



Offshore Design Section  
Engineering Services  
ISO – 9001:2000

Functional Specification for  
Orifice Plate & Flanges  
Assembly

Spec. No.	3203
Rev. No.	05
Discipline	Instrumentation
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FUNCTIONAL SPECIFICATION  
FOR  
ORIFICE PLATE & FLANGE ASSEMBLY

05

Prepared / Revised By	Reviewed By	Approved By	Total No. of Pages	Date	Rev. No.
			8	29.04.2016	05
VKS	ARD	KM	8	29.04.2016	5
BK	ARD	AKR	8	31.08.2009	4
VS	SRS	GRP	9	18.02.2008	3
ET	BK	GRP	10	28.03.2007	2
AK	MC	RK	11	21.07.2005	1
ET	MC	AC	11	25.08.2003	0

FORMAT No. ODS/SOF/004A	Ref. PROCEDURE No. ODS/SOP/008 to 015	ISSUE No. 02	REV. No. 00	REV. DATE: 02.12.2008
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FORMAT No. ODS/SOF/004A	Ref. PROCEDURE No. ODS/SOP/008 to 015	ISSUE No. 02	REV. No. 00	REV. DATE: 02.12.2008
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## 1.0 SCOPE OF THIS DOCUMENT:

- 1.1 This functional specification describes the essential design considerations for the selection of Orifice Plates & flanges Assembly for the intended service.

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## 2.0 CODES & STANDARDS:

- 2.1 **Applicable Codes & Standards:** Latest editions of applicable codes & standards as enlisted in Cl. 3.6.3.1, Instrumentation Design Criteria

### 2.2 Applicable Documents and Specifications:

- a) Basic Bid Work
- b) Design Criteria - Process & Instrumentation
- c) Project P & IDs
- d) Process Data Sheets for Instruments

## 3.0 SCOPE OF SUPPLY:

- 3.1 The quantity to be supplied and installed shall be as per the requirements indicated in the Basic Bid Work, Design Criteria and the P & IDs.
- 3.2 The vendor shall be responsible for the selection of the Orifice Plates & flanges Assembly suitable for its intended application, its procurement, tagging, packing, testing & calibration, preparation for shipment, along with accessories, spares, and assistance where required for its installation & commissioning at site. This FS shall be read in conjunction with the Instrument Design Criteria.

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## 4.0 ORIFICE FLOW METERS:

### 4.1 Application:

- 4.1.1 Orifice Plates & flanges Assembly shall be used as the flow-measuring element wherever dictated by the process requirements.
- 4.1.2 For a standard orifice meter, only one fixed Orifice Plate shall be designed for the rangeability of 3:1 or less.

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In case of flow rangeability higher than 3:1, senior orifice meter with two or more orifice plates shall be required to cover the entire flow range and the each plate shall be sized for the range of 3:1 or less.

### 4.2 General:

- 4.2.1 Fabrication of the orifice plate shall be in accordance with AGA – Gas Measurement Committee, Report No. 3, latest edition for gas measurement.
- 4.2.2 The Orifice meter shall in general comprise of a concentric square edged orifice plate designed for flange tap except for particular process requirements. (*Eccentric, segmental or quadrant edged orifices may be used for special services such as slurry, wet gas or highly viscous service*).
- 4.2.3 Where the orifice plate flow element is coupled with a force balanced or bellows type meter, the meter shall be with a built-in adjustable dampening device.
- 4.2.4 The Orifice Plate shall be capable of withstanding differential pressure equal to full line pressure without zero or calibration change.



4.2.5 Orifice plate beta ratio (orifice bore diameter/ inside pipe diameter) in general shall be between 0.2 and 0.75.

4.3 **Material:**

4.3.1 The material requirements for orifice plates shall in general be according to clause 3.6.4.5 of Instrumentation Design Criteria and the material selection chart provided in Annexure I of this specification.

