INDUSTRY APPLICATIONS SERIES

NATURAL GAS PROCESSING

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Level & Flow Applications for

NATURAL GAS PROCESSING

Level and flow controls in these applications are crucial for both process control and safety shutdown systems.

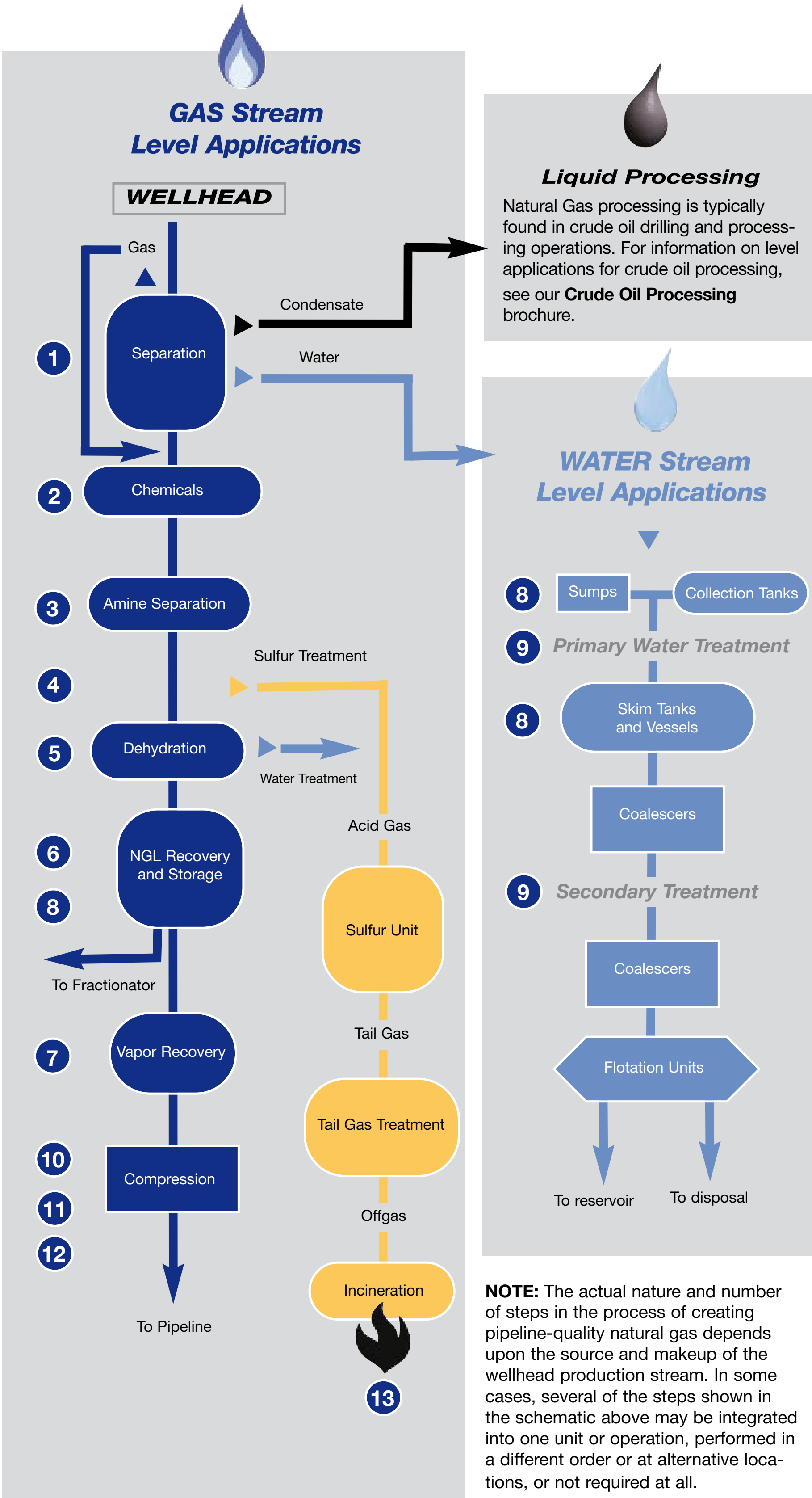
Level Applications:

Flow Applications:

Air and gas flow applications are found throughout natural gas operations. For a brief summary of these applications, see page 10.

