

## SECTION 01 42 00

### REFERENCES

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

##### 1.2 SUMMARY

- A. Section Includes:
  - 1. Definitions.
  - 2. Industry Standards.
  - 3. Abbreviations and Acronyms.
- B. Related Requirements:
  - 1. Section 01 10 00 "Summary" for an explanation of specification and drawing conventions.
  - 2. Section 01 41 00 "Regulatory Requirements" for a list of applicable codes.

##### 1.3 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
  - 1. Definitions in this Section are not intended to be complete, exhaustive or exclusive. They are general and apply to the Work to the extent that such definitions are not stated more explicitly in other provisions of the Contract Documents.
- B. "Approved": When used to convey Architect/Engineer's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect/Engineer's duties and responsibilities as stated in the Conditions of the Contract. Except where expressly indicated, such approval does not release the Contractor from responsibility to fulfill requirements of the Contract Documents.
- C. "Backup": N+1 system.
- D. "Directed": A command or instruction by Architect/Engineer. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- E. "EHS": Environmental Health and Safety.
- F. "Engineer": Architect/Engineer. Other terms including "Mechanical Engineer", "Electrical Engineer", or "Structural Engineer" have the same meaning as "Engineer."
- G. "General Conditions": Contract terms contained in Contractor's Agreement Design/Bid/Build, State Form SC-6.21 and The General Conditions of the Construction Contract Design/Bid/Build, State Form SC-6.23

- H. "General Requirements": Provisions and requirements of all Division 01 Sections as they apply to all aspects of the Work.
- I. "Guarantee": The narrow definition of the term "warranty" applying to both "warranty" and "guarantee" which terms are used interchangeably.
- J. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- K. "Redundant": 2N system. The level of redundancy is determined by design.
- L. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work, whether lawfully imposed by authorities having jurisdiction or not.
- M. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- N. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- O. "Owner": Principal Representative and/or University.
- P. "Provide": Furnish and install, complete and ready for the intended use.
- Q. "Project Manual": Bound, printed volume or volumes including Conditions of the Contract and Specifications, which may also include bidding requirements, contract forms, details, schedules, surveys, reports or other relevant items that may or may not be Contract Documents.
- R. "Project Site": Space available for performing construction activities, either exclusively or in conjunction with others performing other work as part of the Project. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.
- S. "Supplementary Conditions": University Special Supplementary General Conditions. Other terms including "Supplementary General Conditions" shall have the same meaning.

#### 1.4 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
  - 1. Referenced standards take precedence over standards that are not referenced but generally recognized in the construction industry as applicable.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents.



1. Updated Codes and Standards: Where an applicable code or standard has been revised and reissued after the date of the Contract Documents and before performance of Work affected, submit Contractor-Initiated Change Order Bulletin and Change Order Proposal in accordance with Section 01 26 00 "Contract Modification Procedures" for consideration to modify contract requirements to comply with revised code or standard.
- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
  1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.
  2. Where required by individual Specification Sections provide and maintain copies of referenced codes and standards at Project Site.
  3. Although copies of standards needed for enforcement of requirements may be part of required submittals, the Architect/Engineer reserves the right to require the Contractor to submit additional copies as necessary for enforcement of requirements.
- D. Unreferenced Standards: Unreferenced standards are not directly applicable to the Work, except as a general requirement of whether the Work complies with recognized construction industry standards.
- E. Conflicting Requirements: Where compliance with two or more standards is specified, and they establish different or conflicting requirements for minimum quantities or quality levels, the most stringent requirement will be enforced, unless the Contract Documents indicate otherwise. Refer requirements that are different, but apparently equal, and uncertainties as to which quality level is more stringent to the Architect/Engineer for a decision before proceeding.

## 1.5 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

AABC	Associated Air Balance Council www.aabc.com	(202) 737-0202
AAMA	American Architectural Manufacturers Association www.aamanet.org	(847) 303-5664
AASHTO	American Association of State Highway and Transportation Officials www.transportation.org	(202) 624-5800
AATCC	American Association of Textile Chemists and Colorists www.aatcc.org	(919) 549-8141
ABMA	American Bearing Manufacturers Association www.americanbearings.org	(202) 367-1155
ACI	American Concrete Institute (Formerly: ACI International) www.concrete.org	(248) 848-3700

ACPA	American Concrete Pipe Association <a href="http://www.concrete-pipe.org">www.concrete-pipe.org</a>	(972) 506-7216
AEIC	Association of Edison Illuminating Companies, Inc. (The) <a href="http://www.aeic.org">www.aeic.org</a>	(205) 257-2530
AF&PA	American Forest & Paper Association <a href="http://www.afandpa.org">www.afandpa.org</a>	(800) 878-8878 (202) 463-2700
AGA	American Gas Association <a href="http://www.aga.org">www.aga.org</a>	(202) 824-7000
AHAM	Association of Home Appliance Manufacturers <a href="http://www.aham.org">www.aham.org</a>	(202) 872-5955
AHRI	Air-Conditioning, Heating, and Refrigeration Institute (The) <a href="http://www.ahrinet.org">www.ahrinet.org</a>	(703) 524-8800
AI	Asphalt Institute <a href="http://www.asphaltinstitute.org">www.asphaltinstitute.org</a>	(859) 288-4960
AIA	American Institute of Architects (The) <a href="http://www.aia.org">www.aia.org</a>	(800) 242-3837 (202) 626-7300
AISC	American Institute of Steel Construction <a href="http://www.aisc.org">www.aisc.org</a>	(800) 644-2400 (312) 670-2400
AISI	American Iron and Steel Institute <a href="http://www.steel.org">www.steel.org</a>	(202) 452-7100
AITC	American Institute of Timber Construction <a href="http://www.aitc-glulam.org">www.aitc-glulam.org</a>	(303) 792-9559
AMCA	Air Movement and Control Association International, Inc. <a href="http://www.amca.org">www.amca.org</a>	(847) 394-0150
ANSI	American National Standards Institute <a href="http://www.ansi.org">www.ansi.org</a>	(202) 293-8020
AOSA	Association of Official Seed Analysts, Inc. <a href="http://www.aosaseed.com">www.aosaseed.com</a>	(607) 256-3313
APA	APA - The Engineered Wood Association <a href="http://www.apawood.org">www.apawood.org</a>	(253) 565-6600
APA	Architectural Precast Association <a href="http://www.archprecast.org">www.archprecast.org</a>	(239) 454-6989
API	American Petroleum Institute <a href="http://www.api.org">www.api.org</a>	(202) 682-8000
ARI	Air-Conditioning & Refrigeration Institute (See AHRI)	
ARI	American Refrigeration Institute	

(See AHRI)

ARMA	Asphalt Roofing Manufacturers Association <a href="http://www.asphaltroofing.org">www.asphaltroofing.org</a>	(202) 207-0917
ASCE	American Society of Civil Engineers <a href="http://www.asce.org">www.asce.org</a>	(800) 548-2723 (703) 295-6300
ASCE/SEI	American Society of Civil Engineers/Structural Engineering Institute (See ASCE)	
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers <a href="http://www.ashrae.org">www.ashrae.org</a>	(800) 527-4723 (404) 636-8400
ASME	ASME International (American Society of Mechanical Engineers) <a href="http://www.asme.org">www.asme.org</a>	(800) 843-2763 (973) 882-1170
ASSE	American Society of Safety Engineers (The) <a href="http://www.asse.org">www.asse.org</a>	(847) 699-2929
ASSE	American Society of Sanitary Engineering <a href="http://www.asse-plumbing.org">www.asse-plumbing.org</a>	(440) 835-3040
ASTM	ASTM International (American Society for Testing and Materials International) <a href="http://www.astm.org">www.astm.org</a>	(610) 832-9500
ATIS	Alliance for Telecommunications Industry Solutions <a href="http://www.atis.org">www.atis.org</a>	(202) 628-6380
AWEA	American Wind Energy Association <a href="http://www.awea.org">www.awea.org</a>	(202) 383-2500
AWI	Architectural Woodwork Institute <a href="http://www.awinet.org">www.awinet.org</a>	(571) 323-3636
AWMAC	Architectural Woodwork Manufacturers Association of Canada <a href="http://www.awmac.com">www.awmac.com</a>	(403) 453-7387
AWPA	American Wood Protection Association (Formerly: American Wood-Preservers' Association) <a href="http://www.awpa.com">www.awpa.com</a>	(205) 733-4077
AWS	American Welding Society <a href="http://www.aws.org">www.aws.org</a>	(800) 443-9353 (305) 443-9353
AWWA	American Water Works Association <a href="http://www.awwa.org">www.awwa.org</a>	(800) 926-7337 (303) 794-7711
BHMA	Builders Hardware Manufacturers Association <a href="http://www.buildershardware.com">www.buildershardware.com</a>	(212) 297-2122
BIA	Brick Industry Association (The) <a href="http://www.gobrick.com">www.gobrick.com</a>	(703) 620-0010

BICSI	BICSI, Inc. www.bicsi.org	(800) 242-7405 (813) 979-1991
BIFMA	BIFMA International (Business and Institutional Furniture Manufacturer's Association) www.bifma.com	(616) 285-3963
BISSC	Baking Industry Sanitation Standards Committee www.bissc.org	(866) 342-4772
BOCA	BOCA (Building Officials and Code Administrators International Inc.) (See ICC)	
BWF	Badminton World Federation (Formerly: International Badminton Federation) www.bwfbadminton.org	60 3 9283 7155
CDA	Copper Development Association www.copper.org	(800) 232-3282 (212) 251-7200
CEA	Canadian Electricity Association www.electricity.ca	(613) 230-9263
CEA	Consumer Electronics Association www.ce.org	(866) 858-1555 (703) 907-7600
CFFA	Chemical Fabrics & Film Association, Inc. www.chemicalfabricsandfilm.com	(216) 241-7333
CFSEI	Cold-Formed Steel Engineers Institute www.cfsei.org	(866) 465-4732 (202) 263-4488
CGA	Compressed Gas Association www.cganet.com	(703) 788-2700
CIMA	Cellulose Insulation Manufacturers Association www.cellulose.org	(888) 881-2462 (937) 222-2462
CISCA	Ceilings & Interior Systems Construction Association www.cisca.org	(630) 584-1919
CISPI	Cast Iron Soil Pipe Institute www.cispi.org	(404) 622-0073
CLFMI	Chain Link Fence Manufacturers Institute www.chainlinkinfo.org	(301) 596-2583
CPA	Composite Panel Association www.pbmdf.com	(703) 724-1128
CRI	Carpet and Rug Institute (The) www.carpet-rug.org	(706) 278-3176
CRRC	Cool Roof Rating Council	(866) 465-2523

	<a href="http://www.coolroofs.org">www.coolroofs.org</a>	(510) 485-7175
CRSI	Concrete Reinforcing Steel Institute <a href="http://www.crsi.org">www.crsi.org</a>	(800) 328-6306 (847) 517-1200
CSA	Canadian Standards Association <a href="http://www.csa.ca">www.csa.ca</a>	(800) 463-6727 (416) 747-4000
CSA	CSA International (Formerly: IAS - International Approval Services) <a href="http://www.csa-international.org">www.csa-international.org</a>	(866) 797-4272 (416) 747-4000
CSI	Construction Specifications Institute (The) <a href="http://www.csinet.org">www.csinet.org</a>	(800) 689-2900 (703) 684-0300
CSSB	Cedar Shake & Shingle Bureau <a href="http://www.cedarbureau.org">www.cedarbureau.org</a>	(604) 820-7700
CTI	Cooling Technology Institute (Formerly: Cooling Tower Institute) <a href="http://www.cti.org">www.cti.org</a>	(281) 583-4087
CWC	Composite Wood Council (See CPA)	
DASMA	Door and Access Systems Manufacturers Association <a href="http://www.dasma.com">www.dasma.com</a>	(216) 241-7333
DHI	Door and Hardware Institute <a href="http://www.dhi.org">www.dhi.org</a>	(703) 222-2010
ECA	Electronic Components Association <a href="http://www.ec-central.org">www.ec-central.org</a>	(703) 907-8024
ECAMA	Electronic Components Assemblies & Materials Association (See ECA)	
EIA	Electronic Industries Alliance (See TIA)	
EIMA	EIFS Industry Members Association <a href="http://www.eima.com">www.eima.com</a>	(800) 294-3462 (703) 538-1616
EJMA	Expansion Joint Manufacturers Association, Inc. <a href="http://www.ejma.org">www.ejma.org</a>	(914) 332-0040
ESD	ESD Association (Electrostatic Discharge Association) <a href="http://www.esda.org">www.esda.org</a>	(315) 339-6937
ESTA	Entertainment Services and Technology Association (See PLASA)	
EVO	Efficiency Valuation Organization <a href="http://www.evo-world.org">www.evo-world.org</a>	(415) 367-3643 44 20 88 167 857

FIBA	Fédération Internationale de Basketball (The International Basketball Federation) www.fiba.com	41 22 545 00 00
FIVB	Fédération Internationale de Volleyball (The International Volleyball Federation) www.fivb.org	41 21 345 35 45
FM Approvals	FM Approvals LLC www.fmglobal.com	(781) 762-4300
FM Global	FM Global (Formerly: FMG - FM Global) www.fmglobal.com	(401) 275-3000
FRSA	Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc. www.floridarooft.com	(407) 671-3772
FSA	Fluid Sealing Association www.fluidsealing.com	(610) 971-4850
FSC	Forest Stewardship Council U.S. www.fscus.org	(612) 353-4511
GA	Gypsum Association www.gypsum.org	(301) 277-8686
GANA	Glass Association of North America www.glasswebsite.com	(785) 271-0208
GS	Green Seal www.greenseal.org	(202) 872-6400
HI	Hydraulic Institute www.pumps.org	(973) 267-9700
HI/GAMA	Hydronics Institute/Gas Appliance Manufacturers Association (See AHRI)	
HMMA	Hollow Metal Manufacturers Association (See NAAMM)	
HPVA	Hardwood Plywood & Veneer Association www.hpva.org	(703) 435-2900
HPW	H. P. White Laboratory, Inc. www.hpwhite.com	(410) 838-6550
IAPSC	International Association of Professional Security Consultants www.iapsc.org	(415) 536-0288
IAS	International Approval Services (See CSA)	
ICBO	International Conference of Building Officials	

(See ICC)

ICC	International Code Council www.iccsafe.org	(888) 422-7233 (202) 370-1800
ICEA	Insulated Cable Engineers Association, Inc. www.icea.net	(770) 830-0369
ICPA	International Cast Polymer Alliance www.icpa-hq.org	(703) 525-0511
ICRI	International Concrete Repair Institute, Inc. www.icri.org	(847) 827-0830
IEC	International Electrotechnical Commission www.iec.ch	41 22 919 02 11
IEEE	Institute of Electrical and Electronics Engineers, Inc. (The) www.ieee.org	(212) 419-7900
IES	Illuminating Engineering Society (Formerly: Illuminating Engineering Society of North America) www.ies.org	(212) 248-5000
IESNA	Illuminating Engineering Society of North America (See IES)	
IEST	Institute of Environmental Sciences and Technology www.iest.org	(847) 981-0100
IGMA	Insulating Glass Manufacturers Alliance www.igmaonline.org	(613) 233-1510
IGSHPA	International Ground Source Heat Pump Association www.igshpa.okstate.edu	(405) 744-5175
ILI	Indiana Limestone Institute of America, Inc. www.iliai.com	(812) 275-4426
Intertek	Intertek Group (Formerly: ETL SEMCO; Intertek Testing Service NA) www.intertek.com	(800) 967-5352
ISA	International Society of Automation (The) (Formerly: Instrumentation, Systems, and Automation Society) www.isa.org	(919) 549-8411
ISAS	Instrumentation, Systems, and Automation Society (The) (See ISA)	
ISFA	International Surface Fabricators Association (Formerly: International Solid Surface Fabricators Association) www.isfanow.org	(877) 464-7732 (801) 341-7360
ISO	International Organization for Standardization www.iso.org	41 22 749 01 11

ISSFA	International Solid Surface Fabricators Association (See ISFA)	
ITU	International Telecommunication Union <a href="http://www.itu.int/home">www.itu.int/home</a>	41 22 730 51 11
KCMA	Kitchen Cabinet Manufacturers Association <a href="http://www.kcma.org">www.kcma.org</a>	(703) 264-1690
LMA	Laminating Materials Association (See CPA)	
LPI	Lightning Protection Institute <a href="http://www.lightning.org">www.lightning.org</a>	(800) 488-6864
MBMA	Metal Building Manufacturers Association <a href="http://www.mbma.com">www.mbma.com</a>	(216) 241-7333
MCA	Metal Construction Association <a href="http://www.metalconstruction.org">www.metalconstruction.org</a>	(847) 375-4718
MFMA	Maple Flooring Manufacturers Association, Inc. <a href="http://www.maplefloor.org">www.maplefloor.org</a>	(888) 480-9138
MFMA	Metal Framing Manufacturers Association, Inc. <a href="http://www.metalframingmfg.org">www.metalframingmfg.org</a>	(312) 644-6610
MHIA	Material Handling Industry of America <a href="http://www.mhia.org">www.mhia.org</a>	(800) 345-1815 (704) 676-1190
MIA	Marble Institute of America <a href="http://www.marble-institute.com">www.marble-institute.com</a>	(440) 250-9222
MMPA	Moulding & Millwork Producers Association (Formerly: Wood Moulding & Millwork Producers Association) <a href="http://www.wmmpa.com">www.wmmpa.com</a>	(800) 550-7889 (530) 661-9591
MPI	Master Painters Institute <a href="http://www.paintinfo.com">www.paintinfo.com</a>	(888) 674-8937 (604) 298-7578
MSS	Manufacturers Standardization Society of The Valve and Fittings Industry Inc. <a href="http://www.mss-hq.org">www.mss-hq.org</a>	(703) 281-6613
NAAMM	National Association of Architectural Metal Manufacturers <a href="http://www.naamm.org">www.naamm.org</a>	(630) 942-6591
NACE	NACE International (National Association of Corrosion Engineers International) <a href="http://www.nace.org">www.nace.org</a>	(800) 797-6223 (281) 228-6200
NADCA	National Air Duct Cleaners Association <a href="http://www.nadca.com">www.nadca.com</a>	(202) 737-2926
NAIMA	North American Insulation Manufacturers Association	(703) 684-0084



	<a href="http://www.naima.org">www.naima.org</a>	
NBGQA	National Building Granite Quarries Association, Inc. <a href="http://www.nbgqa.com">www.nbgqa.com</a>	(800) 557-2848
NCAA	National Collegiate Athletic Association (The) <a href="http://www.ncaa.org">www.ncaa.org</a>	(317) 917-6222
NCMA	National Concrete Masonry Association <a href="http://www.ncma.org">www.ncma.org</a>	(703) 713-1900
NEBB	National Environmental Balancing Bureau <a href="http://www.nebb.org">www.nebb.org</a>	(301) 977-3698
NECA	National Electrical Contractors Association <a href="http://www.necanet.org">www.necanet.org</a>	(301) 657-3110
NELMA	Northeastern Lumber Manufacturers Association <a href="http://www.nelma.org">www.nelma.org</a>	(207) 829-6901
NEMA	National Electrical Manufacturers Association <a href="http://www.nema.org">www.nema.org</a>	(703) 841-3200
NETA	InterNational Electrical Testing Association <a href="http://www.netaworld.org">www.netaworld.org</a>	(888) 300-6382 (269) 488-6382
NFHS	National Federation of State High School Associations <a href="http://www.nfhs.org">www.nfhs.org</a>	(317) 972-6900
NFPA	NFPA (National Fire Protection Association) <a href="http://www.nfpa.org">www.nfpa.org</a>	(800) 344-3555 (617) 770-3000
NFPA	NFPA International (See NFPA)	
NFRC	National Fenestration Rating Council <a href="http://www.nfrc.org">www.nfrc.org</a>	(301) 589-1776
NHLA	National Hardwood Lumber Association <a href="http://www.nhla.com">www.nhla.com</a>	(800) 933-0318 (901) 377-1818
NLGA	National Lumber Grades Authority <a href="http://www.nlga.org">www.nlga.org</a>	(604) 524-2393
NOFMA	National Oak Flooring Manufacturers Association (See NWFA)	
NOMMA	National Ornamental & Miscellaneous Metals Association <a href="http://www.nomma.org">www.nomma.org</a>	(888) 516-8585
NRCA	National Roofing Contractors Association <a href="http://www.nrca.net">www.nrca.net</a>	(800) 323-9545 (847) 299-9070
NRMCA	National Ready Mixed Concrete Association <a href="http://www.nrmca.org">www.nrmca.org</a>	(888) 846-7622 (301) 587-1400

NSF	NSF International (National Sanitation Foundation International) www.nsf.org	(800) 673-6275 (734) 769-8010
NSPE	National Society of Professional Engineers www.nspe.org	(703) 684-2800
NSSGA	National Stone, Sand & Gravel Association www.nssga.org	(800) 342-1415 (703) 525-8788
NTMA	National Terrazzo & Mosaic Association, Inc. (The) www.ntma.com	(800) 323-9736
NWFA	National Wood Flooring Association www.nwfa.org	(800) 422-4556 (636) 519-9663
PCI	Precast/Prestressed Concrete Institute www.pci.org	(312) 786-0300
PDI	Plumbing & Drainage Institute www.pdionline.org	(800) 589-8956 (978) 557-0720
PLASA	PLASA (Formerly: ESTA - Entertainment Services and Technology Association) www.plasa.org	(212) 244-1505
RCSC	Research Council on Structural Connections www.boltcouncil.org	
RFCI	Resilient Floor Covering Institute www.rfci.com	(706) 882-3833
RIS	Redwood Inspection Service www.redwoodinspection.com	(925) 935-1499
SAE	SAE International (Society of Automotive Engineers) www.sae.org	(877) 606-7323 (724) 776-4841
SBCCI	Southern Building Code Congress International, Inc. (See ICC)	
SCTE	Society of Cable Telecommunications Engineers www.scte.org	(800) 542-5040 (610) 363-6888
SDI	Steel Deck Institute www.sdi.org	(847) 458-4647
SDI	Steel Door Institute www.steeldoor.org	(440) 899-0010
SEFA	Scientific Equipment and Furniture Association www.sefalabs.com	(877) 294-5424 (516) 294-5424

SEI/ASCE	Structural Engineering Institute/American Society of Civil Engineers (See ASCE)	
SIA	Security Industry Association <a href="http://www.siaonline.org">www.siaonline.org</a>	(866) 817-8888 (703) 683-2075
SJI	Steel Joist Institute <a href="http://www.steeljoist.org">www.steeljoist.org</a>	(843) 293-1995
SMA	Screen Manufacturers Association <a href="http://www.smainfo.org">www.smainfo.org</a>	(773) 636-0672
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association <a href="http://www.smacna.org">www.smacna.org</a>	(703) 803-2980
SMPTE	Society of Motion Picture and Television Engineers <a href="http://www.smpte.org">www.smpte.org</a>	(914) 761-1100
SPFA	Spray Polyurethane Foam Alliance <a href="http://www.sprayfoam.org">www.sprayfoam.org</a>	(800) 523-6154
SPIB	Southern Pine Inspection Bureau <a href="http://www.spib.org">www.spib.org</a>	(850) 434-2611
SPRI	Single Ply Roofing Industry <a href="http://www.spri.org">www.spri.org</a>	(781) 647-7026
SRCC	Solar Rating and Certification Corporation <a href="http://www.solar-rating.org">www.solar-rating.org</a>	(321) 638-1537
SSINA	Specialty Steel Industry of North America <a href="http://www.ssina.com">www.ssina.com</a>	(800) 982-0355 (202) 342-8630
SSPC	SSPC: The Society for Protective Coatings <a href="http://www.sspc.org">www.sspc.org</a>	(877) 281-7772 (412) 281-2331
STI	Steel Tank Institute <a href="http://www.steeltank.com">www.steeltank.com</a>	(847) 438-8265
SWI	Steel Window Institute <a href="http://www.steelwindows.com">www.steelwindows.com</a>	(216) 241-7333
SWPA	Submersible Wastewater Pump Association <a href="http://www.swpa.org">www.swpa.org</a>	(847) 681-1868
TCA	Tilt-Up Concrete Association <a href="http://www.tilt-up.org">www.tilt-up.org</a>	(319) 895-6911
TCNA	Tile Council of North America, Inc. (Formerly: Tile Council of America) <a href="http://www.tileusa.com">www.tileusa.com</a>	(864) 646-8453
TEMA	Tubular Exchanger Manufacturers Association, Inc. <a href="http://www.tema.org">www.tema.org</a>	(914) 332-0040
TIA	Telecommunications Industry Association	(703) 907-7700

	(Formerly: TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance) <a href="http://www.tiaonline.org">www.tiaonline.org</a>	
TIA/EIA	Telecommunications Industry Association/Electronic Industries Alliance (See TIA)	
TMS	The Masonry Society <a href="http://www.masonrysociety.org">www.masonrysociety.org</a>	(303) 939-9700
TPI	Truss Plate Institute <a href="http://www.tpinst.org">www.tpinst.org</a>	(703) 683-1010
TPI	Turfgrass Producers International <a href="http://www.turfgrasssod.org">www.turfgrasssod.org</a>	(800) 405-8873 (847) 649-5555
TRI	Tile Roofing Institute <a href="http://www.tilerroofing.org">www.tilerroofing.org</a>	(312) 670-4177
UBC	Uniform Building Code (See ICC)	
UL	Underwriters Laboratories Inc. <a href="http://www.ul.com">www.ul.com</a>	(877) 854-3577
UNI	Uni-Bell PVC Pipe Association <a href="http://www.uni-bell.org">www.uni-bell.org</a>	(972) 243-3902
USAV	USA Volleyball <a href="http://www.usavolleyball.org">www.usavolleyball.org</a>	(888) 786-5539 (719) 228-6800
USGBC	U.S. Green Building Council <a href="http://www.usgbc.org">www.usgbc.org</a>	(800) 795-1747
USITT	United States Institute for Theatre Technology, Inc. <a href="http://www.usitt.org">www.usitt.org</a>	(800) 938-7488 (315) 463-6463
WASTEC	Waste Equipment Technology Association <a href="http://www.wastec.org">www.wastec.org</a>	(800) 424-2869 (202) 244-4700
WCLIB	West Coast Lumber Inspection Bureau <a href="http://www.wclib.org">www.wclib.org</a>	(800) 283-1486 (503) 639-0651
WCMA	Window Covering Manufacturers Association <a href="http://www.wcmanet.org">www.wcmanet.org</a>	(212) 297-2122
WDMA	Window & Door Manufacturers Association <a href="http://www.wdma.com">www.wdma.com</a>	(800) 223-2301 (312) 321-6802
WI	Woodwork Institute (Formerly: WIC - Woodwork Institute of California) <a href="http://www.wicnet.org">www.wicnet.org</a>	(916) 372-9943
WMMPA	Wood Moulding & Millwork Producers Association (See MMPA)	

WSRCA	Western States Roofing Contractors Association <a href="http://www.wsrca.com">www.wsrca.com</a>	(800) 725-0333 (650) 938-5441
WWPA	Western Wood Products Association <a href="http://www.wwpa.org">www.wwpa.org</a>	(503) 224-3930

- B. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

DIN	Deutsches Institut für Normung e.V. <a href="http://www.din.de">www.din.de</a>	49 30 2601-0
IAPMO	International Association of Plumbing and Mechanical Officials <a href="http://www.iapmo.org">www.iapmo.org</a>	(909) 472-4100
ICC	International Code Council <a href="http://www.iccsafe.org">www.iccsafe.org</a>	(888) 422-7233
ICC-ES	ICC Evaluation Service, LLC <a href="http://www.icc-es.org">www.icc-es.org</a>	(800) 423-6587 (562) 699-0543

- C. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

COE	Army Corps of Engineers <a href="http://www.usace.army.mil">www.usace.army.mil</a>	(202) 761-0011
CPSC	Consumer Product Safety Commission <a href="http://www.cpsc.gov">www.cpsc.gov</a>	(800) 638-2772 (301) 504-7923
DOC	Department of Commerce National Institute of Standards and Technology <a href="http://www.nist.gov">www.nist.gov</a>	(301) 975-4040
DOD	Department of Defense <a href="http://dodssp.daps.dla.mil">http://dodssp.daps.dla.mil</a>	(215) 697-2664
DOE	Department of Energy <a href="http://www.energy.gov">www.energy.gov</a>	(202) 586-9220
EPA	Environmental Protection Agency <a href="http://www.epa.gov">www.epa.gov</a>	(202) 272-0167
FAA	Federal Aviation Administration <a href="http://www.faa.gov">www.faa.gov</a>	(866) 835-5322
FG	Federal Government Publications <a href="http://www.gpo.gov">www.gpo.gov</a>	(202) 512-1800

GSA	General Services Administration <a href="http://www.gsa.gov">www.gsa.gov</a>	(800) 488-3111 (202) 619-8925
HUD	Department of Housing and Urban Development <a href="http://www.hud.gov">www.hud.gov</a>	(202) 708-1112
LBL	Lawrence Berkeley National Laboratory Environmental Energy Technologies Division <a href="http://eetd.lbl.gov">http://eetd.lbl.gov</a>	(510) 486-4000
OSHA	Occupational Safety & Health Administration <a href="http://www.osha.gov">www.osha.gov</a>	(800) 321-6742
SD	Department of State <a href="http://www.state.gov">www.state.gov</a>	(202) 647-4000
TRB	Transportation Research Board National Cooperative Highway Research Program <a href="http://www.trb.org">www.trb.org</a>	(202) 334-2934
USDA	Department of Agriculture Agriculture Research Service U.S. Salinity Laboratory <a href="http://www.ars.usda.gov">www.ars.usda.gov</a>	(202) 720-3656
USDA	Department of Agriculture Rural Utilities Service <a href="http://www.usda.gov">www.usda.gov</a>	(202) 720-2791
USDJ	Department of Justice Office of Justice Programs National Institute of Justice <a href="http://www.ojp.usdoj.gov">www.ojp.usdoj.gov</a>	(202) 307-0703
USP	U.S. Pharmacopeia <a href="http://www.usp.org">www.usp.org</a>	(800) 227-8772 (301) 881-0666
USPS	United States Postal Service <a href="http://www.usps.com">www.usps.com</a>	(202) 268-2000

D. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

CFR	Code of Federal Regulations Available from Government Printing Office <a href="http://www.gpo.gov/fdsys">www.gpo.gov/fdsys</a>	(866) 512-1800 (202) 512-1800
DOD	Department of Defense Military Specifications and Standards Available from Department of Defense Single Stock Point <a href="http://dodssp.daps.dla.mil">http://dodssp.daps.dla.mil</a>	(215) 697-2664

DSCC Defense Supply Center Columbus  
(See FS)

FED-STD Federal Standard  
(See FS)

FS Federal Specification  
Available from Department of Defense Single Stock Point  
<http://dodssp.daps.dla.mil>

(215) 697-2664

Available from Defense Standardization Program  
[www.dsp.dla.mil](http://www.dsp.dla.mil)

Available from General Services Administration  
[www.gsa.gov](http://www.gsa.gov)

(800) 488-3111  
(202) 619-8925

Available from National Institute of Building Sciences/Whole Building Design  
Guide  
[www.wbdg.org/ccb](http://www.wbdg.org/ccb)

(202) 289-7800

MILSPEC Military Specification and Standards  
(See DOD)

USAB United States Access Board  
[www.access-board.gov](http://www.access-board.gov)

(800) 872-2253  
(202) 272-0080

USATBCB U.S. Architectural & Transportation Barriers Compliance Board  
(See USAB)

## PART 2 - PRODUCTS (Not Used)

## PART 3 - EXECUTION (Not Used)

**END OF SECTION 01 42 00**

## SECTION 01 50 00

### TEMPORARY FACILITIES AND CONTROLS

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

##### 1.2 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
  - 1. Nothing in this Section is intended to limit types and amounts of temporary work required, and no omission from this Section will be recognized as an indication by Architect/Engineer that such temporary activity is not required for successful completion of the Work. The use of alternative facilities equivalent to those specified is the Contractor's option, subject to Architect/Engineer's and University acceptance.
- B. Related Requirements:
  - 1. Section 01 10 00 "Summary" for work restrictions and limitations on utility interruptions.
  - 2. Section 01 35 46 "Indoor Air Quality" for temporary facility work including HVAC, air filtration, moisture management, air filtration and dust control partitions required to comply with indoor air quality requirements during construction.

##### 1.3 USE CHARGES

- A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to, University's construction forces, Architect/Engineer, testing agencies, and authorities having jurisdiction.
- B. Use Charges: As follows:
  - 1. For new construction: Arrange for and pay for water, sewer, electric power, steam and chilled water use charges for utility usage by all entities for construction operations.
  - 2. For renovations of existing facilities: Arrange for and University will pay for all use charges.
- C. Temporary Metering: For all utility connection; sub-meter at point of connection to existing systems.
  - 1. Temporary utility meter must be approved by University Campus Energy Engineer.
  - 2. Meters shall be operational prior to any use of utility for temporary heating.

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.



- B. Erosion- and Sedimentation-Control Plan: Show compliance with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.
- C. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.
- D. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Identify further options if proposed measures are later determined to be inadequate. Include the following:
  - 1. Locations of dust-control partitions at each phase of work.
  - 2. HVAC system isolation schematic drawing.
  - 3. Location of proposed air-filtration system discharge.
  - 4. Waste handling procedures.
  - 5. Other dust-control measures.

## 1.5 QUALITY ASSURANCE

- A. General: Comply with governing regulations and utility company regulations and recommendations for the construction of temporary facilities including, but not necessarily limited to, code compliances, permits, inspections, testing, health, safety, pollution and environmental compliances.
- B. Fire-safety: Comply with NFPA 421 "Standard for Safeguarding Construction, Alteration, and Demolition Operations."
- C. Safety: Comply with ANSI/ASSE A10 "Construction Package" series of safety construction standards.
- D. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- E. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.
- F. Accessible Temporary Egress: Where temporary accessible egress from existing buildings or portions thereof is provided, comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

## 1.6 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before University's acceptance, regardless of previously assigned responsibilities.
- B. Conditions of Use: Keep temporary services and facilities clean and neat in appearance. Operate in a safe and efficient manner. Take necessary fire prevention measures. Do not overload facilities, or permit them to interfere with progress. Do not allow hazardous, dangerous or unsanitary conditions, or public nuisances to develop or persist on the site.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. General: Provide both new or used materials and equipment for temporary facilities, which are in substantially undamaged and serviceable condition. Provide types and qualities which are recognized in the construction industry as suitable for the intended use in each application. Comply with Utility Company requirements as applicable.

### 2.2 TEMPORARY FACILITIES

- A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Common-Use Field Office: Insulated, weather-tight, of sufficient size to accommodate needs of University, Architect/Engineer, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly.
- C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
1. Store combustible materials apart from building.
  2. Comply with Section 01 10 00 "Summary" for use of site for staging areas.

### 2.3 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. Digital Camera: Minimum 12 megapixel; available in field office for use.
- C. Thermometer: Outdoor, re-settable type indicating daily maximum and minimum temperatures.
1. Locate in a shaded-from-the-sun, conveniently readable location that will give reasonably accurate readings of the actual air temperature and be reached easily for resetting.
  2. Maintain daily log of reading.
- D. Air-Filtration Units: Primary and secondary HEPA-filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate, expand and modify facilities as required by progress of the Work.
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

- C. Use qualified workers for the installation of temporary facilities.

### 3.2 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.

1. Arrange with utility company, University, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services. Comply with requirements in Section 01 10 00 "Summary" for existing utility disruption procedures.

- B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.

1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.

- C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction. Where available, connect to University's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to University. At Substantial Completion, restore these facilities to condition existing before initial use.

1. Obtain and pay for all required water taps.

- D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

1. Toilets: Use of University's existing toilet facilities is not permitted.
2. Provide temporary toilets within available site area in location approved by University which will best serve the needs of construction personnel.
3. Supply and maintain toilet tissue, paper towels, paper cups and similar disposable materials as appropriate for each sanitary facility, and provide appropriate waste paper containers for used materials.
4. At Contractor's option, provide drinking water for construction personnel by either water-system-connected drinking fountains or by containerized tap dispensers with paper cups (or both).

- E. Heating: Provide temporary heating required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

1. HVAC Equipment: Unless University authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
  - a. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
  - b. Heating Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
  - c. Permanent HVAC System: If University authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return-air and exhaust grille in system and remove at end of construction. Clean and adjust HVAC system and put in new condition before Completion as required in Section 01 77 00 "Closeout Procedures".

F. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.

1. Prior to commencing work, isolate the HVAC system in area where work is to be performed.
  - a. Disconnect supply and return ductwork in work area from HVAC systems servicing occupied areas.
  - b. Maintain negative air pressure within work area using HEPA-equipped air-filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.
2. Maintain dust partitions during the Work. Use vacuum collection attachments on dust-producing equipment. Isolate limited work within occupied areas using portable dust-containment devices.
3. Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.

G. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.

1. Provide dehumidification systems when required to reduce substrate moisture levels to level required to allow installation or application of finishes.

H. Electric Power Service: Provide weatherproof, grounded, electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations. Include, as required, transformers, overload protected disconnects, automatic ground fault interrupters and main distribution switchgear. Maintain equipment in a condition acceptable to University.

1. Install electric power service **overhead** unless otherwise indicated.
2. Where available capacity exists in existing system, connect temporary service to University's existing power source, as directed by University.
3. Provide separate connection for power and for lighting.
4. Provide sufficient 220v outlets for special tools, welding equipment and similar devices requiring such service at locations where required.
5. Provide sufficient circuits and duplex 120v single phase outlets so located that any part of the work can be reached with a 75 foot extension cord to accommodate normal power tools and supplemental lighting.

I. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.

1. Provide temporary light to levels and as required by governing regulations but not less than minimum 5 foot-candle illumination in all areas accessible to workers during hours they are at the job; minimum 10 foot-candles for shop areas; 20 foot-candles or more where detailed or finishing work is being done, supplemented as may be required.
2. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
3. Install lighting for Project identification sign.
4. Where permanent light fixtures have been used for temporary lighting, supply temporary lamps and replace with new lamps at time of Completion.
5. Provide lighting in stairways and exits at all times.

- J. Telephone Service: Provide temporary telephone service in Contractor's field office and distribute to each work station.
  1. Pay for line installation, monthly charges, and expenses necessary to extend service from minimum point of presence (MPOP) as determined by University I/S.
  2. Provide temporary telephone service in common-use facilities for use by all construction personnel.
  3. Provide answering machine and a dedicated telephone line for a facsimile machine.
  4. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.

### 3.3 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
  1. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.
  2. Maintain support facilities until Architect/Engineer schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to University.
- B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas within construction limits indicated on Drawings.
  1. Surface temporary access road with road base material of not less than 4 inch thickness and compact.
  2. Provide temporary signage and temporary pedestrian accessways or other special considerations necessary for continued University operations.
  3. Provide stop sign(s) at all points of egress from construction site to meet standards established in the Manual of Uniform Traffic Code Devices (MUTCD).
  4. Maintain University access to areas affected by temporary access roads during inclement weather.
  5. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.
  6. Restore to original condition to satisfaction of University when no longer required.
- C. Temporary Walks: Construct and maintain temporary walks around the construction work and to offices, toilets and similar locations on the site.
- D. Traffic Controls: Comply with requirements of authorities having jurisdiction.
  1. Protect existing site improvements to remain including curbs, pavement, and utilities.
  2. Maintain access for fire-fighting equipment and access to fire hydrants.
- E. Parking: Comply with requirements in Section 01 10 00 "Summary."
- F. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
  1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
  2. Remove snow and ice as required to minimize accumulations.

- G. Project Signs: Provide Project signs at locations indicated or directed. Unauthorized signs are not permitted.
1. Identification Signs: Unless otherwise indicated, provide 4 foot by 8 foot Project identification sign.
    - a. Architect/Engineer will provide sign layout, including colors and graphics as approved by University Resident Architect through University Project Manager.
  2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
    - a. Provide temporary, directional signs for construction personnel and visitors.
  3. Engage an experience sign painter to apply required colors and graphics in a neat and professional manner.
  4. Maintain and touchup signs so they are legible at all times.
- H. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 01 73 00 "Execution."
1. Coordinate with University Project Manager to obtain approval from University Environmental Services Manager.
  2. Provide waste chutes as required in accordance with applicable laws and regulations.
- I. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel. The selection of type, size and number of hoisting facilities is the solely the responsibility of the Contractor.
1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.
- J. Temporary Elevator Use: Use of elevators is not permitted without prior written approval of the Architect/Engineer and University Project Manager.
1. If so approved, only one designated elevator may be used subject to the requirements of "Existing Elevator Use" paragraph below.
- K. Existing Elevator Use: When approved by University, one designated existing elevator may be used at no charge to Contractor or other subcontractors for transporting personnel, small tools, materials, and equipment. Comply with requirements of Section 01 10 00 "Summary" and the following:
1. Contractor will not be granted exclusive use of the designated elevator. University personnel and staff will be permitted to use this elevator as their work duties require.
  2. Entire car is lined (floor, walls, ceiling) with 3/4 inch Fir plywood or equivalent.
  3. Total load carried does not exceed rated capacity of elevator.
  4. No materials, equipment, trash, tools or other items too large to be readily moved into and out of the car may be carried in the elevator.
  5. Before acceptance of the building, linings are removed; all exposed surfaces are in new condition; all controls, relays, other parts showing any wear have been replaced.
  6. Entire elevator, including machinery, electrical components, doors, operators and controls shall be tested, adjusted, and put in new condition with specified warranties and maintenance to take effect at date of Completion Certificate.
  7. Written clearance has been obtained from the Elevator Service Company stating that the installation is safe and complete for this use prior to using it.
  8. The Contractor signs the Elevator Service Company's standard agreement and release forms for this usage and pays charges for maintenance, service, repairs, and reconditioning.

- L. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.
- M. Existing Stair Usage: Use of University's existing stairs will be permitted, provided stairs are cleaned and maintained in a condition acceptable to University. At Substantial Completion, restore stairs to condition existing before initial use.
  - 1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If stairs become damaged, restore damaged areas so no evidence remains of correction work.
- N. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

### 3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
- B. Protection of Work: Protect in-progress and completed work from damage or deterioration, other than normal weathering of exposed materials, through construction duration until completion, as appropriate and as recommended by manufacturer and Installer.
  - 1. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings. Protect finished floors and stairs from traffic, movement of heavy objects, and storage.
  - 2. Prohibit traffic and storage on waterproofed and roofed surfaces, on lawn and landscaped areas.
  - 3. Always protect excavation, trenches, and building, from damage from rain water, spring water, ground water, backing up of drains or sewers. Provide pumps, equipment, enclosures, to provide this protection.
  - 4. Remove protective coverings and materials at the appropriate time but no later than final cleaning operations.
- C. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
  - 1. Comply with work restrictions specified in Section 01 10 00 "Summary."
- D. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to requirements of 2003 EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.
  - 1. Comply with Section 01 41 00 "Regulatory Requirements" Article "MS4 Storm Water and Water Quality Permits."
  - 2. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant- protection zones.
  - 3. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
  - 4. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
  - 5. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

- E. Stormwater Control: Comply with Section 01 41 00 "Regulatory Requirements" Article "MS4 Storm Water and Water Quality Permits."
- F. Tree and Plant Protection: Install temporary fencing or guard located outside the drip line of trees to protect vegetation from damage arising out of construction operations, including cutting, breaking or skinning of roots and skinning or bruising of bark. Protect tree root systems from damage, flooding, and erosion.
  - 1. Do not stockpile construction materials or excavated materials inside dripline.
  - 2. University will identify historically recorded trees and vegetation not to be disturbed.
  - 3. Water trees and other vegetation to remain as required to maintain their health for the duration of the Project.
  - 4. Repair or replace trees and vegetation damaged by construction operations in a manner acceptable to Architect/Engineer. Use a qualified tree surgeon to perform the work.
- G. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using environmentally safe materials.
- H. Site Enclosure Fence: Within 10 business days of mobilization, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates and will protect adjacent sites from damage or contamination..
  - 1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
  - 2. Portable Chain-Link Fencing: Minimum 2-inch, 0.148-inch- thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch- OD line posts and 2-7/8-inch- OD corner and pull posts, with 1-5/8-inch- OD top and bottom rails. Provide bases for supporting posts.
  - 3. Locate so base supports do not extend outside work area where adjacent to walkways.
  - 4. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys to University.
- I. Security: Provide security program and facilities to protect the Work, existing facilities, and University operations and to prevent unauthorized entrance, vandalism, theft, and similar violations of security.
  - 1. Coordinate with University Police.
  - 2. Provide lockable entrances and lock entrances at end of each work day.
  - 3. After review and approval by University, install temporary enclosure around partially completed areas of construction.
  - 4. Storage: Where materials and equipment must be stored, and are of value or attractive for theft, provide a secure lockup. Enforce discipline in connection with the installation and release of material to minimize the opportunity for theft and vandalism.
- J. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting wherever required to prevent accidents and losses.
- K. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.
- L. Covered Walkway: Where regulations require or where a public roadway/walkway adjoins the Project site and materials may be hoisted across the walkway, erect protective, covered walkway for passage of individuals through or adjacent to Project site. Coordinate with entrance gates, other facilities, and obstructions. Comply with regulations of authorities having jurisdiction.



