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Instrument Design Criteria of Equipment Packages (Without Control System)

PRELIMINARY - NOT FOR CONSTRUCTION

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1 General

1.2 Purpose

This project standard and specification defines the design criteria for the instrument and control system in equipment packages envisaged on the Soda Ash Project, Bontang – East Kalimantan, Indonesia.

1.3 Definitions

AMS	Asset management system
API	American Petroleum Institute
C.S	Carbon Steel
CE	Conformity with European
CCR	Central control room
CPU	Central process unit
DCS	Distributed control system
CEMS	Continuous emission monitoring system
DP	Differential pressure
DPDT	Double pole double throw
EMC	Electro-Magnetic compatibility
EMI	Electro-Magnetic interference
ESD	Emergency shutdown system
FAT	Factory acceptance testing
FLD	Functional logic diagram
FBD	Functional block diagram
FAR	Field auxiliary room
GB	Chinese national standard
G, GA	Thread (ISO-228 Pipe threads where pressure-tight joints are not made on the threads)
GDS	Gas detecting and monitoring system
HAZOP	Hazard and operability study
HMI	Human machine interface
HSE	Health, safety and environment
IEC	International Electrochemical Commission
ISA	Instrument Society of America
I/O	Input/output
MCC	Motor control center
MOS	Maintenance override switch
M(M), M(F)	Thread (ISO 262 General purpose metric screw threads)
MFR STD	Manufactory standard

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NA	Not adopt
NPT(M), NPRT(F)	Thread (ANSI/ASME B1.20.1 National pipe thread taper)
OOS	Operational override switch
OPC	Object linked embedding (OLE) for process control
PHA	Preliminary hazard analysis
PLC	Programmable Logic Controller
PRC	People's Republic China
RTD	Resistance temperature detector
SAT	Site acceptance testing
SCADA	Supervisory control and data acquisition
SER	Sequence event recorder
SIS	Safety instrumented system
SIL	Safety integrity level
SPDT	Single pole double throw
S.S	Stainless steel
RTD	Resistance temperature detector
RTU	Remote terminal unit
TC	Thermocouple
TCC	Tianchen Engineering Corporation
UPS	Uninterruptable power supply

Wherever the word “shall” is used, its meaning is to be understood as mandatory.

Wherever the word “should” is used, its meaning is to be understood as strongly recommended or advised.

Wherever the word “maybe” is used, its meaning is to be understood as freedom of choice.

Wherever the word “owner” is used, it refers to PT. Pupuk Kalimantan Timur

Wherever the word “EPC contractor” is used, it refers to Tianchen Engineering Corporation.

1.4 Definitions Standard and code

IEC 60381-1	Analogue Signals for Process Control System Part1: Direct Current Signals
IEC 60381-2	Analogue Signals for Process Control System Part2: Direct Voltage Signals
IEC 60751	Industrial platinum resistance thermometer sensors
IEC 60584	Thermocouples
IEC 61000	Electromagnetic compatibility (EMC)
IEC 61131	Programmable controllers
IEC 61499	Function blocks for industrial process measurement and control system
IEC 61804	Function blocks for process control
IEC 60534-1	Industrial process control valves Part 1: Control valve

