

DIVISION 13
SPECIAL CONSTRUCTION

2 **SECTION 13121**
3 **METAL BUILDING SYSTEMS**

4 **1.1 SUMMARY**

5 A. Section Includes:

- 6 1. Metal building system.
 - 7 a. Building system design.
 - 8 b. Materials.
 - 9 c. Fabrication.
 - 10 d. Shipment.
 - 11 e. Erection of building system.

12 B. Related Sections include but are not necessarily limited to:

- 13 1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- 14 2. Division 1 - General Requirements.
- 15 3. Section 03308 - Concrete Materials and Proportioning.
- 16 4. Section 07900 - Joint Sealants.
- 17 5. Section 08220 - Fiberglass Reinforced Plastic (FRP) Doors and Frames.
- 18 6. Section 08334 - Aluminum Rolling Overhead Door.
- 19 7. Section 08700 - Finish Hardware.
- 20 8. Section 09905 - Painting and Protective Coatings.

21 **1.2 QUALITY ASSURANCE**

22 A. Referenced Standards:

- 23 1. Aluminum Association (AA):
 - 24 a. 45, Designation System for Aluminum Finishes.
- 25 2. American Architectural Manufacturers Association (AAMA):
 - 26 a. 621-02, Voluntary Specifications for High Performance Organic Coatings on Coil
 - 27 Coated Architectural Hot Dipped Galvanized (HDG) and Zinc-Aluminum Coated Steel
 - 28 Substrates.
- 29 3. American Institute of Steel Construction (AISC):
 - 30 a. Specification for Structural Steel Buildings.
 - 31 b. AISC Code of Standard Practice.
 - 32 c. Specification for Structural Joints Using ASTM A325 or A490 Bolts.
 - 33 d. Quality Certification Program.
- 34 4. ASTM International (ASTM):
 - 35 a. A36, Standard Specification for Carbon Structural Steel.
 - 36 b. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile
 - 37 Strength.
 - 38 c. A325, Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi
 - 39 Minimum Tensile Strength.
 - 40 d. A529, Standard Specification for Structural Steel with 42 ksi Minimum Yield Point
 - 41 (1/2 IN Maximum Thickness).
 - 42 e. A570, Standard Specification for Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural
 - 43 Quality.
 - 44 f. A653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron
 - 45 Alloy-Coated Galvannealed) by the Hot-Dip Process, Structural (Physical) Quality.
 - 46 g. A792, Standard Specification for General Requirements, Steel Sheet, Aluminum-Zinc
 - 47 Alloy-Coated by the Hot-Dip Process.
 - 48 h. A924, Standard Specification for General Requirements for Steel Sheet, Metallic
 - 49 Coated by the Hot-Dip Process.
 - 50 i. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

- j. B221, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes.
- k. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
- 5. Metal Building Manufacturer's Association (MBMA):
 - a. Low Rise Building Systems Manual.
- 6. Steel Structures Painting Council (SSPC).
- 7. Underwriters Laboratories, Inc. (UL):
 - a. Building Materials Directory.

B. Qualifications:

- 1. Manufacturer's qualifications:
 - a. Manufacturer must be member in good standing of the Metal Building Manufacturers Association (MBMA).
 - b. Manufacturer must be an AISC Quality Certified Fabricator in the category of Metal Building Systems (MB).
- 2. Erector qualification:
 - a. Erector (installer) must be approved in writing by metal building manufacturer.
 - b. Erector must have minimum of 10 years current experience in erection of similar structures.
- 3. Manufacturer's Structural Engineer:
 - a. Registered in the State of Texas and a minimum of 3 years of experience in this type of design work.

1.3 DEFINITIONS

A. Code:

- 1. International Building Code and associated standards, 2000 Edition, including all City of Kerrville, Texas, 2000 IBC amendments, referred to herein as Building Code.
- 2. Erector (installer):
 - a. Individual(s) actually performing work on site.
 - 1) Erector and installer are synonymous.
- 3. Nomenclature as listed in Bibliography of Low Rise Buildings Systems Manual by MBMA.

1.4 SYSTEM DESCRIPTION

- A. Building shall be insulated (unless otherwise indicated), rigid frame type with vertical walls and gable type roof. Provide full height wall liner panels and full ceiling liner panel.
 - 1. Cross bracing shall be provided in the side walls perpendicular to the rigid frame.

1.5 SUBMITTALS

A. Shop Drawings:

- 1. See Section 01340.
- 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's technical reference manual containing all of the manufacturer's standard construction details and specifications.
 - 1) Manufacturer's erection manual containing all details and methods for installation of building frame, roof system, wall system, and accessories.
 - 2) Edit to mark out items not used for this installation.
 - c. Structural calculations stamped and signed by a professional Structural Engineer licensed in the State of Texas.
 - 1) Include list of design loads and loads transmitted to foundation through columns or walls and location where loads occur.
 - 2) Manufacturer shall notify Engineer if load reactions into foundation exceed design values indicated on plans.
 - 3) Calculations shall be submitted for information only.
- 3. Fabrication drawings:

- 1 a. List of all design loads and combination of loads.
- 2 b. Size and location of each component of the building.
- 3 1) Include clearance under structural framing members.
- 4 2) Include cross-section of components.
- 5 3) Include required framing for monorails.
- 6 c. Fasteners and details of fasteners connecting each component of the building.
- 7 d. Size, location and details of anchor bolts, base plates, and all other components fastened
- 8 to the foundation.
- 9 e. Details of wall panels, roof panels, finishes, flashings, closures, closure strips, trim,
- 10 gutters, downspouts, calking, and all other miscellaneous components.
- 11 B. Samples:
- 12 1. Metal color and finish samples of roof and wall panels, roof trim, wall trim, interior liner
- 13 panel and soffit panel colors for Engineer's selection.
- 14 2. Color chart is not acceptable.
- 15 C. Miscellaneous Submittals:
- 16 1. Manufacturer's and Erector's Qualifications.
- 17 2. Manufacturer's approval of erector.
- 18 D. Operation and Maintenance Manuals:
- 19 1. See Section 01300.

20 1.6 WARRANTY

- 21 A. Manufacturer's standard warranty.
- 22 B. Manufacturer's 20-year warranty of factory applied premium paint finish against blistering,
- 23 chipping, cracking, peeling, or fading of wall and roof panels.
- 24 C. Manufacturer's 10-year weather tightness warranty of roof assembly.
- 25 D. Provide notice of any exceptions taken to warranties.

26 PART 2 - PRODUCTS

27 2.1 ACCEPTABLE MANUFACTURERS

- 28 A. Subject to compliance with the Contract Documents, the following manufacturers are
- 29 acceptable:
- 30 1. Metal building systems:
- 31 a. Butler Building Systems.
- 32 b. Ceco Buildings Systems.
- 33 c. Steelex Building Systems.
- 34 d. VP Buildings (Varco Pruden).
- 35 2. Insulation:
- 36 a. Fiberglass batt or blanket.
- 37 1) Owens-Corning Fiberglass Corp.
- 38 2) United States Gypsum Company (USG).
- 39 3) Certain Teed.
- 40 3. Wall Liner Panel
- 41 a. Dimensional Metals, Inc.
- 42 b. Una-Clad.
- 43 c. Englert.
- 44 d. Merchant & Evans.
- 45 B. Submit requests for substitution in accordance with Specification Section 01630.

46 2.2 MATERIALS

- 1 A. Structural Members: Steel (including crane rail).
- 2 1. Crane rail components shall be compatible with crane rail system specified in Section
- 3 14305.
- 4 B. Anchor Bolts: ASTM A307 or A36 steel.
- 5 C. Fasteners:
- 6 1. Building frame, girts, and purlins: ASTM A325 or A307 bolts.
- 7 a. Girts: 8 IN sections required.
- 8 b. Purlins: 8 IN sections required.
- 9 2. Roof and wall panels: Stainless steel.
- 10 3. Miscellaneous fasteners: Stainless steel.
- 11 D. Roof and Wall Panels: Steel and as specified.
- 12 E. Insulation:
- 13 1. Glass or other inorganic fibers and resinous binders formed into flexible blankets or semi-
- 14 rigid sheets with aluminum foil vapor retarder.
- 15 2. Thermal conductivity (k-value at 75 DegF): 0.27.
- 16 3. Flame spread: ASTM E84, not greater than 25.
- 17 4. R-19 unless otherwise noted.
- 18 F. Gutters and Downspouts: Same material as wall panels.
- 19 G. Grout: See Section 03308.
- 20 H. Closures: Neoprene.
- 21 I. Calking and Sealants: See Section 07900.
- 22 J. Trim: Same material as wall or roof panel.

23 **2.3 ACCESSORIES**

- 24 A. Wall Liner Panel:
- 25 1. Profile: Flat panel or vee-panel section.
- 26 2. Minimum 0.040 IN thickness, aluminum and minimum 1 IN deep profile.
- 27 3. Galvanized, ASTM A653, G90 coating.
- 28 4. Height: Reference drawings.
- 29 5. Finish: Manufacturer's standard 20-year warranty factory applied coating.
- 30 B. Overhead Doors: See Division 8.
- 31 C. Hollow Metal Pedestrian Doors and Frames: See Section 08110.
- 32 D. Framed Openings:
- 33 1. Walls:
- 34 a. Provide all necessary subframing to support wall openings for doors, windows, louvers,
- 35 pipe or duct penetrations, etc.
- 36 1) Material gage to be determined by metal building manufacturer for size of opening.
- 37 b. Size and location of opening as shown on the Drawings.
- 38 c. Jamb, lintel and girts: Zinc-coated steel with factory applied primer coat.
- 39 1) Metal building manufacturer responsible for providing correct size opening for
- 40 penetration scheduled, shown or specified.
- 41 d. Provide trim to cover all exposed areas of opening frames.
- 42 2. Roofs:
- 43 a. Provide all necessary roof subframing to support roof mounted equipment and to frame
- 44 roof penetrations.
- 45 1) Material gage to be determined by metal building manufacturer for size of
- 46 equipment or opening.
- 47 b. Location of roof mounted equipment and/or roof or wall opening as shown on the
- 48 Drawings.

- 1 c. Purlins, angles, clips: Zinc coated steel with factory applied primer coat.
- 2 1) Metal building manufacturer responsible for providing correct size of opening for
- 3 penetration scheduled, shown or specified.
- 4 E. Gutters and Downspouts:
- 5 1. Size:
- 6 a. Provide minimum 4 x 4 IN gutter and minimum 3 x 5 IN downspout in manufacturer's
- 7 standard profile best suited for project, unless other sizes are indicated on drawings.
- 8 2. Minimum 24 GA steel, galvanized G90 per ASTM A653.
- 9 3. Finish same as wall panels.
- 10 4. Expansion joints: 50 FT maximum spacing unless other spacing is indicated on drawings.
- 11 F. Roof Penetration Flashing (Maximum 13 IN DIA):
- 12 1. Flashing material: EPDM rubber with an aluminum sealing ring base.
- 13 2. Minimum projection above the weather surface of the roof: 8 IN.
- 14 3. Configuration of the flanges to match the roof panel.

