HRP Training Aid:
Pressure Transducers and Regulators





DESCRIPTION — ECCN

DEFINITIONS

Pressure transducer: A device that measures liquid or gas pressure within a containment volume and converts the measurement to an electrical signal. To calculate pressure, the pressure transducer contains an internal sensor (e.g., flexible diaphragm) capable of converting the pressure acting on it to an electrical signal.

Programmable logic controller: A programmable device that is designed to record and process electrical signals.

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PRESSURE MEASUREMENT TYPES

Gauge pressure: Pressure measured relative to ambient atmospheric pressure. Tire pressure gauge is an example of this type of measurement.

Differential pressure: The difference in pressure between two points, such as liquid flowing through a pipe.

Absolute pressure: Pressure measured relative to a perfect vacuum using absolute zero as a reference point. Absolute pressure is the type of pressure measurement captured in export control regulations.

ALIASES

Look for any of the following aliases for export-controlled pressure transducers:

- Capacitance diaphragm gauge
- Capacitance manometer
- Gauge pressure sensor
- Pirani gauge
- Pressure sensor
- Pressure transmitter
- Sealed pressure sensor
- Vacuum capacitance manometer
- Vacuum pressure sensor

MAJOR MANUFACTURERS AND TRADE NAMES

Look for any of the following aliases for export-controlled pressure transducers:

- MKS Instruments Inc. (Andover, MA)—Baratron®
- BOC Edwards (Tewksbury, MA)—Barocel® 600
- Entegris Inc. (Billerica, MA)—NT™
- Setra Systems Inc. (Boxborough, MA)—700 Series (e.g., model 730)

Note: Entegris Inc. merged with major supplier Mykrolis in 2005.

TYPICAL COST

Typically, export-controlled pressure transducers cost between $1,000 and $3,000. Pressure transducers capable of measuring absolute pressures at low pressure with high accuracy and those constructed of corrosion-resistant materials are significantly more expensive than uncontrolled devices without these characteristics.

KEY FEATURES OF EXPORT-CONTROLLED PRESSURE TRANSDUCERS

Appearance:

- Typically, controlled pressure transducers are the size of a coffee cup or soda can. They are often cylindrical but may be box-like.
- Controlled devices will have an electrical connection on the body of the pressure transducer (e.g., 5-pin terminal strip, threaded fittings for a conduit, or a 15-pin D-subminiature connector).
- Controlled items have only one piping connection, and a single measurement port is used to measure absolute pressure. If two ports are present (i.e., to measure differential pressure), the item is not subject to controls.

Corrosion-resistant materials of construction

Pressure-sensing elements and wetted surfaces made of the following materials are export controlled:

- Aluminum
- Aluminum alloy
- Aluminum oxide
- Nickel
- Nickel alloy >60% nickel by weight (e.g., Monel, Inconel)

Measurement specifications

Export-controlled pressure transducers are capable of measuring absolute pressure at any point from 0 to 13 kPa.

Units of pressure

- Not controlled: pound per square inch gauge (psig), kg/cm^2, or bar
- Potentially controlled: pound per square inch absolute (psia or torr)

Accuracy

- Better (less) than ±130 Pa for transducers with a full scale ≥13 kPa
- Better (less) than ±1% of full scale for transducers with a full scale <13 kPa

Useful conversions

- 130 Pa = 0.0189 psia = 0.975 torr
- 13 kPa = 1.89 psia = 97.5 torr

APPLICATIONS

Nuclear

- Pressure measurements of uranium hexafluoride (UF_6) in the gas centrifuge uranium enrichment process
- Other uranium enrichment processes using UF_6
- Conversion facilities that produce UF_6 and in nuclear fuel fabrication plants

Other

- Semiconductor manufacturing
- Chemical processing
- High-end analytical equipment (e.g., mass spectrometers)
- Vacuum distillation, drying, and filtration
- Engineering tests
- Basic scientific research

PRESSURE TRANSDUCER EXAMPLES

Note: Different names used by manufacturers.

MKS Model 626D absolute Baratron capacitance manometer

Latest MKS high-performance pressure transducer (replaces previous MKS 626A, 626B, and 626C models)

Full-scale pressure range: 0.1–1,000 torr

0.25% of reading accuracy

0–10 volts of direct current (VDC) proportional analog output with 15-pin D-subminiature connector

Inconel and Incoloy nickel alloy construction of basic sensor operates without damage in virtually any chemical environment

Price: $1,260
Controlled: ECCN 2B230

MKS Model 430E Baratron NEMA4 absolute pressure transmitter

1–25,000 torr full-scale pressure range

0.5% of reading accuracy

4–20 mA analog output proportional to absolute pressure (note the single connection)

Approved for Class I, Divisions 1 and 2, Groups C and D explosion-proof applications

All-Inconel corrosion-resistant sensor construction

Price: $2,600
Controlled: ECCN 2B230

MKS Model 220DA Baratron absolute capacitance manometer

Available in ranges from 1 to 25,000 torr (500 psia)

Signal conditioner and power supply included in rugged, NEMA1-approved box-like housing

Diaphragm gauges using nickel-based alloys such as Inconel and Incoloy

For use in harsh industrial environments

Accuracy ±0.15% of reading

0–10 VDC and 4–20 mA outputs proportional to absolute pressure (note the single connection)

Price: $2,442
Controlled: ECCN 2B230

Setra Model 730 vacuum capacitance manometer

Chemical-resistive Inconel design (all wetted parts)