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	terminology and general consideration
IEC 60534-2-1	Industrial process control valves Part 2: Section one - Flow capacity, sizing equations for incompressible fluid flow under installed conditions
IEC 60534-2-2	Section two -Flow capacity, sizing equations for compressible fluid flow under installed conditions
IEC 60534-2-3	Section three - Flow capacity, test procedure
IEC 60534-4	Industrial process control valves Part 4: Inspection and routine testing
IEC 60534-5	Industrial process control valves Part 5: Marking
IEC 60534-6	Industrial process control valves Part 6: Mounting details for attachment of positioners to control valve actuators
IEC 60534-8-1	Section one -Laboratory measurement of noise generated by aerodynamic flow through control valves
IEC 60534-8-2	Section two -Laboratory measurement of noise generated by hydrodynamic flow through control valves
IEC 60534-8-3	Industrial Control Valve Section three -Control valves aerodynamic noise prediction method
IEC 60534-8-4	Section four -Control valves hydrodynamic noise prediction method
IEC 60529	Degrees of protection provided by enclosures (IP code)
IEC 60092-359	Specification for insulation and sheath of electric cables
IEC 60227	Polyvinyl chloride insulated cables of rated voltages up to and including 440/750 V
IEC 61508- 1-7	Functional safety on electrical / electronic / programmable electronic safety-related systems
API 6D	Specification for pipeline valves
API 6FA	Fire Test for Valves
API RP 500	Classification of Locations for Electrical Installations Petroleum Facilities Classified as Class 1, Division 1 and Division 2
API RP 520	Sizing, Selection and Installation of Pressure Relieving Devices in Refineries, Part I and Part II
API RP 521	Guide for Pressure Relief and Depressing Systems
API RP 551	Process Measurement Instrumentation
API RP 554	Process Instruments and Control
API RP 555	Process Analyzers
API 598	Valve Inspection and Testing
ANSI B 16.37	Hydrostatic testing of control valve
ASME-B 16.10	Face-to-Face and end to end dimensions of valves
ASME B16.36	Orifice flange
ASME/ANSI B 16.5	Steel Pipe Flanges and flange Fittings
ASME/ANSI B1.20.1	Pipe Threads general purpose (Inch)
ASME PTC 19.3	Performance Test Code Temperature Measurement

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ASTM A269	Stainless Steel Tube
ASTM A276.316L	Stainless Steel Fittings
ASTM 370	Standard Test methods and definitions for Mechanical Testing of steel products
ASTM 450	General Requirements for Carbon, Ferritic Alloy, and Austenitic Alloy Steel Tubes
FCI-70-2	Control valve seat leakage
ISA S75.01	Flow equations for sizing control valves
ISA S75.02	Control valve capacity test procedure
ISA S5.1	Instrument Symbol and Identification
ISA S5.4	Binary Logic Diagrams for Process Operations
NAMUR	For proximity switch mounting and solenoid valve connection
ISO 5167	Measurement of fluid flow by means of pressure differential device
ISO 262	General Purpose Metric Threads
SAPKT-PR-BED-0001	Basic Engineering Design Data
SAPKT-IN-SPE-0006	General Specification for Instrumentation Material

1.5 Unit

The measuring unit adopted SI unit, the main units as listed below,

Component	%v, ppm(v)
Liquid flow	m ³ /h, l/h, l/m
Gas flow	Nm ³ /h (0℃,1atm)
Vapor flow	kg/h, t/h
Flow rate	m/s
Level	%, m, mm
Pressure	MPa-g/-a, kPa-g/-a
Temperature	℃
Density	kg/m ³ , kg/Nm ³
Conductivity	μ s/cm
Weigh	kg, t
Viscosity	mPa.s
Distance(Length)	m, mm
Power	W, kW
Force	N, kN
Current	A, mA

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1.6 Environment conditions

Dry season	36°C maximum
Wet season	22°C maximum
mean humidity, night (23°C)	96%
mean humidity, day (33°C)	70%
Rainy seasons	December through April
Max. for 15 minutes	120 mm
Max. for 1 hour	80 mm
Wind velocity	30 km/h exceptionally 90 km/h
Prevailing direction	West January through July / East August through December

2 Definition of supply and work scope

2.1 Supply and work scope

Every packages involved instrumentation and controls shall definite the supply and work scope as following table 2.1

Table 2.1 Supply and work scope of vender

Control system in package		Instrument in package		Take off material in package		Material of Air supply in package		Tracing Material in package	
Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
	✓	✓		✓		✓		✓	
Cable in package		Cable tray or duct in package		Junction Box In package or not		Design Work In package		Installation Work In package	
Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
✓		✓		✓		✓		✓	

2.2 Details of supply scope

- Vender shall provide P&ID and marked on supply and work scope on P&ID in bidding documents.
- Vender shall provide supply list (including type, brand, quantity, etc.) in bidding documents

2.3 Interface

2.3.1 Cabling Interface

- Generally, cabling interface between contractor and vender shall be the junction box or the local control panel/cabinet. The cable and cable tray or duct from filed instrument to

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junction box shall be designed and supplied by vender. The location of junction box shall be confirmed by both two parties. Normally, interface location of cable tray shall be at the 1m outside vender battery limit. **Details requirments of cables, cable tray or duct, junction box will be confirmed during kick-off meeting.**

- If there are few instruments in vender scope, and vender can supply the exact location of instrument, then contractor also can accept connecting cables directly. The cable entries shall be cofirmed by both two parties before ordered the instrument.