15 **2.4 BUILDING DESIGN CRITERIA**

- 16 A. Critical Dimensions:
- 17 1. Roof slope shall be as indicated in drawings.
- 18 2. Provide eave height as indicated in the drawings.
- 19 3. Provide maximum member sizes as indicated in the drawings.
- 20 B. Building Foundation:
- 21 1. All foundations have been designed based on assumed loadings and reactions. Member sizes
- 22 and geometry may vary depending on the building being supplied. Do not construct these
- 23 members until Engineer has verified design with approved shop drawings of metal building
- 24 being supplied.
- 25 C. Modifications to building sizes will not be acceptable.
- 26 D. Roof Live Loads:
- 27 1. Roof panels:
- 28 a. 30 psf uniformly distributed live load.
- 29 b. 200 LB concentrated (point) live load (over a 1 x 1 FT area) located at center of
- 30 maximum roofing (panel) span.
- 31 c. The most severe condition governs.
- 32 2. Roof framing members: Per Building Code. Roof framing members do not need to be
- 33 designed for 50 psf uniform or 200 LB concentrated live loads indicated in Item D.1 above.
- 34 3. The above loads are in addition to other applicable loads and shall be applied to the
- 35 horizontal projection of the roof.
- 36 E. Snow Loads:
- 37 1. Design structure for snow loading as set forth in the Building Code. Project site conditions
- 38 are as follows:
- 39 a. Basic ground snow: 5 psf.
- 40 b. Importance factor: 1.1.
- 41 c. Snow exposure coefficient: C.
- 42 F. Wind Loads:
- 43 1. Design structure for wind loading as set forth in the Building Code. Project site conditions
- 44 are as follows:
- 45 a. Basic wind speed: 90 mph.
- 46 b. Site exposure: Class C.
- 47 c. Importance factor: 1.0.
- 48 G. Seismic (Earthquake) Loads:
- 49 1. Design structure for seismic forces as set forth in the Building Code. Project site conditions
- 50 are as follows:

- 1 a. Seismic design - category A.
- 2 b. Seismic use group -- category II.
- 3 H. Auxiliary Loads:
- 4 1. Other superimposed loads shall be considered as part of the design requirements and
- 5 combined with the normal design (dead, live, seismic and wind) loads as prescribed
- 6 hereafter.
- 7 a. Dynamic loads:
- 8 1) Bridge crane. Reference plan for location.
- 9 2) Membrane building bridge crane capacity = 5 tons.
- 10 b. Static loads:
- 11 1) 10 psf.
- 12 2) Reference mechanical plans for additional roof supported piping.
- 13 c. Mechanical loads:
- 14 1) Design to support pipes/hangers. Reference drawings for locations and sizes.
- 15 2. Magnitude and location of auxiliary loads as shown on Drawings and as specified.
- 16 a. Contractor to coordinate and verify magnitude and location of auxiliary loads before
- 17 fabrication.
- 18 I. Combination of Loads:
- 19 1. The combining of dead, live, wind, seismic and auxiliary loads for design purposes shall be
- 20 set forth in the Building Code, unless otherwise specified.
- 21 2. Horizontal sway deflection of building due to combination of required design loads: 1 IN.
- 22 3. Deflection of purlins and secondary members not to exceed L/180 of its span when
- 23 supporting applicable vertical live, dead, and auxiliary loads.

24 2.5 FABRICATION

- 25 A. General:
- 26 1. Fabricate building structure, roof and wall panels, accessories and trim in accordance with
- 27 requirements of AISC and MBMA.
- 28 2. Provide all necessary clips, flashing angles, caps, channels, closures, bases and any other
- 29 miscellaneous trim required for complete water and airtight installation.
- 30 a. Provide an inside closure at the base of all corrugated panels and an outside closure at
- 31 the top of all corrugated panels in addition to all other closure strips required.
- 32 1) Closure strips shall be formed to fit the corrugation of the metal panels and shall be
- 33 securely supported in place.
- 34 2) Closure strips shall fit between corrugated panels and trim or flashing as required
- 35 to completely separate the interior of the building from the exterior.
- 36 b. Provide flashing at all intersections of wall panels and roof panels, and above all
- 37 openings in wall and roof panels, in addition to all other flashing required.
- 38 1) Flashing shall be formed to completely contain water on the outside of the
- 39 building, and shall be watertight and securely fastened in place.
- 40 c. Provide caulking at all edges where metal panel trim or flashing is adjacent to the
- 41 foundation of the building in addition to all other caulking required.
- 42 1) Calk material shall be securely adhered to the foundation and the metal panels trim
- 43 or flashing.
- 44 3. Provide roof and wall insulation with factory laminated foil scrim faced vapor retarder.
- 45 a. UL flame spread 25 or less.
- 46 b. Perm rating of vinyl not more than 0.9.
- 47 c. Wall insulation minimum R-19.
- 48 d. Roof insulation minimum R-19.
- 49 4. At door, window, and louver openings, provide additional framing and fasteners as required
- 50 to structurally replace the wall panel and/or framing displaced.
- 51 5. Fabricate and prepare material for shipment knocked down.
- 52 6. Frame shall be factory punched to receive all fasteners.
- 53 7. Finishes:

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- a. Clean ferrous surfaces of oil, grease, loose rust, loose mill scale, and other foreign substances.
 - 1) All primary and secondary structural steel members shall be cleaned in accordance with SSPC-SP6.
- b. All rigid frames and columns shall have primer paint coats applied in the shop and finish coats applied in the shop. All secondary members shall be galvanized or galvanized. Secondary members do not require painting.
 - 1) Shop paint, prime and finish coats, all surfaces which will be inaccessible after erection. Primer shall be compatible with finish coats of epoxy paint system.
 - 2) Paint in accordance with Section 09905.
 - 3) Paint surfaces of all components not exposed to view.
 - 4) Manufacturer's standard shop applied primer is not acceptable as substitute for primer specified.
- c. Wall and roof panels:
 - 1) Exterior surface:
 - a) Thermosetting fluoropolymer resin enamel.
 - (1) Minimum 70 percent "KYNAR" resin.
 - b) Meet requirements of AAMA 621-02.
 - c) FM Class 1 rated.
 - d) Exposed screw heads shall match color of panel.
 - 2) Interior surface:
 - a) Manufacturer's standard shop applied coating.

- B. Roof Panels:
 - 1. 24 GA minimum, galvanized G90 per ASTM A653.
 - 2. Standing seam interlocking rib configuration.
 - 3. Factory applied color coating.
 - 4. Meet requirements of AAMA 621-02.
 - 5. Length: Sufficient to cover entire length of any unbroken roof slope.
 - 6. Panel width: Nominal 16 IN.
 - 7. Panel depth: Nominal 1 ½ IN.
 - 8. Concealed fasteners.

- C. Wall Panels:
 - 1. 24 GA minimum, galvanized G90 per ASTM A653.
 - 2. Factory applied color coating.
 - 3. Meet requirements of AAMA 621-02.
 - 4. Length sufficient to cover entire height of any unbroken wall.
 - 5. Panel width: 36 IN.
 - 6. Profile: "R" Panel.
 - 7. Panel depth: 1/2 IN nominal.
 - 8. Exposed fasteners.

2.6 SOURCE QUALITY CONTROL

- A. Testing: Employ and pay for the services of a qualified independent testing agency to inspect and test all structural steel work for compliance with Contract Documents. Independent testing agency shall have a minimum of 5 years performing similar work and shall be subject to Owner's approval.
- B. Responsibilities of Testing Agency:
 - 1. Inspect field welding in accordance with Section 6 of AWS Code including the following non-destructive testing:
 - a. Visually inspect all welds.
 - b. Test 50 percent of full penetration welds and 10 percent of fillet welds with liquid dye penetrant.
 - c. Test 20 percent of full penetration welds with ultrasonic or radiographic testing.

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SECTION 13400
INSTALLATION OF OWNER FURNISHED EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Installation of Owner-furnished membrane system and associated equipment.
- B. Related Sections include but are not necessarily limited to:
 - 1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
 - 2. Division 1 - General Requirements.
 - 3. Section 01011 – Owner Furnished Equipment

1.2 SUBMITTALS

- A. Schedule:
 - 1. Provide Installation schedule.
 - 2. Provide start-up and manufacturer's field services schedule.
 - 3. Provide schedules a minimum of 14 days prior to event.
- B. Produce technical data, fabrication drawings, layout drawings for piping and other structural items and accessories provided by Contractor.

1.3 DEFINITIONS

- A. Manufacturer: Zenon Environmental, 3239 Dundas St. W., Oakville, Ontario L6M 4B2, Canada
- B. Local Contact: Jack Gardiner, Tel: (281) 444-0990.

1.4 JOB CONDITIONS AND RESPONSIBILITIES

- A. Owner has pre-purchased the Membrane System for installation at the New City of Kerrville Water Treatment Plant. Their purchase agreement includes:
 - 1. Shipping of equipment to the site.
 - a. See Section 01011.
 - 2. Operation and Maintenance Manuals.
 - 3. Manufacturer's services:
 - a. Installation Check.
 - b. Field Testing and Adjusting
 - c. Start up services.
 - d. Manufacturer's Field Service Report.
 - e. Training session.
 - 4. Contractor shall arrange for shipment and delivery of equipment directly with the manufacturer in accordance with an approved construction schedule and notify Owner.
 - 5. Contractor is responsible for
 - a. Receiving, unloading, and storing equipment onsite.
 - b. Performing and scheduling installation.
 - c. Scheduling manufacturer's services.
 - d. Installing equipment and all ancillary equipment (including electrical).
 - e. Performing the equipment start-up procedures with assistance from the manufacturer.
- B. Shop drawing information for the Owner-supplied equipment is available for examination upon request.

1 **PART 2 - PRODUCTS**

2.1 **EQUIPMENT**

- A. See Section 01011.
- B. Manufacturer's Tender Package is available on request to the Engineer.

2 **PART 3 - EXECUTION**

3.1 **INSTALLATION**

- A. Install the equipment and provide all electrical, control, and utility connections at the points of interface as required for system operation and as required by manufacturer.
- B. Install electrical and control panels, cabinets, and transformer at locations shown on Drawings.
- C. Make all utility connections to the equipment generally as shown.

3.2 **FIELD TESTING AND ADJUSTING**

- A. To be performed by Manufacturer in conjunction with the Contractor.
- B. See Section 01650.

3.3 **FIELD QUALITY CONTROL**

- A. Representative of Contractor to be present during all visits by manufacturer's representative.
- B. Contractor shall notify Owner when manufacturer's services are required. Services will include:

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- 1. Installation Check.
 - a. Contractor shall rectify installation deficiencies identified by manufacturer's representative.

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- 2. Start-up and Testing.

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- a. Do not start-up or test equipment until manufacturer's representative approves installation.

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- 3. Manufacturer's Field Service Report.

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- 4. Operator Training

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- a. Contractor shall notify Owner when manufacturer's training services are to be provided.

