standard Steel Doors and Frames.
  3. Section 08210 - Wood Doors.
- C. Specific Omissions: Hardware for the following is specified or indicated elsewhere.
  1. Windows
  2. Cabinets of all kinds, including open wall shelving and locks.
  3. Signs, except as noted.
  4. Toilet accessories of all kinds including grab bars.
  5. Installation.
  6. Rough hardware.
  7. Folding partitions, except cylinders where detailed.
  8. Sliding aluminum doors.
  9. Angle sill threshold.
  10. Corner guards.

**SUBSTITUTIONS & SUBMITTALS:**

- A. Requests for substitutions must be made in writing 10 days prior to bid date to allow architect to issue an addendum. If proposing a substitute, submit that product data attached to one showing specified item and indicate savings to be made. No other substitutions will be allowed.
  1. Items listed with no substitute manufactures have been requested by Owner to match existing.
- B. SUBMITTALS: Submit six copies of schedule at earliest possible date prior to delivery of hardware. Organize schedule into "Hardware Sets" with an index of doors and heading,

indicating complete designations of every item required for each door or opening. Include the following information:

2. Type, style, function, size, quantity and finish of each hardware item.
  3. Name, part number and manufacturer of each item.
  4. Fastenings and other pertinent information.
  5. Location of hardware set cross-referenced to indications on drawings both on floor plans and in door schedule.
  6. Explanation of all abbreviations, symbols, and codes contained in schedule.
  7. Mounting locations for hardware.
  8. Door and frame sizes and materials.
  9. Submit manufacturer's technical data and installation instructions for the electronic hardware.
  10. Catalog cuts.
- C. Templates: Where required, furnish hardware templates to each fabricator of doors, frames and other work to be factory-prepared for the installation of hardware.

### **QUALITY ASSURANCE:**

- A. Qualifications:
1. Obtain each kind of hardware (latch and locksets, exit devices, hinges, and closers) from only one manufacturer, although several may be indicated as offering products complying with requirements.
  2. Hardware supplier shall be a direct factory contract supplier who has in his employment a certified architectural hardware consultant (AHC) who is available at all reasonable times during the course of the Work, and for project hardware consultation to the Owner, Architect, and Contractor.
- B. Schedule Designations: Except as otherwise indicated, the use of one manufacturer's numeric designation system in schedules does not imply that another manufacturer's products will not be acceptable, unless they are not equal in design, size, weight, finish function, or other quality of significance. See 1.02 A for substitutions.
- C. Exit Doors: Openable at all times from the inside without the use of a key or any special knowledge or effort.
- D. Fire-rated openings: Provide hardware for fire-rated openings in compliance with NFPA Standard No. 80. This requirement takes precedence over other requirements for such hardware. Provide only such hardware that has been tested and listed by UL for the type and size of door required, and complies with the requirements of the door and the door frame labels. Latching hardware, door closers, ball bearing hinges, and seals are required whether or not listed in the Hardware schedule.
1. Where panic exit devices are required on fire-rated doors, provide supplementary marking on door UL label on exit device indicating "Fire Exit Hardware."

### **DELIVERY, STORAGE, AND HANDLING:**

- A. Acceptance at the Site: Individually package each unit of finish hardware complete with proper fastening and appurtenances, clearly marked on the outside to indicate contents and specific locations in the Work.
- B. Deliver packaged hardware items at the times and to the locations (shop or field) for installation, as directed by the Contractor.

### **PROJECT CONDITIONS:**

- A. Coordination: Coordinate hardware with other work. Furnish hardware items of proper design for use on doors and frames of the thickness, profile, swing security and similar requirements indicated, as necessary for the proper installation and function, regardless of omissions or conflicts in the information on the Contract Documents.
- B. Upon request, check the Shop Drawings for doors and entrances to confirm that adequate provisions will be made for the proper installation of hardware.

### **WARRANTY:**

- A. Provide guarantee from hardware supplier as follows:

1. Closers: Ten years: except electronic closers: Two years.
2. Exit Devices & Locksets: Three years
3. All other Hardware: Two years.

## PRODUCTS

### MANUFACTURERS:

- A. Approval of manufacturers other than those listed shall be in accordance with paragraph 1.02 A.

Item:	Manufacturer:	Approved:	Approved
Hinges	Hager	McKinney	Stanley
Locks	Best	None	
Cylinders	Best	None	
Handles	Best	None	
Exit Devices	Von Duprin	None	
Closers	LCN 4040XP	None	
Auto Operator	LCN Elec. Auto Eq.	None	
Flush Bolts	Trimco	Hager	Rockwood
Pulls	Trimco	Hager	Rockwood
Silencers	Trimco	Hager	Rockwood
Kickplates	Trimco	Hager	Rockwood
Stops	Trimco	Hager	Rockwood
Thresholds	Pemko	Reese	National Guard
Seals/Sweeps	Pemko	Reese	National Guard

- B. Furnish all items of hardware required to complete the work in accordance with specifications and plans.
- C. Carefully inspect Project for the extent of the finish hardware required to complete the Work. Where there is a conflict between these Specification and the existing hardware furnish finish hardware to specification.

### MATERIALS:

**Locksets:** All locksets and latchsets shall be extra-heavy-duty lever cylindrical with Best 7-pin interchangeable core. Lockset and Cores to be of the same manufacturer to maintain complete lockset warranty. Locks to have solid shank with no opening for access to keyed lever keeper. Keyed Lever to be protected by means of a break-away mechanism to prevent forced entry, when excessive torque is applied, a replaceable part will shear. Lock chassis must be through-bolted (outside of the lock chassis prep) to prevent rotation of chassis after installation. Lock manufacturer shall provide a three-year warranty, in writing, to the Owner, along with three copies of the lock service manual. Strikes shall be 16 gauge curved brass, bronze or stainless steel with a 1" deep box construction, and have sufficient length to clear trim and protect clothing.

- Grade 1 Cylindrical Locks shall have minimum 9/16 throw. All deadbolts shall have 1-inch minimum throw.
- Comply with requirements of local security ordinances.
- Lock Series and Design: Best 9K 15D Trim.
- Cylinders: Best 7-Pin

**Hinges:** Outswinging exterior doors shall have continuous geared hinges. All hinge open widths shall be minimum, but of sufficient size to permit door to swing 180. Furnish hinges with five knuckles and flush bearing.

- Furnish 3 hinges per leaf to 7 foot 6 inch height. Add one for each additional 30 inches in height or fraction thereof.
- Provide hinges as listed in schedule.

**Exit Devices:** Furnish all sets at wood doors with sex bolts unless otherwise specified. Lever handle trim shall match locksets. All touch bar type devices shall have deadlocking latchbolt, stainless steel touchpads or vinyl covered pads and be non-handed. The unlatching force shall not exceed 15 pounds when applied in the direction of exit travel.

**Surface Door Closers:** Full rack and pinion type with removable non-ferrous cover. Provide sex bolts at all wood doors. Place closers inside building, stairs, and rooms. Closers shall be non-handed, non-sized and adjustable.

- Provide multi-size 1 through 6 at all doors rated or not.
- Flush transom offset brackets shall be used where parallel arm closers are listed for doors with fixed panels over.
- Drop brackets are required at narrow head rails.
- Set exterior doors closers to have 8.5 lbs maximum pressure to open, interior non-rated at 5 lbs, rated openings at 12 lbs.

**Kickplates:** Provide with four beveled edges, 10 inches high by width less 2 inches on single doors and 1 inch on pairs of doors. Furnish screws to match finish.

**Seals:** All seals shall be finished to match adjacent frame color. Seals shall be furnished as listed in schedule. Material shall be UL listed for labeled openings. G. Screws: All exposed screws shall be Phillips head.

**Silencers:** Furnish silencers on all interior frames, 3 for single doors, 2 for pairs. Omit where any type of seals occur.

**FINISH:**

- A. As Specified
- B. Spray door closers to match other hardware, unless otherwise noted.
- C. Aluminum items shall be finished to match predominant adjacent material. Seals to coordinate with frame color.

**KEYING REQUIREMENTS:**

- Provide brass construction cores and keys during the construction period. Construction control and operating keys and core shall not be part of the Owner's permanent keying system or furnished on the same keyway (or key section) as the Owner's permanent keying system. Permanent cores and keys (prepared according to the accepted keying schedule) will be furnished to the Owner (by the local Best factory representative) prior to occupancy.
- All cylinders shall be Best 7-pin, interchangeable core.
- Permanent keys and cores shall be stamped with the applicable key mark for identification. These visual key control marks or codes will not include the actual key cuts. Permanent keys will also be stamped "Do Not Duplicate."
- Grand Masterkeys, Masterkeys and other Security keys shall be transmitted to the Owner by Registered Mail, return receipt requested.

**Furnish keys in the following quantities:**

- a) 1 each Grand Masterkeys
  - b) 4 each Masterkeys
  - c) 2 each Change keys each keyed core
  - d) 9 each Construction masterkeys
  - e) 1 each Control keys
- The Owner, or the Owner's agent, will install permanent cores and return the construction cores to the Best Access Systems Factory Representative. All Construction cores and keys remain the property of the Hardware Supplier..

**Keying schedule:** Submit three copies of separate detailed schedule indicating clearly how the Owner's final instructions on keying of locks has been fulfilled.

## EXECUTION

### HARDWARE LOCATIONS:

#### Hinges:

- Bottom Hinge: 10 inches from door bottom to bottom of hinge.
- Top Hinge: 5 inches from door top to top of hinge.
- Center Hinge: Center between top and bottom hinge.
- Extra Hinge: 6 inches from bottom of top hinge to top of extra hinge.
- Lock: 38 inches from finished floor to center of lever or knob.
- Push Bar: 44 inches from bottom of door to center of bar.
- Push Plate: 44 inches from bottom of door to center of plate.
- Pull Plate: 42 inches from bottom of door to center of pull.
- Exit Device: 39-13/16 inches from finished floor to center of pad.
- Deadlock Strike: 44 inches from floor, centered.

### INSTALLATION:

Install each hardware item per manufacturer's instructions and recommendations. Do not install surface mounted items until finishes have been completed on the substrate. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation. Installation shall conform to local governing agency security ordinance.

### ADJUSTING:

Adjust and check each operating item of hardware and each door to ensure proper operation or function of every unit. Replace units which cannot be adjusted to operate freely and smoothly.

Inspection: Hardware supplier shall inspect all hardware furnished within 10 days of contractor's request and include with his guarantee a statement that this has been accomplished. Inspector or Contractor shall sign off the hardware as being complete and correctly installed and adjusted. Further corrections of defective material shall be the responsibility of his representative.

### SCHEDULE OF FINISH HARDWARE:

Legend of listed manufacturers:

HA =	Hager
BE =	Best
VD =	Von Duprin
LC =	LCN
AB =	ABH
TM =	Trimco
PE =	Pemko
DJ =	Don Jo

The items listed in the following "Schedule of Finish Hardware" shall conform throughout to the requirements of the foregoing specification. The last column of letters in the Hardware Schedule refers to the manufacturer abbreviation listed above.

The Door Schedule on the Drawings indicates which Hardware Set is used with door.

## 08720 OPERATORS

Automatic Door Operators to allow for handicapped entrance shall be specified for at least one leaf of all building entrances.

## 08730 WEATHER-STRIPPING AND SEALS

Thresholds shall meet ADA requirements. None shall be specified for interior doors. Preferred brand is Pemko. Thresholds shall be aluminum and rated for heavy-duty traffic.

## 08800 GLAZING

Dual pane 1" insulated glass at a minimum shall be specified on all exterior windows. Side lights and/or door lights to be tempered float glass.

All glass within contact by pedestrian traffic to be tempered.

Individual windows or window assemblies shall be designed to easily accommodate washing of the exterior surface. Exterior ledges of window openings shall be designed to allow proper drainage away from the window assembly, ½" per foot minimum.

All window assemblies shall be fully weather-stripped and gasketed.

All glass types shall be a local stock item to eliminate replacement delays.

## 08900 CURTAIN WALLS/STOREFRONTS

### **General:**

This section applies to exterior glazed curtain wall systems and storefronts (also used as fixed window systems).

### **Design Standard:**

The A/E shall specify that a fabricator/erector shall have a minimum of 5 years' experience of similar size and scope in the fabrication and erection of systems specified in the project.

Curtain wall systems shall utilize 1", dual pane insulated glass, fully tempered.

Steel or hollow metal type system shall be specified. Aluminum alloy extrusions are not acceptable in areas that support or are directly adjacent to door openings.

"Kynar 500" or equal shall be specified for painted finishes, spray applied.

Water penetration shall not occur at a test pressure of 7.00 psf when tested in accordance to ASTM E331. Entrances and storefronts shall pass water leak testing prior to substantial completion and prior to payment for materials and labor. Test area shall include perimeter caulk joint. All failed windows shall be retested until they pass. All retesting and associated costs shall be paid for by the Contractor, via deduct change order.

Glass manufacturer shall provide a written warranty that shall guarantee insulating glass units for a period of 10 years.

Maximum air infiltration shall not exceed 0.05 cfm per gross square foot of exterior area, when tested in accordance with ASTM E283, section 4.3.

Where doors are utilized in curtain wall assemblies, at least one section of an exterior door assembly (main ingress and egress) shall have an electric automatic door opener, button-activated at the swing side, interior and exterior.

In areas where the interior clear height of curtain walls exceed 30' (possibly an atrium) an interior system(s) must be designed to facilitate window washing without the use of erected scaffolding or movable lifts. On buildings that exceed 3 stories or 40' from finish grade, an exterior window washing system shall be designed.

## DIVISION 9: FINISHES

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### 09250 GYPSUM BOARD ASSEMBLIES

5/8" Type X gypsum board is preferred. In renovation projects, texture and finishes shall be specified to match existing.

### 09300 TILE

**General:**

Ceramic tile products should be specified that can endure high impact, low water absorption rates and have low dimensional and color variations per order.

Minimum floor tile dimensions shall be 6" x 6" and maximum floor tile dimensions shall be 8" x 8" without prior approval, matte finish (abrasive finish if exterior or lobby applied), and comply with the following requirements:

Through color, 3/8" minimum thickness;

Cove tile bases shall be used in all restroom applications;

Tile inserts or accents in a predominantly matte or abrasive finish field may be polished or glazed; Grout joints should not exceed 1/8". On flooring, a dark grout shall be specified.

Minimum wall tile dimensions shall be 4" x 4" x 5/16" (unless a mosaic design is anticipated, in which case the minimum dimensions will be 2" x 2"), and comply with the following requirements:

Restrooms to be glazes, flat tile, thickset on wet wall(s), thin-set other. Tile shall be full height on the wet wall(s); Grout joints should not exceed 1/16";

Interior or exterior walls other than restrooms (glazed only) may be glazed or matte finish.

A color of tile and grout should be chosen that is easily maintainable and repairable.

Epoxy mortars and grouts shall be used in all exterior applications, wet locations, areas subject to heavy traffic and areas that may come into contact with solvents, chemicals or continuous immersion in water.

Tile color and patterning should be clearly indicated by a sample and a colored sketch or plan and elevation at the final schematic design presentation.

Tile used on step treads shall have an abrasive finish or receive a rough finish imbed a minimum of 2" wide at the stair nosing, running the length of the tread.

**Extra Product:**

A/E shall specify an appropriate amount of product extra stock (minimum 10%) of each color and style of tile to be turned over to owner for future repairs prior to job closeout.

### 09400 TERRAZZO

**General:**

Terrazzo is an extremely durable product, and is recommended for design consideration in corridors, lobbies and restrooms in heavily used facilities, budget permitting.

The A/E should specify that installers be limited to companies specializing in full bed terrazzo applications with documented experience and a member of the National Terrazzo and Mosaic Association and have a minimum of 5 years relative experience in size and scope similar to the project.

Total terrazzo minimum thickness not less than 3/4".

Reinforcing mesh, minimum 2" x 2" x 16-gauge, galvanized should be specified.

Aluminum oxide non-slip aggregate to match surface aggregate should be specified.

Control and divider strips shall be 1/4" width, zinc topped, recommended maximum placement not exceeding 8' x 8'. An aggregate and matrix color should be chosen that is easily maintainable. 1/4" sand cushion is recommended over the structural floor substrate.

Terrazzo used on step treads shall be grooved or have a rough finish imbed with a minimum of 2" wide at the stair nosing, running the length of the tread.

## 09510 ACOUSTICAL CEILINGS

### **General:**

Careful design consideration should be given in the location of all lighting fixtures, diffusers, or any other ceiling projection.

Minimum NRC factor of 0.90 to 1.00, minimum STC rating of 25 to 29, minimum reflectance 75%.

Specification should call for a 2% extra stock material, over actual area used, of each color, size and style.

Suspension grid to be exposed, medium or heavy-duty type.

Lighting, diffusers and sprinklers should be designed to occur in the system at regular or predetermined intervals.

Fire Sprinkler heads shall be located in the center of a tile. Require sub trades to locate ceiling penetrations in locations that are the center of a panel.

Where walls run to the underside of the system, design and specify an acoustical seal at junction.

Surface texture(s) should be chosen that offer low maintenance, can be cleaned periodically and are readily available. Pattern should be in-stock, non-special order.

## 09650 RESILIENT FLOORING & ACCESSORIES

Polished Concrete is our preferred choice. Linoleum sheet goods and VCT are not acceptable. Exception to this is that sheet goods may be specified for areas in temporary or modular buildings requiring them per health department regulations.

A minimum of 2%, or one box of product as extra for maintenance purposes is required. Product extra requirements apply to each type/color or product if more than one is specified.

When a composition base material is utilized, it is to be a rubber base rather than vinyl. It is preferred that the A/E specify that all outside corners shall be pre-formed. Base shall be 4" toeless base, dark in color (to hide impact marks), and matte finish. Exposed or junction edges of the tile shall receive vinyl or aluminum reducer strips.

## 09685 SHEET CARPET

Direct Pressure sensitive glue down carpet is acceptable. Quality and style of carpet is to be selected to meet the service requirements of the area. Minimum requirements: Commercial glue down carpet tiles are preferred.

### **Performance Requirements:**

No edge ravel, at edge or seams under normal use for the life of carpet.

### **Protection:**

It must be the Contractor's responsibility to protect all furniture, walls, doors, etc., from any damages during installation of carpet and base, and removing existing carpet and base where applicable. Any items moved shall be replaced in original position. The Contractor will be responsible for all damages.

### **Job Conditions:**

Installer must examine the substrate and conditions under which the carpeting is to be installed, and notify the Contractor, in writing, of conditions detrimental to the proper and timely completion of the work. The manufacturer must guarantee the following:

### **Wear:**

Warrant that the carpet will lose no more than 10% by weight of pile face fiber during the life of the carpet when installed and maintained in accordance with manufacturer's procedures.

### **Static Protection:**

Warrant that the carpet will give protection from static discharge in excess of 3.0 KV when tested under the standard Shuffle Test Method (at 70o and 20% R.H.) during the life of the carpet.

### **Backing De-lamination:**

Warrant that the secondary backing of the carpet will not de-laminate during the life of the carpet.

**Edge Ravel:**

- Warrant that under normal use, the carpet will not ravel at the seams or at the edge during the life of the carpet.
- Seam sealers or seam welds should not be required for warranties.
- A color and pattern should be specified that is easily maintainable.
- Specify that a seaming diagram be submitted prior to carpet purchase for review by FMD & A/E.
- Specification should call for 10% additional material over actual area used for back-up repairs.
- Specify that all firms that will bid this section have a minimum of not less than 5 years of carpeting installation experience, similar to the size and scope contained in the project.
- Specify that a special project warranty from the installer of a minimum of a 2-year full warranty to fix, repair or replace carpeting failure as the result of defective workmanship.
- 4" x 1/8" coved rubber bases, dark in color to hide impact marks, matte finish. Carpet base is acceptable if appropriate for the project.

**00690 CARPET TILE**

Carpet tile is acceptable in some applications; minimum requirements are same as sheet carpet above. Factory applied carpet tile is required for removable computer raised floor systems. Carpet tile to be the same size as the removable floor panel. Contractor to provide the claw and/or tool to remove the floor panel and carpet tile as one unit.

**09900 PAINTING****General:**

Painting products shall be specified from one manufacturer: Sherwin Williams. Alternative manufacturers may be submitted for approval. Written approval shall be obtained from the FMD prior to specifying alternative manufacturers.

**Delivery & Storage:**

Deliver materials to job site in original, new and unopened packages and containers bearing manufacturer's name, paint identification, formula number, batch number, etc., with labels intact.

**Job Conditions:**

Coatings shall be applied in accordance with the manufacturer's printed directions for the paint used. Special attention will be given to applying a coating when temperature, humidity and other weather factors are acceptable by the manufacturer and/or Owner.

Paint shall not be applied until preceding coat has dried. The Owner reserves the right to take samples of materials for chemical analysis; to gauge wet or dry film thickness; or to utilize any other standard inspection procedures necessary to ensure quality and compliance with requirements of the Contract Documents.

A/E shall specify ventilation and isolation requirements to avoid complaints regarding noxious fumes.

**Materials:**

All paint materials shall be specified to be of manufacturer's premium grade product. Products of manufacturers not named above may be submitted for approval. Insofar as possible, all components of the paint system shall be products of the same manufacturer.

**Submittals:**

The Contractor shall submit specifications for proposed products for approval prior to application.

Close-out requirements shall include:

Product extra requirements of a minimum of one gallon, from the same batch of each color and each type of paint used on the project. Gallon cans shall be labeled with manufacturer's name, color name and formula.

A typed list, by area, of paint used, including: manufacturer, year purchased, color name, finish type (satin, semigloss, etc.) and formula.

An exception to this is projects that have multiple colors, 4" x 4" color cards may be accepted.

**Paint Systems:**

Provide the following coating systems for substrates indicated. Apply each material at the coverage rate required to produce the total composite dry film thickness (DFT) indicated. Materials containing low solids content by volume shall be applied in multiple coats as required to build specified DFT.

Primers are not required on substrates specified to be factory printed under other sections unless required as a bond coat.