2.3.2 Air piping tie-in

- Generally, if there are more than 5 pneumatic instruments or valves in package, then contractor send head air pipe to battery line of package, the air branch pipe in package shall be designed and supplied by vender.
- If the quantities of pneumatic instrument or valves in package is less than 5, and vender can supply exact location of pneumatic instrument and the size of air interface on pneumatic instrument, then contractor can supply the material of air supply.

2.3.3 Power supply Interface

- **Cable of power supply shall be supplied by contractor according to the contract, vender shall provide the information about instrument location, power supply requirement and cable entries size and quantities.**

2.3.4 Work scope of vendor

- Vender shall responsible for the design work of instrument and material supplied by vender. Design document shall meet requirement of item '4.0 Documentation Requirements Sheet'. If the document is required as sample format, vender shall comply with it, such as instrument data sheet.
- Vender shall provide the document according to item '4.0 Documentation Requirements Sheet'. Vender shall guarantee correctness of document and goods. Otherwise contract has the right to compensation the cost of remade work on site that cause by defect of document and goods.
- Sometimes though cable tray or duct is not supplied by vender, but vender will be supplied the main pipe and equipment according, that means vender shall be responsible for layout of space, the vender should make the plan of instrument cable and cable tray or duct.

3 Design and supply philosophy

3.1 General

Vender shall design and supply according to this specification, if there is special case, it shall be approval by contractor.

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3.2 Numbering

Instrument numbering, local panel or cabinet numbering, control panel or cabinet in control room numbering, junction box numbering, air distributor numbering, cable numbering shall follow TCC requirements and will be confirmed during **kick-off meeting**.

3.3 Instrument Selection

- All field instruments connected with well monitoring and control shall be electronic, SMART type. The type of output for smart transmitter shall be in HART 7.
- All instruments connected to control room and remote unit control panels of related systems shall be electronic, SMART type.
- Instrument ranges shall be selected such that the normal operating point is between 20% and 80% of the instrument total range.
- Hand-hold calibration / configuration units shall be supplied to enable online diagnostics, configuration or calibration of electronic instruments from any point in the loop.
- All electronic transmitters shall be 24 VDC loop-powered with 4-20 mA Smart analog output signal. Electronic Transmitters shall have integral LCD display. Where this is not possible, a suitable separate local loop indicator shall be provided. Local electrical control and field alarm switches shall be hermetically sealed SPDT Micro Switch activated. The switches shall be rated for 110 VAC - 5 Amps or 24 VDC - 2 Amps.

3.4 Instrument Power System

- Components of power supply system shall be of highest available quality for reliability and long service life.
- Power supplies for all transmitters, controllers, signal converters, electric system and components in shutdown system shall be supplied from uninterruptible power supplies.
- Power distribution to each consumer shall be through proper, independent switch and fuse. Protective fuses shall be of indicating cartridge type mounted in fuse holders.
- In general, all components / instruments / system shall be suitable for 110 VAC, 50 Hz

3.5 Instrument Earthing System

Three separate earthing systems shall be provided:

- a. Safety Earth - Bonded to the site structure and utilized for electrical safety of metal enclosures and chassis on all instruments and electrical components with symbol PE.
- b. Instrument Earth - Insulated from the site structure and other metal work, utilized for instrument cable screens and bonded to the separate earthing system with symbol IE.

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c. Intrinsically Safe Earth - Insulated from the site structure and other metal work, utilized for termination of IS zener barrier earth connections, and bonded to the separate earthing system with symbol ISE.

