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Guidance on Practice for Field Instruments - Miscellaneous

GP 30-20

BP GROUP
ENGINEERING TECHNICAL PRACTICES

Foreword

This is the first issue of Engineering Technical Practice (ETP) BP GP 30-20. This Guidance on Practice (GP) is based on the heritage document from a merged BP company as follows:

BP

RP 30-2

Instrumentation and Control, Selection and Use of Measurement Instruments (September 1993).

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1. Scope

- a. This GP provides guidance for the specification, selection, and installation of miscellaneous field instruments.
- b. Miscellaneous field instruments are defined as instruments used for measurement other than the major four applications:
 1. Flow.
 2. Temperature.
 3. Pressure.
 4. Level.
- c. Miscellaneous field instruments include single-point analytical devices for measurement such as density, pH, conductivity, and percent oxygen. These devices are locally mounted and do not require analyser shelters or specially trained personnel for maintenance servicing.
- d. Miscellaneous field instruments also include systems for physical measurement such as weighing systems, and position and location devices.
- e. This document does not include guidance on instruments for flame detection, fire and gas detection, or gas chromatography. For these devices, refer to the following documents:
 1. Flame detection: GP 22-xx, burner control section.
 2. Fire and gas detection: GP 30-85.
 3. Gas chromatography: GP 31-xx. (CONFIRM)

2. Normative references

The following normative documents contain requirements that, through reference in this text, constitute requirements of this technical practice. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this technical practice are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies.

[EDS Note: The titles or document numbers of the BP documents below may change. When the document list is finalized, the entries below should be checked for consistency.]

BP

GP 12-60	Guidance on Practice for Hazardous Area Electrical Installations.
GP 30-05	Guidance on Practice for Pressure Instruments.
GP 30-10	Guidance on Practice for Flow Instruments.
GP 30-15	Guidance on Practice for Level Instruments.
GP 30-25	Guidance on Practice for Field Instruments – General.
GP 30-30	Guidance on Practice for Field Communication Buses.
GP 30-80	Guidance on Practice for Safety Instrumented Systems – Implementation.
GP 30-90	Guidance on Practice for Commissioning of Instrumentation and Control Systems.

American Petroleum Institute (API)

API RP 554	Process Instrumentation and Control.
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API Std 670 Machinery Protection Systems.

International Electrotechnical Commission (IEC)

IEC 60529 Degrees of protection provided by enclosures (IP code).

National Electrical Manufacturers Association (NEMA)

NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum).

Organisation Internationale De Métrologie Légale (OIML)

OIML R 76-1 Non Automatic Weighing Instruments, Part 1 & 2.

3. Abbreviations

For the purpose of this GP, the following abbreviations apply:

R/I	Resistance input to DC current
D/P	Differential Pressure.
DPDT	Double pole double throw.
V/I	DC voltage to DC current (also E/I).
I/I	DC current to DC current.
I/P	Current to pressure.
I/V	DC current to DC voltage (also I/E).
ISFET	Ion-sensitive field effect transistor.
mV/I	DC Millivolt to DC current.
LVDT	Linear variable differential transformer.
NDIR	Nondispersive infrared.
ORP	Oxidation reduction potential.
P/I	Pressure to current.
PAS	Process automation system.
ppm	parts per million
SG	Specific gravity.
SIS	Safety instrumented system.

4. General

- a. For general guidance on process instrumentation refer to API RP 554.
- b. If applicable, instrumentation devices shall be installed in accordance with GP 30-25.



- c. Instrumentation devices not covered by GP 30-25 should be installed in accordance with Vendor recommendations.
- d. Instruments installed in hazardous areas shall comply with GP 12-60.
- e. IEC IP65 in accordance with IEC 60529 (NEMA 4X in accordance with NEMA 250) housing and cabling glands or conduit hubs and fittings should be specified for outdoor installation as a minimum to ensure the instrument is adequately protected.
- f. For additional transmitter requirements refer to GP 30-25.
- g. For fieldbus requirements refer to GP 30-30.
- h. For guidance testing, calibration, and commissioning requirements refer to GP 30-90.
- i. If instrumentation is part of a safety instrumented system (SIS), GP 30-80 shall apply.