1. Construct covered walkways using scaffold or shoring framing.
2. Provide overhead waterproof decking, protective enclosure walls, handrails, barricades, warning signs, exit signs, lights, safe and well-drained walkways, and similar provisions for protection and safe passage.
3. Paint and maintain appearance of walkway for duration of the Work in a manner acceptable to the Architect/Engineer and University.
4. Extend back wall beyond structure to complete the enclosure fence.

M. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.

1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.
2. Coordinate temporary enclosures with ventilating and drying-of-the-work requirements, so as to avoid dangerous conditions and deleterious effects.
3. Close openings through floor or roof decks and horizontal surfaces with load-bearing wood-framed construction.

N. Temporary Partitions: Provide floor-to-floor or floor-to-ceiling dustproof partitions terminating in dustproof floor or ceiling above to limit dust and dirt migration and to separate existing active elevator hoistways and other areas occupied by University from dust, fumes and noise in compliance with Section 01 35 46 "Indoor Air Quality" and the following:

1. Construct dustproof partitions with 5/8 inch gypsum wallboard with joints taped on occupied side, and 1/2 inch fire-retardant-treated plywood on construction operations side.
2. Where fire-resistance-rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
3. Insulate partitions to control noise transmission to occupied areas.
4. Seal joints and perimeter. Equip partitions with gasketed dustproof doors and security locks where openings are required.
5. Protect air-handling equipment.
6. Provide walk-off mats at each entrance through temporary partition.
7. At elevator hoistway entrances not used during construction, seal openings with plastic sheet and duct tape.

O. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.

1. Fire Extinguishers: Minimum one per floor at or near useable exit.
  - a. Provide additional extinguishers where convenient and effective for intended purpose.
  - b. Comply with NFPA 10 to the extent applicable.
2. Strictly enforce site prohibition against smoking.
3. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
4. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Coordinate with University Project Manager to review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
5. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

6. Maintain unobstructed access to fire extinguishers, temporary fire protection facilities, stairways and other access routes for fighting fires.
7. Store combustible materials in containers in fire-safe locations.
8. Permanent Fire Protection System: Complete and make operational at earliest possible date. Instruct site personnel on use of permanent system.

### 3.5. MOISTURE AND MOLD CONTROL

- A. Contractor's Moisture-Protection Plan: Comply with requirements in Section 01 35 46 "Indoor Air Quality Procedures."

### 3.6. OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
  1. Do not permit temporary offices and similar temporary or permanent spaces to be used as living quarters or for other unintended occupancies or uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
  1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Janitorial Services: Provide daily janitorial services for temporary offices, toilets, and similar areas at the project site. Require users of other temporary facilities to maintain clean and orderly premises.
- D. Operate Project-identification-sign lighting daily from dusk until 12:00 midnight.
- E. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- F. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion, unless Architect/Engineer requests that it be retained for a longer period of time. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
  1. Materials and facilities that constitute temporary facilities are property of Contractor. University reserves right to take possession of Project identification signs.
  2. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 01 77 00 "Closeout Procedures."

END OF SECTION 01 50 00

## SECTION 01 60 00

### PRODUCT REQUIREMENTS

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

##### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Requirements:
  - 1. Section 01 25 00 "Substitution Procedures" for requests for substitutions.
  - 2. Section 01 42 00 "References" for applicable industry standards for products specified.
  - 3. Section 01 77 00 "Closeout Procedures" for submittal of project warranties.

##### 1.3 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
  - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
  - 2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
  - 3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

##### 1.4 ACTION SUBMITTALS

- A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
  - 1. Requests for consideration of comparable products will only be entertained during bidding.

2. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
3. Architect/Engineer's Action: If necessary, Architect/Engineer will request additional information or documentation for evaluation of a comparable product request. Architect/Engineer will notify Contractor of approval or rejection of proposed comparable product.
  - a. Form of Approval: Written Addendum.

- B. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 01 33 00 "Submittal Procedures." Show compliance with requirements.

## 1.5 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options. The complete compatibility between the various choices available to the Contractor is not assured by the various requirements of the Contract Documents, but must be provided by the Contractor.
- B. Source Limitations: To the fullest extent possible, provide products of the same kind, from a single source.
- C. Nameplates: Except for required labels and operating data, do not attach or imprint manufacturers or producer's nameplates or trademarks on exposed surfaces of products which will be exposed to view in occupied spaces or on the exterior.
- D. Labels: Locate required product labels and stamps on a concealed surface or, where required for observation after installation, on an accessible surface that is not conspicuous.
- E. Equipment Nameplates: Provide a permanent nameplate on each item of service-connected or power-operated equipment. Locate on an easily accessible surface which is inconspicuous in occupied spaces. The nameplate shall contain the following information and other essential operating data.
1. Name of product and manufacturer.
  2. Model and serial number.
  3. Capacity.
  4. Speed.
  5. Ratings.
  6. Power characteristics (if applicable).
  7. UL label or compliance (if applicable).

## 1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
  2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
  3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.

4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
6. Protect stored products from damage and liquids from freezing.

1.7 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents. Such disclaimers and limitations do not relieve warranty requirements on Work that incorporates product nor do they relieve suppliers, manufacturers and subcontractors required to countersign special warranties with the Contractor.

1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to University.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for University.

- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

- C. Submittal Time and Form: Comply with requirements in Section 01 77 00 "Closeout Procedures."

D. Warranty Requirements:

1. Related Damages and Losses: When correcting warranted Work that has failed, remove and replace other Work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted Work.
2. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.
3. Replacement Cost: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective Work regardless of whether the University has benefited from use of the Work through a portion of its anticipated useful service life.
4. University's Recourse:

- a. Written warranties made to the University are in addition to implied warranties, and shall not limit the duties, obligations, rights and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the University can enforce such other duties, obligations, rights, or remedies.
- b. Rejection of Warranties: The University reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.
- c. The University reserves the right to refuse to accept Work for the Project where a special warranty, certification, or similar commitment is required on such Work or part of the Work, until evidence is presented that entities required to countersign such commitments are willing to do so.

## PART 2 - PRODUCTS

### 2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged, are asbestos free, and, unless otherwise indicated, are new at time of installation.
  1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
  2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
  3. University reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
  4. Where products are accompanied by the term "as selected," Architect/Engineer will make selection.
  5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
  6. Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product and provide only products previously approved during bid phase by written Addendum. The determination of equivalence is at the sole discretion of the Architect/Engineer who has no obligation to prove non-equivalence.
  7. Mechanical and electrical equipment design and their space requirements are based on the first named item of the Section in which specified or that scheduled on the Drawings. If other than the first named or scheduled item listed for use is selected, modification to other elements of Work may be required. Show all such modification on shop drawings and submittals as appropriate. The cost of such modifications is solely the responsibility of the Contractor.
  8. Where manufacturers are listed as acceptable for specific proprietary products but precise identification by model, series, or trade name is not specified, submit detailed product information for such products for Architect/Engineer's acceptance prior to ordering. Include specific requirements for modifications to other construction, including but not limited to, power and utility requirements, characteristics, capacities, size and locations. The cost of such modifications is solely the responsibility of the Contractor.
- B. Product Selection Procedures:
  1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
  2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
  3. Products:

- a. Restricted List: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
  4. Manufacturers:
    - a. Restricted List: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
  5. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. If proposing a comparable product by another manufacturer, whether named or not, provide a custom product if manufacturer's standard product does not include salient features of the Basis-of-Design product indicated. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
  6. Contractor's Option: Where materials, products, systems or methods are specified to be selected from a list of options, subject to compliance with requirements, the choice of which material, method, product or system will be solely at the Contractor's discretions. There will be no change in Contract Sum or Time because of such choice.
- C. Visual Matching Specification: Where Specifications require "match Architect/Engineer's sample", provide a product that complies with requirements and matches Architect/Engineer's sample. Architect/Engineer's decision will be final on whether a proposed product matches.
1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 01 25 00 "Substitution Procedures" for proposal of product.
- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect/Engineer from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect/Engineer will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

## 2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration: Prior to bid, Architect/Engineer will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect/Engineer will reject request:
1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
  2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
  3. Evidence that proposed product provides specified warranty.
  4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
  5. Samples, if requested.

## PART 3 - EXECUTION (Not Used)

END OF SECTION 01 60 00

## SECTION 01 7 300

### EXECUTION

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

##### 1.2 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
  - 1. Construction layout.
  - 2. Field engineering and surveying.
  - 3. Installation of the Work.
  - 4. Cutting and patching.
  - 5. Coordination of University-installed products.
  - 6. Progress cleaning.
  - 7. Starting and adjusting.
  - 8. Protection of installed construction.
  - 9. Correction of the Work.
- B. Related Requirements:
  - 1. Section 01 10 00 "Summary" for limits on use of Project site and procedures related to utility interruptions.

##### 1.3 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of other work.
- B. Patching: Fitting and repair work required to restore construction to original conditions after installation of other work.

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For land surveyor or professional engineer.
- B. Certificates: Submit certificate signed by land surveyor or professional engineer certifying that location and elevation of improvements comply with requirements.
- C. Cutting and Patching Plan and Request: Submit plan and request describing procedures at least 21 calendar days prior to the time cutting and patching will be performed.
  - 1. Submit request whenever cutting and patching operation affect:



- a. Work of the University or any separate contractor.
- b. Structural value or integrity of any element of the Project.
- c. Integrity or effectiveness of weather-exposed or moisture-resistant elements or systems.
- d. Efficiency, operational life, maintenance or safety of operational elements.
- e. Visual qualities of sight-exposed elements.
- f. Cutting new openings in existing structural concrete walls, floors and suspended slabs.
- g. Cutting new openings in existing roofs and roofing materials.
- h. Cutting exterior walls.
- i. Cutting into shafts.
2. Include the following information:
  - a. Extent: Describe reason for and extent of each occurrence of cutting and patching, including explanation of why cutting and patching operation cannot be reasonable avoided.
  - b. Changes to In-Place Construction: Describe cutting and patching methods and anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
  - c. Products: List products to be used for patching and firms or entities that will perform patching work.
  - d. Trades: Indicate trades and subcontractors who will perform the work.
  - e. Dates: Indicate when cutting and patching will be performed.
  - f. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.
    - 1) Include description of provisions for temporary services and systems during interruption of permanent services and systems.
    - 2) Comply with requirements of Section 01 10 00 "Summary" related to existing utility and system interruptions.
  - g. Structural Elements: Where cutting and patching structural elements requires the addition of reinforcement, submit details and calculations signed and sealed by an Engineer registered in the State of Colorado. Indicate how new reinforcing will be integrated with original structure.
3. Limitations: Approval of cutting and patching request does not waive right of Architect/Engineer or University to later require complete removal and replacement of work found to be unsatisfactorily cut and patched.

D. Certified Surveys: Submit two copies signed by land surveyor or professional engineer.

E. Final Property Survey: Submit one electronic and two paper copies showing the Work performed and record survey data.

1. Include certified statement that lines and levels of the work comply with the requirements of the Contract Documents and listing authorized or accepted deviations, cross-referenced to Change Order number, where applicable.

## 1.5 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.
- B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.

1. Structural Elements: When cutting and patching structural elements, notify Architect/Engineer of locations and details of cutting and await directions from Architect/Engineer before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
  2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include but are not limited to the following:
    - a. Primary operational systems and equipment.
    - b. Fire separation assemblies.
    - c. Air or smoke barriers.
    - d. Fire-suppression systems.
    - e. Mechanical systems piping and ducts.
    - f. Control systems.
    - g. Communication systems.
    - h. Fire-detection and -alarm systems.
    - i. Conveying systems.
    - j. Electrical wiring systems.
    - k. Operating systems of special construction.
  3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:
    - a. Water, moisture, or vapor barriers.
    - b. Membranes and flashings.
    - c. Exterior curtain-wall construction.
    - d. Sprayed fire-resistive material.
    - e. Equipment supports.
    - f. Piping, ductwork, vessels, and equipment.
    - g. Noise- and vibration-control elements and systems.
  4. Visual Elements: Do not cut and patch construction exposed to the exterior or exposed in occupied spaces in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect/Engineer's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
  5. Hazardous Materials: Do not proceed with cutting and patching operations until University has examined existing construction for the presence of asbestos and/or lead-based coatings. Comply with requirements in Section 01 35 00 "Special Procedures."
- C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
  - 1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with requirements in Division 01 Section "Sustainable Design Requirements."
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
  - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect/Engineer for the visual and functional performance of in-place materials.
- C. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
  - 1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work. Notify University Project Manager and Architect/Engineer and obtain approval prior to disturbing, moving or penetrating soil.
  - 1. Arrange for locating buried utilities including water and sewer lines within construction limits. Obtain location information and stake all known utilities prior to commencing construction activities.
    - a. Contact Utility Notification Center of Colorado (UNCC), 1-800-922-1987, and comply with UNCC guidelines.
  - 2. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, and other utilities.
  - 3. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present, for compliance with requirements for installation tolerances and other conditions affecting performance.
  - 1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.

2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
4. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

- A. Existing Utility Information: Furnish information to local utility or University, as appropriate, that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect/Engineer according to requirements in Section 01 31 00 "Project Management and Coordination."

### 3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect/Engineer promptly.
- B. General: Engage a land surveyor or professional engineer to lay out the Work using accepted surveying practices.
  1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
  2. Establish limits on use of Project site.
  3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
  4. Inform installers of lines and levels to which they must comply.
  5. Check the location, level and plumb, of every major element as the Work progresses.
  6. Notify Architect/Engineer when deviations from required lines and levels exceed allowable tolerances. Record deviation which are accepted (i.e., not corrected) on record drawings in accordance with the requirements of Section 01 78 39 "Project Record Documents."
  7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect/Engineer.

#### 3.4 FIELD ENGINEERING

- A. Identification: University will identify existing benchmarks, control points, and property corners.
- B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
  - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect/Engineer. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect/Engineer before proceeding.
  - 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- C. Benchmarks: Establish and maintain a minimum of **two** permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
  - 1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
  - 2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
  - 3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.
- D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.
- E. Final Property Survey: Engage a land surveyor or professional engineer to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor or professional engineer, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.
  - 1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
  - 2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

### 3.5 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
1. Make vertical work plumb and make horizontal work level.
  2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
  3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
  4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated to the extent they are more explicit or stringent than requirements of the Contract Documents.
- C. Install products at the time and under conditions, including weather that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Isolate each part of complete installation from incompatible material as needed to prevent deterioration.
- E. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- F. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.
- G. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- H. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- I. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned, true and level as applicable, with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect/Engineer.
  2. Allow for building movement, including thermal expansion and contraction.
  3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- J. Attachment to Concrete:
1. No drilled inserts or powder-actuated fasteners are permitted in pre-stressed concrete except as specifically authorized by Contractor and carried out under the direct supervision of its Superintendent.

2. Only those devices with a maximum controlled penetration of 3/4 inch or less will be permitted. Make holes through slabs by means of sleeves placed no closer than 2 inch from tensioning cables. Core drilling will not be permitted unless unavoidable and as specified for cutting and patching in this Section.

- K. Joints: Unless indicated otherwise, make joints of uniform width. Where joint locations in exposed work are required but not indicated, arrange joints for the best visual effect. Confirm arrangement with Architect/Engineer before proceeding. Fit exposed connections together to form hairline joints.
- L. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

### 3.6 CUTTING AND PATCHING

- A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Responsibility: Provide cutting and patching work, including attendant excavation and backfill required to complete the Work or to:
1. Make components fit together properly.
  2. Uncover portions of the Work to provide for installation of ill-timed work.
  3. Remove and replace defective work or work not conforming to requirements of Contract Documents.
  4. Remove samples of installed work as specified for testing.
  5. Provide routine penetrations of non-structural surfaces for installation of piping and electrical conduit.
- C. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- D. Temporary Support: Provide temporary support of work to be cut.
- E. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- F. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in Section 01 10 00 "Summary."
- G. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas, coordinate cutting and patching according to requirements in Section 01 10 00 "Summary."
- H. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
  2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
  3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
  4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations. Employ methods which will prevent settlement or damage to other work.
  5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
  6. Proceed with patching after construction operations requiring cutting are complete.
- I. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements, including tolerance, specified in other Sections, where applicable.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
  2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
    - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    - b. Restore damaged pipe covering to its original condition.
  3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
    - a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
  4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
  5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
- J. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

### 3.7 UNIVERSITY-INSTALLED PRODUCTS

- A. Site Access: Provide access to Project site for University's construction personnel.
- B. Coordination: Coordinate construction and operations of the Work with work performed by University's construction personnel.



1. Construction Schedule: Inform University of Contractor's preferred construction schedule for University's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify University if changes to schedule are required due to differences in actual construction progress.
2. Preinstallation Conferences: Include University's construction personnel at preinstallation conferences covering portions of the Work that are to receive University's work. Attend preinstallation conferences conducted by University's construction personnel if portions of the Work depend on University's construction.

### 3.8 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
  1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
  2. Do not hold waste materials more than seven calendar days during normal weather or three calendar days if the temperature is expected to rise above 80 deg F.
  3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
    - a. Use containers intended for holding waste materials of type to be stored.
- B. Collection Point: Review location with University and obtain approval.
- C. Site: Maintain Project site free of waste materials and debris.
- D. Wind Blown Debris: Prevent spread of trash, debris, cartons, packing material, or other waste on or off Project site by wind.
- E. Dust: Sprinkle dusty debris with water.
- F. Packing Materials: Immediately after uncrating or unpacking materials or equipment, remove all crating, lumber, excelsior, wrapping or other like combustible materials from building to central collection facility.
- G. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
  1. Remove liquid spills promptly.
  2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- H. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- I. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- J. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

- K. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 01 74 19 "Construction Waste Management and Disposal."
- L. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- M. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- N. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.
- O. Snow and Ice: Remove snow and ice from sidewalks adjacent to site and from access ways to building and construction site.
- P. Streets: At frequency required by University and/or governing authority, clean adjacent and nearby streets of dirt resulting from construction operations.

### 3.9 STARTING AND ADJUSTING

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Manufacturer's Field Service: Comply with qualification requirements in Section 01 40 00 "Quality Requirements."

### 3.10 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.
- C. Limiting Exposures: Supervise construction activities to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period. Where applicable, such exposures include, but are not limited to, the following:
  - 1. Excessive static or dynamic loading.
  - 2. Excessive internal or external pressures.
  - 3. Excessively high or low temperatures.
  - 4. Thermal shock.
  - 5. Excessively high or low humidity.

6. Air contamination or pollution.
7. Water or ice.
8. Solvents.
9. Chemicals.
10. Light.
11. Radiation.
12. Puncture.
13. Abrasion.
14. Heavy traffic.
15. Soiling, staining and corrosion.
16. Bacteria.
17. Rodent and insect infestation.
18. Combustion.
19. Electrical current.
20. High speed operation.
21. Improper lubrication.
22. Unusual wear or other misuse.
23. Contact between incompatible materials.
24. Misalignment.
25. Excessive weathering.
26. Unprotected storage.
27. Improper shipping or handling.
28. Theft.
29. Vandalism.

**END OF SECTION 01 73 00**

**SECTION 01 73 05**

**UTILITY INTERRUPTION -- MECHANICAL, ELECTRICAL, PLUMBING**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section includes administrative and procedural requirements governing the shutdown of mechanical, electrical, and plumbing services for proper notification of all impacted by shutdown.
- B. Contractor to complete attached outage request and submit to university project manager.
- C. Outage requests must be submitted in advance per the time periods identified on attached form.

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION**

**3.1 COORDINATION**

- A. University staff will coordinate and announce internally to all impacted areas.
- B. Contractor & Subcontractors requesting outages must be present at specified time identified in approved outage request to initiate the start of outage. If contractors are not present, outage may be postponed.
- C. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

**END OF SECTION 01 73 05**

**SECTION 01 73 06**

**UTILITY INTERRUPTION – FIRE PROTECTION SYSTEMS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section includes administrative and procedural requirements governing the shutdown of fire protection systems for proper notification of all impacted by shutdown.
- B. Contractor to complete attached outage request and submit to university project manager.
- C. Outage requests must be submitted in advance per the time periods identified on attached form.

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION**

**3.1 COORDINATION**

- A. University staff will coordinate and announce internally to all impacted areas.
- B. Contractor & Subcontractors requesting outages must be present at specified time identified in approved outage request to initiate the start of outage. If contractors are not present, outage may be postponed.
- C. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

**END OF SECTION 01 73 06**

## SECTION 01 73 07

### TEMPORARY FIRE DETECTION, SUPPRESSION, AND SITE PROTECTION REQUIREMENTS

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

##### 1.2 SUMMARY

- A. This section includes administrative and procedural requirements governing the temporary fire detection and suppression requirements when impacting active construction activities in occupied facilities.
- B. Contractor shall comply with all fire and life safety code requirements for projects that impact the existing detection and suppression systems.
- C. All temporary protection requirements must be complete and active prior to the disabling or modifications to the existing systems.

#### PART 2 - PRODUCTS (Not Used)

#### PART 3 - EXECUTION

- A. All detection and suppression requirements during construction must meet the 2018 International Fire Code (IFC) Section 33 and 3308.7, and 3301. All requirements as outlined in NFPA 241, Standard for Safeguarding Construction, Alterations, and Demolition Operations must also be followed.

##### 3.2 STEPS for FIRE ALARM / FIRE SPRINKLER within project work:

- A. Fire alarm and/or fire suppression systems protect all areas and need to be maintained throughout the entire duration of the project.
- B. Smoke detection, heat detection, and fire suppression systems all rely on the ceiling structure as part of their functionality. All ceiling structures including ceiling tiles must be put back in place at the end of each workday to maintain functionality. A fire watch must be employed while any system impacts the functionality of suppression and detection systems. The use of a fire-retardant plastic covering at all openings is also acceptable.
- C. If suppression, detection, and ancillary systems are impacted for longer than a fire watch can be employed, temporary heat detection will need to be install at the deck to maintain proper coverage and code requirements.
- D. Fire detection and fire suppression systems can be taken offline to support project work; the FLS Impairment Form will need to be submitted through the CU project manager. Pages 2 and 3 of the Impairment form have instructions and additional information.

- E. Fire detection and fire suppression contractors must always be the first to walk and address the project before demolition of any space begins. As mentioned, the ancillary systems including ceilings, are part of the protection systems and cannot be removed without temporary requirements being installed to maintain systems. Preferred methods are turning all sprinkler heads up towards the deck or installing heat detection at the deck before demolition.
- F. Please note that fire suppression drain down require a re-fill at the end of each day unless fire watch or temporary heat detection is in place.
- G. Contractors are expected to maintain all other code requirements as it pertains to fire and life safety.

**END OF SECTION 01 73 07**

## SECTION 01 74 19

### CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

##### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
  - 1. Salvaging nonhazardous demolition and construction waste.
  - 2. Recycling nonhazardous demolition and construction waste.
  - 3. Disposing of nonhazardous demolition and construction waste.
- B. Related Requirements:
  - 1. Section 02 41 19 "Selective Demolition" for disposition of waste resulting from partial demolition of buildings, structures, and site improvements.
  - 2. Section 31 10 00 "Site Clearing" for disposition of waste resulting from site clearing and removal of above- and below-grade improvements.

##### 1.3 DEFINITIONS

- A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.
- C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.
- D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
- E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
- F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.



#### 1.4 PERFORMANCE REQUIREMENTS

- A. General: Achieve end-of-Project rates for salvage/recycling of minimum 75 percent by weight of total non-hazardous solid waste generated by the Work. Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials, including the following:

1. Demolition Waste:

- a. Asphalt paving.
- b. Concrete.
- c. Concrete reinforcing steel.
- d. Brick.
- e. Concrete masonry units.
- f. Wood studs.
- g. Wood joists.
- h. Plywood and oriented strand board.
- i. Wood paneling.
- j. Wood trim.
- k. Structural and miscellaneous steel.
- l. Rough hardware.
- m. Roofing.
- n. Insulation.
- o. Doors and frames.
- p. Door hardware.
- q. Windows.
- r. Glazing.
- s. Metal studs.
- t. Gypsum board.
- u. Acoustical tile and panels.
- v. Carpet.
- w. Carpet pad.
- x. Demountable partitions.
- y. Equipment.
- z. Cabinets.
- aa. Plumbing fixtures.
- bb. Piping.
- cc. Supports and hangers.
- dd. Valves.
- ee. Sprinklers.
- ff. Mechanical equipment.
- gg. Refrigerants.
- hh. Electrical conduit.
- ii. Copper wiring.
- jj. Lighting fixtures.
- kk. Lamps.
- ll. Ballasts.
- mm. Electrical devices.
- nn. Switchgear and panelboards.
- oo. Transformers.

2. Construction Waste:

- a. Masonry and CMU.
- b. Lumber.
- c. Wood sheet materials.
- d. Wood trim.
- e. Metals.
- f. Roofing.
- g. Insulation.
- h. Carpet and pad.
- i. Gypsum board.
- j. Piping.
- k. Electrical conduit.
- l. Packaging: Regardless of salvage/recycle goal indicated in "General" Paragraph above, salvage or recycle 100 percent of the following uncontaminated packaging materials:
  - 1) Paper.
  - 2) Cardboard.
  - 3) Boxes.
  - 4) Plastic sheet and film.
  - 5) Polystyrene packaging.
  - 6) Wood crates.
  - 7) Plastic pails.

#### 1.5 ACTION SUBMITTALS

- A. Waste Management Plan: Submit plan within 30 calendar days of date established for the Notice to Proceed.

#### 1.6 INFORMATIONAL SUBMITTALS

- A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Use Form CWM-7 for construction waste and Form CWM-8 for demolition waste, as applicable. Include the following information:
  - 1. Material category.
  - 2. Generation point of waste.
  - 3. Total quantity of waste in tons.
  - 4. Quantity of waste salvaged, both estimated and actual in tons.
  - 5. Quantity of waste recycled, both estimated and actual in tons.
  - 6. Total quantity of waste recovered (salvaged plus recycled) in tons.
  - 7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.
- B. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.
- C. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.
- D. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.

- E. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- F. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- G. Qualification Data: For refrigerant recovery technician.
- H. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

#### 1.7 QUALITY ASSURANCE

- A. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.
- B. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.
- C. Waste Management Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00 "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:
  - 1. Review and discuss waste management plan including responsibilities of waste management coordinator.
  - 2. Review requirements for documenting quantities of each type of waste and its disposition.
  - 3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
  - 4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
  - 5. Review waste management requirements for each trade.

#### 1.8 WASTE MANAGEMENT PLAN

- A. General: Develop a waste management plan according to ASTM E 1609 and requirements in this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Where Project includes demolition, distinguish between demolition and construction waste. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.
- B. Waste Identification: Indicate anticipated types and quantities of demolition, site-clearing, and construction waste, as applicable, generated by the Work. Use Form CWM-1 for construction waste and Form CWM-2 for demolition waste. Include estimated quantities and assumptions for estimates.
- C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Use Form CWM-3 for construction waste and Form CWM-4 for demolition waste. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.
  - 1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.

2. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
3. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
5. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
6. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.

## PART 2 - PRODUCTS (Not Used)

## PART 3 - EXECUTION

### 3.1 PLAN IMPLEMENTATION

- A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
  1. Comply with operation, termination, and removal requirements in Section 01 50 00 "Temporary Facilities and Controls."
- B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan. Based on Project size and complexity, waste management coordinator may, if approved in writing by Architect/Engineer and University Project Manager, serve in other construction related roles.
- C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.
  1. Distribute waste management plan to everyone concerned within three business days of submittal return.
  2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.
- D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
  1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
  2. Comply with Section 01 50 00 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

### 3.2 SALVAGING DEMOLITION WASTE

- A. Salvaged Items for Reuse in the Work: Salvage items for reuse and handle as follows:
  1. Clean salvaged items.

2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
  3. Store items in a secure area until installation.
  4. Protect items from damage during transport and storage.
  5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.
- B. Salvaged Items for Sale and Donation: Not permitted on Project site.
- C. Salvaged Items for University's Use: Salvage items for University's use and handle as follows:
1. Clean salvaged items.
  2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
  3. Store items in a secure area until delivery to University.
  4. Transport items to University's storage area designated by University.
  5. Protect items from damage during transport and storage.
- D. Doors and Hardware: Brace open end of door frames. Except for removing door closers, leave door hardware attached to doors.
- E. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs. Protect equipment from exposure to weather.
- F. Plumbing Fixtures: Separate by type and size.
- G. Lighting Fixtures: Separate lamps by type and protect from breakage.
- H. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.

### 3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

- A. General: Recycle paper and beverage containers used by on-site workers.
- B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Contractor.
- C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.
- D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.
1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
    - a. Inspect containers and bins for contamination and remove contaminated materials if found.
  2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
4. Store components off the ground and protect from the weather.
5. Remove recyclable waste from University's property and transport to recycling receiver or processor.

### 3.4 RECYCLING DEMOLITION WASTE

- A. Metals: Separate metals by type.
1. Structural Steel: Stack members according to size, type of member, and length.
  2. Remove and dispose of bolts, nuts, washers, and other rough hardware.
- B. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location. Remove edge trim and sort with other metals. Remove and dispose of fasteners.
- C. Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets and store in a dry location.
- D. Metal Suspension System: Separate metal members including trim, and other metals from acoustical panels and tile and sort with other metals.
- E. Carpet and Pad: Roll large pieces tightly after removing debris, trash, adhesive, and tack strips.
1. Store clean, dry carpet and pad in a closed container or trailer provided by Carpet Reclamation Agency or carpet recycler.
- F. Carpet Tile: Remove debris, trash, and adhesive.
1. Stack tile on pallet and store clean, dry carpet in a closed container or trailer provided by Carpet Reclamation Agency or carpet recycler.
- G. Piping: Reduce piping to straight lengths and store by type and size. Separate supports, hangers, valves, sprinklers, and other components by type and size.
- H. Conduit: Reduce conduit to straight lengths and store by type and size.

### 3.5 RECYCLING CONSTRUCTION WASTE

- A. Packaging:
1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
  2. Polystyrene Packaging: Separate and bag materials.
  3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
  4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.
- B. Wood Materials:
1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
  2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.

C. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.

1. Clean Gypsum Board: If gypsum board is processed on site, grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding. At Contractor<sup>TM</sup>'s option, processing may occur off site.

### 3.6 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
  1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
  2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn waste materials.
- C. Disposal: Remove waste materials from University's property and legally dispose of them.

**END OF SECTION 01 74 19**

**SECTION 01 77 00**  
**CLOSEOUT PROCEDURES**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
1. Substantial Completion procedures, including Notice of Completion and Final Inspection procedures.
  2. Occupancy procedures, including Notice of Approval of Occupancy/Use and University Supplemental Notice of Occupancy and Use List.
  3. Final Acceptance procedures, including Pre-Acceptance Checklist and University Supplemental Building/Project Acceptance List.
  4. Inspections after completion.
  5. Warranties.
  6. Final cleaning.
  7. Repair of the Work.
- B. Related Requirements:
1. Section 01 32 33 "Photographic Documentation" for submitting final completion construction photographic documentation.
  2. Section 01 73 00 "Execution" for progress cleaning of Project site.
  3. Section 01 78 23 "Operation and Maintenance Data" for operation and maintenance manual requirements.
  4. Section 01 78 39 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
  5. Section 01 79 00 "Demonstration and Training" for requirements for instructing University's personnel.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For cleaning agents.
- B. Contractor's List of Incomplete Items: Initial submittal at Notice of Completion.
- C. Certified List of Incomplete Items: Final submittal at Final Acceptance.

**1.4 CLOSEOUT SUBMITTALS**

- A. Certificates of Release: From authorities having jurisdiction.



- B. Certificate of Insurance: For continuing coverage.
- C. Field Report: For pest control inspection.

#### 1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

#### 1.6 NOTICE OF COMPLETION AND SUBSTANTIAL COMPLETION PROCEDURES

- A. Procedures and Submittals Prior to Notice of Completion: Complete and submit all of the following items prior to submitting Notice of Completion to Architect/Engineer. Include Contractor's comprehensive list of items to be completed, corrected or not in compliance with the Drawings and Specifications.
  - 1. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's preliminary punch list), indicating the value of each item on the list and reasons why the Work is incomplete.
  - 2. Building Inspection Record: Submit completed record with all required corrections noted.
  - 3. Certificate of Occupancy: Submit Certificate of Occupancy (CO) or Temporary Certificate of Occupancy (TCO).
  - 4. Final Completion Schedule: Submit schedule for performing and completing all work indicated on the Contractor' list of incomplete items.
  - 5. Submit sustainable design documentation.
  - 6. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
  - 7. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
  - 8. Submit test/adjust/balance records.
- B. Final Inspection: Submit Notice of Completion to Architect/Engineer. Upon receipt, Architect/Engineer and University will review and if all items on the University Supplemental Notice of Completion Checklist are complete will, within the timeframe required by the Contract, schedule and make an inspection of the Project to determine whether the Work is substantially complete.
  - 1. Final Punch List: Based on the inspection, Architect/Engineer will prepare a final punch list of work to be completed, work not in compliance with the Drawings or Specifications, and unsatisfactory work for any reason.
  - 2. Re-inspection: If the cumulative number of items identified on the final punch list prevents a determination that the work is substantially complete, complete those items and when complete resubmit Notice of Completion. Upon receipt of resubmittal, Architect/Engineer and University will then schedule and make a re-inspection of the Project to determine whether the Work is substantially complete.
- C. Notice of Substantial Completion: When inspection of the Work indicates that the Project is substantially complete and all other Contract provisions required for substantial completion have been satisfied, Architect/Engineer will issue a Notice of Substantial Completion (State Form SBP-07).

## 1.7 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor or as approved by Architect/Engineer.
  2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
  3. Include the following information at the top of each page:
    - a. Project name.
    - b. Date.
    - c. Name of Architect/Engineer.
    - d. Name of Contractor.
    - e. Page number.
  4. Submit list of incomplete items in the following format:
    - a. MS Excel and PDF electronic file. Architect/Engineer will return annotated file.

## 1.8 OCCUPANCY PROCEDURES

- A. Procedures and Submittals Prior to Occupancy: Complete and submit all items on both State Form SBP-01 "Notice of Approval of Occupancy/Use" and University Supplemental Notice of Occupancy and Use List.

## 1.9 FINAL ACCEPTANCE PROCEDURES

- A. Procedures and Submittals Prior to Final Acceptance: Complete and submit all items on both State Form SBP-05 "Pre-Acceptance Checklist" and University Supplemental Building/Project Acceptance List.
- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 business days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect/Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect/Engineer will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

## 1.10 SETTLEMENT AND FINAL PAYMENT

- A. Submit and complete all of the following as a condition precedent to settlement and final payment:
1. All guarantees and warranties.
  2. All statement to support local sales tax refunds, if any.
  3. Three (3) sets of operation and maintenance manuals.
  4. One (1) set of as-built Contract Documents showing all job changes.
  5. All demonstration and training completed in accordance with Section 01 79 00.
  6. All punch list items documented as complete.

- B. Final Certificate of Payment: Submit in accordance with the requirements of Section 01 29 00 "Payment Procedures."

#### 1.11 INSPECTIONS AFTER COMPLETION

- A. Warranty/Guarantee Inspections: During the warranty period, accompany Architect/Engineer and University Representative, and participate in inspection(s) of the Project to identify defective and deficient work at intervals and as required by the Contract.
- B. List of Deficient or Defective Work: Within 10 business days of inspection, Architect/Engineer will provide Contractor with a list of items requiring correction.
- C. Remedial Work: Upon receive of itemized list, immediately correct and remedy deficiencies and defects in a manner satisfactory to the Architect/Engineer and University.

#### 1.12 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties to the Architect/Engineer prior to advertisement of the Notice of Contractor's Settlement. If the Notice of Acceptance designates a commencement date for warranties other than the date of Notice of Acceptance for the Work, or a designated portion of the Work, submit written warranties upon request of the Architect.
- B. Partial Occupancy: When a designated portion of the Work is completed and occupied or used by the University, by separate agreement with the Contractor during the construction period, submit properly executed warranties to the Architect/Engineer within fifteen (15) calendar days of completion of that designated portion of the Work.
- C. Special Warranties: When a special warranty is required to be executed by the Contractor, or the Contractor and a Subcontractor, supplier or manufacturer, prepare a written document that contains appropriate terms and identification, ready for execution by the required parties. Submit a draft to the University through the Architect/Engineer for approval prior to final execution. Refer to individual Specification Sections for specific requirements for special warranties.
- D. Form of Submittal: Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
  - 1. Number of Copies: Two.
  - 2. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
  - 3. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
  - 4. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
  - 5. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
- E. Provide additional copies of each warranty to include in operation and maintenance manuals.
- F. List of Extended Warranties: Provide a comprehensive list of all manufacturers' standard and special warranties with duration greater than one year after Notice of Acceptance. Organize list into an orderly sequence based on table of contents of the Project Manual.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.
  2. Do not use sweeping compounds on concrete floors that will leave residue affecting finish floor materials.

## PART 3 - EXECUTION

### 3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
1. Complete the following cleaning operations immediately prior to Occupancy for entire Project or for a designated portion of Project:
    - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
    - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
    - c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
    - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
    - e. Remove snow and ice to provide safe access to building.
    - f. Clean exposed exterior and interior finishes to a dirt-free condition, free of grease, dust, stains, films, fingerprints, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
    - g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
    - h. Sweep concrete floors broom clean in unoccupied spaces.
    - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
    - j. Power scrub and power buff resilient flooring surfaces, tile and fluid-applied flooring.
    - k. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
    - l. Remove labels that are not permanent.
    - m. Wipe surfaces of mechanical and electrical equipment, elevator equipment where applicable, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
    - n. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.

- o. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
  - p. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
    - 1) Clean HVAC system in compliance with NADCA Standard 1992-01. Provide written report on completion of cleaning.
  - q. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
  - r. Clean food service equipment to sanitary condition acceptable for intended food service use and approved by authority having jurisdiction.
  - s. Leave Project clean and ready for occupancy.
- C. Pest Control: Comply with pest control requirements in Section 01 50 00 "Temporary Facilities and Controls." Prepare written report.

### 3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.
- B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
  - 1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
  - 2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that already show evidence of repair or restoration.
    - a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
  - 3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
  - 4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

### 3.3 ATTACHMENTS

- A. Samples of the following forms are appended to this Section for reference following End of Section 01 77 00:
  - 1. University of Colorado Denver | Anschutz Medical Campus Supplemental Notice of Occupancy and Use List.
  - 2. University of Colorado Denver | Anschutz Medical Campus Supplemental Building / Project Acceptance List.

**END OF SECTION 01 77 00**

## SECTION 01 78 23

### OPERATION AND MAINTENANCE DATA

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

##### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
  - 1. Operation and maintenance documentation directory.
  - 2. Systems, subsystems, and equipment operation and maintenance manuals.
  - 3. Product maintenance manuals.
  - 4. Emergency manuals.
  - 5. Framed operating and maintenance instructions.
- B. Related Requirements:
  - 1. Section 01 33 00 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
  - 2. Section 01 91 13 "General Commissioning Requirements" for verification and compilation of data into operation and maintenance manuals.

##### 1.3 DEFINITIONS

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

##### 1.4 CLOSEOUT SUBMITTALS

- A. Schedule: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 30 calendar days before commencing demonstration and training. Architect/Engineer will return copy with comments.
  - 1. Correct or revise each manual to comply with Architect/Engineer's comments. Submit copies of each corrected manual within 15 calendar days of receipt of Architect/Engineer's comments and prior to commencing demonstration and training.
- B. Format: Submit operations and maintenance manuals in the following format:
  - 1. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Architect/Engineer.
    - a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
    - b. Compile entirely from documents with searchable text.

c. Enable inserted reviewer comments on draft submittals.

C. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 30 calendar days before commencing demonstration and training.

Architect/Engineer will return copy with comments.

1. Correct or revise each manual to comply with Architect/Engineer's comments. Submit copies of each corrected manual within 15 calendar days of receipt of Architect/Engineer's comments and prior to commencing demonstration and training.

## PART 2 - PRODUCTS

### 2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. Include a section in the directory for each of the following:

1. List of documents.
2. List of systems.
3. List of equipment.
4. Table of contents.

B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.

C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.

D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

### 2.2 GENERAL REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Intent: Prepare data in form of an instructional manual for use by University personnel.

B. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:

1. Title page.
2. Table of contents.
3. Manual contents.

C. Title Page: Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of University.
4. Date of submittal.
5. Name and contact information for Contractor.

6. Name and contact information for Construction Manager.
  7. Name and contact information for Architect/Engineer.
  8. Name and contact information for Commissioning Authority.
  9. Names and contact information for major consultants to the Architect/Engineer that designed the systems contained in the manuals.
  10. Cross-reference to related systems in other operation and maintenance manuals.
- D. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- E. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- F. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
- G. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
- H. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size and enable OCR (optical character recognition) to provide searchable text.
  2. File Names and Bookmarks: Enable bookmarking of individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

## 2.3 SYSTEMS, SUBSYSTEMS AND EQUIPMENT OPERATION AND MAINTENANCE MANUALS

- A. General: Provide operation and maintenance manuals where indicated in individual Specification Section and the following:
1. Heating, ventilating and air-conditioning equipment and systems.
  2. Plumbing equipment and systems.
  3. Special piping equipment and systems.
  4. Electrical distribution systems.
  5. Standby generator systems.
  6. Communications systems.
  7. Fire alarm and detection systems.
  8. Underground sprinkler systems.



9. Automatic entrances.
10. Food service equipment.
11. Elevators.
12. Other special construction and conveying systems.

B. Operation Content: In addition to requirements in this Section, include operation data required in individual Specification Sections.

1. Additional Operation Content Required:

- a. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
- b. Performance and design criteria if Contractor has delegated design responsibility.
- c. Operating standards.
- d. Operating procedures.
- e. Operating logs.
- f. Wiring diagrams.
- g. Control diagrams.
- h. Piped system diagrams.
- i. Precautions against improper use.
- j. License requirements including inspection and renewal dates.

2. Descriptions: Include the following:

- a. Product name and model number. Use designations for products indicated on Contract Documents.
- b. Manufacturer's name.
- c. Equipment identification with serial number of each component.
- d. Equipment function.
- e. Operating characteristics.
- f. Limiting conditions.
- g. Performance curves.
- h. Engineering data and tests.
- i. Complete nomenclature and number of replacement parts.

3. Operating Procedures: Include the following, as applicable:

- a. Startup procedures.
- b. Equipment or system break-in procedures.
- c. Routine and normal operating instructions.
- d. Regulation and control procedures.
- e. Instructions on stopping.
- f. Normal shutdown instructions.
- g. Seasonal and weekend operating instructions.
- h. Required sequences for electric or electronic systems.
- i. Special operating instructions and procedures.

4. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

5. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

C. Maintenance Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.

1. Source Information: Provide the following information in a list for each product included in manual:
  - a. Name, address, and telephone number of Installer or supplier and maintenance service agent.
  - b. Name, address, and telephone number of local source for supply of replacement parts.
  - c. Name, address, and telephone number of maintenance contractor, where appropriate.
  - d. Cross-reference Specification Section number and title.
  - e. Drawing or schedule designation or identifier where applicable.
2. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
  - a. Standard maintenance instructions and bulletins.
  - b. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
  - c. Identification and nomenclature of parts and components.
  - d. List of items recommended to be stocked as spare parts.
3. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
  - a. Test and inspection instructions.
  - b. Troubleshooting guide.
  - c. Precautions against improper maintenance.
  - d. Disassembly; component removal, repair, and replacement; and reassembly instructions.
  - e. Aligning, adjusting, and checking instructions.
  - f. Demonstration and training video recording, if available.
4. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
  - a. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
  - b. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
5. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
6. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
7. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
  - a. Include procedures to follow and required notifications for warranty claims.
  - b. Include information sheet covering proper procedures in event of failure and instances which might affect validity of warranties and bonds.

## 2.4 PRODUCT MAINTENANCE MANUALS

- A. Content: Organize manual into a separate section for each product, material, and finish. Separate into two manuals: one for exterior moisture protection products and those exposed to weather and one for interior products. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- B. Source Information: Provide the following information for each product included in manual:
1. Name, address, and telephone number of Installer or supplier and maintenance service agent.
  2. Cross-reference Specification Section number and title.
  3. Drawing or schedule designation or identifier where applicable.
- C. Product Information: Include the following, as applicable:
1. Product name and model number.
  2. Manufacturer's name.
  3. Color, pattern, and texture.
  4. Material and chemical composition.
  5. Reordering information for specially manufactured products.
- D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
1. Inspection procedures.
  2. Types of cleaning agents to be used and methods of cleaning.
  3. List of cleaning agents and methods of cleaning detrimental to product.
  4. Schedule for routine cleaning and maintenance.
  5. Repair instructions.
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

## 2.5 EMERGENCY MANUALS

- A. Content: Organize manual into a separate section for each of the following:
1. Type of emergency.
  2. Emergency instructions.
  3. Emergency procedures.
- B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
1. Fire.
  2. Flood.
  3. Gas leak.
  4. Water leak.
  5. Power failure.
  6. Water outage.
  7. System, subsystem, or equipment failure.
  8. Chemical release or spill.

