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SPECIFICATION NO: 17071  
FOR: INSTRUMENTATION REQUIREMENTS FOR PACKAGED  
UNITS

KITECH  
INCHON, SOUTH KOREA  
cGMP BIOPHARM CONTRACT MANUFACTURING  
FACILITY

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**SECTION 17071**  
**SPECIFICATION FOR**  
**INSTRUMENTATION REQUIREMENTS FOR PACKAGED UNITS**

**PART 1        GENERAL**

**1.01    GENERAL REQUIREMENTS**

- A.    This specification prescribes a basis for consistent application of instruments to mechanical packaged equipment installed in a clean room environment, and shall be used as a guide by both mechanical and control systems in development of the mechanical package specifications.

**1.02    SUMMARY**

- A.    All instruments furnished with mechanical packaged equipment shall meet the requirements of this specification. With Buyer's prior concurrence, the use of the Supplier's standard instruments and control systems shall be permitted. Where compliance with this specification causes a deviation from that normally supplied in the standard package, the impact to supply fittings, materials, devices and components shall be stated in the proposal.
- B.    The purpose of this specification is to:
1.    ensure that instrumentation provided by equipment suppliers conforms to the instrumentation design philosophy of the plant.
  2.    reduce the number of different instrument manufacturers and type of instruments in the plant.
  3.    ensure that information on instrumentation items is readily available to all of the Buyer's design departments.
  4.    establish a minimum acceptable instrument quality level.
- C.    This specification describes the minimum instrumentation and control requirements for mechanical packaged equipment. This specification is to ensure that instrumentation and control systems supplied are developed according to Current Good Manufacturing Practice Regulations (cGMPs) in Title 21 Code of the Federal Regulations (CFR) made substantive law by Section 501 of the Food, Drug and Cosmetic Act which will permit validation.
- D.    Equipment Suppliers are **not** expected to reveal trade secrets except under properly executed secrecy agreements between appropriate parties.
- E.    The Equipment Supplier shall permit the Buyer to audit the system development process to ensure that the requirements described above are being met. The

Equipment Supplier shall make a corporate commitment to release to the Buyer any information required for an FDA inspection.

F. Work Included:

1. The Equipment Supplier shall furnish all labor, equipment and materials, and perform all work necessary to complete the installation of all instrumentation and control systems furnished as an integral part of the Equipment Package.
2. The Equipment Supplier shall perform all testing and calibrations to insure proper performance of all instrumentation and control systems provided as part of the Equipment Package. All instrumentation and control systems shall be properly tagged and supplied with calibration certificates.
3. The Equipment Supplier shall indentify the manufacturer, model number, calibrated range, and Buyer's tag number in an instrument index for all instruments furnished with the mechanical equipment.
4. The Equipment Supplier shall be responsible for selection of proper range, pressure rating, and materials of construction based on fluid properties, operating conditions, and mechanical design constraints for all furnished instruments.
5. The Equipment Supplier shall provide all local control systems, such as Programmable Logic Controllers (PLCs), Human-Machine Interfaces (HMIs), printers, etc., complete with all instrumentation and programming, wired, piped and tested.
6. The acceptance of the Equipment Supplier's drawings by the Buyer does not in any way relieve the Equipment Supplier of his design responsibility. Drawing acceptance is authorization to proceed with manufacturing only; it is not an approval of the Equipment Supplier's design nor acceptance of the design as meeting all specified requirements.

G. Work Not Included:

1. Installation of any instrumentation and control systems outside the physical boundaries of the Equipment Packages.
2. One source of instrument quality air at 100 psig.
3. One source of Power, as required.