5. Density or specific gravity devices

5.1. General

- a. Density devices should be specified with transmitters.
- b. Process wetted parts should at least be 316 SS for corrosion protection. Other materials should be considered for process fluids non-compatible with 316 SS.
- c. Liquid level instruments that measure head may be used for density measurement. Level instruments using nucleonic devices may also be used for density measurement. Refer to GP 30-15 for level devices.
- d. Flow devices that measure mass flow may also provide density readouts. Refer to GP 30-10 for flow instruments.
- e. Vapour and gas density measurement shall be temperature compensated.

Temperature has a big effect, especially on gas density.

5.2. Selection criteria

- a. Process fluid characteristics should be considered when selecting a density instrument.
Slurries and aggressive fluids or solids tend to degrade the sensitive measurement apparatus.
- b. Instruments that are inserted in the process fluid may be used for light slurries and liquids.
- c. Nonintrusive devices should be considered for heavy slurries.
- d. Refer to Table 1 for a comparison of common density measuring devices.

Table 1 - Density or specific gravity instrument selection

Density device	Accuracy	Design pressure/temperature	Relative cost
Capacitance	1% of span	34.5 barg/71 °C (500 psig/160 °F)	Low
Sonic and ultrasonic	1% to 5% span	69 barg/199 °C (1000 psig/390 °F)	Low
Hydrostatic head	0.2% to 1% span	345 barg/177 °C (5000 psig/350 °F)	Medium
Coriolis	0.2% SG	345 barg/426 °C (5000 psig/800 °F)	Medium to high
Oscillating spool	0.1% SG 0.15% span	200 barg/160 °C (3000 psig/320 °F)	Medium to high
Nucleonic or radiation	1% span	Unlimited	High



- e. Capacitance, sonic, and ultrasonic density devices should be considered for low cost, qualitative density indications.

Capacitance, sonic, and ultrasonic density devices are often used to indicate density change rather than for absolute density measurement.

- f. Hydrostatic head type devices (usually D/P transmitters) should be considered for liquid density in vessels.

Hydrostatic head type is the most common and is medium cost.

- g. Coriolis instruments should be considered for high accuracy requirements on clean streams.

Coriolis instruments are inline devices used on piping and seldom on vessels. A sample line pumping from a vessel, through the meter, and back into the vessel can allow the Coriolis meter to be used to measure density of a liquid in a vessel.

- h. Oscillating spool density devices should be considered for gas or liquid custody transfer applications, or for in-tank measurements.

The oscillating spool device offers high accuracy and repeatability.

- i. If a nonintrusive density device is required, a nucleonic device should be considered.

Nucleonic devices are nonintrusive and can be used on pipes or vessels, but tend to be the most expensive.

5.3. Capacitance density

- a. Capacitance devices may be considered for low cost indication of density changes in clean fluids.

Capacitance density devices detect changes in dielectric constant of the liquid between two concentric tubes or plates. The capacitance is proportional to the dielectric constant, which is proportional to the density.

- b. Capacitance devices should be used with nonconductive fluids such as petroleum products.
- c. Since the accuracy of capacitance devices is low, use should be limited to qualitative measurements.
- d. Capacitance devices are often used for an indication of phase change or contamination, but not often used in process industries if accuracy is needed.

5.4. Sonic and ultrasonic density

5.4.1. Sonic density

- a. Sonic density devices should be considered to detect differences in densities of clean liquids.

Sonic devices are normally used in pipelines to detect interface between hydrocarbons moving through the pipeline.

- b. Sonic density devices should not be used for emulsions, slurries, or mixed phase flows because of introduced errors.

5.4.2. Ultrasonic density

- a. Ultrasonic devices should be primarily considered for light sludge density measurement in concentrations from 0.1% to 20%.

Ultrasonic devices can be placed in the sludge stream, or in some cases, mounted outside the pipe carrying sludge.