- C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of University's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- D. Emergency Procedures: Include the following, as applicable:
  - 1. Instructions on stopping.
  - 2. Shutdown instructions for each type of emergency.
  - 3. Operating instructions for conditions outside normal operating limits.
  - 4. Required sequences for electric or electronic systems.
  - 5. Special operating instructions and procedures.

## 2.6 FRAMED OPERATING AND MAINTENANCE INSTRUCTIONS

- A. All mechanically and electrically operated equipment and controls shall be provided with legible and complete wiring diagrams, schematics, operating instructions, and pertinent preventative maintenance instructions in a sturdy frame with clear glass or plastic cover. Use non-fading, permanent media.
- B. Locate frames in the same room or service enclosure as equipment, or in the nearest mechanical or electrical room.

## PART 3 - EXECUTION (Not Used)

**END OF SECTION 01 78 23**

**SECTION 01 78 39**

**PROJECT RECORD DOCUMENTS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section includes administrative and procedural requirements for project record documents, including the following:
1. Record Drawings.
  2. Record Specifications.
  3. Record Product Data.
  4. Record Samples.
  5. Miscellaneous record submittals.
- B. Related Requirements:
1. Section 01 73 00 "Execution" for final property survey.
  2. Section 01 77 00 "Closeout Procedures" for general closeout procedures.
  3. Section 01 78 23 "Operation and Maintenance Data" for operation and maintenance manual requirements.

**1.3 CLOSEOUT SUBMITTALS**

- A. General: Submit record drawings with duplicate original transmittal letters containing:
1. Date.
  2. Project title and number.
  3. Contractor's name and address.
  4. Certification that each document as submitted is complete and accurate.
  5. Signature of authorized representative of the Contractor.
- B. Record Drawings: Submit copies of record Drawings as follows:
1. Submit three paper-copy sets of marked-up record prints, two copies will be retained by the University and one copy retained by the Architect/Engineer.
  2. Submit three paper-copy sets and three digital copies on CD of electronic files for all delegated-design submittals. Two copies will be retained by the University and one copy retained by the Architect/Engineer.
- C. Record Specifications: Submit three paper copies of Project's Specifications, including addenda and contract modifications. Two copies will be retained by the University and one copy retained by the Architect/Engineer.

1. Record Product Data: Submit three paper copies of each submittal. Two copies will be retained by the University and one copy retained by the Architect/Engineer.
  2. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.
- D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit three paper copies of each submittal. Two copies will be retained by the University and one copy retained by the Architect/Engineer.
- E. Interior Finishes Binder: Three copies. Two copies will be retained by the University and one copy retained by the Architect/Engineer.

## PART 2 - PRODUCTS

### 2.1 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
    - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
    - b. Accurately record information in an acceptable drawing technique.
    - c. Record data as soon as possible after obtaining it.
    - d. Record and check the markup before enclosing concealed installations.
    - e. Cross-reference record prints to corresponding archive photographic documentation.
    - f. Mark using line types and symbols conforming to Contract Documents.
  2. Content: Types of items requiring marking include, but are not limited to, the following:
    - a. Dimensional changes to Drawings.
    - b. Revisions to details shown on Drawings.
    - c. Depths of foundations below first floor.
    - d. Locations and depths of underground utilities referenced to permanent surface improvements.
    - e. Revisions to routing of piping and conduits.
    - f. Revisions to electrical circuitry.
    - g. Actual equipment locations.
    - h. Duct size and routing.
    - i. Locations of concealed internal utilities referenced to visible and accessible features of structure.
    - j. Locations of concealed valves, dampers, controls, balancing devices, junction boxes, cleanouts, and other items requiring access or maintenance.
    - k. Changes made by Change Order.
    - l. Changes made following Architect/Engineer's written orders.
    - m. Details not on the original Contract Drawings.
    - n. Field records for variable and concealed conditions.

- o. Record information on the Work that is shown only schematically.
    - 3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
    - 4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
    - 5. Mark additional information important to University that was either shown schematically or omitted from original Drawings.
    - 6. Note Change Order numbers, and similar identification, where applicable.
  - B. Record Delegated Design Electronic Files: For all delegated design submittals, including but not limited to landscape irrigation, fire alarm and fire sprinkler plans, prepare electronic files in full compliance with University of Colorado Denver | Anschutz Medical Campus Guidelines and Design Standards, Part 1.0, Paragraph "Drawing Production Standards."
  - C. Identification: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
    - 1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
    - 2. Identification: As follows:
      - a. Project name.
      - b. Date.
      - c. Designation "PROJECT RECORD DRAWINGS."
      - d. Name of Architect/Engineer.
      - e. Name of Contractor.

## 2.2 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
  - 1. Give particular attention to substitutions, selection of options, and similar information on concealed products and installations that cannot be readily identified and recorded later.
  - 2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
  - 3. Note related Change Orders where applicable.
  - 4. Maintain one complete copy of all Addenda, Change Orders and other written change documents in printed form during construction.

## 2.3 RECORD PRODUCT DATA

- A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
  - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
  - 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
  - 3. Note related Change Orders, record Specifications, and record Drawings where applicable.
- B. Directory: Include record Product Data directory organized by Specification Section number and title.

- C. Product List: Update and record any changes to Product List submitted in accordance with Section 01 60 00 "Product Requirements," including any changes to brand, model, subcontractor, or Installer so that final list reflects materials, equipment and systems incorporated into the Work.

## 2.4 RECORD SAMPLES

- A. Prior to Final Acceptance, meet with University Project Manager and Architect/Engineer at site to review and identify which submitted samples maintained during the progress of the Work are to be transmitted to the University.
- B. Deliver selected samples to storage area identified by University.
1. Finishes Binder: Three-ring notebook or notebooks, organized by Specification Section number, providing a listing and description of all material finishes on the Project and including a minimum 6 inch by 6 inch sample thereof to accompany the description. Accompany each material selection indicated with the following:
  2. Manufacturer and product name.
  3. Pattern name and number, as applicable.
  4. Color name, as applicable.
  5. Any additional information required to order replacement product.

## 2.5 MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.
1. Include manufacturer's certifications, field test record, copies of permits, licenses, certifications, inspection reports, releases, notices, receipts for fee payments and similar documents.
  2. Directory: Include miscellaneous record submittals directory organized by Specification Section number and title.

# PART 3 - EXECUTION

## 3.1 RECORDING AND MAINTENANCE

- A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project. Update at least weekly.
- B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect/Engineer's and University's reference during normal working hours.

END OF SECTION 01 78 39



**SECTION 01 78 46**

**EXTRA STOCK MATERIALS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section includes descriptions and quantities of required extra stock materials.

**1.3 INFORMATIONAL SUBMITTALS**

- A. Schedule of Maintenance Materials: Prepare a schedule in tabular form of all extra stock materials required in individual Specification Sections including:
1. Specification Section number and title.
  2. Description of required material
  3. Quantity of required material.

**1.4 MAINTENANCE MATERIALS**

- A. Furnish extra materials that match and are from the same production runs as the product installed.
- B. Provide in the quantities indicated.

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION**

**3.1 MAINTENANCE MATERIAL SCHEDULE**

SECTION	TITLE	DESCRIPTION	QUANTITY
04 42 00	EXTERIOR STONE CLADDING	Dimension Stone Units	Furnish 100 sq. ft. finished stone panels for each finish and variety of stone specified.
09 30 00	TILING	Tile and Trim Units	Furnish 100 sq. ft. of full-size units for each type, composition, color, pattern, and size indicated.
09 30 33	STONE TILING	Dimension Stone Tile	Furnish 100 sq. ft. of full-size units for each type, composition, color, pattern, and size indicated.

09 51 13	ACOUSTICAL PANEL CEILINGS	Acoustical Ceiling Panels	100 sq. ft. of full-size panels.
09 51 23	ACOUSTICAL TILE CEILINGS	Acoustical Ceiling Units	100 sq. ft. of full-size tiles.
09 54 36	SUSPENDED DECORATIVE GRIDS	Suspended Decorative Grids	100 sq. ft. of each suspended decorative grid component, exposed molding, and trim.
09 62 29	CORK FLOORING	Cork Flooring	Furnish 1 box of each type, shade, pattern, and finish of cork flooring installed.
09 65 13	RESILIENT BASE AND ACCESSORIES		Furnish 50 linear feet of each type, color, pattern, and size of wall base installed. Furnish 2% of each type, color, pattern, and size of all other resilient accessories installed.
09 68 13	TILE CARPETING	Carpet Tile	100 sq. ft. of full-size units for each type indicated.
10 13 00	DIRECTORIES	Message Strips	Full-size, blank strips equal to 10 percent of amount installed for each size indicated, but no fewer than 20 strips.
11 12 00	PARKING CONTROL EQUIPMENT	Gate Arms	1 breakaway gate arms for each gate installed, complete with accessory components.
12 21 13	HORIZONTAL LOUVER BLINDS	Horizontal Louver Blinds	Full-size units equal to 1 percent of quantity installed for each size, color, texture, pattern, and gloss indicated, but no fewer than two units and no more than five units.
14 20 00	ELEVATORS		2 sets of complete parts catalogs including manufacturer's recommended spare parts list with clear identification and illustration of each functional part, exploded parts views, identification of part numbers and assembly numbers including replaceable electrical and electronic parts and circuit boards.
21 05 00	FIRE SUPPRESSION	Sprinkler heads and Special Sprinkler Wrenches.	2 heads minimum of each type and temperature rating installed and special sprinkler wrenches enclosed in a steel cabinet in accordance with NFPA 13.
22 30 00	PLUMBING EQUIPMENT	Valve Key	1 valve key for each key operated wall hydrant, post hydrant, hose bib, or faucet installed.
23 05 13	MOTORS	Variable Frequency Drives	1 complete set of spare fuses for each VFD supplied.
23 30 00	HVAC AIR DISTRIBUTION	Fire Dampers	3 fusible links per type installed.
23 57 00	HEAT EXCHANGERS FOR HVAC	Heat Exchanger	1 gasket for each flanged connection for each heat exchanger installed.
23 65 00	COOLING TOWERS		3 spray nozzles for each tower cell provided.
			1 gasket for each gasketed access and inspection opening provided.
			1 set of matched fan belts for each belt driven fan provided.

23 70 00	CENTRAL HVAC EQUIPMENT	Air Handling Units	1 complete set of filters for each air-handling unit installed.
			1 set of belts for each unit installed with label clearly identifying to which fan the belt belongs.
26 09 43	NETWORK LIGHTING CONTROLS	Control Devices	3 devices for each device used.
26 20 00	LOW VOLTAGE ELECTRICAL DISTRIBUTION	Fuses	1 set of 3 of each type and size used on the project and fuse cabinet in main electrical room to hold them.
26 51 00	INTERIOR LIGHTING	Lamps	Provide 5% or a maximum of 25 spares of each lamp type used on the project.
28 31 00	FIRE DETECTION AND ALARM	Initiating and Control Devices	Provide 5 spare devices for each device type used.
		Notification Devices	Provide 5 spare devices for each device type used.

**END OF SECTION 01 78 46**

## SECTION 01 79 00

### DEMONSTRATION AND TRAINING

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

##### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for instructing University's personnel, including the following:
  - 1. Demonstration of operation of systems, subsystems, and equipment.
  - 2. Training in operation and maintenance of systems, subsystems, and equipment.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include outline for each training module.
- B. Qualification Data: For instructor, demonstrating qualifications and ability to instruct on maintenance and care of system, equipment and products.
- C. Schedule of Demonstration and Training: Prepare a schedule in tabular form of all demonstration and training required in individual Specification Sections including:
  - 1. Specification Section number and title.
  - 2. Description of required demonstration and training.
- D. Attendance Record: For each training module, submit list of participants and length of instruction time.

##### 1.4 QUALITY ASSURANCE

- A. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 01 40 00 "Quality Requirements," experienced in operation and maintenance procedures and training. Manufacturer's sales staff is not acceptable.
- B. Pre-instruction Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00 "Project Management and Coordination." Review methods and procedures related to demonstration and training.

## PART 2 - PRODUCTS

### 2.1 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: For each module, include instruction for the following as applicable to the system, equipment, or component:
  - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
    - a. System, subsystem, and equipment descriptions.
    - b. Performance and design criteria if Contractor is delegated design responsibility.
    - c. Operating standards.
    - d. Regulatory requirements.
    - e. Equipment function.
    - f. Operating characteristics.
    - g. Limiting conditions.
    - h. Performance curves.
  - 2. Documentation: Review the following items in detail:
    - a. Emergency manuals.
    - b. Operations manuals.
    - c. Maintenance manuals.
    - d. Project record documents.
    - e. Identification systems.
    - f. Warranties and bonds.
    - g. Maintenance service agreements and similar continuing commitments.
  - 3. Emergencies: Include the following, as applicable:
    - a. Instructions on meaning of warnings, trouble indications, and error messages.
    - b. Instructions on stopping.
    - c. Shutdown instructions for each type of emergency.
    - d. Operating instructions for conditions outside of normal operating limits.
    - e. Sequences for electric or electronic systems.
    - f. Special operating instructions and procedures.
    - g. A tour of the installation identifying the location of all system components.
  - 4. Operations: Include the following, as applicable:
    - a. Startup procedures.
    - b. Equipment or system break-in procedures.
    - c. Routine and normal operating instructions.
    - d. Regulation and control procedures.
    - e. Control sequences.
    - f. Safety procedures.
    - g. Instructions on stopping.
    - h. Normal shutdown instructions.
    - i. Operating procedures for emergencies.
    - j. Operating procedures for system, subsystem, or equipment failure.
    - k. Seasonal and weekend operating instructions.
    - l. Required sequences for electric or electronic systems.
    - m. Special operating instructions and procedures.
    - n. Sequence of operation.
  - 5. Adjustments: Include the following:
    - a. Alignments.
    - b. Checking adjustments.
    - c. Noise and vibration adjustments.

- d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
  - a. Diagnostic instructions.
  - b. Test and inspection procedures.
7. Maintenance: Include the following:
  - a. Inspection procedures.
  - b. Types of cleaning agents to be used and methods of cleaning.
  - c. List of cleaning agents and methods of cleaning detrimental to product.
  - d. Procedures for routine cleaning
  - e. Procedures for preventive maintenance.
  - f. Procedures for routine maintenance.
  - g. Instruction on use of special tools.
8. Repairs: Include the following:
  - a. Diagnosis instructions.
  - b. Repair instructions.
  - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
  - d. Instructions for identifying parts and components.
  - e. Review of spare parts needed for operation and maintenance.
  - f. Product support/service model.
  - g. Purchasing of replacement parts.
9. Instruction specific to Instrumentation and Controls, Electrical Gateway, Network Lighting Controls, or any other new technology that is integrated with another system: Include the following:
  - a. Overview and theory.
  - b. Wiring diagrams, including the one line diagram.
  - c. Creation, editing, and programming of the point database.
  - d. Integration topology and platform for communication.
  - e. Graphics packages and touch screens for the system.
  - f. Alarms and diagnostics.
  - g. Reporting functions dynamically and historically.
  - h. Remote access to the system.
  - i. Database back-up and maintenance.
  - j. Replacement and re-programming of replacement parts.
  - k. Point type and functionality for each type of point.
  - l. Programming.
  - m. Point/object editing.
  - n. Loop tuning.
  - o. Help files and other troubleshooting documentation.
  - p. Instruction is given by the staff that setup the integration.

- C. Operation and Maintenance Manuals: Provide appropriate Operation and Maintenance manuals in each training session so that the detail drawings and maintenance activities are outlined and discussed for each application.

### PART 3 - EXECUTION

#### 3.1 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module.
- B. Set up instructional equipment at instruction location.

### 3.2 INSTRUCTION

- A. Engage qualified instructors to instruct University's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
  - 1. University will furnish Contractor with names and positions of participants.
- B. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
  - 1. Coordinate schedule for all training with University Project Manager and provide the following:
    - a. Minimum 3 weeks notification.
    - b. Training matrix in calendar format.
    - c. Training outline for each session.
  - 2. Do not schedule training until equipment has been started up, commissioned, and is currently operating in its normal condition.
  - 3. Do not schedule overlapping training sessions.
  - 4. Schedule training sessions for a maximum of 4 hours per day; afternoons preferred.
  - 5. Provide separate training session on each system for operational/maintenance groups and user groups.
  - 6. Training sessions will be canceled and rescheduled unless the following documentation is received:
    - a. Instruction qualifications.
    - b. Evidence that equipment has been started up, commissioned, and is currently operating in its normal condition.
    - c. Operation and Maintenance manuals.
- C. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- D. Travel, Room and Board: Coordinate any out-of-state training with the University Project Manager.
- E. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

### 3.3 DEMONSTRATION SCHEDULE

SECTION	TITLE	DESCRIPTION
08 42 29.33	SWINGING AUTOMATIC ENTRANCES	Engage a factory-authorized service representative to train University's maintenance personnel to adjust, operate, and maintain automatic entrances.
10 11 00	VISUAL DISPLAY SURFACES	Engage a factory-authorized service representative to train University's maintenance personnel to adjust, operate, and maintain motor-operated, sliding visual display units.
10 22 38	OPERABLE PANEL PARTITIONS	Engage a factory-authorized service representative to train University's maintenance personnel to adjust, operate, and maintain operable panel partitions.

10 55 00	POSTAL SPECIALTIES	Engage a factory-authorized service representative to train University's maintenance personnel to adjust, operate, and maintain postal specialties.
11 12 00	PARKING CONTROL EQUIPMENT	Engage a factory-authorized service representative to train University's maintenance personnel to adjust, operate, and maintain parking control equipment.
11 13 00	LOADING DOCK EQUIPMENT	Engage a factory-authorized service representative to train University's maintenance personnel to adjust, operate, and maintain loading dock equipment.
11 14 00	FOOD SERVICE EQUIPMENT	Engage a factory-authorized service representative to train University's maintenance personnel to adjust, operate, and maintain foodservice equipment.
11 82 26	FACILITY WASTE COMPACTORS	Engage a factory-authorized service representative to train University's maintenance personnel to adjust, operate, and maintain waste compactors according to manufacturer's requirements and ANSI Z245.2.
12 21 13	HORIZONTAL LOUVER BLINDS	Engage a factory-authorized service representative to train University's maintenance personnel to adjust, operate, and maintain systems.
12 24 13	ROLLER WINDOW SHADES	Engage a factory-authorized service representative to train University's maintenance personnel to adjust, operate, and maintain motor-operated roller shades.
13 20 00	SPECIAL PURPOSE ROOMS	Engage a factory-authorized service representative to train and provide training video to University's maintenance personnel to operate, adjust, maintain, and repair controlled environmental rooms and cold rooms.
14 21 00	ELECTRIC TRACTION ELEVATORS	Engage a factory-authorized service representative to train University's maintenance personnel to operate, adjust, and maintain elevator(s).
14 21 13	ELECTRIC TRACTION FREIGHT ELEVATORS	Engage a factory-authorized service representative to train University's maintenance personnel to operate, adjust, and maintain elevator(s).
14 24 00	HYDRAULIC ELEVATORS	Engage a factory-authorized service representative to train University's maintenance personnel to operate, adjust, and maintain elevator(s).
14 24 13	HYDRAULIC FREIGHT ELEVATORS	Engage a factory-authorized service representative to train University's maintenance personnel to operate, adjust, and maintain elevator(s).



23 00 00	HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)	Schedule instructional meetings for The University of Colorado Anschutz Medical Campus Facilities Operations maintenance personnel on the proper operation and maintenance of mechanical systems. Provide the project manager a minimum of 5 days notice prior to any testing.
23 05 13	MOTORS	Engage a factory-authorized representative to train the University's representative for 2 hours for each variable frequency drive installed. Training includes startup, shutdown, emergency operation, maintenance and servicing.
23 08 00	COMMISSIONING OF HVAC	Engage the commissioning authority to provide a customized one to two day training class for the university's engineering personnel in problem solving techniques including the review of mechanical system design as a whole, integrated unit, unique qualities of the installed mechanical system, insights into how to solve system-wide, multi-faceted problems, and identify a variety of resources to assist with problem solving.
23 09 00	INSTRUMENTATION AND CONTROLS	Engage a factory-authorized trained representative to conduct a minimum of 1-four hour on-site training course and an additional 1-four hour on-site training course per 25,000 sq. ft. for designated University personnel.
		Engage a factory-authorized trained representative to conduct an 8-hour seasonal loop training.
		Provide 40 hours of certified training in Instrument and Controls for every 100,000 sq. ft. of a lab/research building.
23 11 13	FACILITY FUEL-OIL PIPING	Engage a factory-authorized service representative to train University's maintenance personnel to adjust, operate, and maintain liquid-level gage systems, leak-detection and monitoring systems, and fuel-oil pumps.
23 21 23	PUMPS	Engage a factory-authorized service representative to train a University Representative for 2 hours of instruction for each pumping system provided.
23 25 13	CHEMICAL WATER TREATMENT	Engage a factory-authorized service representative to train operating personnel for 8 hours to familiarize them with all treatment equipment and procedures. Include procedure for taking weekly water test on open-loop systems and the application and safe handling of supplied chemicals.

23 64 16	CENTRIFUGAL WATER CHILLERS	Engage a factory-authorized service representative to train the University's representative for 4 hours including the operation of chillers, accessories and controls, procedures for startup and shutdown, troubleshooting, servicing, preventative maintenance, and review of the maintenance manuals.
23 65 00	COOLING TOWERS	Engage a factory-authorized service representative to train the University's personnel for one, 8-hour day, for operation and maintenance of the cooling towers.
23 76 00	EVAPORATIVE COOLING EQUIPMENT	Engage the manufacturer's representative to train the University's personnel for four (4) hours. Include start-up and shutdown procedures, troubleshooting procedures, and servicing and preventative maintenance schedules and procedures, and the contents of the Operating and Maintenance Data.
26 00 00	ELECTRICAL	Engage a factory-authorized service representative to train the University's Operations personnel a minimum of 8 hours for each system. Provide an additional minimum of 4 hours for any electrical gateway or networked lighting controls.
26 56 00	EXTERIOR LIGHTING	Engage a factory-authorized service representative to train University's maintenance personnel to adjust, operate, and maintain luminaire lowering devices.
28 31 00	FIRE DETECTION AND ALARM	Engage a factory-authorized service representative to train the University's Operations personnel a minimum of 8 hours for each system.
32 84 00	PLANTING IRRIGATION	Engage a factory-authorized service representative to train University's maintenance personnel to adjust, operate, and maintain automatic control valves and controllers.

**END OF SECTION 01 79 00**

## SECTION 02 41 19

### SELECTIVE DEMOLITION

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

##### 1.2 SUMMARY

- A. Section Includes:

- 1. Demolition and removal of selected portions of building or structure.
  - 2. Demolition and removal of selected site elements.
  - 3. Salvage of existing items to be reused or recycled.

- B. Related Requirements:

- 1. Section 01 10 00 "Summary" for restrictions on use of the premises, Owner-occupancy requirements, and phasing requirements.
  - 2. Section 01 73 00 "Execution" for cutting and patching procedures.

##### 1.3 DEFINITIONS

- A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.
- B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.
- C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.
- E. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

##### 1.4 PREINSTALLATION MEETINGS

- A. Predemolition Conference: Conduct conference at Project site.
  - 1. Inspect and discuss condition of construction to be selectively demolished.
  - 2. Review structural load limitations of existing structure.

3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Engineering Survey: Submit engineering survey of condition of building.
- B. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.
- C. Schedule of Selective Demolition Activities: Indicate the following:
  1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
  2. Interruption of utility services. Indicate how long utility services will be interrupted.
  3. Coordination for shutoff, capping, and continuation of utility services.
  4. Use of elevator and stairs.
  5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
- D. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by salvage and demolition operations. Comply with Section 01 32 33 "Photographic Documentation." Submit before Work begins.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Inventory: Submit a list of items that have been removed and salvaged.

#### 1.7 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
  1. Hazardous materials will be removed by Owner before start of the Work.
  2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- E. Hazardous Materials: Present in buildings and structures to be selectively demolished. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.

1. Hazardous material remediation is specified elsewhere in the Contract Documents.
2. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified elsewhere in the Contract Documents.
3. Owner will provide material safety data sheets for suspected hazardous materials that are known to be present in buildings and structures to be selectively demolished because of building operations or processes performed there.

F. Storage or sale of removed items or materials on-site is not permitted.

G. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

## 1.8 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties. Notify warrantor before proceeding. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

## 1.9 COORDINATION

A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI/ASSP A10.6 and NFPA 241.
- C. Sustainable Design Requirements for Building Reuse:
  1. Maintain existing interior nonstructural elements (interior walls, doors, floor coverings, and ceiling systems) not indicated to be demolished; do not demolish such existing construction beyond indicated limits.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

- B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- C. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
  - 1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.
- D. Steel Tendons: Locate tensioned steel tendons and include recommendations for de-tensioning.
- E. Verify that hazardous materials have been remediated before proceeding with building demolition operations.
- F. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video.
  - 1. Inventory and record the condition of items to be removed and salvaged.

### 3.2 PREPARATION

- A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

### 3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.
  - 1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
  - 2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
  - 3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.
    - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
    - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
    - d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
    - e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

- f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
- g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

### 3.4 PROTECTION

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
  - 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
  - 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
  - 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
  - 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
  - 5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 01 50 00 "Temporary Facilities and Controls."
- B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
  - 1. Strengthen or add new supports when required during progress of selective demolition.
- C. Remove temporary barricades and protections where hazards no longer exist.

### 3.5 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
  - 1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
  - 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
  - 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
  - 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
  - 5. Maintain fire watch during and for at least 1 hour after flame-cutting operations.
  - 6. Maintain adequate ventilation when using cutting torches.
  - 7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.

8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
  9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
  10. Dispose of demolished items and materials promptly. Comply with requirements in Section 01 74 19 "Construction Waste Management and Disposal."
- B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- C. Removed and Salvaged Items:
1. Clean salvaged items.
  2. Pack or crate items after cleaning. Identify contents of containers.
  3. Store items in a secure area until delivery to Owner.
  4. Transport items to Owner's storage area designated by Owner.
  5. Protect items from damage during transport and storage.
- D. Removed and Reinstalled Items:
1. Clean and repair items to functional condition adequate for intended reuse.
  2. Pack or crate items after cleaning and repairing. Identify contents of containers.
  3. Protect items from damage during transport and storage.
  4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- E. Carpet Reclamation: Remove used carpet for reclamation per Section 01 35 43.19 "Carpet Reclamation".
- F. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

### 3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.
- B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.
- C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.
- D. Carpet.
1. Adhesive Removal Solvents: Remove adhesive according to recommendations of the Carpet and Rug Institute Publication 104.
  2. Carpet and carpet padding: Provide removal and recycling of carpet and carpet padding where locally available, per Section 01 35 42 "Carpet Reclamation."



- E. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings." Do not use methods requiring solvent-based adhesive strippers.

### 3.7 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site and recycle or dispose of them according to Section 01 74 19 "Construction Waste Management and Disposal."
  - 1. Do not allow demolished materials to accumulate on-site.
  - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
  - 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
  - 4. Comply with requirements specified in Section 01 74 19 "Construction Waste Management and Disposal."
- B. Burning: Do not burn demolished materials.

### 3.8 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

### 3.9 CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

- A. Manage construction waste in accordance with provisions of Section 01 74 19 "Construction Waste Management and Disposal."

**END OF SECTION 02 41 19**

## **SECTION 03 30 00**

### **CAST-IN-PLACE CONCRETE**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

##### **1.2 SUMMARY**

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:

- 1. Slabs-on-grade.

##### **1.3 DEFINITIONS**

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

##### **1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
  - 1. Indicate amounts of mixing water to be withheld for later addition at Project site.
  - 2. Submit substantiating data for each concrete mix design contemplated for use to the Architect no less than two weeks prior to first concrete placement. Data for each mix shall include the following:
    - a. Mix identification number (unique for each mix submitted).
    - b. Statement of intended mix use.
    - c. Mixture proportions.
    - d. Water/cementitious materials ratio.
    - e. Wet and dry unit weight.
    - f. Total air content.
    - g. Design slump and allowable range after additions of all admixtures.
    - h. Compressive strength tests.
- C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

1. Show all reinforcing, top and bottom profile of concrete element and supports below element.
2. Show splices of reinforcing, type of splice used and splice location. Identify all ASTM reinforcing locations.

## 1.5 INFORMATIONAL SUBMITTALS

### A. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Form materials and form-release agents.
4. Steel reinforcement and accessories.
5. Curing compounds.
6. Bonding agents.
7. Adhesives.
8. Vapor retarders.
9. Repair materials.

### B. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:

1. Aggregates: Submit test reports indicating that aggregates are not potentially reactive based on the ASTM C295 or ASTM 1260 testing limits set forth in section 5.1 of "Guide Specification for Concrete Subject to Alkali-Silica Reactions" (2007 Portland Cement Association). Alternatively, submit ASTM C1567 test reports indicating that the combination of mix ingredients reduces the expansion due to Alkali aggregate reactivity such that the mix complies with section 5.2 of "Guide Specification for Concrete Subject to Alkali-Silica Reactions" (2007 Portland Cement Association). All tests for submitted reports shall have been performed within one year of the submittal date.

### C. Minutes of preinstallation conference.

### D. Placement Notification: Submit notification to Architect at least 24 hours in advance of placement.

### E. Proposed location of saw cut joints not indicated on Drawings.

### F. Curing compound data demonstrating specified moisture loss performance.

### G. Evaporative retarder product and application data.

## 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94 requirements for production facilities and equipment.
- C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
  2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.
  3. Personnel inspecting concrete reinforcing steel have current certification as an ACI Concrete Construction Inspector or have experience in concrete construction acceptable to the Architect.
- D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- E. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5
  2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- F. Preinstallation Conference: Conduct conference at Project site.
1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
    - a. Contractor's superintendent.
    - b. Ready-mix concrete manufacturer.
    - c. Concrete subcontractor.
    - d. Special concrete finish subcontractor.
    - e. Owner's Testing/Inspection Agency.
  2. Review as applicable to Project special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, forms and form removal limitations, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.
  3. Minutes of the meeting shall be recorded by Contractor and distributed to all parties within five days. Provide one copy to Owner's representative and Architect.
- G. Record of Work: Maintain a record listing time and date of all structural concrete placement. Such record shall be kept until completion of Project and shall be available to Architect for examination at any time.
- H. Pre-Placement Inspection: Formwork installation, reinforcing steel placement and installation of all items to be embedded or cast into concrete shall be verified by Contractor prior to placement.
- 1.7 DELIVERY, STORAGE, AND HANDLING
- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement if present.

## PART 2 - PRODUCTS

### 2.1 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
  - 1. Plywood, metal, or other approved panel materials.
  - 2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
    - a. High-density overlay, Class 1 or better.
    - b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
    - c. Structural 1, B-B or better; mill oiled and edge sealed.
    - d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
  - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- D. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
  - 1. Furnish units that will leave no corrodible metal closer than 1 1/2" inch to the plane of exposed concrete surface.
  - 2. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.
  - 3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

### 2.2 STEEL REINFORCEMENT

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 60 percent.
- B. Reinforcing Bars: ASTM A 615, Grade 60, deformed.
- C. Low-Alloy-Steel Reinforcing Bars: ASTM A 706, deformed, where welding of reinforcement or field bending is noted on Drawings.

### 2.3 REINFORCEMENT ACCESSORIES

- A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

## 2.4 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
  1. Portland Cement: ASTM C 150, Type I or Type I/II, gray. Alternate cementitious materials when proposed to control alkali-silica reactions and tested as part of a representative concrete mix in accordance with ASTM C1567, may be used subject to approval. Supplement with the following:
    - a. Fly Ash: ASTM C 618, Class F or C.
- B. Normal-Weight Aggregates: ASTM C 33, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials. All coarse and fine aggregate shall be tested per ASTM C 295 or ASTM C 1293 in accordance with section 5.1 of "Guide Specification for Concrete Subject to Alkali-Silica Reactions" (2007 Portland Cement Association).
  1. Maximum Coarse-Aggregate Size: As indicated on Drawings.
  2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Water: ASTM C 94 and potable.

## 2.5 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
  1. Water-Reducing Admixture: ASTM C 494, Type A.
  2. Retarding Admixture: ASTM C 494, Type B.
  3. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
  4. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
  5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494, Type G.
  6. Plasticizing and Retarding Admixture: ASTM C 1017, Type II.
  7. Mid-Range Water Reducing Admixture: ASTM C 494, Type A.

## 2.6 VAPOR RETARDERS

- A. Sheet Vapor Retarder: ASTM E 1745, Class A, except with maximum perm rating of 0.01. Include manufacturer's recommended adhesive or pressure-sensitive tape.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Carlisle Coatings & Waterproofing, Inc.; Blackline 400.
    - b. Fortifiber Building Systems Group; Moistop Ultra 15.

- c. Grace Construction Products, W. R. Grace & Co.; Florprufe 120.
- d. Insulation Solutions, Inc.; Viper VaporCheck 16.
- e. Meadows, W. R., Inc.; Perminator 15 mil.
- f. Raven Industries Inc.; Vapor Block 15.
- g. Reef Industries, Inc.; Griffolyn 15 mil Green.
- h. Stego Industries, LLC; Stego Wrap 15 mil Class A.

## 2.7 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Axim Italcementi Group, Inc.; CATEXOL CimFilm.
    - b. BASF Construction Chemicals - Building Systems; Confilm.
    - c. ChemMasters; SprayFilm.
    - d. Conspec by Dayton Superior; Aquafilm.
    - e. Dayton Superior Corporation; Sure Film (J-74).
    - f. Edoco by Dayton Superior; BurkeFilm.
    - g. Euclid Chemical Company (The), an RPM company; Eucobar.
    - h. Kaufman Products, Inc.; Vapor-Aid.
    - i. Lambert Corporation; LAMBCO Skin.
    - j. L&M Construction Chemicals, Inc.; E-CON.
    - k. Meadows, W. R., Inc.; EVAPRE.
    - l. Metalcrete Industries; Waterhold.
    - m. Nox-Crete Products Group; MONOFILM.
    - n. Sika Corporation; SikaFilm.
    - o. SpecChem, LLC; Spec Film.
    - p. Symons by Dayton Superior; Finishing Aid.
    - q. TK Products, Division of Sierra Corporation; TK-2120 TRI-FILM.
    - r. Unitex; PRO-FILM.
    - s. Vexcon Chemicals, Inc.; Certi-Vex Envio Set.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating. Film must chemically break down in a four to six week period. Provide data from independent laboratory indicating maximum moisture less than 0.30 kg/m<sup>2</sup> at 72 hours when tested in accordance with ASTM C 156.

## 2.8 RELATED MATERIALS

- A. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

## 2.9 REPAIR MATERIALS

- A. Submit repair materials and method statement to Architect for review prior to start of repair work.

## 2.10 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
  - 1. Use a qualified testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
  - 1. Fly Ash: 25 percent.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 1.00 for reinforced concrete that will be dry and protected from moisture in service, percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
  - 1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.
  - 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
  - 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.

## 2.11 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Proportion structural normal-weight concrete mixture as noted on Drawings, unless aggregates are "potentially reactive" with alkalis based on the ASTM C 295 or ASTM C 1260 or ASTM C 1293 testing limits of Section 5.1 of "Guide Specification of Concrete Subject to Alkali-Silica Reactions" (2007 Portland Cement Association). When aggregates are "potentially reactive", compliance with Section 5.2 of "Guide Specification for Concrete Subject to Alkali-Silica Reactions" (2007 Portland Cement Association) must be established through ASTM C 1567 testing for proposed alternate concrete mixture. Submit test reports in accordance with Part I of this Specification.

## 2.12 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

## 2.13 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116, and furnish batch ticket information.



## PART 3 - EXECUTION

### 3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
  - 1. Class A, 1/8 inch for smooth-formed finished surfaces.
  - 2. Class B, 1/4 inch for rough-formed finished surfaces.
  - 3. The permissible irregularity is a cumulative value due to all sources including layout, plumbness, member size, formwork offsets, joints, and member levelness. The permissible irregularity shall also apply between adjacent concrete surfaces on opposite sides of construction joint, expansion joint or shrinkage pour strip if present.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
  - 1. Install keyways, reglets, recesses, and the like, for easy removal.
  - 2. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- I. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- J. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- K. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

### 3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303 "Code of Standard Practice for Steel Buildings and Bridges."
    - a. Tolerance of Embedded Items: Comply with ACI 117.
      - 1) Anchor Rods:
        - a) Plumbness: Within +/- 1/16 inch over anchor rod projection.
      - 2) Embedded Plates and Weldments:
        - a) Location: +/- 1 inch vertical, +/- 1 inch horizontal.
        - b) Plumb and Alignment: 1/4 inch in 12 inches (1:48).

### 3.3 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

### 3.4 VAPOR RETARDERS

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.
  - 1. Lap joints 6 inches and seal with manufacturer's recommended tape.

### 3.5 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
  - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
  - 1. Weld reinforcing bars according to AWS D1.4, where indicated.
- D. Size, length, number and placement of supports shall be sufficient as to maintain reinforcing position within specified tolerances during construction traffic and concrete placement.
- E. On vertical formwork, use approved bar chairs or spacers as required to maintain concrete cover and bar position. Do not staple or use any other metallic fastener to secure bolsters, chairs, etc. to formwork for concrete surfaces exposed to exterior.
- F. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

### 3.6 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
  - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated.
  - 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
  - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
  - 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
  - 3. Interior Slabs-on-Grade to Receive Carpet or Wood Floor Covering: Construct slabs as large a placement area as practical. Unless noted otherwise on Drawings, locate construction joints on column centerlines. Provide control joints at column centerlines and at intervals not more than 30 feet each way.
  - 4. All Other Interior Slabs-on-Grade: Unless noted otherwise on Drawings, locate construction joints on column centerlines. Locate control joints where shown on Drawings. If not shown, provide control joints at column centerlines and at intervals not more than 10 feet each way.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
  - 1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
  - 2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
  - 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

### 3.7 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
  - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
  - 1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
  - 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
  - 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- D. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
  - 1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
  - 2. Maintain reinforcement in position on chairs during concrete placement.
  - 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
  - 4. Slope surfaces uniformly to drains where required.
  - 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

### 3.8 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
  - 1. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
  - 1. Apply to concrete surfaces exposed to public view.
- C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces.

Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

### 3.9 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in one direction.
  - 1. Apply scratch finish to surfaces to receive concrete floor toppings or to receive mortar setting beds for bonded cementitious floor finishes.
- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture.
  - 1. Apply float finish to surfaces to receive trowel finish.
- D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
  - 1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
  - 2. Finish surfaces to the following tolerances, according to ASTM E 1155, for a randomly trafficked floor surface:
    - a. Specified overall values of flatness, F(F) 35; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 17; for slabs-on-grade.
  - 3. Finish and measure surface so gap at any point between concrete surface and an unlevelled, freestanding, 10-ft.- long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch.
- E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.
  - 1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.
- F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.
  - 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

### 3.10 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

### 3.11 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
  - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
    - a. Water.
    - b. Continuous water-fog spray.
    - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
  - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape. Moisture-retaining-cover shall be inspected each day by Contractor. Any areas which do not show condensation on underside of cover or any slab areas which are not wet shall be immediately rewetted and cover replaced to prevent moisture loss.
    - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.

- b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
  - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.
- 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
  - a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.
- 4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

### 3.12 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning and that are unacceptable to Architect. Allow Architect and Structural Engineer to observe concrete surfaces upon removal of forms and prior to repair of surface defects. Defects in structural concrete shall be brought to the attention of the Architect and Structural Engineer.
  - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
  - 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
  - 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template. Submit proposed repair to Architect for review prior to commencement of work.
  - 1. Repair finished surfaces containing defects that are unacceptable to Architect. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide

- or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.
  3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
  4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
  5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
  6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
  7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Repair materials and installation not specified above may be used, subject to Architect's approval.

### 3.13 FIELD QUALITY CONTROL

- A. Testing and Inspection: As indicated on Drawings.

### END OF SECTION





**SECTION 07 92 00**

**JOINT SEALANTS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Silicone joint sealants.
  - 2. Mildew-resistant joint sealants.

**1.3 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each joint-sealant product.
- B. Samples: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- C. Joint-Sealant Schedule: Include the following information:
  - 1. Joint-sealant application, joint location, and designation.
  - 2. Joint-sealant manufacturer and product name.
  - 3. Joint-sealant formulation.
  - 4. Joint-sealant color.

**1.5 INFORMATIONAL SUBMITTALS**

- A. Preconstruction Laboratory Test Reports: From sealant manufacturer, indicating the following:
  - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
  - 2. Interpretation of test results and written recommendations for primers and substrate preparation are needed for adhesion.
- B. Field-Adhesion-Test Reports: For each sealant application tested.

## 1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.
- B. Manufacturer Qualifications: Materials shall be supplied by manufacturer who will provide qualified technical assistance at the project site.
- C. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
  - 1. Installed shall have minimum 5 years experience on projects of similar scope.
- D. Product Testing: Test joint sealants using a qualified testing agency.
  - 1. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.
- E. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.
  - 1. Build mockups to demonstrate aesthetic effects and set quality standards for fabrication and installation.
  - 2. Build mockup per requirements for Integrated Exterior Mockup in Section 01 40 00 "Quality Requirements."

## 1.7 PRECONSTRUCTION TESTING

- A. Preconstruction Laboratory Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
  - 1. Adhesion Testing: Use ASTM C 794 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
  - 2. Compatibility Testing: Use ASTM C 1087 to determine sealant compatibility when in contact with glazing and gasket materials.
  - 3. Stain Testing: Use ASTM C 1248 to determine stain potential of sealant when in contact with stone or masonry substrates.
  - 4. Submit manufacturer's recommended number of pieces of each type of material, including joint substrates, joint-sealant backings, and miscellaneous materials.
  - 5. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
  - 6. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures, including use of specially formulated primers.
  - 7. Testing will not be required if joint-sealant manufacturers submit data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, staining of, and compatibility with joint substrates and other materials matching those submitted.
- B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:
  - 1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
  - 2. Conduct field tests for each kind of sealant and joint substrate.
  - 3. Notify Architect seven days in advance of dates and times when test joints will be erected.

4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.
  - a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1.1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
    - 1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
5. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
6. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

#### 1.8 FIELD CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
  1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
  2. When joint substrates are wet.
  3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
  4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

#### 1.9 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
  1. Warranty Period: 20 year from date of Letter of Acceptance of the Work by the University for sealants used in ABSL3 only.
  2. Installer's Warranty to be signed by both General Contractor and Installer.
- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
  1. Warranty Period: 20 years from date of Substantial Completion for all other elastomeric sealants.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
  1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
  2. Disintegration of joint substrates from causes exceeding design specifications.
  3. Mechanical damage caused by individuals, tools, or other outside agents.
  4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

## PART 2 - PRODUCTS

### 2.1 JOINT SEALANTS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- C. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with United States Code of Federal Regulations 21 CFR 177.2600.
- D. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

### 2.2 SILICONE JOINT SEALANTS

- A. Silicone, S, P, 100/50, T, NT: Single-component, pourable, plus 100 percent and minus 50 percent movement capability traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade P, Class 100/50, Uses T and NT.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. The Dow Chemical Company; DOWSIL 890-SL.
    - b. Pecora Corporation; 300 SL.
    - c. Tremco Incorporated; Spectrem 900 SL.

### 2.3 MILDEW-RESISTANT JOINT SEALANTS

- A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.
- B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. BASF Building Systems; Omniplus.
    - b. The Dow Chemical Company; DOWSIL 786-M White.
    - c. GE Construction Sealants; Momentive Performance Materials Inc; SCS1700 Sanitary.
    - d. Tremco Incorporated; Tremisil 200.
    - e. Bostik, Inc.; Chem-Calk 600.

## 2.4 JOINT-SEALANT BACKING

- A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

## 2.5 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
  - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
    - a. Concrete.
    - b. Masonry.
    - c. Unglazed surfaces of ceramic tile.
    - d. Exterior insulation and finish systems.
  3. Remove laitance and form-release agents from concrete.
  4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
    - a. Metal.
    - b. Glass.
    - c. Porcelain enamel.
    - d. Glazed surfaces of ceramic tile.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

### 3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical joint sealant. Install acoustical joint sealants at both faces of partitions, at perimeters, and through penetrations. Comply with ASTM C 919, ASTM C 1193, and manufacturer's written recommendations for closing off sound-flanking paths around or through assemblies, including sealing partitions to underside of floor slabs above acoustical ceilings.
- D. Complete installation of seal system in horizontal joints before installing in vertical joints. Lap vertical joints over horizontal joints. At ends of joints, cut silicone extrusion with a razor knife.
- E. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
  1. Do not leave gaps between ends of sealant backings.
  2. Do not stretch, twist, puncture, or tear sealant backings.