1.03 RELATED DOCUMENTS

A. Reference Specifications:

1. 17000 – Instrument Installation
2. 17021 – Programmable Logic Controllers
3. 16000 – General Provisions for Electrical Work
4. 16001 – Electrical Requirements for Packaged Equipment
5. 16120 – Conductors and Cables

6. 16264 – Uniterrptable Power Supply
  7. 18000 – Specification for Standard Details
  8. 18001 – General Piping Requirements
  9. 18002 – Specification for General Piping Fabrication and Erection
  10. 18003 – Specification for Automatic Welding Procedures and Inspection
  11. 18004 – Specification for Sanitary Tubing Fabrication and Erection
  12. 18005 – Specification for Piping Supports
- B. References: The publications listed form a part of this specification. Each publication shall be the latest revision and addendum in effect on the date this specification is issued for construction unless noted otherwise. Except as modified by the requirements specified herein or the details of the drawings, Work included in this specification shall conform to the applicable provisions of these publications:
1. ANSI (American National Standards Institute)
  2. API (American Petroleum Institute)
  3. ASME (American Society of Mechanical Engineers)
  4. ASTM (American Society for Testing and Materials)
  5. FCC (Federal Communications Commission)
  6. FDA (Food and Drug Administration)
  7. FM (Factory Mutual Engineering Corporation)
  8. GAMP (Good Automated Manufacturing Practice)
  9. cGMP (Current Good Manufacturing Practice)
  10. ICEA (Insulated Cable Engineers Association)
  11. IEEE (Institute of Electrical and Electronics Engineers)
  12. ISA (The Instrumentation Systems and Automation Society)
  13. NEMA (National Electrical Manufacturers Association)
  14. NFPA (National Fire Protection Associations)
  15. NIST (National Institute of Standards Technology)
  16. NPT (American National Taper Pipe Thread)
  17. OSHA (Occupational Safety and Health Administration)
  18. SAMA (Scientific Apparatus Makers Association)
  19. UL (Underwriters' Laboratories)
- C. Attachments:
1. Appendix I – Approved Vendor List

#### 1.04 SUBMITTALS

- A. Supplier shall prepare and submit for Buyer's review detailed datasheets for each instrument provided on ISA (The Instrumentation Systems and Automation Society) Standard S-20 forms. Manufacturer's catalog sheets shall be submitted for all instruments and devices during the design phase of the order.

- B. Each instrument used shall be shown on Supplier's Piping and Instrumentation Diagram (P&ID) according to ISA Standard S5.1. Buyer shall provide instrument tag numbers for all instruments provided by Supplier. Supplier shall add Buyer's tag numbers to the P&IDs.
- C. Each instrument used shall be entered into an instrument index using Microsoft Excel and arranged in alphanumeric order. Supplier is to submit this instrument index to Buyer for review during the design phase of the order. The instrument index shall include tag number, service description, P&ID, instrument range, set point, PLC address (where applicable), engineering units, instrument model number, and other pertinent information.
- D. All field instruments and associated connections to equipment or process lines shall be shown in the proper location on one or more of Supplier's following types of drawings:
1. General arrangement drawings
  2. Piping plans and elevations
  3. Electrical plan or location drawing
  4. Instrument plan or location drawing
- E. Panel and PLC Cabinet Drawings - Drawings of local control panels and PLC Cabinets shall include front and rear layout as well as typical cross sections with dimensions. Supplier shall also furnish recommended layout of remote supervisory control panel instruments, if applicable.
- F. Annotated Ladder Logic Diagrams – All documentation and control systems programming shall be in Korean. PLC Control Systems shall be supplied with annotated ladder logic diagrams.
- G. Installation Details - A set of drawings depicting the mounting, piping, tubing, tracing, and wiring of all field instruments.
- H. Manufacturer's Prints - All suppliers of instruments, whether supplied directly to Supplier or indirectly, shall be required to furnish documents covering specifications, wiring, recommended spare parts lists, and instructions for maintenance and operations.
- I. Wiring and Tubing Drawings - Schematic and/or loop diagrams are required for all pneumatic, electrical, or electronic instruments and control systems. Logic diagrams and elementary wiring diagrams are required for all control systems. Electrical terminal arrangement drawings are required for all electrical devices whether or not they are wired by Supplier.
- J. Junction Box Drawings - Drawings of all junction boxes shall include layout, dimensions, mounting and labeled termination's.