**Exterior Paint System:**Galvanized Steel

1st Primer	Best Quality Exterior	1.5
2nd Coat	Best Latex Exterior SG or Flat	1.5
3rd Coat	Best Latex Exterior SG or Flat	<u>1.5</u>
	Total Mil Thickness	4.5

Ferrous Metal

1st Primer	Best Exterior Primer for System	1.5
2nd Coat	Best Exterior Primer for System	1.5
3rd Coat	100% Solids Urethane Semi Gloss	<u>4.0</u>
	Total Mil Thickness	7.0

Exterior Stucco

1st Coat	Best Exterior Latex Primer	2.0
2nd Coat	Best Exterior Latex Flat	<u>2.0</u>
	Total Mil Thickness	4.0

Exterior Wood

1st Primer	Best Exterior Latex Primer	1.5
2nd Coat	Best Exterior Latex SG or Flat	1.5
3rd Coat	Best Exterior Latex SG or Flat	<u>1.5</u>
	Total Mil Thickness	4.5

Exterior Wood

1st Coat	Best Quality Exterior Transparent Stain*	
2nd Coat	Best Quality Exterior Transparent Stain*	

\*No film build requirement, just even coloration.

**Interior Paint System:**Concrete, Plaster or Gypsum Wallboard

1st Primer	Best Quality Latex Primer	1.5
2nd Coat	Best Quality Latex Semi Gloss	1.5
3rd Coat	Best Quality Latex Semi Gloss	<u>1.5</u>
	Total Mil Thickness	4.5

Ferrous Metal

1st Primer	Best Quality Primer	1.5
2nd Coat	Best Quality Primer	1.5
3rd Coat	Best Alkyd or Latex Finish Coat	<u>2.0</u>

	Total Mil Thickness	5.0
<u>Galvanized Metal</u>		
1st Primer	Best Quality Latex Primer	1.5
2nd Coat	Best Quality Latex Primer	1.5
3rd Coat	Best Alkyd or Latex SG or Flat	<u>1.5</u>
	Total Mil Thickness	4.5
<u>Wood</u>		
1st Primer	Best Quality Latex Primer	1.5
2nd Coat	Best Quality Latex SG or Flat	1.5
3rd Coat	Best Quality Latex SG or Flat	<u>1.5</u>
	Total Mil Thickness	4.5

Note: These paint systems are general in nature. They may not apply to special job requirements and may be changed prior to bid acceptance. Specifications will be provided in writing in the event of a change.

## **SURFACE PREPARATION**

### **General:**

Perform preparation and cleaning procedures in accordance with paint manufacturer's instructions and as herein specified, for each particular substrate condition.

Remove or protect hardware, hardware accessories, machined surfaces, plates, lighting fixtures and similar items that are not to be painted to insure that no paint is applied to these surfaces. Reinstall or remove protection upon completion of painting of the adjacent surfaces.

Clean surfaces to be painted before applying paint or surface treatments. Remove oil and grease prior to mechanical cleaning. Program cleaning and painting so that contaminants from cleaning process will not fall onto wet, newly painted surfaces.

### **Wood:**

Clean wood surfaces to be painted of dirt, oil or other foreign substances with scrapers, mineral spirits and sandpaper as required. Sandpaper smooth those finished surfaces and dust off. Scrape and clean small, dry, seasoned knots and apply a thin coat of white shellac or other recommended knot sealer, before application of priming coat. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood-filler. Sandpaper smooth when dried.

Prime, stain or seal wood required to be job-painted. Prime edges, ends, faces, undersides and backsides of such wood.

Seal tops, bottoms and cutouts of un-primed wood doors with a heavy coat of varnish or equivalent sealer. This is to be inspected by the CPM.

### **Ferrous Metals:**

Clean ferrous surfaces, which are not galvanized or shop-coated, of oil, grease, dirt, loose mill scale and other foreign substances by solvent or mechanical cleaning.

#### **Galvanized Surfaces:**

Clean free of oil and surface contaminants with non-petroleum based solvent and apply pre-wash or bond coat as indicated.

## **APPLICATION**

### **General:**

Apply paint in accordance with manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied.

Understand and honor all applicable OSHA safety and Local, State or Federal VOC requirements.

Apply additional coats when undercoats, stain or other conditions show through final coat of paint, until paint film is of uniform finish, color and appearance. Give special attention to insure that surfaces, including edges, corners, crevices, welds and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.

Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Paint surfaces behind permanently fixed equipment or furniture.

Paint interior surfaces of ducts, where visible through registers or grilles, with a flat black paint.  
Paint backsides of access panels and removable or hinged covers to match exposed surfaces.  
Finish exterior doors on tops, bottoms and side edges same as exterior faces, unless otherwise indicated. Sand lightly between each succeeding enamel or varnish coat.

**Scheduling Painting:**

Apply first-coat material to surfaces that have been cleaned, pre-treated or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.  
Allow sufficient time between successive coats to permit proper drying. Do not re-coat until paint has dried and application of another coat will not cause lifting and loss of adhesion of the undercoat.

**Minimum Coating Thickness:**

Apply materials at not less than manufacturer's recommended spreading rate, to establish a total dry film thickness as indicated or, if not indicated, as recommended by coating manufacturer.

**Prime Coats:**

Apply prime coat to material which is required to be painted or finished, and which has not been prime coated previously. Recoat primed and sealed surfaces where there is evidence of suction spots or unsealed areas in first coat, to assure a finish coat with no burn-through or other defects due to insufficient sealing.

**Stipple Enamel Finish:**

Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling, such as laps, irregularity in texture, skid marks or other surface imperfections.

**Pigmented (Opaque) Finishes:**

Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance and coverage. Cloudiness, spotting, holidays, laps; brush marks, runs, sags, ropiness or other surface imperfections will not be acceptable.  
Metal doors and hollow metal door and window frames shall be spray painted unless otherwise stated.

**Transparent and Semi-Transparent:**

Use multiple coats to produce glass-smooth surface film of even luster. Provide a finish free of laps, cloudiness, color irregularity, runs, brush marks, orange peel, nail holes or other surface imperfections. Provide satin finish for final coats, unless otherwise indicated.

**Completed Work:**

Match approved samples for color, texture and coverage. Remove, refinish or repaint work not in compliance with specified requirements.

**CLEAN-UP AND PROTECTION:****Clean-up:**

During progress of work, remove from site discarded paint materials, rubbish, cans and rags at end of each workday. Contractor will furnish his own trash receptacles and removal. Contractors will not use YC trash containers unless approval is granted.

Upon completion of painting work, clean window glass and other paint-splattered surfaces. Remove splattered paint by proper methods of washing and scraping, using care not to scratch or otherwise damage-finished surfaces.

**Protection:**

Protect work of other trades, whether to be painted or not, against damage by painting and finishing work. Correct any damage by cleaning, repairing or replacing, and repainting as acceptable to Architect.

Provide "Wet Paint" signs as required to protect newly painted finishes. Remove temporary protective wrappings provided by others for protection of their work after completion of painting operations. At the completion of work of other trades, touch-up and restore all damages to painted surfaces.

## 09950 WALL COVERINGS

Wallpaper may be specified for some installations with DPM & CPM approval. Without written approval by a member of the DPM, wall coverings other than washable vinyl wall coverings shall not be specified.

## DIVISION 10: SPECIALTIES

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### 10100 VISUAL DISPLAY BOARDS

All vertical-writing surfaces shall have a continuous tray at the base for markers and erasers. They shall also have a top 1" cork strip.

**Dry marker boards shall be:**

Porcelain boards, a face sheet of 24-gauge enameling grade steel, with a three-coat porcelainize process, a writing coat greater than or equal to 0.0025".

The core material shall be Cortron ½" thick industrial grade particleboard complying with ANSI A208.1, Grade 1M-1.

Backing sheet shall be 0.015" aluminum. Laminating adhesive shall consist of moisture resistant thermoplastic adhesive.

Color of finished face shall be white, non-glare matte type finish. Fabricated frames and trim shall be clear anodized aluminum, not less than 0.062" or as specified by the user group. Marker trays shall be aluminum, solid extrusion with a ribbed section, with smoothly curved ends.

Specify a fifteen-year warranty for marker boards. Warranty shall protect against deterioration of original writing and erasing qualities, becoming slick or shiny, crazing, cracking or flaking.

Cork tackboards shall have a single layer, ¼" thick, seamless, compressed fine grain natural cork sheet, sanded for a natural finish, complying with MS MIL-C-15116, Type II. The user group shall specify chalkboards upon request.

Glass board are allowed per FMD approval as well.

### 10160 TOILET COMPARTMENTS

Plastic laminate on particleboard is not permitted.

A minimum of one 5' x 6' toilet compartment shall be incorporated into each toilet room in order to meet ADA requirements.

**Metal Toilet Compartments:**

Ceiling hung (College preference for ease of cleaning)

Floor-supported

Metal partitions shall not be painted metal Plastic

**Laminate Toilet Compartments:**

Ceiling hung (College preference for ease of cleaning)

Floor-supported

A random pattern is preferred to solid colors (to extend time when discoloration from repetitive cleaning becomes obvious).

### 10400 IDENTIFYING DEVICES

**Plaques:**

Proofs:

The FMD approval of proofs/rubbings for plaques is required prior to final casting or etching.

Fastening:

Concealed threaded studs on back of plaque. Setting should be in grout or epoxy.

**Exterior Signs:**

All exterior signs shall conform to the specifications of the YC Signage Policy. Ask Owner for current design standards and requirements.

**Interior Signs:**

Contractor shall be made responsible for creation and initial installation of signage in new construction. Standard signs will use aluminum frames with matte finish with 'Opera Series' profile.

**Profile Production:**

The Opera Series is manufactured with aluminum profiles from Aluminum alloy 6063. The chemical makeup of the alloy 6063 and the mechanical specifications after thermal treatment have been determined by the American specification QQ-A-200/9D; and the German specification DIN 1725. The extruded profiles are inspected for their geometry, per tolerances that are internationally accepted: BS EN 755-9:2001, and BS EN 12020:2001. Strength testing is per German specification DIN 50125. The strength measurement determined meet the American specification QQ-A-200/9D or the German specification DIN-1748 and DIN 1746.

**Anodized coating:**

Electrochemical treatment creates an oxide of Sulfur on the outer surface of the profile. The process is performed in a electrically conductive solution; the process ends with a sealing. The anodize is performed per Israeli specification 325. Anodic coating on Aluminum. this specification is based on internationally accepted specifications. (A list can be provided upon request). The thickness of the anodize is determined between the customer and the manufacturer; typically 3010 microns. The absolute minimum thickness is 8 microns.

It is possible to achieve three different surface finishes:

**Matte** - Anodize coating on areas that have had no metal treatment, Etching in a bath results in a matte surface.

**Reflective** - Anodize performed after polishing with a polishing compound and a polishing machine.

**Brush** - Anodize performed on a surface that has been brushed.

Anodize coatings can be supplied in the following colors:

**Natural** - No coloring process (silver)

Light brown to black - Electrical coloring process

**Gold** - Coloring process

Testing of the anodize reliability is performed and the integrity of the anodize coating is tested to international specifications ISO 2143-1981. Stability of the color of the anodize process is tested per American STEM G-53-1988.

The degree of color stability is tested per international specification ISO 105 A02-1993. Additional colors can be achieved with polyurethane paint or powder coating process.

Warranty for the aluminum extrusions are lifetime under normal suggested use.

Standard sizes are listed. Custom sizes can be fabricated with use of multiple profiles.

Contact your Customer Service Representative.

All font to be Helvetica Uppercase.

Polycarbonate face with grade 2 integral braille.

1/32" raised tactile letters and numbers.

Minimum 5/8" letter height not to exceed 2" in height.

Clear lenses shall be polycarbonate, matte, non-glare finish were required.

Supplier to provide software and/or template for typical computer program as specified by college for easy modification of paper insert replacement.

**Colors:**

- Background Color: Pantone 5535U
- Text and logo color over background: Pantone 5875C
- Paper Insert Background Color: 'Sawgrass' 5420B, Manufacturer: Neenah
- Paper Insert Text Color: Black

- Standard Classroom: 6" x 6" with top 2" to contain raised room numbers plus Braille plus Y.C. logo. Bottom 4" Room identification in raised letters plus Braille
- Standard Office: 6"x 6" with top 2" to contain raised room numbers plus Braille plus Y.C. logo. Bottom 4" to be clear, 'crystal' acetate over laser printed cardstock.
- Pictographs: Required on restroom signage
- Interior room identification signage:
- No larger than 8" X 8"

## 10520 FIRE PROTECTION SPECIALTIES

Cabinets shall be specified as the recessed type and ADA approved. Cabinets specified shall be clear glass. All extinguisher installations must include brackets. Plastic handles, valve assemblies and siphon tubes shall be prohibited.

All building areas are classified according to the type of hazards that exist. Corresponding extinguishing units shall be specified according to the most current NFPA. Acceptable extinguishers are listed below: Amerex: 2-1/2", 5#, 10#, 20# must be rated ABC.

CO2 – Aluminum case

10# for all computer and electrical component areas – Ansul's Cleanguard Fire extinguisher cabinets must be ADA approved.

## 10810 TOILET ACCESSORIES

Commercial accessories are required in all public restrooms.

ADA accessible accessories shall be provided, as required by latest edition of ADAAG and the UBC.

YC has standardized toilet accessories to ease in custodial maintenance and restocking.

Seat cover dispensers are required in each stall. Sanitary napkin vendors and sanitary napkin disposal units (in stalls) are required in women's restrooms.

The following chart indicates which accessories are acceptable:

### Toilet Accessories

Type	Manufacturer Series		Number	Finish
Toilet Paper Dispenser	Bobrick	Classic	B-2888	Satin
Seat Cover Dispenser	Bobrick	Classic	B-221	Satin
Sanitary Napkin Disposal	Bobrick	Contura	B-270	Satin
Freestanding Waste Disposal	Rubbermaid	Slim Jim 23	FG354060GRAY	Gray
Paper Towel Dispenser	Global Ind.	Automatic	WB640932	Smoke/Beige
Inset Waste Disposal	Bobrick	Classic	B-3961	Satin
Sanitary Napkin Vendor	Bobrick	Classic	B-3706	Satin
Framed Mirror	Bobrick	B Series	B-290	Satin
Tilt Mirror	Bobrick	B Series	B-293	Satin
Grab Bar	Bobrick	B Series	B-6806	Satin / Peened
Soap Dispenser	Hillyard	Affinity	HIL22304	Black

## DIVISION 11: EQUIPMENT

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### 11172 DUMPSTERS AND WASTE COMPONENTS

All building projects must provide an area specifically designated for waste, trash and recycling containers if no existing waste disposal area for these purposes. This area must be carefully screened from public view, but easily accessible for collection and/or disposal operations.

## DIVISION 12: FURNITURE

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### 12510 OFFICE FURNITURE

Styles and colors of instructional furniture systems are also specified for ease in interchanging equipment. All locking cabinets and drawers shall be Best lock series and cores. The following chart indicates what furniture may be acquired:

#### Standard Office Furniture

<u>Type</u>	<u>Manufacturer</u>	<u>Series</u>	<u>Colors</u>
Desk	OFS	Pulse	TFL-W Wood Grain Steel (ST2)
Desk Return	OFS	Pulse	TFL-W Wood Grain Steel (ST2)
2-Drawer Lateral Files	OFS	Pulse	TFL-W Wood Grain Steel (ST2)
Bookcase Organizer	OFS	Pulse	TFL-W Wood Grain Steel (ST2)
Office Desk Chair	Office Master	YES Series	Basic Black Mesh Back MUB; GR1 BAS 1020
Fabric Tackboard	OFS		Momentum Graph Alpine #3077711 Grade 5
Storage Cabinets 3'x3'	OFS	Pulse	TFL-W Wood Grain Steel (ST2)
Storage Cabinets 3'x6'	OFS	Pulse	TFL-W Wood Grain Steel (ST2)
Task Chair	Office Master	OM5-AG	Available from Manufacturer
Office Table - Round	OFS	Pulse	TFL-W Wood Grain Steel (ST2)
	OFS	Pulse	32x32x27.75" Metal X Base

#### Instructional Furniture

<u>Type</u>	<u>Manufacturer</u>	<u>Series</u>	<u>Colors</u>
Classroom Tables	Haworth	Jive	Worktop: Smoke (H-3E) Edge: Smoke (H-3E) Base: Metallic Silver
Chair	Office Master	OM5-AG	BK01 Modern Black; Palladium Gray Frame; Black seat back
Instructor's Chair	Office Master	YS72	Basic Black; CAS4555-S 55mm multi-surface soft caster

## DIVISION 13: SPECIAL CONSTRUCTION

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### 13030 SPECIAL PURPOSE ROOMS

#### **Copy Rooms:**

A minimum area of 5' x 6' for small copy machines and 6' x 9' in length for large copy machines shall be reserved in office area designs. This space should be equipped with a dedicated circuit and shelving and/or lockable cabinets. The copy room area should be "hidden" from daily traffic, yet central to the entire user population.

#### **Custodial Closets:**

There shall be one custodial closet per building floor level, minimum. Custodial closets should contain a minimum working space of 92 square feet and shall be equipped with a 3' 0" minimum door.

#### **Closets shall be equipped with:**

- A corner located, floor mounted porcelain mop sink (with an 8" curb)
- Reinforced hot/cold tap with institutional grade hardware
- Waterproof backsplash to a minimum height of 36" around porcelain mop sink
- Wall-mounted mop racks and a minimum of twelve lineal feet of 11" deep fixed shelving. Shelving to be mounted at five-foot height to allow for machine storage underneath.
- A minimum 5'0" x 2'0" clear floor space shall be maintained to accommodate a vacuum unit. Larger spaces may be necessary at times.
- A floor drain, with the entire floor sloped a minimum 1/4" per foot to the floor drain is required. A minimum of 3 GFI duplex electrical outlets.
- Wall space for chemical mix station.
- Exhaust ventilation in every custodial closet
- Water heaters, electrical panel boxes, pipe chases, entrance doors to adjoining rooms, etc., shall not be included in custodial closet space.
- Closet floors shall be color sealed concrete, ceramic tile,

## DIVISION 14: CONVEYING SYSTEMS

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### 14200 ELEVATORS

**General:**

Elevators are to be provided with button controls to each floor without keying to shut down the unit and, if required by the program, to lock out selected floors.

Elevator controls shall comply with the most recent Fire/life safety and ADA codes. Specifications shall include attention to interlock to existing or proposed fire detection systems and devices.

All elevator-operating switches should be keyed alike according to function.

Elevators shall be located as close as practical to stairways to facilitate use of stairways for those with that preference.

Machinery spaces shall be located to minimize vibration and noise, and shall be fully sound attenuated if located near occupied areas.

A/E shall specify that Contractor shall include in his base bid, and shall be required to provide, the Elevator Owner's Manual to Yavapai College as part of closeout submittals at no additional cost.

## DIVISION 15: MECHANICAL

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### 15010 GENERAL

All mechanical rooms and spaces shall be adequately sized, lighted and arranged so that any and all repair and maintenance that may be necessary can be performed. Controls, mixing boxes, balance dampers, fire dampers, valves, filter banks, heat exchanger coils, pumps, belts, etc., shall be accessible for repair or replacement and shall not be obstructed by any pipe, conduit or other obstacle.

All gas appliances shall be de-rated for the appropriate elevation. Engineer shall request verification of BTU and specific gravity content of supplied gas in order to specify altitude corrections.

All service and supply systems, including, but not limited to, steam, high temperature hot water, natural gas, domestic water, waste and electrical, shall be sized for peak demand throughout the project and shall be sized as far back as the main meter or central distribution system. The adequacy of any central distribution system to carry all added peak loads shall be determined, and no loads shall be connected to any such system that is determined to be undersized.

The Professional Consultant shall clearly define the separation of responsibilities of electrical, mechanical, control, plumbing or any other sub-contractor or sub-consultant involved in the project.

The Professional Consultant, through his sub-consultants, shall be responsible for coordination of all systems including, but not limited to, electrical systems, control systems, heating and cooling systems, plumbing systems and any other mechanical systems as one included in the building design. This responsibility includes all mechanical sub-contractors, Federal, State and Local agencies, and franchised service companies.

The selection of all energy consuming systems and sub-systems shall conform to the requirements of Arizona Revised Statute #34-454, which requires that life-cycle costs shall be calculated based on: owning, operating and maintaining each system. The system with the lowest life-cycle costs shall be selected unless approved by YC. Included are such costs as fuel, energy, labor and replacement components determined on the basis of systematic evaluation and comparison of alternative building systems. The life cycle is the expected life of the system, or twenty-five years (ARS 34-454), whichever is shorter.

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

Gauges and thermometers shall be specified for all HVAC/R equipment.

#### **Quality Assurance:**

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

All parts or products shall be of commercial or industrial quality, and shall be suitable for heavy-duty use. Installers and sub-contractors shall have at least three years experience in installation of similar equipment on similar projects. All sub-contractors shall have a proven track record of response to complaints or problems during, and after, the warranty period.

#### **Design Parameters:**

The Professional Consultant shall evaluate the potential for overheating of building spaces. Particular attention shall be paid to areas which house computers or other electronic equipment. Evaluator shall consider all factors, including but not limited to, equipment, passive solar gain and occupant loads. Where such potential exists, the value and cost effectiveness of cooling shall be analyzed.

Any ventilated space which houses water piping, vessels or equipment, such as equipment rooms, shall be heated to a minimum of 55° F. When equipment rooms must be ventilated to provide boiler combustion air, the heat source shall be independent of the boiler.

The Professional Consultant shall familiarize himself with special altitude and climactic conditions experienced in Yavapai County.

Performance specifications shall not be used in lieu of designed systems unless specifically authorized by the FMD, Director or CPM on an item-by-item basis.

### **Submittals:**

NOTE: Sequence of control diagrams shall be required to be submitted within 21 days of notice to proceed.