3.6 Equipment Protection

a. Environmental Protection

All instruments / equipment and installation material shall be suitable for the overall climatic conditions, the position within the installation and the local environment, with particular attention to site ambient conditions. The conditions will include exposure to moist salt laden atmosphere, NH₃, sunlight, rainfall, temperature, humidity, wind, vibration, shock, EMI and RFI. All equipment shall also be able to withstand these conditions during shipment, storage and installation prior to commissioning. As all of the Owner's sites are subject to seismic activity as indicated in the Basic Engineering Design, all instrument / electrical frames, panel and racks shall be fixed in position suitably secured. In view of the highly corrosive ambient conditions, all internal and external parts which are not inherently corrosion resistant by choice of material shall be prepared and finished by plating or paint finish in accordance with the specification for protective coating. Seals and purges shall be used as necessary, to ensure reliable instrument performance. All field instruments shall be provided with necessary weathering and anticorrosion protection. Plastic plugs shall be fitted to all instrument tubing and air, process and cable entry ports until final connections are made.

b. Ingress Protection

All field instruments shall have ingress protection to IP65 or better. All instruments Installed inside pressurized equipment / control rooms shall have ingress protection to IP 42 as a minimum.

c. Tropicalization

All electrical components shall be tropicalized to protect against humidity, moisture and fungal growth by means of hermetically sealed units, protective coating on circuit boards.

d. Hermetic Sealing

All relays and switches shall be hermetically sealed, and those utilized in 24 VDC control logic circuits shall have contacts rated 0.5 Amp at 24 VDC. Those interfacing with field equipment shall be rated 2 Amp 24 VDC.

e. Hazardous Area Instrumentation

All instruments which are mounted outside of normally pressurized control / equipment rooms shall be certified by bodies such as FM / UL / BASEEFA / CSA / DGMS / CMRS for use in hazardous area. Intrinsic safety approval shall be based on entity concept and necessary compatibility checks shall be carried out by contractor before selecting any equipment. Intrinsically safe protection using external barriers shall be provided for all

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process transmitter loops (closed as well as open). Isolating barriers shall be of the plug-in type, mounted on modular back plane termination units. Each input and output in a loop shall have a separate barrier. No barrier shall be shared between two loops in input / output. All other instrument loops shall be provided with explosion proof / flame proof protection. Solenoid valves, electric hand switches and signaling lamps shall be Explosion proof / flame proof to “Exd”.

If specialist instrumentation cannot be provided with the above methods of protection, then alternative methods suitable for the classified area and certified by an acceptable Authority may be proposed. The Contractor shall submit a technical report justifying the instrument selection for the Owner’s consideration.

f. Radio Frequency Interference

All equipment shall remain unaffected by radio transmissions (Levels of permissible RFI shall be as per IEC 801). Band-pass and / or band stop filters shall be fitted, as necessary.

g. Sealing

Seal systems shall be used to isolate instrument from the process fluid encountered in the following services:

- i. Wet gas, which may condense in the instrument lines.
- ii. Process fluids that vaporize, condense or solidify under operating pressure and ambient temperature.
- iii. Process fluids that will subject the element to high temperature.
- vi. Viscous liquids.

Sealing accomplished with diaphragm seals. All venting instrument and pilot valves shall have bug screens fitted to atmospheric vents.

3.7 Instrument Material Selection

All materials and equipment furnished shall be new and unused, of current manufacture and the highest grade and quality available for the required service, and free of defects. Materials shall be selected with regard to the following criteria:

- a. Suitability for the corrosive effects of the atmosphere.
- b. Galvanic compatibility between dissimilar materials, with isolating bushes, plates, used where necessary to prevent corrosion due to galvanic action.
- c. Wherever process condition demands NACE quality instrument fittings, the same shall be provided as per NACE, latest standard with appropriate material. For non NACE application, material for fitting shall be appropriate for relevant process fluid with SS316 as

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minimum.

d. Owner approval shall be obtained for the use of aluminium for any instrument component. Aluminium may only be used if no other suitable material is available but shall not be used for any component in contact with the process fluid. If aluminium is used for any housing or other component, it shall be suitably coated and certified as copper free i.e. less than 0.4% copper by mass.

e. Material for all junction boxes, and instrument electronics and termination housings shall be stainless steel or epoxy coated cast aluminum.

