Masoneilan™
12400 Series
Digital Level Transmitter/Controller

- SIL2 Capability
- Ease of Use
- Seamless Integration
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.
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-Effected
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

Control System

Third Party Asset Management

ValVue Suite

Open Technologies

eEDL
DTM
Plug-In Application
Snap-On Application
Conventional I/O
Wireless

Field Calibrators with HART

Baker Hughes DPI620 Series Calibrator
HART® Handheld Communicator
Baker Hughes Masoneilan Valscope–PRO™
Baker Hughes Masoneilan ValVue standalone
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.

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

Each discrete contact is configurable for normal open or closed action and with several possible triggers.

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 though 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: ±0.028% /°C of full span (zero and span, over extended temperature range)

 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 μA/V

<table>
<thead>
<tr>
<th>Performance Specifications</th>
<th>Instrument Head Alone</th>
<th>Instrument Head with Torque Tube S/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accuracy (full span)</td>
<td>±0.1%</td>
<td>±0.5% on request ±0.25%</td>
</tr>
<tr>
<td>Hysteresis + Dead Zone (full span)</td>
<td>±0.1%</td>
<td>±0.3%</td>
</tr>
<tr>
<td>Repeatability (full span)</td>
<td>±0.1%</td>
<td>±0.2%</td>
</tr>
</tbody>
</table>

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 μs pulse wave form
• 1.5 kW for 10/1000 μs 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**

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

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**Hazardous Protection**
- FM & FMc (ex CSA), Intrinsically Safe, Explosion proof, and Nema 4X-6P
- JIS, Explosion proof
- CU TR (ex Gost-R), Intrinsically Safe, Explosion proof, and IP 66/67
- Inmetro, Intrinsically Safe, Explosion proof
- ATEX & IECEx Intrinsically Safe, Explosion proof, and IP 66/67
- Other approvals (based on ATEX/IEC approvals)
- Other approvals (not based on ATEX/IEC approvals)

**Mounting**

- Top and bottom Screwed, BW or SW
- Top and top Flanged
- Side and side Flanged
- Top vessel Flanged
- Side vessel Flanged
- Top and side Screwed, BW or SW
- Side and bottom Screwed, BW or SW
- Top and side Flanged
- Side and bottom Flanged
- Top and side Flanged
- Side and side Flanged

**Housing Material**
- Aluminium with epoxy painting
- Stainless steel

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1. Only Transmitter function is SIL certified.
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.

<table>
<thead>
<tr>
<th>Model</th>
<th>Connections</th>
</tr>
</thead>
<tbody>
<tr>
<td>12400</td>
<td>BW, SW or Screwed NPT - 1 1/2&quot; and 2” - DN 40 and DN 50</td>
</tr>
<tr>
<td>12401</td>
<td>Flanged - 1 1/2&quot; and 2” - DN 40 and DN 50</td>
</tr>
<tr>
<td>12409</td>
<td>BW, SW or Screwed NPT - 1 1/2&quot; and 2” - DN 40 and DN 50</td>
</tr>
<tr>
<td>12402</td>
<td>Flanged - 1 1/2&quot; and 2” - DN 40 and DN 50</td>
</tr>
<tr>
<td>12406</td>
<td>BW, SW or Screwed NPT - 1 1/2&quot; and 2” - DN 40 and DN 50</td>
</tr>
<tr>
<td>12408</td>
<td>Flanged - 1 1/2&quot; and 2” - DN 40 and DN 50</td>
</tr>
<tr>
<td>12406</td>
<td>BW, SW or Screwed NPT - 1 1/2&quot; and 2” - DN 40 and DN 50</td>
</tr>
<tr>
<td>12407</td>
<td>Flanged - 1 1/2&quot; and 2” - DN 40 and DN 50</td>
</tr>
<tr>
<td>12403</td>
<td>Flanged - 3” and 4” - DN 80 and DN 10</td>
</tr>
<tr>
<td>12404</td>
<td>Flanged - 4” - DN 100</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Model</th>
<th>356mm</th>
<th>610mm</th>
<th>813mm</th>
<th>1219mm</th>
<th>1524mm</th>
<th>1829mm</th>
<th>2134mm</th>
<th>2438mm</th>
<th>3048mm</th>
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</table>
Materials of Construction
## Materials of Construction