- K. Calculations - Supplier shall furnish sizing calculations for control valves, flow measurement, regulators and pressure relieving devices for Buyer's review during the design phase of the order.
- L. Certifications - Supplier shall provide all certifications necessary to support any test requirement that may be specified in the mechanical equipment general specifications such as seismic, chemical, and physical. Instruments shall have calibration certificates certifying the calibrations traceable to NIST.
- M. All drawing deliverables except loop diagrams shall be submitted on full-size drawings. Loop diagrams and the instrument index shall be submitted on 11" X 17" paper. ISA S-20 datasheets shall be submitted on 8-1/2" X 11" paper. All deliverables shall also be electronically submitted on CD-ROM.

#### 1.05 QUALITY ASSURANCE

##### A. Inspections

- 1. After the installation of the instruments and tubing is complete, the Seller shall visually check each component for conformance to the drawings, specification, and manufacturer's recommendations.
- 2. All materials and workmanship shall be subject to inspection and examination by the Buyer. Any defective material, defective workmanship, and instruments installed inaccessibly or in violation of OSHA or cGMP guidelines shall be replaced, reworked, or relocated to the satisfaction of the Buyer at no additional cost.

##### B. Testing

- 1. The Seller must ensure that all instruments, elements, pressure seals, filters, relief valves, and other items for which the maximum permissible cold test pressure is lower than the hydrostatic test pressure are removed or blanked off from the piping during hydrostatic testing of the piping systems.
- 2. Prior to pneumatic continuity and leak testing, all tubing shall be cleared of chips, burrs, and other foreign material. Cleaning shall be accomplished by disconnecting both termination fittings of each line and applying 80 psig clean, oil- and moisture-free, compressed air or nitrogen before connection to instruments. Dewpoint of the gas shall not exceed -20 degrees C at the operating pressure.
- 3. All pneumatic tubing shall be leak tested per ISA recommended practice number RP-7.1, Paragraphs 5 through 9. Maximum tolerable leak rate is defined in Paragraph 6 of RP-7.1.
- 4. Records of all tests shall be maintained by the Seller and shall be submitted to the Buyer. The Buyer may witness any tests at no additional cost.

5. As a minimum, the Seller shall verify the functional operation of all devices installed, tubed, or piped by the Seller. Seller will be required to perform continuity checks from the Instrument Enclosure termination or control system I/O to each individual instrument.
6. The Seller shall perform a loop check for each instrument loop and shall provide full documentation of all testing results. The Seller shall submit an example of this documentation package with the Seller's bid. The loop check shall include the following:
  - a. Energize each pneumatic instrument and verify proper function at the low, high, and mid points of the range of operation.
  - b. Energize each electronic/electric instrument and verify proper function at the low, high, and mid points of the range of operation.
  - c. Visually check each indicator and gauge.
  - d. Stroke each valve from the Instrument Enclosure termination or Control System I/O.
  - e. Where control system is furnished by Buyer, Buyer reserves the right to perform a loop check utilizing Buyer-supplied control system hardware. Seller shall be responsible for providing technician labor for assisting in this task on a full-time basis, and floor space.
  - f. All test equipment required for this work shall be furnished and retained by Seller. Test equipment for use with the Buyer furnished control system shall be the Buyer's responsibility.
  - g. After approval by the Buyer, Seller shall use his approved software test plan for test execution. Test shall be witnessed by the Buyer prior to acceptance of the control package. Seller to give Buyer a minimum of ten (10) days advance written notice of test.

#### 1.06 DELIVERY, STORAGE, HANDLING

- A. Load cells shall be removed and replaced with "dummy" cells supplied by Seller prior to shipment. Location/orientation should be tagged.
- B. Resistivity, Conductivity, pH, and any other analytical sensing elements which may be damaged in shipment shall be removed prior to shipment.
- C. Instruments that are completely removed from the installed location for shipment must have their locations on the skid and shipping package clearly marked with the instrument tag number.
- D. Piping shall be capped or plugged during shipment. Piping that is completely removed from the installed location for shipment must also have their locations on the skid and shipping package clearly marked with the piping line number.
- E. The seller shall furnish and install stainless steel identification tags for all instruments.

