1 YEAR WARRANTY

User's Guide

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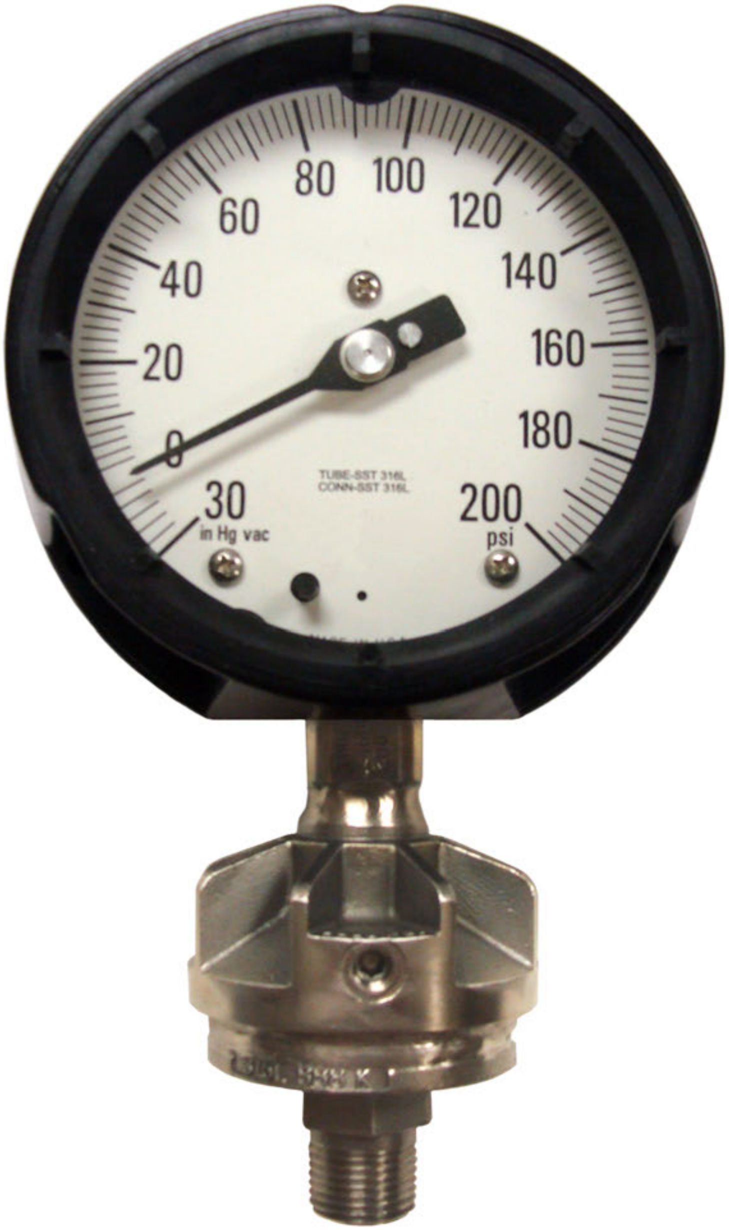

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WARNING - *Misuse of this product may cause explosion and personal injury. Do not use without first reading and understanding these instructions and the apparatus installation and operating instructions.*

USE AND INSTALLATION OF PRESSURE GAUGES

The following information on installation and use has been excerpted from ASME B40.100-2005 incorporated in ASME B40.100-2005. The complete ASME B40.100-2005 standard which contains additional information may be obtained from the American Society of Mechanical Engineers, 22 Law Drive, Box 2300, Fairfield, NJ 07007-2300.

3.3.5 Pressure Connection

3.3.5.1 Location of Connection
(a) stem mounted - bottom or back
(b) surface mounted - bottom or back
(c) flush mounted - back

3.3.5.2 Type of Connection. Taper pipe connections for pressures up through 20,000 psi or 160,000 kPa are usually 1/8-27NPT, 1/4-18NTP, or 1/2-14NPT American Standard external or internal taper pipe threads per ASME B1.20.1. as required. Above this pressure, 1/4 high pressure tubing connections, or equal, may be used. Other appropriately sized connections, employing sealing means other than tapered threads, are acceptable.