<table>
<thead>
<tr>
<th>Description</th>
<th>Carbon Steel</th>
<th>Stainless Steel</th>
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<tbody>
<tr>
<td><strong>Standard Constructions</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Displacer chamber (tube)</td>
<td>ASTM A 106 Gr B (300/600 lbs) / 10425 EN 10216-2 (900/1500 lbs)</td>
<td>ASTM A 312 Ty 316 / 1.4401 EN</td>
</tr>
<tr>
<td>2 Mechanism chamber</td>
<td>ASTM A 216 Gr WCC / 10625 EN 10213-2</td>
<td>ASTM A 351 Gr CF8M / 1.4408 EN 10213</td>
</tr>
<tr>
<td>4 Displacer</td>
<td>ASTM A 312 Ty 316L</td>
<td>ASTM A 312 Ty 316L</td>
</tr>
<tr>
<td>5 Displacer hanger</td>
<td>ASTM A 240 Ty 316L</td>
<td>ASTM A 240 Ty 316L</td>
</tr>
<tr>
<td>6 Extension rod</td>
<td>ASTM A 479 Ty 316L</td>
<td>ASTM A 479 Ty 316L</td>
</tr>
<tr>
<td>7 Torque arm</td>
<td>ASTM A 479 Ty 316L</td>
<td>ASTM A 479 Ty 316L</td>
</tr>
<tr>
<td>8 Torque tube</td>
<td>Inconel 600</td>
<td>Inconel 600</td>
</tr>
<tr>
<td>9 Torque tube housing</td>
<td>ASTM A 106 Gr B / 10425 EN</td>
<td>ASTM A 312 Ty 316 / 1.4404 EN</td>
</tr>
<tr>
<td>10 Torque tube flanges (mechanism</td>
<td>ASTM A 105 / 10481 EN 10273</td>
<td>1.4401 EN 10272</td>
</tr>
<tr>
<td>chamber and instrument sides)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11 Torque tube knife</td>
<td>ASTM A 479 Ty 316L</td>
<td>ASTM A 479 Ty 316L</td>
</tr>
<tr>
<td>12 Torque rod</td>
<td>Inconel 600</td>
<td>Inconel 600</td>
</tr>
<tr>
<td>13 Gaskets (torque tube, flanges)</td>
<td>AISI 316L + Graphite</td>
<td>AISI 316L + Graphite</td>
</tr>
<tr>
<td>14 Studs</td>
<td>ASTM A 193 Gr B7 / 1.7225 EN 10269 zinc bichromate plated</td>
<td>ASTM A 193 Gr B8 Cl 2</td>
</tr>
<tr>
<td>15 Nuts</td>
<td>ASTM A 194 Gr 2H zinc bichromate plated</td>
<td>ASTM A 194 Gr 8</td>
</tr>
<tr>
<td>16 Instrument case</td>
<td>Anodized cast aluminium, with epoxy painting</td>
<td>Anodized cast aluminium, with epoxy painting</td>
</tr>
<tr>
<td>17 Instrument cover</td>
<td>Anodized cast aluminium, with epoxy painting</td>
<td>Anodized cast aluminium, with epoxy painting</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Description</th>
<th>Carbon Steel</th>
<th>Stainless Steel</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>“NACE” Constructions (exposed and non exposed bolting)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Displacer chamber (tube)</td>
<td>ASTM A 106 Gr B (300/600 lbs) / 10425 EN 10216-2 (900/1500 lbs)</td>
<td>ASTM A 312 Ty 316 / 1.4401 EN</td>
</tr>
<tr>
<td>2 Mechanism chamber</td>
<td>ASTM A 216 Gr WCC / 10625 EN 10213-2</td>
<td>ASTM A 351 Gr CF8M / 1.4408 EN 10213</td>
</tr>
<tr>
<td>4 Displacer</td>
<td>ASTM A 312 Ty 316L</td>
<td>ASTM A 312 Ty 316L</td>
</tr>
<tr>
<td>5 Displacer hanger</td>
<td>ASTM A 240 Ty 316L</td>
<td>ASTM A 240 Ty 316L</td>
</tr>
<tr>
<td>6 Extension rod</td>
<td>ASTM A 479 Ty 316L</td>
<td>ASTM A 479 Ty 316L</td>
</tr>
<tr>
<td>7 Torque arm</td>
<td>ASTM A 479 Ty 316L</td>
<td>ASTM A 479 Ty 316L</td>
</tr>
<tr>
<td>8 Torque tube</td>
<td>Inconel 600</td>
<td>Inconel 600</td>
</tr>
<tr>
<td>9 Torque tube housing</td>
<td>ASTM A 106 Gr B / 10425 EN</td>
<td>ASTM A 312 Ty 316 / 1.4404 EN</td>
</tr>
<tr>
<td>10 Torque tube flanges (mechanism</td>
<td>ASTM A 105 / 10481 EN 10273</td>
<td>1.4401 EN 10272</td>
</tr>
<tr>
<td>chamber and instrument sides)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11 Torque tube knife</td>
<td>ASTM A 479 Ty 316L</td>
<td>ASTM A 479 Ty 316L</td>
</tr>
<tr>
<td>12 Torque rod</td>
<td>Inconel 600</td>
<td>Inconel 600</td>
</tr>
<tr>
<td>13 Gaskets (torque tube, flanges)</td>
<td>AISI 316L + Graphite</td>
<td>AISI 316L + Graphite</td>
</tr>
<tr>
<td>16 Instrument case</td>
<td>Anodized cast aluminium, with epoxy painting</td>
<td>Anodized cast aluminium, with epoxy painting</td>
</tr>
<tr>
<td>17 Instrument cover</td>
<td>Anodized cast aluminium, with epoxy painting</td>
<td>Anodized cast aluminium, with epoxy painting</td>
</tr>
</tbody>
</table>

*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

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

<table>
<thead>
<tr>
<th>Dimensions/mm (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4” NPT VENT PLUG</td>
</tr>
<tr>
<td>12406</td>
</tr>
<tr>
<td>12407</td>
</tr>
<tr>
<td>12403</td>
</tr>
<tr>
<td>12404</td>
</tr>
</tbody>
</table>

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