f. All proposed vendor standard plastic components if any shall be non-toxic and fire resistant, UV stabilized and compatible with the environmental conditions.

g. All spindles, bushings, bolting, screws, brackets, etc., shall be manufactured from a suitable grade of stainless steel as a minimum. All bolts and screws shall have a flat 316 SS washer under the nut, and the thread length shall be such that there is complete full engagement of the nut, with a minimum of two threads protruding.

h. Stand pipes, supports for instruments and any other item directly welded to the structure shall be CS galvanized.

i. Moulded polyester parts shall be anti-static for hazardous area locations, and in general be constructed from UV-stabilized glass reinforced polyester.

j. Instrumentation material selection shall refer to SAPKT-IN-SPE-0006 - General Specification for Instrumentation Material.

3.8 Instrument Installation

All works shall be of the highest quality craftsmanship and shall conform to the best applicable engineering practices, and, relevant codes referred in the bid document.

All instruments shall be installed in a neat workmanlike manner ensuring ease of operation and maintenance.

Hook-up and installation detail drawings regarding each type of instrument shall be prepared for the Owner's approval, and shall carry out the installation in accordance with these approved drawings.

Installation of instruments and equipment with due consideration of the following:

All materials and equipment furnished shall be new and unused, of current manufacture and the highest grade and quality available for the required service, and free of defects. Materials shall be selected with regard to the following criteria:

a. No instrument with the exception of pressure gauges and temperature gauges, shall be installed in such a way that it depends on its impulse piping or electrical connections for its support.

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b. Positioning of equipment shall not constitute a safety hazard. Where possible, instruments shall be mounted so that they are protected from the effects of rain and sun, while maintaining the requirements for access and visibility.

c. Where this is not possible, the Contractor shall provide a fixed cover or enclosure to protect transmitter, without impairing access or visibility. The enclosure shall be as following:

i. Enclosure material is from fiberglass.

ii. All enclosure shall have the front access doors with glass window for operation routine checks.

iii. Enclosure shall be furnished with a sloped rain hood and sun shade to reduce heat build-up inside the enclosure.

iv. Neoprene gasket glued sealing shall be provided the inside of the door.

d. Visibility and accessibility for both maintenance and operations purpose.

e. Ease of access for lifting heavy items of equipment such as valves.

f. All instruments and valves shall be free from vibration.

g. Instruments shall be mounted / connected so as not to stress vessel nozzles or pipe tapping.

h. All local process-connected instruments shall be located as close as possible to the point of measurement while still being accessible from the ladder or a platform.

i. The location shall be avoided for instrument installation with due consideration of the following:

- Location where radiant heat from temperature piping or equipment.
- Location subject to corrosive gas and liquid.
- Location subject to dust.
- Near steam trap except instrument steam trap.
- The walk way for operators and operating space for valves.

j. Instruments requiring frequent routine access (including hand-valves, manual resets, manual switches, etc) shall be mounted approximately 1.4m above the platform for ease of accessibility.

k. Instruments shall be properly supported on brackets or mounted on subplates, or placed on a suitable pedestal, pipe stand or structural support.

l. Pipe or structural stands may be welded directly onto platform plate, with a suitable

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penetration in the grating, where applicable. When instrument stanchions are installed in paved areas, small concrete foundation shall be provided permanently.

m. Instruments, tubing, cables and cable ladder shall not be fixed to gratings or handrails.

n. Instruments (other than pressure instruments) shall not be mounted directly on process piping without the Owner's written approval.

o. Instruments or instrument lines shall not be supported on handrails unless approved by the Owner.

Instrument stands or panels shall be in accordance with the approved drawings, with consideration for:

- The most direct routes for tubing and piping to and from the stand, using common tubing runs and avoid crossovers.
- Ease of inter-connections between instruments.
- Ease of access for on-site calibration and / or removal of instruments.
- Minimum interference between tubing, piping and cabling to instruments.

SS316 filter regulator with gauge shall be provided for each instrument requiring regulated gas or air supply.

All drains on field instruments shall be made to face downwards if it is already not so. All open ports (vents/drains) shall be fitted with bug screens.