In applications of stem mounted gauges, especially with liquid filled cases and where vibration is severe, consideration should be given to the possibility of failure of the stem or associated piping caused by the vibrating mass of the gauge. A large connection (e.g., 1/2NPT instead of 1/4NPT) or a stronger stem material (e.g., stainless steel instead of brass), or both, should be considered.

3.4.1.10 Mounting a pressure gauge in a position other than that at which it was calibrated can affect its accuracy. Normal calibration position is upright and vertical. For applications requiring mounting in other than this position, notify the supplier.

3.4.1.12 Caution to Users.
Pressure gauges can be rendered inaccurate during shipment despite care taken in packaging. To ensure conformance to the standard grade to which the pressure gauge was manufactured, it should be checked before use.

4 SAFETY
4.1 Scope
This Section of the Standard presents certain information to guide users, suppliers, and manufacturers toward minimizing the hazards that could result from misuse or misapplication of pressure gauges with elastic elements. The user should become familiar with all sections of this Standard, as all aspects of safety cannot be covered in this Section. Consult the manufacturer or supplier for advice whenever there is uncertainty about the safe application of a pressure gauge.

4.2 General Discussion
4.2.1 Adequate safety results from intelligent planning and careful selection and installation of gauges into a pressure system. The user should inform the supplier of all conditions pertinent to the application and environment so that the supplier can recommend the most suitable gauge for the application.

4.2.2 The history of safety with respect to the use of pressure gauges has been excellent. Injuries to personnel and damages to property have been minimal. In most instances, the cause of failure has been misuse or misapplication.

4.2.3 The pressure sensing element in most gauges is subjected to high internal stresses, and applications exist where the possibility of catastrophic failure is present. Pressure regulators, diaphragm (chemical) seals, pulsation dampers or snubbers, syphons, and other similar items, are available for use in these potentially hazardous systems. The hazard potential increases at higher operating pressure.

4.2.4
The following systems are considered potentially hazardous and must be carefully evaluated:
(a) compressed gas systems
(b) oxygen systems
(c) systems containing hydrogen or free hydrogen atoms
(d) corrosive fluid systems (gas and liquid)
(e) pressure systems containing any explosive or flammable mixture or medium
(f) steam systems
(g) nonsteady pressure systems
(h) systems where high overpressure could be accidentally applied
(i) systems wherein interchangeability of gauges could result in hazardous internal contamination or where lower pressure gauges could be installed in higher pressure systems
(j) systems containing radioactive or toxic fluids (liquids or gases)
(k) systems installed in a hazardous environment

4.2.5 When gauges are to be used in contact with media having known or uncertain corrosive effects or known to be radioactive, random or unique destructive phenomena can occur. In such cases the user should always furnish the supplier or manufacturer with information relative to the application and solicit his advice prior to installation of the gauge.

4.2.6 Fire and explosions within a pressure system can cause pressure element failure with very violent effects, even to the point of completely disintegrating or melting the pressure gauge. Violent effects are also produced when failure occurs due to:
(a) hydrogen embrittlement;
(b) contamination of a compressed gas;
(c) formation of acetylides;
(d) weakening of soft solder joints by steam or other heat sources;
(e) weakening of soft soldered or silver brazed joints caused by heat sources such as fires;
(f) corrosion;
(g) fatigue;
(h) mechanical shock;
(i) excessive vibration.
Failure in a compressed gas system can be expected to produce violent effects.

