

Masoneilan™ 12400 Series

Digital Level Transmitter/Controller

- SIL2 Capability
- Ease of Use
- Seamless Integration



Masoneilan
a Baker Hughes business



The Masoneilan 12400 Series Digital Level Transmitter/Controller from Baker Hughes marks a significant evolution in process control.

The SIL2-capable 12400 Series advanced design reduces complexity, saving you time and money, and delivering precise performance.



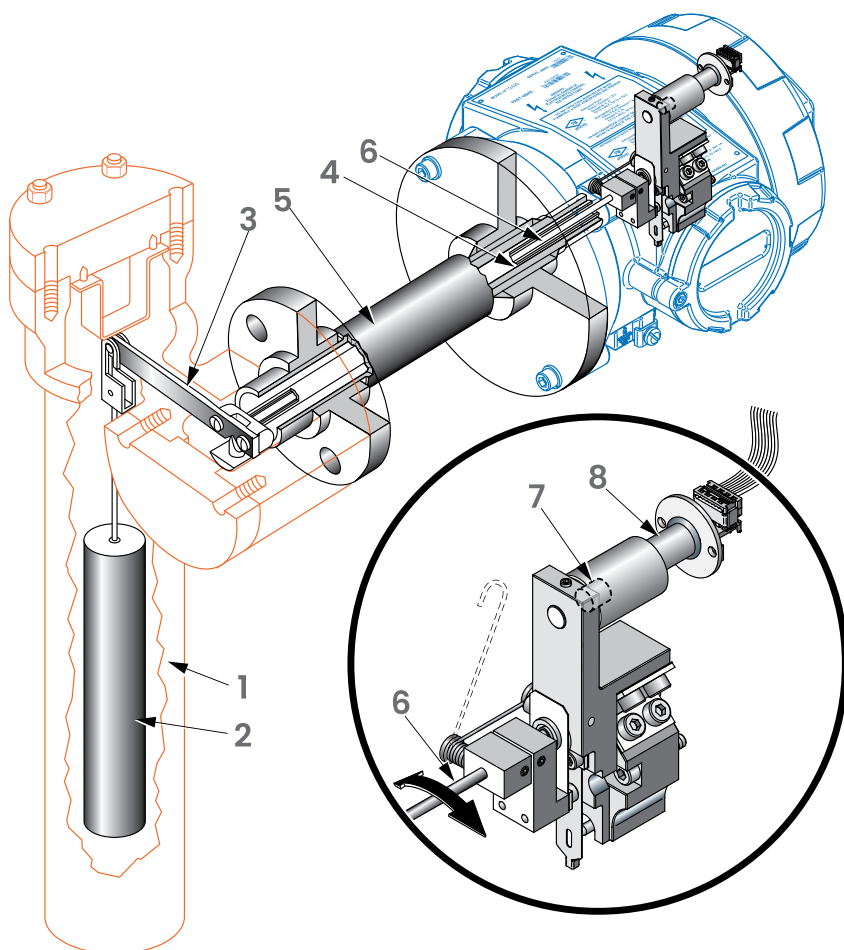
Overview

With a combination of features such as smart filtering, HART® communication protocol compatibility and an optional 4-20 mA analog output signal, Baker Hughes Masoneilan 12400 Series transmitter/controller offers exceptional process control for a wide range of applications – even severe service. Easy to install and operate, it is the first torque tube-type level instrument that integrates level transmitter and switch functions in a single device. Plus, the 12400 Series transmitter/controller is engineered for optimum efficiency, upgradeability and reliability making it a cost-effective investment for the long term.

The Masoneilan 12400 Series instrument is a two-wire, loop-powered level transmitter with HART® Communication that operates according to the fully

proven buoyancy and torque tube principles. A change in liquid level varies the net weight of the displacer (2), increasing or decreasing the load on the torque tube (4) by an amount directly proportional to the change in liquid level. The resulting rotation of the torque rod (6) and attached magnets (7) modifies the magnetic field surrounding a non-contact sensor (8), producing an analog signal proportional to the level in the vessel. This analog signal is converted into an error-free digital signal that is processed by the on-board micro-controller. After processing, the digital result is converted to a 4-20 mA analog output signal.

This sensing method is non-contacting and frictionless, and it provides total isolation between the sensed motion and sensor output.



Sketch showing the arrangement of the different parts.

In black: torque tube, arm and displacer

In orange: mechanism and displacer chambers

In blue: instrument head

- 1 - Displacer chamber
- 2 - Displacer
- 3 - Torque arm
- 4 - Torque tube
- 5 - Torque tube housing
- 6 - Torque rod
- 7 - Magnets
- 8 - Non-contact sensor

Key Benefits

Ease of Use

While the Masoneilan 12400 series transmitter/ controller offers powerful measurement functionality, it delivers efficiency for simplified ownership and operations.

Easy Installation

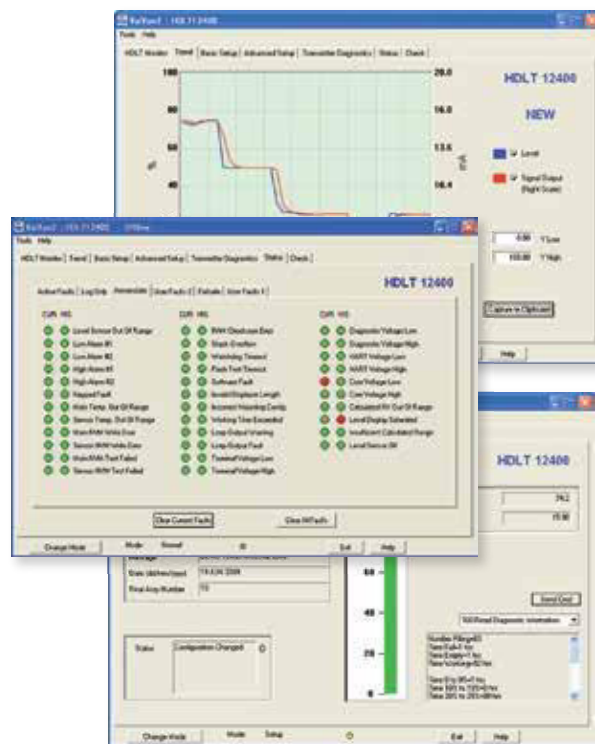
Local and remote installation are available via three explosion-proof pushbuttons or the HART® communication protocol, and the 12400 Series transmitter can be calibrated with or without fluid, including fluid with an unknown specific gravity.

Simple Operation

The 12400 Series instrument offers automated configuration, calibration and diagnostic functions as well as an easy-to-read, seven-language LCD display.

Interoperability

Field data integration is seamless across multiple communication platforms: Baker Hughes Masoneilan *ValVue*™ software, Device Description (DD) and Device Type Manager (DTM), any HART®-compatible handheld and ValVue software plug-in and snap-on.



User-friendly instrument health summary



Key Benefits

Cost-Effective

The 12400 Series instrument saves money, time and other valuable resources through its advanced functionality, reliability and scalability.

Streamlined Functionality

This is the first level instrument to offer integrated level transmitter, controller and switch functions in a single device eliminating the need for additional switches.

Durability for Long-Term Service

The accurate, non-contact sensor provides reduced wear and reliable performance, and the rugged construction protects from weather and harsh elements.

Cost-Saving Upgradeability

Field upgradeable flash firmware for future updates.

Advanced Process Control Performance

With a range of outstanding features in a durable, flexible package, the 12400 Series meets many of the industry's most demanding application requirements.

Compliance

The 12400 Series is SIL2-capable (Transmitter function only) and holds full hazardous areas certifications including ATEX, IECEx, FM and FMc (Factory Mutual Canada).

Severe Service Capability

The instrument withstands high temperature, high pressure and demanding NACE applications.

Flexibility

The instrument meets most installation requirements and accommodates most process structures through top, side or bottom connections and full horizontal plane rotation.