3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.
- F. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- G. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
  1. Place sealants so they directly contact and fully wet joint substrates.
  2. Completely fill recesses in each joint configuration.
  3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- H. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
  1. Remove excess sealant from surfaces adjacent to joints.
  2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
  3. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.
  4. Provide flush joint profile at locations indicated on Drawings according to Figure 8B in ASTM C 1193.
  5. Provide recessed joint configuration of recess depth and at locations indicated on Drawings according to Figure 8C in ASTM C 1193.
    - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

### 3.4 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
  1. Extent of Testing: Test completed and cured sealant joints as follows:
    - a. Perform 10 tests for the first 1000 feet of joint length for each kind of sealant and joint substrate.
    - b. Perform one test for each 1000 feet of joint length thereafter or one test per each floor per elevation.
  2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
    - a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
  3. Inspect tested joints and report on the following:
    - a. Whether sealants filled joint cavities and are free of voids.
    - b. Whether sealant dimensions and configurations comply with specified requirements.



- c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.
  4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.
  5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.
- B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

### 3.5 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

### 3.6 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

### 3.7 CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

- A. Manage construction waste in accordance with provisions of Section 01 74 19 "Construction Waste Management and Disposal."

### 3.8 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.
1. Joint Locations:
    - a. Isolation joints in cast-in-place concrete slabs.
    - b. Control and expansion joints in tile flooring.
  2. Joint Sealant: Type S, Grade P, Class 100/50, Use T.
  3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- B. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations in ABSL-3:
  - a. Ceilings: Fully seal all joints at access panels, light fixtures, electrical devices, mechanical devices, fire protection devices, etc.
  - b. Walls: Fully seal all joints, including but not limited to, joints between finished wall surface and door and window frames, power boxes, plug mold, wire mold, alarm and sensor boxes, access panels, electrical devices, plumbing devices, mechanical devices, fire protection devices, wall bumper mounting plates, wall plates, wall-mounted equipment, window sills and jambs, etc.
  - c. Wall and Ceiling Penetrations: Completely seal all penetrations, including but not limited to, joints between finished surface and electrical conduits, electrical plugs and switches, light fixtures, cover plates, piping for water, gas, vacuum, gas, soil and waste lines, mechanical ducts, registers, etc.
  - d. Sealant is not required at inside corners of wall-to-wall and wall-to-ceiling joints in drywall construction or as a filler in preformed metal control and expansion joints in drywall construction.
2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 25, NT.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

**END OF SECTION 07 92 00**

**SECTION 09 22 16**

**NON-STRUCTURAL METAL FRAMING**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Non-load-bearing steel framing systems for interior partitions.
  - 2. Suspension systems for interior ceilings and soffits.
  - 3. Grid suspension systems for gypsum board ceilings.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Product Certificates: For each type of code-compliance certification for studs and tracks.
- B. Evaluation Reports: For embossed, high-strength steel studs and tracks and firestop tracks submit evaluation reports certified under an independent third-party inspection program administered by an agency accredited by IAS to ICC-ES AC98 IAS accreditation criteria for inspection agencies.

**1.5 QUALITY ASSURANCE**

- A. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Steel Framing Industry Association or a similar organization that provides a verifiable code compliance program.

**1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling as required by AISI S202 "Code of Standard Practice."

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.
- C. Horizontal Deflection: Provide metal framing systems of base-metal thickness and spacing capable of limiting lateral deflections when subjected to a 5 lbf/sq. ft. uniform lateral load to the following:
  - 1. L/240 where supporting gypsum board only.
  - 2. L/360 where supporting plaster or ceramic tile finishes.
  - 3. L/720 where providing backup to stone or masonry.
- D. Partitions enclosing Pressurized Mechanical Rooms: Provide metal framing systems of base-metal thickness and spacing capable of limiting lateral deflections to L/240 when subjected to a 15 lbf/sq. ft. uniform lateral load or the design value induced by the mechanical system, whichever is greater.
- E. Suspended Ceiling Design Requirements: Provide metal framing systems of base-metal thickness and spacing capable of limiting ceiling deflections to L/360 when subjected to a minimum 4 lbf/sq. ft. uniform load or the actual weight of ceiling hung materials whichever is greater.
- F. Design framing systems in accordance with AISI S220 and ASTM C 645, Section 10, unless otherwise indicated.
- G. Engineering design of non-structural metal framing by Contractor.

### 2.2 FRAMING SYSTEMS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Framing Members, General: Comply with AISI S220 and ASTM C 645, Section 10, for conditions indicated.
  - 1. Steel Sheet Components: Comply with AISI S220 and ASTM C 645, Section 10 requirements for steel unless otherwise indicated.
  - 2. Protective Coating: Comply with AISI S220 and ASTM A 653/A 653M, G40. Galvannealed products are not acceptable.
    - a. Coatings shall demonstrate equivalent corrosion resistance with an evaluation report acceptable to authorities having jurisdiction.
- C. Studs and Tracks: AISI S220 and ASTM C 645, Section 10. Use either conventional steel studs and tracks or embossed, high-strength steel studs and tracks.

1. Steel Studs and Tracks:

- a. Minimum Base-Steel Thickness: 0.0329 inch (20 ga) as required to limit allowable deflection of framed assembly indicated in Performance Requirements.
- b. Depth: As indicated on Drawings.
  - 1) Depth of members may not be modified to comply with deflection limits without prior approval of Architect.

2. Embossed, High Strength Steel Studs and Tracks: Roll-formed and embossed with surface deformations to stiffen the framing members so that they are structurally comparable to conventional AISI S220 and ASTM C 645, Section 10 steel studs and tracks.

- a. Minimum Base-Steel Thickness: 0.0296 inch (30 mil EQ ga).
- b. Depth: As indicated on Drawings.
  - 1) Depth of members may not be modified to comply with deflection limits without prior approval of Architect.

D. Slip-Type Head Joints: Where indicated, provide one of the following:

- 1. Clip System: Clips designed for use in head-of-wall deflection conditions that provide a positive attachment of studs to tracks while allowing 1-1/2-inch minimum vertical movement.
  - a. Products: Subject to compliance with requirements, provide one of the following:
    - 1) CEMCO; California Expanded Metal Products Co.; Deflex Clips.
    - 2) ClarkDietrich; FTC3 and.
    - 3) Fire Trak Corp; PosiKlip or.
    - 4) Steel Network, Inc. (The); VertiClip SLD Series.
    - 5) Super Stud Building Products Inc.; Deflection Clips.
- 2. Single Long-Leg Track System: AISI S220 top track with 2-inch- deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top track and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing.
- 3. Double-Track System: AISI S220 top outer tracks, inside track with 2-inch- deep flanges in thickness not less than indicated for studs and fastened to studs, and outer track sized to friction-fit over inner track.
- 4. Deflection Track: Steel sheet top track manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
  - a. Products: provide one of the following:
    - 1) CEMCO; California Expanded Metal Products Co.; SLP-TRK Slotted Deflection Track.
    - 2) ClarkDietrich; SLP-TRK Slotted Deflection Track.
    - 3) Steel Network, Inc. (The); VertiClip SLD.
    - 4) Telling Industries; True Action Slotted Track.

E. Firestop Tracks: Top track manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. CEMCO; California Expanded Metal Products Co.; FAS Trak.
  - b. ClarkDietrich; BlazeFrame.
  - c. Fire Trak Corp; Fire Trak System attached to studs with Fire Trak Posi Klip.
- F. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
  1. Minimum Base-Steel Thickness: 0.0329 inch.
- G. Cold-Rolled Channel Bridging: Steel, 0.0538-inch minimum base-steel thickness, with minimum 1/2-inch- wide flanges.
  1. Depth: 3/4-inch.
  2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch- thick, galvanized steel.
- H. Hat-Shaped, Rigid Furring Channels: AISI S220.
  1. Minimum Base-Steel Thickness: 0.0329 inch.
  2. Depth: 1/2 inch.
  3. Provide ventilated furring channels were indicated on Drawings.
  4. Provide galvanized steel, minimum 18 gauge at locations outside the weather barrier.
    - a. Protective Coating: ASTM A 653/A 653M, G60, hot-dip galvanized unless otherwise indicated.
- I. Resilient Furring Channels: 1/2-inch- deep, steel sheet members designed to reduce sound transmission.
  1. Configuration: Asymmetrical.
- J. Cold-Rolled Furring Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch- wide flanges.
  1. Depth: As indicated on Drawings.
  2. Furring Brackets: Adjustable, corrugated-edge-type steel sheet with minimum steel thickness of 0.0329 inch.
  3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- diameter wire, or double strand of 0.048-inch- diameter wire.
- K. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 3/4 inch, minimum uncoated- steel thickness of 0.0179 inch, and depth required to fit insulation thickness indicated.

## 2.3 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- diameter wire, or double strand of 0.048-inch- diameter wire.
- B. Hanger Attachments to Concrete:
  1. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 AC193 AC58 or AC308 as appropriate for the substrate.

- a. Uses: Securing hangers to structure.
  - b. Type: Torque-controlled, expansion anchor.
  - c. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
  - d. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.
- 2. Power-Actuated Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.
- D. Furring Channels (Furring Members):
  - 1. Cold-Rolled Channels: 0.0538-inch uncoated-steel thickness, with minimum 1/2-inch- wide flanges, 3/4 inch deep.
  - 2. Steel Studs and Tracks: AISI S220 and ASTM C 645, Section 10.
    - a. Minimum Base-Steel Thickness: 0.0179 inch.
    - b. Depth: As indicated on Drawings.
  - 3. Embossed, High-Strength Steel Studs and Tracks: AISI S220 and ASTM C 645, Section 10.
    - a. Minimum Base-Steel Thickness: 0.0147 inch.
    - b. Depth: As indicated on Drawings.
  - 4. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.
    - a. Minimum Base-Steel Thickness: 0.0179 inch.
  - 5. Resilient Furring Channels: 1/2-inch- deep members designed to reduce sound transmission.
    - a. Configuration: Asymmetrical or hat shaped.
- E. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Armstrong World Industries, Inc; Drywall Grid Systems.
    - b. Chicago Metallic Corporation; 640/660 Drywall Ceiling Suspension.
    - c. United States Gypsum Company; Drywall Suspension System.

## 2.4 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
  - 1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide one of the following:

1. Asphalt-Saturated Organic Felt: ASTM D 226/D 226M, Type I (No. 15 asphalt felt), nonperforated.
2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
  1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.
- B. Coordination with Sprayed Fire-Resistive Materials:
  1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling tracks to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches o.c.
  2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of non-load-bearing steel framing. Do not reduce thickness of fire-resistive materials below that are required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

#### 3.3 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754.
  1. Gypsum Plaster Assemblies: Also comply with requirements in ASTM C 841 that apply to framing installation.
  2. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C 1063 that apply to framing installation.
  3. Gypsum Veneer Plaster Assemblies: Also comply with requirements in ASTM C 844 that apply to framing installation.
  4. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.
- B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.



- C. Install supplementary framing, and blocking to support wall-mounted items including but not limited to fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- D. Install bracing at terminations in assemblies.
- E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

### 3.4 INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
  - 1. Single-Layer Application: 16 inches o.c. unless otherwise indicated.
  - 2. Multilayer Application: 16 inches o.c. unless otherwise indicated.
  - 3. Tile Backing Panels: 16 inches o.c. unless otherwise indicated.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install studs so flanges within framing system point in same direction.
- D. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.
  - 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
  - 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.
    - a. Install two studs at each jamb unless otherwise indicated.
    - b. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
  - 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
  - 4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
    - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
  - 5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
  - 6. Curved Partitions:
    - a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
    - b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs 6 inches o.c.

E. Direct Furring:

1. Screw to wood framing.
2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.

F. Z-Shaped Furring Members:

1. Erect insulation, specified in Section 07 21 00 "Thermal Insulation," vertically and hold in place with Z-shaped furring members spaced 24 inches o.c.
2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches from corner and cut insulation to fit.

G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.5 INSTALLING CEILING SUSPENSION SYSTEMS

A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Hangers: 48 inches o.c.
2. Furring Channels (Furring Members): 24 inches o.c.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
  - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
  - a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
4. Do not attach hangers to steel roof deck.

5. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
6. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
7. Do not connect or suspend steel framing from ducts, pipes, or conduit.

- D. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- E. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

### 3.6 CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

- A. Manage construction waste in accordance with provisions of Section 01 74 19 "Construction Waste Management and Disposal."

**END OF SECTION 09 22 16**

**SECTION 09 29 00**

**GYPSUM BOARD**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Interior gypsum board.
  - 2. Sound Attenuation Blankets.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For the following:
  - 1. Gypsum board, Type X.
  - 2. Mold-resistant gypsum board.
  - 3. Interior trim.
  - 4. Joint treatment materials.
  - 5. Sound-attenuation blankets.
- B. Samples: For the following products:
  - 1. Trim Accessories: Full-size Sample in 12-inch- long length for each trim accessory indicated.
- C. Shop Drawings: Provide elevations and details showing layout of all control joints.

**1.4 DELIVERY, STORAGE AND HANDLING**

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

**1.5 FIELD CONDITIONS**

- A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

### 2.2 GYPSUM BOARD, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.
- B. Basis-of-Design Products: The design is based on the product s named. Reference Section 01 60 00 "Product Requirements" for Basis-of-Design product definition and requirements for proposing products comparable to the Basis-of-Design.

### 2.3 INTERIOR GYPSUM BOARD

- A. Gypsum Board, Type X: ASTM C1396/C1396M.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Gypsum.
    - b. CertainTeed Corporation; Saint-Gobain North America.
    - c. Continental Building Products, LLC.
    - d. Georgia-Pacific Gypsum LLC.
    - e. National Gypsum Company.
    - f. PABCO Gypsum.
    - g. Panel Rey SA.
    - h. USG Corporation.
  2. Thickness: 5/8 inch.
  3. Long Edges: Tapered.
- B. Mold-Resistant Gypsum Board: ASTM C1396/C1396M. With moisture- and mold-resistant core and paper surfaces.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. American Gypsum.
  - b. CertainTeed Corporation; Saint-Gobain North America.
  - c. Continental Building Products, LLC.
  - d. Georgia-Pacific Gypsum LLC.
  - e. National Gypsum Company.
  - f. PABCO Gypsum.
  - g. USG Corporation.
2. Core: 5/8 inch, Type X.
  3. Long Edges: Tapered.
  4. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

## 2.4 TRIM ACCESSORIES

### A. Interior Trim: ASTM C1047.

1. Material: Paper-faced galvanized-steel sheet.
2. Shapes:
  - a. Cornerbead.
  - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
  - c. Expansion (control) joint.

## 2.5 JOINT TREATMENT MATERIALS

### A. General: Comply with ASTM C475/C475M.

### B. Joint Tape:

1. Interior Gypsum Board: Paper.

### C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
  - a. Use setting-type compound for installing paper-faced metal trim accessories.
3. Fill Coat: For second coat, use setting-type, sandable topping compound.
4. Finish Coat: For third coat, use setting-type, sandable topping compound.
5. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound.

## 2.6 AUXILIARY MATERIALS

### A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.

### B. Spot-Grout: ASTM C 475, setting type joint compound for spot-grouting hollow metal frames

- C. Steel Drill Screws: ASTM C1002 unless otherwise indicated.
  - 1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
  - 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- D. Sound-Attenuation Blankets: ASTM C665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
  - 1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
- E. Acoustical Joint Sealant: As specified in Section 07 92 00 "Joint Sealants."
- F. Labeling of Fire-Rated Walls: At all fire walls, fire barriers, fire partitions, smoke barriers and smoke partitions indicated on Drawings, provide permanent identification sign or stenciling meeting the following IBC 703.7 requirements:
  - 1. Be located in accessible concealed floor, floor-ceiling or attic spaces;
  - 2. Be located with 15 feet of the end of each wall and at intervals not exceeding 30 feet measured horizontally along the wall or partition;
  - 3. Include lettering not less than 3 inches in height with a minimum 3/8 inch stroke in a contrasting color incorporating the wording "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS."

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION AND FINISHING OF PANELS, GENERAL

- A. Comply with ASTM C840 and GA-214 "Recommended Levels of Gypsum Board Finish."
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
  - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
  - 2. Fit gypsum panels around ducts, pipes, and conduits.
  - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- I. Wood Framing: Install gypsum panels over wood framing, with floating internal corner construction. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members or provide control joints to counteract wood shrinkage.
- J. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
- K. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

### 3.3 INSTALLATION OF INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
  - 1. Type X: Vertical surfaces unless otherwise indicated and ceiling surfaces.
  - 2. Mold-Resistant Type: Interior surfaces of exterior wall assemblies and areas exposed to humidity and water.
- B. Single-Layer Application:
  - 1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
  - 2. On partitions/walls, apply gypsum panels horizontally (perpendicular to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
    - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
    - b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.



3. On Z-shaped furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
3. On Z-shaped furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
4. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

- D. Hollow Metal Frames: Spot-grout hollow metal door frames for solid-core wood doors, hollow metal doors and doors over 32 inches wide. Apply spot-grout at each jamb anchor clip just before inserting board into frame.

### 3.4 INSTALLATION OF TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

- B. Control Joints: Install control joints consistent with lines of building spaces and as follows:

1. Install control joints where indicated on the Drawings. Full height door frames shall be considered equivalent to a control joint.
2. Install control joints where partitions, walls, or ceilings traverse a joint (expansion, seismic, control, deflection-accommodating) in the base building structure. Control joints shall not carry over structural systems.
3. Install control joints in partitions or furred gypsum board at intervals not to exceed 30 feet.
4. Install control joints in interior ceilings with perimeter relief so that linear dimensions between control joints do not exceed 50 feet and total area between control joints does not exceed 2500 sq ft.
5. Install control joints in interior ceilings without perimeter relief so that linear dimensions between control joints do not exceed 30 feet and total area between control joints does not exceed 900 square feet.
6. Install control joints between legs of "L", "U", or "T" shaped fields of gypsum board exceeding 50 square feet.
7. A control joint or intermediate blocking shall be installed where ceiling framing members change direction.
8. Where a control joint occurs in an acoustical or fire-rated system, blocking shall be provided behind the control joint by using a backing material such as 5/8 inch Type X gypsum board, mineral fiber, or other tested equivalent. See the Gypsum Association's "Fire Resistance Design Manual" (GA-600).
9. If control joints are required at locations other than indicated, verify arrangement with Design-Builder's Architect.

C. Interior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners unless otherwise indicated.
2. LC-Bead: Use at exposed panel edges.

3.5 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C840:
1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
  2. Level 2: Panels that are substrate for tile.
  3. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
    - a. Primer and its application to surfaces are specified in Section 09 91 23 "Interior Painting."
  4. Level 5: Where indicated on Drawings.
    - a. Primer and its application to surfaces are specified in Section 09 91 23 "Interior Painting."

3.6 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

3.7 CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

- A. Manage construction waste in accordance with provisions of Section 01 74 19 "Construction Waste Management and Disposal."

END OF SECTION 09 29 00

**SECTION 09 67 23**  
**RESINOUS FLOORING**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section Includes:
1. Resinous flooring.
  2. Re-coating of existing resinous flooring.
  3. Integral cove base accessories.

**1.3 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.
1. Review manufacturer's written instructions for substrate preparation and environmental conditions affecting resinous flooring installation.
  2. Review details of integral cove bases.
  3. Review manufacturer's written instructions for installing resinous flooring systems.
  4. Review protection measures for adjacent construction and installed flooring, floor drainage requirements, curbs, base details, and so forth.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
1. Include manufacturer's technical data, installation instructions, and recommendations for each resinous flooring component required.
- B. Samples for Verification: For each resinous flooring system required and for each color and texture specified, 6 inches square, applied to a rigid backing by Installer for this Project.

**1.5 INFORMATIONAL SUBMITTALS**

- A. Certificates: By Manufacturer of resinous flooring; upon completion of Work, written statement that technical support to Installer and field supervision was sufficient to assure proper application of materials and that installation is acceptable.

## 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For resinous flooring to include in maintenance manuals.

## 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
1. Engage an installer who is certified in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated.
    - a. Installer shall have a minimum of five years of experience applying the resinous flooring systems indicated.
    - b. Installer shall have successfully completed a minimum of 5 projects of similar size and complexity.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
1. Apply full-thickness mockups on 96-inch- square floor area selected by Architect, to verify floor texture.
    - a. Include 96-inch length of integral cove base with inside and outside corner.
  2. Simulate finished lighting conditions for Architect's review of mockups.
  3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.
- B. Material shall be stored in a dry, enclosed area protected from exposure to moisture. Temperature of storage area shall be maintained within range recommended by Manufacturer, but not less than 60 deg F or more than 85 deg F.

## 1.9 FIELD CONDITIONS

- A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring installation.
- B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring installation.
- C. Close spaces to traffic during resinous flooring installation and for 24 hours after installation unless manufacturer recommends a longer period.

- D. Type 1 concrete shall be properly cured for a minimum of 30 days prior to installation. Type III concrete shall be properly cured for a minimum of 7 days prior to installation. A vapor barrier must be present for concrete substrates on or below grade.

#### 1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace floor system components that fail in material or workmanship within specified warranty period.
  - 1. Warranty Period: One year from date of Installation.
  - 2. Resinous flooring manufacturer representative shall return to project within 6 months to conduct inspection of resinous floor area.

### PART 2 - PRODUCTS

#### 2.1 GENERAL

- A. Basis-of-Design Products: The design is based on the products named. Reference Section 01 60 00 "Product Requirements" for Basis-of-Design product definition and requirements for proposing products comparable to the Basis-of-Design.

#### 2.2 PERFORMANCE REQUIREMENTS

- A. Flammability: Self-extinguishing in accordance with ASTM D635.

#### 2.3 RESINOUS FLOORING (RN-1)

- A. Resinous Flooring System: Abrasion-, impact-, and chemical-resistant, aggregate-filled, resin-based monolithic floor surfacing designed to produce a seamless floor and integral cove base.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide **Stonhard; Stonblend HDF**, or comparable product by one of the following:
    - a. BASF Corporation.
    - b. DUDICK Inc.
    - c. Duraflex, Inc.
- B. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, from single source from single manufacturer with a minimum of 10 years of successful experience in manufacturing and installing principal materials described in this Section. Obtain secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from manufacturer recommended in writing by manufacturer of primary materials.
- C. System Characteristics:
  - 1. Color and Pattern: As selected by Architect from manufacturer's full range.
  - 2. Wearing Surface: Smooth matte finish.
  - 3. Overall System Thickness: 3/16 inch.

- D. System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested in accordance with test methods indicated:
1. Compressive Strength: 7,500 psi minimum in accordance with ASTM C579.
  2. Tensile Strength: 1,750 psi minimum in accordance with ASTM C307.
  3. Flexural Modulus of Elasticity: 2,800 psi minimum in accordance with ASTM C580.
  4. Water Absorption: One percent maximum in accordance with ASTM C413.
  5. Impact Resistance: 160 in/lbs. minimum according to ASTM D 4226.
  6. Flammability: Class 1 per ASTM E-648.
  7. Hardness: 85 to 90, Shore D in accordance with ASTM D2240.
- E. Primer: Type recommended in writing by resinous flooring manufacturer for substrate and resinous flooring system indicated.
1. Basis-of-Design Product: Subject to compliance with requirements, provide **Stonhard; Stonblend Primer**, or comparable product.
  2. Formulation Description: Two-component epoxy.
- F. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended in writing by manufacturer for installation indicated.
- G. Moisture Mitigation: Moisture mitigation products as recommended by resinous flooring manufacturer for compatibility and adhesion of flooring system.
- H. Body Coats:
1. Basis-of-Design Product: Subject to compliance with requirements, provide **Stonhard; Stonblend HDF Mortar**, or comparable product.
  2. Resin: Epoxy.
  3. Formulation Description: Three-component.
  4. Type: Pigmented.
  5. Installation Method: Troweled or screeded.
  6. Number of Coats: One.
  7. Thickness of Coats: 3/16-inch.
  8. Aggregates: As selected by Architect.
- I. Grout Coat:
1. Basis-of-Design Product: Subject to compliance with requirements, provide **Stonhard; Stonblend Groutcoat**, or comparable product.
  2. Resin: Epoxy.
  3. Formulation Description: Two-component.
  4. Type: Clear.
  5. Number of Coats: One.
- J. Sealer Coat:
1. Basis-of-Design: Subject to compliance with requirements, provide **Stonhard; Stonkote CE4**, or comparable product.
  2. Resin: Epoxy.
  3. Formulation Description: Two-Component, 100% solids.
  4. Type: Clear.
  5. Finish: Gloss.
  6. Number of Coats: One.

K. Topcoats: Sealing or finish coats.

1. Basis-of-Design Product: Subject to compliance with requirements, provide **Stonhard; Stonseal CF7**, or comparable product.
2. Resin: Urethane.
3. Formulation Description: Two-component, water-based, low VOC.
4. Type: Clear.
5. Number of Coats: Two.
6. Finish: Matte.

L. Metal Cove Termination Strip: 1/8 inch by 1/2 inch, "L" shaped, zinc or equivalent metal, cove strip fastened to wall substrate at cove height indicated on Drawings.

2.4 RESINOUS FLOORING (RN-2)

A. Re-Coating of Existing Resinous Flooring System: Patch and fill existing resinous flooring, mechanically abrade existing flooring, and apply new grout coat, sealer, and topcoat, to produce a seamless floor and integral cove base.

1. Basis-of-Design Product: Subject to compliance with requirements, provide **Stonhard; Stonblend** system, or comparable product by one of the following:
  - a. BASF Corporation.
  - b. DUDICK Inc.
  - c. Duraflex, Inc.

B. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, from single source from single manufacturer with a minimum of 10 years of successful experience in manufacturing and installing principal materials described in this Section. Obtain secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from manufacturer recommended in writing by manufacturer of primary materials.

C. Patching and Fill: All required patching and fill of existing floor to be done utilizing body coat material.

1. Basis-of-Design Product: Subject to compliance with requirements, provide **Stonhard; Stonblend HDF Mortar**, or comparable product.
2. Resin: Epoxy.
3. Formulation Description: Three-component.
4. Type: Pigmented.
5. Installation Method: Troweled or screeded.
6. Number of Coats: One.
7. Thickness of Coats: As required to match existing resinous flooring.
8. Aggregates: As selected by Architect.

D. Prepare existing resinous flooring mechanically.

E. Grout Coat:

1. Basis-of-Design Product: Subject to compliance with requirements, provide **Stonhard; Stonblend Groutcoat**, or comparable product.
2. Resin: Epoxy.
3. Formulation Description: Two-component.
4. Type: Clear.

5. Number of Coats: One.

F. Sealer Coat:

1. Basis-of-Design: Subject to compliance with requirements, provide **Stonhard; Stonkote CE4**, or comparable product.
2. Resin: Epoxy.
3. Formulation Description: Two-Component, 100% solids.
4. Type: Clear.
5. Finish: Gloss.
6. Number of Coats: One

G. Topcoats: Sealing or finish coats.

1. Basis-of-Design Product: Subject to compliance with requirements, provide **Stonhard; Stonseal CF7**, or comparable product.
2. Resin: Urethane.
3. Formulation Description: Two-component, water-based, low VOC.
4. Type: Clear.
5. Number of Coats: Two.
6. Finish: Matte.

## 2.5 INTEGRAL COVE BASE ACCESSORIES

- A. Precast, Integral Cove Base: Impact-resistant, polymer-resin, cove base moldings with a grit profile to promote adhesion of resinous flooring and recommended in writing by resinous flooring manufacturer.

1. Radius Cove Base: 6-inch- high base molding that provides approximately 1-inch radius cove at floor-to-wall joint; for adhesive installation as substrate for resinous flooring system to form an integral cove base.
  - a. Preformed Inside and Outside Corners: Provide manufacturer's standard square inside and 3/4- to 1-inch bullnose outside corners.

- B. Installation Adhesive: As recommended in writing by accessory manufacturer.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resinous flooring systems.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.



### 3.2 PREPARATION

- A. Prepare and clean substrates in accordance with resinous flooring manufacturer's written instructions for substrate indicated to ensure adhesion.
- B. Mechanically prepare existing resinous flooring to be re-coated, according to manufacturer's written instructions.
- C. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.
  - 1. Roughen concrete substrates as follows:
    - a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
    - b. Comply with requirements in SSPC-SP 13/NACE No. 6, with a Concrete Surface Profile of 3 or greater in accordance with ICRI Technical Guideline No. 310.2R, unless manufacturer's written instructions are more stringent.
  - 2. Repair damaged and deteriorated concrete in accordance with resinous flooring manufacturer's written instructions.
  - 3. Verify that concrete substrates are dry.
  - 4. Apply moisture vapor emission control products, as indicated in Section 09 05 61.13 "Moisture Vapor Emission Control," and proceed with installation according to manufacturers recommendations.
- D. Patching and Filling: Use patching and fill material to fill holes and depressions in substrates in accordance with manufacturer's written instructions.
  - 1. Control Joint Treatment: Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring in accordance with manufacturer's written instructions.
- E. Resinous Materials: Mix components and prepare materials in accordance with resinous flooring manufacturer's written instructions.

### 3.3 INSTALLATION

- A. Apply components of resinous flooring system in accordance with manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness specified.
  - 1. Coordinate installation of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
  - 2. Cure resinous flooring components in accordance with manufacturer's written instructions. Prevent contamination during installation and curing processes.
  - 3. Expansion and Isolation Joint Treatment: At substrate expansion and isolation joints, comply with resinous flooring manufacturer's written instructions.
- B. Primer: Apply primer over prepared substrate at spreading rate recommended in writing by manufacturer.

- C. Integral Cove Base Accessories: Adhesively install precast accessories before applying flooring coats and in accordance with manufacturer's written instructions.
- D. Troweled or Screeded Body Coats: Apply troweled or screeded body coats in thickness specified for flooring system. Hand or power trowel and grout to fill voids. When body coats are cured, remove trowel marks and roughness using method recommended in writing by manufacturer.
- E. Grout Coat: Apply grout coat to fill voids in surface of final body coat.
- F. Topcoats: Apply topcoats in number indicated for flooring system specified, at spreading rates recommended in writing by manufacturer, and to produce wearing surface specified.

### 3.4 PROTECTION

- A. Protect resinous flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer.

### 3.5 CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

- A. Manage construction waste in accordance with provisions of Section 01 74 19 "Construction Waste Management and Disposal."

**END OF SECTION 09 67 23**

**SECTION 09 91 23**

**INTERIOR PAINTING**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section includes surface preparation and the application of paint systems on the following interior substrates:
1. Steel and iron.
  2. Galvanized metal.
  3. Gypsum board.

**1.3 DEFINITIONS**

- A. Colorado Department of Public Health and Environment, Air Quality Control Commission, Rule 5 CCR 1001-25 Regulation Number 21 Definitions:
1. Flat Coating: A coating that registers gloss less than 15 on an 85-degree meter or less than five on a 60-degree meter according to ASTM D523.
  2. Non-Flat Coating: A coating that registers gloss of 15 or greater on an 85-degree meter and 5 or greater on a 60-degree meter according to ASTM D523.
  3. Non-Flat High-Gloss Coating: A coating that registers gloss of 70 or greater on a 60-degree meter according to ASTM D523.
  4. Concrete/Masonry Sealer: A clear or opaque coating that is labeled and formulated primarily for application to concrete and masonry surfaces to prevent penetration of water; provide resistance against abrasion, alkalis, acids, mildew, staining, or ultraviolet light; or harden or dustproof the surface of aged or cured concrete.
  5. Dry Fog Coating: A coating labeled and formulated only for spray application such that overspray droplets dry before subsequent contact with incidental surfaces in the vicinity of the surface coating activity.
  6. Floor Coating: An opaque coating that is labeled and designed for application to flooring, including, but not limited to, decks, porches, steps, and other horizontal surfaces which may be subject to foot traffic.

7. **Industrial Maintenance Coatings:** A high performance architectural coating, including primers, sealers, undercoaters, intermediate coats, and topcoats, formulated for application to substrates, including floors, and exposed to one or more of the following extreme environmental conditions: immersion in water, wastewater, or chemical solutions (aqueous and non-aqueous solutions), or chronic exposures of interior surfaces to moisture condensation; acute or chronic exposure to corrosive, caustic, or acidic agents, or to chemicals, chemical fumes, or chemical mixtures or solutions; frequent exposure to temperatures above 121°C (250°F); frequent heavy abrasion, including mechanical wear and scrubbing with industrial solvents, cleansers, or scouring agents; or exterior exposure of metal structures and structural components. Industrial maintenance coatings must be labeled as specified in Part B, Section III. D.1.
  8. **Pretreatment Wash Primer:** A primer that contains a minimum of 0.5 percent acid, by weight, when tested in accordance with ASTM D 1613-06 "Standard Test Method for Acidity in Volatile Solvents and Chemical Intermediates Used in Paint, Varnish, Lacquer and Related Products" (2017), that is labeled and formulated for application directly to bare metal surfaces to provide corrosion resistance and to promote adhesion of subsequent topcoats.
  9. **Rust Preventive Coating:** A coating formulated exclusively for nonindustrial use to prevent the corrosion of metal surfaces for direct-to-metal coating or application over rusty, previously coated surfaces. The rust preventative category does not include coatings that are required to be applied as a topcoat over a primer or coatings that are intended for use on wood or any other nonmetallic surface.
- 
- B. **MPI Gloss Level 1:** Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D523.
  - C. **MPI Gloss Level 2:** Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.
  - D. **MPI Gloss Level 3:** 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.
  - E. **MPI Gloss Level 4:** 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D523.
  - F. **MPI Gloss Level 5:** 35 to 70 units at 60 degrees, according to ASTM D523.
  - G. **MPI Gloss Level 6:** 70 to 85 units at 60 degrees, according to ASTM D523.
  - H. **MPI Gloss Level 7:** More than 85 units at 60 degrees, according to ASTM D523.

#### 1.4 ACTION SUBMITTALS

- A. **Product Data:** For each type of product. Include preparation requirements and application instructions.
  1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
  2. Indicate VOC content.
- B. **Samples for Verification:** For each type of paint system and in each color and gloss of topcoat.
  1. Submit Samples on rigid backing, 8 inches square.
  2. Apply coats on Samples in steps to show each coat required for system.
  3. Label each coat of each Sample.
  4. Label each Sample for location and application area.

- C. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in the Interior Painting Schedule to cross-reference paint systems specified in this Section. Include color designations.

#### 1.5 MAINTENANCE MATERIAL SUBMITTALS

- 1. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

#### 1.6 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver all painting materials in sealed, original labeled containers bearing manufacturer's name, brand name, type of paint or coating and color designation, standard compliance, materials content as well as mixing and/or reducing and application requirements.
- B. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
  - 1. Maintain containers in clean condition, free of foreign materials and residue.
  - 2. Remove rags and waste from storage areas daily.
- C. Where toxic and/or volatile / explosive / flammable materials are being used, provide adequate fireproof storage lockers and take all necessary precautions and post adequate warnings (e.g. no smoking) as required.
- D. Take all necessary precautionary and safety measures to prevent fire hazards and spontaneous combustion and to protect the environment from hazard spills. Materials that constitute a fire hazard (paints, solvents, drop clothes, etc.) shall be store in suitable closed and rated containers and removed from the site on a daily basis.
- E. Comply with requirements of authorities having jurisdiction, in regard to the use, handling, storage and disposal of hazardous materials.

#### 1.8 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures of less than 5 deg F above the dew point; or to damp or wet surfaces.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the products listed in the Interior Painting Schedule for the paint category indicated.

### 2.2 PAINT, GENERAL

- A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products List."
- B. Material Compatibility:
  - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  - 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
- C. VOC Content: For field applications, paints and coatings shall comply with VOC content limits of the Colorado Department of Public Health and Environment, Air Quality Control Commission, Rule 5 CCR 1001-25 Regulation Number 21, and the following VOC content limits:
  - 1. Flat Paints and Coatings (MPI Gloss Level 1): 50 g/L.
  - 2. Non-Flat Paints and Coatings (MPI Gloss Levels 2 through 5): 100 g/L.
  - 3. Non-Flat High-Gloss Paints and Coatings (MPI Gloss Levels 6 and 7): 150 g/L.
  - 4. Dry-Fog Coatings: 150 g/L.
  - 5. Primers, Sealers, and Undercoaters: 100 g/L.
  - 6. Rust-Preventive Coatings: 250 g/L.
  - 7. Industrial Maintenance Coatings: 250 g/L.
  - 8. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
  - 9. Pretreatment Wash Primers: 420 g/L.
  - 10. Floor Coatings: 100 g/L.
  - 11. Concrete/Masonry Sealers: 100 g/L.
  - 12. Shellacs, Clear: 730 g/L.
  - 13. Shellacs, Pigmented: 550 g/L.
- D. Colors: As indicated in Drawings, Finish Legend.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
  - 1. Gypsum Board: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- E. Proceed with coating application only after unsatisfactory conditions have been corrected.
  - 1. Application of coating indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
  - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
  - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:
  - 1. SSPC-SP 2.
- E. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- F. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

### 3.3 INSTALLATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
  - 1. Use applicators and techniques suited for paint and substrate indicated.
  - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.

3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
  4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
  5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
  6. Paint backsides of access panels and removable or hinged covers to match exposed surfaces.
  7. Factory-Primed Objects: Paint all items that are indicated to be factory primed by other sections, as specified in painting schedules.
  8. Factory-Finished Objects: When directed by Architect, paint factory-finished objects such as grilles, louvers, switch-plates, etc. that do not match the color of surfaces in which they are located.
  9. Apply additional coats of primer to joints in gypsum board assemblies as necessary to preclude joint "read-through."
- B. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- D. Painting Fire-Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
1. Paint the following work where exposed in equipment rooms:
    - a. Equipment, including panelboards and switch gear.
    - b. Uninsulated metal piping.
    - c. Uninsulated plastic piping.
    - d. Pipe hangers and supports.
    - e. Metal conduit.
    - f. Plastic conduit.
    - g. Tanks that do not have factory-applied final finishes.
    - h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
  2. Paint the following work where exposed in occupied spaces:
    - a. Equipment, including panelboards.
    - b. Uninsulated metal piping.
    - c. Uninsulated plastic piping.
    - d. Pipe hangers and supports.
    - e. Metal conduit.
    - f. Plastic conduit.
    - g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
    - h. Other items as directed by Architect.
  3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.



### 3.4 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

### 3.5 CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

- A. Manage construction waste in accordance with provisions of Section 01 74 19 "Construction Waste Management and Disposal."

### 3.6 INTERIOR PAINTING SCHEDULE

#### A. Steel Substrates:

- 1. Epoxy-Modified Latex System: Bathrooms, locker rooms, kitchens, and other wet areas.
  - a. Prime Coat: Primer, galvanized, water based, MPI #107.
    - 1) Behr Process Corp.; Behr Pro; Premium Plus Multi-Surface Primer 436.
    - 2) Benjamin Moore & Co.; Ultra Spec HP; Acrylic Metal Primer; HP04/FP04.
    - 3) PPG Architectural; Pitt-Tech DTM Industrial Primer; 90-712.
    - 4) Sherwin-Williams Company (The); Pro Industrial; Pro-Cryl Universal Primer; B66 Series.
  - b. Intermediate Coat: Epoxy-modified latex, matching topcoat.
  - c. Topcoat: Epoxy-modified latex, semi-gloss (MPI Gloss Level 5).
    - 1) Benjamin Moore & Co.; Corotech; Pre-Catalyzed Waterborne Epoxy; V341.
    - 2) PPG Architectural Finishes, Inc.; Pitt-Glze WB1; Interior Semi-Gloss Pre-Catalyzed Water-Borne Acrylic Epoxy, Ig-510.
    - 3) Sherwin-Williams Company (The); Pro Industrial; Waterbased Catalyzed Epoxy; B73-300 Series.

#### B. Galvanized-Metal Substrates:

- 1. Epoxy-Modified Latex System: Bathrooms, locker rooms, kitchens, and other wet areas.
  - a. Prime Coat: Primer, galvanized, water based, MPI #134.
    - 1) Behr Process Corp.; Behr Pro; Premium Plus Multi-Surface Primer 436.
    - 2) Benjamin Moore & Co.; Ultra Spec HP; Acrylic Metal Primer; HP04/FP04.

- 3) PPG Architectural; Pitt-Tech DTM Industrial Primer; 90-712.
- 4) Sherwin-Williams Company (The); Pro Industrial; Pro-Cryl Universal Primer; B66 Series.
- b. Intermediate Coat: Epoxy-modified latex, matching topcoat.
- c. Topcoat: Epoxy-modified latex, semi-gloss (MPI Gloss Level 5).
  - 1) Benjamin Moore & Co.; Corotech; Pre-Catalyzed Waterborne Epoxy; V341.
  - 2) PPG Architectural Finishes, Inc.; Pitt-Glze WB1; Interior Semi-Gloss Pre-Catalyzed Water-Borne Acrylic Epoxy, Ig-510.
  - 3) Sherwin-Williams Company (The); Pro Industrial; Waterbased Catalyzed Epoxy; B73-300 Series.

C. Gypsum Board Substrates:

- 1. Epoxy-Modified Latex System: Bathrooms, locker rooms, kitchens, and other wet areas. MPI INT 9.2F:
  - a. Prime Coat: Primer sealer, latex, interior, MPI #50.
    - 1) Benjamin Moore & Co.; Ultra Spec 500; Waterborne Interior Primer Sealer; N534/K534.
    - 2) PPG Architectural Finishes, Inc.; PPG; Speedhide Zero Interior Zero VOC Latex Sealer; 6-4900XI.
    - 3) Sherwin-Williams Company (The); ProMar 200 Zero, Interior Latex Primer; B28W02600/B28WQ2600.
  - b. Intermediate Coat: Epoxy-modified latex, matching topcoat.
  - c. Topcoat: Epoxy-modified latex, semi-gloss (MPI Gloss Level 5).
    - 1) Benjamin Moore & Co.; Corotech; Pre-Catalyzed Waterborne Epoxy; V341.
    - 2) PPG Architectural Finishes, Inc.; Pitt-Glze WB1; Interior Semi-Gloss Pre-Catalyzed Water-Borne Acrylic Epoxy, Ig-510.
    - 3) Sherwin-Williams Company (The); Pro Industrial; Waterbased Catalyzed Epoxy; B73-300 Series.

**END OF SECTION 09 91 23**

## SECTION 10 26 00

### WALL AND DOOR PROTECTION

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

##### 1.2 SUMMARY

- A. Section Includes:

- 1. Wall guards.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- 1. Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes.
- 2. Include fire ratings of units recessed in fire-rated walls and listings for door-protection items attached to fire-rated doors.

- B. Shop Drawings: For each type of wall and door protection showing locations and extent.

- 1. Include plans, elevations, sections, and attachment details.

- C. Samples for Verification: For each type of exposed finish on the following products, prepared on Samples of size indicated below:

- 1. Wall Guards: 12 inches long. Include examples of joinery, corners, end caps, and field splices.

##### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of wall and door protection product to include in maintenance manuals.

- 1. Include recommended methods and frequency of maintenance for maintaining best condition of plastic covers under anticipated traffic and use conditions. Include precautions against using cleaning materials and methods that may be detrimental to finishes and performance.

##### 1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Mounting and Accessory Components: Amounts proportional to the quantities of extra materials. Package mounting and accessory components with each extra material.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store wall and door protection in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.
  1. Maintain room temperature within storage area at not less than 70 deg F during the period plastic materials are stored.
  2. Keep plastic materials out of direct sunlight.
  3. Store plastic wall- and door-protection components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of 70 deg F.
    - a. Store wall-guard covers in a horizontal position.

## 1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of wall- and door-protection units that fail in materials or workmanship within specified warranty period.
  1. Failures include, but are not limited to, the following:
    - a. Structural failures including detachment of components from each other or from the substrates, delamination, and permanent deformation beyond normal use.
    - b. Deterioration of metals, metal finishes, plastics, and other materials beyond normal use.
  2. Warranty Period: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Source Limitations: Obtain wall- and door-protection products of each type from single source from single manufacturer.
- B. Basis-of-Design Products: The design is based on the product s named. Reference Section 01 60 00 "Product Requirements" for Basis-of-Design product definition and requirements for proposing products comparable to the Basis-of-Design.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Surface Burning Characteristics: Comply with ASTM E 84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  1. Flame-Spread Index: 25 or less.
  2. Smoke-Developed Index: 450 or less.

- B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1.

2.3 WALL GUARDS (WLP-1) and (WLP-2)

- A. Aluminum Wall Protection Rail (WLP-1): 1/4 by 4 inches extruded true bar with 1/8-inch radius edges with satin longitudinal finish.

1. Basis-of-Design Product: Subject to compliance with requirements, provide **Life Science Products, Inc.; Sani-Rail, ASR-1**, or comparable product by one of the following:
  - a. InPro Corporation.
  - b. Koroseal.
  - c. Nystrom, Inc.
  - d. ProTek Systems, Inc.
2. Rail Ends: See drawings details for termination conditions.
3. Bracket Material: Extruded aluminum, 6063-T6 alloy and temper, complying with Federal Specification QQA-200/16, with 0.200" radius vertical flange to eliminate 90° edges at points of possible hand contact. Finish with clear anodized finish complying with MilSpec A8625 Type II.
4. Bracket Dimensions For Metal Doors or Gypsum Board with metal Backing: 5 inches offset from wall to back of rail; 0.13-inch web thickness; 0.20-inch flange thickness; 2-1/2 by 3 inches bracket face at rail and wall.
5. Bracket Dimensions For Gypsum Board without Metal Backing: 27 deg flared bracket; 3 or 5 inches offset from wall to back of rail; 0.13-inch web thickness; 0.20-inch flange thickness; 2-1/2 by 3 inches bracket face at rail; 2-1/2 by 5-1/2 inches bracket face at wall.
6. Provide 0.200-inch radius edge at vertical bracket flanges.
7. Hardware: Aluminum.