4.2.7 Modes of Pressure Gauge Failure
4.2.7.1 Fatigue Failure. Fatigue failure caused by pressure induced stress generally occurs from the inside or the outside along a highly stressed edge radius, appearing as a small crack that propagates along the edge radius. Such failures are usually more critical with compressed gas media than with liquid media.
Fatigue cracks usually release the media fluid slowly so case pressure buildup can be averted by providing pressure relief openings in the gauge case. However, in high pressure elastic elements where the yield strength approaches the ultimate strength of the element material, fatigue failure may resemble explosive failure. A snubber (restrictor) placed in the gauge pressure inlet will reduce pressure surges and restrict fluid flow from the partially open elastic element.

4.2.7.2 Overpressure Failure. Overpressure failure is caused by the application of internal pressure greater than the rated limits of the elastic element and can occur when a low pressure gauge is installed in a high pressure port or system. The effects of overpressure failure, usually more critical in compressed gas systems than in liquid filled systems, are unpredictable and may cause parts to be propelled in any direction. Cases with pressure relief openings will not always retain expelled parts.

Placing a snubber (restrictor) in the pressure gauge inlet will not reduce the immediate effect of failure, but will help control flow of escaping fluid following rupture and reduce the potential of secondary effects.
It is generally accepted that solid front cases with pressure relief back will reduce the possibility of parts being projected forward in the event of failure.

The window alone will not provide adequate protection against internal case pressure buildup, and can be the most hazardous component.

Short duration pressure impulses (pressure spikes) may occur in hydraulic or pneumatic systems, especially when valves open or close. The magnitude of the spikes may be many times the normal operating pressure, and may not be indicated by the gauge. The result could be immediate failure, or a large upscale error. A snubber (restrictor) may reduce the magnitude of the pressure transmitted to the elastic element.

4.2.7.3 Corrosion Failure. Corrosion failure occurs when the elastic element has been weakened through attack by corrosive chemicals present in either the media inside or the environment outside it. Failure may occur as pin-hole leakage through the element walls or early fatigue failure due to stress cracking brought about by chemical deterioration or embrittlement of the material.

A diaphragm (chemical) seal should be considered for use with pressure media that may have a corrosive effect on the element.

4.2.7.4 Explosive Failure. Explosive failure is caused by the release of explosive energy generated by a chemical reaction such as can result when adiabetic compression of oxygen occurs in the presence of hydrocarbons. It is generally accepted that there is no known means of predicting the magnitude of or effects of this type of failure. For this mode of failure, a solid wall or partition between the elastic element and the window will not necessarily prevent parts being projected forward.

4.2.7.5 Vibration Failure. The most common mode of vibration failure is movement parts wear because of high cyclic loading caused by vibration, resulting in gradual loss of accuracy, and, ultimately failure of the pointer to indicate any pressure change.

4.2.7.6 Vibration-Induced Fatigue Failure. In addition to its effect of the gauge movement and linkage (see para. 4.2.7.5) vibration may, in some instances, result in high loading of various parts of the pressure element assembly. This loading could cause cracks in the element itself, or in joints. Case pressure buildup may be slow, but it is possible that a large hole may suddenly develop, with a high rate of case pressure rise, which could result in a failure similar to an explosive failure.

4.2.8 Pressure Connection. See recommendations in para. 3.3.5.

4.3 Safety Recommendations
4.3.1 Operating Pressure. The pressure gauge selected should have a full scale pressure such that the operating pressure occurs in the middle half (25 to 75%) of the scale. The full scale pressure of the gauge selected should be approximately two times the intended operating pressure.

Should it be necessary for the operating pressure to exceed 75% of full scale, contact the supplier for recommendations.
This does not apply to test, retarded, or suppressed scale gauges.

4.3.2 Use of Gauges Near Zero Pressure
The use of gauges near zero pressure is not recommended because the accuracy tolerance of the gauge may be a large percentage of the applied pressure. If for example, 1 0/100 psi Grade A gauge is used to measure 4 psi, the accuracy of measurement will be +/- 2 psi, or 50% of the applied pressure.