Accuracy

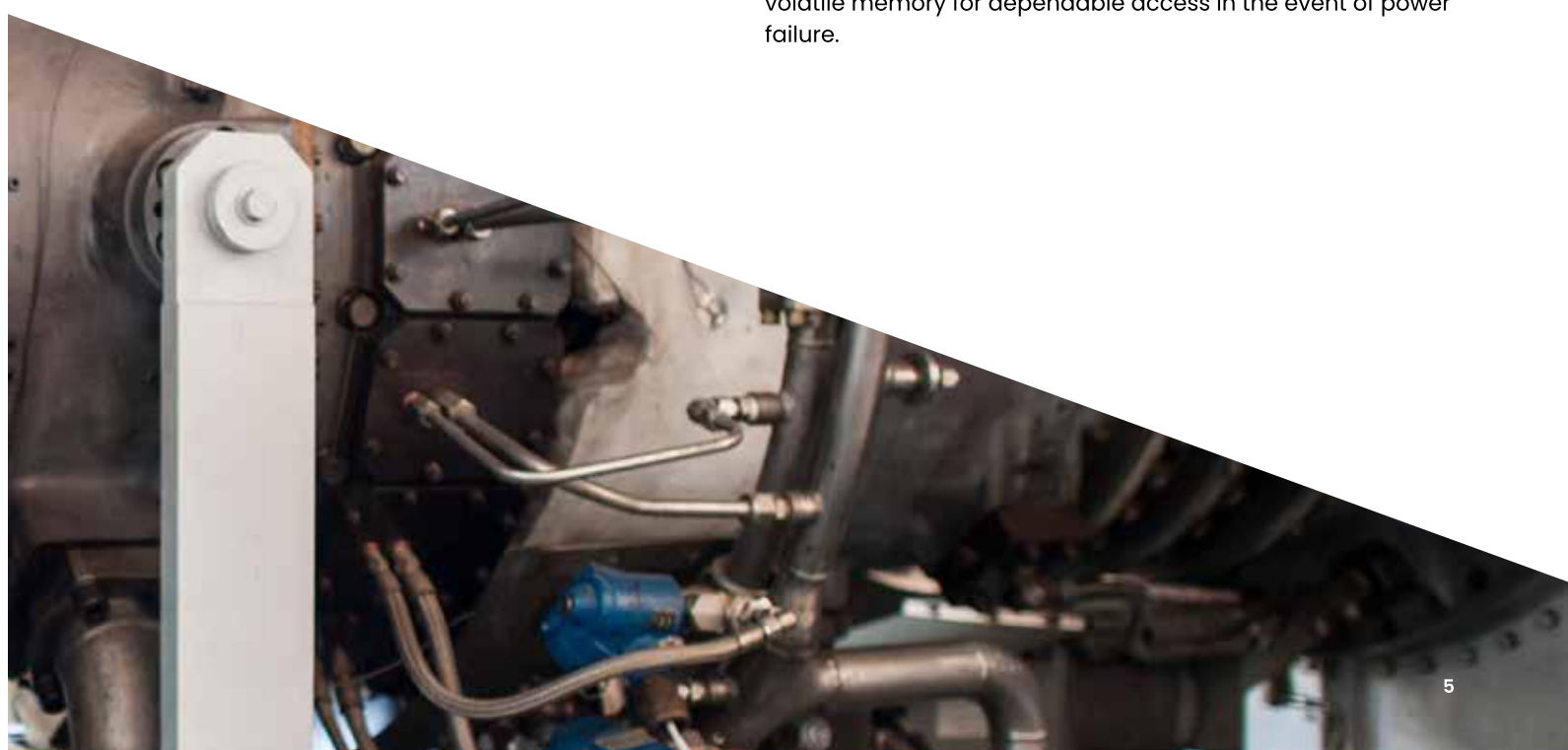
Smart filtering reduces unwanted oscillations without changing response speeds, and the frictionless sensor offers 0.1 percent measurement resolution.

Stability

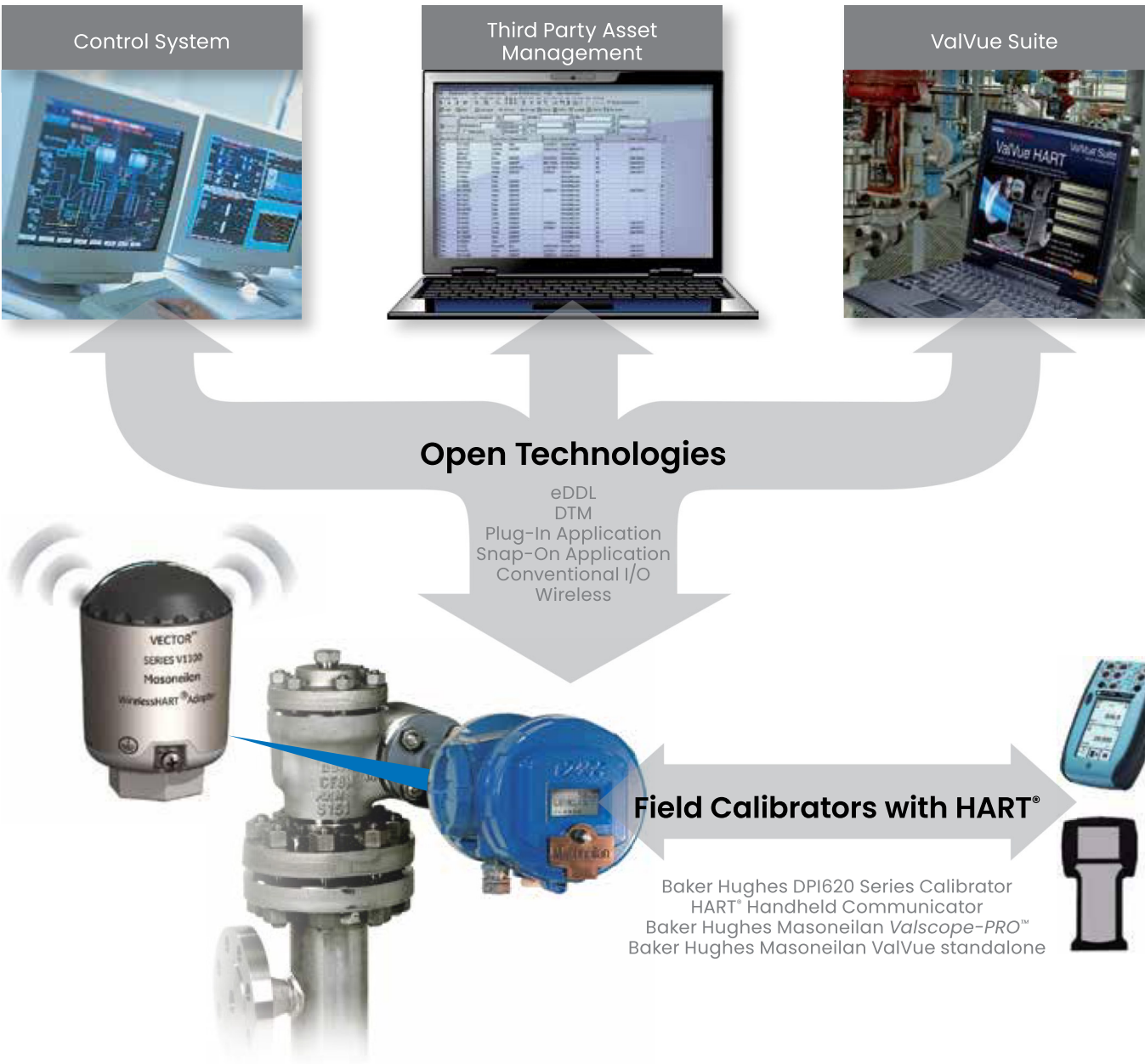
Inside a chamber, surface turbulence and foam do not impede the displacer, and process fluid agitation does not affect measurement.

Reliable Data

Continuous recording and recent data is stored in non-volatile memory for dependable access in the event of power failure.