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END OF SECTION

2 **SECTION 13440**

3 **INSTRUMENTATION FOR PROCESS CONTROL: BASIC REQUIREMENTS**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

6 A. Section Includes:

- 7 1. Basic requirements for complete instrumentation system for process control, including
- 8 installation of Owner furnished equipment.

9 B. Related Sections include but are not necessarily limited to:

- 10 1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- 11 2. Division 1 - General Requirements.
- 12 3. Section 10400 - Identification, Stenciling, and Tagging Systems.
- 13 4. Section 11005 - Equipment: Basic Requirements.
- 14 5. Section 16010 - Electrical: Basic Requirements.
- 15 6. Section 16120 - Wire and Cable - 600 Volt and Below.

16 **1.2 QUALITY ASSURANCE**

17 A. Referenced Standards:

- 18 1. International Society for Measurement and Control (ISA):
- 19 a. S5.1, Instrumentation Symbols and Identification.
- 20 b. S5.2, Binary Logic Diagrams for Process Operations.
- 21 c. S5.3, Graphic Symbols for Distributed Control/Shared Display Instrumentation, Logic
- 22 and Computer Systems.
- 23 d. S5.4, Standard Instrument Loop Diagrams.
- 24 e. S20, Standard Specification Forms for Process Measurement and Control Instruments,
- 25 Primary Elements and Control Valves.
- 26 f. RP7.1-56, Pneumatic Control Circuit Pressure Test.
- 27 2. National Institute of Standards and Technology (NIST).

28 B. Miscellaneous:

- 29 1. Comply with electrical classifications and NEMA enclosure types shown on Drawings.

30 C. Qualifications:

- 31 1. Instrumentation subcontractor:
- 32 a. Experience.
- 33 1) Have satisfactorily provided a control system for a minimum of five projects of
- 34 similar magnitude and function.

35 **1.3 DEFINITIONS**

36 A. Instrument Air Header: The segment of air supply piping and tubing which transports air from
37 the compressed instrument air source through the branch isolation valve of any takeoff (branch)
38 line.

39 B. Branch Line: The segment of air supply piping and tubing which transports air from the outlet of
40 the air header branch isolation valve through an air user's isolation valve.

41 C. Calibrate: To standardize a device so that it provides a specified response to known inputs.

42 **1.4 SYSTEM DESCRIPTION**

43 A. Control System Requirements:

- 1 1. This Specification Section 13440 provides the general requirements for the instrument and
- 2 control system.
- 3 2. The instrument and control system consists of all primary elements, transmitters, switches,
- 4 controllers, computers, recorders, indicators, panels, signal converters, signal boosters,
- 5 amplifiers, special power supplies, special or shielded cable, special grounding or isolation,
- 6 auxiliaries, software, wiring, and other devices required to provide complete control of the
- 7 plant as specified in the Contract Documents.
- 8 B. Unless otherwise required for instrument compatibility, electric control signals shall be 4 to 20
- 9 mA, 24 V DC and pneumatic signals shall be 3 to 15 psi.
- 10 C. All signals shall be directly linearly proportional to measured variable unless specifically noted
- 11 otherwise.
- 12 D. Single Instrumentation Subcontractor:
- 13 1. Furnish and coordinate instrumentation system through a single instrumentation
- 14 subcontractor. The instrumentation subcontractor shall be responsible for functional
- 15 operations of all systems, performance of control system engineering, supervision of
- 16 installation, final connections, calibrations, preparation of drawings and operation and
- 17 maintenance manuals, startup, training, demonstration of substantial completion and all
- 18 other aspects of the control system.
- 19 2. Ensure coordination of instrumentation with other work, including Owner furnished
- 20 equipment, to ensure that necessary wiring, conduits, contacts, relays, converters, and
- 21 incidentals are provided in order to transmit, receive, and control necessary signals to other
- 22 control elements, to control panels, and to receiving stations.

23 1.5 SUBMITTALS

- 24 A. Shop Drawings:
- 25 1. See Section 01340.
- 26 2. Submittals shall be original printed material or clear unblemished photocopies of original
- 27 printed material. Facsimile information is not acceptable.
- 28 3. Product technical data including:
- 29 a. Acknowledgement that products submitted meet requirements of standards referenced.
- 30 b. Equipment catalog cut sheets.
- 31 c. Instrument data sheets:
- 32 1) ISA S20 or approved equal.
- 33 2) Separate data sheet for each instrument.
- 34 d. Materials of construction.
- 35 e. Minimum and maximum flow ranges.
- 36 f. Pressure loss curves.
- 37 g. Physical limits of components including temperature and pressure limits.
- 38 h. Size and weight.
- 39 i. Electrical power requirements and wiring diagrams.
- 40 j. NEMA rating of housings.
- 41 k. Submittals shall be marked with arrows to show exact features to be provided.
- 42 4. Loop diagrams per ISA S5.4.
- 43 a. Each loop diagram on a separate sheet.
- 44 b. Each sheet shall contain the following minimum information.
- 45 1) All loop devices clearly identified.
- 46 2) Identification of the loop and each loop component, including connections to such
- 47 things as recorders and computers. Numbering and tagging must agree with the
- 48 P&ID.
- 49 3) All interconnections with identifying numbers for:
- 50 a) Electrical cables.
- 51 b) Conductor pairs.
- 52 c) Pneumatic or hydraulic tubing.

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- 4) Identification of connections including:
 - a) Junction boxes.
 - b) Terminals.
 - c) Bulkheads.
 - d) Ports.
 - e) Computer input/output connections.
 - f) Grounding systems.
 - 5) Signal levels and ranges.
 - 6) Device location.
 - 7) Energy sources designating voltage, pressure, and other applicable requirements.
 - 8) Enough process lines and equipment to clearly show the process side of the loop and provide clarity of control action. This includes:
 - a) What is being measured.
 - b) What is being controlled.
 - c) Other information required to complete the process loop.
 - 9) Reference to supplementary records and drawings to show inter-relation to other control loops.
 - 10) Controller action.
 - 11) Control valve action upon electronic, hydraulic, or pneumatic failure.
5. Process connected instrument installation details containing the following minimum information:
 - a. Bill of materials providing as a minimum the following information:
 - 1) Tube material and size.
 - 2) Connection size.
 - 3) Fitting size, material, and rating.
 - 4) Valve type and material.
 - 5) Instrument description.
 - 6) Pipe stand size and material.
 - b. Tube slope requirements.
 - c. Required elevations and dimensions.
 6. Comprehensive set of point-to-point wiring diagrams showing all interconnections between packaged systems or equipment control panels, motor control centers, instrumentation and all other electrical equipment as required to depict a complete and functional plant-wide electrical control system. Instrumentation wiring already shown on loop diagrams need not be included on point-to-point wiring diagrams.
 - a. Diagrams shall provide the following minimum information:
 - 1) Terminal block identification (includes terminals on remote equipment furnished by Others).
 - 2) Wire size.
 - 3) Wire type.
 - 4) Wire color.
 - 5) Wire shielding and insulation type.
 - 6) Conductor quantities and associated conduit size.
 - 7) Ground points.
 - 8) Interconnection requirements to existing systems or equipment furnished by Others.
 - b. Diagrams shall be provided on Drawings of sufficient size so as to minimize the number of drawings.
 - 1) Maximum drawing size 24 x 36 IN.
 - 2) Minimum drawing size: 11 x 17 IN.
 7. Electrical schematic control diagrams. Diagrams shall include:
 - a. Terminal identification.
 - b. Unique identification of all control devices and contacts.
 - 1) Utilize Owner's device identification numbers where applicable.
 - c. Wire identification.

- 1 d. Equipment identification.
- 2 e. Indication of remote and local devices and wiring.
- 3 f. Overcurrent protection indication.
- 4 g. Voltage.
- 5 h. All control logic.
- 6 8. Panel fabrication drawings.
- 7 9. Scaled floor plan layouts of control room.
- 8 10. PLC/DCS equipment drawings.
- 9 11. Graphic layouts.
- 10 12. Graphic component construction.
- 11 13. Nameplate layout drawings.
- 12 14. Drawings, systems, and other elements are represented schematically in accordance with
- 13 ISA S5.1 and S5.3. The nomenclature, tag numbers, equipment numbers, panel numbers,
- 14 and related series identification contained in the Contract Documents shall be employed
- 15 exclusively throughout submittals.
- 16 15. Certifications:
- 17 a. Documentation verifying that calibration equipment is certified with NIST traceability.
- 18 b. Approvals from independent testing laboratories or approval agencies, such as UL, FM
- 19 or CSA. Certification documentation is required for all equipment for which the
- 20 specifications require independent agency approval.
- 21 16. Testing reports:
- 22 a. Source quality control reports.
- 23 B. Operation and Maintenance Manuals:
- 24 1. See Section 01340.
- 25 2. Warranties: Provide copies of warranties and list of factory authorized service agents.

26 1.6 DELIVERY, STORAGE, AND HANDLING

- 27 A. Do not remove shipping blocks, plugs, caps, and desiccant dryers installed to protect the
- 28 instrumentation during shipment until the instruments are installed and permanent connections
- 29 are made.

30 PART 2 - PRODUCTS

31 2.1 PERFORMANCE AND DESIGN REQUIREMENTS

- 32 A. System Operating Criteria:
- 33 1. Stability: After controls have taken corrective action, as result of a change in the controlled
- 34 variable or a change in setpoint, oscillation of final control element shall not exceed two
- 35 cycles per minute or a magnitude of movement of 0.5 percent full travel.
- 36 2. Response: Any change in setpoint or change in controlled variable shall produce a
- 37 corresponding corrective change in position of final control element and become stabilized
- 38 within 30 seconds.
- 39 3. Agreement: Setpoint indication of controlled variable and measured indication of controlled
- 40 variable shall agree within 3 percent of full scale over a 6:1 operating range.
- 41 4. Repeatability: For any repeated magnitude of control signal, from either an increasing or
- 42 decreasing direction, the final control element shall take a repeated position within 0.5
- 43 percent of full travel regardless of force required to position final element.
- 44 5. Sensitivity: Controls shall respond to setpoint deviations and measured variable deviations
- 45 within 1.0 percent of full scale.
- 46 6. Performance: All instruments and control devices shall perform in accordance with
- 47 manufacturer's specifications.

48 2.2 ACCESSORIES

- 49 A. Provide instruments with manufacturer's identification nameplate showing:

- 1 1. Manufacturer's model number.
- 2 2. Manufacturer's serial number.
- 3 3. Range.
- 4 a. Utilize the same units of measurement as are utilized in the Contract Documents.
- 5 4. Power supply requirement.

6 **PART 3 - EXECUTION**

7 **3.1 INSTALLATION**

- 8 A. Use bottom entry for all conduit entry to instruments and junction boxes.
- 9 B. Install electrical components per Division 16.
- 10 C. Panel-Mounted Instruments:
 - 11 1. Mount and wire so removal or replacement may be accomplished without interruption of
 - 12 service to adjacent devices.
 - 13 2. Locate all devices mounted inside enclosures so terminals and adjustment devices are
 - 14 readily accessible without use of special tools and with terminal markings clearly visible.
- 15 D. See Section 16120.