For this reason, gauges should not be used for the purposes of indicating the residual pressure in a tank, autoclave, or other similar device which has been seemingly exhausted. Depending on the accuracy and the range of the gauge, hazardous pressure may remain in the tank even thought the gauge is indicating zero pressure. The operator may develop a false sense of security when the gauge indicates zero or near-zero pressure even though there may be substantial pressure in the system. A venting device must be used to completely reduce the pressure to zero before unlocking covers, removing fittings, or performing other similar activities.

4.3.3 Compatibility With Medium
4.3.3.1 Wetted Parts
The elastic element is generally a thin-walled member, which of necessity operates under high stress conditions and must; therefore, be carefully selected for compatibility with the medium being measured. None of the common element materials is impervious to every type of chemical attack. The potential for corrosive attack is established by many factors, including the concentration, temperature, and contamination of the medium. The user should inform the gauge supplier of the installation conditions so that the appropriate element material can be selected.

4.3.4 In addition to the factors discussed above, the capability of a pressure element is influenced by the design, material and fabrication of the joints between its parts.

IMPORTANT - ***Read other side for additional instructions and warnings.***

(Excerpts from ASME B40.100-2005 continue on back)

Common methods of joining are soft soldering, silver brazing, and welding. Joints can be affected by temperature, stress, and corrosive media. Where application questions arise, these factors should be considered and discussed by the user and supplier.

4.3.5 Some special applications require that the pressure element assembly have a high degree of leakage integrity. User should contact the supplier to assure that the allowable leakage rate is not exceeded.

4.3.6 Cases
4.3.6.1 Case, Solid Front. It is generally accepted that a solid front case per para. 3.3.1 will reduce the possibility of parts being projected forward in the event of elastic element assembly failure. An exception is explosive failure of the elastic element assembly.

4.3.6.2 Cases, Liquid Filled. It has been general practice to use glycerine or silicone filling liquids. These fluids must be avoided where strong oxidizing agents, including, but not limited to, oxygen, chlorine, nitric acid, and hydrogen peroxide are involved. In the presence of oxidizing agents, potential hazard can result from chemical reaction, ignition, or explosion. Completely fluorinated or chlorinated fluids or both, may be more suitable for such applications.

The user shall furnish detailed information relative to the application of gauges having liquid filled cases and solicit the advice of the gauge supplier prior to installation.

In a compressed gas application consideration should also be given to the instantaneous hydraulic effect that may be created by one of the modes of failure outlined in para 4.2.7. The hydraulic effect due to pressure element failure could cause the window to be projected forward even when a case having a solid front is employed.

4.3.7 Snubber Placing a snubber or a restrictor between the pressure connection and the elastic element will not reduce the immediate effect of failure, but will help reduce flow of escaping fluid following rupture and reduce the potential of secondary effects.

4.3.8 Specific Service Conditions
4.3.8.1 Specific applications for pressure gauges exist where hazards are known. In many instances, requirements for design, construction and use of gauges for these applications are specified by state or federal agencies or Underwriters Laboratories, Inc. Some of these specific service gauges are listed below. This list is not intended to include all types, and the user should always advise the supplier for all application details.

4.3.8.2 Acetylene Gauge. A gauge designed to indicate acetylene pressure (and other gases having similar properties). The gauge may bear the inscription ACETYLENE on the dial.

4.3.8.3 Ammonia Gauge. A gauge designed to indicate ammonia pressure and to withstand corrosive effects of ammonia. The gauge may bear the inscription AMMONIA or NH3 on the dial. It should also include the equivalent saturation temperature scale markings on the dial. Materials such as copper, brass, and silver brazing alloys should not be used.

4.3.8.4 Chemical Gauge. A gauge designed to indicate the pressure of corrosive or high viscosity fluids, or both. The primary material(s) in contact with the pressure medium may be identified on the dial. It may be equipped with a diaphragm (chemical) seal, pulsation damper, or pressure relief device, or a combination. These devices help to minimize potential damage to personnel and property on the event of gauge failure. They may, however, also reduce accuracy or sensitivity, or both.