Seamless Integration

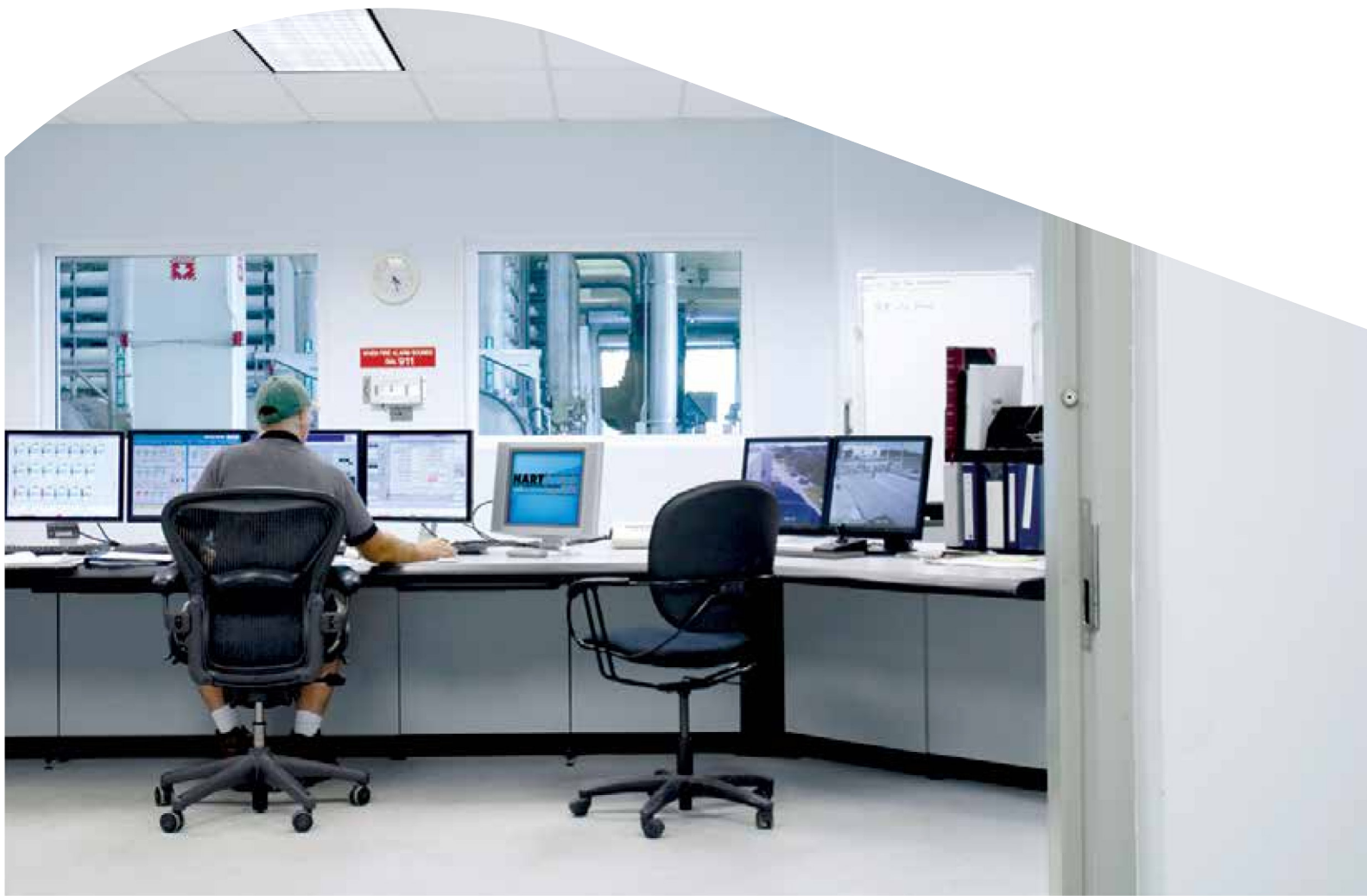


Open Technology

The 12400 Series digital level instruments can be integrated with a broad range of controllers, control systems and software available in the industry.



Feature	Integration Benefit
Low compliance voltage (10 VDC)	For legacy system, low impedance circuitry, and Masoneilan VECTOR™ (loop-powered wireless HART® adaptor)
Built-In Analog and Discrete signals	For non-HART® systems and to meet specific industry requirements where digital communications is not approved
HART®, wired or wireless compliant	Integration flexibility of device calibration and diagnostic, and level variables
eDDL compliant	Interface that Integrates with eDDL hosts, software, portable calibrators
DTM compliant	Integrates with FDT capable hosts
Asset management compliant	Integrates with plant management software



SIL 2 Capability for Enhanced Safety



The 12400 Series transmitter, SIL2-certified in accordance with IEC61508 per EXIDA, is suitable for use in safety instrumented functions.

Complete Safety Function: From Displacer up to Analog Output Signal

The safety function of the 12400 Series transmitter is not limited to the instrument head, but also includes all measurement components.

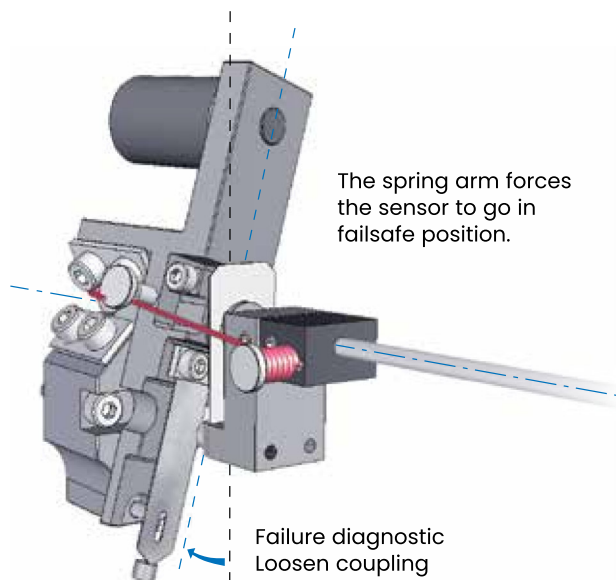
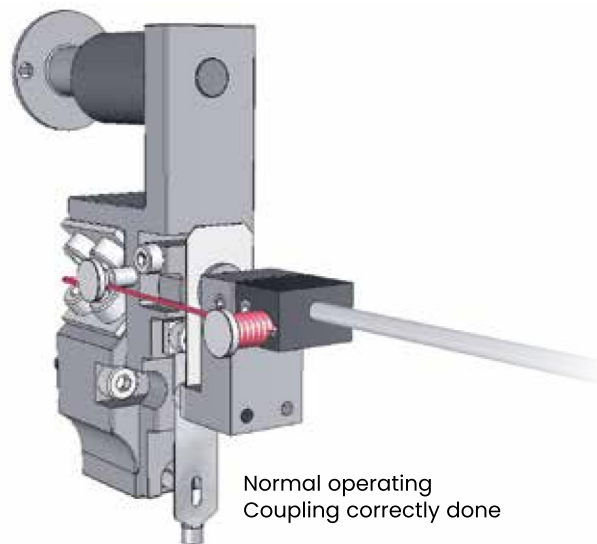
The FMEDA analysis results include the entire transmitter from displacer through the torque tube, the sensor, and the electronics up to the 4–20 mA output signal. In contrast, other available devices limit their analysis to the instrument head only.

Including all measurement components in the safety function means a higher diagnostic coverage and a Safe Failure Fraction greater than 90 percent.

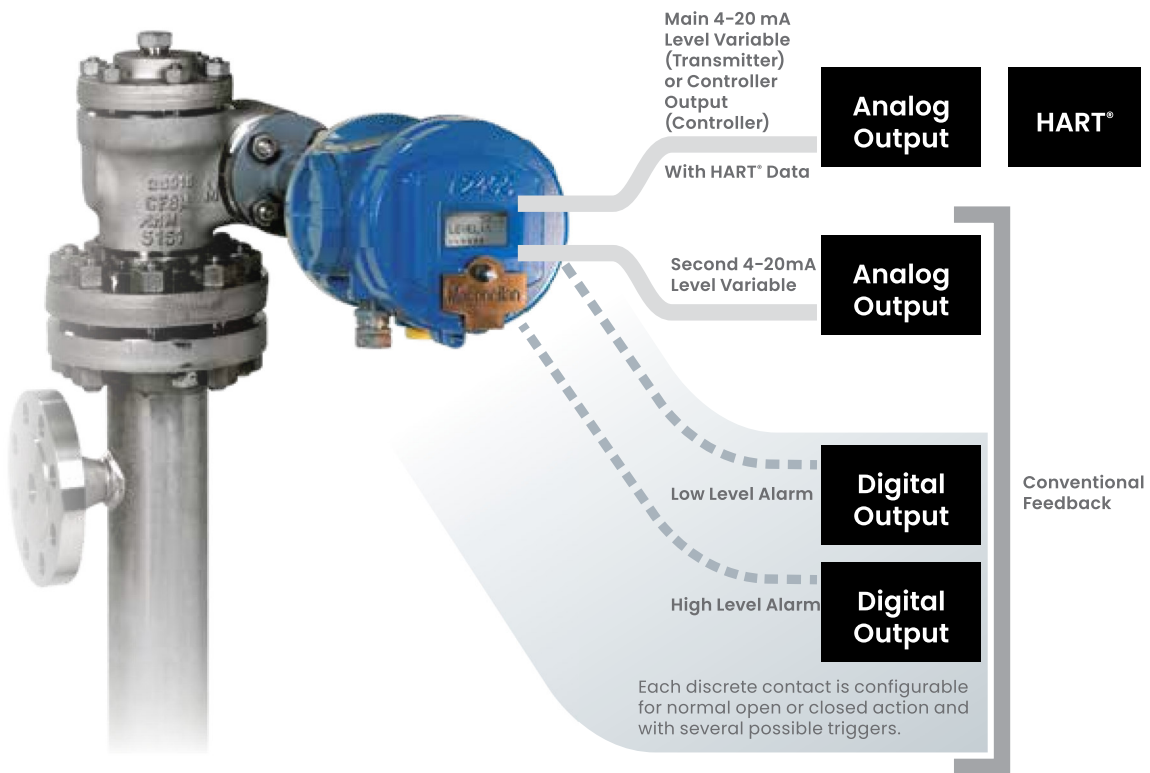
Enhanced Diagnostic Coverage

The 12400 Series instrument has been enhanced with a new sensor bias sub-assembly to enable a better diagnostic coverage of internal and user faults. Following in the footsteps of many other innovations that have made Baker Hughes Masoneilan product line a technology leader, this new patented solution improves the diagnostic analysis on all components between the sensor and the torque rod. In case of failure caused by a loose part or human error, the spring arm will force the sensor to go into the repeatable failsafe position.