Good Practices:

Good practice recommendations for major level and flow instrumentation can be found on page 11.



Liquid Processing

Natural Gas processing is typically found in crude oil drilling and processing operations. For information on level applications for crude oil processing, see our **Crude Oil Processing** brochure.

NOTE: The actual nature and number of steps in the process of creating pipeline-quality natural gas depends upon the source and makeup of the wellhead production stream. In some cases, several of the steps shown in the schematic above may be integrated into one unit or operation, performed in a different order or at alternative locations, or not required at all.

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INTERFACE MEASUREMENT APPLICATION

❶ INLET SEPARATORS

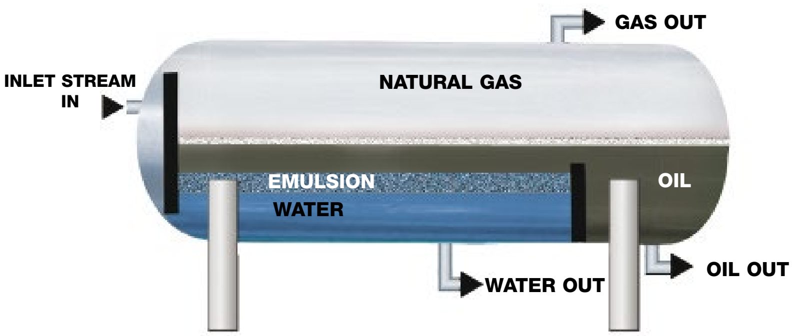
Application: Separators are large drums designed to separate wellstreams into their individual components. They are commonly designed to separate two-phase (gas/liquid) or three-phase (gas/crude/water) wellstreams. Separators are also classified according to horizontal or vertical configuration (see below), operating pressure, turbulent or laminar flow, and test or production separation.

Challenges: Interface level measurement will actuate a valve to adjust vessel level. An emulsion layer along the oil/water interface can contaminate the oil with water or the water with oil. Foaming along the gas/liquid interface, if entrained, can cause liquid carryover or gas blowby.

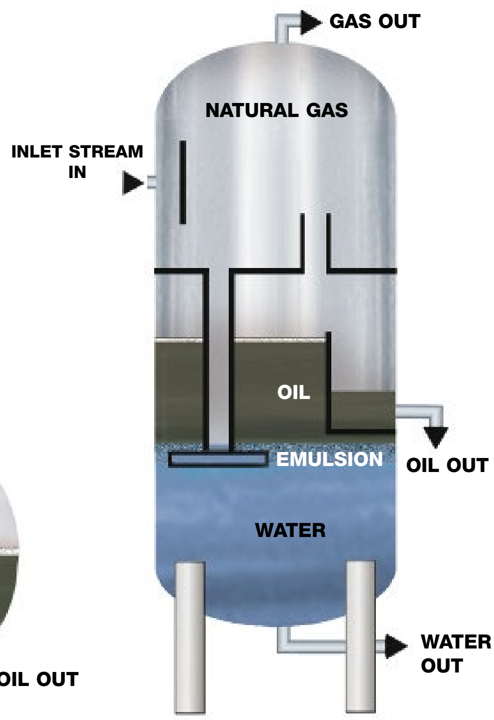
TWO PRINCIPAL TYPES OF SEPARATORS

Vertical (right): Vertical separators can accommodate large surges of liq-uids. They are well suited for high sediment loads—conical bottoms are sometimes attached for large sediment deposits. Vertical separators are preferred when wellstreams have large liquid-to-gas ratios. These sepa-rators occupy less floor space than horizontal types and are often found on offshore platforms where floor space is at a premium.

Horizontal (below): These separators are well-suited for three-phase separation because of their large interfacial area between the two liquid phases. Horizontal types are preferred when wellstreams have high gas-to-oil ratios, when wellstream flow is more or less constant, and when liquid surges are insignificant. These separators also have a much greater gas/liquid interface area, which aids in the release of solution gas and in the reduction of foaming.