4.3.8.5 Oxygen Gauge. A gauge designed to indicate oxygen pressure. Cleanliness shall comply with Level IV (see Section 5). The dial shall be clearly marked with a universal symbol and/or USE NO OIL in red color (see para. 6.1.1.4).

4.4 Reuse of Pressure Gauges
It is not recommended that pressure gauges be moved from one application to another for the following reasons:

(a) Chemical Compatibility. The consequences of incompatibility can range from contamination to explosive failure. For example, moving an oil service gauge to oxygen service can result in explosive failure.

(b) Partial Fatigue. The first installation may involve pressure pulsation that has expended most of the gauge life, resulting in early fatigue in the second installation.

(c) Corrosion. Corrosion of the pressure element assembly in the first installation may be sufficient to cause early failure in the second installation.

In addition to the ASME B40.100-2005 standard, the following additional instructions and warnings should be read and understood before using this product.

A very important aspect of selecting and installing pressure gauges is the consideration of the hazards that will result in the event the gauge fails. The primary causes of failure are misapplication and/or abuse of the gauge. Those people who are responsible for the selection and installation of pressure gauges must recognize conditions which will adversely affect the ability of the gauge to perform its function or which will lead to early failure. These conditions may then be discussed with the supplier to obtain their recommendations.

Failure may constitute:

1. Loss of accuracy.
2. Clogging of the pressure port, or damage to the internal mechanism so that there is either:
   a. no indication when pressure is applied or
   b. there is an indication of pressure even though none is applied.
3. A leak in the pressure containing parts or joints.
4. A crack or fatigue failure of the bourdon.
5. Bursting of the bourdon due to severe overpressure.
6. An explosion with the system due to a chemical reaction of the pressure medium with contaminants cause the bourdon to explode.

When specifying, using or installing a pressure gauge, the following factors must be given attention:

1. Operating Pressure
Do not continuously operate the gauge at more than 75% of the span. Bourdon tubes are necessarily highly stressed, especially in ranges over 1000 psi and continuous operation at full scale will result in early fatigue failure and subsequent rupture.

2. Materials
Be certain the materials of the pressure containing portions of the gauge are compatible with the pressurized medium. Gauges are commonly made of copper alloys (brass, bronze, etc.) and may be subject to stress corrosion or chemical attack. Bourdons have relatively thin walls, and the accuracy of the indication is directly affected by any reduction in the wall thickness. Use of the same material for bourdon as used for the tank or associated piping is not necessarily good practice. A material having a corrosion rate of .001"/year may be suitable for the piping, but will be entirely unsuitable for a bourdon having a wall thickness of, for example, .008 inches. It is imperative that the proper bourdon material be selected for the service on which the gauge is used. Gauges specifically constructed for corrosion services are available.

3. Cyclic Pressure and Vibration
Continuous, rapid pointer motion will result in excessive war of the internal mechanism and cause gross errors in the pressure indicated and possibly early fatigue failure of the bourdon. If the pointer motion is due to mechanical vibration, the gauge must be remotely mounted on a non-vibrating surface and connected to the apparatus by flexible tubing. If the pointer motion is due to pressure pulsations, a suitable damper must be used between the pressure source and the gauge.

4. Fatigue
As with any spring, the bourdon will fail after extended use and release the pressurized medium. The larger the number of applied pressure cycles and the greater the extent of the pressure cycle, the earlier failure will occur. The fatigue failure may be explosive. Since such a failure will be hazardous to personnel or property, precautions must be taken to contain or direct the release of the pressurized medium in a safe manner.

5. Frequency of Accuracy Evaluation
Where the pressure measurement is critical and gauge failure or gross inaccuracy will result in hazard to personnel or property, the gauge should be checked for accuracy and proper operation on a periodic basis.