16 **3.2 FIELD QUALITY CONTROL**

- 17 A. See Section 01650.
- 18 B. Maintain accurate daily log of all startup activities, calibration functions, and final setpoint
- 19 adjustments.
 - 20 1. Documentation requirements include the utilization of the forms located at the end of this
 - 21 section.
 - 22 a. Loop Checkout Sheet.
 - 23 b. Instrument Certification Sheet.
 - 24 c. Final Control Element Certification Sheet.
- 25 C. In the event that instrument air is not available during calibration and testing, supply either
- 26 filtered, dry, instrument quality air from a portable compressor or bottled, dry, instrument quality
- 27 air. Do not, under any circumstances, apply hydrostatic test to any part of the air supply system
- 28 or pneumatic control system.
- 29 D. Pneumatic Signal Tubing Testing:
 - 30 1. Before the leak test is begun, blow clean with dry air.
 - 31 2. Test signal tubing per ISA RP7.1, except for tubing runs of less than 10 FT where simple
 - 32 soap bubble testing will suffice.
 - 33 3. If a leak is detected, repair the leak and repeat the leak test.
 - 34 4. After completion of the leak test, check each signal line for obstructions. If any are
 - 35 indicated, remove and retest.
- 36 E. Instrumentation Calibration:
 - 37 1. Verify that all instruments and control devices are calibrated to provide the performance
 - 38 required by the Contract Documents.
 - 39 2. Calibrate all field-mounted instruments, other than local pressure and temperature gages,
 - 40 after the device is mounted in place to assure proper installed operation.
 - 41 3. Calibrate in accordance with the manufacturer's specifications.
 - 42 4. Bench calibrate pressure and temperature gages. Field mount gage within 1 day of
 - 43 calibration.
 - 44 5. Check the calibration of each transmitter and gage across its specified range at 0, 25, 50,
 - 45 75, and 100 percent. Check for both increasing and decreasing input signals to detect
 - 46 hysteresis.
 - 47 6. Replace any instrument which cannot be properly adjusted.

- 1 7. Stroke control valves with clean dry air to verify control action, positioner settings, and
2 solenoid functions.
3 8. Mark range, date, setpoint and calibrator's initials on each instrument by means of blue or
4 black ink on a waterproof tag affixed to the instrument.
5 9. Calibration equipment shall be certified by an independent agency with traceability to NIST.
6 Certification shall be up-to-date. Use of equipment with expired certifications shall not be
7 permitted.
8 10. Calibration equipment shall be at least three times more accurate as the device being
9 calibrated.
- 10 F. Loop checkout requirements are as follows:
11 1. Check control signal generation, transmission, reception and response for all control loops
12 under simulated operating conditions by imposing a signal on the loop at the instrument
13 connections. Use actual signals where available. Closely observe controllers, recorders,
14 alarm and trip units, remote setpoints, ratio systems, and other control components. Make
15 corrections as required. Following any corrections, retest the loop as before.
16 2. Stroke all control valves, cylinders, drives and connecting linkages from the local control
17 station and from the control room operator interface.
18 3. Check all interlocks to the maximum extent possible.
19 4. In addition to any other as-recorded documents, record all setpoint and calibration changes
20 on all affected Contract Documents and turn over to the Owner.
- 21 G. Provide verification of system assembly, power, ground, and I/O tests.
22 H. Verify existence and measure adequacy of all grounds required for instrumentation and controls.

23

END OF SECTION



Final Control Element Certification Sheet

Project Name:	Buyer's Project No. (if applicable):
Project Buyer:	Regulatory Agency Project No. (if applicable):
HDR Project No.	Date:
Control Loop No.:	

Tag No.	Actuator: Pneumatic: _____ Electric: _____
Description:	Positioner: Direct: _____ Reverse: _____
Manufacturer:	Positioner: Input: _____ Output: _____
Model No.	I/P Converter: Input: _____ Output: _____
Serial No.	Valve to _____ on air failure
	Valve to _____ on power failure

I/P CONVERTER

% OF SPAN	INCREASING INPUT			DECREASING INPUT		
	INPUT	OUTPUT	ERROR (% of span)	INPUT	OUTPUT	ERROR (% of span)
0%						
25%						
50%						
75%						
100%						

Specified I/P converter accuracy: _____ % of span.

FINAL CONTROL ELEMENT

% OF SPAN	INCREASING INPUT			DECREASING INPUT		
	INPUT	TRAVEL	ERROR (% of full travel)	INPUT	TRAVEL	ERROR (% of full travel)
0%						
25%						
50%						
75%						
100%						

Remarks: _____

CALIBRATION EQUIPMENT UTILIZED

DEVICE TYPE	MFR/MODEL NO.	ACCURACY	NIST TRACEABILITY?

Certified by: _____

Date Certified: _____



Final Control Element Certification Sheet

Project Name:	BIG PROJECT	Buyer's Project No. (if applicable):	
Project Buyer:	ABC Company	Regulatory Agency Project No. (if applicable):	
HDR Project No.	10050-211-134	Date:	12/19/98
Control Loop No.:	056		

Tag No.	LCV-056A
Description:	Control Valve
Manufacturer:	ACE, Inc.
Model No.	XYZ-123
Serial No.	748569AP2

Actuator:	Pneumatic: <input checked="" type="checkbox"/>	Electric: <input type="checkbox"/>
Positioner:	Direct: <input checked="" type="checkbox"/>	Reverse: <input type="checkbox"/>
Positioner:	Input: <u>9-15 psi</u>	Output: <u>0-100%</u>
I/P Converter:	Input: <u>4-20 mA</u>	Output: <u>3-15 psi</u>
Valve to	<u>Open</u> on air failure	
Valve to	<u>Open</u> on power failure	

I/P CONVERTER

% OF SPAN	INCREASING INPUT			DECREASING INPUT		
	INPUT	OUTPUT	ERROR (% of span)	INPUT	OUTPUT	ERROR (% of span)
0%	4.00 mA	3.01 psi	0.08	4.00 mA	3.02 psi	0.17
25%	8.00 mA	6.04 psi	0.33	8.00 mA	6.05 psi	0.42
50%	12.00 mA	9.00 psi	0.00	12.00 mA	9.01 psi	0.08
75%	16.00 mA	11.97 psi	0.25	16.00 mA	12.03 psi	0.25
100%	20.00 mA	14.99 psi	0.08	20.00 mA	14.99 psi	0.08

Specified I/P converter accuracy: 0.50% % of span.

FINAL CONTROL ELEMENT

% OF SPAN	INCREASING INPUT			DECREASING INPUT		
	INPUT	TRAVEL	ERROR (% of full travel)	INPUT	TRAVEL	ERROR (% of full travel)
0%	9.00 psi	0%	-	9.00 psi	0%	-
25%	10.50 psi	25%	-	10.50 psi	25%	-
50%	12.00 psi	50%	-	12.00 psi	50%	-
75%	13.50 psi	75%	-	13.50 psi	75%	-
100%	15.00 psi	100%	-	15.00 psi	100%	-

Remarks: LCV-056A is not furnished with position transmitter, so travel checks were visual.

CALIBRATION EQUIPMENT UTILIZED

DEVICE TYPE	MFR/MODEL NO.	ACCURACY	NIST TRACEABILITY?
Multi-fct calibrator	Fluke-XL743B	0.01% Rdg + 0.015% FS	Yes
Pressure Module	Fluke-XL700POS (0-30")	0.05% FS	Yes

Certified by: Joe Smith

Date Certified: 12/19/98



Instrument Certification Sheet

Project Name:	Buyer's Project No. (if applicable):
Project Buyer:	Regulatory Agency Project No. (if applicable):
HDR Project No.	Date:
Control Loop No.:	
Instrument Tag No.	Transmitter/gauge span:
Manufacturer:	Switch set-point:
Model No.	Switch dead band:
Serial No.	Switch range:

TRANSMITTERS AND INDICATORS

% OF SPAN	INCREASING INPUT			DECREASING INPUT		
	INPUT	OUTPUT	ERROR (% of span)	INPUT	OUTPUT	ERROR (% of span)
0%						
25%						
50%						
75%						
100%						
Other (if applicable)						
Other (if applicable)						

SWITCHES

ACTUATION POINT	INCREASING INPUT			DECREASING INPUT		
	INPUT	OUTPUT	ERROR (% of range)	INPUT	OUTPUT	ERROR (% of range)
High (Increasing input)						
Low (Decreasing input)						

Maximum allowable error (per Procurement Documents): _____

Remarks: _____

CALIBRATION EQUIPMENT UTILIZED

DEVICE TYPE	MFR/MODEL NO.	ACCURACY	NIST TRACEABILITY?

Certified by: _____

Date Certified: _____



Instrument Certification Sheet

Project Name:	BIG PROJECT	Buyer's Project No. (if applicable):	
Project Buyer:	ABC Company	Regulatory Agency Project No. (if applicable):	
HDR Project No.	10050-211-134	Date:	12/19/98
Control Loop No.:	222		
Instrument Tag No.	TSH-222	Transmitter/gauge span:	
Manufacturer:	ACE, Inc.	Switch set-point:	50 F
Model No.	TL-2983-SH5	Switch dead band:	5 F
Serial No.	10293583	Switch range:	32-200 F

TRANSMITTERS AND INDICATORS

% OF SPAN	INCREASING INPUT			DECREASING INPUT		
	INPUT	OUTPUT	ERROR (% of span)	INPUT	OUTPUT	ERROR (% of span)
0%						
25%						
50%						
75%						
100%						
Other (if applicable)						
Other (if applicable)						

SWITCHES

ACTUATION POINT	INCREASING INPUT			DECREASING INPUT		
	INPUT	OUTPUT	ERROR (% of range)	INPUT	OUTPUT	ERROR (% of range)
High (Increasing input)	49.8 F	Contact Close	0.1%	45.1 F	Contact Open	0.2%
Low (Decreasing input)						