HORIZONTAL



VERTICAL

INSTRUMENTATION


Point Level:
Series 3 Float-Actuated External Cage Switch or Thermatel® Model TD1/TD2 Thermal Dispersion Switch

Continuous Level and Interface Level:
Eclipse® Model 706 Guided Wave Radar Transmitter; Jupiter® Magnetostrictive Transmitter or E3 Modulevel® Displacer Transmitter

Visual Indication:
Atlas™ or Aurora® Magnetic Level Indicators

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2 CHEMICAL INJECTION


Chemical Injection Skid

Application: Chemical agents employed in natural gas processing include drilling fluid additives, methanol injection for freeze protection, glycol injection for hydrate inhibition, produced water treatment chemicals, foam and corrosion inhibitors, de-emulsifiers, desalting chemicals and drag reduction agents. Chemicals are frequently administered by way of chemical injection skids.

Challenges: Level monitoring controls chemical inventory and determines when the tanks require filling. The careful selection and application of level controls to chemical injection systems can effectively protect against tanks running out of chemicals or overfilling.

INSTRUMENTATION

Point Level: Echotel® Model 961 Ultrasonic Switch or THERMATEL Model TD1/TD2 Thermal Dispersion Switch

Continuous Level: ECLIPSE Model 706 Guided Wave Radar Transmitte or JUPITER Magnetostrictive Transmitter

Visual Indication: ATLAS or AURORA Magnetic Level Indicators

3 AMINE SEPARATION SOUR GAS TREATMENT


Amine Separation

Application: Pipeline specifications require removal of the harmful acid gases carbon dioxide (**CO_2**) and hydrogen sulfide (**H_2S**). H_2S is highly toxic and corrosive to carbon steels. CO_2 is also corrosive and reduces the BTU value of natural gas. Gas sweetening processes remove these acid gases and make natural gas marketable and suitable for pipeline distribution.

Challenges: Amine treatment removes acid gases through absorption and chemical reaction. Each of the four common amines (MEA, DEA, DGA and MDEA) offer distinct advantages in specific applications. Level control applications include reactors, separators, absorbers, scrubbers and flash tanks.

INSTRUMENTATION

Point Level: ECHOTEL Model 961 Ultrasonic Switch or THERMATEL Model TD1/TD2 Thermal Dispersion Switch

Continuous Level: ECLIPSE Model 706 Guided Wave Radar Transmitter

Visual Indication: ATLAS or AURORA Magnetic Level Indicators

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❹ SULFUR RECOVERY


Sulfur Recovery Unit

Application: A sulfur recovery unit converts the hydrogen sulfide in the acid gas into elemental sulfur. Of the processes available for these conversions, the Claus process is by far the most well-known for recovering elemental sulfur, whereas the conventional Contact Process and the WSA Process are the most used technologies for recovering sulfuric acid. The residual gas from the Claus process is commonly called tail gas. Tail gas is subsequently processed in a gas treating unit.

Challenges: The sulfur condenser vessel is equipped with a disengagement section on the outlet end in order to allow for efficient separation of the liquid sulfur from the process gas. A collection vessel equipped with continuous level control is used to store and remove the sulfur product from the process.

INSTRUMENTATION

Point Level:
ECHOTEL Model 961 Ultrasonic Switch or THERMATEL Model TD1/TD2 Thermal Dispersion Switch

Continuous Level:
ECLIPSE Model 706 Guided Wave Radar Transmitter

Visual Indication:
ATLAS or AURORA Magnetic Level Indicators

❺ GAS DEHYDRATION


Gas Dehydration Skid

Application: Natural gas dehydration removes hydrates which can grow as crystals and plug lines and retard the flow of gaseous hydrocarbon streams. Dehydration also reduces corrosion, eliminates foaming, and prevents problems with catalysts downstream. Compressor stations typically contain some type of liquid separator to dehydrate natural gas prior to compression.

Challenges: The most common dehydration method is the absorption of water vapor in the liquid desiccant glycol. The withdrawal of the water rich glycol from the bottom of the absorber is facilitated by a level control. High and low level shut down can be applied to the reboiler, surge tank and flash separator.