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

- Equipment room layouts, drawn to scale, showing all equipment, piping and accessories and clearances for operation and servicing.
- All HVAC equipment including boilers, heat exchangers, pumps, tanks, valves, hangers, air-handlers, filters, louvers and dampers, relief valves, strainers, traps and drip legs, etc...
- All terminal equipment including volume control boxes, registers, grilles, diffusers, etc...  Design curves and characteristics of fans, blowers and pumps.
- Control diagrams and sequence of operations for all HVAC equipment.
- HVAC and motor control wiring diagrams.
- Plumbing fixture cuts, trim and fittings, rough-in dimensions and special supports.
- Piping materials, fittings, and specialties.
- Expansion loops, joints, guides and anchors.
- Foundations, supports, hangers and inserts.
- Drains (roof/floor), carriers, clean-outs and downspout nozzles.
- Insulation materials and finishes, duct and piping.
- Mechanical identification.
- Converters with saddles and relief valves.
- Gauges and thermometers.
- Flow fittings.
- Utility sets with vibration isolation.
- Dampers – Back draft, volume, smoke, fire, and combination smoke/fire.
- Temperature control equipment, schematics and diagrams.
- Panelboards, gauges and thermometers.
- Fire Protection system – hydraulic calcs.
- Fire Protection equipment and specialties (wet, dry and halon).
- Wiring diagrams and motor control equipment. (Wiring diagrams must be project specific, manufacturer's standard diagrams will not be accepted).
- All closeout submittals shall be indexed to the specifications, separated by dividers and bound in three-ring binders, or an electronic application formatted to our database configurations.
- Provide product extras as applicable for the following:
  - Laptop computer or programming devices.
  - Thermometers, each type.
  - Two sets keys/wrenches for any covers.
  - Spare belts for all fans.
  - Spare thermostats.
  - Chemical test kits as appropriate.
  - One set of filters, installed just prior to balancing.
  - One extra set of filters.
  - One set of any proprietary trouble-shooting or maintenance tools.
  - Two copies any proprietary computer software for systems control, program back up, trouble-shooting or maintenance.
- 1- 3 day start-up training as applicable (coordinated with Facilities Development). To be videotaped by YC.
  - Valve tag index mounted under rigid clear protection in the mechanical room(s) and diagram submitted with the O & M manuals.
  - Hard copies of all control codes.
  - Provide Manufacturer's certificates or test results for the following:  Air balance reports.
  - Heat exchangers.
  - Boilers and chillers.
  - Chemical treatment products, application limits, test methods and apparatus.
  - Glycol mixing formula.

- Backflow preventers.
- Potable water system purification.
- Hydrostatic test on sprinkler system. □ Hydronic balancing.
- Field test make up air units and fans.
- Final inspection from Mechanical Engineer.
- Provide O & M manuals for the following:
- All HVAC equipment, indexed, referenced to the spec and bound in three-ring binders, or an electronic application formatted to our database configurations.
- Equipment directory, name plate data all units.
- Provide belt and filter sizes for all air handling equipment, and email a separate copy to our planner of preventative maintenance.
- All air filters and filter racks shall be standard manufactured sizes.
- Local supplier directory.
- Complete list of all motors indicating locations, horsepower, voltage, phase and amperage draw of each motor.
- Provide written Warranty Certificates for the following:
- Entire scope of HVAC work – 2 years minimum.
- Any system or piece of equipment with a warranty, which extends past two years.

## 15060 PIPES AND PIPE FITTINGS

All glycol-charged piping systems shall be isolated water make-up using backflow device(s). Provide a mixing tank and pressurization pump for the addition of glycol mix to the system.

Under no circumstances shall hazardous materials including, but not limited to, cement asbestos pipe be used. All site piping fabrication, alteration and installation shall be conducted in a manner that complies with any environmental and OSHA requirements.

Documented, on-site, pre-burial pressure testing for forty-eight hours to be conducted by installer

## 15070 DRAINS

All drains, reliefs and fire system test drains shall be piped to floor drains properly located by the Professional Consultant.

All floor drains serving fire sprinkler systems shall be sufficient to accept full test flow.

## 15100 VALVES

The Professional Consultant shall specify supply valves of domestic quality, i.e., Milwaukee Manufacturing or approved equivalent.

- All valves to be ball valves.
- Unions shall be installed on the downstream side of all valves for access and repair of systems.
- All valves shall be accessible for repair and maintenance, generally without the necessity of using a ladder. Isolation valves shall be at each fixture installation area.
- Isolation valves shall be installed on all branch piping.

## 15120 PIPING SPECIALTIES

Dielectric materials must be used to eliminate dissimilar metal contact pipe to pipe, pipe to hanger, pipe to fittings, etc...

- Dissimilar metals must be kept to a minimum to reduce the number of dielectric fittings as much as possible or practical.
- Flange gaskets for steam, condensate or HTHW service shall be spiral wound metallic, similar to Flexitallic.

## 15130 GAUGES

Pressure gauges shall be required on all inlet and outlet lines of the following:

- Boilers

- Converters
- Pumps
- Pneumatic Controls
- Main steam supply line
- Static pressure gauges on all static controlled lines □ Thermometers shall be provide on all of the following:
- Air Handlers (mixed air, hot deck, cold deck)
- Boilers
- Converters
- Cooling equipment, chillers
- Heat recovery systems

## 15140 SUPPORTS AND ANCHORS

Drawings shall be detailed to show location and method of support for pipe anchors, thrust blocks, guides, expansion compensators, arresters, etc... Details shall be such that the Contractor has no question of how the work is to be accomplished.

## 15150 METERS

Specify totalizing meters for all steam, high temperature hot water, chilled water, domestic water, electric power (including demand), and gas systems to the facility.

All specified gas meters shall be temperature and pressure compensating. Specify sewage flow meters.

## 15160 PUMPS

All pump motors located remote from the master control center shall have a local disconnect that may be locked out. Dual system back-up pumps shall be specified in the base bid and installed on all new building and water heating and cooling systems. All heating, cooling and domestic hot water circulation pumps shall have back up. Automatic switchover in case of failure is to be required on heating water pumps.

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

Ball installation valves shall be installed so that the pump can be isolated for repair. No butterfly valves shall be installed in any underground application.

## 15190 MECHANICAL IDENTIFICATION

Provide and secure brass identification tags to all valves feeding mechanical equipment. Incorporate in valve tag index. Identify all piping within equipment rooms.

## 15240 MECHANICAL SOUND, VIBRATION ISOLATION

All rotating machinery requires vibration isolation at machinery to floor, machinery to ducts and machinery to pipe connections. An exception to this will occur where machinery is rigidly fastened to a concrete housekeeping pad. In this case, the machine shall be grouted to the pad with non-shrink grout.

## 15250 MECHANICAL INSULATION

### **Piping:**

Insulate all elbows, valves, expansion joints, etc...

All pipe insulation shall meet the following specifications:

2" and smaller; 1" thick fiberglass

2-1/2" – 7"; 1-1/2" thick fiberglass 8"

and larger; 2" thick fiberglass

**Ductwork:**

Insulation shall be specified for all ductwork running through non-conditioned areas in accordance to UMC.

## 15300 FIRE PROTECTION

**General:**

Inspection required by local Fire Marshal.

Maintain a three-foot minimum clear working space around all permanent equipment.

**Underground Installations:**

The Office of the Arizona State Fire Marshal requires the Contractor to submit site drawings, scaled and engineered, for the installation of all underground fire lines, hydrants and fire protection water lines to the local Fire Marshal for approval. The A/E shall specify submittal requirements that include review by A/E and YC prior to submittal and identify any changes proposed from the original bid documents.

**Automatic Sprinkler System:**

The Professional Consultant shall provide system design approved by the local Fire Marshal and FMD.

The system shall be easy to understand, operate, access, trouble-shoot and repair.

System will include multiple zones for sprinklers and smoke detectors gathered into an annunciator panel to be located inside the facility at a point designated by FMD.

All piping and wiring shall be hidden from view, including stairwell areas. Soffits will be permitted to encase piping and wiring. Alarms in the annunciator panel are required for the wet system alarm check valve, trouble, as well as flow switch alarm by zone, dry system low pressure and air compressor malfunction.

**Sprinkler Heads:**

Sprinkler heads shall be located in the center of individual ceiling tiles.

Sprinkler heads approved manufacturer: Viking or prior approved equal.

**Drain Valves:**

Specify drain valves for each low stoop of the system. Specify that field location of drain valves shall be inspected by the CPM.

Drains shall be piped to the outside or to a floor sink.

**Test Valves:**

Inspector's test valve should be located as far away from system riser as possible.

Valve shall be labeled, shall have visible standard flow and shall remain accessible at all times. Provide access panels for all hidden valves. Provide flow arrows on all accessible pipes.

**Submittals:**

Completed "As Built" drawings

Complete schematic for electronics with all specifications

O & M specifications for all systems, parts, detectors, panels and cards

**Panels:**

The motherboard shall be with least components, place provided for screwed and removable zone cards.

Each zone or detector shall be designed to alarm individually.

Trouble signals shall be incorporated for each zone for missing or loose detectors and designed to signal any other trouble condition, like home trouble or low battery, etc...

**Annunciator Panel:**

The annunciator panel shall be LED (incandescent bulbs are not acceptable) and break/shatterproof.

**Smoke Detectors:**

Photo-electric types shall be:

- Blinking function LED
- Low-profile preferred
- Rugged, break-proof
- Internally delayed types for certain places □
- 135 – 165o rate of rise type □ Rugged, low-profile □
- Pull Stations: Heavy-duty
- Double action, non-break glass, push type

**15330 WET-PIPE SPRINKLER SYSTEM**

No wet-pipe sprinkler lines shall be run in or through any unconditioned spaces including attics, basements, and exterior storage rooms or within exterior walls. Include reduced pressure backflow prevention devices on all wet-pipe systems.

**15335 DRY-PIPE SPRINKLER SYSTEM**

Include reduced pressure backflow prevention devices at main for all dry-pipe systems.

**15400 PLUMBING**

All cleanouts, meters, controllers, valves, etc., in any green belt area must be installed in boxes with removable lids. All boxes shall be flush to surface at grade.

Backflow preventers and testing by the CPM. Preventer shall be installed as close as practicable to the service connection.

Domestic water systems shall be zoned with shut-off capability for stacked rooms.

Provide isolation valves for each floor and for every bathroom or equipment with multiple fixtures. All isolation valves shall be ball valves.

**15410 PLUMBING PIPING**

Domestic water lines shall be a minimum of Type L copper. Waste and vent piping shall be cast iron, ABS or PVC.

**15430 ROOF AND FLOOR DRAINS**

Floor drains and sinks shall be precisely located on drawings. The location shall be such as to minimize length of drainpipes lying on the floor.

All floor drains shall be supplied with trap primers.

**15440 PLUMBING FIXTURES**

Plumbing fixtures shall be low flow, meeting the standards identified in Arizona State Governor's Executive Order 91-3.

**Toilets:**

Touchless

**Urinals:**

Touchless

**Lavatory faucets**

Touchless

**Kitchen faucets:**

Touchless

**Shower heads:**

2.5 gallons per minute (shower heads shall be tamper-resistant)

The DP shall specify plumbing fixtures as manufactured by the following (or approved equal): American Standard, Chicago or Elger.

No substitutions shall be allowed for the following valves, as the FMD has standardized the campus in order to stock the required parts:

**Flush valves:**

Sloan

**Water Coolers**

Elkay or owner approved equal.

**Shower/Lavatory/Kitchen:**

Delta, single handle, ADA compliant, pressure and temperature balanced

**Custodial and Laboratory:**

Chicago with vacuum breaker

Handicapped shower units shall require pressure and temperature balancing type, single-handed shower valve assembly with screwdriver stops, wand type shower head on flexible hose attached to arm on shower walls. Internal grab bars and seat shall be included in the assembly.

Pre-fabricated fiberglass shower enclosures shall be utilized which have full height walls, grout backed shower floors and internal braces for rigidity.

Custodial closets are to be provided with floor service sinks. If fire sprinkler system test valves drain into these, they must accept the full flow of the test.

## 15480 GAS PIPING

The Professional Consultant shall cross-reference gas piping requirements within this section with those in Section 02685.

## 15500 HEATING, VENTILATION & AIR CONDITIONING (HVAC)

All HVAC/R equipment requires prior approval by FMD HVAC department. Mini splits, and VRF systems are required to be Trane or Mitsubishi. No other brands will be accepted without prior approval from FMD HVAC department. All air handling fans and blowers shall be operated at less than maximum RPM's to deliver design air pressures, flows and velocities, to minimize vibration and noise problems, and to allow for air balancing without fan or blower over-speed. All fans, motors, blowers and their attachments must be de-rated for altitude.

## 15540 HVAC PUMPS

All heating hot water and domestic hot water circulating pumps shall have back up, and shall have automatic change-over on HHW pumps, and shall be specified for other pumps. All critical area chilled water pumps shall be similarly backed up and provided with automatic changeover.

All pumps will be selected for minimum maintenance, such as, in-line circulators where appropriate. All coupled pumps shall be aligned after installation and alignment documentation shall be provided.

All pumps shall have in-line strainers installed.

All pumps shall automatically restart after a power outage.

All HVAC equipment shall be connected to a Hand/Off/Auto starter; no momentary starters shall be used.

## 15555 BOILERS

All boilers shall be commercial/industrial quality. Boiler manufacturer requires prior approval by FMD Facility Services Gas/HVAC department. Submit proposed manufacturers before finalizing specifications. All boiler installations shall allow for a three-foot clear working area around all sides of the boiler, including the top.

Boilers shall be modified as necessary and shall be stamped for design performance at the appropriate elevation.

All safeties shall be non-lockout, unless codes require otherwise.

## 15630 SOLAR ENERGY DEVICES

Solar energy options shall be considered on all facilities.

## 15650 REFRIGERATION

Summertime cooling systems shall have economizer cycles with 100% outside air capability. Enthalpy controls shall be provided on all systems that run continuously. Indirect evaporative cooling shall be considered as an additional capacity system.

All air-cooled condensers shall have low ambient temperature controls and head pressure sensing or equivalent controls. Variable speed for the primary condenser fan is preferred.

## 15680 WATER CHILLERS

The selection of the type of air conditioning to be used shall be based on a 15-year life cycle cost analysis of all viable alternatives. This analysis shall include all expenses including equipment purchase and anticipated replacement costs, maintenance, refrigerant handling, replacement and disposal costs, and anticipated costs of energy. Where applicable, the efficiency of equipment shall be calculated, and used in the life cycle cost analysis, for all expected load ranges. Electrical rates used in life cycle cost analysis shall be actual demand and consumption costs, not “average” costs.

All central air conditioning systems shall have airside economizers with enthalpy controls. Wet side economizers shall be evaluated using life cycle cost analysis.

The suitability of using evaporative cooling, whether alone or in addition to a mechanical or indirect evaporative system, shall be evaluated. For wet wall installations, face and bypass dampers must be used for temperature control. Wet wall pump cycling shall not be an option for temperature control. Bypass dampers shall be sized to allow full airflow around the wet wall.

## 15850 AIR HANDLING

Air handler blowers shall be sized so that less than a maximum blower speed is required to provide design air flows, velocities and pressures to minimize vibration and noise.

Contractor shall notify DP, in writing, along with shop drawing submittals, potential for or deviation from, design intent.

Ventilation standards shall be a minimum of 20 cubic feet per minute per occupant.

Noise level volumes of air movement and equipment shall be designed and installed as compatible for intended functions within building spaces.

## 15850 MODULAR AIR HANDLING UNITS

### WORK INCLUDED

- Central Station Air Handling Units.

### RELATED SECTIONS

- Section 01513-Temporary Heating, Cooling, and Ventilating.
- Section 15121 - Expansion Compensation
- Section 15170 - Motors.
- Section 15242 - Vibration Isolation.
- Section 15290 - Ductwork Insulation.
- Section 15410 - Plumbing Piping: Equipment drains.
- Section 15790 - Air Coils.
- Section 15811 - Evaporative Humidifier.
- Section 15812 - Evaporative Pan Humidifier.
- Section 15813 - Steam Grid Humidifier.
- Section 15821 - Spray Coil Humidifier.
- Section 15860 - Centrifugal Fans.
- Section 15865 - Axial Fans.
- Section 15885 - Air Cleaning.

- Section 15890 - Ductwork.
- Section 15910 - Ductwork Accessories: Flexible Duct Connections.
- Section 16180 - Equipment Wiring Systems: Electrical characteristics and wiring connections.

## REFERENCES

- AMCA 99 - Standard Handbook.
- AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes.
- AMCA 300 - Test Code for Sound Rating Air Moving Devices.
- AMCA 301 - Method of Publishing Sound Ratings for Air Moving Devices.
- AMCA 500 - Test Methods for Louver, Dampers, and Shutters.
- ANSI/AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
- ANSI/UL 900 - Test Performance of Air Filter Units.
- ARI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils.
- ARI 430 - Standard for Central-Station Air-Handling Units.
- ARI 435 - Standard for Application of Central-Station Air Handling Units.
- NFPA 90A - Installation of Air Conditioning and Ventilation Systems.
- SMACNA - Low Pressure Duct Construction Standards.

## QUALITY ASSURANCE

- Fan Performance Ratings: Conform to AMCA 210
- Sound Ratings: ARI 410.
- Fabrication: Conform to ARI 430.
- Filter Media: ANSI/UL 900 listed, Class I or Class II, approved by local authorities.
- Air Coils: Certify capacities, pressure drops, and selection procedures in accordance with ARI 410.
- Air Handling Units: Product of manufacturer regularly engaged in production of components who issues complete catalog data on total product.

## SUBMITTALS

- Submit all shop drawings and product data.
- Shop drawings shall indicate assembly, unit dimensions, weight loading, required clearances, construction details, and field connection details.
- Product data shall indicate dimensions, weights, capacities, ratings, fan performance, motor electrical characteristics, and gauges and finishes of materials.
- Provide fan curves with specified operating point clearly plotted.
- Submit product data of filter media, filter performance data, filter assembly, and filter frames.
- Submit electrical requirements for power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring.
- Submit manufacturer's installation instructions.

## OPERATION AND MAINTENANCE DATA

- Submit all operation and maintenance data
- Include instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

## DELIVERY, STORAGE, AND HANDLING

- Store and protect all products under provisions.
- Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures and finish.

## ENVIRONMENTAL REQUIREMENTS

- Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

## EXTRA STOCK

- Provide one set of disposable air filters for each unit plus one complete filter change if equipment has been operated during construction.

### *Products*

#### **ACCEPTABLE MANUFACTURERS**

- York AirPak or approved equal.

#### **GENERAL DESCRIPTION**

- Fabricate [draw-thru] [blow-thru] type air handling units suitable for the scheduled capacities.
- Fabricate units with a supply fan segment plus accessories, including [cooling coil segment] [heating coil segment] [filter segment] [mixing box segment] [economizer segment] [air blender segment] [face and bypass damper segment] [discharge plenum segment] [access segment] [diffuser segment] [return or exhaust air fan segment] [integral face and bypass coil segment] [humidifier segment] [humidifier segment] [sound attenuator segment] [electric heat segment].
- Factory fabricate and test air handling units of sizes, capacities, and configuration as indicated and specified.
- Base performance on sea level conditions.
- All internal components specified in the air handling unit schedule shall be factory furnished and installed. Unit(s) shall be completely factory assembled.
- Units shall ship in one (1) piece where possible. Shipping splits can be provided as required for installation. Lifting lugs will be supplied on each side of the split to facilitate rigging and joining of segments.
- Units with shipping splits shall be provided with "male" and "female" connection pieces for easy field assembly. Units requiring field installed gasketing must be assembled under supervision by factory trained and employed personnel from the air unit manufacturer.

#### **CASING**

- The entire unit shall be provided with a full-length, continuous, base rail channel. Base rail channels will be formed of a minimum of 12 gage galvanized steel. The base channel will have a minimum height of 5 inches for sizes AP 35 - 500 and 8 inches for sizes AP 580 - 1000. All major components shall be supported from the base. Integral lifting lugs shall be provided. Units without a complete and continuous base rail will not be acceptable.
- The unit shall have a frame construction consisting of cast aluminum corner pieces and galvanized steel vertical and horizontal structural members. The frame shall be constructed to permit complete removal of the wall and roof panels without affecting the structural integrity of the unit.
- All segments shall be double wall and shall be constructed of G90 mill galvanized sheet steel, formed and reinforced to provide a rigid assembly. The exterior casing shall be constructed of a minimum 18 gage galvanized steel. The interior lining shall be a solid lining of a minimum of 20 gage perforated aluminum lining or a minimum of 18 gage solid galvanized steel.
- All access panels shall be completely removable for unit access and removal of components. All access panels must be removable without the use of electricity or compressed air. Panels will be removable with a 5/16" Hex Wrench. Access panels requiring the removal of sheet metal screws for panel removal will not be acceptable.
- All panels shall be completely gasketed prior to shipment with a minimum of 1/4" thick and 3/4" wide closed cell neoprene.
- All panels shall be insulated with 2"-1.5# [2"-3#] fiberglass insulation. The panel insulation must be a full 2" (non-compressed) throughout the entire unit. Units with less than 2" of insulation in any part of the walls, floor, roof or drain pan shall not be acceptable. The insulation shall meet the flame and smoke generation requirements of NFPA-90A.
- Any portion of the unit that is not insulated (gaps) or has less than 2" of insulation shall be the responsibility of the contractor to modify.

- The cooling coil segments shall have a full width, sloped drain pan that extends downstream of the coil to provide sufficient amount of space to contain moisture carryover. The unit design shall not require a drain pan in any downstream section to contain the coil condensate.
- The main coil drain pan shall be sloped to assure positive condensate drainage with connections on both sides. The pan shall be of double wall construction with a galvanized [stainless steel] liner and have a minimum of 2" of insulation (uncompressed). The pan shall have a minimum depth (free-board) of 4 inches.
- Coils with finned height greater than 48" shall have an intermediate drain pan extending the entire finned length of the coil. Cooling coils in excess of 48" in height shall not be acceptable unless provided with an intermediate drain pan. The intermediate pans shall have drop tubes to guide condensate to the main drain pan.
- Double wall access doors shall be provided in the fan and filter segments on the coil header-side of the unit. Access doors must also be provided in all segments where the removal of sheet metal screws is required for unit access.
- Doors shall be of the same thickness and construction as the wall panels. A 3/8" bulb-type gasket shall be provided around the entire door perimeter. Industrial style hinges shall permit a complete 180 degree door swing.
- Viewing windows shall be available as specified by the engineer in all access doors. Windows will be double pane glass.
- The exterior of the unit shall be completely cleaned prior to application of finished coats. A prime coat of epoxy chromate shall be applied to a minimum thickness 1.5 mils. A finish coat of beige acrylic polyurethane shall then be applied to a minimum thickness of 2.5 mils.
- When tested in accordance with ASTM B-117 the finished unit shall withstand 125 hour salt spray solution (5%) without any sign of red rust.
- All remaining segments of the unit shall be provided with auxiliary drain pans. The auxiliary pans shall also be of double wall construction with drain connections on both sides of the unit.