- F. The Seller shall attach a tag with the user identification number to each single pneumatic tube at the field end and to each single pneumatic tube at the supply end. The Seller shall also attach a tag with the appropriate identification number to each multi-tube bundle at the supply end and to each pneumatic junction box.

#### 1.07 PLC DOCUMENTATION

- A. The Seller shall supply documentation including the following in accordance with GAMP Guide for Validation of Automated Systems in Pharmaceutical Manufacture :
1. Software QA program
  2. Functional Design Specification
  3. Software Design Description including as a minimum the following items:
    - a. List of all input and output signals associated with the process control system and the PLC address associated with each signal.
    - b. Summary of all alarm and interlock trip setting.
    - c. Summary of all recipe parameters, including high limit, low limit, and default values.
    - d. The Seller shall provide all application source code to the Buyer. To meet these requirements, the Seller shall supply a printout of the final Software Configuration, including the following items.
      - (1) A table of registers for each PLC.
      - (2) A complete MMI/SCADA configuration printout.
      - (3) A complete, fully annotated ladder logic printout.
      - (4) Printouts of any other application software programs employed for the process and mechanical package.
- B. The Seller shall provide all loadable code to the Buyer on magnetic media /CD ROM. The loadable code must be the final program revision after the FAT is completed and any changes have been made. Furthermore, if the vendor performs any on-site startup and any changes are made, the latest revision must be submitted.
- C. The Seller shall supply samples of the above documentation to be included with the Seller's bid.
- D. The Seller shall provide a copy of any configuration software package not currently owned by the Buyer.

#### 1.08 TEST PROCEDURES

- A. In addition to written test plans and procedures for the entire process or mechanical package, written test plans and procedures including but not limited to a Factory Acceptance Test and a Site Acceptance Test for the process control system software shall be submitted for review & approval.
- B. Cleaning Procedures



1. Written cleaning procedures for piping materials shall be submitted for review and approval.

C. Testing Records

1. Seller shall provide full documentation of all testing results. An example of this documentation package shall be included with the Seller's bid.

## PART 2 PRODUCTS

### 2.01 GENERAL

- A. The equipment Supplier shall provide all instruments and control systems.
- B. Indicating instruments furnished by the equipment Supplier shall be provided with scales using the following units of measurement:

MEASUREMENT	UNITS
Temperature:	Degrees Celsius
Pressure Gauge:	PSIG
Room Differential Pressure	InWC
Vacuum:	inHg
Level:	Liters
Liquid Flow:	LPM
Mass Flow:	kg/hr
Gas Flow:	kg/hr
Weight:	kg
Conductivity	uS-cm

- C. Standard transmitter outputs shall be 4 to 20 mA for electronic signals and 3 to 15 psig for pneumatic signals. Loop powered electronic transmitters shall be 2 wire 24 VDC, Smart HART Compatible. Externally powered electronic transmitters shall be powered by 220 VAC or 24 VDC. All solenoid valves shall be 24 VDC.
- D. All equipment Supplier furnished electrical instruments installed in a hazardous area shall be designed for operation according to the applicable electrical area classification. All electrical instruments shall be UL or FM listed, unless otherwise approved by Buyer.

- E. One external power source and instrument air source connection shall be provided by the Buyer. The Supplier shall identify the power requirements (voltage and amperes) and quantity of required instrument air during the design phase of the order. The Supplier shall distribute power and instrument air utilizing distribution panels and subheaders. Instrument power shall be terminated in junction boxes separate from instrument signal termination's.
- F. All conduit shall be 3/4 of an inch minimum size and shall be PVC coated rigid galvanized steel in process areas and rigid galvanized (without PVC coating) steel in technical and interstitial areas. All PVC coated conduit runs shall be installed with matching fittings and connectors. Devices and exposed conduit shall be kept to a minimum and shall enter the room from below, or from rear if located next to a wall. Exposed conduits against walls will be grouped and covered with stainless steel shrouds for cleanability.
- G. All conductors shall be identified at each termination point using "Brady" wire marking system or approved equal.

