MAINTENANCE AND
REPAIR MANUAL

ASHCROFT
GAUGES

Form Number 250-1353B

A product of
MANNING, MAXWELL & MOORE
INCORPORATED
STRATFORD • CONNECTICUT

MAINTENANCE AND REPAIR MANUAL

for

ASHCROFT GAUGES

Form Number 250-1353B

A product of

MANNING, MAXWELL & MOORE, INC.

STRATFORD CONNECTICUT

ILLUSTRATIONS

CONTENTS

ASHCROFT TEST GAUGES

Ashcroft Test Gauges are designed and built for highly precise reference work. They should be used ***only*** as reference gauges if they are to maintain accuracy. An Ashcroft Test Gauge should be mounted vertically. The very best accuracy and repeatability, better than the ¼% accuracy which is guaranteed, is obtained by lightly tapping the gauge on either the front or back center of the case.

Low pressure Test Gauges (15 or 30 psi) are most conveniently used on air or gas as this eliminates any need to compensate for head error. As a head of only one inch of oil is about equal to one-quarter percent of accuracy of a 15 psi test gauge, an ***exact*** knowledge of the head is needed. This knowledge is quite difficult to obtain if gauge and fittings are empty and oil is the testing medium. If oil is to be used, the test gauge should be filled with oil so that the head of oil is known and constant.

TEST EQUIPMENT FOR PRESSURE GAUGES

Laboratory Test Gauge

The Ashcroft Laboratory Test Gauge (Catalog Number 1082 Series) is a reference gauge used for checking and calibrating service gauges. This gauge is a highly precise and sensitive instrument, accurate to within ¼ of 1 percent of its range. It should always be handled with extreme care and kept where it is safe from possible damage.

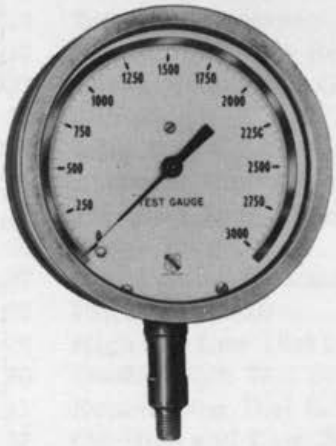


Figure 1

ASHCROFT LABORATORY TEST GAUGE
Catalog No. 1082 Series*

The dial includes a mirror surface under the pointer tip. By lining up the actual pointer with its mirrored reflection, parallax error is eliminated, and thus every reading is necessarily the same for every user.

Dials are linear. This provides the dual advantages of easier and faster recalibration. Hand marked dials, used by many manufacturers, are usually non-linear. Once calibration is disturbed on a hand-marked non-linear dial, it is practically impossible to restore the gauge to its original accuracy.

Even the best test gauges should be checked periodically, with an Ashcroft Dead Weight Tester or with an Ashcroft Maxitest Test Gauge.

When equipping an instrument shop, it is recommended that the ranges of shop test gauges be selected to match closely the ranges of the service gauges to be checked. The 1082 Series test gauges are available in 4½", 6", and 8½" sizes. The 8½" dial size is recommended for clearest readability.

Occasionally a small size reference gauge is needed. The 3" Ashcroft 1084P Pocket Test Gauge has an accuracy of ½ of 1 percent of its range and is exceptionally readable for a smaller gauge. It is used primarily for field inspection work and is available with protective cover.

Maxitest Test Gauge

The Ashcroft Maxitest is the finest portable Test Gauge that you can buy. It combines maximum accuracy with easy readability. As a Master Reference Gauge it is especially suited for checking the accuracy of, and calibrating, test gauges, receiver gauges, pressure transmitters, and other instruments.

Unique in every respect, the Maxitest is designed for portability and easy reading under almost any conditions. The case is of durable, lightweight "Alumalife" (a specially developed aluminum alloy). The case and the anti-parallax dial are finished in contrasting colors scientifically developed to provide maximum readability and minimum eye strain.

Specially designed metal tabs are used instead of the usual printed dial graduations. These tabs are positioned near the outer circumference of the dial at the major graduation points. Each one can be individually and precisely set so that the pressure reading at each point is exact. This provides an accuracy, at any dial tab reading, of not less than

---

* See Ashcroft Gauge Catalog 300B, Pg. 56.

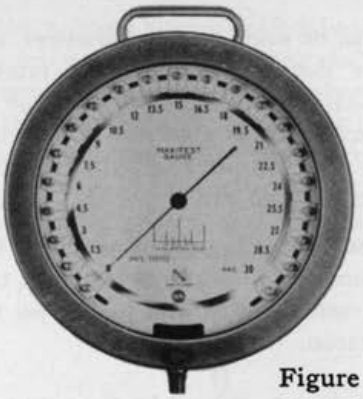


Figure 2

MAXITEST TEST GAUGE
Catalog No. 1080 Series*

that of the calibration standard: 1/10th of 1 percent with the Dead Weight Gauge Tester. No intermediate dial graduations are provided.

To further insure accuracy, each tab is marked to indicate any deviation from a standard reading.