Maximum allowable error (per Procurement Documents): 1.0% Switch Range

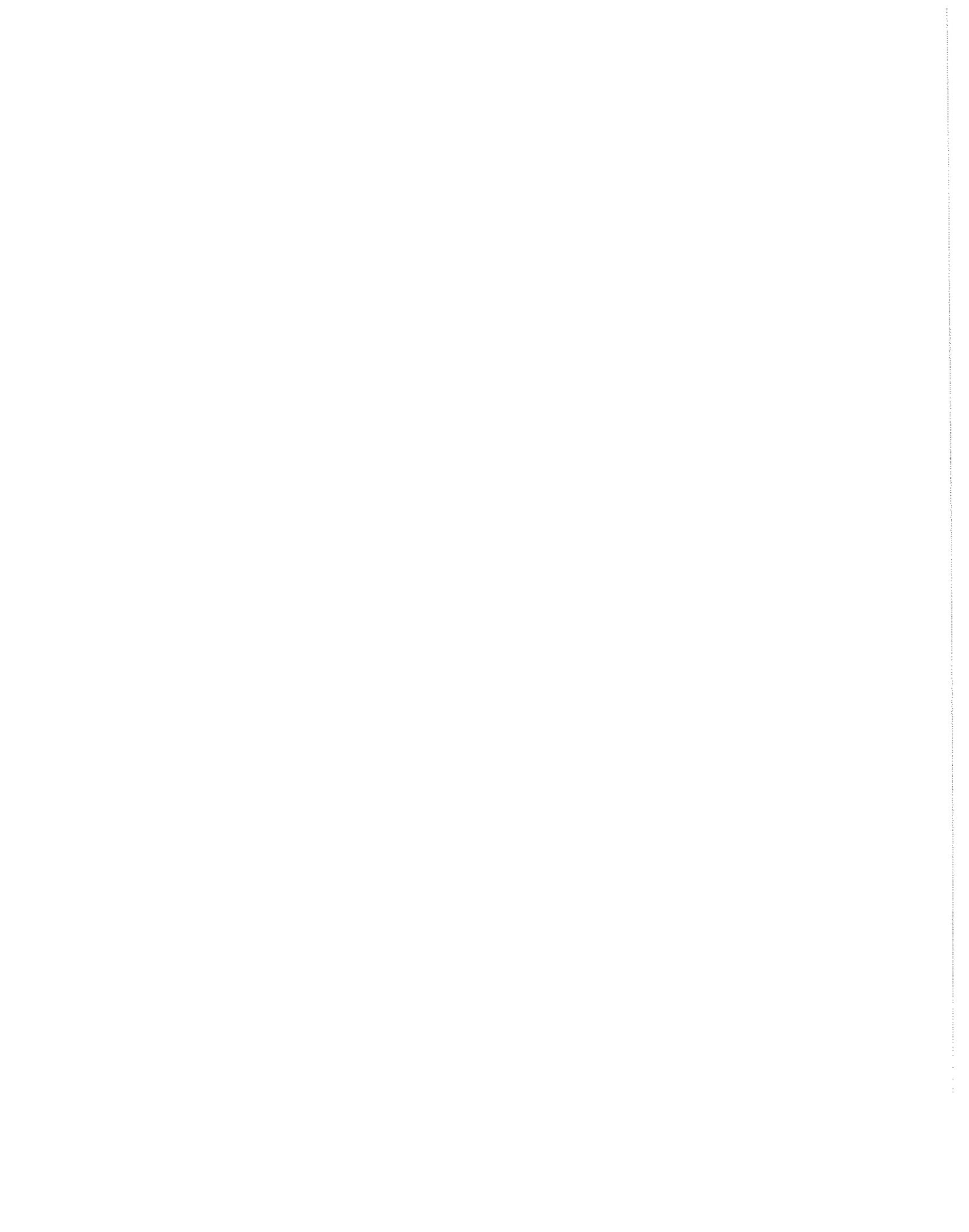
Remarks: _____

CALIBRATION EQUIPMENT UTILIZED

DEVICE TYPE	MFR/MODEL NO.	ACCURACY	NIST TRACEABILITY?
Temperature (dry block) calibrator	Hart Scientific XL5897T	0.1 F	Yes

Certified by: Joe Smith

Date Certified: 12/19/98





Instrument Certification Sheet

Project Name:	BIG PROJECT	Buyer's Project No. (if applicable):	
Project Buyer:	ABC Company	Regulatory Agency Project No. (if applicable):	
HDR Project No.	10050-211-134	Date:	12/19/98
Control Loop No.:	106		
Instrument Tag No.	PIT-106A	Transmitter/gauge span:	0-200 psi
Manufacturer:	ACE, Inc.	Switch set-point:	
Model No.	1275-X	Switch dead band:	
Serial No.	3049569TSH	Switch range:	

TRANSMITTERS AND INDICATORS

% OF SPAN	INCREASING INPUT			DECREASING INPUT		
	INPUT	OUTPUT	ERROR (% of span)	INPUT	OUTPUT	ERROR (% of span)
0%	0.00 psi	4.02 mA	0.13	0.00 psi	4.00 mA	0.00
25%	50.00 psi	8.00 mA	0.00	50.00 psi	8.01 mA	0.06
50%	100.00 psi	12.01 mA	0.06	100.00 psi	12.00 mA	0.00
75%	150.00 psi	16.00 mA	0.00	150.00 psi	16.01 mA	0.06
100%	200.00 psi	20.00 mA	0.00	200.00 psi	19.99 mA	0.06
Other (if applicable)						
Other (if applicable)						

SWITCHES

ACTUATION POINT	INCREASING INPUT			DECREASING INPUT		
	INPUT	OUTPUT	ERROR (% of range)	INPUT	OUTPUT	ERROR (% of range)
High (Increasing input)						
Low (Decreasing input)						

Maximum allowable error (per Procurement Documents): 0.15% span

Remarks: Adjusted zero-otherwise no adjustments required

CALIBRATION EQUIPMENT UTILIZED

DEVICE TYPE	MFR/MODEL NO.	ACCURACY	NIST TRACEABILITY?
Pressure calibrator	Hathaway/Beta XL5946P	0.025% full scale	Yes
Pressure module	Hathaway/Beta XL5948P-6:0-150 psi	0.025% full scale	Yes

Certified by: Joe Smith

Date Certified: 12/19/98



Project Name:	Buyer's Project No. (if applicable):	Page	of
Project Buyer:	Regulatory Agency Project No. (if applicable):		
HDR Project No.:	Date:		

LEAK AND TERMINATION/CONTINUITY CHECKS

DESCRIPTION	FIELD					CONTROL CAB	
	LEAK CHECK ₍₁₎			TERM/CONT CHECK ₍₂₎		TERM/CONT CHECK ₍₂₎	
	Device Tag No.	Process Conn.	Signal Tube	Device Tag No.	Termination Ident.	Device Tag No.	Termination Ident.

1. Leak check for pneumatic signal tubing to be per ISA-PR7.1.
2. Termination/continuity check includes check at terminated equipment for: (a) correct polarity, (b) appropriate signal generation, transmission and reception, and (c) correct shield & ground terminations.

OPERATOR INTERFACE CHECK-OUT

MONITORING POINTS OBSERVED

PARAMETER TYPE	TAG NO.					
PROCESS VAR						
EQUIP STATUS						
ALARM POINT						

OPERATOR CONTROL FUNCTIONS CHECKED

FUNCTION TYPE	TAG NO.	LOCATION	TAG NO.	LOCATION	TAG NO.	LOCATION

AS LEFT SETTINGS

TAG NO.	SWITCH & ALARM SP	CONTROLLERS			
		Gain	Reset, rpm	Deriv. (rate), min	PV Set Point

Describe all interlocks checked, equipment started/stopped, valves/operators stroked. Describe modes of operation checked, and location of operator interface (local/remote).

I certify that the control loop referenced on this page has been completely checked and functions in accordance with applicable drawings and specifications.

Certified by: _____ Date: _____
 (Work Performed By)



Project Name: BIG PROJECT	Buyer's Project No. (if applicable):	Page 1 of 2
Project Buyer: ABC Company	Regulatory Agency Project No. (if applicable):	
HDR Project No.: 10050-211-134	Date: 12/19/98	
Control Loop No. 107		

LEAK AND TERMINATION/CONTINUITY CHECKS

DESCRIPTION	FIELD				CONTROL CAB		
	LEAK CHECK ₍₁₎			TERM/CONT CHECK ₍₂₎		TERM/CONT CHECK ₍₂₎	
	Device Tag No.	Process Conn.	Signal Tube	Device Tag No.	Termination Ident.	Device Tag No.	Termination Ident.
P201 Start Sig				VFD-107	21, 22	PLC Cab	103, 104
P201, Speed inp				VFD-107	27, 28	PLC Cab	67, 68, 69
P201 Start out				VFD-107	31, 32	PLC Cab	72, 73, 74
Press transmit	PIT-107	JS	--	PIT-107	+ / -	PLC Cab	98, 99, 100

- Leak check for pneumatic signal tubing to be per ISA-PR7.1.
- Termination/continuity check includes check at terminated equipment for: (a) correct polarity, (b) appropriate signal generation, transmission and reception, and (c) correct shield & ground terminations.

OPERATOR INTERFACE CHECK-OUT
MONITORING POINTS OBSERVED

PARAMETER TYPE	TAG NO.	TAG NO.	TAG NO.	TAG NO.	TAG NO.	TAG NO.
PROCESS VAR	PI-107A	SI-107				
EQUIP STATUS	P201 ON	P201 OFF	V-107 open	V-107 close		
ALARM POINT	PAH-107					

OPERATOR CONTROL FUNCTIONS CHECKED

FUNCTION TYPE	TAG NO.	LOCATION	TAG NO.	LOCATION	TAG NO.	LOCATION
H-O-A sel sw	HS-107A	VFD-107				
L-O-R sel sw	HS-107B	@ P201				
S/S switch	HS-107C	MCC	HS-107D	MCC		

AS LEFT SETTINGS

TAG NO.	SWITCH & ALARM SP	CONTROLLERS			
		Gain	Reset, rpm	Deriv. (rate), min	PV Set Point
PAH-107	120 psi				
SC-107		2.0	5.0	0.2	80 psi