- B. Bumper Rail (WLP-2): Standard-duty, PVC-free assembly consisting of continuous molded polyurethane bumper installed over continuous aluminum retainer; designed to withstand impacts.

1. Basis-of-Design Product: Subject to compliance with requirements, provide **Pawling Corporation; EB-4 Industrial Wall Guard**, or comparable product by one of the following:
  - a. American Floor Products Company, Inc.
  - b. Babcock-Davis.
  - c. Boston Retail Products.
  - d. Construction Specialties, Inc.
  - e. InPro Corporation (IPC).
  - f. Korogard Wall Protection Systems; a division of RJF International Corporation.
  - g. Musson Rubber Co.
  - h. Nystrom, Inc.
  - i. WallGuard.com.
2. Bumper: Molded polyurethane, as follows:
  - a. Profile: Flat profile with beveled edges, nominal 4 inches high by 1-1/2 inches deep.
  - b. Color and Texture: As selected by Architect from manufacturer's full range.
3. Continuous Retainer: Minimum 0.125-inch- thick, one-piece, extruded aluminum.
4. End Caps and Corners: Prefabricated, matching bumper material and color.

5. Accessories: Mounting hardware.
6. Mounting: Surface mounted directly to wall.

## 2.4 MATERIALS

- A. Plastic Materials: Chemical- and stain-resistant, high-impact-resistant plastic with integral color throughout; extruded and sheet material as required, thickness as indicated.
- B. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.
- C. Adhesive: As recommended by protection product manufacturer.
  1. Adhesives shall have a VOC content of 70 g/L or less.

## 2.5 FABRICATION

- A. Fabricate wall and door protection according to requirements indicated for design, performance, dimensions, and member sizes, including thicknesses of components.
- B. Factory Assembly: Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.
- C. Quality: Fabricate components with uniformly tight seams and joints and with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

## 2.6 FINISHES

- A. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances, fire rating, and other conditions affecting performance of the Work.
- B. Examine walls to which wall and door protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.
  1. For wall and door protection attached with adhesive, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Complete finishing operations, including painting, before installing wall and door protection.
- B. Before installation, clean substrate to remove dust, debris, and loose particles.

### 3.3 INSTALLATION

- A. Installation Quality: Install wall and door protection according to manufacturer's written instructions, level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
- B. Mounting Heights: Install wall and door protection in locations and at mounting heights indicated on Drawings.
- C. Accessories: Provide splices, mounting hardware, anchors, trim, joint moldings, and other accessories required for a complete installation.
  - 1. Provide anchoring devices and suitable locations to withstand imposed loads.
  - 2. Where splices occur in horizontal runs of more than 20 feet, splice aluminum retainers and plastic covers at different locations along the run, but no closer than 12 inches apart.
  - 3. Adjust end and top caps as required to ensure tight seams.

### 3.4 CLEANING

- A. Immediately after completion of installation, clean plastic covers and accessories using a standard ammonia-based household cleaning agent.
- B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

### 3.5 CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

- A. Manage construction waste in accordance with provisions of Section 01 74 19 "Construction Waste Management and Disposal."

**END OF SECTION 10 26 00**

## SECTION 10 28 00

### TOILET, BATH, AND LAUNDRY ACCESSORIES

#### PART 1 - GENERAL

##### 1.1 SUMMARY

###### A. Section Includes:

1. Public-use washroom accessories.

##### 1.2 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

##### 1.3 ACTION SUBMITTALS

###### A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.

###### B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

1. Identify locations using room designations indicated.
2. Identify accessories using designations indicated.

##### 1.4 CLOSEOUT SUBMITTALS

###### A. Maintenance Data: For accessories to include in maintenance manuals.

#### PART 2 - PRODUCTS



- 2.1 Basis-of-Design Products: The design is based on the products named. Reference Section 01 60 00 "Product Requirements" for Basis-of-Design product definition and requirements for proposing products comparable to the Basis-of-Design.

2.2 OWNER-FURNISHED MATERIALS

A. Owner-Furnished, Contractor Installed (OFCI) Materials:

1. Paper Towel Dispensers.
2. Soap Dispensers.

2.3 PUBLIC-USE WASHROOM ACCESSORIES

- A. Source Limitations: Obtain each type of public-use washroom accessory from single source from single manufacturer.

- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated or comparable product by one of the following:

- a. AJW Architectural Products.
- b. American Specialties, Inc. (ASI).
- c. Bobrick Washroom Equipment, Inc.
- d. Bradley Corporation.
- e. GAMCO Specialty Accessories; a division of Bobrick.

C. Paper Towel (Roll) Dispenser (TA-2c):

1. Basis-of-Design Product: **Kimberly-Clark; Scott Control Slimroll Manual Towel Dispenser #47092.** Owner Furnished Contractor Installed (OFCI).
2. Description: Manual mechanism permits controlled delivery of paper rolls in preset lengths per pull.
3. Mounting: Surface mounted.
4. Minimum Capacity: 10 -inch-wide.
5. Material and Finish: Smoke/Grey.
6. Lockset: Tumbler type.

D. Liquid-Soap Dispenser, Surface Mounted (TA-4c):

1. Basis-of-Design Product: **Kimberly-Clark; Cassette Skin Care Dispenser #92145.** Owner Furnished Contractor Installed (OFCI).
2. Description: Designed for dispensing soap in liquid or lotion form.
3. Mounting: Vertically oriented, surface mounted.
4. Color: Black.
5. Lockset: Tumbler type.
6. Refill Indicator: Window type.

## 2.4 FABRICATION

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install accessories in accordance with manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
  - 1. Remove temporary labels and protective coatings.

### 3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Clean and polish exposed surfaces in accordance with manufacturer's written instructions.

### 3.3 CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

- A. Manage construction waste in accordance with provisions of Section 01 74 19 "Construction Waste Management and Disposal."

**END OF SECTION 10 28 00**

## SECTION 11 53 53

### BIOLOGICAL SAFETY CABINETS

(University Furnished and Installed, OFOI)

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

##### 1.2 SUMMARY

- A. Section Includes:
  - 1. Biological safety cabinets.
- B. Related Sections:
  - 1. Division 23 "Heating Ventilating and Air-Conditions (HVAC)" for piping and HVAC requirements in laboratory facilities, Contractor Furnished, Contractor Installed.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Submit complete shop fabrication and installation drawings, including plans, elevations, sections, details and schedules. Show relationship to adjoining materials and construction.
- C. Samples: Submit samples of each type of specified finish and color range available.

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Test reports: Submit the following performance test reports:
  - 1. Factory Testing: Each unit shall be factory-tested for NSF Class II requirements.
  - 2. Certification: Submit certification by an independent testing company stating that equipment is installed per applicable and referenced codes and standards, tested, adjusted and balanced for design operations, and is complete and ready for intended function.
  - 3. Sound Level Certification: Provide certification of biological safety cabinet compliance with design criteria for maximum allowable noise within laboratories. Test data of octave band analysis verifying cabinet is capable of a 50 NC value. Measurements shall be taken 36 inches in front of open sash at 100 fpm face velocity.

## 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: Provide data for complete operation and maintenance manuals that describe proper operating procedures, maintenance and replacement schedules, components parts list, and closest factory representative for components and service.

## 1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish complete touchup kit for each type and color of biological safety cabinets finish provided. Include fillers, primers, paints, and other materials necessary to perform permanent repairs to damaged biological safety cabinets finish.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect finished surfaces during handling and installation with protective covering of polyethylene film or another suitable material.

## 1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install biological safety cabinets until building is enclosed, wet work and utility roughing-in are complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Locate concealed framing, blocking, and reinforcements that support biological safety cabinets by field measurements before being enclosed, and indicate measurements on Shop Drawings.

## 1.9 COORDINATION

- A. Work of this Section requires close coordination with Work of Divisions 22, 23 and 26 and Work specified in other Sections, to be completed by Contractor. Contractor to sequence all Work to ensure an orderly progress in the project without removal of previously installed Work and so as to prevent damage to finishes and products.

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. Basis-of-Design Products: The design is based on the products named. Reference Section 01 60 00 "Product Requirements" for Basis-of-Design product definition. Substitutions will not be accepted.

### 2.2 PERFORMANCE REQUIREMENTS

- A. NSF/ANSI 49: Class II (Laminar Flow) Biohazard Cabinetry.
- B. Comply with UL 61010-1, Electrical Equipment For Measurement, Control, and Laboratory Use.

## 2.3 BIOLOGICAL SAFETY CABINETS (BSC-1)

### A. Biological Safety Cabinets: Bench top console with basestand.

1. Basis-of-Design Product: Subject to compliance with requirements, provide **Nuaire; Labgard ES, #NU-677-600 Animal Handling Biosafety Safety Cabinet**. Substitutions will not be accepted.

### B. Class II, Type A2 Laminar Flow Biological Safety Cabinets

1. Overall Dimensions:
  - a. Width: 77-5/8 inches
  - b. Depth: 32-3/4 inches.
  - c. Height (Retracted): 79 inches.
  - d. Height (Extended): 97-1/2 inches.
2. Interior Dimensions:
  - a. Width: 70-3/8 inches.
  - b. Depth: 25 inches.
  - c. Height: 28 inches.
3. Performance: Cabinet shall provide airflows and Biosafety performance as specified
  - a. Cabinet shall provide biological containment protection for both operator and product proven by an actual test, conducted by NSF and routinely validated by manufacturer.
  - b. Cabinet: All welded, 16 gauge, Type 304 stainless steel, with No. 4 finish.
  - c. Cabinet shall be easily fumigated employing an established procedures such as that recommended by NSF.
  - d. Supply HEPA filter shall be of full cabinet work zone with and depth; work zone below supply HEPA shall be of fixed cross-sectional area.
  - e. Supply HEPA filter shall be protected by a perforated metal diffusers covering the entire top of the work zone.
  - f. Air Velocity from the supply filter shall average 55 to 65 fpm with no single point outside the 20 percent of average range measured in a horizontal plane within the work zone.
  - g. Work access opening shall be 12 inches high.
  - h. Average inflow velocity shall nominally be 105 lfpm
4. The cabinet shall be ergonomically designed for maximum user comfort and adjustability to meet the requirements of the American Disabilities Act.
  - a. Standard non-metallic armrest/airfoil incorporating large 2 inch forearm support area with 1/2 inch recessed front grill designed for armrest comfort while maintaining containment performance.
  - b. Maximum visibility into cabinet workzone shall be at least 23-7/8 inches from front access airfoil to exterior light housing.
  - c. Cabinet shall have a centrally located instrument panel within the control center that is easily serviced with quick disconnects.
  - d. Cabinet shall incorporate a user adjustable base stand.
  - e. The cabinet shall have a smooth operating sliding window from full closure to full opening at 20 inches.

- f. Cabinet shall have a large flat removable worktray (21-3/4 inch depth). Worktray may also be raised in place and held with hinged support rods
  - g. Cabinet shall have a 10 degree slope.
- 5. The cabinet shall have all positive pressure plenums surrounded by a vacuum relative to the room.
- 6. Electrical power shall be supplied with a 12-foot (2.5m), 3-wire cord with molded plug. Electrical supply should be 115 VAC, 60 Hz protected with thermal circuit breaker from distribution pane.
- 7. The cabinet shall use a DC ECM Motor with an optimally determined forward-curved fan for each model size/with to maximize both energy efficiency and filter loading capacity.
- 8. The cabinet shall have two internal electrical circuits; one for blower/lights and one for the duplex outlets. Each circuit shall be protected with a circuit breaker located in the Control Center.
- 9. The cabinet shall be listed by Underwriters Laboratories to meet the requirements of both the U.S. and Canada for electrical/mechanical integrity.
- 10. Cabinet shall contain control system consisting of electronic modules that will perform the following functions:
  - a. Easy user interface via LED's and function keys.
  - b. Control blower via solid state switch.
  - c. Control lights via solid state switch.
  - d. Control outlets via solid state switch.
  - e. Disable audible alarm switch with ring back function.
  - f. Control blower DC ECM motor with solid-state DC motor Controller that provides automatic compensation (constant volume control) for both filter loading and line voltage variances.
  - g. Monitor and display airflow system performance via monitor.
- 11. Cabinet shall contain control system that provides the following optional functional features:
  - a. Security password protection of cabinet use.
  - b. Night setback mode. Upon sliding window closure, blower will continue to operate at a lower rate to save energy and maintain interior clean air conditions ready for use upon sliding window opening .
  - c. Cabinet usage sync functions with blower, fluorescent light, outlets and accessory outlet.
  - d. Cabinet usage auto duration timers, fluorescent light, UV light and outlets.
- 12. Balancing of cabinet workzone downflow (recycling flow) to exhaust flow shall be accomplished with an internal exhaust flow damper, externally adjustable.
- 13. The cabinet shall be easily transportable through a standard 36-inch wide door without disassembly when in retracted position.
- 14. Sound level shall be no more than 67 dBA measured 15 inches above the work tray and 12 inches in front of viewing window.
- 15. Fluorescent Lighting shall be energy efficient LED (T8) internally mounted and provide 90 (968) to 120 (1291) foot-candles (LUX) on work surface.
- 16. Cabinet shall come standard with two outlets with a drip proof covers on back wall, and two service couplings (gas and vacuum) in location indicated on Drawings..
- 17. Integral auto-lift base stand shall be stainless steel construction with 5-inch (127mm) heavy-duty lockable castors.
- 18. Cabinet workzone shall be all 16/18 GA. stainless steel (silicone free) with integral prefilter in rear wall drawer design for easy removal and cleaning.
- 19. A 3/8-inch (10 mm) ball valve shall be provided in the drain trough beneath the work tray.
- 20. Cabinet shall have a permanent positive pressure plenum with quick release supply filter removal.
- 21. Motor/blower shall be positioned so as to create an even filter loading, thereby prolonging the life of HEPA filters, automatically handling a 250 percent minimum increase in filter loading without reducing total air delivery by more than 10 percent.

22. Cabinet shall be capable of front filter removal without disassembly of the control panel and sliding window tracks/hardware.

### PART 3 - EXECUTION

#### 3.1 SITE CONDITIONS

- A. Inspection: Prior to installation of laboratory equipment, carefully inspect the installed work specified in other Sections and verify that all such work is complete to the point where this installation may properly commence.
- B. Verify that all Work has been installed in complete accordance with the original design, received submittals, and the manufacturer's recommendations.
- C. Discrepancies: In the event of discrepancy, immediately notify the Architect. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

#### 3.2 INSTALLATION

- A. Work in this Section requires close coordination with Work specified in Division 22, 23 and Division 26, as well as installation by Owner of Owner furnished components. Coordinate all Work to ensure an orderly process in the Project, without removal of previously installed Work, and so as to prevent damage to finishes and products.
- B. Coordinate location and alignment of biological safety cabinets for proper connection of all piping and duct work.
- C. Install all equipment in accordance with applicable codes and regulations, accepted Shop Drawings, and as necessary for a complete operating system.

#### 3.3 QUALITY CONTROL

- A. Balance, test and certify each biological safety cabinet in accordance with Annex F Field Tests appended to National Sanitation Foundation (NSF) Standard 49 "Class II (Laminar Flow) Biohazard Cabinetry.
- B. Biological safety cabinet field tests shall be performed by an independent NSF-accredited testing company.
- C. Balancing of the building exhaust system is in the scope of work of Division 23.

#### 3.4 CLEANING

- A. Repair or remove and replace defective Work as directed by the Architect upon completion of installation.
- B. Adjust all moving or operating part to function within their design parameters.
- C. Clean equipment, touch up as required.

- D. Protect all units before, during, and after installation. Damaged materials due to improper protection shall be cause for rejection.

### 3.5 DEMONSTRATION AND TRAINING

- A. Engage services of factory-qualified instructor to instruct and train Owner's operating and maintenance personnel in operation, service, and maintenance of equipment.
- B. Test equipment prior to demonstration. Ensure equipment, including specified accessories, is operational.
- C. Provide demonstration of equipment operation and instruction of Owner's personnel.
- D. Demonstrate operating capability of equipment and systems. Include control and safety features, and service and maintenance procedures.

### 3.6 CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

- A. Manage construction waste in accordance with provisions of Section 01 74 19 "Construction Waste Management and Disposal."

**END OF SECTION 11 53 53**



## SECTION 22 30 00

### PLUMBING EQUIPMENT

#### PART 1 – GENERAL

##### 1.1 DESCRIPTION OF WORK:

- A. Extent of plumbing fixtures work required by this section is indicated on drawings, schedules and by specified requirements of this section.
- B. See Plumbing Fixture Schedule on drawings for types of fixtures specified.

##### 1.2 QUALITY ASSURANCE:

- A. Codes and Standards:
  - 1. International Plumbing Code.
  - 2. NSF Standard 61: "Drinking Water System Components."
  - 3. ASHRAE Standard 18: "Methods of Testing for Rating Drinking-Water Coolers with Self-Contained Mechanical Refrigeration."
  - 4. ARI Standard 1010: "Self Contained, Mechanically Refrigerated Drinking Water Coolers."
  - 5. UL Standard 399: "Drinking Water Coolers."
  - 6. Colorado Drinking Water Act – Current Addition.
  - 7. Colorado Department of Public Health and Environment Regulations.
  - 8. Colorado Cross-Connection Control Manual: "Fifth Edition."
  - 9. ANSI Standard A117.1: "Standard on Accessible and Usable Buildings and Facilities."
  - 10. Public Law 101-336: "The Americans with Disabilities Act."
  - 11. Public Law 102-486: "Energy Policy Act."
  - 12. Energy Conservation Act - 2001: "Energy Conservation Standards."
- B. Where fixtures are indicated on the architectural drawings and intended to be ADA compliant, it shall be the sole responsibility for all manufacturers and/or suppliers to provide plumbing fixtures and related trim which meets the ADA requirements. Such indication may be shown by note on floor plans or schedules, by clearance dimensions or areas on the plans or other graphics or notes on elevations.

##### 1.3 SUBMITTALS:

- A. Product Data: Submit product data and installation instructions for each fixture, faucet, specialty, accessory and trim specified or shown on plumbing fixture schedule; clearly indicate rated capacities of selected models.
- B. Shop Drawings: Submit rough-in drawings with brand names on each sheet and item. Detail dimensions, rough-in requirements, required clearances and methods of assembly of components and anchorages. Coordinate requirements with architectural casework shop drawings specified in Division 6 for fixtures installed in countertops and cabinets. Furnish templates for use in casework shop drawings.
- C. Wiring Diagrams: Submit manufacturer's electrical requirements and wiring diagrams for power supply to units. Clearly differentiate between portions of wiring that are factory installed and field installed. Coordinate and provide matrix of mechanical and electrical requirements as specified in Division 22.
- D. Color Charts: Coordinate fixture color with Architect and submit manufacturer's standard color charts for cabinet finishes and fixture colors.

- E. Maintenance Data: Submit maintenance data and spare parts lists for each type of manufactured plumbing fixture, valve and trim. In addition to providing in the submittals, include this data, product data and shop drawings with operations and maintenance manuals.
  - F. Submit certification of compliance with specified performance verification requirements and IPC, NSF, ANSI, UL and ASHRAE Standards.
- 1.4 DELIVERY, STORAGE AND HANDLING:
- A. Store fixtures where environmental conditions are uniformly maintained within the manufacturer's recommended temperatures to prevent damage.
  - B. Store fixtures and trim in the manufacturer's original shipping containers. Do not stack containers or store in such a manner that may cause damage to the fixture or trim. Keep covered and protected at all times.
- 1.5 SEQUENCING AND SCHEDULING:
- A. Schedule rough-in installations with the installation of other building components. Provide access as required or as shown in the manufacturer's guidelines.
- 1.6 MAINTENANCE:
- A. Extra Stock:
    - 1. Furnish special wrenches and other devices necessary for servicing plumbing fixtures and trim to Owner with receipt in a quantity of one device for each 10 fixtures, minimum of one wrench and one device.
    - 2. For each type of faucet, furnish faucet repair kits complete with all necessary washers, springs, pins, retainers, packings, O-rings, sleeves, cartridges and seats in a quantity of 1 kit for each 20 faucets, minimum one repair kit per faucet type.

## PART 2 – PRODUCTS

- 2.1 MANUFACTURERS:
- A. Manufacturer subject to compliance with requirements, provide products by one of the following specified manufacturers:
    - 1. Stainless Steel Sinks:
      - a. Elkay
      - b. Just
      - c. Moen, Div. of Stanadyne
      - d. Eljer
    - 2. Fixture Carriers and Supports:
      - a. J.R. Smith
      - b. Zurn
    - 3. Faucets:

- a. Chicago Faucets (Preferred)
    - b. American Standard
    - c. Zurn
  - 4. Auto Faucets:
    - a. Sloan Valve Co. (Preferred)
    - b. Zurn
  - 5. Emergency Fixtures:
    - a. Bradley
    - b. Haws
    - c. Guardian
  - 6. Fixture Supplies, Stops & Traps:
    - a. McGuire
    - b. Brasscraft
  - 7. Under Lavatory/Sink Protective Pipe Covers:
    - a. McGuire
    - b. True Bro
    - c. Watts Regulator Co.
    - d. Apollo
    - e. Wilkins
- 2.2 FIXTURES:
- A. Stainless Steel Sinks
    - 1. Material: Type 304, 18-gauge stainless steel.
    - 2. Fixture Color: No. 4 satin finish for stainless steel. Composites only as specified.
    - 3. Mounting: Wall mounted and carrier mounted sinks shall be installed per manufacturer recommendations and instructions.
    - 4. Faucet hole drillings shall match the faucet configuration and accessories specified in the mechanical and architectural documents, i.e. dishwasher air gaps, liquid dispensers, remote drain operators, eye washes, etc. when mounted in the sink back ledge. Note: Faucet hole covers will not be acceptable. Contractor to coordinate prior to ordering sinks.
    - 5. Stainless steel sinks to be sound deadened with undercoating.
- 2.3 FIXTURE SUPPORTS AND CARRIERS:
- A. Lavatory Supports: Commercial grade cast iron supports, having tubular steel uprights with concealed arms and sleeves, mounted on adjustable headers and complete with heavy cast iron short feet bolted to floor, alignment trusses and mounting fasteners.
  - B. Clinical Service Sink Supports: Commercial grade adjustable, factory painted, cast iron face plate, support base and appropriate type waste fitting having face plate gasket; zinc plated steel fixture studs and fasteners; coated and threaded adjustable wall coupling with neoprene closet outlet gasket; and chrome plated fixture cap nuts and fiber fixture washers. Units shall have type of sanitary piping system to which it is connected. Provide minimum 500 lb. load rated carrier for all wall hung service sinks. Structural carriers shall not be used.

2.4 FAUCETS:

A. Sink Trim

1. All sink faucets shall be provided with 1/4-turn handles, laminar flow controls in lieu of aerators.
2. All sink faucets shall be provided with ceramic disc cartridges.
3. Alternate faucet controls, i.e. self-closing, knee operated, foot operated, etc. shall be provided complete with all necessary anchoring and mounting devices recommended and supplied by the device manufacturer.
4. All sink faucets shall be chrome plated brass complying with restrictions for lead content for the requirements of the jurisdiction or district. Types include hand, foot, knee, infra-red or heat sensing type operations.
5. Infrared faucets must be provided with integral stops.

B. Clinical Service Sink Trim

1. All service sink faucets shall be provided with 1/4-turn handles.
2. All service sink faucets shall be provided with ceramic disc cartridges.
3. Alternate faucet controls, i.e. foot operated, etc. shall be provided complete with all necessary anchoring and mounting devices recommended and supplied by the device manufacturer.
4. All service sink faucets shall be chrome plated brass complying with restrictions for lead content for the requirements of the jurisdiction or district. Types include foot type operations.

2.5 EMERGENCY FIXTURES:

A. Emergency Showers

1. Description: 10" Deluge shower head with overhead supply and internal 20 gpm regulator for flow control.
2. Finish: Chrome finish
3. Valve: 1" brass stay-open valve with chrome finish and aluminum triangular pull rod.
4. Performance: Capable of 20 gpm @ 20 psi.
5. Emergency showers shall be served by a thermostatic mixing valve that meets ANSI Z358.1 requirements.

B. Emergency Eyewashes

1. Description: Wall mounted, Vitreous china or stainless steel receptor with mounting bracket, twin chrome plated heads angled to direct water flow into eyes and ocular face area. Two aerated spray outlets with flip-top dust caps.
2. Valve: 1/2" brass stay-open valve with chrome finish and stainless steel push handle.
3. Performance: Capable of 3.6 gpm @ 30 psi
4. Emergency eyewash shall be served by a thermostatic mixing valve that meets ANSI Z358.1 requirements.

C. Combination Emergency Shower and Eye Wash: Floor mounted, free standing, all chrome plated brass construction with 10 inch diameter deluge shower head and eye wash bowl. Shower shall have rigid pull rod to actuate instant-action stay open ball valve. Eye wash shall have twin antisquirt heads angled to direct water flow into eyes and ocular face area with flag push-type ball valve actuator, valve to stay open until manually closed. Water delivered by the Emergency Shower and Eye Wash shall be tepid (lukewarm). Installation shall meet or exceed the provisions of ANSI Z358.1(latest version).

2.6 FITTINGS, TRIM, AND ACCESSORIES:

- A. Stops and Supplies for Lavatories and Sinks: Polished, chrome-plated, brass ball and stem, loose key, ¼-turn angle stop having ½" inlet and 3/8" O.D. x 12" long chrome plated copper supply riser or braided stainless steel flexible tubing; outlet with collar, wall flange and escutcheon. Quantity to match trim specified. Deliver all handles to Owner.

Hot water supply shall always be located on the left side of fixture and the cold supply shall always be located on the right side of fixture.

- B. Sink Strainers: All sink strainers shall be "Spin-N-Grin" type models unless specifically specified otherwise.
- C. Traps for Lavatories, Electric Water Coolers and Drinking Fountains: 17-gauge, 1-1/4" chrome-plated tubular brass, 1-1/4" adjustable "P" trap and waste to wall with escutcheon.
- D. Traps for Sinks: 17-gauge, chrome-plated tubular brass, 1-1/2" or 2" adjustable "P" trap and waste to wall with escutcheon.
- E. Escutcheons: Chrome-plated cast brass, one piece with set screw.
- F. All ADA accessible lavatories and sinks shall have the supply and waste piping insulated with under lavatory/sink ADA covers.

2.7 UNDER LAVATORY/SINK PROTECTIVE PIPE COVERS:

- A. ADA Accessible Lavatories and Sinks: Provide white, molded antimicrobial vinyl cover for stops, supplies, trap and tailpiece.

PART 3 – EXECUTION

3.1 EXAMINATION:

- A. Verify all dimensions by field measurements. Verify that all plumbing fixtures may be installed in accordance with codes & regulations, the intended design and the referenced standards.
- B. Examine rough-in for potable water and waste piping systems to verify actual locations of piping connections prior to installing fixtures.
- C. Examine walls, floors and cabinets for suitable conditions where fixtures are to be installed.
- D. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION:

- A. Install plumbing fixtures level and plumb in accordance with fixture manufacturer's written instructions, rough-in drawings, codes & regulations, the intended design and the referenced standards. All exposed piping serving plumbing fixtures that may be used for ADA purposes shall have traps and supplies insulated per ADA requirements.
- B. All wall hung fixtures shall be supported from the building structure with floor mounted carriers. Do not support from walls.

- C. Securely fasten the fixture carrier or support to the building structure using ½" all-thread rods and bolts. Fasten plumbing fixtures securely to supports or building structure as specified. Secure supplies within wall and cabinet construction to provide rigid installation.
  - D. Install fixture water stop valves in accessible locations. Hot water supply shall always be located on the left side of fixture and the cold supply shall always be located on the right side of the fixture.
  - E. Provide cleanouts as shown on drawings or per the applicable Plumbing Code.
  - F. Install escutcheons at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork. Seal pipe penetration prior to installing. Use correct size of escutcheon to cover entire opening.
  - G. Seal fixtures to walls and floors using non-hardening silicone sealant with coved finish as specified in Division 7. Match sealant color to fixture color, except for stainless steel sinks.
  - H. Chrome plated cap nuts for wall hung fixtures shall be installed with strap wrench to prevent marring.
  - I. Fixtures shall be product of one manufacturer and must be manufactured in the USA per Division 22.
  - J. Install hose end faucets and hose connection with field backflow preventers to meet Colorado Cross Connection Control Manual regulations and current jurisdictional codes.
  - K. Solidly attach floor mounted water closets to floor flanges.
  - L. Provide a tempering valve that conforms to ASSE 1070 for all lavatories and sinks used as a public hand wash facility.
- 3.3 EQUIPMENT CONNECTIONS:
- A. Piping Runouts to Fixtures: Provide hot and cold water piping runouts to fixtures of sizes indicated, but in no case smaller than required by Plumbing Code.
- 3.4 PIPING INSTALLATION:
- A. Refer to Division 23 for materials and methods for installation of piping.
- 3.5 HANGERS AND SUPPORTS:
- A. Refer to Division 23 for installation of supports and anchors.
- 3.6 PIPE AND TUBE JOINT CONSTRUCTION:
- A. Refer to Division 22 and 23 for materials and methods for pipe joints.
- 3.7 VALVE APPLICATIONS:
- A. General Duty Valve Applications: The drawings indicate valve types to be used. Where specific valve types are not indicated the following requirements apply:
    - 1. Shut-off duty: Use gate, ball and butterfly valves.
    - 2. Throttling duty: Use globe, ball and butterfly valves.
- 3.8 INSTALLATION OF VALVES:

- A. Sectional Valves: Install sectional valves on each branch and riser, close to main, where branch or riser serves 2 or more plumbing fixtures or equipment connections, and elsewhere as indicated. For sectional valves 2" and smaller, use gate or ball valves; for sectional valves 2-1/2" and larger, use gate or butterfly valves.
- B. Shutoff Valves: Install shutoff valves on inlet of each plumbing equipment item, on inlet of each plumbing fixture and elsewhere as indicated. For shutoff valves 2" and smaller, use ball valves; for shutoff valves 2-1/2" and larger, use gate or butterfly valves.

3.9 ADA ACCESSIBILITY:

- A. Review Mechanical and Architectural drawings to determine fixtures requiring ADA accessibility. Notify Architect/Engineer of any physical conflicts preventing full dimensional compliance prior to beginning work.
- B. Comply with the installation requirements of ANSI A117.1-1998 and Public Law 90-480-1968 with respect to plumbing fixtures for the physically handicapped. Arrange flush valve/flush tank handles with proper orientation to meet ADA requirements.

3.10 FIELD QUALITY CONTROL:

- A. Test fixtures to demonstrate proper operation upon completion of installation and after units are water pressurized. Replace malfunctioning units, then retest.
- B. Inspect each installed unit for damage. Replace damaged fixtures.
- C. Inspections: Inspect water distribution piping as follows:
  - 1. Do not enclose, cover, or put into operation water distribution piping system until it has been inspected and approved by the authority having jurisdiction.
  - 2. During the progress of the installation, notify the Local Authority Having Jurisdiction, at least 48 hours prior to the time such inspection must be made. Perform tests specified below in the presence of the plumbing official.
    - a. Rough-in Inspection: Arrange for inspection of the piping system after the system is roughed-in but before concealing or closing in piping and prior to setting fixtures.
    - b. Final Inspection: Arrange for a final inspection by the plumbing official to observe the tests specified below and to ensure compliance with the requirements of the plumbing code.
  - 3. Reinspections: Whenever the plumbing official finds that the piping system will not pass the test or inspection, make the required corrections and arrange for reinspection by the plumbing official.
  - 4. Reports: Prepare inspection reports, signed by the plumbing official.
- D. Test water distribution piping as follows:
- E. Refer to Division 23 for materials and methods for performing pipe tests.

3.11 ADJUSTING:

- A. Adjust water pressure at drinking fountains, faucets and shower valves to provide proper flow and stream. Contractor shall adjust flush valve to proper flow rate for appropriate wash and flush water volume to match the intended flush action for the installed units.

- B. Replace leaking or dripping faucets and stops.
- C. Provide copies of State backflow preventer certification tests.

3.12 CLEANING:

- A. Clean fixtures, trim and strainers using manufacturer's recommended cleaning methods and materials prior to final turnover to Owner.
- B. Clean and disinfect water distribution piping as follows:
  - 1. Purge all new water distribution piping systems and parts of existing systems, which have been altered, extended or repaired prior to use.
  - 2. Use the purging and disinfecting procedure prescribed by the authority having jurisdiction, or in case a method is not prescribed by that authority, the procedure described in either AWWA C651, AWWA C652 or as described below:
    - a. Flush the piping system with clean, potable water until dirty water does not appear at the points of outlet.
    - b. Fill the system or part thereof, with a water/chlorine solution containing at least 50 parts per million of chlorine. Isolate (valve off) the system, or part thereof, and allow to stand for 24 hours.
    - c. Drain the system, or part thereof, of the previous solution, and refill with a water/chlorine solution containing at least 200 parts per million of chlorine and isolate and allow to stand for 3 hours.
    - d. Following the allowed standing time, flush the system with clean potable water until chlorine does not remain in the water coming from the system.
    - e. Submit water samples in sterile bottles to the authority having jurisdiction. Repeat the procedure if the biological examination made by the authority shows evidence of contamination.
- C. Prepare reports for all purging and disinfecting activities.

3.13 PROTECTION:

- A. Provide protective covering for installed fixtures and trim as required by this section.
- B. Do not allow use of fixtures for temporary facilities unless expressly approved in writing by the Owner.

3.14 FIXTURE MOUNTING HEIGHT SCHEDULE:

- A. Fixture mounting height and rough-in dimensions shall be per ADA requirements or as indicated on the architectural drawings and specifications.

3.15 WATER CONSERVATION:

- A. All plumbing fixtures shall be of water conservation design per the Water Conservation Act of 2004. As a minimum, provide devices to restrict water flow as follows unless scheduled otherwise:
  - 1. Lavatory .35 gpm maximum
  - 2. Sink 1.0 gpm maximum
  - 3. Water Closets (siphon jet) 1.28 gpf maximum



- |    |                            |                     |
|----|----------------------------|---------------------|
| 4. | Water Closets (dual flush) | 1.1/1.6 gpf maximum |
| 5. | Urinals (siphon jet)       | 0.125 gpf maximum   |
| 6. | Shower Heads               | 0.625 gpm maximum   |

**END OF SECTION**

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## SECTION 23 00 00

### PLUMBING, HEATING, VENTILATING AND AIR CONDITIONING (HVAC)

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS AND REFERENCES:

- A. All drawings associated with the entire project, including general provisions of the Contract, including The General Conditions of the Contract for Construction, General and Supplementary Conditions and Division-1 Conditions specification sections shall apply to the Division 23 specifications and drawings. The Contractor shall be responsible for reviewing and becoming familiar with the aforementioned and all other Contract Documents associated with the project.
- B. Related Sections: Refer to all sections in Division 23. Refer to Division 26 specification sections and Division 26 drawings.
- C. Where contradictions occur between this section and Division 1, the more stringent requirement shall apply.
- D. Contractor shall be defined as any and all entities involved with the construction of the project.
- E. Project Planning and Design Guidelines and Standards, Manual Part 3.

##### 1.2 SUMMARY:

- A. This Section specifies the basic requirements for mechanical installations and includes requirements common to more than one section of Division 23. It expands and supplements the requirements specified in Division 1.

##### 1.3 MECHANICAL INSTALLATIONS:

- A. The Contract Documents are diagrammatic, showing certain physical relationships which must be established within the mechanical work and its interface with all other work. Such establishment is the exclusive responsibility of the Contractor. Drawings shall not be scaled for the purpose of establishing material quantities.
- B. Drawings and specifications are complementary. Whatever is called for in either is binding as though called for in both. Report any discrepancies to the Engineer and obtain written instructions before proceeding. Where any contradictions occur between the specifications and the drawings the more stringent requirement shall apply. The contractor shall include pricing for the more stringent and expensive requirements.
- C. Drawings shall not be scaled for rough-in measurements or used as shop drawings. Where drawings are required for these purposes or have to be made from field measurement, Contractor shall take the necessary measurements and prepare the drawings.
- D. The exact location for some items in this specification may not be shown on the drawings. The location of such items may be established by the Engineer during the progress of the work.
- E. The contract documents indicate required size and points of terminations of pipes, and suggest proper routes to conform to structure, avoid obstructions and preserve clearances. It is not intended that drawings indicate necessary offsets. The contractor shall make the installation in such a manner as to conform to the structure, avoid obstructions, preserve headroom and keep openings and passageways

clear, without further instructions or costs to the Owner. All equipment shall be installed so access is maintained for serviceability.

- F. Before any work is installed, determine that equipment will properly fit the space; that required piping grades can be maintained and that ductwork can be run as intended without interferences between systems, structural elements or work of other trades.
- G. Verify all dimensions by field measurements.
- H. Coordinate installation in chases, slots and openings with all other building components to allow for proper mechanical installations.
- I. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing-in the building.
- J. Where mounting heights are not detailed or dimensioned, install mechanical services and overhead equipment to provide the maximum headroom possible.
- K. Install mechanical equipment to facilitate maintenance and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
- L. Make allowance for expansion and contraction for all building components and piping systems that are subject to such.
- M. The ceiling space shall not be "layered". It is the contractor's responsibility to offset and coordinate the system as required to allow installation within the identified ceiling cavity. The contractor shall include labor and material in the base bid to accommodate such offsets.
- N. In general, all "static" piping systems shall be routed as high as possible, i.e. fire protection systems. Keep all equipment in accessible areas such as corridors and coordinate with systems and equipment from other sections.
- O. The Contractor shall provide all labor and material necessary but not limited to the starting/stopping of all mechanical equipment, opening/closing of all valves, draining/refilling all mechanical systems and operating/verifying the operation of all mechanical systems controls as required to accomplish all work necessary to meet construction document requirements. Contractor shall submit records of such activities to engineer and include in the O & M manuals.

#### 1.4 COORDINATION:

- A. Work out all installation conditions in advance of installation. The Contractor shall be responsible for preparing coordination drawings, showing all work, in all areas. The Contractor shall be responsible for providing all labor and material, including but not limited to all fittings, isolation valves, offsets, hangers, control devices, etc., necessary to overcome congested conditions at no increase in contract sum. The Contractor's base bid shall include any and all time and manpower necessary to develop such coordination efforts and drawings. Increases to contract sum or schedule shall not be considered for such effort.
- B. Provide proper documentation of equipment, product data and shop drawings to all entities involved in the project. Coordination shall include, but not be limited to the following:
  - 1. Fire Protection and Fire Alarm Contractor shall provide shop drawings to all other Division 23 Contractors.

2. Automatic Temperature Controls, Building Management and Testing, Adjusting and Balancing Contractors shall be provided with equipment product data and shop drawings from other Division 23 and Division 26 Contractors and shall furnish the same information involving control devices to the appropriate Division 23 Contractor.

C. Existing Conditions:

1. Carefully survey existing conditions prior to bidding work. In addition, Contractor shall complete a thorough ceiling cavity survey.
2. Provide proper coordination of mechanical work with existing conditions.
3. Report any issues or conflicts immediately to Engineer before commencing with work and prior to purchasing equipment and materials.

1.5 COORDINATION WITH OTHER DIVISIONS:

A. General:

1. Coordinate all work to conform with the progress of the work of other trades.
2. Complete the entire installation as soon as the condition of the building will permit. No extras will be allowed for corrections of ill timed work, when such corrections are required for proper installation of other work.

B. Coordinate ceiling cavity space carefully with all trades. In the event of conflict, install mechanical and electrical systems within the cavity space allocation in the following order of priority:

1. Equipment and required clearances
2. Plumbing waste, cooling coil drain piping and roof drain mains and leaders.
3. Cable Trays
4. Ductwork mains
5. Fire sprinkler mains
6. Plumbing vent piping
7. Domestic hot and cold water, med gas/lab gas systems
8. Branch piping and drops (locate as tight to structure as possible)
9. Low pressure ductwork and air devices.
10. Electrical and communication conduits, raceways and cabletray.
11. Hydronic piping
12. DDC control wiring and other low voltage systems.
13. Fire alarm systems.

C. Chases, Inserts and Openings:

1. Provide measurements, drawings and layouts so that openings, inserts and chases in new construction can be built in as construction progresses.
2. Check sizes and locations of openings provided. Including the access panels for equipment in hard lid ceilings and wall cavities.
3. Any cutting and patching made necessary by failure to provide measurements, drawings and layouts at the proper time shall be done at no additional cost in contract sum.

D. Support Dimensions: Provide dimensions and drawings so that concrete basis and other equipment supports to be provided under other sections of the specifications can be built at the proper time.

E. Coordinate the installation of required supporting devices and sleeves to be set in poured in place concrete and other structural components, as they are constructed.

- F. Coordinate the cutting and patching of building components to accommodate the installation of mechanical equipment and materials. Refer to Division 1 and Division 23.
- G. Modifications required as result of failure to resolve interferences, provide correct coordination drawings or call attentions to changes required in other work as result of modifications shall be paid for by responsible Contractor/Subcontractor.
- H. Coordination with Electrical Work: Refer to Division 1 and 26.

1.6 DESIGN WORK REQUIRED BY CONTRACTOR:

- A. The construction of this project requires the Contractor to include the detailing and design of several systems and/or subsystems. All such design work associated with the development of the coordination drawings shall be the complete responsibility of the Contractor.
- B. The Contractor shall take the full responsibility to develop and complete routing strategies which will allow fully coordinated system to be installed in a fully functional manner. The Engineers contract drawings shall be for system design intent and general configurations.
- C. Systems or subsystems which require design responsibility by the contractor include but are not limited to:
  - 1. Final coordinated distribution of duct, hydronic, plumbing and other systems within the ceiling cavity.
  - 2. Fire protection systems
  - 3. Equipment supports, hangers, anchors and seismic systems not fully detailed nor specified in these documents, or catalogued by the manufacturer.
  - 4. Temperature controls systems
- D. Design Limitations:
  - 1. The Contractor shall not modify the Engineers design intent in any way.
  - 2. The Contractor shall not change any pipe size or equipment size without prior written approval from the Engineer.
  - 3. The Contractor shall conform to the SMACNA Duct Construction Standards when modifying the ductwork layout to avoid collisions.
  - 4. Back to back 90° fittings on duct system shall not be installed under any circumstance.
  - 5. Bull nosed tees on piping systems shall not be installed under any circumstance.

1.7 PROJECT CONDITIONS:

- A. The Contractor shall be required to attend a mandatory pre-bid walk-thru and shall make themselves familiar with the existing conditions. No additional costs to the Owner shall be accepted for additional work for existing conditions.
- B. Field verify all conditions prior to submitting bids.
- C. Report any damaged equipment or systems to the Owner prior to any work.
- D. Protect all mechanical and electrical work against theft, injury or damage from all causes until it has been tested and accepted.
- E. Be responsible for all damage to the property of the Owner or to the work of other contractors during the construction and guarantee period. Repair or replace any part of the work which may show defect during one year from the final acceptance of all work, provided such defect is, in the opinion of the

Architect, due to imperfect material or workmanship and not due to the Owner's carelessness or improper use.

- F. The Contractor shall coordinate and co-operate with Owner at all times for all new to existing connections, system shutdowns and start-ups, flushing and filling both new and existing systems.
  - G. Provide temporary ductwork and piping services, where required, to maintain existing areas operable.
  - H. Coordinate all services shut-down with the Owner; provide temporary services. Coordinate any required disruptions with Owner, one week in advance.
  - I. Minimize disruptions to operation of mechanical systems in occupied areas.
- 1.8 SAFETY:
- A. Refer to Division 1.
- 1.9 EQUAL EMPLOYMENT OPPORTUNITY REQUIREMENTS:
- A. Refer to Division 1 and conform with the Owners requirements.
- 1.10 REQUIREMENTS OF REGULATORY AGENCIES:
- A. Refer to Division 1.
  - B. Execute and inspect all work in accordance with all Underwriters, local and state codes, rules and regulations applicable to the trade affected as a minimum, but if the plans and/or specifications call for requirements that exceed these rules and regulations, the greater requirement shall be followed. Follow recommendations of NFPA, SMACNA, EPA, OSHA and ASHRAE.
  - C. Comply with standards in effect at the date of these Contract Documents, except where a standard or specific date or edition is indicated.
  - D. The handling, removal and disposal of regulated refrigerants shall be in accordance with U.S. EPA, state and local regulations.
  - E. The handling, removal and disposal of lead based paint and other lead containing materials shall comply with EPA, OSHA, and any other Federal, State, or local regulations.
  - F. After entering into contract, Contractor will be held to complete all work necessary to meet these requirements without additional expense to the Owner.
- 1.11 PERMITS AND FEES:
- A. Refer to Division 1.
  - B. The Contractor shall pay all tap, development, meter, etc., fees required for connection to municipal and public utility facilities, unless directed otherwise by the General Contractor/Owner – IN WRITING.
  - C. Contractor shall arrange for and pay for all inspections, licenses and certificates required in connection with the work.
  - D. Refer to the Instructions to Bidders and Division 1.