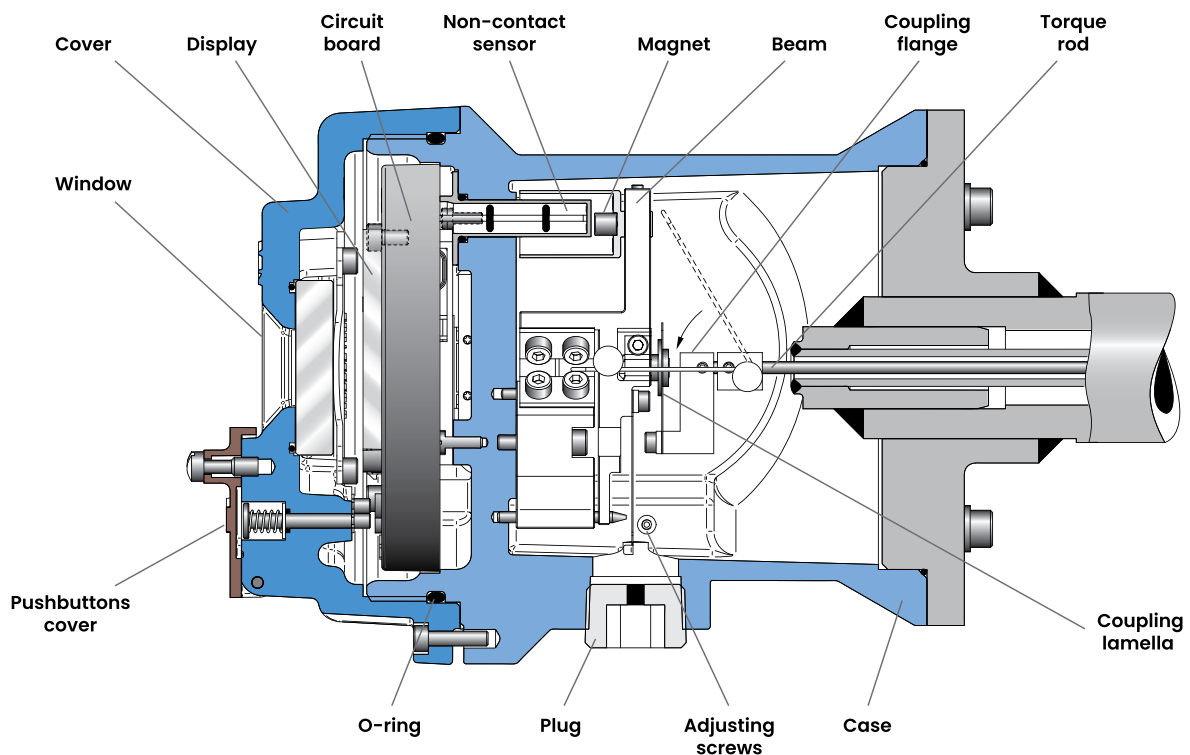
This is particularly useful in detecting the main faults that are often human errors during the coupling procedure. For instance, the wrong coupling or a loose coupling between the sensor mechanism and the torque rod can occur when the work is done by untrained people. These errors are now fully detected and diagnosed, and they will generate a HART fault message and could even activate one of the two optional switches.



Electrical Implementation



Case Sketch

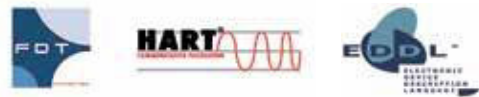


General Data

Instrument

User Interface:

- Handheld Communicator
- Pushbuttons operation with digital display
- ValVue software
- ValVue AMS™ snap-on
- ValVue PRM™ plug-in
- DTM through any FDT/DTM compatible host



Level Transmitter/Controller:

- Level or interface level measurement
- Specific gravity measurement and display (only with the displacer fully immersed)
 - Zero and span digital calibration:
 - independent zero and span adjustment
 - current loop range independent from zero/span calibration (can be changed at any time without zero/span re-calibration)
 - manual or automatic calculation for reduced span and zero shift for interface service
- Self-tuning for smart filtering
- Selectable low and high level alarms
- Low or high failsafe output signal immediately activated in case of a failure detection
- Continuous self-diagnostic with bargraph
- Continuous data record: number of fillings, low level time, high level time, working time
- Configuration check: analysis of 12400 data base to avoid bad mounting, out of range use
- Storage and display of alarms that have appeared
- Output current generator for loop check

Level Controller:

- P, I, D ... advanced control
- Remote setpoint and controller output
- Low and high controller alarms (absolute and deviations)
- Process trend through ValVue software suite

Level Switches:

- Two built-in solid state switches: 1 A - 30 VDC max
- Configurable: low and high level alarms, fault or reset occurred, instrument in failsafe

Second 4-20 mA Analog Output:

- Second level variable measurement, useful to connect a local level indicator

Action:

- Direct or reverse via software

Output Signal Filtering:

- First order filtering of output signal with adjustable time constant
- Smart filtering of contactless sensor output signal, to eliminate noise before digital signal processing

Software and Hardware Locks:

- Software lock for pushbuttons
- Hardware jumper lock for full protection against parameter change

General Data

Operating Limits

Ambient Temperature Limits:

- Standard Operating range: -40°C to +80°C (-40°F to +176°F)
- Extended Operating range: -50°C to +85°C (-58°F to +185°F)
 - For devices installed in hazardous area, temperature limits depend on the marking
 - LCD display may not be readable below -15°C (+5°F)
 - Beyond standard operating range, performance may be affected by the temperature shift
- Storage and transportation: -50°C to +93°C (-58°F to +200°F)
- Ambient temperature shift: $\pm 0.028\%$ /°C of full span (zero and span, over extended temperature range)

Process Temperature Limits:

- -210°C to +450°C (-350°F to +850°F)

For temperature higher than +150°C (+302°F) or lower than -100°C (-150°F), an extension is required between the case and the torque tube. Note: See diagram page 12 and approval certificates.

Specific Gravity Range:

- 0.15 to 1.4 with a standard displacer
- Lower and higher specific gravities with special displacers (consult your local sales contact)

Electric Characteristics Following NAMUR NE 43:

- Normal output signal: 3.8 to 20.5 mA
- Low failsafe output signal (< 3.6 mA)
- High failsafe output signal (> 21 mA)

Supply Voltage:

- U min = 10 VDC
- U max = 30 VDC (intrinsic safety)
- U max = 40 VDC for AO_1
30 VDC for AO_2 (flameproof envelope)

Supply Voltage Influence:

- 0.1 μ A/V

Performance Specifications	Instrument Head Alone	Instrument Head with Torque Tube S/A
Accuracy (full span)	$\pm 0.1\%$	$\pm 0.5\%$ on request $\pm 0.25\%$
Hysteresis + Dead Zone (full span)	$\pm 0.1\%$	$\pm 0.3\%$
Repeatability (full span)	$\pm 0.1\%$	$\pm 0.2\%$

Performance at room temperature with standard displacer and specific gravity from 0.15 to 1.4 (or special displacer with equivalent sensor angle variation) within standard operating temperature range.