INSTRUMENTATION

Point Level:
Tuffy® II Float-Actuated Switch; ECHOTEL Model 961 Ultrasonic Switch or THERMATEL Model TD1/TD2 Thermal Dispersion Switch

Continuous Level:
ECLIPSE Model 706 Guided Wave Radar Transmitter or JUPITER Magnetostrictive Transmitter

Visual Indication:
ATLAS or AURORA Magnetic Level Indicators

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❻ NGL RECOVERY & STORAGE

Application: Separating the hydrocarbons and fluids from pure natural gas produces pipeline quality dry natural gas. The two principle techniques for removing Natural Gas Liquids (**NGLs**) are the absorption and the cryogenic expander method. The absorption method is very similar to that of dehydration except that an absorbing oil is used instead of glycol. Once NGLs have been removed from the natural gas stream, they must be separated out, or fractionated.

Challenges: Absorption method level control is typically found on flash drums, separation towers and reflux systems. Cryogenic method level control is applied to the separator and dehydrator.

INSTRUMENTATION

Point Level:
ECHOTEL Model 961 Ultrasonic Switch or THERMATEL Model TD1/TD2 Thermal Dispersion Switch

Continuous Level:
ECLIPSE Model 706 Guided Wave Radar Transmitter or E3 MODULEVEL Displacer Transmitter

Visual Indication:
ATLAS or AURORA Magnetic Level Indicators

❼ VAPOR RECOVERY UNIT FLASH DRUM

Application: A Vapor Recovery Unit (VRU) captures valuable volatile organic compounds and other rich gas streams that may otherwise be a significant environmental pollutant. A Vapor Recovery Unit (VRU) collects from storage and loading facilities, reliquefies the vapors, and returns the liquid hydrocarbons back to storage. Methods to recover vapors include absorption, condensation, adsorption and simple cooling.

Challenges: A VRU is a simple, economical process unit that provides EPA compliance and improves operating economies by capturing up to 95% of fugitive emissions. Critical to the VRU is the flash drum where vapors are reliquefied. Liquid level control of the flash drum is essential.

INSTRUMENTATION

Point Level:
Series 3 External Cage Switch; TUFFY II Float-Actuated Switch; ECHOTEL Model 961 Ultrasonic Switch or THERMATEL Model TD1/TD2 Thermal Dispersion Switch

Continuous Level:
ECLIPSE Model 706 Guided Wave Radar Transmitter or E3 MODULEVEL Displacer Transmitter

Visual Indication:
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INTERFACE MEASUREMENT APPLICATION

8 STORAGE TANKS

Storage Tanks

Application: Natural gas, oil, liquid fuel, treatment chemicals, extracted condensate from separators and water are stored in gas fields. Unlike midstream tank farms at terminals and refineries, field storage consists of smaller vessels. Diesel generator fuel, potable water, and fire water are also stored in tanks.

Challenges: Tank level monitoring can be provided with overflow control and alarm systems or shutdown pumps when level falls below the specified low level. Interface controls will sense the beginning of an oil/water interface during tank dewatering and control the water draw-off.

INSTRUMENTATION

Point Level:
Model A15 Series Displacer Switch with optional Proofer® or ECHOTEL Model 961 Ultrasonic Switch

Continuous Level:
ECLIPSE Model 706 Guided Wave Radar Transmitter; Pulsar® Model R86 Radar Transmitter or JUPITER Magnetostrictive Transmitter

Visual Indication:
ATLAS or AURORA Magnetic Level Indicators

INTERFACE MEASUREMENT APPLICATION

9 WATER PROCESSING

Water Wash Tank

Application: Produced water, wash-down water or collected rainwater require treatment whether they're re-used for reservoir flooding or simply disposed of. Water collected from process operations contains hydrocarbon concentrations too high for safe discharge. Suspended hydrocarbon droplets in water also hinders well-injection.

Challenges: Treatment equipment is similar to three-phase separators except that water is the main product. Level control is found on skim tanks, precipitators, coalescers, flotation units, and collection tanks and sumps. Interface level measurement is essential for proper draining of clean water and removal of the residual oil.

