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Instrumentation for Compressors and Drivers

GP 15-01-02

Scope

- 1) [I] This Global Practice (GP) covers the design of machine and auxiliary system instrumentation and panels for compressors and drivers. It also delineates the responsibilities of the machinery vendor and the Owner in supplying the instrumentation.
 - 2) [I] An asterisk (*) indicates that either a decision by the Purchaser is required, that additional information is to be furnished by the Purchaser, or that information for Purchaser approval is to be supplied by the Vendor or Contractor.
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1. Required References

[I] This Section lists Practices and Standards that are generically referenced and assumed to be a part of this document. Unless otherwise specified herein, use the latest edition.

1.1. Global Practices–ExxonMobil Engineering Practices

GP 03-06-01	Piping for Instruments
GP 10-12-01	Vibration, Axial-Position, and Bearing-Temperature Monitoring Systems for Compressors and Drivers
GP 10-14-01	Lube and Seal Oil Systems for Machinery
GP 14-03-01	Fireproofing
GP 15-02-01	Temperature Instruments
GP 15-03-01	Pressure Instruments
GP 15-04-01	Flow Instruments
GP 15-05-01	Level Instruments
GP 15-06-01	Electronic and Pneumatic Instruments
GP 15-06-02	Environmental Protection for Instrumentation
GP 15-07-02	Protective Systems
GP 15-07-03	Alarm Systems
GP 15-09-01	Control Valves
GP 15-10-01	Instrument Transmission Systems

2. Additional Requirements

* [I] The following Practices and Standards shall be used with this Practice as specified by the Purchaser.

2.1. Global Practices–ExxonMobil Engineering Practices

GP 15-07-01	Electric Power Branch Circuit Design for Instrumentation
GP 15-11-01	Instrument Control Panels

3. Definitions

Term	[I] Description
critical services	* Those services where a life cycle evaluation of an unspared compressor installation has shown that the costs associated with a compressor outage justify the added costs of redundant field instrumentation and logic systems with TMR architecture. Critical services shall be specified.
control house operating consoles	Panels in the main control house which are used for overall process operation.
local panels	Provide mounting for all indicating instruments and controllers for process and auxiliary system variables which the operator requires for placing the machine in process service.
locally mounted instruments	Mounted on or near the machinery, at or near piping, but not on panels, and include switches, transmitters, thermocouples, and gages.
Triple Modular Redundant (TMR) architecture	An integrated fault tolerant programmable logic system composed of three isolated parallel subsystems (triplicated central processing units, triplicated communication paths, and input/output modules whose module design contains triplicated data handling circuits). Two-out-of-three voting is performed at each part of the system, where possible. TMR logic systems may be used with either single or redundant field sensors.

4. Design

- [I] Tables 3 through 10 list instrumentation to be supplied and installation locations. Purchaser/Vendor responsibilities are also delineated.
- * [O] Contractor shall provide a local panel for each compressor in order to facilitate startup and routine monitoring. Space may be required for readout instrumentation supplied by Machinery Vendor.
- [R], [C] Purchaser shall specify the manufacturer and model of standard instruments to be supplied by Machinery Vendors. To the maximum extent possible, these shall be the same as used in the rest of the plant. Instruments shall be in accordance with [GP 15-06-01](#) and [GP 15-06-02](#).
- [I] Temperature instruments shall be in accordance with [GP 15-02-01](#).
- [I] Pressure instruments shall be in accordance with [GP 15-03-01](#).
- [O] Pressure instruments shall be mounted near the sensing point elevation to eliminate the need for head compensation of readings/setpoints.
- [I] Flow instruments shall be in accordance with [GP 15-04-01](#).
- [I] Level instruments shall be in accordance with [GP 15-05-01](#).

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- 9) * [S], [R] Protective systems shall be in accordance with [GP 15-07-02](#). In addition, the following requirements shall apply to automatic startup and shutdown systems:
- Automatic startup systems (e.g., spare oil pump cut-in) shall be designed as protective systems and may be integrated with the protective systems. These auto-start systems are to be included as part of the primary protective system rather than as a separate relay or PLC based system
 - * The design of protective circuits shall be Fail-No-Action per [GP 15-07-02](#); however, automatic startup circuits shall be designed Fail-Action. The Owner's Engineer shall approve all exceptions.
 - * Automatic startup and shutdown systems for critical services shall be implemented using TMR logic systems. Sensor and end-element-redundancy (as well as associated voting requirements) shall be according to Table 4 or Table 7 as applicable.
 - * Sensor and end-element-redundancy (and voting requirements) for critical initiators shall be specified by the Owner's Engineer.
 - Redundant protective system sensors shall be equipped with separate taps/isolation valves or wells in order to facilitate online testing or maintenance.
 - Automatic startup and shutdown circuits shall be designed to allow online testing of each system component without affecting process operations.
- 10) [O], [R] Upon failure of instrument air or electrical power, regulating devices (including governors) shall fail in such a position as to ensure continued safe operation of compressor and driver. The design shall provide manual shutdown capability from both the local panel and control house.
- Manual trip initiators shall be designed to remain operable regardless of a protective system logic failure. These manual trip initiators shall also be input to the protective system logic, and shall be fireproofed per [GP 14-03-01](#).
- 11) [O] Alarms shall be in accordance with [GP 15-07-03](#). One common annunciator shall be furnished for each compressor. The local panel alarms on each compressor service (compressor, gear, driver) shall actuate common alarms in the control house to alert the (control house) operator to an alarm condition at the machine.
- 12) * [O] When specified by Purchaser, instrumentation (in whole or in part) designated to be located on the local panel may be located or duplicated in the control house.