## 2.02 DESIGN CRITERIA

- A. All components in contact with the sensed fluid or gas shall be 316L SS, or as required by the process fluid.
- B. All sanitary temperature instruments shall be installed in sanitary 1-1/2 inch tri-clamped 316L SS thermowells. 1 inch socketweld thermowells shall be used in non-sanitary services.
- C. Local temperature switches, temperature indicators, and temperature controllers shall have compensated filled systems.
- D. RTDs (Resistance Temperature Detectors) shall be Platinum Pt 100, 3-wire devices.
- E. Sanitary diaphragm seals shall be 316L SS or as required by the process.
- F. Instrument capillaries shall be 316 SS. Fill fluid shall be FDA approved for the process system and shall withstand sterilization temperatures of 121 degrees Celcius.
- G. Switch elements shall be double pole, double throw.
- H. Dual setpoint switches are not allowed if setpoints are the same value.
- I. Alarm and shutdown applications shall use separate switches in separate housings and have separate connections to the sensing point.

- J. Enclosures shall be 316 SS NEMA 4X, water tight corrosion resistant construction as a minimum, and as required by the electrical classification of that area. Enclosures shall be sloped for cleanability. Exterior screw-type clamps are not permitted. Conduit and tubing penetrations shall be through the sides or bottom. Provisions shall be made to “pipe-away” instrument air exhaust from solenoid valves and condensate from coalescing filters to a location outside the clean area unless otherwise noted. Enclosures shall be constructed to permit easy cleaning with bleach and caustic solutions.
- K. Process tubing to instrumentation shall be 1/2 of an inch OD (outside diameter) 316 SS minimum with 0.035 wall thickness.
- L. Pulsation dampers shall be furnished as an integral part of all pressure transmitters and liquid filled pressure gages on the inlet and discharge of reciprocating pumps; on the suction and discharge of reciprocating compressors; and other pulsating services.
- M. Control valve packing shall be Teflon for services with operating temperatures up to 350 degrees F and graphoil packing for all other applications. Positioners shall be provided on all control valves. Electro-pneumatic transducers shall be mounted on control valves in non-clean areas and inside local panels for control valves in clean areas.
- N. Solenoid valves to be used in clean areas shall be mounted in hygienic panels with provisions for exhausting outside the hygienic environment.
- O. All in-line instruments shall be 3A approved and stamped in sanitary process areas and meet clean-in-place (CIP) or steam-in-place (SIP) standards.
- P. All instrument air users shall have filters or combination air filter regulators preceding the pneumatic device. Coalescing filters capable of 1 micron particle removal shall be used in clean process areas. All air tubing shall be 316 stainless steel and terminate in a weatherproof corrosion- resistant junction box through bulkhead fittings on the side or bottom. Top entry is not permissible. In clean process areas, pneumatic tubing headers shall be enclosed within panels.
- Q. 4 to 20 mA signal wiring shall be single pair cable having #16 AWG stranded copper conductors with 15 mills 90 degree C PVC insulation. The conductors shall be twisted, wrapped with aluminum mylar shield and copper drain wire and be covered with 35 mill, sunlight resistant black, gas vapor tight PVC jacket.
- R. Multiconductor control and power cable shall be Type TC and consist of #14 or #12 AWG stranded copper conductors with THHN/THWN insulation, one #14 AWG bare, stranded ground wire and an overall sunlight resistant, gas/vapor tight, black PVC jacket. Cable shall be rated for 600 volts, 90 degree C in dry and 75 degree C

in wet locations. All 120 VAC control wiring shall be #14 AWG and all 120 VAC power distribution cabling shall be #12 AWG.

- S. All instrument and power wiring shall be terminated on terminal blocks in the equipment Supplier junction boxes. A minimum of 20% spare terminals shall be provided. Analog signals, digital signals and instrument power shall each be in separate junction boxes. The equipment Supplier shall provide the number and location of junction boxes in the quotation.