## FANS

- The fan segment shall be equipped with double width double inlet (DWDI) centrifugal type wheels. All fans shall be forward curved (FC) or airfoil (AF) as required for stable operation.
- Fan and unit performance shall be rated and certified in accordance with ARI Standard 430. All units that are not ARI Certified shall be witness tested at an independent laboratory to assure performance.
- All airfoil fans shall bear the AMCA Seal. Airfoil fan performance shall be based on tests made in accordance with AMCA standards 210 and comply with the requirements of the AMCA certified ratings program for air and sound. In addition, all airfoil wheels shall comply with AMCA standard 99-2408-69 and 99-2401-82.
- The fan segment shall be equipped with single width single inlet (SWSI) centrifugal type wheels. All fans shall have airfoil (AF) blades. Flat plate blades shall not be acceptable.
- All airfoil fans shall bear the AMCA Seal. Airfoil fan performance shall be based on tests made in accordance with AMCA standards 210 and comply with the requirements of the AMCA certified ratings program for air and sound. In addition, all airfoil wheels shall comply with AMCA standard 99-2408-69 and 99-2401-82.
- After the pre-balanced fan is installed in the air handler, the entire fan section shall be run-balanced at the specified speed to insure smooth and trouble-free operation. The run balance shall include filter-in and filter-out balancing in all three (3) planes, on both sides of the fan assembly at the bearings.
- Filter-in measurements shall be taken in the horizontal and vertical planes on the drive and opposite-drive sides of the fan shaft.
- Filter-out measurements shall be taken in the horizontal, vertical and axial planes on the drive and opposite-drive sides of the fan shaft.
- Fans with variable frequency drives shall be balanced for inverter duty operation. The fan will be balanced over the entire range of fan operation (30% to 100% of RPM). Filter-in measurements shall not exceed 5 mils in the horizontal and vertical planes. Filter-out measurements shall not exceed 7.5 mils in the horizontal, vertical and axial planes.
- Fan and fan motor shall be internally mounted and isolated on a full width isolator support channel using 1" springs [2" springs] [1" springs with seismic restraints] [2" springs with seismic restraints]. The fan

discharge shall be connected to the fan cabinet using a flexible connection to insure vibration-free operation. The isolator support rail shall be structurally supported from the unit base. Cantilever supports of the isolator support base are unacceptable.

- Rear, rear-inverted, top, top-inverted, bottom and bottom-inverted discharges shall be available on all unit and fan sizes.
- Variable inlet vanes for airfoil wheels shall be an integral part of the inlet cone and constructed of heavy gage, corrosive resistant blades with zinc-plated steel inter-locking and operating mechanism. Both inlet vanes must operate from a single shaft and be synchronized for precise control.
- The forward curved wheel shall have variable inlet vanes attached to the scroll of the fan. The support ring shall be rolled angle iron. The blades shall be heavy gage galvanized steel. Both inlet vanes must operate from a single shaft and be synchronized for precise control.

### **BEARINGS AND DRIVES**

- Fan bearings shall be self-aligning, pillow block or flanged type regreaseable ball bearings or rubber housed sealed bearings and shall be designed for an average life (L50) of at least 200,000 hours. All regreaseable bearings shall be factory lubricated and equipped with standard hydraulic grease fittings and lube lines extended to the motor side of the fan.
- Fan drives shall be selected for a 1.5 service factor and anti-static belts shall be furnished. All drives less than 20 hp shall be fixed [adjustable] pitch. All drives 20hp and above shall be fixed pitch.
- Fan shafts shall be selected to operate well below the first critical speed and each shaft shall be factory coated after assembly with an anti-corrosion coating.

### **ELECTRICAL CHARACTERISTICS AND COMPONENTS**

- Fan motors shall be NEMA design ball bearing type with electrical characteristics and horsepower as specified on the schedule. Motors shall be 1750 FPM, open drip-proof [totally enclosed, fan cooled] type. All motors shall be standard [high] [premium] efficiency.
- The motor shall be mounted on the same isolation base as the fan. The motor shall be on an adjustable base.
- Fan unloading for variable-air-volume control shall be accomplished through a factory mounted variable frequency drive (York Air-Modulator). The VFD shall bear the same label as the unit manufacturer to assure compatibility and proper fan balancing.
- After final assembly, the fan and motor assembly shall be factory balanced for 10 - 100% of design speed of the air handling unit. Units that are balanced for a specific point of operation shall be field balanced for the entire RPM range.
- After the air handling unit is installed, the VFD shall be field commissioned by a factory trained and employed service technician.
- The VFD shall be UL listed and comply with all applicable provisions of the National Electric Code.
- Each unit shall be equipped with a power panel that will serve as the fan motor starter(s). The panel and all associated components shall be UL listed. All wiring shall be done in accordance with the latest N.E.C. Guidelines.
- The power panel shall be enclosed in a NEMA 3R equivalent enclosure. The panel shall contain a main power block, single speed fan motor contactor with overload device, three phase ambient compensated overload heater elements, power wiring to the fan motor, two primary control fuses, one secondary control line size fuse, terminal strip and on/off/auto switch. Control voltage will be 115 volt.
- A single panel enclosure containing supply and return fan motor starters shall be provided with separate on/off/auto switch when a return air fan is specified.
- Each unit shall be equipped with a unit mounted, non-fused disconnect switch.
- The disconnect shall be mounted on the exterior of the unit in a NEMA 3R enclosure.
- The disconnect shall be UL listed.
- The disconnect shall be factory wired through flexible metal conduit to the power panel. All wiring shall be done in accordance with the latest N.E.C. Guidelines.
- A marine-type, vapor proof service light shall be provided in the fan segment [and additional segments]. Each light will be 100 watt service and shall be wired to an individual switch. Lights will require a 115/1/60 power source that is separate from the main power to the unit. This will permit light operation

during periods of unit shutdown. □ A single 115 volt convenience outlet shall be provided at the light switch.

## COILS

- All cooling and/or heating coils shall be furnished to meet the performance requirements set forth in the schedule. All coils shall have performance certified in accordance with ARI Standard 410.
- All coils shall be installed on tracks for easy removal from the air handling unit. Units that require disassembly of the unit for coil removal are not acceptable.
- Drainable Water coils shall be designed to operate at 250 psig design working pressure and up to 300F and shall be tested with 325 psig compressed air under water. Circuiting shall provide free and complete draining and venting when installed in the unit. All vent and drain connections shall be extended to the outside of the unit casing.
- Coils shall be circuited for counter flow of air and water. Water velocities shall not to exceed 7 feet per second and/or exceed the water pressure drops scheduled. All coils must have same end connections regardless of the number of rows deep.
- Direct expansion coils shall be designed to conform to the ANSI B9.1 (Safety Code for Mechanical Refrigeration) when operating with a refrigerant pressure not exceeding 250 psig and shall be tested with 325 psig compressed air under water. The completed coil shall be dehydrated, including headers, return bends and distributor and sealed for shipment. Each coil shall be furnished with a brass distributor with solder-type connections. Suction and discharge connections shall be on the same end regardless of rows deep.
- Coil casing to be constructed of 16 gage gauge galvanized steel [stainless steel]. Intermediate casing supports shall be supplied for finned lengths that exceed 60".
- The primary surface shall be 5/8" O.D. copper tube, staggered in direction of airflow. Tubes shall be mandrel expanded to form fin bond and provide burnished, work-hardened interior surface. The tubes shall have a minimum tube wall thickness of 0.020" [0.025"] [0.035"].
- The primary surface shall be 1/2" O.D. copper tube, staggered in direction of airflow. Tubes shall be mandrel expanded to form fin bond and provide burnished, work-hardened interior surface. The tubes shall have a minimum tube wall thickness of 0.016" [0.020"] [0.032"].
- Extended surface shall consist of die-formed, continuous, aluminum [copper] fins. The fins shall have fully drawn collars to accurately space fins, and to form a protective sheath for the primary surface. The fin thickness shall be 0.006" [0.010"].
- Headers shall be of heavy seamless copper tubing, silver-brazed to tubes. Connections shall be of red brass, with male pipe threads, silver-brazed to the headers. A 1/4" FPT, plugged, vent or drain tap will be provided on each connection.
- Coil grommets shall be provided on all coils to completely seal the area between the coil connection and the unit casing.
- Steam Distributing (1" O.D.) coils shall be designed for operation at 100 psig pressure and a corresponding saturated steam temperature of 338F. Coils shall be tested with 315 psig compressed air under water. The outer tube shall be 1" O.D. and the inner distribution tube will be 5/8" O.D. The circuiting shall be of a non-trapping condensate drainable design facilitating gravity drain. The steam shall discharge in the direction of condensate flow to insure even distribution and heat transfer through the full length of each tube.

## FILTERS

- Flat Filter Segments shall accommodate 2 [4] inch media. Media shall be throwaway (2"), permanent cleanable (2") or 30% pleated (2" or 4").
- The filter frames shall be constructed of galvanized steel and be built as an integral part of the unit. All filter segments shall be side service with an access door on the drive side of the unit.
- All Filter Frames shall utilize standard factory manufactured filter sizes.
- Angle Filter Segments shall accommodate 2 [4] inch media. Media shall be throwaway (2"), permanent cleanable (2") or 30% pleated (2" or 4").
- The filter frames shall be constructed of galvanized steel and be built as an integral part of the unit. All filter segments shall be side service with an access door on the drive side of the unit.

- Open Return Filter Segments shall accommodate 2 [4] inch media. Media shall be throwaway (2"), permanent cleanable (2") or 30% pleated (2" or 4").
- The filter frames shall be constructed of galvanized steel and be built as an integral part of the unit. The filter segment shall be front service.
- Bag Filter Segments shall accommodate 2 [4] inch prefilters and high efficiency bag filters of the specified efficiency. Filter frames shall be provided with neoprene gasketing on the leaving air side of the filter for pressure sealing assembly.
- Bag filter media shall be 21 [32] inches deep and the efficiency shall be a minimum of 65% [85%] [95%] as determined by ASHRAE Standard 52-76. Filter media shall be listed Class 2 [Class 1] under U.L. Standard 900.
- The filter frames shall be constructed of galvanized steel and be built as an integral part of the unit. All filter segments shall be side service with an access door on the drive side of the unit.
- Rigid Filter Segments shall accommodate 2 [4] inch prefilters and high efficiency rigid filters of the specified efficiency. Filter frames shall be provided with neoprene gasketing on the leaving air side of the filter for pressure sealing assembly.
- Rigid filter media shall be 12 inches deep and the efficiency shall be a minimum of 65% [85%] [95%] as determined by ASHRAE Standard 52-76. Filter media shall be listed Class 2 [Class 1] under U.L. Standard 900.
- The filter frames shall be constructed of galvanized steel and be built as an integral part of the unit. All filter segments shall be side service with an access door on the drive side of the unit.
- A magnahelic, differential pressure gage shall be factory installed and flush mounted on drive side to measure the pressure drop across the [prefilter only] [high efficiency filter only][prefilter and high efficiency filters].

#### **APPURTENANCES**

- The Mixing Box Segment shall consist of multi-leaf, parallel [opposed] acting blades, with inter-connecting return air and outside air dampers. The dampers shall be located in the top and rear [bottom and rear] [top and bottom] of the unit.
- The Combination Filter/Mixing Box shall combine the filtering and mixing functions in one standard segment. Filter media shall be arranged in an angle configuration and shall provide 2" [4"] filters available as throwaway (2"), permanent cleanable (2") or 30% efficient pleated (2" or 4").
- The segment shall have a hinged access door on the drive side of the unit. The dampers shall be located in the top and rear [bottom and rear] [top and bottom] of the unit.
- The Economizer Segment shall contain three sets of dampers to control the return, exhaust and outside air. The economizer section shall be an integral part of the unit.
- The Internal Face and Bypass Segment shall be of the internal type as called for in the schedule. The dampers to be multi-leaf, opposed acting blades interlocked with one control point. The blades to rotate in nylon bearings providing smooth action and requiring no lubrication. Dampers shall be segmented to limit blade length and prevent warpage assuring a tight closure.
- The Diffuser Segment shall be constructed with a perforated diffuser plate assuring even distribution of airflow across the entire unit air tunnel. Units with blow-through coils and final filters (downstream of the fan) must have a diffuser segment immediately downstream of the fan. Units with fans blowing directly into coils and/or filters are unacceptable.
- The Access Segment(s) shall be provided for placement anywhere in the unit to gain access to a particular area. The access segment shall be available with a depth of either 12", 18" or 24".
- The Air Blender Segment shall have factory installed air blenders as an integral part of the air handling unit. Blenders shall be integrated into the overall unit design to maximize the performance of the downstream components. The blenders shall be fixed devices, with no moving parts.
- The Discharge Plenum shall be provided as the last segment in direction of airflow. The plenum shall be suitable for single or multiple discharges [horizontal] [top][bottom].
- The Multizone Segment shall have factory installed hot and cold decks. The decks shall be internally sealed to prevent the two airstreams from mixing. The hot deck shall be completely removable from the cold deck without disassembly of the segment. A balance plate shall be provided as needed to equate the pressure of the two paths. Hot and cold deck dampers shall be provided. The hot and cold deck dampers are to be opposite acting, secured at 90E to each other. The dampers shall be removable from the unit and

from each other. Dampers shall have airfoil blades with Santoprene rubber seals and metal-compressible jamb seals. All bearings shall be stainless steel sleeve type.

- The IT high efficiency bypass segment shall consist of standard low leak dampers. Dampers shall be of low leak design. The blades shall be parallel acting. The high efficient filters will be contained within type 8 frames with brush seals. Frames will be constructed of galvanized steel. The frames will slide into extruded aluminum tracks and be built as an integral part of the unit. Filter module will be side service with a standard access door on both the drive and opposite drive side of the unit. Both 4" and 12" deep high efficient media shall be available.

## DAMPERS

- Dampers shall be of low leak design having stamped 16 gage galvanized steel blades. The damper blades shall be provided with a PVC coated polyester fabric mechanically locked into the blade edge. The jamb is a flexible metal, compression type. Leakage will not exceed 7.20 CFM/square foot at 1" w.g. and 14.0 CFM/square foot at 4" w.g. The blades shall be parallel [opposed] acting.
- Dampers will be of ultra-low leak design having airfoil blades constructed of 14 gage, double skin, galvanized steel. The damper blades shall be provided with extruded vinyl edge seals and flexible metal compressible jamb seals. Leakage shall not exceed will not exceed 3.70 CFM/square foot at 1" w.g. and 8.0 CFM/square foot at 4" w.g. The blades shall be parallel [opposed] acting.

## CONTROLS

The fan shall be supplied with a variable frequency drive (VFD) for variable air volume control. The variable frequency drive shall be factory mounted in a dedicated conditioned control compartment inside the air-handling unit. The VFD shall bear the same label as the unit manufacturer to assure compatibility and proper fan balancing. The VFD shall operate at a carrier frequency in the range of 0.5 - 16 kHz to ensure quiet operation. The VFD shall be UL listed and comply with all applicable provisions of the National Electric Code.

- Air handling unit shall be equipped with a single-point motor starter panel with variable frequency drive(s) serving fan motor(s).
- The drive shall be available in a NEMA 3R, weatherproof enclosure directly from the manufacturer with the option of an integral bypass. The design of the enclosure shall be of modular construction to allow maximum flexibility when mounting to the Air Handler.
- The enclosure shall mount to the unit air handler and have provisions for cooling from the Air Handler Fan Section. The drive enclosure and cooling provisions shall be engineered to allow the drive to operate in the following environmental conditions:
  - Outdoor Ambient Temperature  $-10^{\circ}\text{C}$  to  $60^{\circ}\text{C}$  ( $14^{\circ}\text{F}$  to  $140^{\circ}\text{F}$ )
  - Enclosure Internal Ambient Temperature  $-10^{\circ}\text{C}$  to  $40^{\circ}\text{C}$  ( $14^{\circ}\text{F}$ - $104^{\circ}\text{F}$ )
  - Humidity 5-90% RH non-condensing
  - Altitude up to 1,829 meters ( 6,000 feet)
- Operation outside of the specified environmental conditions shall require the addition of a high or low ambient kit provided by the drive manufacturer.
- Integral Devices. The VFD supplier shall include the following standard devices:
  - Main disconnect.
  - Individual drive fusing for Supply and Return Fan Drives Electromechanical 3 contactor isolated bypass.
  - Integrally mounted pilot devices and selector switches.
  - 120 VAC control transformer.
  - Motor overload relay(s).
- Integral Options. The VFD supplier shall include options for the following:
  - A 2 kVA or 3 kVA lighting transformer externally mounted with separate circuit breaker disconnect to be used for 120VAC AHU lighting circuit.
  - A 120VAC GFI convenience receptacle with switch integrally mounted.
  - A separate fused circuit to feed an electric heater in the AHU.

- Up to 2 additional fused control transformers 120VAC: 24VAC for customer use.
- Package Construction. The VFD package shall be UL listed and comply with the latest applicable standards of ANSI, IEEE, and NEMA. The NEMA 3R design features shall consist of:
  - Powder coated steel enclosure, with bottom inlet for cooling air and top exhaust air slots.
  - Single Point Input Power connection.
  - All enclosures to have dead front with internal swing out door for mounting of pilot devices.
  - Air handling unit shall be supplied with a unit mounted non-fused disconnect.
  - The disconnect shall be an integral part of the motor starter panel [in a separate NEMA 3R enclosure].
  - Air handling unit shall be supplied with direct digital controls (DDC) furnished by the air-handling unit manufacturer.
  - Controls shall be factory mounted, wired and programmed by the air handling unit manufacturer.
  - Program entries shall be fill-in-the-blank editing format.
  - A local keypad and LCD display (2 line by 40 character) shall be provided for interrogating and editing the control program.
  - Factory supplied control panel shall include power supplies for main control panel, actuators, (including valve actuators) and transducers provided as part of the air handling unit assembly.
  - The complete control system shall include the following auxiliary control devices, factory mounted and wired, where applicable: damper actuators, temperature sensors, differential pressure transmitters, differential pressure switches, low limit thermostats, control valves actuators, control valve junction box.
  - All control valves shall be shipped loose for field installation.
  - Control valve leads shall be factory marked to match terminal strip in the junction box.
  - Controller shall be located flush mounted on unit exterior. or  
Controller shall be located in a dedicated conditioned control cabinet integral to the air-handling unit. Control cabinet shall house master controller, variable frequency drives, and any other controls supplied by the air handling unit manufacturer as specified. Cabinet shall be fabricated such that the controls are not in direct contact with the airstream. Cabinet shall be weather-tight. Access shall be gained through double wall access door(s) with continuous hinges and manufacturer's standard door handles.
  - Cabinet shall be of NEMA3R design. Cabinet shall be conditioned by supply air, providing conditioned air to the unit controls. Ventilation shall be designed to adequately dissipate the heat generated by the controls. Ventilation shall provide a means to elevate or reduce the ambient temperature at the controls to within acceptable limits within 10 minutes after startup in extreme environments of 0° - 140°F. Temperatures beyond these limits may require controls and variable frequency drives to be mounted indoors.
- All control devices, except control valves, space temperature sensor, and the outdoor air temperature sensor (if no outdoor air damper), are to be factory installed and wired in accordance with NEC codes.
- All control wiring shall be Class II.
- Wiring shall be contained in the integral unit-framing members.
- Control panel wiring and power supplies shall be complete, except for 120 VAC power wiring by electrical contractor and remote mounted devices as noted below.
- Wires crossing shipping splits shall terminate in junction boxes with numbered plug in connectors for easy field connection.
- Kits shall be provided for field installation of static pressure pickups for space static, outdoor air static and remote duct static, if required for the control application.
- Kits shall include probe and appropriate mounting hardware.
- One-quarter inch fire rated PVC tubing or equivalent shall be supplied by the (mechanical) contractor.
- Four wire space temperature sensors shall be provided by the factory for field installation by (electrical) contractor and wired to the terminal strip in central control panel.
- Valve actuators shall be field wired by (electrical) contractor.

- Two 24 VAC power wires and two 0-10 VDC control wires shall be run to each valve actuator from the terminal strip provided in the control panel.

## EXECUTION

### INSTALLATION:

- Install in accordance with manufacturer's instructions.
- Install in conformance with ARI 435.
- Assemble high pressure units by bolting segments together. Isolate fan segment with flexible duct connections.

## 15860 CENTRIFUGAL FANS

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

## 15880 FUME HOODS

### General:

Utilize one fan of the industrial unitary type (pre-assembled package unit) for each fume hood. Manifold systems can be considered as an option for high-density lab fume hood applications. Prior approval for design required. Energy recovery will be required when manifold systems are installed.

Fume hood fan and motor sheaves will be the continuously adjustable type.

Fume hoods will be provided with airflow indicators of the pilot tube-type and alarmed.

The users and maintenance staff should know when a chemical fume hood is not functioning. Remote alarms, where specified, shall be through a dry contact and wired to the nearest mechanical space and terminated on a terminal block for future connection to an annunciation panel.

A pre-heat mechanism shall be incorporated into the HVAC system design where 100% outside air is utilized.

The system should be energy-efficient within the design criteria.

Fume hoods with built-in exhaust fans are not allowed. When relocating or remodeling fan enclosed fume hoods, they must be removed and replaced.