Table 1: Abbreviations for Functional Hardware (Tables 3 through 10)

Letters	Variable Types	Function Codes		
		Position 1	Position 2	Position 3
A		Alarm	Alarm	Alarm
B	Burner Flame			
C		Controller or Control	Controller or Control	
(CI)			Cut In	
(CO)		Cut Out	Cut Out	Cut Out

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Letters	Variable Types	Function Codes		
		Position 1	Position 2	Position 3
D			Dial	
D		Differential		
E		Element (Primary)	Element (Primary)	
F	Flow			
G		Gage		
H	Hand Actuated	High	High	
I	Current	Indicating or Indicator	Indicating or Indicator	
L	Level	Low	Low	
P	Pressure	Phase		
R	Remote	Recording or Recorder		
S	Speed	Switch	Switch	
T	Temperature	Transmitter	Transmitter	
(TC)	Thermocouple			
V	Vibration		Valve	Valve
W		Well		
Z	Position (Displacement)			

Table 2: Abbreviations for Mounting Location (Tables 3 through 10)

Letters	Location
Brg	Bearing
CH	Control House Panel
D	Drum
GB	Gage Board
LP	Local Panel
Ma	Machine
P	Piping
SP	Gas Seal Panel
T	Lube and Seal Oil Reservoir } as indicated Overhead Seal Oil Tank



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Table 3: Instrumentation for Centrifugal, Axial, and (Dry) Rotary Screw Compressors

Table 3

System	Equipment	By Vendor		By Purchaser	
		Functional Hardware (Quantity as Indicated)	Mounting Location	Functional Hardware	Mounting Location
Lube Oil System	Oil Reservoir	TW and TID LG LS LS*	T T T T	— — LLA LHA*	— — LP LP
	Oil Pump-Standby	PL(CI) and PLCV PI and PS	P P	— PHA	— LP
	Oil Pump-Main	PI	P	—	—
	Pump Discharge Header	PCV PI TW and TID	P P P	— — —	— — —
	Oil Coolers - Oil Outlet	TW and (TC) TW and TID TCV	P P P	THA, TI — —	LP Note 1 — —
	Oil Filter	PdI PdS	P P	— PdHA	— LP
	Accumulator, Direct Contact Type	PI (Charge Gas) LG LS LS LS and LLCV	P T T T T and P	— — LHA LLA —	— — LP LP —
	Oil Supply Header	PI PS PS (One)	P P P	— PLA PLL(CI), PLL(CI)A	— — LP Note 2
	Lube Oil Header	PCV PI PS PS (One)	P P P P	PI — PLA PLL(CO)A and PLL(CO)	LP — LP LP Note 3
	Compressor Drains, Each Bearing	FI (Sight Glass) TW and TID	P P	— —	— —
	Coupling Housing Drain	FI (Sight Glass)	P	—	—

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Table 3

System	Equipment	By Vendor		By Purchaser	
		Functional Hardware (Quantity as Indicated)	Mounting Location	Functional Hardware	Mounting Location
Control Oil System	Control Oil Header	PCV (If Applicable) PI PS	P P P	— PI PLA	— LP LP
Seal Oil System	Oil Reservoir	TW and TID LG LS	T T T	— — LLA	— — LP
	Oil Pump - Standby	PI (Two) and PS	P	PHA	LP
	Oil Pump - Main	PI (Two)	P	—	—
	Oil Coolers - Oil Outlet	TW and (TC) TCV TW and TID	P P P	TI, THA — —	LP Note 5 — —
	Oil Filter	PdI PdS	P P	— PdHA	— LP
	Head Tank, Each Casing (If Applicable)	LC LCV LG LS (One) LS (One) LS (One)	T P T T T T	— — — LHA LLA, LL (CI), LL (CI)A LLL (CO) Note 4 and LLL (CO)A Note 4	— — — LP LP Note 2 LP Note 3
	Seal Oil Header	PCV (If Applicable) PI	P P	PI —	LP —
	Seals/Buffered Labyrinths	PdI and PdS	P	PdA	LP
	Atmospheric Drain	FI (Sight Glass) TW and TID	P P	— —	— —
	Drain Trap (If Applicable)	LG LC and LCV	P P	— —	— —