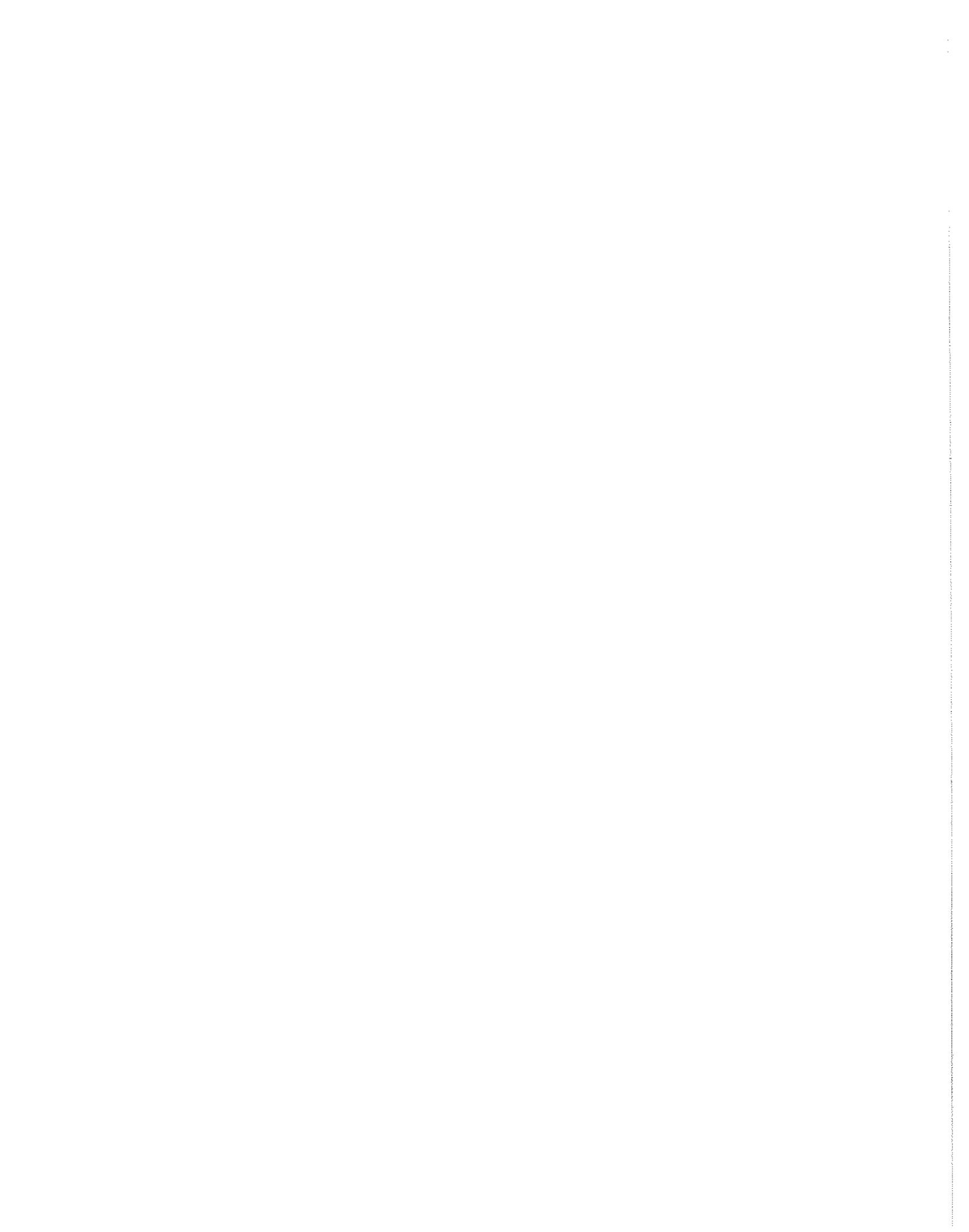
Describe all interlocks checked, equipment started/stopped, valves/operators stroked. Describe modes of operation checked, and location of operator interface (local/remote).

(1) HS-107B in Local: (a) start/stop operation via HS-107A and HS-107C, D (b) Manual/auto operation via HS-107A. In auto, pump stopped on hi press, started on lo press. (2) HS-107B in Remote: Observed operation from PLC-pump stopped on hi press, started on lo press. (3) Observed V-107 open/close automatically in accord with pump run condition. (4) Observed all indications and terminations shown above. (5) Tuned SC-107

I certify that the control loop referenced on this page has been completely checked and functions in accordance with applicable drawings and specifications.

Certified by: Joe Smith
(Work Performed By)

Date: 12/19/98





Project Name: BIG PROJECT	Buyer's Project No. (if applicable):	Page 2 of 2
Project Buyer: ABC Company	Regulatory Agency Project No. (if applicable):	
HDR Project No.: 10050-211-134	Date: 12/19/98	
Control Loop No. 107		

LEAK AND TERMINATION/CONTINUITY CHECKS

DESCRIPTION	FIELD				CONTROL CAB		
	LEAK CHECK ₍₁₎			TERM/CONT CHECK ₍₂₎		TERM/CONT CHECK ₍₂₎	
	Device Tag No.	Process Conn.	Signal Tube	Device Tag No.	Termination Ident.	Device Tag No.	Termination Ident.
V-107 open ZS				ZSO-107	+/-	PLC Cab	112, 113
V-107 close ZS				ZSC-107	+/-	PLC Cab	114, 115

- Leak check for pneumatic signal tubing to be per ISA-PR7.1.
- Termination/continuity check includes check at terminated equipment for: (a) correct polarity, (b) appropriate signal generation, transmission and reception, and (c) correct shield & ground terminations.

OPERATOR INTERFACE CHECK-OUT
MONITORING POINTS OBSERVED

PARAMETER TYPE	TAG NO.					
PROCESS VAR						
EQUIP STATUS	ZOI-107	ZCL-107				
ALARM POINT						

OPERATOR CONTROL FUNCTIONS CHECKED

FUNCTION TYPE	TAG NO.	LOCATION	TAG NO.	LOCATION	TAG NO.	LOCATION

AS LEFT SETTINGS

TAG NO.	SWITCH & ALARM SP	CONTROLLERS			
		Gain	Reset, rpm	Deriv. (rate), min	PV Set Point

Describe all interlocks checked, equipment started/stopped, valves/operators stroked. Describe modes of operation checked, and location of operator interface (local/remote).

Checked terminations and verified indications shown above.

I certify that the control loop referenced on this page has been completely checked and functions in accordance with applicable drawings and specifications.

Certified by: Joe Smith Date: 12/19/98
(Work Performed By)

SECTION 13442
PRIMARY ELEMENTS AND TRANSMITTERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Flow components.

2. Pressure components.

3. Level components.

4. Analytical components.

5. Pipe, tubing and fittings.

6. Instrument valves.

B. Related Sections include but are not necessarily limited to:

1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

2. Division 1 - General Requirements.

3. Section 11005 - Equipment: General Requirements.

4. Section 13440 - Instrumentation for Process Control: Basic Requirements.

5. Section 13441 - Control Loop Descriptions.

6. Section 15060 - Pipe and Pipe Fittings: Basic Requirements.

7. Section 15061 - Pipe: Steel.

1.2 QUALITY ASSURANCE

A. Referenced Standards:

1. American Gas Association (AGA):

a. Gas Measurement Committee Report #3.

2. American Iron and Steel Institute (AISI).

3. American National Standards Institute (ANSI):

a. B16.5, Pipe Flanges and Flanged Fittings.

b. B16.22, Wrought Copper and Bronze Solder-Joint Pressure Fittings.

c. PTC 19.3, Instruments and Apparatus, Part 3 Temperature Measurement.

d. MC96.1, Temperature Measurement Thermocouples.

4. American Society of Mechanical Engineers (ASME):

a. B31.1, Power Piping.

b. SEC II-A SA-182, Standard Specification for Forged or Rolled Alloy Steel Pipe

Flanges, Forged Fittings, and Valves and Parts for High-Temperature.

c. SEC II-A SA-479, Standard Specification for Stainless and Heat-Resisting Steel Bars

and Shapes for Use in Boilers and Other Pressure Vessels.

d. Fluid Meters, Sixth Edition.

5. American Society for Testing and Materials (ASTM):

a. A106, Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.

b. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe

Fittings.

c. A182, Standard Specification for Forged or Rolled Alloy - Steel Pipe Flanges, Forged

Fittings and Valves and Parts for High Temperature Service.

d. A234, Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy

Steel for Moderate and Elevated Temperatures.

e. A240, Standard Specification for Heat-Resisting Chromium and Chromium-Nickel

Stainless Steel Plate, Sheet, and Strip for Pressure Vessels.

- f. A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
- g. A276, Standard Specification for Stainless Steel Bars and Shapes.
- h. A479, Standard Specification for Stainless Steel Bars and Shapes for use in Boilers and other Pressure Vessels.
- i. B16, Standard Specification for Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines.
- j. B32, Standard Specification for Solder Metal.
- k. B68, Standard Specification for Seamless Copper Tube, Bright Annealed.
- l. B75, Standard Specification for Seamless Copper Tube.
- m. B88, Standard Specification for Seamless Copper Water Tube
- n. B124, Standard Specification for Copper and Copper-Alloy Forging Rod, Bar, and Shapes.
- o. B283, Standard Specification for Copper and Copper-Alloy Die Forgings (Hot-Pressed).
- p. B453, Standard Specification for Copper-Zinc-Lead Alloy (Leaded-Brass) Rod.
- q. B61, Standard Specification for Steam or Valve Bronze Castings.
- 6. National Electrical Manufacturers Association (NEMA):
 - a. ICS 6, Enclosures for Industrial Controls and Systems.

1.3 SYSTEM DESCRIPTION

- A. The instruments specified in this Section are the primary element components for the control loops shown on the "I" series Drawings and specified in Section 13441. These instruments are integrated with other control system components specified under the 13440 specification series to produce the functional control defined in the Contract Documents.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. See Sections 01340 and 13440.
- B. Operation and Maintenance Manuals:
 - 1. See Section 01340.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the Manufacturers listed in the articles describing the elements are acceptable.
- B. Submit requests for substitutions in accordance with Specification Section 01640.

2.2 FLOW COMPONENTS

- A. Magnetic Flow Meters:
 - 1. Acceptable Manufacturers:
 - a. Bailey-Fischer and Porter.
 - b. Johnson Yokogawa.
 - c. Rosemount.
 - d. Endress Hauser.
 - 2. Design and fabrication:
 - a. Utilize characterized field principle of electromagnetic induction to produce signal directly proportional to flow rate.
 - b. High input impedance pre-amplifiers.
 - 1) Minimum impedance: 10^{10} ohms.

- c. Provide flanged end connections per ANSI B16.5 rated for piping system operating and test conditions.
 - d. Splash and dripproof and capable of temporary submersion for a period of 24 HRS under 15 FT of water.
 - e. Operating pressure: 30 psi.
 - f. Operating temperature: 90 DegF.
 - g. Grounding requirements:
 - 1) Nonmetallic or lined pipe:
 - a) Inlet and outlet grounding rings of same material as electrode.
 - 2) Conductive piping:
 - a) Conductive path between the meter and the piping flanges.
 - h. Provide cable between magnetic flow meter and transmitter.
 - i. Pulsed DC magnetic field excitation.
 - j. Automatic zero.
 - k. Adjustable low flow cutoff.
 - l. Minimum signal lock (empty tube zero) to prevent false measurement when tube is empty.
 - m. Inaccuracy:
 - 1) Above 10 percent of range: ± 1.0 percent of rate.
 - 2) Below 10 percent of range: ± 0.1 percent of range setting.
 - 3) Add ± 0.1 percent of range to above inaccuracies for analog outputs.
 - n. 4-20 mA DC isolated output into maximum 800 ohms.
 - o. Power supply: 117 V ± 10 percent, 60 HZ.
 - p. Indication of flow rate and totalized flow at transmitter.
 - q. Meter operable as specified in liquids with 5.0 micro mho/cm or more conductivity.
 - r. Transmitter electronics shall use microprocessor based architecture and be configured using parameters.
3. Schedule:

TAG NUMBER	SERVICE	FLOW RANGE (GPM)	METER SIZE (IN)
FE-9820	Clarifier Flow Meter	3500	14
FE-7620-1	Membrane Flow Meter	1350	10
FE-7820	Backwash Recycle Flow Meter	60-200	4

TAG NUMBER	LINER MATERIAL	ELECTRODE MATERIAL	INTEGRAL, FIELD OR PANEL-MOUNTED TRANSMITTER
FE-9820	Rubber	316 SST	Integral
FE-7620-1	Rubber	316 SST	Integral
FE-7820	Rubber	316 SST	Integral

2.3 PRESSURE COMPONENTS

- A. Pressure Switches:
 - 1. Acceptable manufacturers:
 - a. Mercoid.
 - b. Automatic Switch Company.
 - c. United Electric.
 - 2. Materials:
 - a. Wetted switch elements: 316 stainless steel.
 - b. Diaphragm seal housing: 316 stainless steel.
 - c. Pressure snubber:
 - 1) Filter disc: 316 stainless steel.
 - 2) Housing: 316 stainless steel.
 - 3. Accessories:
 - a. Provide ball valve to isolate pressure switch from source.