### Acoustics:

#### Maximum allowable noise within laboratories shall be:

For hood operating with a sash face velocity greater than 100 feet per minute, excluding perchloric hoods; a maximum decibel level of 72 dba.

For perchloric hoods; decibel levels which are within the standards for the industry with the following two considerations:

An appropriately specified and adequately designed fume hood system

An installation by the general contractor per the direction delineated in the contract documents Fume hoods, excluding perchloric hoods, will be tested in accordance with the ASHRAE 110 Test at the manufacturing facility and in accordance with the most recent SAMA Test after the building HVAC system is balanced.

### Flow Rates:

Fume hood fans will be selected for the specified velocity with the sash in a fully open position. Fume hood systems will be selected for the specified velocity of 100 feet per minute with the sash in a fully open position, with the exception for hoods requiring a greater face velocity. For hoods requiring a greater face velocity, fume hood systems will also be selected to provide the required face velocity with the sash in the fully open position. The laboratories will have a minimum of 8 air changes per hour; air shall be 100% exhausted.

A minimum duct velocity of 1600 feet per minute will be provided through ductwork up to the exhaust fan for hoods requiring a face velocity of 100 feet per minute.

### Ductwork:

#### Fume hood ductwork will be constructed of:

- Spiral duct, with flanged connections

- 26-gauge stainless steel, type 316

Joints will be constructed with a process equal to the Thermofit Wraparound Duct Bands manufactured by Raychem 90o bends and offsets in ductwork will be kept to an absolute minimum. When they are required, they will be designed with long radius sweeps to avoid turbulence in the duct.

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

### **Controls:**

#### *Lab Airflow Control System Requirements*

A successful lab design is predicated upon attention to a number of subtleties. Compromise on any one of them, especially with all the inaccuracies in the balance of the mechanical systems, can result in less than optimal laboratory performance as well as creating a safety risk. Strict adherence to these criteria will ensure the successful outcome of every lab airflow design. Deviation from the criteria in Part 2.0 (except item 2.1d which is energy related) can result in an increased chance of unsafe operation, odor migration, unpredictable research/production results, excessive noise, temperature control problems, etc.

### **PART 1.1 Description**

A laboratory airflow control system shall be designed to control the airflow into and out of laboratory rooms and adjacent areas. The exhaust flow rate of a laboratory fume hood shall be required to be precisely controlled to maintain a constant average face velocity into the fume hood at either a standard/in-use or standby level based on an operator being present in front of the fume hood. The laboratory control system shall volumetrically vary the amount of make-up/supply air into the room to operate the laboratories at the lowest possible airflow rates necessary to maintain temperature control, achieve minimum ventilation rates, and maintain laboratory pressurization in relation to adjacent spaces (positive or negative).

### **Part 2.0 System Performance Requirements Airflow Control System Description**

- A.** Each individual laboratory requires a dedicated laboratory airflow control system in accordance with the ASHRAE handbook (page 13.11 & 12)\*1.
- B.** The laboratory airflow control system is required to employ individual average face velocity controllers that directly measure the area of the fume hood sash opening and proportionally control the hood's exhaust airflow to maintain a constant face velocity over a minimum range of 20 to 100% of sash travel. The corresponding minimum hood exhaust flow turndown ratio can be no less than 5 to 1 ASHRAE Handbook (page 13.9, 13.11 & 12)\*1. No through the wall sash sensing allowed in conformance with UL 913 (Intrinsic Safety, page 6, section 1.4.9 & page 19, section 4.1.1)\*2 and Prudent Practices (page 179)\*3.
- C.** To function correctly the hood exhaust airflow control device is required to respond to the fume hood sash opening by achieving 90% of its commanded value within one second of the sash reaching 90% of its final position (with no more than 5% overshoot/undershoot) of required airflow ASHRAE Handbook (page 13.9, 13.11 & 12)\*1. Rate of sash movement shall be between 1.0 to 1.5 feet per second. Hood ACH rate shall meet the requirements of NFPA (2000 version paragraph A.6.4.6.)\*4 and not reduced to less than 1 L/sec/m<sup>2</sup> (25 CFM/ft<sup>2</sup>) of internal hood work surface even when the sash is fully closed.
- D.** The hood exhaust airflow control device shall be required to automatically be switched between in-use and standby levels based on operator presence immediately in front of the hood. A presence and motion sensor shall activate the switching. Equip face velocity meter with a energy waste alert to activate an audible/visual signal at the monitor in the event a hood sash is left open and the laboratory lights are turned off.
- E.** The airflow control device shall achieve the required in-use commanded value in less than one second from moment of detection with no more than a 5% overshoot or undershoot ASHRAE Handbook (page 13.9, 13.11 & 12)\*1.
- F.** The laboratory airflow control system shall maintain specific airflow ( $\pm$  5% of signal within less than one second of a change in duct static pressure) regardless of the magnitude of the pressure change (within 0.6" to 3.0" wc), airflow change or quantity of airflow control devices on the manifold ASHRAE Handbook (page 13.9, 13.11 & 12)\*1.

- G.** The laboratory airflow control system shall use volumetric offset control to maintain room pressurization. The system shall maintain proper room pressurization polarity (negative or positive) regardless of any change in room/system conditions such as the raising and lowering of any or all fume hood sashes or rapid changes in duct static pressure. No differential sensing systems, pitot tube or thermo-anemometers shall be incorporated to comply with the ANSI Z9.5 standard (page 7, section 4.11.4)\*4 and ANSI Z9.5 (Clarification letter, page 1-3)\*4.
- H.** The laboratory airflow control system shall maintain specific airflow ( $\pm$  5% of signal) with a minimum 15 to 1 turndown to insure accurate pressurization at low airflow and guarantee the maximum system diversity and energy efficiency. The calibration data for each valve must be traceable to NIST and with the valve having a combined accuracy of at least  $\pm$  1% of signal over the entire range of measurement. Electronic airflow control devices shall be further calibrated and their accuracy verified to  $\pm$  5% of signal at a minimum of eight different airflows across the full operating range of the device. No damper operated airflow devices shall be permitted in any lab exhaust or supply duct work in compliance with the ASHRAE handbook (page 13.9, 13.11 & 12) \*1, NIH Mechanical (page D-131, section 16.17) \*5 and AIA (page 33)\*6.
- I.** The airflow control devices used in the laboratory shall be venturi valves. They shall be pressure independent in compliance with the ASHRAE handbook (page 13.9) \*1, NIH Mechanical (page D-131, section 16.17 & page D-140, section D.16.22) \*5 and AIA (page 33)\*6.
- J.** All actuators shall be spring return (NFPA 45 page 45-13 section 6-5.7 8)\*7 pneumatic devices capable of working in to static pressures up to 3.0”

## 2.2

### Airflow Control Sound Specifications

- A.** The airflow control device shall not exceed the sound power levels in Table 1, Table 2 and Table 3.
- B.** If the airflow control device cannot meet the sound power level specification, a properly sized silencer or sound attenuator must be used. All silencers must be of a packless design (constructed of at least 18 gauge 316L stainless steel when used with fume hood exhaust) with a maximum pressure drop at the device’s maximum rated flow rate not to exceed 0.20 inches of water.
- C.** All proposed airflow control devices shall include discharge, exhaust and radiated sound power level performance and the laboratory system shall comply with NC levels defined in the ASHRAE Handbook (page 46.25)\*1.

**Table 1. Exhaust Airflow Control Device Sound Power Level**

	Exhaust Sound Power Level in dB (re: 10 <sup>-12</sup> watts)					
Octave Band Number	2	3	4	5	6	7
Center Frequency in Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
<b>1000-50 cfm Device</b>						
800 cfm @ 0.6" wc	63	55	52	54	50	49
200 cfm @ 0.6" wc	46	42	38	37	32	25
800 cfm @ 3.0" wc	73	70	64	66	65	60
200 cfm @ 3.0" wc	51	52	51	50	52	51
<b>1500-100 cfm Device</b>						
1200 cfm @ 0.6" wc	65	58	53	56	52	52
400 cfm @ 0.6" wc	50	45	38	39	37	31
1200 cfm @ 3.0" wc	72	70	62	65	64	60
400 cfm @ 3.0" wc	55	57	55	53	56	55
<b>3000-200 cfm Device</b>						
2400 cfm @ 0.6" wc	63	56	55	58	54	55
800 cfm @ 0.6" wc	51	45	41	42	39	34
2400 cfm @ 3.0" wc	75	71	65	68	67	63
800 cfm @ 3.0" wc	58	58	56	56	59	58

**Table 2. Supply Airflow Control Device Sound Power Level (Discharge)**

	Discharge Sound Power Level in dB (re: 10 <sup>-12</sup> watts)					
Octave Band Number	2	3	4	5	6	7
Center Frequency in Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
<b>1000-50 cfm Device</b>						
800 cfm @ 0.6" wc	62	57	54	58	54	51
200 cfm @ 0.6" wc	45	46	42	44	40	34
800 cfm @ 3.0" wc	72	71	67	75	72	68
200 cfm @ 3.0" wc	53	56	54	58	56	54
<b>1500-100 cfm Device</b>						
1200 cfm @ 0.6" wc	63	59	55	60	54	53
400 cfm @ 0.6" wc	53	49	44	49	45	39
1200 cfm @ 3.0" wc	72	73	69	77	72	68
400 cfm @ 3.0" wc	58	63	61	63	60	57
<b>3000-200 cfm Device</b>						
2400 cfm @ 0.6" wc	64	60	58	63	56	56
800 cfm @ 0.6" wc	52	48	47	52	46	41
2400 cfm @ 3.0" wc	75	75	72	78	73	70
800 cfm @ 3.0" wc	59	62	62	66	62	60

**Table 3. Supply Airflow Control Device Sound Power Level (Radiated)**

Octave Band Number	Radiated Sound Power Level in dB (re: 10 <sup>-12</sup> watts)					
	2	3	4	5	6	7
Center Frequency in Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
<b>1000-50 cfm Device</b>						
800 cfm @ 0.6" wc	44	41	45	41	36	34
200 cfm @ 0.6" wc	33	28	31	29	26	20
800 cfm @ 3.0" wc	53	53	56	57	55	53
200 cfm @ 3.0" wc	41	38	41	39	39	37
<b>1500-100 cfm Device</b>						
1200 cfm @ 0.6" wc	47	53	40	42	38	36
400 cfm @ 0.6" wc	35	39	31	34	33	26
1200 cfm @ 3.0" wc	52	60	54	60	59	53
400 cfm @ 3.0" wc	42	44	43	46	46	42
<b>3000-200 cfm Device</b>						
2400 cfm @ 0.6" wc	58	56	45	47	43	42
800 cfm @ 0.6" wc	45	43	36	39	37	29
2400 cfm @ 3.0" wc	69	68	60	65	63	57
800 cfm @ 3.0" wc	54	53	48	51	50	48

### 2.3 Products

- A.** The airflow control device shall be a pressure independent venturi valve as described in the ASHRAE Handbook on page 13.9, AIA page 33 and NIH Mechanical page D131 section 16-17.
- B.** The airflow control device shall be pressure independent over its specified differential static pressure operating range in compliance with ASHRAE Handbook page (13.9) and AIA page 33. The integral pressure independent assembly shall respond and maintain specific airflow within one second of a change in duct static pressure irrespective of the magnitude of pressure and/or flow change or quantity of airflow controllers on a manifolded system.
- C.** The airflow control device shall maintain accuracy ( $\pm$  5%) of signal over an airflow turndown range of no less than 15 to 1. No minimum entrance or exit duct diameters shall be required to ensure accuracy and/or pressure independence.
- D.** The airflow control device shall be constructed of one of the following three types:
  1. **Class A** - The airflow control device for non-corrosive airstreams such as supply and general exhaust shall be constructed of 16-gauge aluminum. The device's shaft and shaft support brackets shall be made of 316 stainless steel. The pivot arm and internal mounting link shall be made of aluminum. The pressure independent springs shall be a spring grade stainless steel. All shaft bearing surfaces shall be made of a Teflon or Celenex composite. All supply devices will be externally pre-insulated at the factory, except for constant volume devices, which have stand-offs for field insulation. Sound attenuating devices used in conjunction with general exhaust or supply airflow control devices shall be constructed using 24 gauge galvanized steel or other suitable material used in standard duct construction. No sound absorptive materials of any kind shall be used.
  2. **Class B** - The airflow control device for corrosive airstreams such as fume hoods and bio-safety cabinets shall have a baked-on corrosion resistant phenolic coating consisting of

Heresite and applied by a licensed coating company. The device's shaft shall be made of 316 stainless steel with a baked-on corrosion resistant phenolic coating. The shaft support brackets shall be made of 316 stainless steel. The pivot arm and internal mounting link shall be made of 316 or 303 stainless steel. The pressure independent springs shall be a spring grade stainless steel and coated with Heresite applied by a licensed coating company. The internal nuts, bolts and rivets shall be stainless steel. All shaft bearing surfaces shall be made of a Teflon or Celenex composite.

3. Class C - The airflow control device for highly corrosive airstreams shall be constructed as defined in paragraph D.2 and in addition, shall have no exposed aluminum or stainless steel components. Shaft support brackets, pivot arm, internal mounting link, and pressure independent springs shall have a baked-on corrosion resistant phenolic coating in addition to the materials defined in paragraph D.2 and applied by a licensed coating company. The internal nuts, bolts, and rivets shall be phenolic-coated stainless steel and/or titanium. Only devices clearly defined as "Class C" on project drawings will require this construction.

## **E. Certification**

1. Each airflow control device shall be factory calibrated to the job specific airflows as detailed on the plans and specifications using NIST traceable air stations and instrumentation having a combined accuracy of at least  $\pm 1\%$  of signal over the entire range of measurement. Electronic airflow control devices shall be further calibrated and their accuracy verified to  $\pm 5\%$  of signal at a minimum of eight different airflows across the full operating range of the device.

2. All airflow control devices shall be individually marked with device specific, factory calibration data at 8 points. As a minimum, it should include: tag number, serial number, model number, eight point characterization information (for electronic devices), and quality control inspection numbers. All information shall be stored by the manufacturer for use with as-built documentation.

Further, in an effort to assure you receive the value of the product described above the successful bidder should as part of the contract documents be able to provide the following:

### **Preventive Maintenance**

The laboratory airflow controls system supplier shall provide at no additional cost to the owner during and after the warranty period, five years of required preventive maintenance on all airflow sensors (e.g., pitot tube, flow cross, orifice ring, air bar, hot wire, vortex shedder, side wall sensors, etc.), and flow transducers provided under this section in accordance with applicable sections of NFPA 45 (page 45-15 section 6-13-6-13.6)\*7 where detectors and alarms are described. The laboratory controls supplier shall remove the airflow sensors quarterly each year during the five year period to inspect and clean them as to prevent inaccuracies due to long term buildup from corrosion, lab tissues, wet or sticky particles, or other materials that foul the sensor. If airflow straighteners are used they shall be cleaned in accordance with sensor cleaning to ensure laminar air profiles in the duct system. Any waste from this cleaning process must be disposed of in accordance with AHJ guidelines for hazardous waste. If impractical to remove the airflow sensors, the laboratory control system supplier shall include in the proposal the cost of supplying and installing duct access doors, one for each sensor. The transducer shall be checked and recalibrated annually to insure long-term accuracy. Note that auto-zero recalibration of transducers is not acceptable as a substitute for annual recalibration. Include, as part of submittal a copy of the terms, service plan and dates of the no charge 5-year service agreement, intended technicians credentials as noted in Section 3.0 below for review by the engineer, architect and owner. Failure to include service contract information shall be grounds for rejection of proposals or bids.

### **Warranty Period**

Warranty shall commence upon the date of shipment and extend for a period of thirty-six months whereupon any defects in materials or laboratory airflow control system performance shall be repaired by the supplier at no cost to the owner.

### **Experience**

The laboratory airflow controls system supplier shall provide a list of at least five similar laboratory airflow control systems installed in the state as part of this proposal.

The laboratory airflow controls systems supplier shall provide the names, addresses, and the telephone numbers of the consulting engineer and the owner's representative for each of these installations. It is understood that the consulting engineer, owner or owner's representative may contact any or all of the above consulting engineers or owner's representatives and question them regarding timely delivery, the quality of installation, the operation and performance of the equipment and the service requirements for each installation. Unsatisfactory performance or inability to provide references shall be grounds for rejection of proposals or bids.

The laboratory airflow controls supplier shall submit a letter from the manufacture documenting which personal have successfully completed factory training. This letter shall have affixed a copy of the relevant certificate of completion for the individual(s) intended to perform installation or start-up as applicable as well as an outline of the training course completed with the dates the intended start up individual(s) attended this course. Include this documentation with the submittal package for engineer, architect, and owner review and approval. Inability to provide manufacture documentation and certificate(s) of completion shall be grounds for rejection of proposals or bids.

### **Performance Verification**

The alternate laboratory airflow control system supplier shall demonstrate the typical laboratory space that includes multiple fume hoods (4 or more), a general exhaust, and a supply valve for the purpose of verifying the laboratory airflow control system's ability to meet the performance requirements indicated in this specification. All travel and lodging costs to witness the performance verification shall be the responsibility of the laboratory airflow controls supplier.

The alternate laboratory airflow control system supplier, at the time of submitting the compliance schedule described in section 1.3, shall submit a detailed technical proposal for the owner's evaluation. The proposal shall describe the manner of compliance with this minimum performance specification, with particular emphasis on the following areas: diversity and energy analysis; proposed equipment; experience; and performance verification. This proposal shall be separate from any building automation system (BAS) proposal(s), and it shall include the scope of information and services detailed in paragraphs A. through D. of this subsection.

### **Proposed Equipment**

- 1 Any alternate laboratory controls supplier shall provide a detailed proposal describing all elements of the laboratory control system. A schematic laboratory layout shall be provided, showing relationship of these elements and a description of how they interact.
- 2 Technical specification data sheets shall be provided for all proposed system components and devices.
- 3 All proposed airflow control devices shall include discharge, exhaust, and radiated sound power level performance obtained from testing in accordance with ARI Standard 880.
- 4 Suppliers of airflow control devices or airflow measuring devices requiring minimum duct diameters shall provide revised duct layouts showing the required straight duct runs upstream and downstream of these devices. Coordination drawings reflecting these changes shall be submitted by the supplier of the laboratory airflow control system. In addition, suppliers shall include static pressure loss calculations as part of their submittals. All costs to modify the ductwork, increase fan sizes and horsepower, and all associated electrical changes shall be borne by the laboratory airflow control supplier.
- 5 Airflow control devices that are not venturi valves, and airflow measuring devices (e.g., pitot tube, flow cross, air bar, orifice ring, vortex shedder, thermo-anemometers etc.) shall only be acceptable provided they meet all the performance and construction characteristics as stated throughout this document and:
  - a) The airflow control device employs transducers manufactured by Rosemount, Bailey, Bristol, or Foxboro.

Accuracy shall be no less than  $\pm 0.15\%$  of span (to equal  $\pm 5\%$  of signal with a 15 to 1 turndown) over the appropriate full-scale range including the combined effects of nonlinearity, hysteresis, repeatability, drift over a one-year period, and temperature effect.

- b) For any airflow measurement device 316L stainless steel materials shall be provided for all exhaust applications. The use of 304 stainless steel materials shall be provided for all make-up air applications. Provide where minimum duct diameters cannot be fully achieved properly applied flanged straighteners manufactured from 316 stainless steel and mounted according to manufacturer's recommendations. After installation in these instances, manufacturer's representative shall provide certified field test and balance report demonstrating device accuracy per the specification requirements and replace as necessary to achieve device performance.

### Compliance Schedule

- A. Any alternate laboratory airflow control system supplier shall provide a separate compliance schedule, which shall include the section, paragraph, and subparagraph of these specifications and direct statement to indicate compliance or noncompliance with the requirements. For all areas of noncompliance the supplier shall describe what specific and alternative approach has been taken and document the impact this will have on the sizing of the air delivery systems, the required cooling and heating capacities, energy costs and maintenance of building.
- B. The alternate laboratory airflow control system supplier shall furnish a letter of compliance to the engineer, signed by a corporate officer of the laboratory system manufacturer, certifying the compliance and noncompliance items as stated above 20 days prior to the bid for evaluation by the owner, architect and engineer to allow for a reasonable evaluation of compliance.

### Technical Proposal

The alternate laboratory airflow control system supplier, at the time of submitting the compliance schedule described in section 6.0, shall submit a detailed technical proposal for the owner's evaluation. The proposal shall describe the manner of compliance with this minimum performance specification, with particular emphasis on the following areas: diversity and energy analysis; proposed equipment; experience; and performance verification. This proposal shall be separate from any building management system (BMS) proposal(s), and it shall include the scope of information and services detailed in below of this subsection.

#### A. Diversity and Energy Analysis

1. Diversity Analysis of the sizing of the ductwork, fans, air handlers, chillers, and boilers for the laboratory spaces. The analysis shall be based upon:
- 2.

Number of hoods	=	*
Occupied Hours	=	*
User Presence Hours	=	*
Sash Position – User Present	=	100%
Sash Position (a) – User Absent	=	100%
Sash Position (b) – User Absent	=	50%
cfm/Ton Cooling	=	*

The analysis shall provide the following:

- Required Exhaust Capacity w/ user absent sash position (a)
- per manifold (in cfm) w/ user absent sash position (b)
- Required Supply Capacity w/ user absent sash position (a)
- per manifold (in cfm) w/ user absent sash position (b)
- Required Cooling Capacity w/ user absent sash position (a)
- (in tons)w/ user absent sash position (b)

Energy Analysis for the laboratory spaces. The analysis shall be based upon:

Number of hoods	=	*
Occupied Hours	=	*
User Presence Hours	=	*
Sash Position – User Present	=	100%
Sash Position (a) – User Absent	=	100%
Sash Position (b) – User Absent	=	50%
\$/cfm	=	*

The analysis shall provide:

Energy Costs	w/ user absent sash position (a)
	w/ user absent sash position (b)

\* Actual project parameters as defined by the owner or consulting engineer

## 15950 CONTROLS

All controls shall be specified to be industrial/commercial grade.