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Table 3

System	Equipment	By Vendor		By Purchaser	
		Functional Hardware (Quantity as Indicated)	Mounting Location	Functional Hardware	Mounting Location
Compressor Dry Gas Seals Figure 1: Unpressurized Dual (Tandem) Seal Design w/o Internal Labyrinth	Buffer Gas Filtration	PdT PdI	P SP	PdHA —	LP —
	Buffer Gas Header Pressure Control	PCV PI, TW and TID	P P	— —	— —
	Individual Seal Cartridge Buffer Gas Supply (IB and OB)	FE, FT PdT PdI, FI	P P SP	— PdLA, PdHA —	— LP —
	Individual Seal Primary Seal Leakage (IB and OB)	PI FE, FT (Two) FI PT	SP P SP P	— FHA *FHH (CO) and FHH (CO) A — —	— LP Notes 3 and 6 — — —
	Individual Seal Secondary Seal Leakage (IB and OB)	PI PT FE, FT FI	SP P P SP	— — — —	— — — —
	Individual Seal Outboard Separation Gas	PCV PT PI FE, FT FI	P P P, SP P SP	— PLA, PHA — — —	— LP — — —
	Primary Seal Vent vs Secondary Seal Vent Differential Pressure	PdI	SP	PdLA	LP

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Table 3

System	Equipment	By Vendor		By Purchaser	
		Functional Hardware (Quantity as Indicated)	Mounting Location	Functional Hardware	Mounting Location
Compressor Dry Gas Seal Figure 2: Unpressurized Dual (Tandem) Seal Design with Internal Labyrinth	Buffer Gas Filtration	PdT PdI	P SP	PdHA —	LP —
	Buffer Gas Header Pressure Control	PCV PI, TW and TID	P P	— —	— —
	Individual Seal Cartridge Buffer Gas Supply (IB and OB)	FE, FT PdT PdI, FI	P P SP	— PdLA, PdHA —	— LP —
	Individual Seal Primary Seal Leakage (IB and OB)	PI FE, FT (Two) FI PT	P P SP P	FHA, *FHH(CO) and FHH(CO)A — —	LP Notes 3, 6, 7 — —
	Individual Seal Secondary Seal Leakage (IB and OB)	PI PT FE, FT FI	P P P SP	— — — —	— — — —
	Purge Gas Filtration/Pressure Control	PdT PdI PCV	P SP P	PdHA — —	LP — —
	Individual Seal Purge Gas	FE, FT Note 7 PI, PT FI	P P SP	FHA, FLA PLA —	LP LP —
	Purge Gas vs Secondary Seal Vent Differential Pressure	PdI	SP	PdLA	LP
	Individual Seal Outboard Separation Gas	PCV PT PI FE, FT FI	P P P, SP P SP	— PLA — — —	— LP — — —

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Table 3

System	Equipment	By Vendor		By Purchaser	
		Functional Hardware (Quantity as Indicated)	Mounting Location	Functional Hardware	Mounting Location
Compressor Dry Gas Seals Figure 3: Pressurized Dual(Double) Seal Design	Barrier Gas Filtration	PdT PdI	P SP	PdHA —	LP —
	Barrier Gas Header Pressure Control	PCV PI, TW and TID	P P	— —	— —
	Individual Seal Cartridge Barrier Gas Supply (IB and OB)	FE, FT PdT PdI, FI PdT	P P SP P	FHA PdLA — PdLL(CO) and PdLL(CO)A	LP LP — LP Note 3
	Individual Seal Secondary Seal Leakage (IB and OB)	PI FE, FT FI	P P SP	— FHA —	— LP —
	Individual Seal Outboard Separation Gas	PCV PT PI FE, FT FI	P P P, SP P SP	— DPLA, DPHA — — —	— LP — — —
Compressor Gas Stream	Suction K.O. Drum	—	—	LS (Two) LHA LHH(CO) and LHH(CO)A	D LP LP and Note 3
	Each Casing Inlet (Including Each Side Stream)	—	—	TW and TID, TW and (TC) TI PT, PI PI	P LP P LP
	Each Casing Discharge (Including Each Side Stream)	—	—	TW and TID, TW and (TC) THA, TI PT, PI TI and PI	P LP P LP
	Inlet, Interstage and Discharge Motor Operated Valve (MOV)	—	—	ZS ZL(CO) ZL(CO)A	P LP Notes 3 and 8 LP
	Anti Surge System	—	—	FCV and Note 9	P
	Total Compressor Flow	— —	— —	FI FE, FT	LP P
	Recycle Flow	— —	— —	FI FE, FT	LP P

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