INSTRUMENTATION

Point Level:
ECHOTEL Model 940/941 Ultrasonic Switch; THERMATEL Model TD1/TD2 Thermal Dispersion Switch or Float- or Displacer-Actuated Switch

Continuous Level:
ECLIPSE Model 706 Guided Wave Radar Transmitter or E3 MODULEVEL Displacer Transmitter

Visual Indication:
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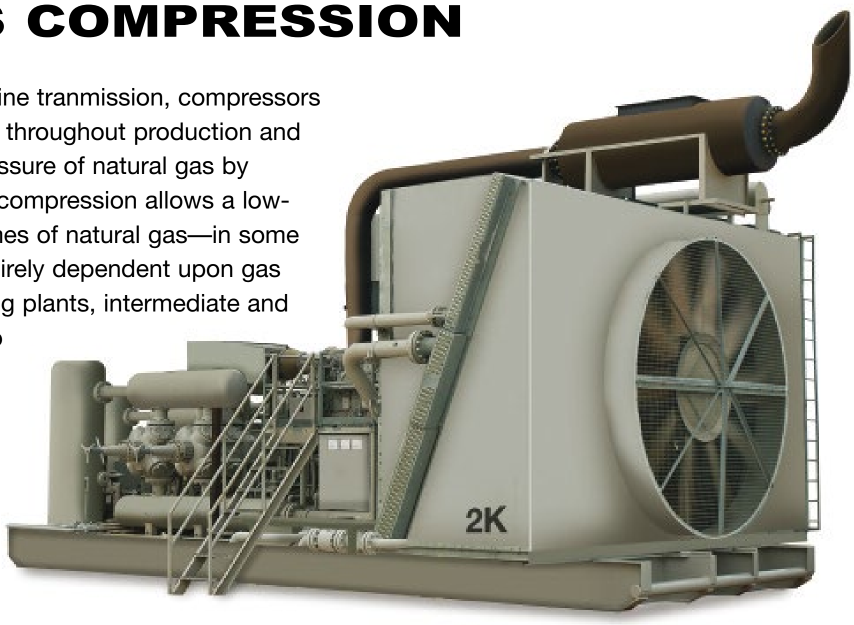
NATURAL GAS COMPRESSION

From natural gas extraction to pipeline tranmission, compressors are an essential technology employed throughout production and distribution chains to increase the pressure of natural gas by reducing its volume. At the wellhead, compression allows a low-pressure well to produce higher volumes of natural gas—in some instances, well production may be entirely dependent upon gas compression. In natural gas processing plants, intermediate and end product gases are compressed to facilitate gathering and processing operations. In pipeline transport of purified natural gas, compression stations ensure the movement of gas from the production site to the consumer. Compressors may also be used in association with above ground or underground natural gas storage facilities. Three typical level and flow applications related to gas compression follow below.



Above, a gas compression skid designed for field use. The configuration of a compressor is determined by its compression capacity, by whether it is a turbine or reciprocating type, by its power source, and by the environmental or sound attenuation requirements that may be required.

⑩ COMPRESSOR LUBRICATION TANK

Compressor Unit

Application: Lubrication systems protect compressor components from increased amounts of wear and deposit formation and help the equipment run cooler and more efficiently. A wide range of engine lubricants formulated with different base oils are available. Lubricants vary by ISO grade, viscosity, flash point, and formulation. Lubricating fluids are typically stored in integral stainless steel and carbon steel tanks and in remote bulk storage tanks that are monitored for level.

Challenges: Level monitoring of lubricant reservoirs will ensure the proper functioning of compressors. Temperature shifts in integral reservoirs affect media density that will exclude some level technologies, such as pressure transmitters. Because ISO cleanliness levels increase lube change frequency, controls should be easy to remove.

INSTRUMENTATION

▲ **Point Level:**
ECHOTEL Model 961 Ultrasonic Switch; THERMATEL Model TD1/TD2 Thermal Dispersion Switch; or TUFFY II Float-Actuated Switch

▲ **Continuous Level:**
ECLIPSE Model 706 Guided Wave Radar Transmitter or JUPITER Magnetostrictive Transmitter

▲ **Visual Indication:**
ATLAS or AURORA Magnetic Level Indicators

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11 COMPRESSOR SCRUBBER

Application: Natural gas can travel through thousands of miles of pipeline. Compressors placed at key intervals keep the natural gas moving evenly and reliably. A typical compressor station consists of an inlet scrubber to collect liquids and slugs that may have formed in the gas pipeline. The scrubber consists of a primary section where liquids and solid parts are separated from the gas stream and a secondary section where oil mist is removed.