Indoor space temperatures shall be maintained at a range of 68-74o F. in a heating mode, as measured 4' above the floor and 2' from the exterior wall shielded from the sun and artificial heat sources. Indoor space temperature shall be maintained at a range of 72-78o F. in a cooling mode as measured 4' above the floor and 2' from any exterior walls.

## 15955 BUILDING SYSTEMS CONTROLS

Heating systems shall be zoned to differentiate between north, south, east and west exposures, internal areas, locations of large glass areas with independent controls for each zone, and shall include outside air and zone temperature reset, and solar gain compensation. JCI Metasys EMS used proprietarily to maximize system function and scheduling.

## 15990 TESTING, ADJUSTING & BALANCING

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

The firm's services shall be paid for and the firm shall be selected by the FMD. Under no circumstances shall the balance contractor be a sub-contractor to the General Contractor or the Mechanical Contractor. The airflows shall be set within 3% of the design requirements. The Professional Consultant shall specify all the necessary dampers, extractors, controls and sheaves required to meet these balance conditions. The final air balance will be conducted after all systems are in place and operational, and have been accepted.

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

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

### Equipment:

Equipment shall be adjusted so that indoor ambient conditions to be maintained during the winter are 68o F. minimum measured 4' above the floor and 2' from the exterior wall shielded from the sun and artificial heat sources. Indoor ambient conditions to be maintained during the summer are 78o F. maximum measured 4' above the floor and 2' from the exterior wall shielded from sun and artificial heat sources.

### Air Systems:

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

All air distribution systems shall be balanced in the heating mode.

Provide verification that systems operate at 50% to 75% of capacity as designed.

**Demonstration:**

- Maintenance training sessions shall be required to be provided on all systems. All sessions shall be scheduled through Facility Services. Sessions shall be videotaped by the College.
- All required close-out diagrams, sequence of operations and O/M manuals shall be on site and available at the time of the scheduled training sessions.
- All installed controls shall be properly labeled and identified, schematics and diagrams shall be provided

## DIVISION 16: ELECTRICAL

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### 16000 GENERAL

All work shall comply with the exterior lighting ordinances of the Local Government, with all requirements of the National Electrical Code (latest edition) and requirements of the local power supplier.

All materials shall be new, Underwriter listed and standard first line products of their respective kinds. All electrical work shall be inspected and approved by the FMD or designee. All tests are to be observed by the Owner or its designee.

Any electrical work that will interfere with or interrupt the operation of any existing building services must be coordinated with the CPM at least one (1) week in advance for proper scheduling. This activity may be required to be done during non-working hours at no increase in contract price. Outages shall be for minimum time periods. All preparation work shall be planned and executed prior to the actual outage. Emergency generators will be required in critical situations.

### 16050 BASIC ELECTRICAL MATERIALS & METHODS

**General:**

- In general, no more than six circuits shall be run in a single ¾" homerun if conductors are #12's or smaller. Size of all homerun conduits shall be ¾" minimum.
- Do not combine homeruns when shown separate. If conduit is greater than ¾", fill shall be no more than 50% allowed by NEC.
- Neutral conductors shall be #10 AWG minimum where two or more 20 amp circuits share a common neutral.
- Metallic tags or labels shall not be used inside switchboards, panels and/or MCC's.
- Telephone plates and devices or jacks (modular) shall match electrical device plates and devices, in color and material.
- Panelboards, gutters, junction boxes and other electrical equipment with removable covers shall not be painted other than original factory paint and necessary touch-up paint.
- Different systems shall be run in separate conduits as complete systems with conduit, wire-ways, boxes, etc... Examples of separate systems are as follows: 120/208 volts, 277/480 volts, fire alarm, emergency lighting and power, computer, telephone, intrusion alarms, building automation and energy management. All wiring shall be in conduits or raceways regardless of voltage. All main service, main feeder and general circuitry wiring shall be specified as copper.
- Telephone, cable and power limiter cable for fire alarm systems shall be in conduit unless they are plenum rated. All shall be properly installed and supported.
- Sleeves shall be specified for penetration through floor and shall extend a minimum of 1" AFF (above finished floor). Fireproofing shall be provided for all penetrations.
- All electrical equipment, disconnects, starters, panels, devices and plates shall be installed plumb and true.
- All adjacent boxes shall be aligned and level.
- Devices, junction boxes and equipment will be installed with enough clearance and access to allow maintenance, repair or calibration.
- All Panelboards, disconnects and starters shall be mounted at a height to make testing and maintenance as easy as possible. In no case shall panelboards be mounted so that the maximum height of any circuit

breaker exceeds 78" to top of breaker. For panelboards with excessive height, mount panelboard so that the bottom of the cabinet will not be less than 12" above the finished floor.

- Electrical wires, electronic wires and air lines shall not be run in the same conduit. Control wiring of different voltages for the wiring of electrical equipment shall not be run in the same conduit as power feeders.
- Conductor splices shall only be allowed in outlet boxes, gutters, junction boxes or pull boxes.

## 16110 RACEWAYS

### General:

- Raceway systems shall be installed as complete systems. Support shall be every 10' and within 3' of boxes, cabinets or fittings, and within 18" of each change in direction (per NEC).
- Wiremold or similar, and equal, wireways shall be installed as complete systems using accessory fittings (elbows, end plates, tees, etc.) according to the manufacturer's recommendations assuring a rigid mechanical and electrical connection between parts. Wiremold is acceptable only in exposed locations. If a box is located behind the raceway, the opening in the raceway shall be of the same dimension as the box opening. The opening shall be provided with a bushing.
- Raceway installations shall be made in such a way that no wrench or tool teeth marks are evident.

### Conduits:

- Wiring of every description shall be in an approved raceway. All conduit shall be a minimum of ¾".
- Exception: ½" conduit may be used in walls for dead-end runs only.
- Flexible Steel Conduits shall be used only where approved by the CPM for connection to equipment which is movable for adjustment, mounted on isolation units for elimination of vibration and sound, or for connection from a close-by junction box to lay-in type light fixtures in a "T" grid ceiling. Run green ground wire in all conduits. Seal tight flex shall be applied spirally wound steel.
- Connectors for flexible steel conduit shall be of steel type. Twist on type connectors shall also be of steel type. Under no circumstances shall runs of flexible conduit exceed six feet. Junction boxes shall be as close as possible to fixtures. Junction boxes shall be fully accessible without removing the fixture.
- Type "MC" cable shall be the exception and not the norm. It shall only be used by special permission from the authority having jurisdiction. Type "MC" cable shall be of the steel type, color-coded along its entire external length. Minimum size wire shall be #12. Light fixtures with factory "MC" whips are acceptable when approved per the Engineer / Architect.
- Use of flexible metal tubing or non-metallic flexible conduit is prohibited.
- Minimum burial depth shall be 18" for runs 600 volts or less and 36" for runs over 600 volts. Electrical power ducts and phone communications or data ducts shall be separated by 12" minimum. A minimum of 12" separation shall additionally be maintained between electrical and water and sewer lines.
- PVC shall be totally encased over 600 volts with a minimum of 3000-pound (RED) concrete on all sides of each conduit. For two or more conduits, use approved plastic base and intermediate spacers placed no further apart than 18" from terminations and every five (5) feet thereafter. Tie conduits down securely before concrete pour. For duct bank runs, concrete shall be with aggregate small enough to work around conduits and provide the strength and durability required. Concrete around duct banks shall be carefully vibrated to prevent voids around and under conduits.
- PVC shall not be used to penetrate outside walls or floors. Rigid heavy wall steel conduit shall be used and extended a minimum of 3' beyond the building exterior. High contrast underground hazard 3" wide marking tape with metal locating strip and proper legend shall be placed in the ditch with all buried electrical conduits. If duct bank is more than two conduits wide, use two marking tapes, one at each edge of the trench or ditch. Locating tape shall be placed within 12" of finish grade.
- All conduits shall terminate with a box except communications, data, phone, etc.; lines may terminate with metallic, insulated throat threaded bushings at TTB or cable trays.

- Spare conduits shall be extended up from flush mounted panels to the space above false ceilings and capped. If there is no false ceiling, these conduits shall extend to an accessible location and terminate in a labeled junction box with suitable blank cover. A minimum of 1-3/4" spare conduit shall be provided for each 3 (or fraction thereof) one-pole spares/spaces, with at least 3 spare conduits provided. Surface conduits shall be painted same color as surface it is attached to. Panels, gutters and other electrical equipment with removable covers shall not be painted. Conduits concealed, run in tunnels or equipment rooms shall not be painted.

### **Installation of Conduit:**

- Conduit shall be run concealed, except in certain approved locations. Conduit shall be secured both horizontally and vertically against movement. Listed mechanical fasteners shall be used. Outlet boxes, junction and pull boxes, etc., shall be installed so as not to interfere with any piping, fixtures or equipment. All boxes shall be fully accessible. Exposed conduits shall be grouped in neat parallel lines, properly supported, following the lines of the building structure as closely as possible and as directed. All phone conduits that are buried and contain fiber optics shall have marking tape with metal locating strip 6" above.
- Conduit shall not run through any structural member of the building except as specifically directed by the Architect. Conduit run through ribbed slabs shall run at 45o angles to joints or parallel and in the joints. No running threads will be permitted. Union fittings may be used as necessary. Rigid conduit threadless connectors or couplings, split couplings that bolt together, self-threading or couplings permanently attached to conduit shall not be used unless approved by the Engineer.
- 90o bends in conduit 1-1/2" and larger shall be made with factory bent standard conduit elbows or by hydraulic type benders. No more than four 90o bends (360o) shall be used between pull and junction boxes. No more than three 90o bends (270o) shall be used between pull and junction boxes on data, communications or phone conduits.
- The ends of all conduits shall be cut square, carefully reamed to full size and shouldered in fittings. EMT shall be fully seated in connector and couplings. Drip pans shall be used under threading equipment.
- Roller type tubing cutters shall not be used.
- Conduit installation shall be such that conduits are not abraded, scraped, flattened, dented or wrinkled, and the interior diameter is not effectively reduced. Install conduit in a way that condensation or water cannot be trapped.
- Perforated strap iron or plumber's tape shall not be used for hanging conduit or boxes. Use standard pipe hangers with rings and rods for all conduits suspended from ceilings. Standard 16.5-gauge Ty Wire is acceptable with prior approval, but only when tied per ironworkers tie.
- Runs of one conduit, suspended, shall be on rings with rod hangers with self-drilling anchors or other approved methods. Runs of more than one conduit, suspended, shall be on a strut trapeze support with clamps. Trapeze supports shall be 1-5/8" x 1-5/8" strut channel supported by minimum 3/8" rods. Strut clamps shall be of the nut and bolt type, minimum 300-lb. Static load limit.
- Drive-it straps are not acceptable. Plastic sleeve, lead anchor, rawl plugs or power driven anchors are not acceptable.
- When using all thread or bolts, they must be backed on both sides with washers, lock-washers and nuts (floating unistrut/conduit straps, etc., are not acceptable).
- Electrical, metallic conduits shall not touch any plumbing pipe. Where unavoidable, approved insulation shall be used.
- Upon completion of all runs, all conduits shall be properly sealed until ready to pull wires.
- Install pull cords in all empty conduits and install plates on all communication boxes. All boxes shall have covers or plates.
- Provide moisture-tight hubs for entrance from above or sides of exterior boxes, gutters, panelboards, switchboards, etc...
- Short pulling elbows and 90o connectors shall not be used on conduit sized greater than 1".
- Bushings shall be insulated throat metallic bushings with a 150o C. rating. Bushings shall be similar to T & B #BIM 75 series. Grounding bushings shall be similar to T & B #3871 series.
- All conduits shall be terminated with a box, cabinet, panel, gutter or a piece of electrical equipment. In fixtures, surface metal raceways and boxes where conductors pass through either factory or field punched,

cut or drilled slots or holes in metal members, the conductors shall be protected by bushing material or grommets securely fastened in the opening prior to installation of the unit.

- Units shall have mechanical and electrical continuity. When conduits for communications, telephone or data are to be terminated by being clamped to cable tray, a threaded bushing and connector may be used in lieu of other terminal fittings at the cable tray.
- A Gedney CTC clamp or approved equal shall be used to clamp conduit to cable tray.
- Conduit containing cables rated over 600 volts shall be identified, at least every 20 feet, with high visibility labeling. Transformers, switches, equipment, pull boxes, cabinets, junction boxes and gutters having voltages of more than 600 volts shall be identified as to the voltage of the cables within. Letters and numbers shall be a minimum of 2” high and are to be highly visible contrasting colors.
- “DANGER – HIGH VOLTAGE – KEEP OUT” signs shall be permanently attached to the primary section door on transformers and on doors of sectionalizing switches of 600 volts or more. Signs are to be bilingual Spanish/English and sized according to OSHA codes.
- The firewall integrity shall not be compromised.

**Cable Trays:**

All buildings, except dorms, shall have cable tray facilities for computer and/or communication type wiring. These cable trays to terminate in designated communication room with air conditioning. There must be adequate raceways from the communications room to the tunnel for necessary access, and adequate raceways from floor to floor. Fire stop material must be used for penetration of fire rated walls and all floors. Communication conduits shall be attached to cable trays with listed type clamps, such as Gedney CTC or approved equal, and terminated with threaded insulated metallic bushing on conduit. All cable trays to be grounded (NEC 318-7).

Support for cable tray shall be every 5’ and within 1-1/2’ of terminations or changes of direction.

**Busways:**

Busways shall be installed as a system, with wall flanges at all wall penetrations. Floor penetrations shall have a 1” minimum lip to prevent water from dripping through. Firewalls shall not be compromised.

**16120 WIRE & CABLE**

- Wire shall be type THHN (THWN in damp locations).
- Minimum wire size shall be #12 except for controls wiring. Wire of size #10 and larger shall be stranded.
- All motor wiring and controls shall be stranded.
- Wire shall be color-coded throughout its entire length, except feeders shall be identified with multiple rings or spirals of color-coding tape at terminal points and any other accessible points. Grounded and grounding conductors shall be identified continuously at all visible points.
- Circuits and feeder wires shall be continuous from switch to terminal or most distant outlet.
- Continuity of all conductors shall not be dependent upon device connections, where the removal of such devices would interrupt the continuity of other conductors in the circuit.
- Joints in wiring, #8 B & S gauge, and larger, shall be made with compression only connectors.
- Branch circuits and neutrals shall be tagged in the load centers, with circuit numbers to correspond to the plans.
- When using twist on wire connectors, wires shall be twisted together, with pliers, before applying connector.
- Carefully cable all wires, in panel boards, gutters and wire ways, in a neat arrangement with termination located directly opposite terminals. Label and leave wire loops, not less than 6” long, in each outlet box, even if wires do not stop in the box.
- Color-code wire throughout, including feeders, branch circuits and equipment ground conductors, as specified and indicated.

PHASE	120/208 VOLTS	277/480 VOLTS
A	BLACK	BROWN
B	RED	ORANGE

B	BLUE	YELLOW
NEUTRAL	WHITE	GRAY
GROUND	GREEN	GREEN
ISO	GREEN/YELLOW	GREEN/YELLOW

Wiring for switches shall be the same color as phase wire. Colored insulation shall be used up through No. 6 Conductors. No. 4 and larger may be phase-coded with multiple bands of ½” wide color-coding tape at all accessible locations. Grounded wires (neutral) and ground wires shall have a continuous color-coding at all accessible locations. Maintain the same conductor color-coding from incoming line to last device.

## 16130 BOXES

### General:

- Boxes shall be 4” square as a minimum. For convenience outlets, switch, data, telephone, fire alarm system or intercom outlets use a 4” square or larger box with plaster ring.
- For outlets in unplastered masonry walls, use masonry boxes of the proper depth. The face of all boxes shall be vertical and not more than ¼” in from the finished surface. The mason and electrical contractor shall be mutually responsible for the proper execution of masonry work. Handy boxes or handy box extension rings shall not be used. Boxes shall be no less than 4” square. Use of more than one extension ring is not acceptable.
- Ceiling outlet boxes shall be equipped with 3” plaster rings. Fixture studs shall be provided if fixture is to be mounted directly on box.
- For convenience outlets, switch, data, telephone, fire alarm systems or inter-communication outlets, use 4” square or larger, pressed steel boxes with plaster rings.
- Boxes shall not be installed back to back, even if associated with different systems.
- All boxes shall be grounded to conduit system and bonded to the equipment ground, which shall be bonded to the equipment ground screw, on all devices.
- In walls or ceilings of non-combustible material, boxes will not be set back more than ¼”. In walls of wood or other combustible material, boxes shall be flush with the finished surface. There shall be no broken surfaces, gaps or open spaces at the edge of boxes.
- All surface mounted fire alarm break stations shall be mounted on back-boxes specifically made for the purpose and red in color.
- Pendant outlet boxes shall be highly visible Woodhead #3000 series boxes (or approved equal) with appropriate strain reliefs for the cord. Plates shall match box and outlet used.

### Pull and Junction Boxes:

- Pull boxes and junction boxes shall be identified as to which circuit and panel the run feeds from. Boxes shall be galvanized or metal with baked enamel. Boxes shall be constructed with suitable barriers separating the different systems. Boxes shall be provided with removable covers, secured with machine screws. Gangable boxes shall be used for remodel fish jobs only.
- Conduit shall enter boxes through tight fitting bored or punched clearance holes and be secured to boxes. Provide inserts, or expansion anchors, rods and angle iron members to support pull boxes independently of the conduit runs. Conduit shall enter boxes at right angle with no binding. Offsets shall be used as necessary for proper fit. Offset connectors are not acceptable.
- Install junction boxes or pull boxes in order to facilitate the pulling in of wires or cables. Runs shall not exceed 90° between boxes.
- Branch circuits including neutral conductors shall be left tagged in the panel boards and pull boxes for the purpose of distinguishing the various circuits. Tags to be plainly marked with indelible ink and attached to the wires.
- Pull boxes and junction boxes shall be grounded to conduit system and bonded to the equipment ground, which shall be bonded to the equipment ground screw, on all devices.

**Support of Boxes:**

- Boxes shall be accurately placed, rigidly and securely supported from the structure. Boxes for concealed work shall be set flush with the finished surfaces of the walls or ceilings. Boxes may be supported by rods from the ceiling only when fitted with approved support devices.
- Approved bar hangers, fitted with fixture studs, shall be used to support boxes in ceilings.
- Data and telephone outlet boxes shall be located at heights to match adjoining receptacles unless noted differently for wall-mount phone. In remodeled locations, box height shall match existing.

**16140 WIRE CONNECTIONS & CONNECTING DEVICES**

Push-on devices are not acceptable. Back and side-wired outlets with a tightening screw shall be used.

Devices may not be used as a terminal jumper; all wires are to be pig-tailed.

Wiring devices shall be 20-amp. 15-amp devices are not acceptable. All power outlets shall be according to the NEMA configuration charts.

Cover plates shall be stainless steel type 302, nylon or endura lexan. All plates shall be commercial specification grade. Plates shall be specified for all openings, with devices or blank. All plates shall match devices.

**Receptacles**

**Duplex:** extra hard use specification grade, back and side wired; 2 pole, 3 wire, grounding type, 20-amp, 125 volt, White (NEMA 5 – 20 r) Hubbel #5362, or approved equal. Back wire through a hole with clamp type wiring assembly suitable for stranded wire.

Ground Fault Circuit interrupter: 2 pole, 3 wire, grounding type, 20-amp, 125 volt, White (NEMA 5 – 20 r) Hubbel #GF5362, or approved equal. Surge suppression with Isolated Ground, 20-amp, 125 volt, blue, UL listed to Standards 498 and 1449, Hubbel IG #5352 S.

**Isolated Ground:** 20-amp, 125 volt, Orange, Hubbel IB #5362 BR. Use Green wire with Yellow stripe for tracer for isolated ground wire. In addition to isolated grounds, an equipment ground shall also be provided. The equipment ground shall be pulled and bonded to the box.

All plugs and receptacles shall have the configuration specified by NEMA charts for circuit characteristics where they are being used. Hubbel numbers are used to establish a standard.

Receptacles shall be 18" to bottom in stud walls (per the current requirements of the Americans with Disabilities Act), or 48" or 40" where table, workbenches and counters occur, or as noted. In remodeled locations, box heights shall match existing. Receptacle outlets in office areas and classrooms, designated for instruction in the use of office or lab equipment, shall be located at a maximum of 6' on center.

**16195 ELECTRICAL IDENTIFICATION**

Provide plastic laminate (black with white letters) labels mounted on equipment switches, disconnects, etc. designating unit controlled, panel and circuit #. Mount with machine screws.; stick-on tape of metal or plastic are not approved. All finished devices, duplex, receptacles, light switches etc. , Shall be labeled with panel and circuit. Red with white letters shall be furnished for emergency equipment. Panel board cabinet doors shall be labeled with panel designation and voltages. Letters to be a minimum 3/8" with inscription centered on plate. For equipment with spare breakers or spaces, the labels shall be left blank for future engraving.

KWH meters to have multiplier marked on meter. CT cabinets shall have ratio labeling on the outside of the cabinet.

**16300 HIGH VOLTAGE DISTRIBUTION (ABOVE 600 VOLTS)**

The primary electrical distribution system throughout the campus is an APS network and is distributed at 12470 Volts Each new building shall provide the necessary switches and transformers for its connected load.

High voltage cable shall be ethylene-propylene-rubber, 133% insulation and shielded cable with a 40-year warranty.

High voltage switchgear shall be pad mounted, low profile, dead front type, and S & C manufacturer.

## 16320 TRANSFORMERS

Service transformers shall be liquid cooled non-PCB type. Locate at exterior service side of building for accessibility. A concrete lip of 36" shall extend on the door side of the pad mount transformers and pad mount sectionalizing switches, 6" on other sides. Penta head bolt shall be used on transformer door (Penta head socket to be turned over to FMD when job is complete).

Transformers shall not be located in basements or other areas subject to contaminant by floodwaters.

## 16400 SERVICE & DISTRIBUTION (600 VOLTS AND BELOW)

All switchboard, distribution panel, MCC and branch circuit panel board buses shall be copper. All cans shall be field punched. Pre-punched knockouts are not approved. All switchgear shall be specified as Siemens or equal.