- E. Materials and equipment of equivalent quality may be submitted for substituted prior to bidding. This may be done by submitting to the Architect/Engineer at least ten (10) working days prior to the bid date a letter in triplicate requesting prior review. This submittal shall include all data necessary for complete evaluation of the product.
  - 1. Substitutions shall be allowed only upon the written approval of the Architect/Engineer NO EXCEPTIONS.
  - 2. The Contractor shall be responsible for removal, replacement and remedy of any system or equipment which has been installed which does not meet the specifications or which does not have prior approval.

1.12 MECHANICAL SUBMITTALS:

A. General

- 1. Refer to the Conditions of the Contract (General and Supplementary), Division 1.
  - 2. The submittals shall be submitted as one package identified by the specification section. Submittals that are not complete with the required information will be sent back to be corrected.
  - 3. The Contractor shall identify any "long lead time" items which may impact the overall project schedule. If these submittal requirements affect the schedule, the Contractor shall identify the impacts and confer with the Engineer within two weeks of entering into the contract.
  - 4. At least one copy of the first submittal package shall be provided in expandable, 3 post, hard back binders, sized to fit all future submittals for this job. The cover shall be identified with the job name, Owner's project number, date, Prime Contractor's name, etc.
  - 5. Submittals may be provided electronically. All electronic submittals need to be complete with all design information and stamped for conformity by the contractor. Any submittal not stamped or complete will be sent back. Submittals that are submitted electronically will be reviewed, marked appropriately and returned by the same means received.
  - 6. An index shall be provided which includes:
    - a. Product
    - b. Plan Code (if applicable)
    - c. Specification Section
    - d. Manufacturer and Model Number
  - 7. Fire protection and coordination drawings do not apply to the above. These drawings may be submitted in a separate submittal.
- B. The manufacturer's material or equipment listed in the schedule or identified by name on the drawings are the types to be provided for the establishment of size, capacity, grade and quality. If alternates are used in lieu of the scheduled names, the cost of any changes in construction required by their use shall be borne by Contractor.
- C. All equipment shall conform to the State and/or local Energy Conservation Standards.
- D. Submittal of shop drawings, product data and samples will be accepted only when submitted by and stamped by the General Contractor. Data submitted from Subcontractors and material suppliers directly to the Engineer will not be processed unless prior written approval is obtained by the General Contractor.
- E. Before starting work, prepare and submit to the Architect/Engineer shop drawings and descriptive equipment data required for the project. Unless each item is identified with specification section and sufficient data to identify its compliance with the specifications and drawings, the item will be returned "Revise and Resubmit". Where an entire submittal package is returned for action by the Contractor, the Engineer will summarize comments in letter format and return the entire set. Continue to submit six (6)



sets of any individual shop drawings, product data or samples which were returned without a "make corrections noted" or "no exceptions taken" action, until they are so marked. When a "Make Corrections Noted" is received, make the required corrections for inclusion in the operation and maintenance manual. Submittals marked "Make Corrections Noted" shall not be resubmitted during the submittal process.

- F. The Design Professional's review and appropriate action on all submittals and shop drawings is only for the limited purpose of checking for conformance with the design concept and the information expressed in the contract documents. This review shall not include:
  - 1. Accuracy or completeness of details, such as quantities, dimensions, weights or gauges, fabrication processes
  - 2. Construction means or methods
  - 3. Coordination of the work with other trades
  - 4. Construction safety precautions
- G. The Design Professional's review shall be conducted with reasonable promptness while allowing sufficient time in the Design Professional's judgment to permit adequate review. Review of a specific item shall not indicate that the Design Professional has reviewed the entire assembly of which the item is a component.
- H. The Design Professional shall not be responsible for any deviations from the contract documents not brought specifically to the attention of the Design Professional in writing by the Contractor. This shall clearly identify the design and the specific element which vary from the Design. The Contractor shall be responsible for all remedy for lack of strict conformance associated with this criteria.
- I. The Design Professional shall not be required to review partial submissions or those for which submissions of correlated items have not been received.

#### 1.13 SPECIFIC CATEGORY SUBMITTAL REQUIREMENTS:

##### A. Product Data:

- 1. Where pre-printed data covers more than one distinct product, size, type, material, trim, accessory group or other variation, mark submitted copy with black pen to indicate which of the variations is to be provided.
- 2. Delete or mark-out portions of pre-printed data which are not applicable.
- 3. Where operating ranges are shown, mark data to show portion of range required for project application.
- 4. For each product, include the following:
  - a. Sizes.
  - b. Weights.
  - c. Speeds.
  - d. Capacities.
  - e. Piping and electrical connection sizes and locations.
  - f. Statements of compliance with the required standards and regulations.
  - g. Performance data.
  - h. Manufacturer's specifications.

##### B. Shop Drawings:

1. Shop Drawings are defined as mechanical system layout drawings prepared specifically for this project, or fabrication and assembly type drawings of system components to show more detail than typical pre-printed materials.
  2. Prepare Mechanical Shop Drawings, except diagrams, to accurate scale, min 1/8"-1'-0", unless otherwise noted.
    - a. Show clearance dimensions at critical locations.
    - b. Show dimensions of spaces required for operation and maintenance.
    - c. Show interfaces with other work, including structural support.
- C. Test Reports:
1. Submit test reports which have been signed and dated by the accredited firm or testing agency performing the test.
  2. Prepare test reports in the manner specified in the standard or regulation governing the test procedure (if any) as indicated.
  3. Submit test reports as required for O & M manuals.
- D. Product Listing:
1. Prepare listing of major mechanical equipment and materials for the project, within (2) two weeks of signing the Contract Documents and transmit to the Architect. A sample schedule is included at the end of this section to complete this requirement.
    - a. Provide all information requested.
    - b. Submit this listing as a part of the submittal requirement specified in Division 1, "PRODUCTS AND SUBSTITUTION."
  2. Unless otherwise specified, all materials and equipment shall be of domestic (USA) manufacture and shall be of the best quality used for the purpose in commercial practice.
  3. When two or more items of same material or equipment are required (plumbing fixtures, pumps, valves, air conditioning units, etc.) they shall be of the same manufacturer. Product manufacturer uniformity does not apply to raw materials, bulk materials, pipe, tube, fittings (except flanged and grooved types), sheet metal, wire, steel bar stock, welding rods, solder, fasteners, motors for dissimilar equipment units and similar items used in work, except as otherwise indicated.
    - a. Provide products which are compatible within systems and other connected items.
- E. Required Submittals: Provide submittals for each item of equipment specified or scheduled in the contract documents. See table at the end of this section.
- F. If more than two submittals (either for product data, shop drawings, record drawings, or test and balance reports) are made by the Contractor, the Owner reserves the right to charge the Contractor for subsequent reviews by their consultants. Such extra fees shall be deducted from payments by the Owner to the Contractor.
- 1.14 DELIVERY, STORAGE, AND HANDLING:
- A. Refer to Division 1.
  - B. Deliver products to project properly identified with names, model numbers, types, grades, compliance labels and similar information needed for distinct identifications; adequately packaged and protected to prevent damage or contamination during shipment, storage, and handling.

- C. Check delivered equipment against contract documents and submittals.
- D. Store equipment and materials at the site, unless off-site storage is authorized in writing. Protect stored equipment and materials from damage, dirt, dust, freezing, heat and moisture.
- E. Coordinate deliveries of mechanical materials and equipment to minimize construction site congestion. Limit each shipment of materials and equipment to the items and quantities needed for the smooth and efficient flow of installations.
- F. Provide factory-applied plastic end-caps on each length of pipe and tube, except for concrete, corrugated metal, hub-and-spigot, clay pipe. Maintain end-caps through shipping, storage and handling to prevent pipe-end damage and prevent entrance of dirt, debris and moisture.
- G. Protect stored ductwork, pipes and tubes. Elevate above grade and enclose with durable, waterproof wrapping. When stored inside, do not exceed structural capacity of the floor.
- H. Protect flanges, fittings and specialties from moisture and dirt by inside storage and enclosure, or be packaging with durable, waterproof wrapping.
- I. Protect sheet metal ductwork and fittings. Elevate and store above grade and cover ends with waterproof wrapping.

1.15 DEMOLITION:

- A. Refer to Division 1. The following paragraphs supplement the requirements of Division 1.
- B. During the demolition phase of this contract it is the responsibility of this Contractor to carefully remove existing equipment, piping or ductwork and related items either as shown on the demolition drawings as being removed, or as required for the work. These items shall be tagged, protected from damage and stored as directed by the Architect. A list of all items stored shall be turned over to the Architect. At the completion of the remodeling work or when directed by the Architect, all stored items not reused or wanted by the Owner shall be removed from the premises. Disposition of items not reused is by the direction of the Project Manager.
- C. The location of existing equipment, pipes, ductwork, etc., shown on the drawings has been taken from existing drawings and is, therefore, only as accurate as that information. All existing conditions shall be verified from field measurements with necessary adjustment being made to the drawing information.

1.16 CUTTING AND PATCHING:

- A. This Article specifies the cutting and patching of mechanical equipment, components and materials to include removal and legal disposal of selected materials, components and equipment.
- B. Refer to Division 1.
- C. Do not endanger or damage installed work through procedures and processes of cutting and patching.
- D. Arrange for repairs required to restore other work, because of damage caused as a result of mechanical installations.
- E. No additional compensation will be authorized for cutting and patching work that is necessitated by ill-timed, defective or non-conforming installations.
- F. Perform cutting, fitting and patching of mechanical equipment and materials required to:

1. Uncover work to provide for installation of ill-timed work;
  2. Remove and replace defective work;
  3. Remove and replace work not conforming to requirements of the Contract Documents;
  4. Remove samples of installed work as specified for testing;
  5. Install equipment and materials in existing structures;
  6. Upon written instructions from the Architect, uncover and restore work to provide for Architect observation of concealed work.
- G. Cut, remove and legally dispose of selected mechanical equipment, components, and materials as indicated, including, but not limited to removal of mechanical piping, heating units, plumbing fixtures and trim and other mechanical items made obsolete by the new work.
- H. Protect the structure, furnishings, finishes and adjacent materials not indicated or scheduled to be removed.
- I. Locate, identify, and protect mechanical and electrical services passing through remodeling or demolition area and serving other areas required to be maintained operational. When services must be interrupted, provide temporary services for the affected areas and notify the Owner prior to changeover. Cover openings in ductwork to remain. Protect equipment and systems to remain.
- 1.17 ROUGH-IN:
- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
  - B. Refer to equipment shop drawings and manufacturer's requirements for actual provided equipment for rough-in requirements.
  - C. Work through all coordination before rough-in begins.
- 1.18 ACCESSIBILITY:
- A. Install equipment and materials to provide required access for servicing and maintenance. Coordinate the final location of concealed equipment and devices requiring access with final location of required access panels and doors. Allow ample space for removal of all parts that require replacement or servicing.
  - B. Extend all grease fittings to an accessible location.
  - C. Furnish hinged steel access doors with concealed latch, whether shown on drawings or not, in all walls and ceilings for access to all concealed valves, shock absorbers, air vents, motors, fans, balancing cocks, and other operating devices requiring adjustment or servicing. Refer to Division 1 for access door specification and Division 23 for duct access door requirements.
  - D. The minimum size of any access door shall not be less than the size of the equipment to be removed or 12 inches x 12 inches if used for service only.
  - E. Furnish doors to trades performing work in which they are to be built, in ample time for building-in as the work progresses. Whenever possible, group valves, cocks, etc., to permit use of minimum number of access doors within a given room or space.
  - F. Factory manufactured doors shall be of a type compatible with the finish in which they are to be installed. In lieu of these doors, approved shop fabricated access doors with DuroDyne hinges may be used.

- G. Access doors in fire-rated walls and ceilings shall have equivalent U.L. label and fire rating.

1.19 EXCAVATING AND BACKFILLING:

A. General:

- 1. Provide all necessary excavation and backfill for installation of mechanical work in accordance with Division 2.
- 2. In general, follow all regulations of OSHA as specified in Part 1926, Subpart P, "Excavations, Trenching and Shoring." Follow specifications of Division 23 as they refer specifically to the mechanical work.

- B. Contact Owners of all underground utilities to have them located and marked, at least 2 business days before excavation is to begin. Also, prior to starting excavation brief employees on marking and color codes and train employees on excavation and safety procedures for natural gas lines. When excavation approaches gas lines, expose lines by carefully probing and hand digging.

- C. Provide all necessary pumping, cribbing and shoring.

- D. Walls of all trenches shall be a minimum of 6 inches clearance from the side of the nearest mechanical work. Install pipes with a minimum of 6 inches clearance between them when located in same trench.

E. Pipe Trenching:

- 1. Dig trenches to depth, width, configuration, and grade appropriate to the piping being installed. Dig trenches to 6 inches below the level of the bottom of the pipe to be installed. Install 6 inches bed of pea gravel or squeegee, mechanically tamp to provide a firm bed for piping, true to line and grade without irregularity. Provide depressions only at hubs, couplings, flanges, or other normal pipe protrusions.

- F. Backfilling shall not be started until all work has been inspected, tested and accepted. All backfill material shall be reviewed by the soils engineer. In no case shall lumber, metal or other debris be buried in with backfill.

- 1. Provide warning tape for marking and locating underground utilities. Tape shall be specifically manufactured for this purpose and shall be polyethylene film, 6 inches wide, 0.004 inches thick and have a minimum strength of 1750 psi. Tape shall carry continuous inscription naming the specific utility.

- a. Tape shall have magnetic strip and be used for exterior underground system only.

G. Trench Backfill:

- 1. Backfill to 12 inches above top of piping with pea gravel or squeegee, the same as used for piping bed, compact properly.
- 2. Continue backfill to finish grade, using friable material free of rock and other debris. Install in 6 inch layers, each properly moistened and mechanically compacted prior to installation of ensuing layer. Compaction by hydraulic jetting is not permissible.

- H. After backfilling and compacting, any settling shall be refilled, tamped, and refinished at this contractor's expense.

- I. This contractor shall repair and pay for any damage to finished surfaces.

- J. Complete the backfilling near manholes using pea gravel or squeegee, installing it in 6 inch lifts and mechanically tamping to achieve 95 percent compaction.
  - K. Use suitable excavated material to complete the backfill, installed in 6 inch lifts and mechanically compacted to seal against water infiltration. Compact to 95 percent for the upper, 30 inches below paving and slabs and 90 percent elsewhere.
- 1.20 CLEANING:
- A. Refer to Division 1.
  - B. Refer to Division 23, "TESTING, ADJUSTING AND BALANCING" for requirements for cleaning filters, strainers, and mechanical systems prior to final acceptance.
- 1.21 RECORD DOCUMENTS:
- A. Refer to Division 1. The following paragraphs supplement the requirements of Division 1.
  - B. Keep a complete set of record document prints in custody during entire period of construction at the construction site. Documents shall be updated on a weekly basis.
  - C. Mark Drawing Prints to indicate revisions to piping and ductwork, size and location both exterior and interior; including locations of coils, dampers and other control devices, filters, boxes, and similar units requiring periodic maintenance or repair; actual equipment locations, dimensioned from column lines; actual inverts and locations of underground piping; concealed equipment, dimensioned to column lines; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.); Change Orders; concealed control system devices. Changes to be noted on the drawings shall include final location of any piping or ductwork relocated more than 1 foot-0inches from where shown on the drawings.
  - D. Mark shop drawings to indicate approved substitutions; Change Orders; actual equipment and materials used.
  - E. Mark equipment and fixture schedules on drawings to indicate manufacturer and model numbers of installed equipment and fixtures.
  - F. Revisions to the Contract Documents shall be legible and shall be prepared using the following color scheme:
    - 1. Red shall indicate new items, deviations and routing.
    - 2. Green shall indicate items removed or deleted.
    - 3. Blue shall be used for relevant notes and descriptions.
  - G. At the completion of the project, obtain from the Architect a complete set of the Mechanical Contract Documents in a read-only electronic format (.pdf unless otherwise noted). This set will include all revisions officially documented through the Architect/Engineer. Plot these drawings and using the above color scheme, transfer any undocumented revisions from the construction site record drawings to this complete set. Submit original hardcopies of both sets of marked up documents to the Architect/Engineer. This contract will not be considered completed until these record documents have been received and reviewed by the Architect/Engineer.
  - H. At the completion of the project, obtain from the Architect a complete set of the Mechanical Construction Documents in the electronic format used by the design team. This set will include all revisions officially issued through the Architect. The Contractor shall transfer all revisions noted on the

record document prints to the electronic drawings. The Contractor shall transmit the final record documents in the electronic format used on the project to the Architect. This contract will not be considered completed until these record drawings have been received and reviewed by the Architect/Engineer.

1.22 OPERATION AND MAINTENANCE DATA:

- A. Refer to Division 1. The following paragraphs supplement the requirements of Division 1.
  - 1. Submit one (1) copy of the manual to the Engineer for preliminary review prior to the production of the final manual.
  - 2. Following review of the preliminary manual by the Engineer, prepare and submit final copies of the manual complying with the Engineer's comments noted on the preliminary manual.
- B. The testing and balancing report shall be submitted and received by the Engineer at least fifteen calendar days prior to the contractor's request for final observation time frame requirements. Include in the O & M Manual after review with "No Exceptions Taken" has been accomplished.
- C. In addition to the information required above and by Division 1 for Maintenance Data, include the following information:
  - 1. Description of mechanical equipment, function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of all replaceable parts.
  - 2. Manufacturer's printed operating procedures to include start-up, break-in, routine and normal operating instructions; regulation, control, stopping, shut-down, and emergency instructions; and summer and winter operating instructions. Provide any test reports and start-up documents.
  - 3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
  - 4. Servicing instructions, lubrication charts and schedules, including Contractor lubrication reports.
  - 5. Manufacturer's service manuals for all mechanical equipment provide under this contract.
  - 6. Include the valve tag list.
  - 7. Name, Address and Telephone number of party to be contacted for 24-hour service for each item of equipment.
  - 8. Starting, stopping, lubrication, equipment identification numbers and adjustment clearly indicated for each piece of equipment.
  - 9. Complete parts list. Provide to Owner, recommended spare parts list.
  - 10. Mechanical warranties.
  - 11. Final schedule of values with all mechanical change order costs included and identified.
- D. This contract will not be considered completed nor will final payment be made until all specified material, including testing and balancing report and final schedule of values with all mechanical change order costs included and identified, is received in this operating and maintenance report and the manual is reviewed by the Architect/Engineer.

1.23 PROJECT CLOSEOUT:

- A. In addition to the requirements specified in Division 1, complete the requirements listed below.
- B. The Contractor shall be responsible for the following Mechanical Checklist either by performing and/or coordinating such items prior to applying for certification of substantial completion. Refer to individual specification sections for additional requirements.
- C. Mechanical Checklist

1.24 WARRANTIES:

- A. Refer to the Division 1 for procedures and submittal requirements for warranties. Refer to individual equipment specifications for warranty requirements. In any case the entire mechanical system shall be warranted no less than one year from the time of acceptance by the Owner.
- B. Compile and assemble the warranties specified in Division 23, into the operating and maintenance manuals.
- C. Provide complete warranty information for each item to include product or equipment to include date or beginning of warranty or bond; duration of warranty or bond; and names, addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services.

SPEC SECTION	ITEM	REQUIREMENTS							
		SUBMITTALS			SUPPLEMENTAL		FACTORY REP SUPER-VISION AT SITE	TRAINING REQ AT SITE	EXTRA MATERIAL
		Shop		Include in					
223000	PLUMBING FIXTURES		X	X					X
230000	EQUIPMENT WARRANTIES			X					
	O&M MANUALS								
	COORDINATION DRAWINGS	X							
230523	VALVES		X	X					
230553	MECHANICAL IDENTIFICATION		X	X					X



SPEC SECTION	ITEM	REQUIREMENTS							
		SUBMITTALS			SUPPLEMENTAL		FACTORY REP SUPER-VISION AT SITE	TRAINING REQ AT SITE	EXTRA MATERIAL
		Shop		Include in					
230593	TESTING ,ADJUSTING AND BALANCING			X		X			
230700	MECHANICAL INSULATION		X	X					
232000	PIPING		X	X	X	X			
233000	HVAC AIR DISTRIBUTION	X	X	X	X	X			

<sup>1</sup> For Soft Starters and Variable Frequency Drives

<sup>2</sup> Requires Review & Approval from T & B Contractor

<sup>3</sup>Warranty Report/Warranty

<sup>4</sup> Kitchen Exhaust Hood

<sup>5</sup> See Specific Specification Section for Test & Certification Requirements

**END OF SECTION**

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## SECTION 23 05 23

### GENERAL DUTY VALVES FOR PIPING

#### PART 1 - GENERAL

##### 1.1 DESCRIPTION OF WORK:

- A. This Section includes general duty valves common to most mechanical piping systems.

##### 1.2 SUBMITTALS:

- A. Product Data: including body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions.

##### 1.3 QUALITY ASSURANCE:

- A. Single Source Responsibility: Comply with the requirements specified in Division-23 Section "Basic Mechanical Requirements," under "Product Options."

- B. MSS Standard Practices: Comply with the following standards for valves:

1. MSS SP-45: Bypass and Drain Connection Standard
2. MSS SP-67: Butterfly Valves
3. MSS SP-70: Cast Iron Gate Valves, Flanged and Threaded Ends
4. MSS SP-71: Cast Iron Swing Check Valves, Flanged and Threaded Ends
5. MSS SP-72: Ball Valves with Flanged or Butt-Welding Ends for General Service
6. MSS SP-78: Cast Iron Plug Valves, Flanged and Threaded Ends
7. MSS SP-80: Bronze Gate, Globe Angle and Check Valves
8. MSS SP-84: Steel Valves - Socket Welding and Threaded Ends
9. MSS SP-85: Cast Iron Globe and Angle Valves, Flanged and Threaded Ends

10. MSS SP-92: MSS Valve User Guide

- C. NSF Standard 61: Drinking Water System Components.

##### 1.4 DELIVERY, STORAGE, AND HANDLING:

- A. Preparation for Transport: Prepare valves for shipping as follows:

1. Ensure valves are dry and internally protected against rusting and galvanic corrosion.
2. Protect valve ends against mechanical damage to threads, flange faces and weld end preps.
3. Set valves in best position for handling. Globe and gate valves shall be closed to prevent rattling; ball and plug valves shall be open to minimize exposure of functional surfaces; butterfly valves shall be shipped closed or slightly open; and swing check valves shall be blocked in either closed or open position.

- B. Storage: Use the following precautions during storage:

1. Valves shall be stored and protected against all dirt, debris and foreign material at all times.
2. Do not remove valve end protectors unless necessary for inspection; then reinstall for storage.
3. Protect valves against weather. Where practical store valves indoors. Maintain valve temperature higher than the ambient dew point temperature. If outdoor storage is necessary, support valves off the ground or pavement and protect in watertight enclosures.

- C. Handling: Valves whose size requires handling by crane or lift shall be slung or rigged to avoid damage to exposed valve parts. Handwheels and stems, in particular, shall not be used as lifting or rigging points.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS:

- A. Manufacturer: Subject to compliance with requirements, provide products by the manufacturers listed.

- 1. Ball Valves:

- a. Apollo
- b. Crane
- c. Jamesbury
- d. Jenkins

### 2.2 VALVE FEATURES:

- A. General: Comply with MSS-92 1980 "Valve Users Manual".
- B. Valve Design: Valves shall have rising stem, or rising stem outside screw and yoke design; except, non-rising stem valves may be used where headroom prevents full operation of rising stem valves.
- C. Sizes: Unless otherwise indicated, provide valves of same size as upstream pipe size. (Control valves shall be sized for required flow.)
- D. Operators: Provide the following special operator features:
  - 1. Handwheels, fastened to valve stem for valves other than quarter turn.
  - 2. Lever handle on quarter turn valves 6 inch and smaller, except plug valves. Provide a wrench for every plug valve.
  - 3. Chainwheel operators for valves 4" and larger that are installed 84" or higher above finished floor elevation. Provide chains to an elevation of 6'-0" above finished floor elevation.
  - 4. Worm gear operators of an enclosed weather-proof design shall be provided on all quarter turn valves 8 inches and larger.
- E. Extended Stems: Where insulation is indicated or specified, provide extended stems to allow full operation of the valve without interference by the insulation.
- F. Bypass and Drain Connections: Comply with MSS SP-45.
- G. End Connections: As specified in the individual valves specifications.
  - 1. Threads: Comply with ANSI B2.1.
  - 2. Flanges: Comply with ANSI B16.1 for cast iron, ANSI B16.5 for steel, and ANSI B16.24 for bronze.
  - 3. Solder-Joint: Comply with ANSI B16.18.
    - a. Caution: Where soldered end connections are used, use solder having a melting point below 840 °F for gate, globe, and check valves and below 421 °F for ball valves.

### 2.3 BALL VALVES:

- A. Blowout proof stems 3-piece, full port type, brass or bronze body, chrome plated or stainless steel ball, Teflon seals and seat, vinyl covered handle with memory stop. Pressure rating 150 psi SWP and 600 psi WOG.
- B. Ball valves shall be 2" or less. Larger pipe sizes shall require gate or butterfly valves.

C. Ball valve options/accessories: Provide the following as required or as specifically indicated:

1. Tee handle for tight fit applications (within enclosures, etc.).
2. Locking handle.
3. Drain.
4. Stem extension.
5. Mounting pads.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION:

- A. Install valves in accordance with manufacturer's instructions.
- B. Examine valve interior through the end ports, for cleanliness, freedom from foreign matter and corrosion. Remove special packing materials, such as blocks used which prevents disc movement during shipping and handling.
- C. Actuate valve through an open-close and close-open cycle. Examine functionally significant features, such as guides and seats made accessible by such actuation. Following examination, return the valve closure member to the position in which it was shipped.
- D. Examine threads on both the valve and the mating pipe for form (out-of-round or local indentation) and cleanliness.
- E. Examine mating flange faces for conditions which might cause leakage. Check bolting for proper size, length, and material. Check gasket material for proper size and material, and for freedom from defects and damage.
- F. Prior to valve installation, examine the piping for cleanliness, freedom from foreign materials, and proper alignment.

#### 3.2 VALVE SELECTION:

- A. Selection of Valve Ends (Pipe Connections): Except as otherwise indicated, select valves with the following ends or types of pipe/tube connections:
  1. Copper Tube Size 2 Inch and Smaller: Solder ends, except in heating hot water and low pressure steam service which shall have threaded ends.
  2. Steel Pipe Sizes 2 Inch and Smaller: Threaded or grooved-end.
  3. Steel Pipe Sizes 2-1/2 Inch and Larger: Flanged or grooved end.
  4. At all piping hot taps provide a ball valve with the hot tap and a ball valve or butterfly valve for shut-off service. Hot taps shall be provided only where approved by the Engineer.
  5. Contractor shall provide and install hi-performance steam butterfly valves on sizes 6" and larger (or) [where limited space does allow adequate access to maintain gate valves].

#### 3.3 VALVE INSTALLATIONS:

Valve Application Table

SERVICE	VALVE TYPE
Plumbing Water Services; 2" or smaller	Ball Valve

- A. Locate valves for easy access and provide separate support where necessary.
- B. Install valves and unions for each fixture and item of equipment in a manner to allow equipment removal without system shut-down. Unions are not required on flanged devices.
- C. Install 3-valve bypass around each pressure reducing valve using throttling type valves.
- D. Gate and globe valves shall be installed with the stem in the upright position. In overhead horizontal piping, ball valves shall be installed with the handle in the side or bottom of the piping. Butterfly valves shall be installed with the stem within 45 degrees of the horizontal position. The handle of quarter turn valves shall open in the direction of flow. Quarter turn valves with hand wheels or chain wheels shall be located so that the position indicator is visible from the floor without the use of a ladder or climbing on equipment or piping.

3.4 SOLDER CONNECTIONS:

- A. Cut tube square and to exact lengths.
- B. Clean end of tube to depth of valve socket, using steel wool, sand cloth, or a steel wire brush to a bright finish. Clean valve socket in same manner.
- C. Apply proper soldering flux in an even coat to inside of valve socket and outside of tube.
- D. Open gate and globe valves to fully open position.
- E. Remove the cap and disc holder of swing check valves with composition discs.
- F. Insert tube into valve socket making sure the end rests against the shoulder inside valve. Rotate tube or valve slightly to insure even distribution of the flux.
- G. Apply heat evenly to outside of valve around joint until solder will melt upon contact. Feed solder until it completely fills the joint around tube. Avoid hot spots or overheating the valve. Once the solder starts cooling, remove excess amounts around the joint with a cloth or brush.

3.5 THREADED CONNECTIONS:

- A. Note the internal length of threads in valve ends, and proximity of valve internal seat or wall, to determine how far pipe should be threaded into valve.
- B. Align threads at point of assembly.
- C. Apply appropriate tape or thread compound to the external pipe threads (except where dry seal threading is specified).
- D. Assemble joint wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.

3.6 FIELD QUALITY CONTROL:

- A. Testing: After piping systems have been tested and put into service, but before final adjusting and balancing, inspect each valve for leaks. Adjust or replace packing to stop leaks; replace valve if leak persists.

3.7 ADJUSTING AND CLEANING:

- A. Cleaning: Clean mill scale, grease, and protective coatings from exterior of valves and prepare to receive finish painting or insulation.

**END OF SECTION**

## SECTION 23 05 53

### IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

#### PART 1 - GENERAL

##### 1.1 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of identification devices of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Codes and Standards:
  - 1. ANSI Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

##### 1.2 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical product data and installation instructions for each identification material and device required.
- B. Schedules: Submit valve schedule for each piping system, typewritten and reproduced on 8-1/2" x 11" bond paper. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), size of valve, and variations for identification (if any). Only tag valves which are intended for emergency shut-off and similar special uses, such as valve to isolate individual system risers, individual floor branches or building system shut off valves. In addition to mounted copies, furnish extra copies for Maintenance Manuals as specified in Division 23.

#### PART 2 - PRODUCTS

##### 2.1 MANUFACTURERS:

- A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
- B. Mechanical Identification:
  - 1. Seton Name Plate Corp.
  - 2. Marking Systems, Inc. (MSI)
  - 3. National Marker Co.
- C. Paint:
  - 1. Benjamin Moore
  - 2. Devco
  - 3. Glidden

##### 2.2 MECHANICAL IDENTIFICATION MATERIALS:

- A. General: Provide manufacturer's standard products of categories and types required for each application as referenced in other Division-23 sections. Where more than single type is specified for application, selection is Installer's option, but provide single selection for each product category.

##### 2.3 PAINTED IDENTIFICATION MATERIALS:

- A. Stencils: Standard metal stencils, prepared for required applications with letter sizes generally complying with recommendations of ANSI A13.1 for piping or to match existing size in existing building, but not less than 1-1/4" high letters for ductwork and not less than 3/4" high letters for access door signs and similar operational instructions.
- B. Stencil Paint: Standard exterior type oil based allcoloid glass spray paint color complying with NEMA 2535.1.
- C. Identification Paint: Standard identification enamel of colors indicated or, if not otherwise indicated comply with ANSI A13.1 for colors or to match existing building standard identification.

#### 2.4 PLASTIC PIPE MARKERS:

- A. Snap-On Type: Provide manufacturer's standard pre-printed, semi-rigid snap-on, color-coded pipe markers, complying with ANSI A13.1.
- B. Insulation: Furnish 1 inch thick molded fiberglass insulation with jacket for each plastic pipe marker to be installed on uninsulated pipes subjected to fluid temperatures of 125 degrees F. (52 degrees C.) or greater. Cut length to extend 2 inches beyond each end of plastic pipe marker.
- C. Small Pipes: For external diameters less than 6 inches (including insulation if any), provide full-band pipe markers, extending 360 degrees around pipe at each location taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4 inch wide; full circle at both ends of pipe marker, tape lapped 1-1/2 inch.
- D. Large Pipes: For external diameters of 6 inches and larger (including insulation if any), provide either full-band or strip-type pipe markers, but not narrower than 3 times letter height (and of required length), taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 1-1/2 inches wide; full circle at both ends of pipe marker, tape lapped 3 inches.
- E. Lettering: Comply with piping system nomenclature as specified, scheduled, shown, or to match existing building lettering nomenclature system and abbreviate only as necessary for each application length.
- F. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as separate unit of plastic.

#### 2.5 PLASTIC DUCT MARKERS:

- A. General: Provide manufacturer's standard laminated plastic, duct markers.
- B. For hazardous exhausts, use colors and designs recommended by ANSI A13.1.
- C. Nomenclature: Include the following:
  - 1. Direction of air flow.
  - 2. Duct service (supply, return, exhaust, etc.)

#### 2.6 PLASTIC TAPE:

- A. General: Provide manufacturer's standard color-coded pressure-sensitive (self-adhesive) vinyl tape, not less than 3 mils thick.
- B. Width: Provide 1-1/2 inches wide tape markers on pipes with outside diameters (including insulation, if any) of less than 6 inches, 2-1/2 inches wide tape for larger pipes.
- C. Color: Comply with ANSI A13.1, except where another color selection is indicated.

#### 2.7 PLASTICIZED TAGS:



- A. General: Manufacturer's standard pre-printed or partially pre-printed accident-prevention tags, of plasticized card stock with matt finish suitable for writing, approximately 3-1/4inch x 5-5/8 inch, with brass grommets and wire fasteners, and with appropriate pre-printed wording including large- size primary wording (as examples; DANGER, CAUTION, DO NOT OPERATE).

## 2.8 LETTERING AND GRAPHICS:

- A. General: Coordinate names, abbreviations and other designations used in mechanical identification work, with corresponding designations shown, specified, scheduled and approved by the Owner/Engineer. Provide numbers, lettering and wording as indicated and approved by the Owner/Engineer for proper identification and operation/ maintenance of mechanical systems and equipment.
- B. Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as designated on the drawings or schedule as well as service.

## PART 3 - EXECUTION

### 3.1 GENERAL INSTALLATION REQUIREMENTS:

- A. Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finish including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

### 3.2 DUCTWORK IDENTIFICATION:

- A. General: Identify air supply, return, exhaust, intake and relief ductwork and duct access doors with duct markers; or provide stenciled signs and arrows, showing ductwork service and direction of flow, in black or white (whichever provides most contrast with ductwork color). Existing building identification shall match the existing method which exists in the building.
- B. Location: In each space where ductwork is exposed, or concealed only by removable ceiling system, locate signs near points where ductwork originates or continues into concealed enclosures (shaft, underground or similar concealment), and at 50 foot spacing along exposed runs.
- C. Access Doors: Provide duct markers or stenciled signs on each access door in ductwork and housings, indicating purpose of access (to what equipment), other maintenance and operating instructions, and appropriate safety and procedural information.
- D. Concealed Doors: Where access doors are concealed above acoustical ceilings or similar concealment, plasticized tags may be installed for identification in lieu of specified signs, at Installer's option.

### 3.3 PIPING SYSTEM IDENTIFICATION:

- A. General: Install pipe markers of the following type on each system indicated to receive identification, and include arrows to show normal direction of flow. Existing building identification shall match the existing method which exists in the building.
- B. Plastic pipe markers, with application system as indicated under "Materials" in this section. Install on pipe insulation segment where required for hot non- insulated pipes.
- C. Stenciled markers, including color-coded background band or rectangle, and contrasting lettering of black or white. Extend color band or rectangle 2 inches beyond ends of lettering.

- D. Locate pipe markers and color bands as follows wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, crawl spaces plenums) and exterior non-concealed locations.
  - E. Within 3 inches of each valve and control device.
  - F. Near each branch, excluding short take-offs for fixtures and terminal units; mark each pipe at branch, where there could be question of flow pattern.
  - G. Near locations where pipes pass through walls or floors/ceilings, or enter non-accessible enclosures.
  - H. At access doors, manholes and similar access points which permit view of concealed piping.
  - I. Near major equipment items and other points of origination and termination.
  - J. Spaced intermediately at maximum spacing of 25 feet along each piping run, except reduce spacing to 15' in congested areas of piping and equipment.
  - K. On piping above removable acoustical ceilings.
  - L. Pipes under ¾" O.D. fasten tags securely at specified legend locations.
- 3.4 ACCESS DOORS:
- A. Provide engraved nameplates or painted stencils to identify concealed valves, controls, dampers or other similar concealed mechanical equipment above accessible ceilings.
  - B. Access door for fire damper shall be painted red. Location above accessible ceilings shall be identified with a red circular dot at least ¾" in diameter, or embossed tape, adhered to the nearest T-bar.
- 3.5 LIFT-OUT CEILINGS:
- A. Provide engraved nameplates on ceiling tee stem (screwed or riveted, adhesive not allowed) to identify concealed valves, fire/smoke dampers or similar concealed mechanical equipment that is directly above nameplate in ceiling space.
  - B. Obtain the University Project Manager's approval before installation.
- 3.6 SCHEDULES:.
- A. Piping Identification:

Classification	Color of Field	The Campus Letters		Legend
Materials Inherently Hazardous:				
Flammable or Explosive:				
Natural Gas		Yellow	Black	NG
Lab Waste		Yellow	Black	AW

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Extreme Temperatures or Pressures:	Yellow	Black	
Domestic Hot Water	Yellow	Black	Dom HW
Domestic Hot Water, Circulating	Yellow	Black	Dom HWC
Heating Water Supply	Yellow	Black	HWS
Heating Water Return	Yellow	Black	HWR
Low Pressure Steam	Yellow	Black	LPS
Low Pressure Steam Condensate	Yellow	Black	LPSC
High Pressure Steam	Yellow	Black	HPS
High Pressure Steam Condensate	Yellow	Black	HPSC
Boiler Feed Water	Yellow	Black	BFW
Refrigerant	Yellow	Black	REF
High Pressure Compressed Air (over 90 psig)	Yellow	Black	CA
Materials of Inherently Low Hazard:			
Liquid or Liquid Admixture:	Green	White	
Distilled Water	Green	White	DW
Domestic Cold Water	Green	White	Dom CW
Sanitary Sewer	Green	White	SAN
Waste Vent	Green	White	V
Chilled Water Supply	Green	White	CWS
Chilled Water Return	Green	White	CWR
Condenser Water Supply	Green	White	CS
Condenser Water Return	Green	White	CR
Gas or Gaseous Admixture:	Blue	White	
Medium Pressure Compressed Air (30 to 90 psig)	Blue	White	CA
Low Pressure Compressed Air (less than 30 psig)	Blue	White	CA

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Vacuum	White	Black	VAC
Fire Quenching Materials:			
Fire Lines	Red	White	FL

**B. Mechanical Equipment Naming Strategy:**

- Equipment identification numbers may be up to 32 characters. Equipment naming strategy is:

System – Bld – Number

###-#####-##-###

- The first three placeholders are reserved for the system designation (alpha characters)
- The fourth character is a hyphen.
- The fifth through ninth placeholders are reserved for the building designation (alpha and/or numeric)
- The tenth character is a hyphen
- The eleventh through sixteenth placeholders are a “smart number.” It is composed of a two-digit, alpha or numeric, floor location designator followed by a hyphen and a three digit numeric sequential indicator.
- The seventeenth character is a hyphen
- In some instances the point name will be followed by a hyphen and a sub-point name
- All device and point names will be assigned by the Facilities Operations, Building Operations Department.
- All references to equipment and devices in drawings, labels, equipment tags, BAS system, etc., must use this naming convention.
- Equipment designation, for prints may exclude the building designator.

**3.7 ADJUSTING AND CLEANING:**

- Adjusting: Relocate any mechanical identification device which has become visually blocked by work of this division or other divisions.
- Cleaning: Clean face of identification devices, and glass frames of valve charts.

**END OF SECTION**

**SECTION 23 05 93**

**TESTING, ADJUSTING AND BALANCING FOR HVAC**

**PART 1 - GENERAL**

**1.1 DESCRIPTION OF WORK:**

- A. This section covers testing and balancing of environmental systems described herein and specified under Division 23. The testing and balancing of all environmental systems shall be the responsibility of one Testing, Balancing and Adjusting firm.
  - 1. Test, adjust and balance the following mechanical systems and the mechanical equipment associated with these systems:
    - a. General Systems and Equipment Procedures.
    - b. Air Side Systems and Equipment
      - 1) Supply/Return Air Systems
      - 2) Lab and Research Facility Systems
  - B. Items such as start-up, initial testing, cleaning, and calibration of controls, electrical testing, etc., are to be completed prior to the commencement of TAB work.

**1.2 QUALIFICATIONS OF CONTRACTOR:**

- A. The Mechanical Contractor shall procure the services of an independent testing and balancing agency specializing in the testing, adjusting and balancing of environmental systems to perform the above mentioned work. An independent contractor is defined as an organization that is not engaged in engineering design or is not a division of a mechanical contractor entity, which installs mechanical systems.
- B. The actual fieldwork shall be performed by qualified technicians who are currently certified by the National Environmental Balancing Bureau (NEBB), or the Associated Air Balance Council (AABC) certification agencies.
- C. The Testing & Balancing Contractor shall have a minimum of three years experience in testing and balancing mechanical systems.
- D. The Test & Balance Contractor shall have previous experience in testing and balancing variable air volume laboratory fume hood systems in the last two years. Qualification submission must include a detailed resume describing past project experience in laboratory variable air volume systems, a list of projects, including peoples' names, phone numbers and addresses of references.
- E. Testing and balancing work shall be directly supervised by a Registered Engineer, NEBB or AABC certified supervisor and the results attested to by a Registered Professional Engineer or certified supervisor on the Testing & Balancing Contractor's staff. The Engineer/Supervisor shall represent the Testing & Balancing Contractor in progress meetings as requested, and shall be available for interpreting all material found in the balance report.

**1.3 APPROVAL OF CONTRACTOR:**

- A. The following firms are preferred contractors to complete the work. Any Testing and Balancing firm desiring to offer their services for this work and who are not listed below, shall submit their qualifications to the Architect/Engineer, not less than seven (7) working days before the bid date. Approval or disapproval will be given on each request and this action will be given in writing prior to bidding the work.

1. JPG Engineering
2. Griffith Engineering
3. Lawrence H. Finn & Assoc.
4. TAB Services, Inc.

- B. Firms who are not listed, or who have not received prior approval shall not be approved to complete work on this project.

1.4 CODES AND STANDARDS:

- A. ASHRAE: ASHRAE Handbook, Systems Volume, Testing, Adjusting, and Balancing.
- B. NEBB: "Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems."
- C. SMACNA: "HVAC Systems-Testing, Adjusting & Balancing."

1.5 PRELIMINARY SUBMITTALS:

- A. Within ten (10) days of award of the contract the Mechanical Contractor shall submit the name of the Test and Balance Contractor who will be performing the work. The submittal shall include a resume of the agency, a complete list of all technicians who will be performing the field work and include a photocopy of their current certification by either NEBB or AABC certification agencies. Only those technicians included in the submittal shall perform the work. Any personnel or staff used to perform the work without prior approval of the Engineer, who are not included in the submittal, shall be grounds for rejecting the test and balance report and the project in whole.
- B. Meet all requirements of Section 230000 as applicable.
- C. Submit a list of all instrumentation to be used on an individual project and include calibration dates. Submit calibration curves. If more than one instrument of a similar type is used, a comparison of individual readings should be made. The variation between instrument readings should not exceed plus or minus 5%.
- D. Prior to the start of any test and balance work of the mechanical system, the Contractor shall submit, for approval, a written procedure of how balance will be performed and a description and manufacturer's name of equipment and instruments to be used. The submittal shall include, but not necessarily be limited to the following:
  1. List of preliminary checks to be performed at the job site such as confirmation that manual volume dampers are present, filters are installed, frequency drive units operational, location of control sensors, etc.
  2. Identify how the air outlets will be measured and the type of instruments to be used.
  3. Locations of pilot traverses and the type of instruments to be used.
  4. Modes of operation that the system will be placed in during balancing and testing, i.e., full cooling and heating, maximum and minimum outside air flows, maximum and minimum sash positions for fume hoods, toilet fans on or off, etc.
  5. Position of doors and windows during balance, i.e., some labs should be balanced with doors shut.
  6. Operating static pressures for terminal devices and pressure sensors for controlled devices.
  7. Method of adjusting outside and return air quantities at air handling units.
  8. Initial test procedures for preliminary balance.
  9. Final test procedures.
  10. List of deficiencies in mechanical system that could hinder the balance work such as missing or leaky dampers, incomplete systems, inadequate fans, etc.
  11. Sample of data sheets and test forms to be used in final report.
  12. Identification and manufacturer's name of equipment to be used on project and proof of last calibration on each piece.

- E. Progress Report(s) – Report, in writing, any deficiencies or problems with air or water systems that have affected balance work. Include items that affect system performance such as broken thermostats, damaged ductwork, excessive noise, etc.