Challenges: The liquids collected from the suction scrubber are typically routed by way of scrubber level control valves to a low pressure (LP) tank. The vapors produced from the flashing liquids are vented to the atmosphere or to a flare. The low pressure condensate is periodically trucked out. Scrubbers are often equipped with high and low level alarms.

INSTRUMENTATION

▲ **Point Level:**
ECHOTEL Model 961
Ultrasonic Switch

▲ **Continuous Level:**
ECLIPSE Model 706
Guided Wave Radar
Transmitter

▲ **Visual Indication:**
ATLAS or AURORA
Magnetic Level
Indicators

INTERFACE MEASUREMENT APPLICATION

12 COMPRESSOR WASTE LIQUID

Application: Compression station scrubbers and filters that capture liquid waste and unwanted particles route waste liquids to a storage tank. Wastes can be water condensates or heavier hydrocarbons from the natural gas. The wastes are collected in one or several tanks depending on the size of the remote station. As a waste tank fills, tank trucks are typically scheduled for tank emptying operations. As these wastes are hazardous materials, the waste holding tanks are classified as Class 1, Div. 1 areas.

Challenges: Measurements for both total level and interface levels between the condensed hydrocarbons and condensed water are typically made. Tank level monitoring can be provided with overflow control and alarm systems or shutdown pumps when level falls below the specified low level.

INSTRUMENTATION

▲ **Point Level:**
ECHOTEL Model 961
Ultrasonic Switch or
THERMATEL
Model TD1/TD2
Thermal Dispersion
Switch

▲ **Continuous Level:**
ECLIPSE Model 706
Guided Wave Radar
Transmitter or JUPITER
Magnetostrictive
Transmitter

▲ **Visual Indication:**
ATLAS or AURORA
Magnetic Level
Indicators

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13 FLARE KNOCK-OUT DRUM

INTERFACE MEASUREMENT APPLICATION


Knockout Drum

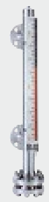
Application: Liquid in the vent stream can extinguish the flame or cause irregular combustion and smoking. In addition, flaring liquids can generate a spray of burning chemicals—a “rain of fire”—that create a severe safety hazard. A knockout drum collects these liquids prior to entering the flare system. A level gauge and drain connections are built into the knockout drum.

Challenges: When a large liquid storage vessel is required and the vapor flow is high, a horizontal drum is usually more economical. Vertical separators are used when there is small liquid load, limited plot space, or where ease of level control is desired. Knockout drums are equipped with instrumentation to monitor liquid level with pump out or drain facilities. High and low level alarms are frequently installed in knockout drums.

INSTRUMENTATION

Point Level: ECHOTEL Model 961 Ultrasonic Switch or External Cage Float Switch

Continuous Level: ECLIPSE Model 706 Guided Wave Radar Transmitter or E3 MODULEVEL Displacer Transmitter



Visual Indication: ATLAS or AURORA Magnetic Level Indicators

14 AIR and GAS FLOW MONITORING

Application: From the wellhead to the compression station, monitoring the flow of natural gas is essential. Other flow monitoring applications found in natural gas settings may include mass air and compressed air flow, process and waste gas flow (often required for reporting environmental emissions), and pump protection afforded by the sensing of reduced or no-flow conditions.

Challenges: Significant flow variables include pipe diameters, wide flow ranges, varying velocities, and low flow sensitivity. Flow meters ensure efficient operation at rated SCUM output and also detect leaks. A flow meter with a totalizer provides an accurate measurement of air or gas consumption. A flow switch along a pump’s discharge piping will actuate an alarm and shut down the pump when liquid flow drops below the minimum flow rate.