Available in ranges from 0 to 1,000 torr

High accuracy: ±0.25% of reading

Tensioned diaphragm provides superior performance

Dimensions

- Body: 3 in. H × 1.5 in. D
- Piping connection: 0.25 in. D or 0.5 in. D

Applications

- Semiconductor
- Petrochemical
- Plasma sterilizers
- Vacuum packaging

Price: $1,300
Controlled: ECCN 2B230

MKS Model 740B general purpose Baratron gauge capacitance manometer

1,000 psig gauge pressure transducer (referenced to atmospheric pressure)

1% of reading accuracy

0–10 VDC analog output with 9-pin D-subminiature connector

Wetted parts material: Inconel and 316L stainless steel

Mounted in rugged stainless-steel enclosure to withstand harsh industrial environments

Price: $1,024
Not controlled

Setra Model 264 Differential Pressure Transducer

Measures differential pressure (note the two connections)

Stainless-steel capacitive sensing element

±0.25%, ±0.4%, ±1% full-scale accuracy

Industry standard for very low differential pressure measurement

Applications

- HVAC/R systems
- Room pressurization for critical environments
- Energy management systems
- Variable air volume and fan control
- Environmental pollution control
- Lab and fume hood control

Price: $300
Not controlled

MKS Model 750C general purpose Baratron absolute capacitance manometer

0–3,000 torr absolute pressure transducer (referenced to vacuum)

1% of reading accuracy

0–10 VDC analog output with 9-pin D-subminiature connector

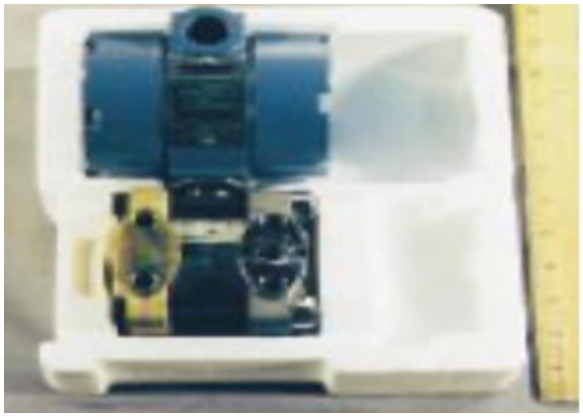
Wetted parts material: Inconel and 316L stainless steel

Mounted in rugged stainless-steel enclosure to withstand harsh industrial environments

Price: $1,092
Not controlled

TYPICAL PACKAGING AND HANDLING

- Form-fitting Styrofoam® or individual plastic clamshell packaging
- When more than one, typically packaged separately and placed in a larger cardboard box for a single shipment
- *Handle with care* and *fragile* markings on outer box



Quartz Pressure Transducers
ECCN 6A226.b

KEY POINTS

- Quartz pressure transducers are not to be confused with ECCN 2B230 pressure transducers, which are for low pressure applications.
- These items are specialized instrumentation for extremely high pressures >10 GPa. Conversion: 10 GPa = 100 kilobars or ~10,000 atmospheres.
- Quartz crystal is used as a piezoelectric material to convert the pressure acting on it to an electrical signal.

APPLICATIONS

- Perform hydrodynamic testing of nuclear technologies
- Characterize the response of materials to dynamic stresses
- Develop conventional military detonators and ordnance
- Measure a system's response to explosions and shock loading

APPEARANCE

- Generally cylindrical, ~5 cm (2 in.) long
- One end will have a flat face and the other end will have a small coaxial electrical connector
- One or both ends of the transducer are typically protected by plastic caps during shipment

Quartz pressure transducer (lower left) with typical power supply for its operation.

Plastic case with soft foam inserts for shipping quartz pressure transducers. Two transducers are inserted into holes in the foam, and a third transducer lies on top of the foam.

Pressure Regulators (diving applications)
ECCN 8A992.h

Pressure regulators that control the pressure of breathing gas for diving are controlled for antiterrorism reasons under ECCN 8A992.h. Other self-contained underwater breathing apparatus (scuba gear) and related equipment, not elsewhere specified, are also controlled.

KEY POINTS

- Also called diving regulators or demand valves.
- The most common application is to reduce pressurized breathing gas to ambient pressure and deliver it to the diver.
- In a single-hose designs, the pressure regulator is either held in the diver's mouth by a mouthpiece or attached to a full-face mask or helmet.
- In twin-hose designs, the regulator is usually attached directly to the scuba cylinder valve or manifold outlet, with a remote mouthpiece supplied at ambient pressure.

Apeks XTX tungsten pressure regulator

Physical vapor deposition plating of titanium, zirconium, and chromium to create a "tough as nails" finish

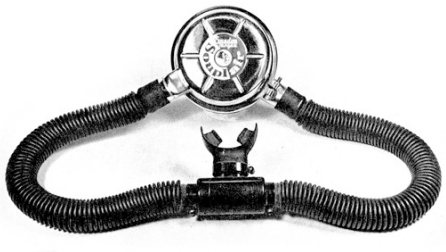
Superior performance at depth

Second stage manufactured with active protection (additive) against infection for all molded parts

Heat exchanger surrounds valve mechanism

OMS Airstream EVOque DIN physical vapor deposition 56 cm regulator set.

Submersible wireless pressure transducer for remote dive computer display.



Beuchat "Souplair" single-stage twin hose pressure regulator.

DOE/NNSA High Risk Property

https://hrp.doe.gov

https://ecap.doe.gov

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