Electromagnetic Compatibility

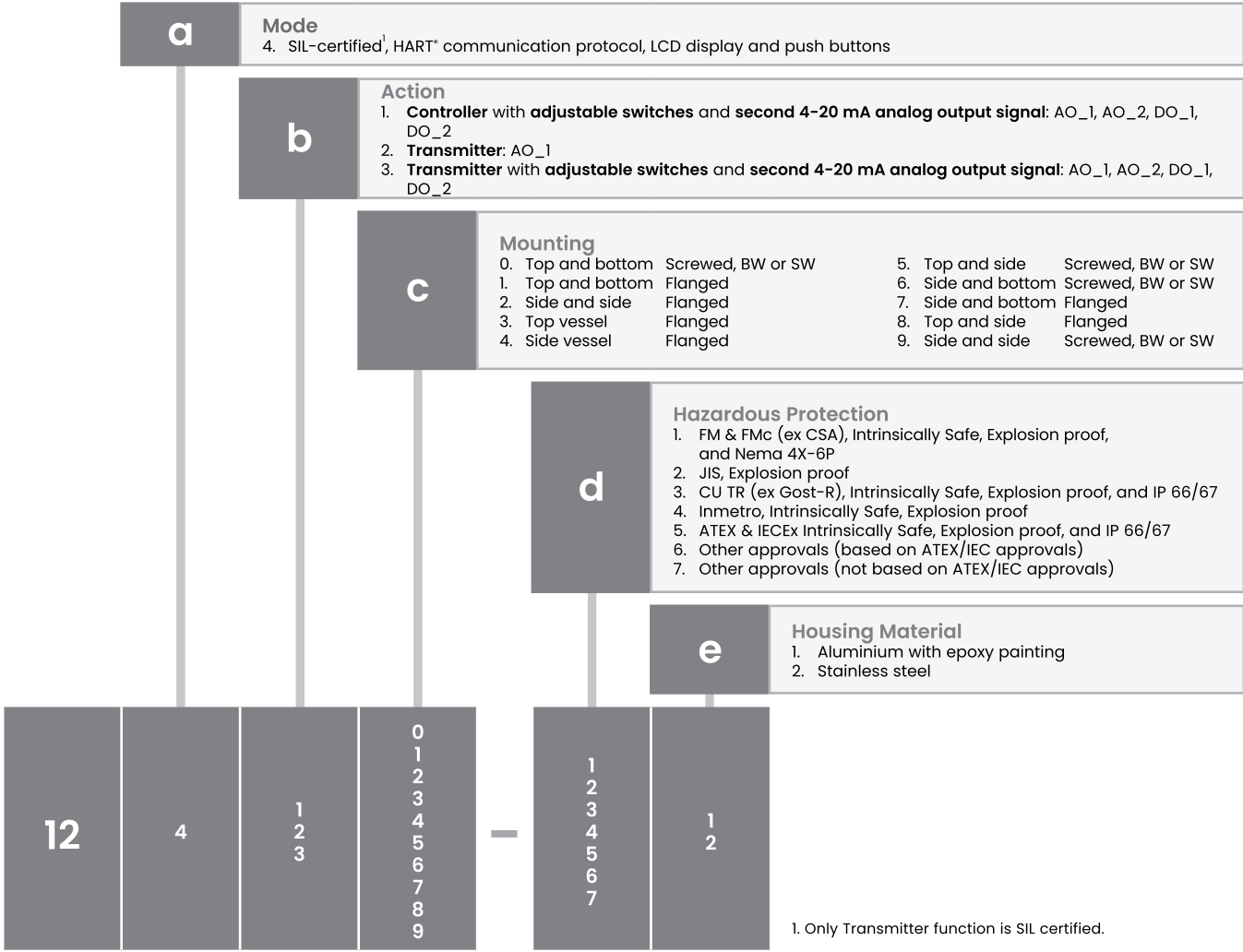
Compliance with EMC Directive 2004/108/EC, including NF EN 61000-6-2, NF EN 61326-1, NF EN 61326-3-1, NF EN 61000-6-4 and NF EN 55022 standards.

Over-voltage Protection (at 25°C / 77°F)

- 10 kW for 8/20 μ s pulse wave form
- 1.5 kW for 10/1000 μ s pulse wave form

Numbering System

Series Identification 12abc – de



Pressure Envelope Characteristics

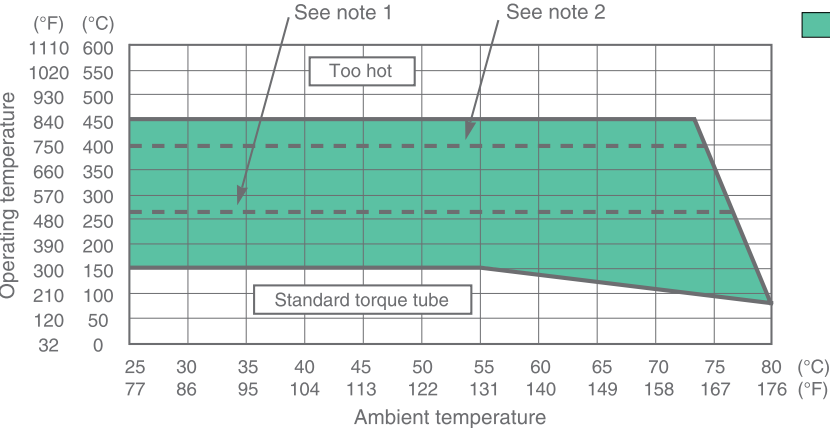
Rating

- ANSI class 150 to 2500
- PN 10 to PN 420

Ranges

- 356, 610, 813, 1219, 1524, 1829, 2134, 2438, 3048mm (14", 24", 32", 48", 60", 72", 84", 96", 120")
- Other ranges on request

Temperature Limits



Use an extension between case and torque tube for temperatures included in colored area.

Notes:

1. Above 260°C (500°F), torque tube must be in Inconel.
2. 12402, 12406, 12407 and 12409 models only, for stainless steel version, can be used between +400°C (+750°F) and +450°C (+850°F).
3. For devices installed in hazardous location, temperature limits depend on the marking. See page 13 for complete information.

Hazardous Location Protection

ATEX & IECEx Approvals (94/9/EC Directive)

Explosion proof

- II 2 G/D
Ex d IIC T6, T5 or T4 Gb
Ex tb IIIC T85°C, T100°C or T135°C Db IP66/IP67

Intrinsic safety

- II 1 G/D
Ex ia IIC T6, T5 or T4 Ga
Ex ia IIIC T85°C, T100°C or T135°C Da
IP 66/67

Other approvals:

- CU TR (Russia, Belarus and Kazakhstan)
- JIS (Japan)
- KOSHA (Korea)
- CCOE (India)
- Inmetro (Brazil)
- NEPSI (China)
- IA (South Africa)
- CRN (Canada)

FM and FMc Approvals (Factory Mutual and Factory Mutual Canada)

Explosion proof

- Class I ; Division 1 & 2
Groups B, C, D
T6 or T5

Dust-ignition proof

- Class II & III ; Division 1 & 2
Groups E, F, G
T6 or T5

Intrinsically safe

- Class I, II, III ; Division 1 & 2
Groups A, B, C, D, E, F, G
T6, T5 or T4

Non-incendive

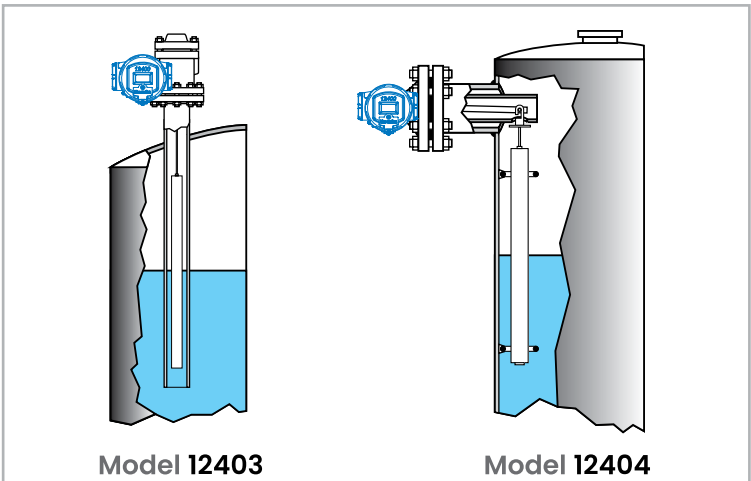
- Class I, II, III ; Division 2
Groups A, B, C, D, F, G
T6 or T5

Enclosure Rating

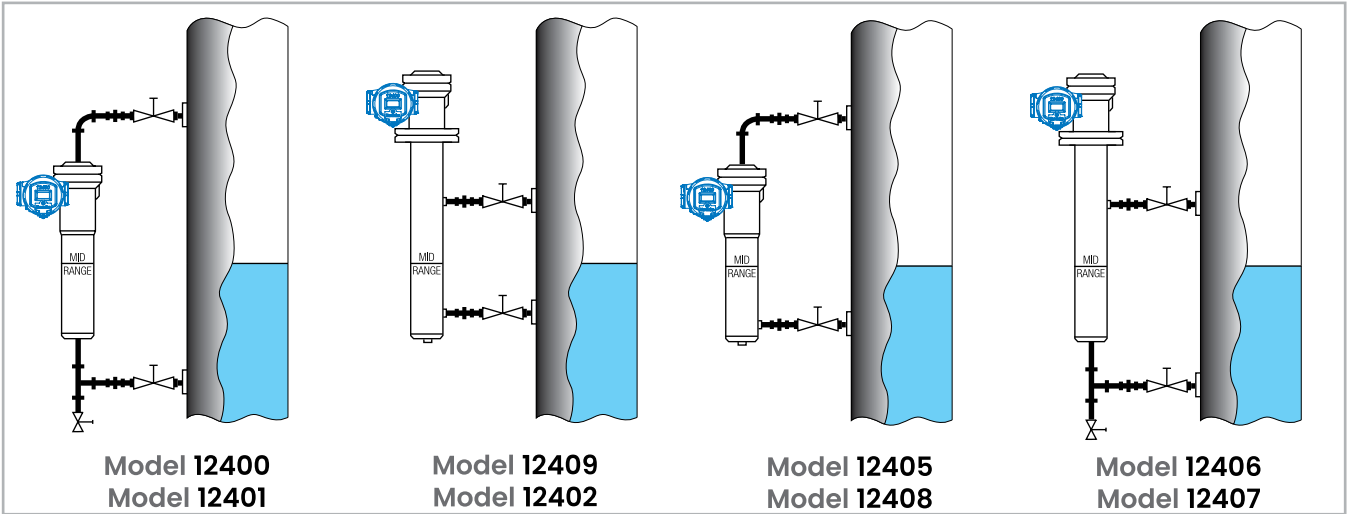
- IP 66 / IP 67
- NEMA 4X - 6P



Mounting



In case of internal mounting, the instrument has no displacer chamber; the mechanism chamber flange is bolted directly on the vessel flange. In case of liquid turbulence, it is recommended that the displacer is isolated with a damping chamber to prevent oscillations.