## 2.03 CONNECTION REQUIREMENTS

- A. 1/4 of an inch air supply and signal shall be FNPT.
- B. 3/4 of an inch minimum electrical conduit / cable entries FNPT.
- C. Thermowells shall be standard 1-1/2 inch 316L SS (or as required to be compatible with the process) Tri-Clamp in sanitary process areas and 1 inch socketweld in non-sanitary process areas.
- D. Sanitary pressure gages shall be diaphragm sealed with 1-1/2 inch 316L SS (or as required to be compatible with the process) Tri-Clamp.
- E. Utility pressure gages shall be 1/2 inch MNPT. Siphons shall be used on steam service. Pulsation dampeners shall be used on all pulsating services.
- F. Non-sanitary differential pressure (dP) flow instruments shall be 1/2 of an inch FNPT.
- G. All sanitary transmitters and switches shall be diaphragm sealed with 1-1/2 inch 316L SS (or as required to be compatible with the process) Tri-Clamp.
- H. Sanitary dP level transmitters on vessels shall utilize sanitary tank spuds.
- I. Sanitary Control Valves and On/Off Valves shall be Tri-Clamped.
- J. Non-sanitary Control Valves and On/Off Valves 1/2" or larger shall be 150 Lb. RF Flanged. Control Valves and On/Off Valves smaller than 1/2" inch shall have socketweld connections.
- K. Non-sanitary Relief Valves shall be ANSI 150 Lb. RF (raised face) Flanged as a minimum rating depending on service. On thermal liquid expansion service inlets may be 3/4 of an inch MNPT and outlets may be 1 inch ANSI FNPT as a minimum depending on service. Sanitary Relief Valves shall utilize Tri-Clamp connections and be rated for ASME service.
- L. Rupture Discs shall utilize Sanitary Tri-Clamp connections.

- M. All in-line instruments shall be mounted in a self-draining position with no “dead legs” or liquid trapping surfaces.

## 2.04 IDENTIFICATION AND TAGGING

- A. Tag Numbers - Each instrument shall be assigned a unique tag number by Buyer.
- B. Identification - Each Supplier provided instrument shall have the instrument tag number stamped on a stainless steel nameplate permanently fastened to the instrument. The instrument tag number shall be stamped with minimum 1/4 of an inch English Language Characters.
- C. Junction Boxes - Each Supplier provided junction box shall have the junction box number along with an identification as to either analog, digital, power or pneumatic stamped on a stainless steel nameplate permanently fastened to the junction box. The tag shall be stamped with a minimum 1” English Language Characters. In clean process areas, the data shall be electro-etched onto the junction box.

## 2.05 DOCUMENTATION

- A. Instrument Calibration Sheets and calibration stickers shall be provided by the equipment Supplier showing the calibration data, results, calibration date, test equipment serial number and technician’s initials. All calibrations shall be traceable to the National Institute of Standards Technology (NIST). Calibration stickers shall be applied to each device.
- B. Operator/User Manual - This manual shall describe the system and how to operate it in everyday language. The manual shall contain as a minimum the calibration procedures, control diagrams, wirign diagrams, loop sheets, instrumentation data sheets, operator interface control procedures (system access, security features, etc.) and alarms.
- C. Maintenance Manual - This manual shall be written for the engineer who has responsibility for supporting and maintaining the system once it is installed. This manual shall contain as a minimum the hardware configuration, I/O list, logic flow diagrams, preventive maintenance procedures, common troubleshooting problems/solutions and software (development, testing, support and maintenance) information. Detailed function descriptions, program software, application source code as well as other design documentation necessary to permit a qualified software engineer to maintain the software shall also be included in this manual.
- D. Test Documentation - Test documentation shall be supplied for any computer based system to demonstrate that the system which was delivered operates the way it was designed to operate. This documentation shall also include software test protocols and software development QC records.

- E. Functional Description - The functional description will provide a detailed sequence of operation providing all required actions and expected results. It shall be provided within 3 weeks of order placement. 4 copies shall be provided.
- F. Validation Documentation - Validation documentation shall be provided to include Installation Qualification and Operational Qualification Protocols, description of validation experiments, list of summary data and documented evidence that the design intentions are met.

## PART 3 EXECUTION

### 3.01 PREPARATION

- A. Any instrument that must be removed from the equipment prior to shipment must be tagged and boxed separate from any mechanical parts or equipment.
- B. The container is to state Buyer's shipping address, PO number, instrument tag numbers and other pertinent information stated in the PO.