Panic buttons shall be installed in each electrical service entrance switchboard room at the exits. These panic buttons shall be wired to a shunt trip main breaker in parallel with the ground fault trip. The buttons shall be Allen Bradley #800T-BGA (or approved equal) extended head red push-button units with Allen Bradley #800-N13 (or approved equal) extra-long guard ring. These panic buttons are to be marked "EMERGENCY POWER OFF SWITCH" by a red and white laminate label. Mushroom head pushbuttons are not acceptable.

## 16420 SERVICE ENTRANCE

Service entrance switchboards shall be provided with ammeter, voltmeter (both with phase switching positions and off positions). Provide kilowatt-hour meter with demand register. Multiplier shall be marked on meter. Label switchboards with CT ratios. KWH meters shall be adaptable to supply a pulse train output for future EMCS System. Metering tied to EMS.

Provide an equipment ground, sized per NEC, shall be pulled and connected to all devices.

All conductors used for grounding will be color-coded green continuously in all visible places, cabinets, equipment, pull boxes, junction boxes, switchboards, etc., or shall be bare copper continuously.

Conductors used for isolated grounds shall be Green with Yellow stripe or tracer.

## 16460 BONDING

The non-current carrying metal parts of all outlet, device, pull and junction boxes, gutters, motors, cabinets, switchgear and panels shall be bonded to an equipment ground.

## 16470 PANELBOARDS

Panelboards shall be single door. The exterior surfaces of all cabinet fronts shall be painted with two coats of gray lacquer over a filler coat. Panelboards and cabinets shall be of a sufficient height and width to allow a minimum of 4" of wiring gutters around all sides. Minimum size shall be 20" wide x 5-3/4" deep; maximum width shall be 22". The doors should be keyed alike.

Buses shall be copper. Main breakers shall be provided, center-mounted, in line with bus. Acceptable manufacturers are: GE, Square D, Crouse-Hinds or Westinghouse with Square D being the preferred manufacturer. Cover fastening bolts shall be accessible only when cabinet door is open. Cans shall be galvanized steel with blank end walls. Knockouts to be field punched. When more than one panelboard is used at the same location, they shall be mounted the same height.

Panelboards shall be circuit-breaker type. All Circuit breakers in 120/208-volt and 277/480-volt panels shall be bolt-in type. Circuit breakers in 277/480-volt panels shall be bolt-in type. All circuit breakers shall be specified as Siemens or equal. Breakers shall be numbered between the breakers. Decal numbering is not satisfactory. Panels shall be sequence phased. Two pole or three pole breakers shall be the "AB" common trip. Breaker handles shall not be tied together to make a multi-pole breaker. All circuit breakers shall be of the same manufacturer as the Panelboards.

Furnish and install neat directory form with cover of thick plastic on inside of each panel cabinet door. Provide typewritten list of complete circuits in directory frame, showing portions of building or equipment supplied by each circuit. Use room numbers painted on doors as designated by Owner. Minimum size shall be 5" x 8" for panels up to 20 circuits, two for panels above 20 circuits, or 6" x 11". Numbering to be odd on the left and even on the right. Submit sample directory with submittals.

Independent surge suppression shall be considered for computer intensive and/or critical information dependent offices. Surge suppression shall:

- Use indicator light
- Lifetime warranty
- All modes of protection
- Active phase indicator lights
- Parallel connection
- Surge current 100 amps minimum

## 16480 MOTOR CONTROL

Motors shall have disconnecting means furnished by the Contractor. Westinghouse, Cutler Hammer, Square D or Crouse-Hinds are approved manufacturers. Magnetic switches shall be installed on motors 1hp or larger (controls to be 120 volt). Magnetic switches shall have green and red pilot lights, in covers.

All switches to be HD (heavy-duty).

Single-phase motors are to be protected with Allen Bradley Bulletin 600 or Fusetrans. All magnetic switches to have one overload relay per phase.

## 16490 SWITCHES

Toggle: extra hard use specification grade, back and side wired, 20 amps, 120/277 volts, white, Hubbel #1221.

Momentary contact: 3-position, Hubbel #1557.

Lighted toggle: clear, Hubbel #1221, ILC.

Pilot toggle: clear, Hubbel #1221, PLC.

All switches to have body securely locked to bridge by staked screw assembly. Back wire through a hole with clamp type wiring assembly suitable for stranded wire.

Lighted toggle switches shall be used in all tunnels and equipment rooms so switch locations will glow in the dark.

Lighted toggle switches shall be white or clear, not red or ivory.

Toilet rooms shall be equipped with motion sensing switches for both lights and fans controlled by EMS. Switch plate covers: Stainless steel, if requested by electric shop. Plates in exposed wiring to be steel rounded to box edge. Oversized plates are not acceptable.

Wall switches shall be on the latching side of doors according to the architectural plans. All switches shall be 48" high to the bottom of the switch, except where located in cabinets, see details.

## 16500 LIGHTING

Interior lighting shall be designed to the maximum efficiency incorporating energy saving fixtures and day lighting when possible. Target range for lighting electrical consumption should be no more than 1.5 watts/s.f. (Reference: lighting levels table in Design Guidelines). LED is preferred.

## 16501 LAMPS

Specification of fluorescent fixtures shall only be allowed when specifically authorized in writing by the FMD.

## 16510 LIGHTING FIXTURES

Fixtures mounted in plaster or drywall ceiling shall be rigidly supported in approved manner with channel supported across plaster framing. Provide proper plaster frames for all fixtures requiring them. Wiring for fluorescent fixtures is to be accessible after fixture installation, without requiring removal of the fixture from the ceiling. Mount all fixtures with a minimum of three ¼" bolts for 1' x 8' fixtures; two ¼" bolts for 1' x 4' fixtures; and four ¼" bolts for 2' x 4' fixtures. Only approved anchors shall be used (toggle bolt may not be used in damp location).

Recessed fixtures shall be supported to the supporting building structure above (not the roof deck). All fixtures shall be supported on at least two points (opposite corners each individual fixture). Support shall be with #12-gauge wire with a minimum of 3 twists of wire at each point of attachment. Two or more wires shall not be supported by a single anchor. Point of attachment and anchoring shall be approved by the Engineer. Install strut channel as necessary to provide support between building structure.

Contractor shall note that if certain areas in the building contain fire rated ceilings which require fire rated enclosures, the fixtures supplied for use in these areas shall be approved and suitable for the purpose.

## 16530 SITE LIGHTING

- All exterior shall meet the requirements of the local and county ordinances.
- Vehicular, pedestrian and parking lot lighting to be designed at a high security level from dusk until 10 PM at an average of 3 to 4 foot candles with a minimum of 2 foot candles.
- After 10 PM lighting designs to lowered by 50% to provide energy savings in parking lots only.
- LED lot style fixtures to be the standard.
- Pole base's to be set on minimum of 24" tall concrete supports as per IBC/UBC standards in parking or traffic areas.
- Label circuit #, panel and building # on the inside of the light pole hand hole cover plate with permanent marker. Minimum wire size shall be #10. All wire to be stranded.

## 16535 EMERGENCY LIGHTING

The preferred concept for emergency lighting is the use of a centrally located low voltage emergency lighting system. These systems will have a power source consisting of a power supply to operate lighting and a battery system to run the lights when normal power is lost. To maintain an already existing system, an acceptable alternate is specification of sealed beam emergency lights with individual power packs. Such power packs shall be run on the same circuit as the lighting in that room. All other power for emergency lighting systems, without exception, shall be run from "E" panels.

### **Exit Lights:**

When renovating, exit light fixtures shall be fitted with LED type. LED exit lights shall be specified for all new applications.

## 16610 UNINTERRUPTABLE POWER SUPPLY SYSTEMS

Projects requiring emergency power shall have a feasibility study; inverter/generator vs. individual battery packs. Short battery life due to temperature extremes, vandalism, unreliability and high maintenance costs of battery packs should be considered in the study.

Switch and outlet plates for devices on emergency power shall be red and engraved "Emergency Power".

## 16660 GROUND FAULT PROTECTION SYSTEMS

Ground fault protection systems for personnel shall meet or exceed the latest NEC standards. All exterior receptacles, or receptacles within 6' of a water source (such as a sink, eyewash, drinking fountains, emergency showers, hose bibs, etc.,) shall be GFI.

## 16670 LIGHTING PROTECTION SYSTEMS

Lighting protection systems shall be per NEC, latest edition, and/or the Engineer/Architect's specifications, whichever is more stringent.

## 16721 Fire Alarm

Manufacturer: Subject to compliance with specific project requirements YC has a proprietary contract with Notified (Onyxworks) for fire alarm control panels, parts and accessories. Provide mapping with proper descriptions programming into Onyxworks of all changes or new installations.

Tests of the system should follow in accordance with the procedures outlined in NFPA 72H, Chapters 2 and 4 and NFPA 72E, Chapter 8

Provide maintenance of the fire alarm system and equipment for one year after substantial completion

# Telecommunications Design Guide And Infrastructure

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## Yavapai College Information Technology Services November 2000

### 1. Introduction

The purpose of the Telecommunications Design Guide and Infrastructure Standards is to establish a strategic direction for the physical connection of communications devices at Yavapai College. This document sets forth the overall standards and recommended guidelines for the physical telecom network comprised of cabling, connectors, outlets, patch panels, patch/drop cords, and supporting infrastructure such as equipment rooms. It will serve as both a design guide for architects and as an infrastructure standards guide for college staff.

The convergence of voice, video, and data communication systems creates a need for standardized cabling systems. It is expensive and time-consuming to continually change cabling systems to support different computer systems, network configurations, and the relocation of employees. In recent years, national and international standards organizations have been developing standards for the various elements of telecommunications cabling systems. Yavapai College's implementation of these standards will ensure a flexible and uniform Data / telecom environment and:

Provide for architecture based on documented standards, to support efficient, long lasting and cost-effective, data/ telecommunications operations.

Improve the service levels from departments and/or vendors providing telecommunications-based services to end users thereby reducing the amount of time required to install, implement, or relocate systems. Provide the ability to operate many different technologies on a common cable plant.

Eliminate installation of non-standard, vendor-unique cabling by providing industry standard cabling

Improve network manageability through uniformity in cable systems, networks, network interconnectivity and workstation connectivity

Facilitate automated cable system management through the use of uniform and industry standard identification and numbering schemes.

Allow for the implementation of anticipated high speed, high bandwidth LANs and WANs required by specialized applications.

### 2. Network Infrastructure Design Overview

Given the importance of uniform cabling standards across the college district, the need to prepare for next generation of data/telecommunications applications, as well as the implications of the Master Plan, Yavapai College has adopted an aggressive infrastructure upgrade plan. The following paragraphs will provide an overview of the infrastructure to be provided by contractors in both renovation and new construction projects. This section is

intended to provide an overview only. Specific standards will be addressed in Section 3 of this document. Yavapai College has standardized on switched (100mb) Ethernet technology to the desktop, Cabletron backbone switches with 100mb or 1gb up-links, and T-carrier wide-area network connectivity. Any renovation or new construction plans must include the following components:

All new buildings and renovations will be wired with Category [5e or 6] cabling, as specified at the time of the award.

There must be a minimum of two information outlets (as defined in section 3.8a) in each office space on opposite walls. There must be at least two information outlets in each classroom and a sufficient amount of data jack outlets (4 jacks minimum at each outlet) for the classrooms intended function. Locations will be specified in job drawings. Fiber optic data jack installed for future use in classrooms with twenty (20) or more data jacks.

A fiber optic backbone system, to link Telecommunications rooms,

Each lab, classroom or common area shall have at least one Cat 5e or 6 drop terminated on an RJ45 jack above the drop ceiling at the approximate center of the room or as specified in the job drawing. This wire shall run to a patch panel in an IDF for future wireless or video applications.

Distance learning systems, and other video delivery systems will be used extensively to deliver instruction. As a result, any renovation or new construction plans must include a multimedia distribution system (appropriate to current technology) that will provide one (1) dedicated multimedia outlet to each classroom and each conference room. (A multimedia outlet will be defined by the application)

### 3. Standards and Guidelines

#### 3.1 Infrastructure Designer Qualifications and General Information

Construction projects require the use of a Registered Communications Distribution Designer (RCDD) with a current Building Industry Consulting Service International (BICSI) registration. Technology moves, adds, and changes after initial construction will be the responsibility of Yavapai College's Information Technology Services Department, Network Services group; or their approved contractor. Other Campus personnel are not authorized to install network wiring or network equipment

T-series numbers in the approved Construction Drawings shall identify communications/data drawings. The communications/data section of the specifications manual shall be numbered separately and distinctly from other sections.

#### 3.2 Infrastructure Installer Qualifications and General Information

The cable plant installers shall be certified for the level of cabling specified in the contract. The cable plant installer must meet all warranty related guidelines of any manufacturer specified in the contract. Copies of certification must be submitted to ITS prior to project commencement.

#### 3.3 Local Code and Regulatory Requirements

All pertaining statutes, ordinances, rules, codes, regulations, standards, and the lawful orders of all public authorities having jurisdiction over the construction of telecommunications cable systems shall be followed in the design and installation of new cable systems. These include, without limitation, applicable building codes, handicapped regulations, municipal codes, fire codes, State Statutes and the regulations of the Occupational Safety and Health Administration (OSHA) unless superseded by State Statutes or local law.

#### 3.4 EIA/TIA Standards

Yavapai College's telecommunications infrastructure standards shall generally follow the applicable standards and technical service bulletins published by the Electronic Industry Association/Telecommunications Industry Association (EIA/TIA). The specific EIA/TIA standards are indicated in sections within this document. While the EIA/TIA standards are considered the primary standards, other organization's standards, such as the Underwriter's Laboratory (UL), the American National Standards Institute (ANSI) and the Building Industry Consulting Service International (BICSI) shall also apply.

#### 3.5 Telecommunications Rooms/Equipment Rooms

Telecommunications rooms (TR) contain workstation wire terminations as well as riser or distribution cable terminations necessary to cross-connect workstations to network or telephone equipment. TRs must have the space

and environmental facilities required by the electronic equipment used in today's enterprise networks, including hubs, switches, and backbone multiplexing systems, fiber optic distribution panels, workstation patch panels and other devices. Every building is serviced by at least one TR with a minimum of one TR per floor. There is no maximum number of TRs that may be provided within a building.

The following guidelines shall apply to Yavapai College's Telecommunications rooms:

Racking shall be used to house termination patch panels and network equipment. Racks shall be 84 inches (2133 mm) tall, 19 inches (482 mm) wide and be EIA/TIA standard racks of heavy-duty grade A aluminum with a clear finish. The racks should also be of a standard floor mount design with a two-sided EIA hole pattern. Separate racks shall be used to mount patch panel equipment and network equipment with a minimum of three (3) feet between rows of racks. (Hubbell rack PN HPW84RR19ML)

Wall mounting is only acceptable when approved by ITS prior to installation.

Each telecommunications room shall be a lockable (keyed to ITS) enclosed room dedicated to telecommunications equipment and termination hardware. The doors will be fully opening (to 180 degrees) that are 3.0 ft (0.91m) wide and 6.7 ft (2.0m[80 in]) tall. Doorsills should not be provided, if allowed by code, because they impede the movement of equipment.

The sizing of the rooms should be based on the size of the floor area to be supported, the maximum number of workstations anticipated, and applicable growth factors. The following table shall be used for sizing of the rooms:

Serving Area	Closet Size
ft <sup>2</sup>	ft x ft
10,000	10 x 11
8,000	10 x 9
5,000	10 x 7

Equipment rooms shall provide for .75 ft<sup>2</sup> for every 100-ft<sup>2</sup> workstation space with a minimum of 150-ft<sup>2</sup> floor areas.

The environment of the equipment rooms is very important. The rooms shall have adequate air conditioning to support planned equipment. TRs temperatures shall be limited to a range between 50° F (35° C) and 85° F (29° C) maximum with a relative humidity between 55% and 85% based on a continuous heat load of 3000 watts. A ventilation fan on a UPS circuit controlled by a thermostat set to 95° F shall be provided in the event of an air conditioning failure.

The rooms shall be equipped to provide adequate electrical and grounding facilities as follows.

Branch circuits for equipment power that are protected and wired for 20A capacity.

A minimum of one dedicated, (non-switched), 120v 20A duplex outlet, on a separate branch circuit, per equipment rack.

Separate duplex 120 V 15A convenience outlets which are located at least 6 in above the finished floor at 6 ft intervals around the perimeter walls (outlets heights of less than 15in are allowed because the TR is not considered a public space) [if allowed by local code].

Coordinate light switch locations for easy access upon entry.

The building earth ground rod in one first floor closet of every building will be looped to all other communications closets in the building with a minimum #6 AGW wire.

All closets containing critical equipment (as defined by ITS) should have an uninterrupted power supply of 200% of the initial power demand for a period of 60 minutes.

Closet walls should be lined with ¾-inch AC fire-treated plywood, with the "A" side exposed and painted white. Plywood is to be eight (8) feet high sheets. The plywood backer is to be installed on a minimum of three walls.

Depending on the room layout the plywood backer may also be installed on the fourth wall.

Twelve (12) inch ladder-rack (unless otherwise specified by ITS) shall be used to support cable above working closet walls and racks. Ladder-rack shall be Hubbell Next-Frame or ITS approved equivalent.

Switched fluorescent lighting shall be supplied and shall produce a maintained average of 50 foot-candles of horizontal illumination with a working plane of 30 inches. If RF ballasts are used, they shall conform to FCC CFR47 Part 15 and shall not produce any electrical interference with communications equipment.

Wire management shall include one (1) 2-position wire management panel for each 48 ports and not less than two (2) panels per rack.

Horizontal wire management panels shall be Hubbell Part number HC219CE3N or ITS approved equivalent.

Vertical wire management shall be dual channel Hubbell metallic CPI 11729-503 or ITS approved equivalent,

placed between all racks. In a single rack application, one side vertical wire management is required. Patch panels are to be Hubbell c5e 24/48 port as required for the projected usage w/568B jacks, Part Number: P5E24B19E for 24 port, and P5E48B190E for 48 port or ITS approved equivalent. The outlets shall be terminated on the patch panels in the rack in order from lowest to highest workstation number, left to right, top to bottom as follows: Actual connection to telephone/data system shall be held in abeyance until cable certification is completed in accordance with current IEEE and BICSI standards.

Telecommunications rooms shall require a minimum of 12 strands of multi-mode fiber between them and the entrance facility (unless otherwise specified by ITS). A minimum of twenty (20) foot service loop is required at each end. The service loop shall be coiled neatly and secured to the main board observing the minimum bend radius in the manufacturer's specifications.

Fiber connectors shall be ST style and duplex. Fiber termination devices shall be rack mounted in the highest position on the rack. Using Hubbell PN FPR3SP fiber panel.

Telecommunication Rooms shall be placed so that a maximum horizontal distribution distance to a workstation does not exceed 300 feet (90 m). The closet is to be located as near to the center of the service area as possible. Each floor shall have at least one Telecommunications Room. Telecommunications rooms shall stack unless otherwise specified by ITS.

Each Telecommunications Room shall have uninterrupted access without interfering with normal business activities. Access to the room should be direct from corridors and should not be via classrooms, conference rooms, etc. All racks and cable ladders shall be bonded with a 10 AWG copper bonding jumper and have the proper aluminum to copper fittings where required.

Each Telecommunications Room shall have cable ladder above each plywood-clad wall.

Each Telecommunications Room shall have a minimum ceiling height of 8'-6". The flooring shall be light-color, vinyl tile.

Each Telecommunications Room shall have an analog wall mount phone.

Spare patch panel outlets shall be installed to provide for a minimum of fifteen (15) percent growth.

Adequate workspace shall be provided in all Telecommunications Rooms for technicians to work on all equipment and wiring. There will be a minimum distance of three feet (3'), between rows of racks and between racks and the walls.

### 3.6 Inside Plant Cabling and Requirements - Horizontal

Horizontal cabling runs from rack to wall outlet. Use the following standards:

Install cables with two (2) feet of slack at each outlet or at the entrance of the conduit.

Provide at least two (2) 4-inch empty conduit stubs from each Telecommunications Room to an accessible above-ceiling location for future use. Provide fire stopping where necessary.

Keep cables a minimum of eighteen (18) inches away from EMI-producing fixtures, transformers, etc. Where the distance cannot be maintained install cables in metallic conduit. Support free-run cables at distances not exceeding five (5) feet.

Use tubular cable raceway or cable tray, minimum twelve (12) inch wide, routed above corridor ceilings, supported by wall brackets or hanger rods, unless otherwise specified by ITS.

Provide one (1) 3/4-inch empty conduit stub from information outlets up to an accessible above-ceiling location.

Outlet boxes in hard-walled office areas and serving modular furniture systems shall be two (2) inches x four (4) inches and as deep as possible with mud rings. Junction boxes, if specified shall be four (4) inches x four (4) inches and as deep as possible.

Provide three (3) 4-pair extended frequency Category 5e or Category 6 cables to each information outlet, as specified by ITS.

Category 5e cable installation and termination practices shall be in compliance with EIA/TIA Technical Bulletins TSB-40 and TSB-95 as well as BICSI standards.

Horizontal cable will be plenum rated and must be classified as meeting the low flame spread and smoke producing characteristics of the National Electrical Code, Section 800-3(d)(b), as determined by the Underwriter's Laboratories.

Install horizontal cable without bridges, splices, or half taps.

All newly installed telecommunications conduits shall be used to support and protect communications cabling only. Under no circumstances shall any AC line voltage, or electrical cabling, be located within any conduit used to route communications cabling.

No section of conduit shall contain more than two (2) 90-degree bends between pull points or junction/pull boxes.

### 3.7 Inside Plant Cabling and Requirements – Backbone

Backbone distribution system is the part of a premises distribution that provides connection between equipment rooms (ER), telecommunications rooms (TR), and telecommunications service facilities.

Backbone systems have become a major concern of code authorities. The distribution designer must check all current local and national codes and regulations.