In case of external mounting, the instrument is connected to the vessel either with flanges or with screwed or welded connections. The instrument is constructed so that the mid-range level reference on the displacer chamber coincides with the normal level in the vessel.

It is recommended that shut-off valves be inserted between the level connections and the vessel, with a drain valve on the lower part of the level.

Model	Connections
12400	BW, SW or Screwed NPT - 1 1/2" and 2" - DN 40 and DN 50
12401	Flanged - 1 1/2" and 2" - DN 40 and DN 50
12409	BW, SW or Screwed NPT - 1 1/2" and 2" - DN 40 and DN 50
12402	Flanged - 1 1/2" and 2" - DN 40 and DN 50
12405	BW, SW or Screwed NPT - 1 1/2" and 2" - DN 40 and DN 50
12408	Flanged - 1 1/2" and 2" - DN 40 and DN 50
12406	BW, SW or Screwed NPT - 1 1/2" and 2" - DN 40 and DN 50
12407	Flanged - 1 1/2" and 2" - DN 40 and DN 50
12403	Flanged - 3" and 4" - DN 80 and DN 100
12404	Flanged - 4" - DN 100

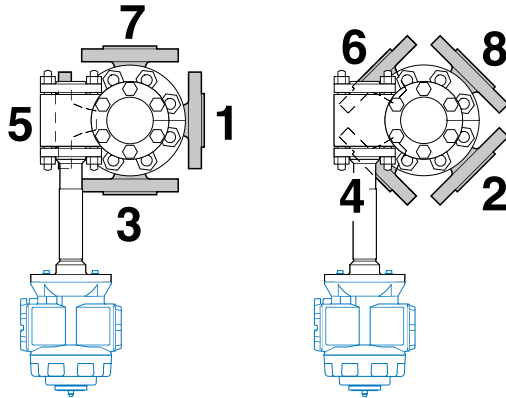
Flanges:

- Class flanges—according to EN 1759-1 and ASME B16-5 standards
- PN flanges—according to NF EN 1092-1 or DIN standards
- Other standards and dimensions, please consult your local Baker Hughes sales contact

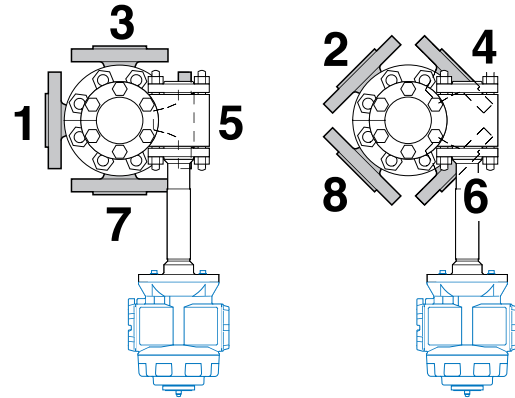
Orientation

Models: 12402, 12405, 12406, 12407, 12408 & 12409

Left hand instrument mounting



Right hand instrument mounting



Note: Unless otherwise specified, the case will be position 1 left-mounted

Weight (lbs)

Models: ANSI 600 and PN 100

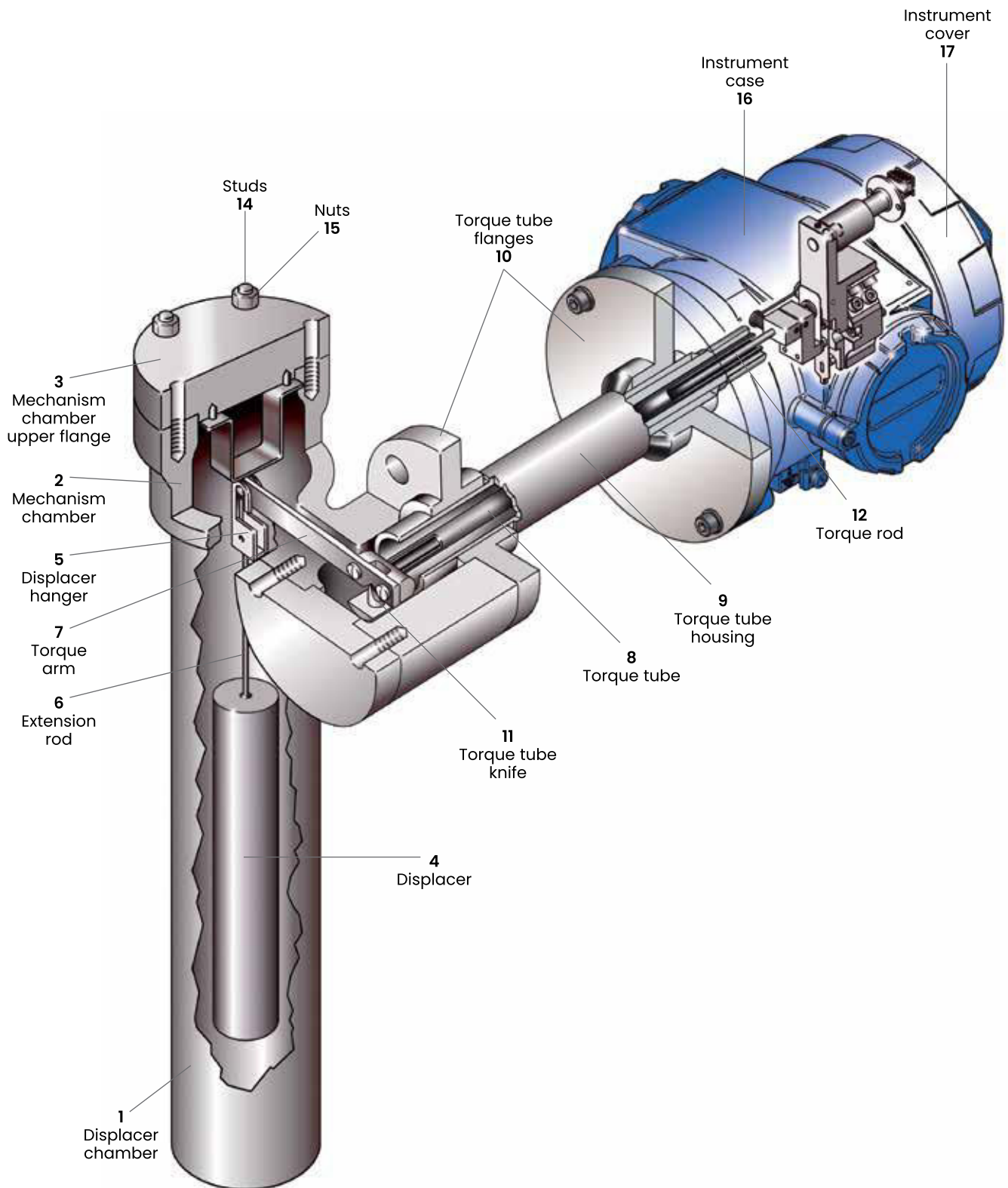
Model	Level ranges								
	356mm 14"	610mm 24"	813mm 32"	1219mm 48"	1524mm 60"	1829mm 72"	2134mm 84"	2438mm 96"	3048mm 120"
12400	79	90	90	101	108	117	123	130	146
12401	90	101	101	112	119	128	135	141	157
12409	112	123	123	135	141	150	157	163	179
12402	121	132	132	143	150	159	165	172	187
12405	110	121	121	132	139	148	154	161	176
12408	119	130	130	141	148	157	163	170	185
12406	110	121	121	132	139	148	154	161	176
12407	121	132	132	143	150	159	165	172	187
12403	88	88	88	88	88	88	88	88	88
12404	88	88	88	88	88	88	88	88	88

Weight (kg)

Models: ANSI 600 and PN 100

Model	Level ranges								
	356mm 14"	610mm 24"	813mm 32"	1219mm 48"	1524mm 60"	1829mm 72"	2134mm 84"	2438mm 96"	3048mm 120"
12400	36	41	41	46	49	53	56	59	66
12401	41	46	46	51	54	58	61	64	71
12409	51	56	56	61	64	68	71	74	81
12402	55	60	60	65	68	72	75	78	85
12405	50	55	55	60	63	67	70	73	80
12408	54	59	59	64	67	71	74	77	84
12406	50	55	55	60	63	67	70	73	80
12407	55	60	60	65	68	72	75	78	85
12403	40	40	40	40	40	40	40	40	40
12404	40	40	40	40	40	40	40	40	40