### 3.02 INSTRUMENT INSTALLATION

- A. All instruments shall be installed according to the Manufacturer's instructions in addition to the requirements stated herein.
- B. All instruments shall be installed so that accuracy or reliability shall not be impaired due to vibration, pulsation, temperature, or contamination.
- C. All instruments shall be installed so that they are easily accessible for maintenance and inspection. They shall not be located under grating or in any place or manner that would make it difficult or dangerous for personnel to inspect or work on them during operation or shutdown. Pipestands for mounting remote instruments shall be 316 stainless steel and be 4'-6" above grade. Junction Boxes shall be installed 5'-0" above grade.
- D. Instrument piping, tubing, and conduit shall be properly protected and supported. All tubing under 1/2 of an inch OD, including capillary, shall be continuously supported and protected. Pipe, conduit, and larger tubing shall be securely supported.
- E. Conduit or piping shall not apply stress loads to instrument cases or mountings. This includes situations where the conduit or piping may be used for hand holds or to stand on by installation or maintenance personnel.
- F. Instruments shall have sufficient wiring to allow for devices to be disassembled and calibrated on a cart 24 inches away and 18 inches above the installed location.

### 3.03 INSPECTION AND CHECKOUT

- A. Buyer reserves the right to inspect and witness testing of all instrumentation and electrical wiring prior to shipment from Supplier's factory. Before Buyer's inspection, Supplier's engineers shall have carefully inspected, checked, and tested all instrumentation to verify full compliance with the drawings and specifications listed in the PO.
- B. Supplier shall notify Buyer 2 weeks in advance of any scheduled acceptance test. Prior to the acceptance test and checkout by Buyer's inspector, Supplier shall have completely tested all instrumentation and control systems and made appropriate corrections if required.

## APPENDIX I

### AUTOMATION APPROVED VENDORS LIST

#### Flow Transmitters

Type	Manufacturer # 1	Manufacturer # 2	Manufacturer # 3
Coriolis- Mass Flow	Micromotion	Krohne	Endress & Hauser
Positive Displacement	Badger	Brooks Instruments	Neptune
Vortex	Rosemount	Foxboro	Fischer & Porter
Thermal	FCI	Thermal Instrument	Sierra
Orifice Plates	Daniel	Foxboro	
Magnetic	Rosemount	ABB	Bailey Fisher Porter
Turbine	Brooks Instruments	Fischer & Porter	

#### Level Transmitters

Type	Manufacturer # 1	Manufacturer # 2	Manufacturer # 3
D/P	Rosemount	Viatran	Honeywell
Radar	Rosemount	Ohmart Vega	Endress & Hauser
Ultrasonic	Krohne	Ohmart Vega	Endress & Hauser
Float	MTS	GEMS	Krohne

#### Pressure Transmitters

Type	Manufacturer # 1	Manufacturer # 2	Manufacturer # 3
Gauge	Rosemount	Anderson	Honeywell
Absolute	Rosemount	Anderson	Honeywell
Vacuum	Rosemount	Anderson	Honeywell
D/P	Rosemount	Anderson	Honeywell

#### Temperature Transmitters

Type	Manufacturer # 1	Manufacturer # 2	Manufacturer # 3
Transmitter	Rosemount	Foxboro	Honeywell
RTD	Burns	Pyromation	Anderson

#### Flow Gauges

Type	Manufacturer # 1	Manufacturer # 2	Manufacturer # 3
Rotometer	Brooks Instrument	Fischer & Porter	



### Pressure Gauges

Type	Manufacturer # 1	Manufacturer # 2	Manufacturer # 3
Standard	US Gauge	Ashcroft	Chicago
Absolute	US Gauge	Ashcroft	Chicago
Vacuum	US Gauge	Ashcroft	Chicago
Compound	US Gauge	Ashcroft	Chicago
Sanitary	Anderson	Ashcroft	Chicago

### Thermometers

Type	Manufacturer # 1	Manufacturer # 2	Manufacturer # 3
Standard	Ashcroft	Tel-Tru	Wika
Sanitary	Ashcroft	Tel-Tru	