- 1 4. Design and fabrication:
2 a. Utilize snap acting switches.
3 b. Two SPDT contacts rated:
4 1) 1 amp inductive at 125 V DC.
5 2) 5 A inductive at 120 V AC.
6 c. Switch set points:
7 1) Set points between 30 and 70 percent of switch rated working range.
8 2) Operating pressure not to exceed 75 percent of switch rated working range.
9 d. Accuracy: Better than 1 percent of full scale.
10 e. Process connection: Minimum of 1/4 IN.
- 11 B. Pressure Gage:
12 1. Acceptable manufacturers:
13 a. Ashcroft.
14 b. Ametek.
15 2. Materials:
16 a. Bourdon tube, socket, connecting tube: 316 stainless steel.
17 b. Case: Phenolic.
18 c. Diaphragm seal housing: 316 stainless steel.
19 d. Pressure snubber:
20 1) Filter disc: 316 stainless steel.
21 2) Housing: 316 stainless steel.
22 3. Accessories:
23 a. Provide valve at point of connection to equipment and at panel if panel mounted.
24 b. Utilize pressure snubbers with porous metal discs to provide pulsation dampening on
25 gauge applications as shown on schedule.
26 c. Provide 1/2 IN stainless steel antisiphon pigtail inlet connection for hot water and steam
27 applications.
28 4. Design and fabrication:
29 a. All components suitable for service at:
30 1) 250 DegF.
31 2) The maximum process temperature to which the gage is to be exposed.
32 b. Provide viewer protection from element rupture.
33 c. Calibrate gages at jobsite for pressure and temperature in accordance with
34 manufacturer's instructions.
35 d. Unless otherwise required by codes, provide stem mounted or flush mounted, as
36 required, with dial diameter as follows:
37

PIPE SIZE	DIAL SIZE	GAGE CONNECTION
1-1/2 IN or less	2-1/2 IN	1/4 IN
Larger than 1-1/2 IN	4-1/2 IN	1/2 IN

- 38 e. Equip with white faces, black numerals and black pointers.
39 f. Gage tapping position to be clear of equipment functions and movements, and protected
40 from maintenance and operation of equipment. Gage to be readable from an accessible
41 standing position.
42 g. Gage accuracy: 1 percent of full range.
43 h. Select gage range so that:
44 1) The normal operating value is in the middle third of the dial.
45 2) Maximum operating pressure does not exceed 75 percent of the full scale range.
46

47 **2.4 LEVEL ELEMENTS**

- 48 A. Gage glasses shall conform to the following:
49 1. Gage glasses shall be of the type and design for the operating pressure and temperature.

- 1 2. Gage glasses shall be complete with shutoff cocks and drain cocks. Shutoff cocks shall be
- 2 furnished with built-in check valves. Guard bars shall be furnished to protect against glass
- 3 breakage.
- 4 B. Induction Electrodes and Relays:
- 5 1. Acceptable manufacturers:
- 6 a. Anatek B/W Controls.
- 7 b. Warrick.
- 8 2. Design and fabrication:
- 9 a. 3 IN flanged type electrode holder.
- 10 b. Relays mounted in separate control panel.
- 11 c. Secondary coil voltage: As required for liquid.
- 12 d. Field convertible relay contacts.
- 13 e. Electrode strengthened by spacers.

14 **2.5 PIPE, TUBING, AND FITTINGS**

- 15 A. Acceptable Manufacturers:
- 16 1. Subject to compliance with the Contract Documents, the following manufacturers are
- 17 acceptable:
- 18 a. Tube fittings:
- 19 1) Parker CPI.
- 20 2) Swagelok.
- 21 B. Submit requests for substitution in accordance with Specification Section 01640.
- 22 C. Instrument Tubing and Fittings:
- 23 1. Material:
- 24 a. Tubing: ASTM A269, Grade TP 316 stainless steel.
- 25 b. Straight fittings: 316 stainless steel per ASME SA-479 or ASTM A276.
- 26 c. Shaped bodies: ASME SA-182 F316 stainless steel.
- 27 2. Design and fabrication:
- 28 a. Tubing:
- 29 1) Seamless.
- 30 2) Fully annealed.
- 31 3) Maximum hardness: 80 Rb.
- 32 4) Free from surface scratches and imperfections.
- 33 5) Diameter: 1/2 IN OD unless specified otherwise.
- 34 6) Wall thickness:
- 35 a) Meet requirements of paragraph 122.3 of ASME B31.1.
- 36 b) Minimum 0.049 IN for 1/2 IN OD tubing.
- 37 b. Fittings:
- 38 1) Flareless.
- 39 2) Compression type.
- 40 D. Instrument Piping:
- 41 1. For applications where the instrument is supported solely by the sensing line, (e.g. pressure
- 42 gauge directly mounted to process line) utilize piping as specified below.
- 43 a. Diameter: 1/2 IN unless specified otherwise.
- 44 b. Schedule 80.
- 45 c. 316 stainless steel.
- 46 E. Pneumatic Signal Tubing:
- 47 1. Material: Copper per ASTM B75.
- 48 2. Design and fabrication:
- 49 a. Soft annealed.
- 50 b. Free from surface scratches and imperfections.
- 51 c. Wall thickness:
- 52 1) 0.030 IN for 1/4 IN OD.

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2) 0.035 IN for 3/8 IN OD.

F. Pneumatic Tube Fittings:

1. Material:
 - a. Straight fittings: Brass per ASTM B16 and B453.
 - b. Shaped bodies: Brass per ASTM B124 Alloy 377 or ASTM B283.
2. Design and fabrication:
 - a. Flareless.
 - b. Compression type.

2.6 INSTRUMENT VALVES

A. Process instrument multi-valve manifolds, isolation, vent and blow-down valves:

1. Acceptable manufacturers:
 - a. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1) Whitey Co.
 - 2) Anderson-Greenwood USA, Inc.
 - b. Submit requests for substitution in accordance with Specification Section 01640.
2. Materials:
 - a. Packing:
 - 1) 450 DegF and above: Graphite.
 - 2) Below 450 DegF: Graphite or Teflon.
 - b. Body: 316 stainless steel per ASTM A479.
 - c. Stem: 316 stainless steel per ASTM A276.
 - d. Ball: 316 stainless steel per ASTM A276.
 - e. Support rings: 316 stainless steel per ASTM A276.
 - f. Seats:
 - 1) Metal:
 - a) 316 stainless steel per ASTM A276.
 - 2) Soft:
 - a) Teflon, Delrin, or equivalent.
 - b) Only utilized on applications where manufacturer's temperature and pressure ratings exceed process design conditions.
3. Design and fabrication:
 - a. Either of the following:
 - 1) Ball valve with 1/4 turn activation.
 - 2) Free-swiveling ball stem.
 - b. Provide body wall thickness sufficient for process design conditions per ASME B31.1.
 - c. Temperature: Manufacturer's temperature rating for all components shall exceed process design conditions.

B. Isolation Valves in Copper Instrument Air Tubing:

1. Acceptable manufacturers:
 - a. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1) Whitey Co.
 - 2) Or equal.
 - b. Submit requests for substitution in accordance with Specification Section 01640.
2. Materials:
 - a. Packing: Graphite or Teflon.
 - b. Body: Brass per ASTM B16.
 - c. Stem: 316 stainless steel per ASTM A276.
 - d. Ball: 316 stainless steel per ASTM A276.
 - e. Support rings: 316 stainless steel per ASTM A276.
 - f. Seats:
 - 1) Metal:
 - a) 316 stainless steel per ASTM A276.

- 1 D. Locate instrument piping and tubing so as to be free of vibration and interference with other
- 2 piping, conduit, or equipment.
- 3 E. Keep foreign matter out of the system.
- 4 F. Remove all oil on piping and tubing with solvent before piping and tubing installation.
- 5 G. Plug all open ends and connections to keep out contaminants.
- 6 H. Tubing Installation:
- 7 1. General:
- 8 a. Install such that tube shows no sign of crumpling, bends of too short a radius, or
- 9 flattening, etc.
- 10 b. Make tube runs straight and parallel or perpendicular to the floor, equipment and piping
- 11 runs.
- 12 c. For liquid and steam applications, slope continuously from the process to the
- 13 instrument with a minimum slope of 0.50 IN per foot.
- 14 d. For gas and air applications, slope continuously from the instrument to the process with
- 15 a minimum slope of 0.50 IN per foot.
- 16 e. If the sensing line cannot be continuously sloped, install high point vents and low point
- 17 drains.
- 18 f. Keep instrument tubing clean during all phases of work.
- 19 g. Blow out with clean, dry, oil-free air immediately before final assembly.
- 20 h. Cut by sawing only and debur.
- 21 2. Bending:
- 22 a. Make each bend with tube bender of the correct size for the tube.
- 23 b. Make all bends smooth and continuous.
- 24 c. Rebending is not permitted.
- 25 d. Make bends true to angle and radius.
- 26 e. Maintain a true circular cross section of tubing without buckling or undue stretch of
- 27 tube wall.
- 28 f. Allowable tolerance for flattening out of tubing bends: Maximum of 8 percent of the
- 29 OD for stainless steel tubing.
- 30 g. Minimum bending radius for stainless steel tubing:
- 31

TUBE OD INCHES	MINIMUM BENDING RADIUS, INCHES
1/4	9/16
3/8	15/16
1/2	1-1/2

- 32 h. Minimum bending radius for type L, hard (drawn) copper.