Materials of Construction



Materials of Construction

Standard Constructions			
Description		Carbon Steel	Stainless Steel
1	Displacer chamber (tube)	ASTM A 106 Gr B (300/600 lbs) / 1.0425 EN 10216-2 (900/1500 lbs)	ASTM A 312 Ty 316 / 1.4401 EN
2	Mechanism chamber	ASTM A 216 Gr WCC / 1.0625 EN 10213-2	ASTM A 351 Gr CF8M / 1.4408 EN 10213
3	Mechanism chamber upper flange	Flanged: ASTM A 216 Gr WCC / 1.0625 EN 10213-2 Others: ASTM A 105 / 1.0481 EN 10273	Flanged: ASTM A 351 Gr CF8M / 1.4408 EN 10213 Others: 1.4401 EN 10272
4	Displacer	ASTM A 312 Ty 316L	ASTM A 312 Ty 316L
5	Displacer hanger	ASTM A 240 Ty 316L	ASTM A 240 Ty 316L
6	Extension rod	ASTM A 479 Ty 316L	ASTM A 479 Ty 316L
7	Torque arm	ASTM A 479 Ty 316L	ASTM A 479 Ty 316L
8	Torque tube	Inconel 600	Inconel 600
9	Torque tube housing	ASTM A 106 Gr B / 1.0425 EN	ASTM A 312 Ty 316 / 1.4404 EN
10	Torque tube flanges (mechanism chamber and instrument sides)	ASTM A 105 / 1.0481 EN 10273	1.4401 EN 10272
11	Torque tube knife	ASTM A 479 Ty 316L	ASTM A 479 Ty 316L
12	Torque rod	Inconel 600	Inconel 600
13	Gaskets (torque tube, flanges)	AISI 316L + Graphite	AISI 316L + Graphite
14	Studs	ASTM A 193 Gr B7 / 1.7225 EN 10269 zinc bichromate plated	ASTM A 193 Gr B8 Cl. 2
15	Nuts	ASTM A 194 Gr 2H zinc bichromate plated	ASTM A 194 Gr 8
16	Instrument case	Anodized cast aluminium, with epoxy painting	Anodized cast aluminium, with epoxy painting
17	Instrument cover	Anodized cast aluminium, with epoxy painting	Anodized cast aluminium, with epoxy painting

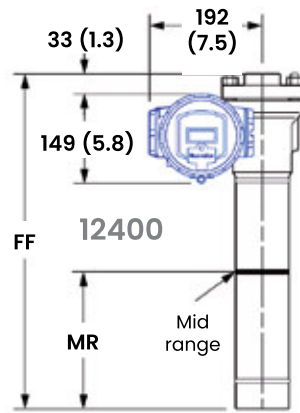
Note: Many other materials are available as option: alloy steels, K-Monel, Hastelloy... Please consult Baker Hughes.

"NACE" Constructions (exposed and non exposed bolting)			
Description		Carbon Steel	Stainless Steel
1	Displacer chamber (tube)	ASTM A 106 Gr B (300/600 lbs) / 1.0425 EN 10216-2 (900/1500 lbs)	ASTM A 312 Ty 316 / 1.4401 EN
2	Mechanism chamber	ASTM A 216 Gr WCC / 1.0625 EN 10213-2	ASTM A 351 Gr CF8M / 1.4408 EN 10213
3	Mechanism chamber upper flange	Flanged: ASTM A 216 Gr WCC / 1.0625 EN 10213-2 Others: ASTM A 105 / 1.0481 EN 10273	Flanged: ASTM A 351 Gr CF8M / 1.4408 EN 10213 Others: 1.4401 EN 10272
4	Displacer	ASTM A 312 Ty 316L	ASTM A 312 Ty 316L
5	Displacer hanger	ASTM A 240 Ty 316L	ASTM A 240 Ty 316L
6	Extension rod	ASTM A 479 Ty 316L	ASTM A 479 Ty 316L
7	Torque arm	ASTM A 479 Ty 316L	ASTM A 479 Ty 316L
8	Torque tube	Inconel 600	Inconel 600
9	Torque tube housing	ASTM A 106 Gr B / 1.0425 EN	ASTM A 312 Ty 316 / 1.4404 EN
10	Torque tube flanges (mechanism chamber and instrument sides)	ASTM A 105 / 1.0481 EN 10273	1.4401 EN 10272
11	Torque tube knife	ASTM A 479 Ty 316L	ASTM A 479 Ty 316L
12	Torque rod	Inconel 600	Inconel 600
13	Gaskets (torque tube, flanges)	AISI 316L + Graphite	AISI 316L + Graphite
14	Studs	Exposed: ASTM A 193 Gr B7M electroless nickel plated Non exposed: ASTM A 193 Gr B7 / 1.7225 EN 10269 zinc bichromate plated	Exposed: ASTM A 193 Gr B8M Cl 2 Non exposed: ASTM A 193 Gr B8 Cl2
15	Nuts	Exposed: ASTM A 194 GR 2HM electroless nickel plated Non exposed: ASTM A 194 GR 2H zinc bichromate plated	Exposed: ASTM A 194 Gr 8 MA Non exposed: ASTM A 194 Gr 8
16	Instrument case	Anodized cast aluminium, with epoxy painting	Anodized cast aluminium, with epoxy painting
17	Instrument cover	Anodized cast aluminium, with epoxy painting	Anodized cast aluminium, with epoxy painting

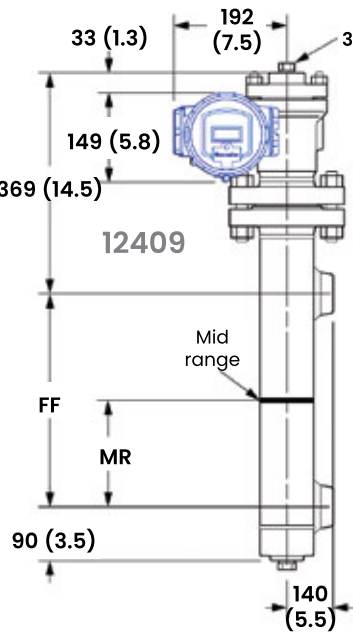
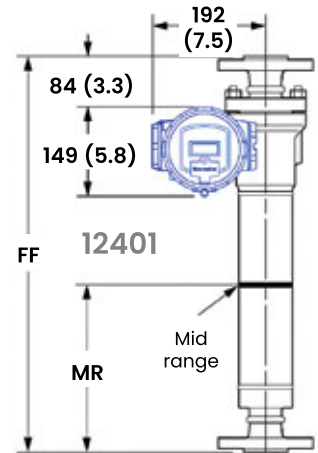
Note: Standard materials and processes are in accordance with the requirements of NACE specification MR0103. Applications requiring compliance to MR0175-2003 or ISO 15156 must be reviewed by Baker Hughes.

Dimensions/mm (inches)

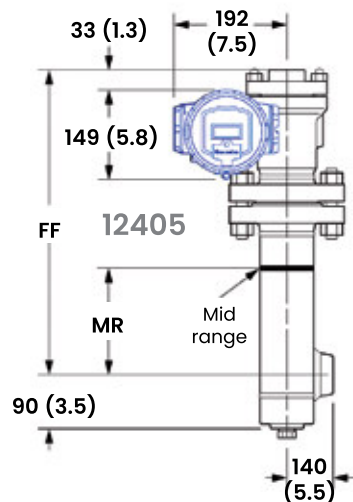
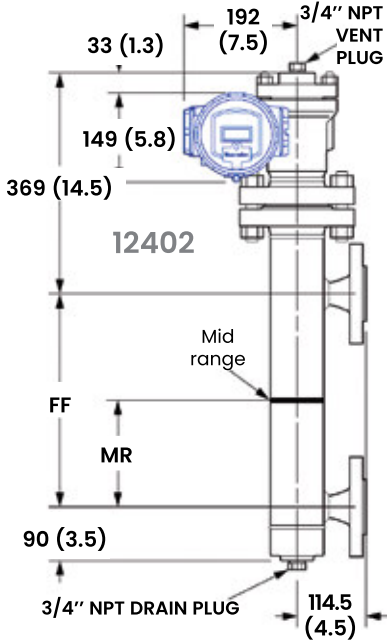
Models: 12400, 12401, 12409, 12402, 12405 & 12408, ANSI 300–600 and PN 50–100