1.6 FINAL REPORTS:

- A. Refer to Division 1 for supplemental requirements.
- B. The Testing and Balancing Contractor shall submit six (6) bound copies of the final testing and balancing report at least fifteen (15) calendar days prior to substantial completion, unless noted otherwise in Division 1. Report contents shall be per Part 3 of this Section.
- C. Meet all requirements of Section 23 00 00 as applicable.
- D. If more than two reports are made by the contractor, the Owner reserves the right to charge the contractor for subsequent reviews by their consultants. Such extra fees shall be deducted from payments by the Owner to the contractor.
- E. Guarantee of Work: TAB contractor shall guarantee the balancing for a period of 90 days from date of acceptance of final report. During this period, the TAB contractor shall make personnel available at no cost to the university to verify measurements and/or correct deficiencies in the balance. During this period, emergency adjustments shall not void this warranty.

1.7 SEQUENCING AND SCHEDULING:

- A. Notify Contractor/Engineer/Architect in writing of conditions detrimental to the proper completion of the test and balance work. Provide the Contractor/Architect/Engineer with a copy of the notification.
- B. Prepare a project schedule. Schedule shall indicate critical path of the balancing process and shall incorporate both requirements of other contractors necessary to meet test and balance commitments and process flow of test and balance work. Coordinate with general and mechanical contractors and insert critical steps into project master schedule.

PART 2 - PRODUCTS

- 2.1 N/A

PART 3 - EXECUTION

3.1 PRELIMINARY PROCEDURES:

- A. Testing and balancing shall not begin until the system has been completed and is in full working order and the following project conditions have been determined suitable for start of work.
  - 1. Pre-Balancing Conference: Before beginning testing, adjusting, and balancing procedures, schedule and conduct a conference with University Project Manager, Facilities Operations Representative(s) and representatives of installers of mechanical and control systems. Conference objective is final coordination and verification of system operation and readiness for testing, adjusting, and balancing, and assigning testing responsibilities of each installer.
  - 2. Preliminary Testing & Balancing Contractor requirements shall be ascertained prior to the commencement of work through a review of the project plans and specifications. In addition, visual observations at the site during construction shall be made to determine the location of required balancing

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- devices, that they are being installed properly, and in an accessible location for the need. Report in writing any deficiencies to the Contractor/Engineer/Architect immediately.
3. Systems shall be complete and fully operational prior to beginning procedures. Insure all items such as thermometer wells, pressure test-cocks, access doors, etc., are installed to facilitate tests and adjustments.
  4. Before any air balance work is done, the system shall be checked for duct leakage (obtain pressure test results), assure filters are installed, verify filters are changed if they are dirty, check for correct fan rotation, equipment vibration, and check automatic dampers for proper operation. All volume control dampers and outlets shall be wide open at this time.
  5. Before any Hydronic, domestic water or applicable system balancing work is done, the systems shall be checked for plugged strainers, proper pump rotation, proper control valve installation and operation, air locks, proper system static pressure to assure a full system, proper flow meter and check valve installation. All throttling devices and control valves shall be open at this time.
  6. Verify systems do not exhibit excessive sound and/or vibration levels. Report in writing any deficiencies to the Contractor/Engineer/Architect immediately.

### 3.2 PRELIMINARY PROCEDURES – REMODEL WORK:

- A. In remodel area, a complete preliminary test and balance report shall be accomplished prior to any work. Any obvious deficiencies shall be identified at that time. A complete report of all readings, recommendations, etc. shall be submitted to the University Project Manager and the Engineer.

### 3.3 GENERAL SYSTEM AND EQUIPMENT PROCEDURES:

- A. Balance all air and heating water flows at terminals within +10% to -10% of design flow quantities, cooling water and snow melt systems shall be balanced to within  $\pm 5\%$  of design flow rates. Notify Contractor/Engineer/Architect in writing of conditions detrimental to the proper completion of the test and balance work. Provide the Contractor/Architect/Engineer with a copy of the notification.
- B. Pressure relationships indicated on drawings shall take priority over air quantities.
- C. Cut insulation, ductwork, and piping for installation of test probes to minimum extent necessary to allow adequate performance of procedures.
- D. Mark equipment settings with paint, including damper control positions, balancing cocks, circuit setters, valve indicators, fan speed control settings and similar controls and devices, to show final settings at completion of test-adjust-balance work.
- E. Patch holes in insulation, ductwork and housings, which have been cut or drilled for test purposes, in a manner recommend by the original installer. Test for and repair leaks. Reseal insulation to re-establish integrity of the vapor barrier.
- F. Measure, adjust and report equipment running motor amps and power factor, KW, rated motor amperage, listed motor power factor, voltage, and all nameplate data. Perform these measurements for all equipment operational modes.
- G. Check and adjust equipment belt tensioning.
- H. Check keyway and setscrew tightness. Report any loose screws and notify Mechanical Contractor prior to equipment balancing.
- I. Record and include in report all equipment nameplate data.
- J. Verify that all equipment safety and operating controls are in place, tested, adjusted and set prior to balancing.
- K. Verify that manufacturer start-up has occurred per specification prior to balancing.
- L. Retest, adjust, and balance systems subsequent to significant system modifications, and resubmit test results.



M. Sequencing and Scheduling:

1. Systems shall be fully operational before beginning procedures.
2. Conduct tests in the presence of the University Project Manager after providing 7-day notice before any test is to be conducted. Provide water and electricity required for tests. Determine that all dampers, registers, and valves are in a set or full open position.

3.4 AIR SIDE SYSTEMS AND EQUIPMENT PROCEDURES:

- A. In addition to the procedures identified under each specific heading below, provide general data required by 3.3 above.
- B. Adjust automatic damper linkages to provide air flow quantities shown. Check all automatic dampers in normal operation to verify proper operation. Verify return, relief air, and fresh air intake dampers operate as designed to produce desired room comfort.
- C. Filters shall be restricted to increase pressure drop to 50% of span between initial pressure drop and final recommended pressure drop for setting final airflows for fans. Check fan motor amps with clean filters and simulated loaded filters to guard against overload, fan rotation, operability of static pressure limit switch, automatic dampers for proper position, air and water resets operating to deliver required temperatures and air leaks in casing and around coils and filter frames, and report for each piece of equipment. Equipment shall be supplied with clean filters upon completion of balance. Balance and report air quantities.
- D. Place all fans (supply, return and exhaust) in operation.
- E. Supply/Return Air Systems:
  1. Balance and report supply and return diffuser/grille quantities. Air diffusion patterns shall be set as noted on drawings and to minimize objectionable drafts and noise.
  2. Provide full pitot traverses in duct mains downstream of supply fans, upstream of return fans, and in each zone duct downstream of a multizone unit. For VAV systems perform these at the system diversity condition (if any). Balance and report air quantities. Mark locations of traverses on reduced drawings in final report.
    - a. Note temperature and barometric pressure. Corrections shall be made for systems operating at 5200-foot elevation.
    - b. After establishing total air being delivered, adjust fan speed to obtain design airflow. Check power and speed to see that motor power and critical fan speed have not been exceeded.
    - c. Proportionally adjust branch dampers until each has proper air volume.
    - d. With all dampers and registers in system open and with supply, return, and exhaust fans operating at design cfm or speed, set minimum outdoor and return air ratio.
    - e. After minimum outside air damper has been set for proper percentage of outside air, take another traverse of mixture temperatures. Notify the University Project Manager and note in balancing report if variation from average is more than 5 percent.
  3. Provide full pitot traverses at each air terminal or duct coil. For VAV systems, perform these at zone maximum air condition. Balance and report air quantities.
  4. Report design air device inlet or outlet size, actual inlet or outlet size, design and actual velocity through the orifice, for each terminal in the system. Balance terminal outlets in each control zone in proportion to each other. Use branch dampers for major adjusting and terminal dampers for trim or minor adjustment only.
  5. Balance and report the above measurements in all system operational/modes.
    - a. Minimum outside air and 100% outside air economizer mode.
    - b. VAV maximum zone air condition and system diversity condition.
    - c. Unoccupied mode.
    - d. Two-speed fan, both speeds.

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- e. VFD bypass mode and full system demand.
  - f. General Exhaust/Supply Fans:
- F. Adjust CFM to system requirements. For belt drive include sheave and belt exchange to deliver airflow within limits of installed motor horsepower and mechanical stress limits of the fan. Determine the limiting fan tip speed before increasing RPM. Final fan speed setting shall allow for filter loading (as applicable) and shall establish proper duct pressures for operation of zone CFM regulators. For direct drive with speed taps: Set fan speed on tap which most closely approaches design CFM by adjusting the speed control After adjustment, check fans ability to re-start after powering down. Increase setting if required for proper starting.
- 1. Measure and report static pressures upstream and downstream of all fans.
  - 2. Measure and report fan RPM.
  - 3. Report design fan inlet or outlet size, actual inlet or outlet size, design and actual velocity through the orifice.
- G. Supply Air system:
- 1. Terminal Boxes:
    - a. For variable air volume (VAV), constant volume boxes, or dual duct boxes, set regulators to provide design minimum and maximum airflow rates. Adjust thermostat to assure proper damper operation.
    - b. For VAV, or constant volume boxes with reheat, set regulators to provide design minimum and maximum air flow rates. Check control sequence operation to assure proper sequencing.
    - c. Air flow performance of boxes for both primary and secondary balance settings shall be verified by flow measuring hood measurements at diffuser outlets.
- H. General Exhaust Systems:
- 1. Balance and report exhaust grille quantities. Report objectionable noise.
  - 2. Provide full pitot traverses at each individual exhaust riser and at each exhaust fan. Balance and report.
  - 3. Report design air device inlet or outlet size, actual inlet or outlet size, design and actual velocity through the orifice, for each terminal in the system.
- I. Laboratory and Research Facility System Requirements:
- 1. General requirements:
    - a. Balance all rooms to required pressure relationships as noted on the drawings. Document in the test and balance report that all pressure relationships have been set as specified.
    - b. Performance testing of the Room Pressurization Control System and the fume Hood Exhaust System shall be performed after the entire mechanical system for the building is complete. All systems shall have been calibrated, tested and balanced before performance testing begins.
    - c. Performance testing shall be done by the balancing contractor in the presence of the University Project Manager, user groups, and a representative from the Department of Environmental Health and Safety.
    - d. The performance testing must be successfully completed before the University Project Manager will accept control of the building's mechanical system.
  - 2. Fume Hood Exhaust Systems:
    - a. Measure and set flows for all fume hoods, biosafety cabinets, flammable storage cabinets, etc. Balance all thimble connected Class II, A2 or A3 Bio-Safety cabinets to meet manufacturer requirements and NSF 49.
  - 3. Room Pressurization Control System Performance Evaluation:

- a. The Balancing Contractor shall demonstrate with smoke that the correct relative pressure relationship is being maintained in each area. Every room for which a relative pressure value was assigned on the mechanical plans shall be tested.
- b. The testing shall be performed in each room under the following conditions:
  - 1) Door closed
  - 2) Door open
  - 3) In labs with fume hoods or bio-safety cabinets:
    - a) Hood sash complete open
    - b) Hood sash closed
    - c) Hood sash partially open
  - 4) Thermostat set to its minimum set point
  - 5) Thermostat set to its maximum set point
  - 6) If the correct pressure relationships cannot be demonstrated for a particular room, the room shall be retested after the problem has been corrected.

### 3.5 REPORT OF WORK:

- A. The Testing and Balancing Contractor shall submit a preliminary report within 30 days of the final testing and balancing work. Report shall include the following information:
  1. A general discussion preface section. This section shall summarize all abnormalities or problems encountered during the project and what course of action was taken. This summary should be assembled from the written progress reports described earlier, except that it will be expanded to include responses from the Engineer, the University Project Manager and Contractor regarding each problem indicated in the progress reports.
  2. Copies of correspondence if related to the performance and balance of the systems.
  3. Status of doors, windows and equipment static pressures during balance work.
  4. Reduced 11" x 17", readable, as-built drawings obtained from the University Project Manager. All devices and equipment shall be clearly labeled.
  5. Belt and sheave information, fan and motor nameplates information, full load operating voltage and amperage indicate sheave diameter as pitch diameter.
  6. Design and final actual cfm at each system terminal unit. Include terminal/size, inlet static pressure, temperature and velocities read to attain the design cfm.
  7. Overload protection for all motors shall be recorded. Starter and brand model, enclosure type, installed overload devices, original ratings, and set points (and revised device ratings and set points when application) shall be recorded.
- B. A complete reduced set of mechanical contract drawings (showing each system) shall be included in the report with all equipment, flow measuring devices, terminals (outlets, inlets, coils, fan coil units, schedules, etc.) clearly marked and all equipment designated. The test and balance contractor can obtain drawing files from the University Project Manager for development of these drawings.
- C. Data shall be reported per Part 3 of this Section on standard NEBB forms. Generate custom forms that contain the information in this Section when a standard NEBB form does not exist for a piece of equipment. All NEBB forms shall be fully filled out for this report. When additional information is required by this Section, it shall be provided.
- D. The report shall include a list of all equipment used in the testing and balancing work. This list shall closely resemble the list submitted with the Preliminary Systematic Procedures report with any discrepancies accounted for.
- E. Report systems for excessive sound and vibration per the sound and vibration inspection and testing portions of this specification.

- F. Substantial completion of this project will not take place until a satisfactory report is received. The Testing & Balancing Contractor shall respond and correct all deficiencies within 30 days of the preliminary report. Failure to comply will result in holding retainage of the final payment until all items have been corrected to the satisfaction of the University Project Manager/Engineer.
  - G. Provide four (4) copies of the final TAB report. The report shall be signed by the supervising registered professional engineer or supervisor and affixed with their registration stamp, signed and dated in accordance with state law.
- 3.6 GUARANTEE OF WORK:
- A. The Testing & Balancing Contractor shall guarantee the accuracy of the tests and balance for a period of 90 days from date of final acceptance of the test and balance report. During this period, the Testing & Balancing Contractor shall make personnel available at no cost to the Owner to correct deficiencies that may become apparent in the system balance.
- 3.7 COMMISSIONING (DEMONSTRATION):
- A. Upon request of the university Facilities Operations Representative, through the University Project Manager, the balancing firm shall demonstrate measured quantities of randomly selected equipment. The number of readings verified will not exceed 10 percent of the total in the report.

**END OF SECTION**

## SECTION 23 07 00

### INSULATION

#### PART 1 - GENERAL

##### 1.1 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of mechanical insulation products and systems, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.
- B. Installer's Qualifications: Firm with at least 5 years successful installation experience on projects with mechanical insulations similar to that required for this project.
- C. Flame/Smoke Ratings: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 (NFPA 255) method. In addition, the products, when tested, shall not drip flame particles, and flame shall not be progressive. Provide Underwriters Laboratories Inc., label or listing, or satisfactory certified test report from an approved testing laboratory to prove that fire hazard ratings for materials proposed for use do not exceed those specified.
- D. Codes and Standards:
  - 1. Worst case between ASHRAE 90.1 or 2021 IECC.

##### 1.2 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, k-value, thickness, density, and furnished accessories for each mechanical system requiring insulation. Submit detail product information and installation information for all jacketing systems specified in this section.

##### 1.3 DELIVERY, STORAGE, AND HANDLING:

- A. Deliver insulation, coverings, cements, adhesives, and coatings to site in containers with manufacturer's stamp or label, affixed showing fire hazard indexes of products.
- B. Protect insulation against dirt, water, and chemical and mechanical damage. Do not install damaged or wet insulation; remove from project site.

##### 1.4 DEFINITIONS:

- A. Concealed: As used in this section refers to insulation in ceiling plenums, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, unexcavated areas and crawl spaces.
- B. Exposed: As used in this section refers to insulation that is not concealed.

#### PART 2 - PRODUCTS

##### 2.1 MANUFACTURERS:

- A. Manufacturer: Subject to compliance with requirements, provide product by one of the following:

1. Insulation Identification and/or type of material from a manufacturer is as shown under each heading at 2.2 Materials, General:
  - a. Manville Corp.
  - b. Certain Teed
  - c. Knauf Fiber Glass
  - d. Pittsburgh Corning Corp.
  - e. Rubatex Corp.
2. Adhesives, Coatings and Sealants:
  - a. Childers Product Company
  - b. Foster
  - c. Hardeast

## 2.2 PIPING INSULATION MATERIALS:

- A. Fiberglass Piping Insulation: ASTM C 547, Class 1 unless otherwise indicated. "K" factor shall be maximum 0.24 at 75 degrees F. mean temperature, jacket with tensile strength of 35 lbs/in, mullen burst 70 psi, beach puncture 50 oz. in/in, permeability .02 perm factory applied vapor barrier jacket and adhesive self-sealing lap joint.
- B. Jackets for Piping Insulation: ASTM C 921, Type I for piping with temperatures below ambient, Type II for piping with temperatures above ambient. Type I may be used for all piping at Installers option.
  1. Fitting Covers: UV resistant PVC, pre-molded fitting covers, flame spread 25, smoke developed 50. PVC tape for cold systems, serrated tacks or PVC tape for hot systems.
  2. PVC Jacketing: UV resistant PVC, 20 mil thick, flame spread 25, smoke developed 50, factory cut and curled to fit O.D. of insulated pipe. Solvent weld adhesive for sealing joints and seams.
  3. Stainless Steel: 0.010 inch thick, type 304 stainless steel with smooth or corrugated finish.
- C. Staples, Bands, Wires, and Cement: As recommended by insulation manufacturer for applications indicated.
- D. Adhesives, Sealers, and Protective Finishes: As recommended by insulation manufacturer for applications indicated and additional finishes as specified.

## 2.3 DUCTWORK INSULATION MATERIALS:

- A. Flexible Fiberglass Ductwork Insulation: ASTM C 553, Type I, Class B-3, 1.0 lbs per cu. ft. density. "K" value shall be maximum 0.25 at 75 degrees F. mean temperature, 250 degree F temperature limit, vapor transmission rating shall not exceed 0.02 perms, facing of .7 mil foil reinforced with glass mesh and laminated to 40 lb Kraft.
- B. Ductwork Insulation Accessories: Provide staples, bands, wires, tape, anchors, corner angles and similar accessories as recommended by insulation manufacturer for applications indicated.
- C. Ductwork Insulation Compounds: Provide cements, adhesives, coatings, sealers, protective finishes and similar compounds as recommended by insulation manufacturer for applications indicated.

## PART 3 - EXECUTION

### 3.1 INSPECTION:

- A. Examine areas and conditions under which mechanical insulation is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer and have been tested and approved by the Project Manager.

- B. Workmanship shall be first class and of the highest quality, poor installation or bad appearance as determined by the engineer shall be due cause to reject the entire project in whole and retainage will be withheld until corrective action is completed to the engineer's satisfaction.

### 3.2 GENERAL INSTALLATION:

- A. Continue insulation vapor barriers through penetrations except where prohibited by code.
- B. Install pipe and duct insulation continuous through wall and floor openings except where the penetrated surfaces or assemblies are fire-resistance rated. Provide fire-stop insulation at penetrations of fire-rated surfaces and assemblies. Maintain fire-resistance ratings of penetrated surfaces and assemblies.
- C. Install insulation on cold surfaces with a continuous, unbroken vapor seal. Insulate and vapor seal supports and anchors, which are directly secured to cold surfaces.
- D. Seal all exposed raw edges of insulation with vapor retarder or finishing cement.
- E. Do not use staples on vapor barrier jackets. Where staples must be used, thoroughly seal the vapor barrier penetrations with a white vapor-barrier finish. The Engineer prior to installation must approve use of staples.
- F. Do not weld insulation support pins to pressure vessels.
- G. Leave all insulation surfaces dry and clean, and ready for subsequent work
- H. Install fire stop insulation per manufacturer's listing.

### 3.3 PLUMBING PIPING SYSTEM INSULATION:

- A. Insulation Omitted: Omit insulation on chrome-plated exposed piping (except for handicapped fixtures), air chambers, unions, balance cocks, flow regulators, drain lines from water coolers, drainage piping located in crawl spaces or tunnels, fire protection piping, and pre-insulated equipment.
- B. Cold Piping:
  - 1. Application Requirements: Insulate the following cold plumbing piping systems:
    - a. Potable and non-potable cold water piping.
  - 2. Insulate each piping system specified above with the following types and thicknesses of insulation:
    - a. Above Ground Inside Building Fiberglass; ½ inch thickness.
- C. Hot Piping:
  - 1. Application Requirements: Insulate the following hot plumbing piping systems:
    - a. Potable hot water and tempered piping.
    - b. Potable hot water and tempered recirculating piping.
  - 2. Insulate each piping system specified above with the following types and thicknesses of insulation:
    - a. Fiberglass: 1 inch for pipe sizes up to 1-1/4, 1-1/2" thick for all pipes over 1-1/4".

### 3.4 DUCTWORK SYSTEM INSULATION:

- A. Insulation Omitted: Do not insulate fibrous glass ductwork, or lined ductwork.
- B. Application Requirements: Insulate the following ductwork:
1. Outdoor air intake ductwork and plenums between air entrance and fan inlet or HVAC unit inlet.
  2. Mixed air ductwork and plenums between air entrance and fan inlet or HVAC unit inlet.
  3. HVAC supply ductwork between fan discharge, or HVAC unit discharge, and room terminal outlet.
  4. HVAC return ductwork in unconditioned spaces or exterior.
  5. HVAC plenums and unit housings not pre-insulated at factory or lined.
  6. Rigid oval or round supply air ductwork.
- C. Insulate each ductwork system specified above with the following types and thicknesses of insulation:

APPLICATION	TYPE, THICKNESS	
	FLEXIBLE FIBERGLASS	FLEXIBLE ELASTOMERIC**
Interior; concealed; cold, hot or dual temperature supply duct	1-1/2"	1"

### 3.5 INSTALLATION OF PIPING INSULATION:

- A. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.
- B. Install insulation on pipe systems subsequent to installation of heat tracing, testing, and acceptance of tests.
- C. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other.
- D. Clean and dry pipe surfaces prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.
- E. Maintain integrity of vapor-barrier jackets on cold pipe insulation, and protect to prevent puncture or other damage.
1. Do not use staples or tacks on vapor barrier jackets.
  2. Seal vapor barrier penetrations with vapor barrier finish recommended by the manufacturer.
  3. Seal fitting covers with PVC tape.
  4. Cover all unions, check valves, and other in-line devices. Mark outer covering with indelible marker to identify item covered.
- F. Neatly bevel and seal insulation at all exposed edges.
- G. Cover valves, fittings and similar items in each piping system with equivalent thickness and composition of insulation as applied to adjoining pipe run. Install factory molded, precut or job fabricated units (at Installer's option) except where specific form or type is indicated.
- H. Extend piping insulation without interruption through walls, floors and similar piping penetrations, except where otherwise indicated.
- I. See equipment insulation for removable insulation on accessible piping components.



3.6 INSTALLATION OF DUCTWORK INSULATION:

- A. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose. For exterior ductwork, install insulation with weather protection jacket.
- B. Install insulation materials with smooth and even surfaces.
- C. Clean and dry ductwork prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.
- D. Maintain integrity of vapor-barrier on ductwork insulation, and protect it to prevent puncture and other damage.
  - 1. Avoid the use of staples on vapor barrier jackets.
  - 2. Seal vapor barrier penetrations with vapor barrier tape recommended by the manufacturer.
- E. Extend ductwork insulation without interruption through walls, floors and similar ductwork penetrations, except where otherwise indicated. Ducts subject to physical abuse in mechanical equipment rooms shall be protected with a PVC or aluminum jacket.
- F. Flexible Fiberglass Insulation: Cut back insulation to provide a 2 inch facing overlap at all seams. Seams shall be stapled approximately 6 inches on center with outward clinching staples, then sealed with pressure-sensitive tape matching the facing and designed for use with duct insulation. The underside of ductwork 30 inches or greater shall be secured with mechanical fasteners and speed clips spaced approximately 18 inches on center. The protruding ends of the fasteners should be cut off flush after the speed clips are installed, and then sealed with the same tape as specified above.
- G. Corner Angles: Except for oven and hood exhaust duct insulation, install corner angles on all external corners of insulation on ductwork in exposed finished spaces before covering with jacketing.
- H. Adhere flexible elastomeric sheets to clean oil-free metal surface by compression fit method and full coverage of adhesive. Seal butt joints with same adhesive. For exterior ductwork, notch insulation at reinforcements and joint flanges to provide a smooth surface, unless the reinforcements or joints would penetrate the insulation. Provide a minimum ½ inch cap over any penetrating item. Stagger all joints and seams on multi-layer insulation.

3.7 EXISTING INSULATION REPAIR:

- A. Repair damaged sections of existing mechanical insulation, both previously damaged or damaged during this construction period. Use insulation, install new jacket lapping and sealed over existing.

3.8 PROTECTION AND REPLACEMENT:

- A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.
- B. Protection: Insulation Installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

**END OF SECTION**

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## SECTION 23 20 00

### PIPING

#### PART 1 - GENERAL

##### 1.1 SUBMITTALS:

- A. Refer to Division 1 and 23 00 00 Common Work Results for Mechanical for administrative and procedural requirements for submittals.
- B. Product Data:
  - 1. Submit industry standards and manufacturer's technical product data, installation instructions, and dimensioned drawings for each type of pipe and pipe fitting. Submit piping schedule showing pipe or tube weight, fitting type, and joint type for each piping system.
  - 2. Submit manufacturer's technical product data, including installation instructions for each type of expansion compensation product. Submit expansion compensation schedule showing Manufacturer's figure number, size, location, and features for each required expansion compensation product.
  - 3. Submit manufacturer's technical product data, including installation instructions for each type of support and anchor. Submit pipe hanger and support schedule showing Manufacturer's figure number, size, location, and features for each required pipe hanger and support.
- C. Welding Certifications: Submit reports as required for piping work.
- D. Brazing Certifications: Submit reports as required for piping work.
- E. Shop Drawings: Submit manufacturer's assembly-type shop drawings for each type of expansion compensation product, indicating dimensions, weights, required clearances and methods of assembly of components.
- F. Shop Drawings: Submit shop drawings for fabricated expansion loops indicating location, dimensions, pipe sizes, and location and method of attachment of anchors.
- G. Maintenance Data: Submit maintenance data and spare parts lists for each type of expansion compensation product. Include this data, product data, and shop drawings in Maintenance Manual; in accordance with requirements of Division 23.
- H. Shop Drawings: Submit manufacturer's assembly-type shop drawings for each type of support and anchor, indicating dimensions, weights, required clearances, and methods of assembly of components.
- I. Product certificates signed by the manufacturer of hangers and supports certifying that their products meet the specified requirements.
- J. Maintenance Data: Submit maintenance data and parts list for each type of support and anchor. Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements of Division 23.
- K. Installers of mechanical grooved couplings shall be trained and certified by the coupling manufacturer.
  - 1. Certification shall consist of training of field personnel. Crews installing Mechanical Grooved Couplings shall be supervised on the job site by a person trained to the specific grooved coupling manufacturer's standards.

1.2 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of pipes and pipe fittings; expansion compensation products; and supports and anchors of types and sizes required whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Welder's Qualifications: All welders shall be qualified in accordance with ASME Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Qualifications.
- C. Welding procedures and testing shall comply with the latest revisions of the applicable sections for B31, of the ANSI/ASME standard codes for pressure piping, noted as follows: B31.2 - Fuel Gas Piping Code / B31.5 - Refrigeration Piping / B31.9 - Building Service Piping Code.
- D. Before any welding is performed, the contractor shall submit to the Project Manager, or his authorized, a copy of the Manufacturer's Record of Welder or Welding Operator Qualification Tests and his Welding Procedure Specification together with the Procedure Qualification Record as required by ASME Boiler and Pressure Vessel Code.
- E. Each manufacturer or contractor shall be responsible for the quality of welding done by his organization and shall repair or replace any work not in accordance with these specifications.
- F. Soldering and Brazing procedures shall conform to ANSI B9.1 Standard Safety Code for Mechanical Refrigeration.
- G. Codes and Standards:
  - 1. EJMA Compliance: Construct expansion compensation products in accordance with standards of the Expansion Joint Manufacturer's Association (EJMA).
  - 2. Regulatory Requirements: Comply with applicable plumbing codes pertaining to product materials and installation of supports and anchors.
  - 3. NFPA Compliance: Hangers and supports shall comply with NFPA standard No. 13 when used as a component of a fire protection system and NFPA Standard No. 14 when used as a component of a standpipe system. NFPA 99 shall be used for medical gas systems.
  - 4. UL and FM Compliance: Hangers, supports, and components shall be listed and labeled by UL and FM where used for fire protection piping systems.
  - 5. Duct Hangers: SMACNA Duct Manuals
  - 6. MSS Standard Compliance:
    - a. Provide pipe hangers and supports of which materials, design, and manufacture comply with MSS SP-69.

PART 2 PRODUCTS

2.1 MANUFACTURERS:

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. Manufacturer's Qualifications: Firms regularly engaged in manufacture of pipes and pipe fittings of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

2. Piping Connectors
  - a. Fernco, Inc.
3. Pipe Thread Sealant
  - a. The Rectorseal Corp.
4. Drainage Piping Specialties, including backwater valves, drains, cleanouts, flashing flange and vent flashing sleeve.
  - a. JR Smith
  - b. Zurn Industries
  - c. Wade
  - d. Josam
5. Pipe Hangers and Supports:
  - a. B-Line Systems Inc.
  - b. ANVIL International
  - c. PHD Manufacturing, Inc.
  - d. Unistrut Metal Framing Systems
  - e. Hubbard Enterprises (Supports for domestic water piping)
  - f. Specialty Products Co. (Supports for domestic water piping.
  - g. Erico
  - h. Grinnell
6. Saddles, Shield and Thermal Shield Inserts:
  - a. ANVIL International
  - b. Pipe Shields, Inc.
  - c. B-Line
  - d. Snapp Itz
  - e. Erico
  - f. Value Engineered Products, Inc.
  - g. Grinnell

## 2.2 MATERIALS GENERAL:

- A. Piping Materials: Provide pipe and tube of type, pressure and temperature ratings, capacities, joint type, grade, size and weight (wall thickness or Class) indicated for each service. Where type, grade or class is not indicated, provide proper selection as determined by Installer for installation requirements, and comply with governing regulations and industry standards.
- B. Pipe/Tube Fittings: Provide factory-fabricated fittings of type, materials, grade, class and pressure rating indicated for each service and pipe size. Provide sizes and types matching pipe, tube, valve or equipment connection in each case. Where not otherwise indicated, comply with governing regulations and industry standards for selections, and with pipe manufacturer's recommendations where applicable.

## 2.3 COPPER TUBE AND FITTINGS:

- A. Copper Tube: ASTM B 88; Type K or L as indicated for each service; hard-drawn temper, except as otherwise indicated.

- B. Cast-Copper Solder-Joint Fittings: ANSI B16.18.
- C. Wrought-Copper Solder-Joint Fittings: ANSI B16.22.
- D. Cast-Copper Solder-Joint Drainage Fittings: ANSI B16.23 (drainage and vent with DWV or tube).
- E. Wrought-Copper Solder-Joint Drainage Fittings: ANSI B16.29.
- F. Cast-Copper Flared Tube Fittings: ANSI B16.26.

2.4 CAST-IRON SOIL PIPES AND PIPE FITTINGS:

- A. Hubless Cast-Iron Soil Pipe: FS WW-P-401 and CISPI Standards 301 and 310. Pipe and fittings shall be marked with the collective trademark of the cast iron soil pipe institute or receive prior approval of the engineer.
- B. Cast-Iron Hub-and-Spigot Soil Pipe: ASTM A 74. Pipe and fittings shall be marked with the collective trademark of the cast iron soil pipe institute or receive prior approval of the engineer.
- C. Hubless Cast-Iron Soil Pipe Couplings: Neoprene gasket complying with ASTM C564, CISPI Standard 310 and stainless steel clamp holding band.
- D. Heavy Duty Hubless Cast Iron Soil Pipe Couplings: Neoprene gasket coupling with ASTM C564. 304 stainless steel shield, minimum 0.15 inches thick, minimum 3 inches wide with 4 sealing bands up to 4 inch pipe, minimum 9 inches wide with 6 sealing bands up to 10 inch pipe.
  - 1. Basis of Design: Husky SD 4000.
- E. Cast-Iron Hub-and-Spigot Soil Pipe Fittings: Match soil pipe units; complying with ASTM A 74.
- F. Neoprene Compression Gaskets: ASTM C 564.

2.5 MISCELLANEOUS PIPING MATERIALS/PRODUCTS:

- A. Welding Materials: Except as otherwise indicated, provide welding materials as determined by Installer to comply with installation requirements.
  - 1. Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials.
- B. Soldering Materials: All soldering materials shall be lead free.
  - 1. 95-5 Tin-Antimony: ASTM B 32, Grade 95TA. Melting Range 450-470 degrees F.
  - 2. Silver-Tin Alloy: Fed. Spec. QQ-S-571E, NSFC2. Melting Range 430 to 530 degrees F.
  - 3. Flux: All flux shall be lead free, water soluble, and compatible with the solder and the materials being joined. ASTM B813-93.
- C. Piping Connectors for Dissimilar Non-Pressure Pipe: Elastomeric annular ring insert, or elastomeric flexible coupling secured at each end with stainless steel clamps, sized for exact fit to pipe ends and subject to approval by plumbing code.
  - 1. Manufacturer: Subject to compliance with requirements, provide piping connectors of the following:
    - a. Husky Technologies (Husky SD 4000):

- D. Pipe Thread Sealant Material: Except as otherwise indicated, provide all pipe threads with the sealant material as recommended by the manufacturer for the service.

2.6 PIPE HANGERS & SUPPORTS:

- A. Hangers and support components shall be factory fabricated of materials, design, and manufacturer complying with MSS SP-69.
1. Components shall have galvanized coatings where installed for piping and equipment that will not have field-applied finish.
  2. Pipe attachments shall have nonmetallic coating for electrolytic protection where attachments are in direct contact with copper tubing.
- B. Adjustable Clevis Hanger: MSS Type.
1. Steel Pipe, size 3/8" thru 30", Type 1.
  2. Non-insulated Copper Pipe, size 1/2" thru 4", Type 1. (PVC Coated)
  3. Cast Iron Pipe, size 4" thru 24", Type 1.
- C. Adjustable Swivel Ring for Non-insulated Pipe: MSS Type .
1. Steel Pipe, size 1/2" thru 8", Type 7.
  2. Copper Pipe, size 1/2" thru 4", Type 7 (PVC Coated)
- D. Pipe Clamps: MSS Type .
1. Steel Pipe, size 3/4" thru 24", Type 8.
  2. Copper Pipe, size 1/2" thru 4", Type 8 (PVC Coated).
- E. U Bolts: MSS Type .
1. Steel Pipe, size 1/2" thru 30" Type 24
  2. Copper Pipe, size 1/2" thru 8", Type 24 (PVC Coated).
- F. Straps: MSS Type 26.
- G. Pipe Stanchion Saddle: MSS Type 37.
- H. Yoke & Roller Hanger: MSS Type 43
- I. Hanger Rods: Continuous threaded steel, sizes as specified.
- J. Hangers:
1. Hot Pipes:
    - a. 1/2" through 1-1/2": Adjustable wrought steel ring.
    - b. 2" through 5": Adjustable wrought steel clevis.
    - c. 6" and Over: Adjustable steel yoke and cast iron roll.
  2. Cold Pipes:
    - a. 1/2" through 1-1/2": Adjustable wrought steel ring.

- b. 2" and Over: Adjustable wrought steel clevis.
  - 3. Multiple or Trapeze: Structural steel channel (with web vertical and engineered for the specific applications), with welded spacers and hanger rods. Provide cast iron roll and base plate for hot pipe sizes six inches and over. Provide hanger rods one size larger than for largest pipe in trapeze. If the deflection at center of trapeze exceeds 1/360 of the distance between the end hangers, install an additional hanger at mid-span or use a larger channel.
- K. Wall Supports for Horizontal Steel Pipe:
- 1. ½ inch through 4 inches: Offset or straight j-hook.
  - 2. 4 inches and Over: Welded steel bracket Type 31, 32 or 33 and wrought steel clamp. Provide adjustable steel yoke and cast iron roll Type 44 for hot pipe 200° F and over and for sizes six inches and over.
- L. Supports for Vertical Pipe: Steel riser clamp. Type 8.
- M. Upper Attachments:
- 1. For attaching hanger rods to structural steel I-beams:
    - a. Provide adjustable beam clamp, MSS-Type 21. Attach to bottom flange of beam.
  - 2. For attaching hanger rods to bar joists:
    - a. When bottom chord is constructed of structural steel angles, provide square washer. Place hanger rod between backs of the two angles and support with the washer and dual locking nuts on top of the angles. Spot weld washer to angles.
    - b. When bottom chord is constructed of round bars, provide Elcen No. 137 bar joint washer or equal.

## 2.7 SADDLES AND THERMAL SHIELD INSERTS:

- A. Protection Saddles: MSS Type 39; fill interior voids with segments of insulation matching adjoining insulation.
- B. Protection Shields: MSS Type 40; 180 degrees arc, galvanized steel, minimum 12 inches long, to prevent crushing of insulation.
- C. Thermal Shield Inserts: Provide 100-psi minimum compressive strength, waterproof, asbestos free calcium silicate, encased with a sheet metal enclosure. Insert and shield shall cover the entire circumference or the bottom half circumference of the pipe as required by Part 3 of this Specification, and shall be of length recommended by the manufacturer for pipe size and thickness of insulation. For cold piping, calcium silicate shall extend beyond the sheet metal shield to allow overlap of the vapor barrier. Where piping 4 inches and larger is supported on trapeze or pipe rollers, provide double thickness shields. For piping 12 inches and over, provide 600 psi calcium silicate structural insert.

## PART 3 - EXECUTION

### 3.1 EXAMINATION:



- A. Verify all dimensions by field measurements. Verify that all water distribution piping may be installed in accordance with pertinent codes and regulations, and original design, and the referenced standards.
- B. Examine rough-in requirements for plumbing fixtures and other equipment having water connections to verify actual locations of piping connections prior to installation.
- C. Do not proceed until unsatisfactory conditions have been corrected.
- D. Examine areas and conditions under which expansion compensation products are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer. Coordinate anchor locations & loads with Structural Engineer.
- E. Examine areas and conditions under which supports, and anchors are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

### 3.2 PIPING INSTALLATION:

- A. General: Install pipes and pipe fittings in accordance with recognized industry practices which will achieve permanently-leakproof piping systems, capable of performing each indicated service without piping failure. Install each run with minimum joints and couplings, but with adequate and accessible unions for disassembly and maintenance/replacement of valves and equipment. Reduce sizes (where indicated) by use of reducing fittings. Align piping accurately at connections, within 1/16 inch misalignment tolerance.
  - 1. Comply with ANSI B31 Code for Pressure Piping.
  - 2. Electrical Equipment Spaces: Do not run piping through transformer vaults and other electrical or electronic equipment spaces and enclosures. Only piping serving this type of equipment space shall be allowed.
  - 3. Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of piping systems. Locations and arrangements of piping take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated.
  - 4. Use fittings for all changes in direction and all branch connections.
  - 5. Install piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.
  - 6. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.
  - 7. Install piping tight to slabs, beams, joists, columns, walls, and other permanent elements of the building. Provide space to permit insulation applications, with 1 inch clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.
  - 8. Locate groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
  - 9. Install drains in pressure pipe systems at all low points in mains, risers, and branch lines consisting of a tee fitting, 3/4 inch ball valve, and short 3/4 inch threaded end nipple and cap with chain.
  - 10. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.
  - 11. Fire and Smoke Wall Penetrations: Where pipes pass through fire and smoke rated walls, partitions, ceilings, and floors, maintain the fire and smoke rated integrity. Refer to Division 23, Sections 23 05 18 and 23 05 07 for materials.
  - 12. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and mechanical sleeve seals (See Section 23 05 18). Pipe sleeves smaller than 6 inch shall be steel; pipe sleeves 6 inches and larger shall be sheet metal.
  - 13. Anchor piping to ensure proper direction of expansion and contraction.
  - 14. Coordinate foundation and all other structural penetrations with structural engineer.

15. Install drainage piping with a minimum 1/8" per foot downward slope in the direction of the drain and maximum slope of 1/4" per foot.
16. Install pipe connections to pumps, compressors, etc. with adequate allowance for movement and vibration. Support connections so the equipment does not carry weight.

B. Sanitary Waste and Vent; Roof Drain and Storm Drain Piping:

1. Install plumbing drainage piping with 1/4 inch per foot (2 percent) downward slope in direction of drain for piping 3 inches and smaller, and 1/8 inch per foot (1 percent) for piping 4 inch and larger. Install cast iron pipe in accordance with the Cast Iron Soil Pipe Institute Handbook.
2. Install 1 inch thick extruded polystyrene over underground drainage piping that is above frost line and not under building. Provide width to extend minimum of 12 inches beyond each side of pipe. Install directly over pipe, centered on pipe center line.
3. Make changes in direction for drainage and vent piping using appropriate 45 degree wyes, half-wyes, or long sweep quarter, sixth, eighth, or sixteenth bends. SANITARY CROSSES OR SHORT QUARTER BENDS SHALL NOT BE USED IN DRAIN PIPING.
4. Provide thrust restraints (bracing to structure or rodded joints) at branches and changes in direction for cast iron pipe 5 inches and larger suspended within the building.
5. Where cast iron piping is suspended in excess of 18 inches on single rod hangers, sway bracing shall be provided to prevent shear at the joints.
6. Install underground drain piping to conform with the plumbing code, and in accordance with the Cast Iron Soil Pipe Institute Engineering Manual.
7. Lay piping beginning at low point of system, true to grades and alignment indicated, with unbroken continuity of invert.
8. Place bell ends or groove ends of piping facing upstream.
9. Install gaskets in accordance with manufacturer's recommendations for use of lubricants, cements, and other special installation requirements.
10. Install sub-surface drain piping according to requirements of the soils engineers requirements when required and connect to storm sewer / sump pump.
11. Grade trench bottoms to provide a smooth, firm, and stable foundation, free from rock, throughout the length of the pipe.
12. Remove unstable, soft, and unsuitable materials at the surface upon which pipes shall be laid, and backfill with clean sand or pea gravel to indicated invert elevation.
13. Shape bottom of trench to fit the bottom 1/4 of the circumference of pipe. Fill unevenness with tamped sand. At each pipe joint dig bell holes to relieve the bell of the pipe of all loads, and to ensure continuous bearing of the pipe barrel on the foundation.

3.3 PIPING SYSTEM JOINTS:

- A. General: Provide joints of type indicated in each piping system.
- B. Thread pipe in accordance with ANSI B2.1; cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe joint compound, or pipe joint tape (Teflon) where recommended by pipe/fitting manufacturer, on male threads at each joint and tighten joint to leave not more than 3 threads exposed.
- C. Solder copper tube-and-fitting joints with silver solder or 95-5 tin-antimony. Cut tube ends squarely, ream to full inside diameter, and clean outside of tube ends and inside of fittings. Apply solder flux to joint areas of both tubes and fittings. Insert tube full depth into fitting, and solder in manner which will draw solder full depth and circumference of joint. Wipe excess solder from joint before it hardens.
- D. Hubless Cast-Iron Joints: Comply with coupling manufacturer's installation instructions. Use pre-set torque wrench set to 80 in-lbs on heavy duty couplings.

3.4 PIPE JOINT CONSTRUCTION:

- A. Soldered Joints: Comply with the procedures contained in the AWS "Soldering Manual".
- B. Brazed Joints: Comply with the procedures contained in the AWS "Brazing Manual". CAUTION: Remove stems, seats, and packing of valves and accessible internal parts at piping specialties before brazing.
- C. Fill all medical gas and refrigerant pipe and fittings during brazing with an inert gas, i.e., nitrogen or carbon dioxide, to prevent formation of scale.
- D. Heat joints using oxy-acetylene torch. Heat to proper and uniform temperature.
- E. For all copper piping, ream and remove all burrs prior to making joints.
- F. Threaded Joints: Conform to ANSI B1.20.1.
- G. Damaged Threads: Do not use pipe with threads that are corroded or damaged. If a weld opens during cutting or threading operations, that portion of pipe shall not be used.

### 3.5 PIPE FITTINGS:

- A. Use dielectric waterway fittings where dissimilar metals are connected. Isolate building distribution gas piping with dielectric unions from gas main for cathodic protection.
- B. Make reductions in size with reducing fittings.
- C. All screwed nipples from copper fittings shall be red brass.

### 3.6 PIPING APPLICATION:

#### A. Domestic Hot and Cold Water - Inside Building:

##### 1. Above Grade Inside Building:

- a. 6 inches and Smaller: Type L, hard drawn copper tube with wrought copper or bronze fittings lead free soldered joints, or schedule 40 galvanized steel pipe A53 grade B, ERW, with galvanized grooved end fittings.

#### B. Sanitary Drainage and Vents - Inside Building:

- 1. Above Grade: Service weight cast iron, no-hub type with neoprene gaskets; service weight cast iron, hub and spigot type with neoprene gaskets; or DWV copper with wrought copper or cast brass fittings.

- a. Provide heavy duty no hub couplings 4" wide 304 stainless steel shield on pipe, with six (6) stainless steel clamps mounted in series on the following:

- 1) Sanitary vent piping 4" and larger
- 2) Sanitary piping 3" and larger
- 3) All storm piping

- 2. Below Grade: Match the existing piping being connected to.

- 3. Cleanout Openings: Two-way type, 1-1/4 inch nominal size minimum and located such that long lines can be entered from both ends. Lubricate plugs at installation.