### Pressure Switches

Type	Manufacturer # 1	Manufacturer # 2	Manufacturer # 3
Standard	United Electric	Ashcroft	SOR
Absolute	United Electric	Ashcroft	SOR
Vacuum	United Electric	Ashcroft	SOR
Compound	United Electric	Ashcroft	SOR
Sanitary	SOR	Ashcroft	United Electric

### Ball Valves

Type	Manufacturer # 1	Manufacturer # 2	Manufacturer # 3
Metal (Process)	Worcester	Fisher	PBM
Metal (Utility)	Worcester	Fisher	Jamesbury
Lined	Xomox	Atomic	Neotecha
Plastic (TFE)	George Fisher	Asahi	
Sanitary	Jordan Valve	PBM	

### Diaphragm Valves

Type	Manufacturer # 1	Manufacturer # 2	Manufacturer # 3
Sanitary	ITT	Gemu	Saunders

### Tank Bottom Valves

Type	Manufacturer # 1	Manufacturer # 2	Manufacturer # 3
Flush	ITT	Asepco	MCF

### Solenoid Valves

Type	Manufacturer # 1	Manufacturer # 2	Manufacturer # 3
Solenoid	ASCO	Burkert	Skinner

### Modulating Valves

Type	Manufacturer # 1	Manufacturer # 2	Manufacturer # 3
Globe	Fisher	Jamesbury	Valtek
Diaphragm	ITT	Gemu	Saunders
Ball	Worcester	Fisher	Jamesbury

### I/P Transducers

Type	Manufacturer # 1	Manufacturer # 2	Manufacturer # 3
I/P	Control Air	Conoflow	Fisher

### Regulators

Type	Manufacturer # 1	Manufacturer # 2	Manufacturer # 3
Non-Sanitary	Fisher	Jordan	Tescom
Sanitary	Jordan	Baumann	Tescom

### Weighing Systems

Type	Manufacturer # 1	Manufacturer # 2	Manufacturer # 3
Load Cells	Toledo	Kistler-Morse	BLH
Platform Scales	Toledo	Fairbanks	General Electronic Sys.
Bench Scales	Toledo	Ohaus	Sartorius

### Analytical Instruments

Section 8.1 Analytical Instruments:				pH Instruments
Type	Manufacturer # 1	Manufacturer # 2	Manufacturer # 3	Manufacturer # 4
pH	Thorton	Rosemount	Ingold	
Conductivity	Thorton	Rosemount	Ingold	
Density	Canty			
TOC	Sievers	Anatol	Rosemount	
Dissolved Oxygen	Rosemount	Ingold		
Resistivity	Thornton	Rosemount		

### Recording Instruments

Type	Manufacturer # 1	Manufacturer # 2	Manufacturer # 3
Circular Chart	Partlow	Honeywell	Yokogawa

Strip Chart	Yokogawa	Partlow	Honeywell
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### Miscellaneous

Type	Manufacturer # 1	Manufacturer # 2	Manufacturer # 3
Thermowells	Rosemount	Anderson	
Proximity Switches	Allen Bradley	Pepperl & Fuchs	Turks
Control Panels	Hoffmann	Rittal	Crouse-Hinds
Terminal Blocks	Allen Bradley	Weidmuller	
Relays	Allen Bradley	Struthers-Dunn	Deltrol Controls
Fuses	Littlefuse		
Power Supplies	Sola	Acopian	Lamda
Panel Meters	Digital		
Annunciators	Ronan	Panalarm	
Alarm Horn	Federal	Crouse-Hinds	
Alarm/Pilot Lights	Allen Bradley	Crouse-Hinds	
Pushbuttons and Switches	Allen Bradley	Couse-Hinds	

### Control Systems

Type	Manufacturer # 1	Manufacturer # 2	Manufacturer # 3
PLC	Allen Bradley	Siemens	
Software	Intellution	Siemens	Wonderware
Printers	HP Laserjet	Cannon Laserjet	
Operator Interfaces	AB Panelview 1000	AB Panelview 1400	
Systems Integrators	Superior Controls	Dumont	

**END OF SECTION**