INSTRUMENTATION

Flow Alarm: THERMATEL Model TD1/TD2 Thermal Dispersion Flow Switch

Pump Protection: THERMATEL Model TD1/TD2 Thermal Dispersion Flow Switch

Continuous Flow: THERMATEL Model TA2 Thermal Dispersion Mass Flow Meter

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Guided Wave Radar Probe Buildup

Of relevance to:

- Gas Production
- Gas Processing Facilities
- Platforms
- Crude Production

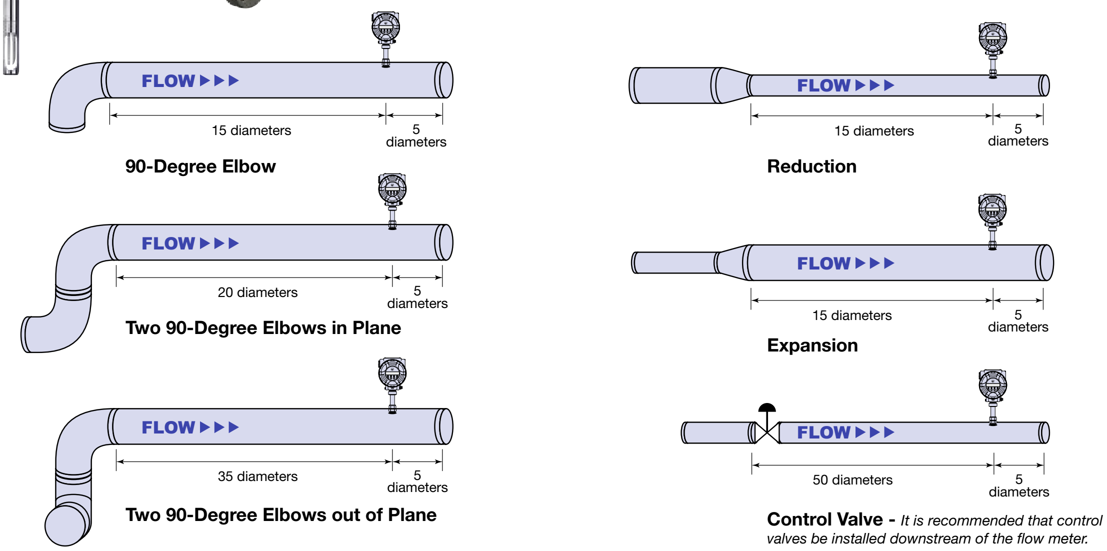
7XD	7XG	7XT
HTHP Coaxial	Caged Single Rod	Interface Coaxial

Natural gas, condensate and crude processing applications have some special requirements that are not evident from Instrument Data Sheets. Experience has lead to some simple but effective recommendations to address these field issues not contained in Data Sheets. Natural gas, condensate and crude processing applications can experience paraffin, asphaltenes, grit and grime buildup. The degree of buildup varies widely. Even in applications where it isn't prevalent, over time it can happen during cold weather periods or when bringing units up or down due to temperature, pressure and process material fluctuations. Like distillation columns, chambers/cages/bridles may require cleaning from time to time. Even direct insertion GWR probes can at times experience buildup. Below are some good practices that can minimize build up and reduce maintenance time.

- Use Enlarged Coax GWR Probes with more clearance for buildup to occur.
- Consider using the Model 7xG Chamber Probe whenever possible. The 7xG provides the sensitivity and performance of a coaxial probe with the viscosity immunity of a single rod.
- Insulate the probe necks of Overfill Probes to reduce any cooling at the top of the probe inside the vessel, chamber, cage or bridle.
- Chambers should be insulated even in warm weather locations. The temperature differential between a warm/hot vessel (like a separator) and uninsulated chamber/cages can be significant resulting in paraffin deposition and/or viscosity increases.
- Insulate chamber flanges to reduce any cooling at the top of the probe
- Use probes with integral flushing connection to simplify flushing/dissolving puffins or grit. Flushing connections are an option available on all Magnetrol® coaxial GWR probes.
- Use probes that have low end dielectric specifications (a 1.4 rating) in the application, especially for condensates.

Flow Meter Straight Pipe Installation, Upstream and Downstream

The figure below indicates the minimum recommended straight-run distances required to obtain the desired fully developed flow profile for a THERMATEL Model TA2 Mass Flow Meter. If these straight-run distances are not available, the over- all accuracy of the flow measurement will be affected; however, the repeatability of the measurement will be maintained. Calibration requires the TA2 sensor to be positioned in a test section; the test section should have a sufficient upstream and downstream straight run to ensure the formation of a fully developed flow profile. Calibration should be performed using the same gas which the unit is calibrated for.



Probe Installations

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