TUBE OD INCHES	MINIMUM BENDING RADIUS, INCHES
3/8	1-3/4
1/2	2-1/2

- 35 3. Tubing support:
- 36 a. Intermittently support by clamping to support angle.
- 37 b. Install supports to be self-draining, supported by hangers, or cantilevered from walls or
- 38 structural beams.
- 39 c. Support at 5 FT-0 IN maximum spans for horizontal or vertical runs.
- 40 d. Use tubing trays in areas where spans between supports are greater than 5 FT and for all
- 41 signal tubing support.
- 42 e. Support each tubing tray at 10 FT maximum spans.
- 43

- 1 f. Align tubing in orderly rows and retain in the tray by bolted clips. The use of spring or
- 2 speed clips is not acceptable.
- 3 g. Maintain order of the tubing throughout the length of the tray.
- 4 h. Locate angle, channel and tray installation to protect tubing from spills and mechanical
- 5 damage.
- 6 i. Locate support members to clear all piping, conduit, equipment, hatchways, monorails,
- 7 and personnel access ways and allow access for equipment operation and maintenance.
- 8 j. Support trays to prevent torsion, sway or sag.
- 9 k. Permanently attach supports to building steel or other permanent structural members.
- 10 l. Arrange supports and trays so that they do not become a trough or trap.
- 11 4. Routing and orientation:
- 12 a. Route to maintain a minimum headroom clearance of 8 FT.
- 13 b. Locate and orient valves and specialties so that they are accessible for operation and
- 14 maintenance from the operating floor. Do not route through or over equipment removal
- 15 areas, below monorails or cranes nor above or below hatches.
- 16 5. Expansion and vibration provisions:
- 17 a. Provide horizontal expansion loops at the process connections.
- 18 b. Route tubing parallel to relative motion through sleeved supports that allow linear tube
- 19 movement.
- 20 c. Cold springing of tubing to compensate for thermal expansion is prohibited.
- 21 d. Utilize flexible hoses to connect pneumatic tubing to air users which may move or
- 22 vibrate.
- 23 I. Air Supply:
- 24 1. Connect all instruments requiring air to air supply piping and tubing. Provide connections as
- 25 follows:
- 26 a. Terminate branch supply line not more than 36 IN from the device with a 1/2 IN
- 27 isolation valve.
- 28 b. For remaining line, use 1/4 or 3/8 IN tubing of a length to allow for normal equipment
- 29 movement and vibration.
- 30 c. Use flexible hoses to connect pneumatic tubing to air users which may experience
- 31 significant movement or vibration.
- 32 d. Make branch connections to individual instruments from the top of the supply header.
- 33 e. Purge instrument air piping of extraneous material by blowing clean, dry, oil-free air
- 34 through the system prior to final connection.
- 35 J. Threaded Connection Seals:
- 36 1. Use Tite-Seal or acceptable alternate.
- 37 2. Use of lead base pipe dope or Teflon tape is not acceptable.
- 38 3. Do not apply Tite-Seal to tubing threads of compression fittings.
- 39 K. Capillary Tubing:
- 40 1. Route capillary tubing in tubing tray.
- 41 2. Install capillary tubing with a 2 IN minimum bend radius which does not kink or pinch the
- 42 capillaries.
- 43 3. Do not cut or disconnect at any point.
- 44 4. Coil excess capillary tubing and secure at the instrument.
- 45 L. Temperature Elements:
- 46 1. Assemble in the following sequence:
- 47 a. Remove temperature sensor sheaths and terminal blocks from the head and nipple
- 48 assembly.
- 49 b. Connect nipple and head to thermowell installed in the pipe.
- 50 c. Insert sheath and terminal block until it seats in the thermowell.
- 51 d. Connect to the head.
- 52 M. Instrument Mounting:
- 53 1. Mount all instruments where they will be accessible from fixed ladders, platforms, or grade.

- 1 2. Mount all local indicating instruments with face forward toward the normal operating area,
- 2 within reading distance, and in the line of sight.
- 3 3. Mount instruments level, plumb, and support rigidly.
- 4 4. Mount to provide:
- 5 a. Protection from heat, shock, and vibrations.
- 6 b. Accessibility for maintenance.
- 7 c. Freedom from interference with piping, conduit and equipment.

8 **3.2 TRAINING**

- 9 A. Provide on-site training in accordance with Section 01650.

10

END OF SECTION

2 **SECTION 13448**
3 **CONTROL PANELS AND ENCLOSURES**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

- 6 A. Section Includes:
- 7 1. Control panels.
- 8 B. Related Sections include but are not necessarily limited to:
- 9 1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- 10 2. Division 1 - General Requirements.
- 11 3. Section 10400 - Identification, Stenciling and Tagging Systems.
- 12 4. Section 13440 - Instrumentation for Process Control: Basic Requirements.

13 **1.2 QUALITY ASSURANCE**

- 14 A. Referenced Standards:
- 15 1. American Society for Testing and Materials (ASTM):
- 16 a. A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel
- 17 Tubing for General Service.
- 18 2. National Electrical Manufacturers Association (NEMA):
- 19 a. ICS 4, Terminal Blocks for Industrial Use.
- 20 b. ICS 6, Enclosures for Industrial Controls and Systems.
- 21 c. 250, Enclosures for Electrical Equipment (1000 V Maximum).
- 22 3. National Fire Protection Association (NFPA):
- 23 a. National Electric Code (NEC).
- 24 4. Underwriters Laboratories Inc. (UL):
- 25 a. UL 508, Industrial Control Equipment.
- 26 B. Miscellaneous:
- 27 1. Obtain approved control panel layouts prior to installation of conduit feeds
- 28 2. Provide completely matching color tones for any individual color specified.
- 29 3. Provide panel with the required NEMA rating per NEMA Publication No. 250 to meet
- 30 classifications shown on drawings or specifications.
- 31 4. Approved supplier of Industrial Control Equipment under provisions of UL 508. Entire
- 32 assembly shall be affixed with a UL 508 label "Listed Enclosed Industrial Control Panel"
- 33 prior to shipment to the jobsite. Any control panel which arrives to the jobsite without an
- 34 UL 508 label shall be rejected and sent back to the panel shop.

35 **1.3 DEFINITIONS**

- 36 A. The term "panel" refers to any control panel or enclosure included in this specification section or
- 37 indicated on the Instrumentation Drawings.
- 38 B. Foreign voltages: Voltages present in circuit even when the panel main power is disconnected.

39 **1.4 SUBMITTALS**

- 40 A. Shop Drawings:
- 41 1. See Section 13440.
- 42 2. Statement of panel wiring methods including wire type, insulation colors, insulation rating,
- 43 wire sized, wire routing, and wire labeling strategy to be implemented during panel
- 44 fabrication.
- 45 3. Letter documenting UL 508 capabilities.

- 1 4. Scaled panel face and subpanel face instrument and nameplate layout drawings.
- 2 5. Panel and subpanel materials of construction.
- 3 6. Panel and subpanel dimensions and weights.
- 4 7. Panel access openings.
- 5 8. Conduit and wiring access locations.
- 6 9. Internal wiring and terminal block drawings.
- 7 10. Internal component layout to scale.
- 8 11. Nameplate text.
- 9 12. Scaled layouts of any graphic panels.
- 10 13. Total electrical load of panels and enclosures.
- 11 B. As-Built Drawings:
- 12 1. Update the control panel drawings and ship at least one copy with the control panel to the
- 13 jobsite.
- 14 C. Operation and Maintenance Manuals:
- 15 1. See Section 01340.

16 **PART 2 - PRODUCTS**

17 **2.1 ACCEPTABLE MANUFACTURERS**

- 18 A. Subject to compliance with the Contract Documents, the following manufacturers are
- 19 acceptable:
- 20 1. Enclosures:
- 21 a. Hoffman Engineering Co.
- 22 B. Submit requests for substitution in accordance with Specification Section 01640.

23 **2.2 ACCESSORIES**

- 24 A. Panel Nameplates and Identification:
- 25 1. See Section 10400.
- 26 B. Provide cautionary markings, if required, in accordance with UL 508, subpart 59.
- 27 1. Locate cautionary markings per UL 508, subparts 59.1, 59.3.
- 28 2. Prefix the cautionary marking with the word "CAUTION" or "WARNING" utilizing letters
- 29 sized per UL 508, subpart 59.2.
- 30 3. If more than one disconnect switch is required to disconnect all power within a panel or
- 31 enclosure, provide a cautionary marking with the word "CAUTION" and the following or
- 32 equivalent, "Risk of Electric Shock-More than one disconnect switch required to de-
- 33 energize the equipment before servicing."
- 34 a. Locate the cautionary marking on the outside of the equipment or on a stationary fixed,
- 35 nonremovable part inside the equipment where easily and clearly seen.

36 **2.3 WALL MOUNTED PANELS**

- 37 A. Seams continuously welded and ground smooth.
- 38 B. Rolled lip around all sides of enclosure door opening.
- 39 C. Gasketed dust tight.
- 40 D. Three-point latching mechanism operated by oil tight key-locking handle.
- 41 E. Key doors alike.
- 42 F. Continuous heavy GA hinge pin on doors.
- 43 1. Hinges rated for 1.5 times door plus instrument weight.
- 44 G. After cutouts have been made, finish opening edges to smooth and true surface condition.

- 1 H. Front full opening door.
- 2 I. Brackets for wall mounting.
- 3 **2.4 PANEL WIRING AND PIPING:**
- 4 A. Factory wire panels to identified terminal blocks equipped with screw type lugs.
- 5 B. Install all wiring without splicing in factory in plastic wire duct:
 - 6 1. Do not exceed manufacturer's recommended fill limits.
 - 7 2. Size raceways per NEC Article 362.
 - 8 3. Ducts shall have removable covers.
- 9 C. Splicing and tapping of wires allowed only at terminal blocks.
- 10 D. Keep AC power lines separate from low-level DC lines, I/O power supply cables, and all I/O
 - 11 rack interconnect cables. Separate by at least 6 IN, except at unavoidable crossover points and at
 - 12 device terminations.
- 13 E. Arrange circuits on terminal blocks plus any spare conductors on adjacent terminals.
- 14 F. Provide necessary power supplies for control equipment.
- 15 G. Assure each panel mounted device is bonded or otherwise grounded to panel or panel grounding
 - 16 system by means of locknuts or pressure mounting methods.
 - 17 1. Equip panel with grounding terminals.
 - 18 2. All sub-panels and hinged doors shall be bonded to ground.
- 19 H. Arrange wiring with sufficient clearance for all leads. Arrange wire neatly, cut to proper length,
 - 20 and remove surplus wire.
- 21 I. Identify all wires with plastic sleeve type (heat-shrinkable) wire markers at each end. Markers
 - 22 shall:
 - 23 a. Identify circuit numbers.
 - 24 b. Identify function and polarity.
- 25 J. Termination requirements:
 - 26 1. Terminal block markings, mechanical characteristics and electrical characteristics shall be in
 - 27 accordance with NEMA ICS 4.
 - 28 2. Terminals shall facilitate wire sizes as follows:
 - 29 a. 120 V AC applications: Wire size 12 AWG and smaller.
 - 30 b. Other: Wire size 14 AWG and smaller.
 - 31 3. Provide terminal blocks with continuous marking strip.
 - 32 4. Tag each I/O terminal to indicate tag number of the connected device.
 - 33 5. Provide terminals for individual termination of each signal shield.
 - 34 6. Provide 20 percent excess terminals for future expansion.
 - 35 7. Use terminal blocks with bladed switch where control voltages enter or leave the control
 - 36 panel. Bladed terminal block body to be orange where foreign voltages connect to the
 - 37 panel.
 - 38 8. Use fused terminal blocks where the control circuit is energizing a solenoid valve or where
 - 39 providing DC power to loop-powered transmitter. Blown fuse indicators to be utilized on
 - 40 all fused terminal blocks.
 - 41 9. Install DIN rail along entire terminal strip area to facilitate future expansion.
 - 42 10. Utilize busses for DC and AC control voltages within panel. Include space for expansion.

43 **PART 3 - EXECUTION**

44 **3.1 INSTALLATION**

- 45 A. Install free-standing panels including Owner furnished panels on concrete pads as detailed on the
 - 46 Drawings.

- 1 B. Anchor panels in a manner to prevent the enclosure from racking, which may cause the doors to
2 become misaligned.

3

END OF SECTION