6. Use with Oxygen
Gauges used for measurement of oxygen pressure must be free of contamination within the pressure containing portion. Various levels of cleanliness are specified in ASME B40.1. The gauge itself and the equipment to which the gauge is attached (pressure regulators, cylinders, etc.) must be kept clean so as not to contaminate the gauge. Filters on the equipment must be examined periodically and cleaned or replaced. The sudden in-rush of a high pressure gas will momentarily create a very high temperature which in the presence of oxygen may ignite the contaminant causing a violent explosion. **Therefore, when the valve on the oxygen supply tank is opened, to admit oxygen to the regulator, the valve should be opened very slowly so as to allow the pressure to build up slowly.** In order to accomplish this it is recommended that the tank valve be opened momentarily and the closed snugly but not excessively before attaching the regulator. This will not only blow out accumulated dirt in the valve, but will also place the valve in a condition that will permit it to be opened slowly rather than suddenly breaking loose as a result of being closed too tightly. When bleeding the oxygen tank prior to attaching the regulator, be certain the valve opening is directed away from any open flame and the operator. **When opening the oxygen tank valve, the operator must not stand in front of or behind the gauge and must wear eye and face protection.** In this position if there is an explosion due to contaminated equipment any particles projected from the gauge will not be propelled directly at the operator.

7. Use with Hydrogen
Steel bourdons including 400 series stainless steel are subject to hydrogen embrittlement when stressed. Measurement of gas or liquids containing hydrogen (such as natural gas, sour oil) require the use of special materials for the bourdon.

8. Venting of Case
Vents provided in the pressure gauge case (clearance around pressure connection, rubber grommets, pressure relief back, etc.) must not be closed or restricted from operating. There is always the possibility that the pressure medium will be admitted to the case interior as a result of a leaking joint or bourdon tube failure. If this occurs, the pressure medium must be vented from the case so as not to build up sufficient pressure to rupture the case or window. However, venting will not prevent case rupture in the event of a violent explosion.

9. Liquid Filled Gauges
Performance of pressure gauges used in severe vibration or pulsating pressure service, can be improved by filling the gauge case with a viscous fluid. Gauges constructed in this manner necessarily require sealed cases to prevent the escape of the liquid. However, some means of venting the case must be provided. In some instances this vent is sealed to prevent loss of fluid during shipment, and must be released after the gauge is installed. Be certain to follow the installation instructions for properly venting the gauge after installation. The liquid filling most commonly used is a mixture of glycerin and water.

Glycerin can combine with strong oxidizing agents including (but not limited to) oxygen, chlorine, nitric acid and hydrogen peroxide, and result in an explosion which can cause property damage and personal injury. If gauges are to be used in such service, do not use glycerin filled gauges; consult the supplier for proper filling medium.

WARNING - *Misuse of this product may cause explosion and personal injury. Do not use without first reading and understanding these instructions and the apparatus installation and operating instructions.*

Important - Read other side for additional instructions and warnings.

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OMEGA ENGINEERING, INC. warrants this unit to be free of defects in materials and workmanship for a period of **13 months** from date of purchase. OMEGA's WARRANTY adds an additional one (1) month grace period to the normal **one (1) year product warranty** to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product.

If the unit malfunctions, it must be returned to the factory for evaluation. OMEGA's Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective, it will be repaired or replaced at no charge. OMEGA's WARRANTY does not apply to defects resulting from any action of the purchaser, including but not limited to mishandling, improper interfacing, operation outside of design limits, improper repair, or unauthorized modification. This WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of having been damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components in which wear is not warranted, include but are not limited to contact points, fuses, and triacs.

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RETURN REQUESTS/INQUIRIES

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The purchaser is responsible for shipping charges, freight, insurance and proper packaging to prevent breakage in transit.

FOR **WARRANTY** RETURNS, please have the following information available BEFORE contacting OMEGA:

1. Purchase Order number under which the product was PURCHASED,
2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems relative to the product.

FOR **NON-WARRANTY** REPAIRS, consult OMEGA for current repair charges. Have the following information available BEFORE contacting OMEGA:

1. Purchase Order number to cover the COST of the repair,
2. Model and serial number of the product, and
3. Repair instructions and/or specific problems relative to the product.

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