The following backbone cabling standards shall be followed:

**Fiber optic cable:** Fiber optic cable shall be certified to meet or exceed the current specific requirements of table 770-50 of the NEC, as well as American National Standards Institute (ANSI) Fiber Distributed Data Interface (FDDI) specification. Substitutions of cable will only be authorized if in accordance with section 770-53 of the NEC. The cable shall be enclosed in orange innerduct.

**Copper Riser Cable:** Riser cables shall be 24 AWG solid copper conductors with plenum rated sheath as specified in table 800-50 of the NEC. Substitutions of cable will only be authorized if in accordance with section 800-53 of the NEC. Or PVC jacket as required. Cable shall meet or exceed 100Base-T testing standards for attenuation, impedance, pair loss and cross talk (NEXT).

**Electrical Metallic Tubing:** Electrical Metallic Tubing (EMT) conduit shall be a minimum of four (4) inches in diameter. EMT shall be used to house all backbone cable, except in vertical riser shafts, in which steel sleeves shall be used as the routing shaft. All backbone cable in vertical riser shafts shall be secured to a permanent building fixture at least every ten (10) feet (3m). No other conduits or pipes shall be used to secure any cabling.

The design team and contractor shall be prudent in the cable placement design plan and installation of intra-building cabling to fully utilize already existing individual conduits or sleeves if available. This will avoid the need to install new additional conduits or sleeves. A fully utilized conduit shall be considered at its maximum when it reaches a forty (40) percent fill ratio.

Backbone access between floors shall consist of a minimum two (2) 4-inch (100mm) steel sleeves. These should extend two (2) inches (50 mm) above the finished floor. After cables are installed, the sleeves shall be appropriately fire stopped with approved putty. This includes any unused conduit sleeves. Fiber optic cable between vertical shafts shall be housed in fire-rated innerduct in EMT conduit.

Empty fire-rated innerducts, with pull cords, shall be installed in all fiber conduit pathways not fully utilized. This will facilitate potential future cable pulls. Additionally, the transition of all fiber optic cables within vertical shafts will be housed in fire-rated innerduct or EMT conduit.

All newly installed telecommunications conduits shall be used to support and protect communications cabling only. Under no circumstances shall electrical cabling be located within any conduit used to route communications cabling. The installation of all cable shall be as straight as possible. Routing should be along hallways using adjacent walls of the corridors whenever possible.

No section of conduit shall be longer than 100 feet (30 meters) or contain more than two (2) 90-degree bends between pull points or pull boxes.

Pull or splice boxes shall be placed in a readily accessible location. Pull boxes shall not be placed in a fixed false ceiling space unless immediately above a marked, hinged panel.

Bonding and grounding of backbone pathways and cable shall comply with EIA/TIA 607 Grounding Standards and applicable electrical codes.

### 3.8 Information Outlets

All information outlets will be of a modular design that will allow for the easy transition to other connector types if needed in the future. At a minimum, provide three (3) 4-pair extended frequency Category 5e or Category 6 cables (as specified by ITS) to each information outlet. Each information outlet shall be equipped with three (3) 568B jacks (see attachment 4.2). In some workstation locations it may be necessary to install additional information outlets (see attachment 4.3) depending on the number of physical devices requiring connectivity.

The wiring sequence in the jacks shall not be altered or reconfigured. Under no circumstances should it be necessary to rewire a jack to accommodate a specific manufacturer's equipment. If any equipment requires a nonstandard wiring sequence, the adaptation shall be made with customized drop and patch cords or modular-tomodular adapters.

Information outlets in new construction or renovations require a two (2) inch x four (4) inch 'deep' box.

Fiber connectors shall be epoxy cure or hot glue. Crimp type connectors may be used with ITS certification prior to the project commencement.

### 3.9 Outside Plant Cabling and Requirements

All outside plant cable shall be gel filled and installed in conduit sufficiently protected to prevent damage. Copper interconnect cable shall be 24 AWG solid copper conductors insulated with gel filling rated PE-89 or better. Cable shall meet or exceed 100Base-T testing requirements for attenuation, impedance, pair loss and cross talk (NEXT). Fiber optic backbone cable shall be multi-mode and/or single-mode optical fibers (as specified by ITS) contained in a single orange innerduct within the conduit.

Multi-mode and Single-mode fiber shall comply with the current standards of EIA/TIA and BICSI as specified by ITS.

### 3.10 Basic Pathway Materials and Requirements

#### 3.10.1 Communications Conduits – Underground

Two (2) 4-inch conduits shall be required from the main Telecommunications Room. The first shall run to the QWEST pedestal and the second shall run to the right-of-way that provides a likely path to a competitive access provider (CAP) for future use. All conduits shall have a pull rope installed and the second conduit shall be capped and covered with a 3M Model #1255 electronic mini-marker. Three (3) 4-inch conduits shall be provided between telecommunication closets. One of the 4-inch conduits shall have a minimum of four (4) 1-inch innerducts with pull ropes installed. A continuous, separate 8 AWG tracer wire shall be installed in the conduit external to the interducts. Each conduit will be labeled at each end indicating the destination of the conduit.

No section of conduit shall contain more than two (2) 90-degree bends between pull points or pull boxes. All underground conduits shall be schedule 40 PVC and shall be buried a minimum of 36 inches (1m) to the top, with a minimum one (1) sack ABC slurry backfill surrounding the conduits in a four (4) inch (100 mm) envelope. Conduits installed, Particularly PVC, passing under roads, driveways, or areas of vehicle movement need to be encased in concrete for 3' on either side of the pavement. And must follow all pertinent local and State codes as well as Yavapai College Facilities standards.

Underground risers shall extend four (4) inches (100mm) above the finished grade. Bend radii shall be not less than ten (10) times the diameter of the conduit. Where conduits enter from underground, at the building floor, the conduit shall be buried deep enough so that the entire bend is underground.

**An electronically detectable six (6) inch (152 mm) fiber warning tape shall be installed** twelve (12) inches (305 mm) above the conduits.

An electronic marker, 3M model #1255 mini-marker, shall be provided at the location of any capped conduit not in a building. Unoccupied or capped conduits shall have pull rope installed, secured at each end.

All conduits shall be permanently labeled with location of opposite end.

Minimum underground conduit size shall be two (2) inch (50mm) IN diameter.

#### 3.10.2 Communications Conduits – Above Grade

Minimum conduit size shall be 1-inch (25mm). Conduits shall be routed parallel or perpendicular to the building lines. NO diagonal runs will be permitted.

Conduits two (2) inches (50mm) and smaller shall be steel EMT. The EMT shall be galvanized on the outside and coated on the inside with a smooth hard finish of lacquer, varnish or enamel and shall comply with UL Standard UL797 and ANSI C80-1. EMT couplings and box connectors for EMT shall be of the steel compression gland type. Conduits 2 ½ inches (64mm) and larger shall be rigid galvanized steel (RGS). RGS conduit shall be hot-dipped galvanized steel with zinc coating or corrosion resistant lacquer on the inside, and shall comply with UL Standard UL6 and ANSI C80-1. Fittings shall be threaded, water and concrete-tight.

All conduits subject to mechanical injury or exposed to the elements shall be rigid galvanized steel.

Conduit from a workstation that does not run home to the Telecommunications Room but rather is specified as a stub out above a lay-in tile ceiling shall include a gentle sweep toward the proposed Telecommunications Room, a connector and bushing installed in the end.

Where conduits are not contiguous from workstation to closet, cables must be supported in an approved method (Jhooks or cable tray system) at intervals not exceeding every five (5) feet (1.5m).

Raceways and conduits passing through fire barriers shall be fire stopped in accordance with all local, State, and NFPA codes. Fire stopping rating shall match the rating of the wall being penetrated.

#### 3.10.3 Junction and Pull Boxes

Boxes shall be of the size required by the National Electrical Code or larger in size. Except as noted on the Drawings, or as hereinafter specified, boxes shall be fabricated of galvanized steel and each shall be of a type approved for its particular location and purpose. A pull box will be installed in a run at 100 ft. intervals or after two 90-degree bends.

Junction boxes shall be four (4) inch square deep. Junction boxes shall have proper cover plates to match the surrounding environment. Junction boxes shall not open into finished areas unless specifically permitted by the Project Manager. If determined necessary for cable installation, additional pull boxes or junction boxes may be installed in unfinished areas or in concealed but accessible locations.

Where pull boxes larger than outlet boxes are required, galvanized steel boxes may be used with covers attached by brass machine screws. Boxes exposed to the weather shall be approved for that purpose, have conduit entrances on the side, and shall have an interchangeable hub with gasket and adapter nut. Pull boxes exposed to the weather shall be gasketed and weatherproof.

### **Underground Pull Boxes and Vaults**

Pull boxes shall be pre-cast concrete 56 inches x 56 inches x 50 inches (1422mm x 1422mm x 1270mm) including locking cover piece. Cover shall be metallic, H/20 traffic rated and gasket to be weather-tight and lockable, and be securable with bolts and have a watertight seal. Pull boxes shall have eight (8) inch (203mm) diameter sump for drainage, ground knockouts, recessed pulling irons and “C” channels pre-cast into the form. The end form shall provide an 18 inches x 18 inches (457 mm x 457 mm) knockout on each face. Pull boxes shall sit on a minimum twelve (12) inches (305mm) of gravel to assist drainage. The top plane of the cover shall be minimum of six (6) inches above possible standing water level for the location. Pull boxes shall not be placed in a location where water drainage or standing water may occur. Contractor shall provide all necessary collars, extensions, hardware, and conduit caps for a complete and professional installation. The pull boxes shall be marked “**Yavapai College Telecommunications.**”

Conduit entries shall be packed with duct sealant to make them weather-tight.

Cables passing through pull boxes require a minimum twelve (12) inch (305mm) service loop where attainable without exceeding manufacturer’s minimum bend radius. Cables pulled through manholes/vaults require one (1) full revolution around the vault and not less than 30 feet (9m) before exiting.

### **3.10.5 Surface Raceways (Dual or Tri-channel)**

Multi-station, multi-use type (power and telecom): Raceway shall be non-metallic Hubbell Media-rak raceway including all components intended for a proper professional installation as required. This raceway will generally be used in such spaces as existing classrooms or larger offices where multiple stations are provided. Raceways must comply with all 568A standards (specifically the minimum one (1) inch bend radius), NEC Article 352A and U.L. Standard UL-5. 90-degree turns in raceway must be provided with the appropriate fittings to ensure nonviolation of bend radius. Raceway shall be provided with a divider channel where used for line and low voltage services. Generally, provide a vertical section of the raceway from the horizontal section to terminate above the ceiling for an entry feed point. All raceway shall be in a color as selected by the architect to match adjacent finishes. Single-station, multi-use type (power and telecom): Where it is necessary to route power/telecom circuits exposed because existing conditions prohibit concealment, provide dual section surface non-metallic raceway and boxes where visible as specified herein. This raceway will generally be used in such spaces as offices to feed single stations with one (1) duplex receptacle and data/voice outlet. Power conductors shall be installed in the latching side channel and telecom cables shall be installed in the hinged side channel. Raceway shall be non-metallic raceway including all components intended for a proper professional installation as required. All raceway shall be in a color as selected by the architect to match adjacent finishes. In addition, for aesthetics, raceway should be extended to cover an entire wall.

Single-station, single use type (telecom only): Where it is necessary to route telecom circuits exposed because existing conditions prohibit concealment, provide surface non-metallic raceway and boxes where visible as specified herein. This raceway will generally be used in offices or classrooms to feed single station information outlets. Raceway shall be non-metallic raceway including all components intended for a proper professional installation as required. All raceway shall be in a color as selected by the architect to match adjacent finishes.

### 3.11 Cable Testing and Labeling

Test equipment shall be suitable for certifying all EIA/TIA 568A Addendum 5 (and greater) specifications. Performance requirements for testers will meet the level II-E accuracy. Contractor shall provide proof of current factory calibration of all test equipment.

Contractor shall provide a complete test plan to the Project Manager not later than seven (7) days prior to the proposed test date, specifying capabilities and function to be tested. Tests shall be in accordance with TSB67 level II-E accuracy. All tests shall be forwarded to the Project Manager, with a copy to ITS, upon completion.

Contractor shall test and certify that all station cable meets EIA/TIA 568A Addendum 5 (and greater) Additional Transmission Performance Guidelines. Contractor shall provide one licensed copy of test equipment software that provides a means of viewing test results in the format that the original test equipment was designed.

Contractor shall certify and warrant the complete system for operation at current EIA/TIA 586A 100 MHz specifications for a period of not less than ten (10) years.

Contractor shall provide test reports in both booklet format and electronic flat ASCII file format. Indicating the type of cable tester used and all pass/ fail information compared to the last draft of EIA/81A category 5E/6 specifications.

Contractor shall provide appropriate plans to the Project Manager, one reproducible hardcopy and one copy electronically formatted in the current release of Auto-Cad, of the as-builts for the communications, cableways, data, and circuit plans. Circuit plans shall be on a separate layer compatible with Yavapai College Facilities Planning models.

Horizontal cable runs shall be identified at the workstation end of the cable according to the following scheme:  
Building – (Room Number- Jack)

Multiple jacks within a room shall be labeled alphabetically.

Example: 1-104, 1-104a, 1-104b.

### 3.12 Fiber Optic Testing and Labeling

Optical test equipment shall be suitable for measuring the attenuation and optical characteristics of the installed fiber optic plant. Contractor shall provide proof of recent factory calibration of all test equipment.

#### **Contractor shall provide the following tests:**

Attenuation in accordance with EIA 455-46A or EIA 455-53A.

Bandwidth, in accordance with EIA 455-54A FOTP-30 EIA 455-5 time domain.

Contractor shall provide a complete test plan, to the Project Manager, not less than seven (7) days prior to the proposed test date, specifying capabilities and function to be tested. All tests shall be forwarded to the Project Manager, with a copy to ITS, upon completion.

Two optical tests shall be performed: Optical Time Domain Reflectometer (OTDR) test and attenuation (power meter) test.

The OTDR test shall be used to determine the adequacy of the cable installations. OTDR test shall be measured in both directions at both wavelengths of 830 and 1330 nanometer. A reference length of fiber, 328 feet (100m) minimum, used, as the delay line shall be placed before the new connector and after the far end patch panel connectors for inspection of connector signature.

End-to-end attenuation measurements shall be made on all fibers, in both directions, using the appropriate light source for the test.

Contractor shall provide appropriate plans to the Project Manager, one reproducible hardcopy and one copy electronically formatted in the current release of Auto-Cad, of the as-builts for the fiber plant. Fiber plant plans shall be on a separate layer compatible with Yavapai College Facilities Planning models.

Provide test reports, in both booklet form and electronic format. Additionally, provide one licensed copy of test equipment software that provides a means for viewing both copper and fiber test results in the format that the original test equipment was designed.

#### Labeling Fiber Cable:

All horizontal fiber optic cables will be labeled according to the same scheme as horizontal cable runs described above in Section 3.10(g).

All vertical, interbuilding or intercommunications closet Fiber Optic Cables will be identified with the following scheme. Within three (3) feet (1m) of termination, a Panduit part #PST-FO or equal yellow and black

“CAUTION Fiber Optic Cable” plastic label will be attached. It will be labeled at both ends in according to the following scheme:

Example: Building number, telecommunications room number, LIU number and pair number. (Ex.1-130b 2/4)

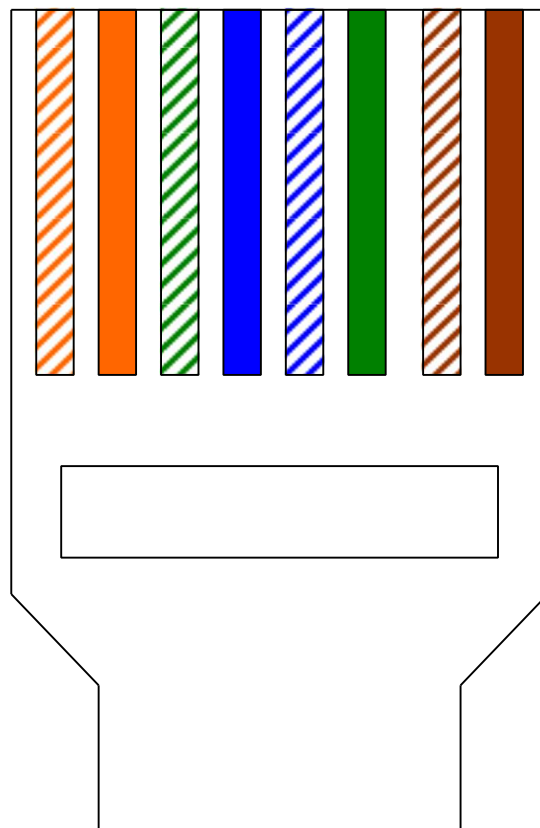
Attachments

Typical 568B Color Coding

Typical Office and Lab Information outlet Typical Lab Data information outlet Typical 48 Port Patch Panel Illustrations by Sandy Sligar Yavapai College Infin-e-Station is a trade mark of Hubbell Inc. (Delaware) Attachment 4.1

**TYPICAL 568B WIRING LOOKING FROM BOTTOM**

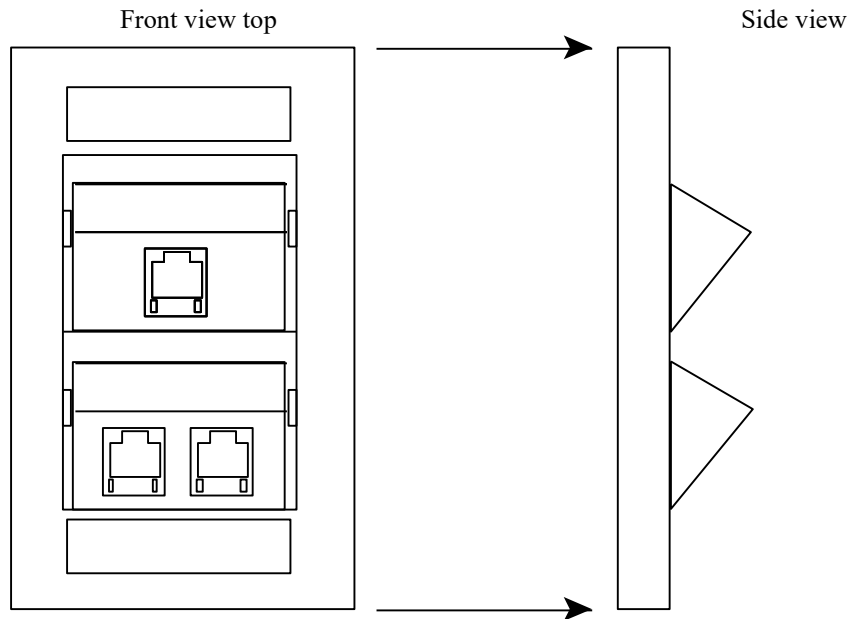
(NON-KEYED SIDE)



Attachment 4.2

Typical Office & Lab Phone Information Outlet

Hubbell P/N	IMF10W	Infin-e-station	Plate Frames
	IM1KA150W	Single 568B Insert	
	IM2KA150W	Dual 568B Insert	
	HXJ5EOW	Cat. 5e Jack	

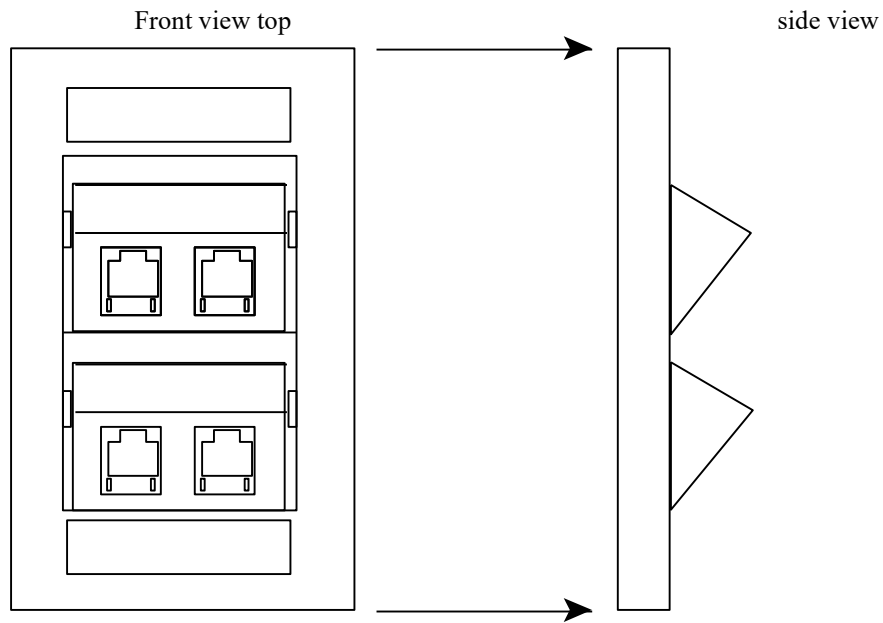


Attachment 4.3

Typical Lab Data Information Outlet

Hubbell P/N- IMF10W  
IM2KA150W  
HXJ5EOW

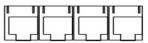
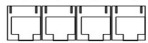
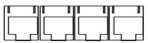
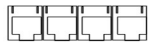
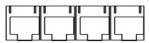
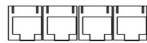
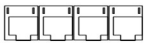
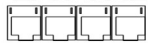
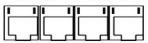
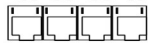
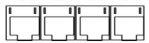
Infin-e-Station Plate Frame  
Jack insert  
Cat. 5e Jack



Attachment 4.4

Hubbell P/N-P5E24B19E 24 Port Style  
Hubbell P/N-P5E48B19E 48 Port Style

Typical Patch Panel

<b>1 2 3 4</b> 	<b>5 6 7 8</b> 	<b>9 10 11 12</b> 	<b>13 14 15 16</b> 	<b>17 18 19 20</b> 	<b>21 22 23 24</b> 
<b>25 26 27 28</b> 	<b>29 30 31 32</b> 	<b>33 34 35 36</b> 	<b>37 38 39 40</b> 	<b>41 42 43 44</b> 	<b>45 46 47 48</b> 