3.9 Instrument Inspection & Testing

a. General

- Quality plan shall include a comprehensive fully documented inspection and testing plan specific to the project.
- The procedures shall include inspection specifically for compliance with hazardous areas requirements, including current certificate, without which no circuit or loop shall be energized.
- Suitable workshop facilities and all necessary test and calibration instruments and equipment will be provided.
- TCC will in the presence of the Owner Representative, verify by inspection, calibration and loop testing, that, all instrumentation in field and control room including local and remote/central control panels, are complete and operable as per specification requirement. All testing and calibration will be subject to approval of the Owner.
- In addition to calibration/testing, loop checking, setting for safety devices like process switches, safety valves etc. And simulation testing of all interlock and shutdown systems, done at fabrication yards, the same shall also be carried out at offshore site as well.

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- In general, the pipes and tubes shall be cleaned before testing. They shall then be subject to hydrotest (or other applicable tests) and then blow dried.

b. Flushing of Lines

The Contractor shall remove in line instruments like flow meter, control valves/safety valves, if necessary, and provide spool pieces/flanges prior to flushing of lines.

c. Instrument Supply Lines

- Instrument air/gas piping and tubing shall be disconnected upstream of all filter/regulators before testing. The piping and tubing shall then be leakage test as explained below. Test fluid shall use air or nitrogen.

- Instrument air supply lines shall be blown with instrument air prior to connecting to instruments. Instrument air/gas mains shall be isolated from the instrument and pressurized to maximum operating pressure with instrument air, they shall be isolated from the pressure source and the pressure reading on a test gauge shall not fall by more than one psig in ten minutes. All joints and connections shall be checked by Snoop fluid or equal and examined the leaks.

d. Instrument Signal Lines

Instrument signal lines shall be blown with instrument air prior to connecting to instruments. All air/gas tubing shall be tested and inspected by one of the methods given in Instrument System & Automation Society (formerly known as Instrument Society of America) Recommended Practice RP 7.1 "Pneumatic control circuit pressure test". Clean, oil free instrument air shall be used for the test.

e. Impulse Lines

- All process impulse lines shall be disconnected and blown with air or nitrogen. Hydraulic lines shall be flushed with hydraulic oil. After blowing process impulse lines shall be isolated from the instrument and pressurized to 1 1/2 times maximum working pressure corrected for ambient temperature. They shall then be isolated from the pressure source.
- Fluid test shall be air or nitrogen. Before testing, union test shall be checked. After Closing the process isolating valve and opening the equalizing valve (if installed), test fluid shall be fed into impulse line from vent or drain plug. Snoop fluid or equal (leakage test fluid) shall be used to confirm there are no leaks.

f. Direct Mounted Instruments

For direct mounted instrument such as level gauges, level transmitters (displacer type), level switches etc, the installations shall be pressurized to maximum operating pressure slowly and steadily with the instruments. The installations shall then be isolated from main pressure source.

g. Wiring

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Wiring shall be checked to ensure that it is correctly connected and properly grounded. Insulation test shall be carried out on all wiring taking necessary precautions. Correct connections of all electric or pneumatic switches shall be checked.

h. Calibration & Testing

The Contractor's instrument personnel shall calibrate instruments. This calibration shall, when possible, be done with the instrument or system in place, otherwise calibration prior to installation or removal for calibration shall be done. The Contractor shall provide written results of all instrument calibration in prescribed format and shall submit such formats well in advance for Owner's approval. The Contractor shall submit document confirming that the testing equipment to be used for calibration purpose are certified and calibrated.