4.4 **Range:**

4.4.1 Differential ranges for orifice flow meters shall not exceed 5000 mm (200 inches) of water. Typical meter ranges for gas, steam, or vapor, streams shall be as follows:

**STATIC PRESSURE**

(Kg / cm<sup>2</sup> g (PSIG))

0.35 to 2.5 (5-35)

2.5 to 6 (35 - 85)

Above 6 (Above 85)

**DIFFERENTIAL PRESSURE**

(mm of Water (inches))

500 - 1250 (20 - 50)

1250 - 2500 (50 - 100)

As per AGA-3 guidelines.

4.4.2 The range 2500 mmWC (100 inches WC) is desirable wherever possible in line with AGA-3 guidelines in case of static pressure of 6 Kg/cm<sup>2</sup>g and above.

4.4.3 Orifice meter ranges shall preferably be chosen such that the normal flow is between 60% and 80% of the meter range.

4.5 **Scales:**

4.5.1 Scales for orifice metering system shall be 0 - 10 square root with multiplication factor to suit rate of flow requirements for DP (Bellows ) type Pneumatic flow meter.

Orifice flow meter with totalizer (with or without pressure correction) shall be provided with a proper multiplication factor in line with the flow calculation as per AGA-3 with AGA-8 (for gas). Linear scale of DPT shall be combined with the Square root scale of Totalizer.

In case of orifice meter with MVT (with integrated flow computer / separate Flow computer at site) and FT with panel (at CCR) mounted flow computer, the range of process parameters like Pressure, Temperature, Diff. Pressure, Flow etc shall be as per the Basic Bid Work / approved P & IDs of the respective projects.

4.6 **Flanges:**

4.6.1 Orifice flanges and fittings shall be installed according to AGA - Gas Measurement Committee Report No. 3.

4.6.2 Orifice flanges shall be in accordance with the standard ANSI B 16.36 with a minimum flange rating of 300# ANSI and a minimum of 1½-inch pipe size.

4.6.3 Two pairs of flange taps located diametrically opposite shall be provided. Location of taps & Tap sizes shall be in accordance with the AGA-3 standard, latest edition. The spare tapings shall be plugged with SS 316 as a minimum.

4.6.4 Unless otherwise specified, Orifice flange shall be RF, weld neck type for pressure application less than rating ANSI # 600. For pressure application greater than or equal to rating ANSI # 600, RTJ type flanges shall be used. Based on process requirement, final material and selection of flanges shall be in accordance with the standard ANSI B-16.36 & AGA-3.



#### 4.7 Meter Runs:

- 4.7.1 All meter runs (Upstream & Downstream) shall be designed for flange tap differential measurement unless otherwise specified as per AGA - Gas measurement committee report No. 3, latest edition.
- 4.7.2 Orifice meter runs shall not be for less than 1 - ½" nominal pipe size. Where required, the piping dia shall be blown up to the required size for installing the meter run / orifice, in line with the applicable standards.
- 4.7.3 The straight length of upstream & downstream pipe works shall be in accordance with the standard AGA-3. No connections shall be made in either the upstream or downstream straight pipe work, other than the orifice flange tapings. In case sufficient straight run is not available for the given piping geometry, meter runs with Flow conditioner may be used. These Flow conditioner shall be as per AGA 3. The Flow conditioner material shall be 316 SS or better to suit the process conditions. The location of Temperature sensor (on the downstream only) shall be within 5 to 20 D internal diameter of the pipe run.

#### 4.8 Orifice Plate Sizing:

Orifice plate sizing shall be based on AGA 3 with AGA-8 standards for gas application & ISO-5167 for liquid application. Sizing calculations shall be submitted to Company for approvals.