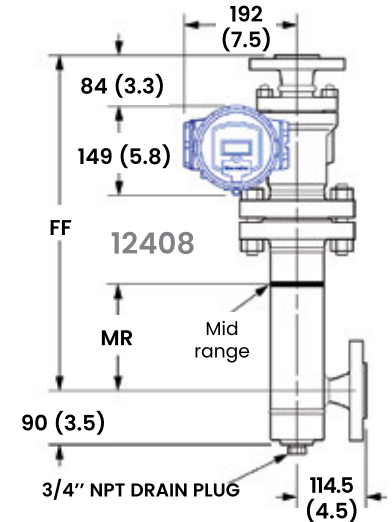
12400				RANGE		12401			
FF		MR				FF		MR	
mm	inch	mm	inch	mm	inch	mm	inch	mm	inch
569	22	239	9	356	14	660	26	279	11
823	32	366	14	610	24	915	36	406	16
1026	40	467	18	813	32	1118	44	508	20
1432	56	670	26	1219	48	1524	60	711	28
1737	68	823	32	1524	60	1829	72	864	34
2042	80	975	38	1829	72	2134	84	1016	40
2347	92	1128	44	2134	84	2438	96	1168	46
2652	104	1280	50	2438	96	2743	108	1321	52
3261	128	1585	62	3048	120	3353	132	1626	64



12409				RANGE		12402			
FF		MR				FF		MR	
mm	inch	mm	inch	mm	inch	mm	inch	mm	inch
356	14	178	7	356	14	356	14	178	7
610	24	305	12	610	24	610	24	305	12
813	32	406	16	813	32	813	32	406	16
1219	48	610	24	1219	48	1219	48	610	24
1524	60	762	30	1524	60	1524	60	762	30
1829	72	914	36	1829	72	1829	72	914	36
2134	84	1067	42	2134	84	2134	84	1067	42
2438	96	1219	48	2438	96	2438	96	1219	48
3048	120	1524	60	3048	120	3048	120	1524	60



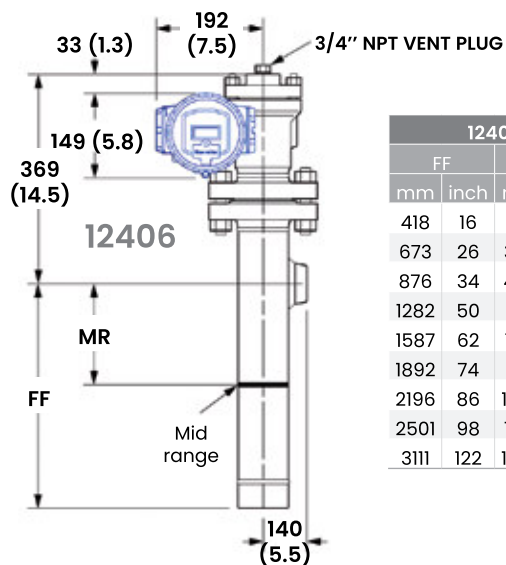
12405				RANGE		12408			
FF		MR				FF		MR	
mm	inch	mm	inch	mm	inch	mm	inch	mm	inch
508	20	178	7	356	14	559	22	178	7
763	30	305	12	610	24	813	32	305	12
966	38	406	16	813	32	1016	40	406	16
1372	54	610	24	1219	48	1422	56	610	24
1677	66	762	30	1524	60	1727	68	762	30
1982	78	914	36	1829	72	2032	80	914	36
2286	90	1067	42	2134	84	2337	92	1067	42
2591	102	1219	48	2438	96	2642	104	1219	48
3201	126	1524	60	3048	120	3251	128	1524	60



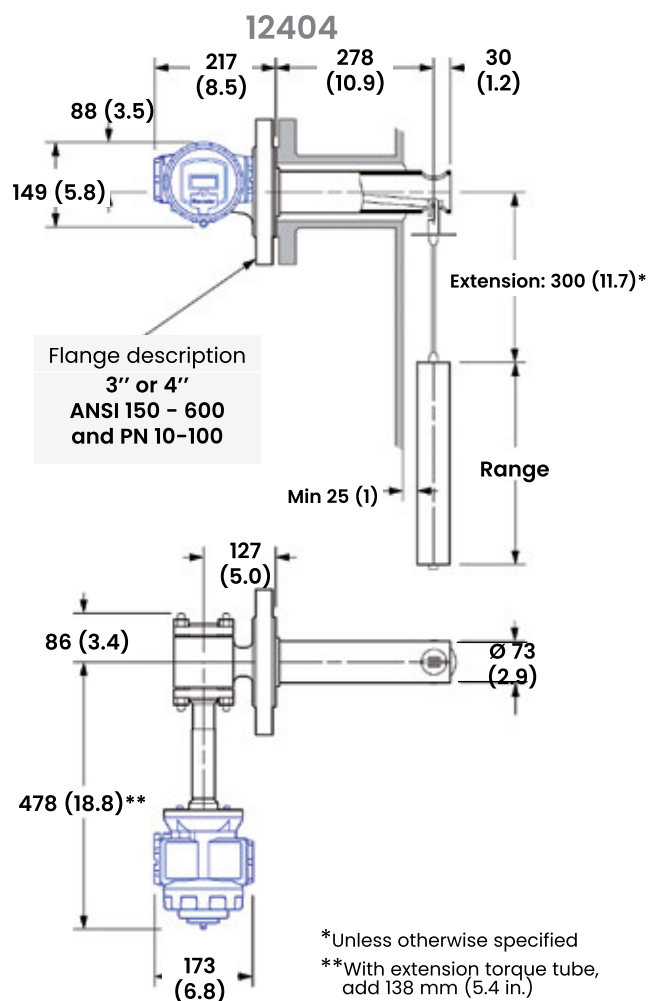
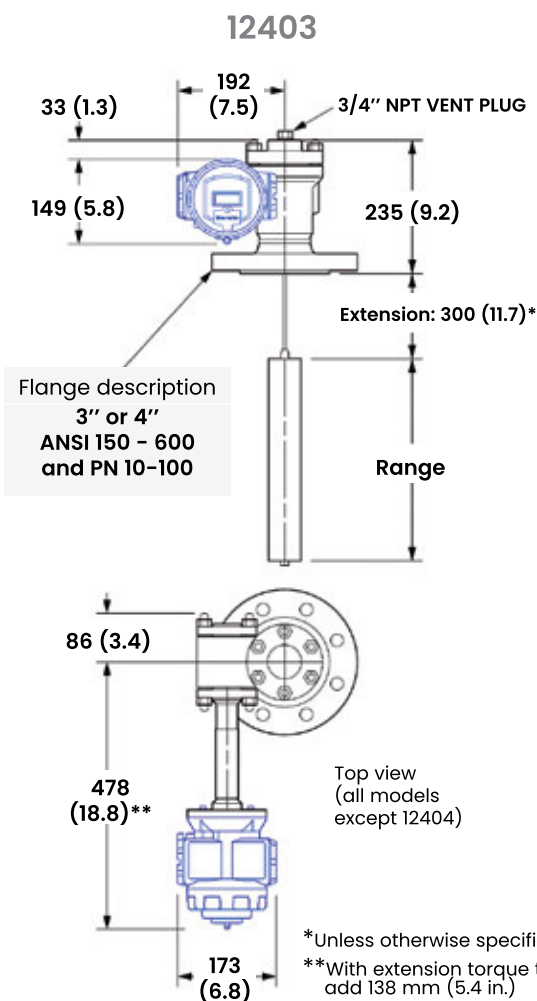
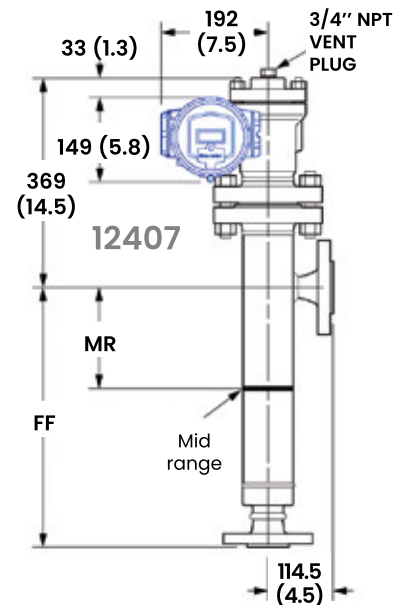
For ratings higher than ANSI 600 and PN 100, please consult your local Baker Hughes sales contact.

Dimensions/mm (inches)

Models: 12406, 12407, 12403 & 12404, ANSI 150-600 and PN 50-100



12406				RANGE		12407			
FF		MR				FF		MR	
mm	inch	mm	inch	mm	inch	mm	inch	mm	inch
418	16	178	7	356	14	457	18	178	7
673	26	305	12	610	24	711	28	305	12
876	34	406	16	813	32	914	36	406	16
1282	50	610	24	1219	48	1321	52	610	24
1587	62	762	30	1524	60	1626	64	762	30
1892	74	914	36	1829	72	1930	76	914	36
2196	86	1067	42	2134	84	2235	88	1067	42
2501	98	1219	48	2438	96	2540	100	1219	48
3111	122	1524	60	3048	120	3150	124	1524	60



For ratings higher than ANSI 600 and PN 100, please consult your local Baker Hughes sales contact.

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