4 Documents requirements sheet

DOCUMENT TYPE LEGEND		TIME LEGEND						
X = Original		A = Weeks after contract award						
P = Print		B = Weeks before work starts						
R = Reproducible		C = Weeks after work complete						
E = Electronic media (Disk, Tape, etc.)		D = Weekly						
N/A=Not Applicable		E = Shipment						
DOCUMENTATION		WITH QUOTE	INFORMATION COPIES		APPROVAL COPIES		AS BUILT COPIES	DATA BOOKS COPIES
		QTY TYPE	QTY TYPE	TIME	QTY TYPE	TIME	QTY TYPE	QTY TYPE
GENERAL								
1	Statement of compliance							
2	List of exceptions to specification							
3	Control philosophy narrative	1E	1E,1X	A 2weeks	1E,1X	A 3weeks	1E,1X, C	1E,1X, E
4	Equipment protection philosophy narrative	1E	1E,1X	A 2weeks	1E,1X	A 3weeks	1E,1X, C	1E,1X, E
INSTRUMENTATION, LOGIC, EQUIPMENT PROTECTION AND SAFETY SYSTEMS ACCEPTANCE TESTING PROCEDURES/REPORTS								
5	Factory Acceptance Test (FAT) procedures							
6	Site Acceptance Test (SAT) procedures							
7	Material inspection and testing procedures							
8	Material test reports							
9	Acceptance test reports							
INSTRUMENTATION								
10	Instrument Index	1E	1E,1X	A 2weeks	1E,1X	A 3weeks	1E,1X, C	1E,1X, E
11	I/O list	1E	1E,1X	A 2weeks	1E,1X	A 3weeks	1E,1X, C	
12	Alarm and Shutdown Set point List	1E	1E,1X	A 2weeks	1E,1X	A 3weeks	1E,1X, C	1E
13	Completed instrument data sheets	1E	1E,1X	A 2weeks	1E,1X	A 3weeks	1E,1X, C	1E
14	Manufacturers outline drawings							
15	Installation details for shipped loose instruments							1E
16	General arrangement (plan and elevation drawings)		1E,1X	A 2weeks	1E,1X	A 3weeks	1E,1X, C	
17	Logic diagrams		1E,1X	A 2weeks	1E,1X	A 3weeks	1E,1X, C	1E
18	Program listing for programmable devices							
19	Piping and Instrument Diagrams (P&ID)	1E	1E,1X	A 2weeks	1E,1X	A 3weeks	1E,1X, C	1E
20	Process sample extraction conditioning systems and installation details							
21	Sample line take-off and return line routing							
22	Analyzer house documentation (layout, dimensional, civil information)							
INSTRUMENT ELECTRICAL								
23	Electrical area classification certificate							
24	Junction Box (JB) locations with tag id		1E,1X	A 2weeks	1E,1X	A 3weeks	1E,1X, C	1E
25	JB outline dimensions with conduit entrances		1E,1X	A 2weeks	1E,1X	A 3weeks	1E,1X, C	1E
26	JB terminal board layout and wiring diagram		1E,1X	A 2weeks	1E,1X	A 3weeks	1E,1X, C	1E
27	Grounding system design							
CONTROL PANEL								
28	Control panel assembly drawing							
29	Layout drawing							
30	Internal wiring diagram							
31	Internal pneumatic circuits diagram							
32	Power tie-in points, distribution and grounding requirements drawing							

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SAFETY INSTRUMENTED SYSTEMS								
33	Shutdown and interlock equipment protection logic drawings							
34	Shutdown and interlock equipment protection wiring diagrams							
CALCULATIONS								
35	Fast control loops response times							
36	Analyzer system response time (analyzer response time + sample system lag time)							
37	Sample system flow and pressure drop							
38	Analyzer building HVAC loads							
39	Where building purging is approved, the Analyzer building purge air changes rate and velocity							
40	Utility consumption (Power, Instrument Air, other)							
41	Sizing of flow measuring devices							
42	Thermowell frequency response limits							
43	Sizing of control valves and actuators							
44	Sizing of pressure relief devices							
45	Control valve noise level							
MISCELLANEOUS								
46	List of special tools including software required for maintenance or calibration							
47	List of recommended spare parts for start-up and commissioning							
48	List of recommended spare parts for two year operation							
49	Maintenance and operating manuals including manufacturer's catalog cut-sheets							
50	Documentation index		1E,1X	A 2weeks	1E,1X	A 3weeks	1E,1X, C	1E
SHIPMENT								
51	List of shipped loose items							1E,1X, E
52	One complete set of maintenance and operating manuals shipped with equipment package							1E,1X, E
53	Record of discrepancies allowed by owner to permit shipment of packaged equipment							
54	Procedure for correction of listed discrepancies including schedule and responsibility							