#### 4.9 Miscellaneous:

- 4.9.1 Orifice meter design and installation shall be in accordance with the AGA - Gas Measurement Committee Report No. 3. It is preferred that metering orifices be located in horizontal lines.
- 4.9.2 Orifice flanges or meter tubes shall be installed horizontally near the deck or platform for ease of accessibility and safe changing of the orifice plate.
- 4.9.3 Orifice plates shall be installed after line flushing is completed, before hydro testing.
- 4.9.4 Prior to installing the orifice plate, it shall be checked against the Instrument Specification sheet and inspected by the Company's representative.
- 4.9.5 The static pressure element shall be connected to the upstream pressure tap on gas flow measurement.
- 4.9.6 Piping and equipment shall be arranged so that flashing does not occur at or upstream of orifice plates.
- 4.9.7 The piping layout shall preferably be arranged such that flow conditioner are not required and gas meter runs are self-draining.
- 4.9.8 Upstream elbows in more than one plane shall be avoided to minimize vorticity.
- 4.9.9 Orifice plate shall be checked for correct alignment, and correct orientation with respect to the process flow.
- 4.9.10 Orifice Plates shall be checked visually for nameplate data and for an upstream sharp edge. Bore shall be callipered to check for compliance with specifications.
- 4.9.11 All socket-weldings shall be 100% Dye penetration / Magnetic particle tested. All other welding shall be 100% radio graphed.
- 4.9.12 The orifice plates shall be suitably marked with tag. Nos., bore size & direction of mounting.

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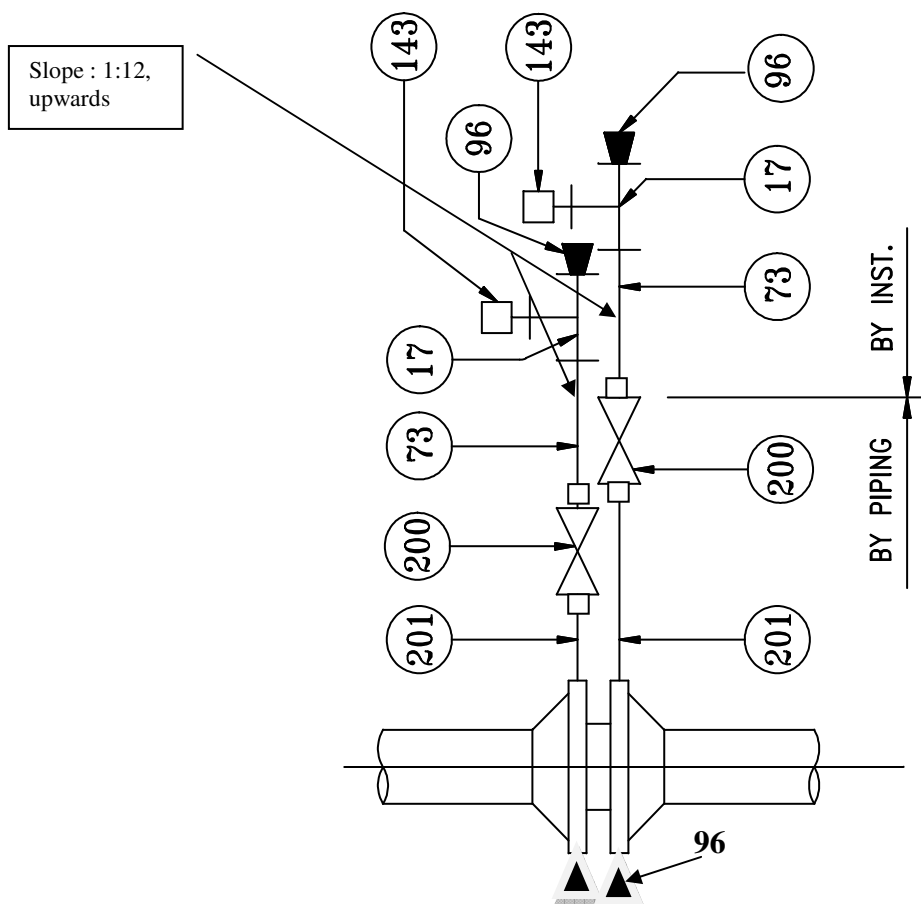
**ANNEXURE – I**