3.7 EXPOSED PIPING IN FINISHED AREAS:

- A. Plumbing piping and fittings which are exposed (and uninsulated) in finished areas generally occupied by people including, but not limited to, kitchens, animal cagewash/equipment washing rooms, hospital autoclave or sterilizing rooms shall be installed with a smooth, high polish, durable chrome plated finish.

3.8 PIPING TESTS:

- A. General: Provide temporary equipment for testing, including pump and gauges. Test piping system before insulation is installed wherever feasible, and remove control devices before testing. Test each section of each piping system independently but do not use piping system valves to isolate sections where test pressure exceeds valve pressure rating. Fill each section with water and pressurize for indicated pressure and time.
- B. Test all piping systems as specified. Correct leaks by remaking joints. Remove equipment not able to withstand test procedure during test.
- C. Work to be installed shall remain uncovered until the required tests have been completed.
- D. Piping which is to be concealed shall be tested before being permanently enclosed.
- E. As soon as work has been completed, conduct preliminary tests to ascertain compliance with specified requirements. Make repairs or replacements as required.
- F. Give a minimum of twenty-four hours notice to Engineer of dates when acceptance test will be conducted. Conduct tests as specified for each system in presence of University Project Manager or agency having jurisdiction or his representative. Submit three (3) copies of successful tests to the Engineer for his review. Report shall state system tested and date of successful test.
- G. Contractor shall obtain certificates of approval, acceptance and compliance with regulations of agencies having jurisdiction. Work shall not be considered complete until such certificates have been delivered by the Engineer to the Owner.
- H. All costs involved in these tests shall be borne by Contractor.
- I. System Tests
  - 1. Hydrostatic Test: The test shall be accomplished by hand pumping the system to the specified water pressure, and maintaining that pressure until the entire system has been inspected for leaks, but in no case for a time period of less than four hours.
    - a. Domestic water systems: 100 psig or 150 percent of system pressure, whichever is greater.
    - b. Heating water: 100 psig or 150 percent of operating pressure, whichever is greater.
    - c. Chilled water: 100 psig or 150 percent of system pressure, whichever is greater.
    - d. Condenser water: 100 psig or 150 percent of system pressure, whichever is greater.
  - 2. Compressed Air or Nitrogen Test: Compressed air tests may be substituted for hydrostatic tests only when ambient conditions or existing building conditions prohibit safe use of hydrostatic testing and must be reviewed by the Engineer prior to any testing. For tests of this type, the piping system shall be subjected to the gas pressure indicated for that specific system. The piping capped or plugged and water-pumped with oil free air, or a nitrogen bottle shall be introduced into the entire system to the pressure specified. The system shall maintain that pressure for the duration of a soapy water test of each joint.

3. Waste, Drain and Vent Piping: All waste and vent piping, including building drain, roof drain and building sewer, shall be subjected to a water test. All openings in the piping system shall be tightly closed, except the highest opening, and the system filled with water to the point of overflow. The water shall be kept in the system, or in the portion under test, for at least 15 minutes before inspection starts; the system shall then be tight to all points. No section shall be tested with less than a ten foot head of water. Roof drain shall be closed at the lowest point and filled with water to the point of overflow.
4. Sump Pump Discharge: With water in sump and pump running at full capacity, check for leaks until satisfied that system is tight.
5. Repair piping systems sections which fail required piping test, by disassembly and re-installation, using new materials to extent required to overcome leakage. Do not use chemicals, stop-leak compounds, mastics, or other temporary repair methods.
6. Drain test water from piping systems after testing and repair work has been completed.
7. Gas Pipe Testing: Test with air, nitrogen or carbon dioxide with a pressure 1-1/2 times the proposed maximum working pressure, but not less than 3 psig. Test systems having a volume of 10 cubic feet or less for a period of not less than 10 minutes and larger systems for a period of not less than 1/2 hour for each 500 cubic foot of pipe volume or fraction thereof without showing any drop in pressure. Fully purge gas piping after piping has been checked.

### 3.9 UNDERGROUND PIPE INSTALLATION:

- A. Clean fittings, nipples and other field joints thoroughly before coating.
- B. Protect gray and ductile cast iron pipe installed below grade with polyethylene encasement applied in strict accordance with ANSI/AWWA C105/A21.5.
- C. Install ductile iron pipe below grade as prescribed by AWWA C600.
- D. Provide concrete thrust block and 3/4 inch steel threaded tie bar at each direction change on underground pressure pipe. Imbed tie bar in thrust block and connect to upstream fitting. Paint tie bar with two coats of bitumastic #50 paint.
- E. Bury all outside water piping minimum 5 feet-0 inches below grade to top of pipe.

### 3.10 PREPARATION:

- A. Proceed with installation of hangers, supports and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including (but not limited to) proper placement of inserts, anchors and other building structural attachments. Review Structural Drawings to obtain structural support limitations.
- B. Prior to installation of hangers, supports, anchors and associated work, Installer shall meet at project site with Contractor, installer of each component of associated work, inspection and testing agency representatives (if any), installers of other work requiring coordination with work of this section and Architect/Engineer for purpose of reviewing material selections and procedures to be followed in performing the work in compliance with requirements specified. Provide Shop Drawing showing method and support locations from structure.

### 3.11 INSTALLATION OF BUILDING ATTACHMENTS:

- A. Install building attachments within concrete or on structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert to forms. Where concrete with

compressive strength less than 2500 psi is indicated, install reinforcing bars through openings at top of inserts.

B. Existing Construction:

1. In existing concrete construction, drill into concrete slab and insert and tighten expansion anchor bolt. Connect anchor bolt to hanger rod. Care must be taken in existing concrete construction not to sever reinforcement rods or tension wires.

3.12 INSTALLATION OF HANGERS AND SUPPORTS:

- A. Install hangers, supports, clamps and attachments to support piping properly from building structure; comply with MSS SP-69. Arrange for grouping of parallel runs of horizontal piping to be supported together on field fabricated, heavy-duty trapeze hangers where possible. Install supports with maximum spacings complying with MSS SP-69. Where piping of various sizes is supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping.
- B. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories.
- C. Support fire-water piping independently from other piping systems.
- D. Prevent electrolysis and abrasion in support of copper tubing by use of hangers and supports which are plastic coated, or with EPDM isolation strips. Duct tape or copper coated hangers are not acceptable.
- E. Install hangers and supports to allow controlled movement of piping systems, to permit freedom of movement between pipe anchors, to facilitate action of expansion joints, expansion loops, expansion bends and similar units and within 1'-0" of each horizontal elbow.
- F. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.
- G. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes, and so that maximum pipe deflections allowed by ANSI B31.9 Building Services Piping Code is not exceeded.
- H. Insulated Piping: Comply with the following installation requirements.
1. Clamps: Attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ANSI B31.
  2. Saddles: Install Protection saddles where supported by pipe rollers. Fill interior voids with segments of insulation that match adjoining pipe insulation.
  3. Shields: Install galvanized steel protection shields, on all insulated piping 2 inches and less, except where required to be clamped. Where necessary to prevent dislocation, strap shield to pipe with wire ties or "Zip Strips".
  4. Thermal Inserts: Provide thermal shield inserts at all supports for all insulated piping over 2 inches and for all piping required to be clamped. Provide 180 percent inserts at clevis and roller hangers. Provide 360 percent inserts for all trapeze and clamped supports.
- I. Install medical gas piping hangers with the following maximum spacing.
1. 1/2" Pipe Size: 6' O.C.
  2. 3/4" Pipe Size: 7' O.C., 1" pipe size: 8'
  3. 1-1/4" or Larger Pipe Size: 9' O.C.
  4. 1-1/2" and larger: 10'

5. Vertical Piping: Every floor level.
- J. Support horizontal cast iron pipe as follows:
1. Hub & Spigot: All sizes.
    - a. 10 ft. max spacing: min of one (1) hanger per pipe section close to joint on the barrel. Also at change of direction and branch connections.
    - b. Support vertical cast iron pipe at each story height and at its base. Secure vertical hub and spigot pipe immediately below the hub.
    - c. Use hanger rods same size as for steel pipe.
  2. No-Hub: All sizes
    - a. With Clamp-All and Anaheim Series 4000 stainless steel couplings and MG cast iron couplings: one hanger to each joint.
    - b. With all other stainless steel band type couplings: one hanger to each side of joint.
    - c. Support all horizontal cast iron pipe within 18 inches of each joint and with 5 feet maximum spacing between hangers, except that pipe exceeding 5 feet in length shall be supported at intervals no greater than 10 feet.
    - d. Use hanger rods same size as for steel pipe.
    - e. Support vertical cast iron pipe at each story height and at its base. Support vertical no-hub pipe so that the weight is carried from the pipe to the support and not from the joint to the support.
- K. Place a hanger within one foot of each horizontal elbow.
- L. Use hangers which are vertically adjustable 1-1/2 inch minimum after piping is erected.
- M. Support vertical steel and copper piping at every story height but at not more than 15 foot intervals for steel and 10 feet for copper.
- N. Where several pipes can be installed in parallel and at same elevation, provide trapeze hangers.
- O. Where practical, support riser piping independently of connected horizontal piping.
- P. Each pipe drop to equipment shall be adequately supported. All supporting lugs or guides shall be securely anchored to the building structure.
- Q. Securely anchor and support plumbing domestic water piping in chases or walls. Use factory manufactured clamps and brackets connected to fixture s, waste/vent piping or brackets connected to studs. Wires or straps will not be permitted.
1. When copper supplies are connected to flush valves, support the tubing by the studs or by a fixture, not by clamping to waste/vent piping.
  2. Prevent copper tubes from making contact with steel brackets using fire retardant polyethylene inserts or other dielectric insulating material. Duct tape shall not be used.
- R. Install anchors and fasteners in accordance with manufacturer's recommendations and the following:
1. In the event a self-drilling expansion shield or machine bolt expansion shield is considered to have been installed improperly, the Contractor shall make an acceptable replacement or demonstrate the stability of the anchor by performing an on-site test under which the anchor will be subjected to a load equal to twice the actual load.

2. Powder-driven fasteners may be used only where they will be concealed after the construction is complete. Where an occasional fastener appears to be improperly installed, additional fastener(s) shall be driven nearby (not closer than 6 inches) in undisturbed concrete. Where it is considered that many fasteners are improperly installed, the Contractor shall test load any 50 successively driven fasteners. If 10 percent or more of these fasteners fail, the Contractor shall utilize other fastening means as approved and at no additional cost to the Owner.
3. Hangers for piping and ducts shall be attached to cellular steel floor decks with steel plates and bolted rod conforming to the steel deck manufacturer's requirements. Where the individual hanger load exceeds the capacity of a single floor deck attachment, steel angles, beams or channels shall be provided to span the number of floor deck attachments required.
4. Welding may be used for securing hangers to steel structural members. Welded attachments shall be designed so that the fiber stress at any point of the weld or attachment will not exceed the fiber stress in the hanger rod.

### 3.13 INSTALLATION OF ANCHORS:

- A. Install anchors at proper locations to prevent stresses from exceeding those permitted by ANSI B31.9, and to prevent transfer of loading and stresses to connected equipment.
- B. Fabricate and install anchor by welding steel shapes, plates and bars to piping and to structure. Comply with ANSI B31.9 and with AWS Standards D1.1.
- C. Where expansion compensators are indicated, install anchors in accordance with expansion unit manufacturer's written instructions, to control movement to compensators.
- D. Anchor Spacings: Where not otherwise indicated, install anchors at ends of principal pipe-runs, at intermediate points in pipe-runs between expansion loops and bends. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping. Provide shop drawing for review by Engineer.

### 3.14 ADJUSTING AND CLEANING:

- A. General: Clean exterior surfaces of installed piping systems of superfluous materials, and prepare for application of specified coatings (if any). Flush out piping systems with clean water before proceeding with required tests. Inspect each run of each system for completion of joints, supports and accessory items.
  1. Inspect pressure piping in accordance with procedures of ASME B31.
- B. Disinfect all potable water mains and water service piping in accordance with local and health department requirements. Submit test results report.
- C. Clean and flush hydronic piping systems. Remove, clean, and replace strainer screens. After cleaning and flushing hydronic piping system, but before balancing, remove disposable fine mesh strainers in pump suction diffusers. Flush each new system with the University Representative present. Fill each new system with the proper chemicals and with the University Representative present.
- D. Chemical Treatment: Provide a water analysis prepared by the chemical treatment supplier to determine the type and level of chemicals required for prevention of scale and corrosion. Perform initial treatment after completion of system testing.
- E. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe. Cut off the bottom of threaded rods so they are no more than one rod diameter below the bottom nut.



- F. Touch-Up Painting: Immediately after erection of anchors and supports, clean field welds and abraded areas of shop paint and paint exposed areas with same material as used for shop painting to comply with SSPC-PA-1 requirements for touch-up of field-painted surfaces.

1. Touch-Up Painting: Cleaning and touch-up painting of field welds, bolted connections, and abraded areas of the shop paint on miscellaneous metal is specified in Division 9 section "Painting" of these specifications.

- G. For galvanized surfaces clean welds bolted connections and abraded areas and apply galvanizing repair paint to comply with ASTM A 780.

3.15 COMMISSIONING:

- A. Fill system and perform initial chemical treatment.
- B. Check expansion tanks to determine that they are not air bound and that the system is completely full of water.
- C. Before operating the system perform these steps:
1. Open valves to full open position. Close coil bypass valves.
  2. Remove and clean strainers.
  3. Check pump for proper rotation and proper wiring.
  4. Set automatic fill valves for required system pressure.
  5. Check air vents at high points of systems and determine if all are installed and operating freely (automatic type) or to bleed air completely (manual type).
  6. Set temperature controls so all coils are calling for full flow.
  7. Check operation of automatic bypass valve.
  8. Check and set operating temperature of boilers, chillers, and cooling towers to design requirements.
  9. Lubricate motors and bearings.

**END OF SECTION**

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## SECTION 23 21 16

### PIPING SPECIALTIES

#### PART 1 - GENERAL

##### 1.1 DESCRIPTION OF WORK:

- A. Extent of piping specialties work required by this section is indicated on drawings and schedules and by requirements of this section.
- B. Piping specialties furnished as part of factory-fabricated equipment, are specified as part of equipment assembly in other Division-23 sections.

##### 1.2 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of piping specialties of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Codes and Standards:
  - 1. FCI Compliance: Test and rate "Y" type strainers in accordance with FCI 73-1 "Pressure Rating Standard for "Y" Type Strainers". Test and rate other type strainers in accordance with FCI 78-1 "Pressure Rating Standard for Pipeline Strainers Other than "Y" Type".
  - 2. ASME B 31.9 "Building Services Piping" for materials, products, and installation.
  - 3. Safety valves and pressure vessels shall bear the appropriate ASME label.
  - 4. Fabricate and stamp air separators and compression tanks to comply with ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.
  - 5. ASME "Boiler and Pressure Vessel Code", Section IX, "Welding and Brazing Qualification" for qualifications for welding processes and operators.

##### 1.3 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical product data, including installation instructions, and dimensioned drawings for each type of manufactured piping specialty. Include pressure drop curve or chart for each type and size of pipeline strainer. Submit schedule showing manufacturer's figure number, size, location, and features for each required piping specialty.
- B. Shop Drawings: Submit for fabricated specialties, indicating details of fabrication, materials, and method of support.
- C. Maintenance Data: Submit maintenance data and spare parts lists for each type of manufactured piping specialty. Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements of Division 23.

#### PART 2 - PRODUCTS

##### 2.1 MANUFACTURERS:

- A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:

1. Pipe Escutcheons:
  - a. Chicago Specialty Mfg. Co.
  - b. Producers Specialty & Mfg. Corp.
  - c. Sanitary-Dash Mfg. Co.

## 2.2 PIPE ESCUTCHEONS:

- A. General: Provide pipe escutcheons as specified herein with inside diameter closely fitting pipe outside diameter, or outside of pipe insulation where pipe is insulated. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, walls, or ceilings; and pipe sleeve extension, if any. Furnish pipe escutcheons with nickel or chrome finish for occupied areas, prime paint finish for unoccupied areas.
- B. Pipe Escutcheons for Moist Areas: For waterproof floors, and areas where water and condensation can be expected to accumulate, provide cast brass or sheet brass escutcheons, solid or split hinged.
- C. Pipe Escutcheons for Oversized Holes: Provide sheet steel escutcheons, solid or split hinged.

## PART 3 - EXECUTION

### 3.1 INSTALLATION OF PIPING SPECIALTIES:

- A. Pipe Escutcheons: Install pipe escutcheons on each pipe penetration thru floors, walls, partitions, and ceilings where penetration is exposed to view; and on exterior of building. Secure escutcheon to pipe or insulation so escutcheon covers penetration hole, and is flush with adjoining surface.
- B. For BSL-3 spaces, the wall penetration shall be sealed air tight prior to installation of escutcheons.

**END OF SECTION**

**SECTION 23 30 00**

**HVAC AIR DISTRIBUTION**

**PART 1 - GENERAL**

**1.1 DESCRIPTION OF WORK:**

- A. Extent of metal ductwork is indicated on drawings and in schedules, and by requirements of this section.

DUCT SERVICE	TYPE/CONSTRUCTION
Rectangular supply air from discharge of terminal box/fan to air devices (low pressure).	Galvanized sheet metal /spiral round and oval or rectangular
General building exhaust.	Galvanized sheet metal (lined as noted on drawings); factory or shop fabricated.
Bio-hazard room air and Bio-safety cabinets exhaust air.	304 stainless steel all welded construction; factory or shop fabricated. OR Match existing exhaust ductwork material to the system serving the rooms being remodeled.

- B. Refer to other Division-23 sections for testing, adjusting, and balancing of metal ductwork systems.

**1.2 DEFINITIONS:**

- A. Low Pressure Duct: Duct required by the drawings, specifications, or referenced standards to be constructed to 2" or less, positive or negative pressure class.
- B. Medium or High Pressure Duct: Duct required by the drawings, specifications, or referenced standards to be constructed to greater than 2" positive or negative pressure class.

**1.3 QUALITY ASSURANCE:**

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of metal ductwork products of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer's Qualifications: Firm with at least 3 years of successful installation experience on projects with metal ductwork systems similar to that required for project.
- C. References to SMACNA, ASHRAE and NFPA are minimum requirements, the Contractor shall fabricate, construct, install, seal and leak test all ductwork as described in this specification and as shown on the drawings, in addition to these minimum standard references.
- D. Codes and Standards:

1. SMACNA Standards: Comply with the current SMACNA "HVAC Duct Construction Standards, Metal and Flexible" for fabrication and installation of metal ductwork. Comply with SMACNA "HVAC Air Duct Leakage Test Manual" for testing of duct systems.
2. NFPA Compliance: Comply with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" and NFPA 90B "Standard for the Installation of Warm Air Heating and Air Conditioning Systems".
3. NFPA Compliance: Construct sound attenuators using acoustical fill complying with NFPA 90A, "Air Conditioning and Ventilating Systems."
4. ASTM Compliances: Comply with applicable requirements of ASTM E90 and E477.
5. AMCA 1011 CRP Compliance

E. SMACNA Industrial Construction Standards.

F. Field Reference Manual: Have available for reference at project field office, copy of the current SMACNA "HVAC Duct Construction Standards, Metal and Flexible", and the current SMACNA "HVAC Air Duct Leakage Test Manual".

#### 1.4 SUBMITTALS:

A. Product Data:

6. Submit manufacturer's technical product data and installation instructions for ductwork materials and products. Provide product data for manufactured joining systems. Include sound attenuation by octave band for sound rated flexible duct.
7. Submit manufacturer's technical product data, including performance data for each size and type of air terminal, sound attenuator, louver and air device furnished; schedule showing drawing designation, room location, number furnished, model number, size, and accessories furnished; and installation and start-up instructions.
8. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weight loadings, required clearances, and methods of assembly of components.
9. Wiring Diagrams: Submit ladder-type wiring diagrams for electric power and control components, clearly indicating required field electrical connections.

B. Shop Drawings: Submit 1/4" scaled fabrication and layout drawings of metal ductwork and fittings including, but not limited to, duct sizes, locations, elevations, and slopes of horizontal runs, wall and floor penetrations, and connections. Show interface and spatial relationship between ductwork and proximate equipment. Show modifications of indicated requirements, made to conform to local shop practice, and how those modifications ensure that free area, materials, and rigidity are not reduced.

C. Clean Duct Protocol Procedures: Submit written procedures confirming compliance with the clean duct protocol.

D. Record Drawings: At project closeout, submit record drawings of installed systems, in accordance with requirements of Divisions 1 and 23.

E. Maintenance Data: Submit maintenance data and parts lists for metal ductwork materials, products, sound attenuators, each type of air terminal, maintenance data with cleaning instructions for finishes and spare parts lists for all air devices. Include this data, product data, shop drawings, and record drawings in maintenance manual; in accordance with requirements of Divisions 1 and 23.

#### 1.5 DELIVERY, STORAGE, AND HANDLING:

- A. Protection: Protect ductwork, accessories and purchased products from damage during shipping, storage and handling. Prevent end damage and prevent dirt and moisture from entering ducts, fittings and products.
- B. Storage: Store ductwork, fittings and products inside elevated from floor on pallets and protected from weather, dirt, dust and debris.
- C. Clean Duct Protocol: Contractor shall take every precaution to prevent contamination of all/supply duct. Develop procedures similar or more substantial than the following:
  - 10. In the shop: The inside of ductwork shall be wiped down after fabrication with an oil cutting solvent to remove fabrication oils. All ductwork 96" and less in any single dimension shall be assembled in the shop, with plastic film placed over the open ends.
  - 11. In transport: Ductwork shall be shipped in closed trucks or trailers on pallets. End covers shall be maintained at all times.
  - 12. At the site: Minimize ductwork in storage – "just in time" delivery is encouraged. Ductwork shall be stored on pallets in weather-tight enclosures. Ductwork may be stored on pallets in the building if the building is weather-tight, in a dedicated location separated from the rest of the construction area by dust tight partitions. End covers shall be maintained at all times.
  - 13. During installation: Duct sections shall be staged at the installation location only as needed for installation within 4 hours. Any field assembly of ducts over 96" shall be made only in dedicated dust-free areas, or where other construction activities in the vicinity have ceased to produce dust, dirt or debris. End caps shall be maintained on all openings except one being actively joined.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 14. Flexible Ducts
  - 15. Duct Take Off Fittings
    - a. Hercules Industries
    - b. Flexmaster
    - c. Thermaflex
  - 16. Grilles, Registers and Diffusers:
    - d. Metalaire
    - e. Titus
    - f. Price
    - g. Nailor
  - 17. Dampers:
    - h. Greenheck
    - i. Ruskin
    - j. Pottoroff

18. Duct Hardware:

- k. Ventfabrics, Inc.
- l. Young Regulator Co.
- m. Duro-Dyne Corp.

19. Duct Access Doors:

- n. Kess
- o. Greenheck
- p. Flexmaster
- q. Cesco-Advanced Air
- r. Duro Dyne Corp.
- s. Ventfabrics, Inc.

2.2 DUCTWORK MATERIALS:

- A. Exposed Ductwork Materials: Where ductwork is exposed to view in occupied spaces, provide materials which are free from visual imperfections including pitting, seam marks, roller marks, stains, dents, discolorations, and other imperfections, including those which would impair painting.
- B. Sheet Metal: Except as otherwise indicated, fabricate ductwork from galvanized sheet steel complying with ASTM A 527, lockforming quality; with G 90 zinc coating in accordance with ASTM A 525; and mill phosphatized for exposed locations. Provide flat seam construction where standing seams are a hazard to the Owner's operation personnel.
- C. Stainless Steel Sheet: Where indicated, provide stainless steel complying with ASTM A 480; Type 316; with No. 4 finish where exposed to view in occupied spaces, Type 304 No. 1 finish elsewhere. Protect finished surfaces with mill-applied adhesive protective paper, maintained through fabrication and installation.

2.3 MISCELLANEOUS DUCTWORK MATERIALS:

- A. General: Provide miscellaneous materials and products of types and sizes indicated and, where not otherwise indicated, provide type and size required to comply with ductwork system requirements including proper connection of ductwork and equipment.
- B. Fittings: Provide radius type fittings fabricated of multiple sections with maximum 15 deg. change of direction per section. Unless specifically detailed otherwise, use 45 deg. laterals and 45 deg. elbows for branch takeoff connections. Where 90 deg. branches are indicated, provide conical type tees.
- C. Duct Sealant: UL listed, Class I flame spread 0, fuel contributed 0, smoke developed 0, water based non-hardening, non-migrating mastic or liquid elastic sealant, type applicable for fabrication/ installation detail, as compounded and recommended by manufacturer specifically for sealing joints and seams in ductwork. All PVC coated exhaust ductwork shall be sealed with an approved chemical resistant sealant as manufactured by Foremost Co. PCD No. 8 duct sealer and wrap with hardcast tape. For outdoor ductwork, sealant shall also be U.V. resistant and weather resistant.
- D. Ductwork Support Materials: Except as otherwise indicated, provide hot-dipped galvanized steel fasteners, anchors, rods, straps, trim and angles for support of ductwork.

20. For exposed stainless steel ductwork, provide matching stainless steel support materials.



21. For aluminum ductwork, provide aluminum support materials except where materials are electrolytically separated from ductwork.
- E. Flexible Ducts: Flexible air ducts shall be listed under UL-181 standards as Class I Air Duct Material and shall comply with NFPA Standards 90A and 90B. Minimum operating pressure rating shall be 10" W.C. positive, 1" negative for sizes up to 12" through a temperature range of -20° to 150°F; minimum working velocity rating shall be 4000 f.p.m. Contractor shall assume responsibility for supplying material approved by the authority having jurisdiction.
22. All flexible duct shall be rated for sound attenuation. Inner core shall be black CPE supported by a galvanized steel helix, with minimum R-5 insulation and metalized reinforced outer jacket. Sound attenuation shall be as scheduled below:

INSERTION LOSS dB (6-foot Section, Flexmaster 1M-R6, 500 FPM Air Velocity)							
Octave Band	125	250	500	1000	2000	4000	8000
8" Diameter	5.6	10.6	23.9	34.0	22.5	17.0	11.9
12" Diameter	6.6	27.8	22.8	29.0	18.7	10.9	8.2

- a. Flexmaster Type 1M
23. Non-insulated flexible ducts shall be the same as insulated less the insulation and other jacket.
- F. Duct Take Off Fittings to Individual Air Inlets & Outlets: Provide conical spin-in fittings at flexible or round sheet metal duct takeoffs. Where specifically shown on drawings, where the duct dimension does not allow for a conical spin-in, or at Contractor's option, provide 45° inlet rectangular to round duct take off fittings, with factory applied gasket. Fittings shall include butterfly type manual volume damper with regulator, and dual locking device. Dual locking device shall consist of two shaft mounted wing nuts, one on each side of the damper. Wing nuts shall tighten on shafts to lock butterfly in place. Shafts shall be solid metal, rolled metal shafts are not acceptable.
- G. Duct take off fittings to air terminals: same as for individual air inlets and outlets, less the damper.
- H. All fasteners and hardware for stainless steel ductwork shall be made of stainless steel.
- 2.4 MANUAL VOLUME DAMPERS:
- A. Low Pressure Rectangular Dampers (less than 2000 FPM and under 2" W.C. S.P. Differential):
24. For 12" in height or larger, use multiple opposed blade type and close fitted to ducts. The frame and blades shall be constructed of 16 ga. galvanized steel with plated steel shaft mounted with synthetic bearings. Linkage shall be in-jamb fixed type located outside the airstream made of plated steel tie bar and crank plates, with stainless steel pivots. Damper panels shall not exceed 48" wide. Provide jack shafting when duct size required is greater than 48" wide. Provide notched shaft end indicating damper position, locking quadrant to fix damper position and handle.

Provide stand off bracket for insulated ducts. For flat oval and round ductwork, provide type C housing.

25. For ducts less than 12" in height, frame shall be 18 ga. blade galvanized steel, steel axle with synthetic bearings locking quadrant handle and notched shaft end indicating damper position. Provide stand off bracket for insulated ducts.

B. Low Pressure Round Dampers (less than 1800 FPM and under 1" W.C. S.P. differential):

26. For low pressure spin-in fitting dampers serving individual returns/diffusers, see 15891.  
27. Dampers 4" diameter through 18" diameter shall be 20 ga. galvanized steel frame and blade, utilize multi-blade square dampers with transitions for ducts over 18" diameter.

Axle shaft shall be plated steel with retainers mounted on synthetic bearings with notched end shaft indicating damper position, locking quadrant and handle. Provide stand off brackets for insulated ducts.

- a. Greenheck M8DR-50 or approved equivalent.

C. Medium/High Pressure Rectangular Dampers (less than 4000 FPM and under 6" W.C. (48" wide or less) S.P. or 8" W.C. S.P. (36" wide or less)):

28. Dampers shall be opposed blade for volume control and parallel blade for isolation/shut-off service.  
29. Frame shall be 16 ga. galvanized steel with welded corners or 1/8" thick 6063-T5 alloy aluminum frame. Blades shall be double skin galvanized steel with single-lock seam, or .081" thick 6060-T5 extruded aluminum, airfoil shape. Blade edge seals shall be vinyl, silicone, or other approved synthetic and metallic compression seals at the jambs. Axles shall be hexagonal or square plated steel mounted on bronze oilite or synthetic (ACETAL) bearings. Linkage shall be in-jamb type located outside the airstream. Maximum damper size shall be 48" wide and 60" high. For isolation or shut-off duty, damper leakage shall not exceed 9.5 CFM/Ft<sup>2</sup> at 4" W.C. S.P. differential. Provide extended shaft with notched end indicating damper position, locking quadrant and handle. Provide standoff brackets for insulated ducts.

2.5 DUCT HARDWARE:

- A. General: Provide duct hardware, manufactured by one manufacturer for all items on project, for the following:
- B. Test Holes: Provide in ductwork at fan inlet and outlet, and elsewhere as indicated, duct test holes, consisting of slot and cover, for instrument tests.
- C. Quadrant Locks: Provide for each manual volume damper, quadrant lock device on one end of shaft; and end bearing plate on other end for damper lengths over 12". Provide extended quadrant locks and end extended bearing plates for externally insulated ductwork.

2.6 DUCT ACCESS DOORS:

- A. Access Doors for Low Pressure Rectangular Duct: Construct of same or greater gauge as ductwork served, provide double wall insulated doors for insulated ductwork. Exposed insulation adhered to door is not acceptable. Provide flush frames for uninsulated ductwork, extended frames for externally insulated duct. All access doors shall have gasket and will be air tight. Provide one side hinged, other side with one handle-type latch for doors 12" high and smaller, 2 handle-type latches for larger doors. Where a hinged door cannot be fully opened a removable door may be used.

- B. Access Doors for Medium and High Pressure Rectangular Duct: Insulated double wall round door and frame arranged for "Spin-In" installation, with continuous gasket in frame for door. Leakage of less than .5 cfm at 6" W.G.

Flexmaster "Inspector Series Spin Door" or equivalent.

- C. Access Doors for Round Duct 20" and Less: Sandwich type door, constructed of an insulated double wall outer door connected to gasketed inner plate carriage bolts with hand knobs, and formed to fit the radius of the duct.

Ductmate "Sandwich" or equivalent.

- D. Access Door for Round Duct Greater Than 20": 18" round insulated double wall access door in gasketed frame, attached to duct section similar to tee fitting.

- E. Access Doors for Flat Oval Duct: Use door specified for medium and high pressure rectangular duct in flat portion, use door specified for round duct in curved portion.

- F. All access doors in exhaust system shall have inside duct surface PVC coated or at the Contractor's option, Heresite coated as specified in this section.

## 2.7 CEILING AIR DIFFUSERS:

- A. General: Except as otherwise indicated, provide manufacturer's standard ceiling air diffusers where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.
- B. Performance: Provide ceiling air diffusers that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.
- C. Ceiling Compatibility: Provide diffusers with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling systems, which will contain each type of ceiling air diffuser.
- D. Types: Provide ceiling diffusers of type, capacity, and with accessories and finishes as listed on air device schedule.

## 2.8 REGISTERS AND GRILLES:

- A. General: Except as otherwise indicated, provide manufacturer's standard registers and grilles where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.
- B. Performance: Provide registers and grilles that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.
- C. Wall Compatibility: Provide registers and grilles with border styles that are compatible with adjacent wall systems, and that are specifically manufactured to fit into wall construction with accurate fit and adequate support. Refer to general construction drawings and specifications for types of wall construction, which will contain each type of wall register and grille.

- D. Types: Provide registers and grilles of type, capacity, and with accessories and finishes as listed on air device schedule.

2.9 FABRICATION:

- A. Fabricate ductwork in 4, 8, 10 or 12-ft lengths, unless otherwise indicated or required to complete runs. Preassemble work in shop to greatest extent possible, so as to minimize field assembly of systems. Disassemble systems only to extent necessary for shipping and handling. Match (-) mark sections for reassembly and coordinated installation.
- B. Fabricate ductwork of gauges and reinforcement complying with the latest SMACNA "HVAC Duct Construction Standards". Minimum 26 GA where ducts are within corridors.
- C. Where the standard allows the choice of external reinforcing or internal tie rods, only the external reinforcing options shall be used.
- D. If manufacturer flange joining systems are used as part of the reinforcing, the EI rating and rigidity class shall be equivalent to the reinforcing requirements of the standard. Submit manufacturer's product data.
- E. Aluminum duct shall be fabricated using the aluminum thickness equivalence table in the standard. Simply increasing the thickness by two gauges is not acceptable.
- F. Fabricate duct fittings to match adjoining ducts, and to comply with duct requirements as applicable to fittings. Except as otherwise indicated, fabricate elbows and offsets with center-line radius equal to 1.5 times the associated duct width; and fabricate to include turning vanes in elbows where shorter radius is necessary. 90° mitered elbows with turning vanes may be used where specifically shown on drawings. Mitered elbows or offsets of other than 90° shall not be used. Two 90° mitered elbows shall be separated by a minimum of 2 equivalent duct diameters. Use radiused "Ogee" for offsets less than 90°. Limit angular tapers to 30 deg. for contracting tapers and 20 deg. for expanding tapers. Divided flow fittings shall be 45° inlet branches, stationary splitters and elbows, or as shown on drawings.
- G. Fabricate ductwork with accessories installed during fabrication to the greatest extent possible. Refer to Division-23 section "Ductwork Accessories" for accessory requirements. All exhaust ductwork accessories (including dampers, turning vanes, access doors, etc.) shall be Heresite or PVC coated. All stainless steel ductwork shall have stainless steel accessories (including dampers, turning vanes, access doors, etc.) construction.
- H. Fabricate ductwork with duct liner in each section of duct where indicated. Laminate liner to internal surfaces of duct in accordance with instructions by manufacturers of lining and adhesive, and fasten with mechanical fasteners. Provide sheet metal nosing on all leading edges preceded by unlined duct, at duct openings, and at fan or terminal unit connections.

2.10 ROUND AND FLAT OVAL DUCTWORK:

- A. Material: Galvanized sheet steel complying with ASTM A 527, lockforming quality, with ASTM A 525, G90 zinc coating, mill phosphatized. Spiral lockseam construction. Individual runouts to air devices may be longitudinal seam.
- B. Gauge: In accordance with the SMACNA "HVAC Duct Construction Standards", minimum 26 gauge.

- C. Elbows: One piece construction for 90 deg. and 45 deg. elbows 14" and smaller. Provide multiple gore construction for larger diameters with standing seam circumferential joint. Radius to centerline shall be 1.5 times duct diameter. Spot welded and bonded construction. Elbows on runouts to individual air devices may be pleated or adjustable.
- D. Divided Flow Fittings: 90 deg. tees, constructed with branch spot welded and bonded to duct fitting body, or saddle tap fitting, with minimum 2" flange shaped to fit main duct.

### PART 3 - EXECUTION

#### 3.1 INSPECTION:

- A. General: Examine areas and conditions under which metal ductwork is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION OF METAL DUCTWORK:

- A. Duct Sealing:

- 30. Seal all low pressure ducts to SMACNA Seal Class "B".
  - 31. Seal all medium and high pressure ducts to SMACNA Seal Class "A".

- B. General: Assemble and install ductwork in accordance with recognized industry practices which will achieve air-tight and noiseless (no objectionable noise) systems, capable of performing each indicated service. Install each run with minimum number of joints. Align ductwork accurately at connections, within 1/8" misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with suitable ties, braces, hangers and anchors of type which will hold ducts true-to-shape and to prevent buckling, popping or compressing. Support vertical ducts at every floor.
- C. Construct ductwork to schedule of operating pressures as shown on drawings.
- D. Inserts: Install concrete inserts for support of ductwork in coordination with formwork, as required to avoid delays in work.
- E. Field Fabrication: Complete fabrication of work at project as necessary to match shop-fabricated work and accommodate installation requirements.
- F. Routing: Locate ductwork runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs wherever possible. Locate runs as indicated by diagrams, details and notations or, if not otherwise indicated, run ductwork in shortest route which does not obstruct useable space or block access for servicing building and its equipment. Hold ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building. Limit clearance to 1/2" where furring is shown for enclosure or concealment of ducts, but allow for insulation thickness, if any. Where possible, locate insulated ductwork for 1" clearance outside of insulation. Wherever possible in finished and occupied spaces, conceal ductwork from view, by locating in mechanical shafts, hollow wall construction or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.

- G. Electrical Equipment Spaces: Do not route ductwork through transformer vaults and their electrical equipment spaces and enclosures.
- H. Slope shower, locker room, and high moisture ductwork down to air device.
- I. Penetrations: Where ducts pass through fire rated walls and do not contain fire or smoke dampers, protect with fire stop material installed in accordance with its listing. Where ducts pass through interior partitions or exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same gauge as duct. Overlap opening on all four sides by at least 1-1/2". Fasten to duct only. Where ducts penetrate non-fire rated, mechanical, electrical or acoustically sensitive walls, provide 1/2" to 3/4" annular space between duct and wall, pack annular space with mineral wood insulation, and caulk both sides with non-hardening acoustical sealant.
- J. Coordination: Coordinate duct installations with installation of accessories, dampers, coil frames, equipment, controls and other associated work of ductwork system.
- K. Installation: Install metal ductwork in accordance with SMACNA HVAC Duct Construction Standards and Industrial Construction Standards.
- L. Temporary Closure: At ends of ducts which are not connected to equipment or air distribution devices at time of ductwork installation, provide temporary closure of polyethylene film or other covering which will prevent entrance of dust and debris until time connections are to be completed.

### 3.3 INSTALLATION OF DUCT TAKE-OFF FITTINGS:

- A. Fully seal all joints.
- B. Sheet metal screw regulator arm to duct after balance is complete. Mark and date position of regulator arm.
- C. Insulation over regulator arm is not required.

### 3.4 INSTALLATION OF FLEXIBLE DUCTS:

- A. Maximum Length: For any duct run using flexible ductwork, do not exceed 6' - 0".
- B. Installation: Install in accordance with SMACNA's, "HVAC Duct Construction Standards, Metal and Flexible".
- C. Full inside diameter of flexible duct shall be maintained. Support to prevent kinking.
- D. Flexible duct shall not be installed above an inaccessible ceiling unless the air device is set in a frame allowing access to both ends of the flexible duct.

### 3.5 INSTALLATION OF DUCTWORK ACCESSORIES:

- A. Install ductwork accessories in accordance with manufacturer's installation instructions, with applicable portions of details of construction as shown in SMACNA standards, and in accordance with recognized industry practices to ensure that products serve intended function.
- B. Install turning vanes in square or rectangular 90 deg. elbows in supply, return and exhaust air systems, and elsewhere as indicated.

- C. Install access doors to open against system air pressure, with latches operable from either side, except outside only where duct is too small for person to enter.
- D. Coordinate with other work, including ductwork, as necessary to interface installation of ductwork accessories properly with other work.
- E. Provide duct access doors whether shown or not for inspection and cleaning upstream of all coils, fans, automatic dampers, fire dampers (minimum 16" x 24" in ducts larger than 18"), fire/smoke dampers, duct smoke detectors and elsewhere as indicated. Review locations prior to fabrication. Provide multiple access doors for large ductwork to provide adequate reach to equipment.
- F. Provide balancing dampers at points on low pressure supply, return, and exhaust systems where branches are taken from larger ducts and as required for air balancing.
- G. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and equipment subject to forced vibration. Provide matching flanged backing frame with flexible connector where flanged fan connections are provided.

### 3.6 INSTALLATION OF AIR DEVICES:

- A. General: Install air outlets and inlets in accordance with manufacturer's written instructions and in accordance with recognized industry practices to insure that products serve intended functions.
- B. Coordinate with other work, including ductwork and duct accessories, as necessary to interface installation of air outlets and inlets with other work.
- C. Locate ceiling air diffusers, registers, and grilles, as indicated on general construction "Reflected Ceiling Plans". Unless otherwise indicated, locate units in center of acoustical ceiling modules.

### 3.7 FIELD QUALITY CONTROL:

- A. Leakage Tests:
  - 32. Conduct duct leakage test in accordance with SMACNA HVAC Air Duct Leakage Test Manual. Repair leaks and repeat tests until total leakage is less than the maximum permissible leakage as specified below.
  - 33. Operate installed ductwork accessories after installation to demonstrate compliance with requirements. Test for air leakage while system is operating. Repair or replace faulty accessories, as required to obtain proper operation and leakproof performance.
- B. General:
  - 34. Ductwork pressure tests shall be observed by Architect/Engineer prior to installation of insulation.
  - 35. Ductwork systems in  $\pm 3$ " W.G. pressure class and higher shall be tested in their entirety for leaks. Arbitrary sections of ductwork in  $\pm 2$ " W.G. and lower pressure class shall be tested as required by Architect/Engineer.
  - 36. Test Failures: Duct systems shall be repaired if test pressure and leakage requirements are not met or if air noise condition is encountered. Repairs and sealing shall be done with sheet metal, tape, sealant or a combination thereof.
- C. Test Equipment:

37. Portable rotary type blower or tank type vacuum cleaner with control damper. Equipment shall have sufficient capacity to properly test reasonably large duct system section. Equipment shall have been calibrated within 2 years of the testing.
38. Orifice assembly consisting of straightening vanes and calibrated orifice plate mounted in a straight tube with properly located pressure taps.
39. Two (2) U-tube manometers, one to measure drop across calibrated orifice and one to measure S.P. in duct being tested. Provide low differential pressure Dwyer magnehelic gauges for low leak testing in lieu of U-tube manometers.
40. Provide Dwyer magnehelic gauge with 0-.25" W.C. range for testing 0% leakage ductwork.

D. Testing Pressures and Permissible Leakage:

41. Test pressure shall be equal to the construction class. Negative pressure duct shall be tested at the equivalent positive pressure.
42. Allowable leakage shall be determined from the following equation (or figure 4-1 in the above referenced Standard):

$$F = C_L (P)^{.65}$$

Where: F = Allowable leakage factor CFM/100 Sq. Ft.

$C_L$  = Leakage Class

P = Test pressure inches W.C.

43. Leakage class shall be as follows:
  - a. Seal class A, Round or oval duct, CL = 3.
  - b. Seal class A, Rectangular duct, CL = 6.
  - c. Seal class B, Round or oval duct, CL = 6.
  - d. Seal class B, Rectangular duct, CL = 12.
  - e. Seal class C, Round or oval duct, CL = 12.
  - f. Seal class C, Rectangular duct, CL = 24.
44. Record all tests using the procedure and forms in the above referenced standard.
45. All plenums and casings shall be tested by pressuring to the pressure class indicated and visually observing leakage and panel deflection.
  - g. No noticeable leakage shall be allowed.
  - h. Deflection shall be less than 1/8" per foot.
46. All bio-safety room, cabinet exhaust and radioisotope exhaust shall be leak tested at 4" S.P. at 0% leakage.

3.8 EQUIPMENT CONNECTIONS:

- A. General: Connect metal ductwork to equipment as indicated. Provide flexible connection for each ductwork connection to equipment mounted on vibration isolators, and/or equipment containing rotating machinery. Provide access doors where required for service, maintenance and inspection of ductwork accessories. See section 23 33 00.

3.9 ADJUSTING AND CLEANING:



- A. Clean ductwork internally, unit by unit as it is installed, of dust and debris. Clean external surfaces of foreign substances. Where ductwork is to be painted clean and prepare surface for painting.
- B. Protection:
  - 47. Store duct a minimum of 4" above ground or floor to avoid damage from weather or spills.
  - 48. Cover all stored ducts to protect from moisture, dust or debris.
  - 49. Maintain a cover on all ends of installed ductwork at all times, except when actually connecting additional sections of duct.
- C. Strip protective paper from stainless ductwork surfaces, and repair finish wherever it has been damaged.
- D. Balancing: Refer to Division-23 section "Testing, Adjusting, and Balancing" for air distribution balancing of metal ductwork; not work of this section. Seal any leaks in ductwork that become apparent in balancing process.

**END OF SECTION**

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**AndersonMasonDale**  
**Architects**

3198 Speer Boulevard  
Denver, Colorado 80211  
303 294 9448  
Fax 303 294 0762  
[amd@amdarchitects.com](mailto:amd@amdarchitects.com)