**Material Selection Chart for Orifice Plates**

Sl.No.	Piping Class	Orifice Assembly	
		Flange / Body	Plate
1	A1, B1, D1, E1, F1, XF1, F1, PA1, PB1, PD1, PE1, PXF1, PF1, A2, B2, D2, E2, XG1, A1H, A3, B3, A8 (EXCEPT WAT. INJ. SERVICE)	CARBON STEEL	SS 316
2	INJECTION WATER SERVICE	CARBON STEEL	SS 316
3	A4, A6, A9, B9, D9, E9	SS 316	SS 316
4	A5	90-10 Cu Ni / MONEL	MONEL
5	A7	TITANIUM	TITANIUM
6	A1N, B1N, D1N, E1N, F1N, XF1N, PA1N, PB1N, PD1N, PF1N, XG1N	CARBON STEEL	SS 316
7	A10, B10, D10, E10, F10	SS 316 L	SS 316 L
8	A11, B11, D11, E11, F11, PA11, PB11, PD11, PE11, PF11	DUPLEX SS	INCONEL 625



**ANNEXURE – II (Hook-Up Drawing, typical, for Gas application)**



**ORIFICE PLATES FLANGE CONNECTIONS**

BILL OF MATERIAL				
ITEM	QTY.	SIZE	DESCRIPTION	MATERIAL
17	2	1/2"	PIPE TEE. THxTHxTH NPTF	
143	2	1/2"THx1/2"OD	MALE TUBING CONNECTOR	
96	2	1/2"	PIPING PLUG NPTM SCREWED	
73	2	1/2"	SWAGE NIPPLE PLxTH NPTM	
200	2		VALVE \	BY PIPING
201	2		NIPPLE	BY PIPING



### **ANNEXURE – III - Typical Data Sheet For Orifice Plates**

<b>ORIFICE PLATES (With FLANGES)</b>									
UNITS: Flow    Liquid – M <sup>3</sup> /HR.    Gas – NM <sup>3</sup> /HR.    Pressure – Kg/cm <sup>2</sup> Temperature – °C    Level/Length - M									
<b>GENERAL</b>	1	Tag Number							
	2	Line Number							
	3	Line Size & Schedule							
	4	Service							
	5	Inlet Line ID	Outlet Line ID						
<b>METER</b>	6	Diff Range In mm H <sub>2</sub> O							
	7	Meter Maximum							
<b>PLATE</b>	8	Type							
	9	Sizing As Per							
	10	Material							
	11	Thickness "W" In Mm							
	12	Beta Ratio d/D							
	13	Bore Dia. 'd'							
	14	Vent / Drain							
<b>FLANGES</b>	15	Center Distance 'R'							
	16	Type							
	17	Tap Type	Size						
	18	Number Of Taps Per Flange							
	19	Material							
	20	Size & Rating							
	21	Facing & Finish							
	22	Line ID / OD							
	23	Gasket Thickness Mm							
	24	Gasket Material							
	25	Plate Holder							
	26	Plate Holder Material							
	27	Stud Bolt Material							
	28	Nut Material							
	29	Wetted Part Material							
	<b>OPTIONS</b>	30	Flow conditioner						
31		Connection							
32		Material							
<b>SERVICE CONDITIONS</b>	33	Fluid	State						
	34	Flow Min.	Maximum						
	35	Flow Normal							
	36	Inlet Pressure Operating	Maximum						
	37	Temperature Operating	Maximum						
	38	Sp. Gr. At Oper. Temp.	15 °C						
	39	Molecular Weight	Cp / Cv						
	40	Operating Viscosity (Cp)							
	41	Compressibility Factor							
	42	Pipe Reynolds Number							
<b>ITEM DETAILS</b>	43	Manufacturer							
	44	Model Number							

NOTE:-

1. Orifice assembly must include supply of plates, flanges, stud, bolts, nuts, jack screw, gasket / plate, holder & plugs.

VENDOR'S SIGNATURE WITH SEAL