Deviation is shown in terms equal to percent of total error, from ⅛ of 1 percent to 1 percent of total dial graduation. These extra marks are useful in checking another gauge to a specified accuracy. When used in this way, the gauge under test and the Maxitest are connected to the same source of pressure and the pressure is adjusted so that the ***gauge under test*** exactly indicates at the center of a major graduation. The Maxitest reading will then show the exact error of the gauge under test. This procedure eliminates the need to estimate and calculate errors on the gauge under test. The tolerance marks are correct when the Maxitest is the same range as the gauge being tested. When they are of different ranges, the value of the tolerance lines will have to be estimated.

The Maxitest dial and pointer are designed to eliminate parallax error.

A blank dial is available to permit setting of tabs according to the user's needs.

The Maxitest is furnished in 8½" dial size.

CAUTION: DO NOT USE
TEST GAUGES AS SERVICE GAUGES

Ashcroft Portable Dual Range Dead Weight Gauge Tester

CARE AND MAINTENANCE

The Ashcroft Dead Weight Gauge Tester is a precision built hydraulic instrument which is a basic standard of pressure. It should receive the care and treatment that is accorded any other fine laboratory equipment.

The piston supporting the weight platform and the cylinder is manufactured to extremely close tolerances and to an area accuracy of 1/20 of 1 percent. The area of these parts is controlled by accurate measurement of the diameter by standards traceable to the National Bureau of Standards.

Dead Weights are carefully checked against weights certified by the National Bureau of Standards. (The accuracy of finished weights is better than 1/20 of 1 percent).

This Dual Range Tester is supplied with two interchangeable piston and cylinder assemblies.

One assembly is high pressure, with 1/80 square inch piston area. The other assembly is low pressure, with 1/16 square inch piston area. The area of the high and low pressure assemblies are in an exact ratio of 5:1. The same weights are used on both assemblies and are marked with the equivalent psi value for each area.

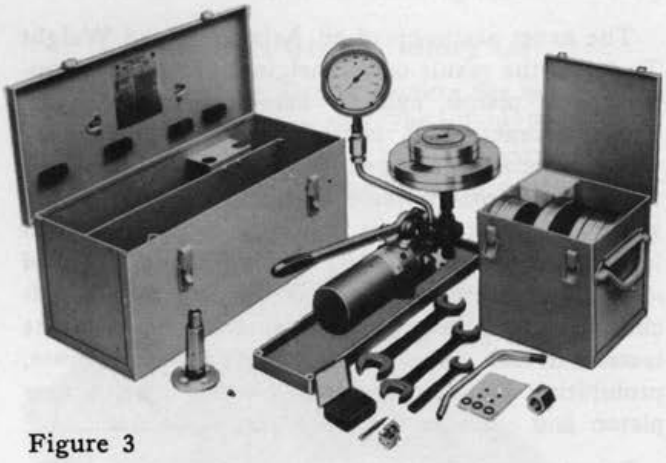


Figure 3

DEAD WEIGHT GAUGE TESTER
Catalog No. 1305 Series**

As the range of the Dead Weight Tester increases, the area of the pistons supporting the weight platform decreases and the fit between the piston and cylinder becomes tighter. This closeness of fit prevents excess leakage of the hydraulic fluids past the piston. As the High Pressure Dead Weight Tester needs a closer fit, it is less sensitive when used on very low pressures. Ashcroft recommendations are, therefore, that when using the low pressure piston (1/16 square inch area) the lowest pressure that should be tested is 10 psi. When testing higher pressures with the high pressure piston (1/80 square inch area) the lowest pressure that should be tested is 50 psi.

Periodically, the Dead Weight Tester should be flushed out with a solvent such as Naphtha and the hydraulic fluid should be kept very clean.

---

* See Ashcroft Gauge Catalog 300B, Pg. 67.

** See Ashcroft Gauge Catalog 300B, Pg. 65.

This care will assure the longest service life of the piston and cylinder assembly. It will also protect against possible sticking between piston and cylinder.

When a Dead Weight Tester is inactive for long periods, or when a piston and cylinder assembly is being replaced, the piston should always be removed from the cylinder and coated with oil. This will insure that it will never be operated in the dry state. When removing or replacing the piston always rotate it back and forth as it passes through the cylinder.

Although several fluids can be used in a Dead Weight Tester, a light grade (SAE 10 or 20) of machine or automotive oil is recommended. Less viscous oils cause increased leakage past the piston, with a resulting faster drop of the weights. Oils of higher viscosity, or fluids with lower lubricating properties, cause sticky piston action and make low pressure readings more difficult.

The exact accuracy of an Ashcroft Dead Weight Tester is the result of the original precision manufacture of piston, cylinder assembly and weights. This accuracy will last indefinitely unless the weights become damaged by mishandling; or unless the piston diameter wears. The only way that piston wear will occur is from improper or contaminated lubrication, excessive dirt, or after many years of normal continued use. A dead weight tester is self-checking for if the piston or cylinder does wear, the tester will leak oil past the piston at a very fast rate, prohibiting further operation. In this case, a new piston and cylinder assembly should be installed.

Sustained original accuracy is, then, automatic. No adjustments are needed to maintain it.

Testing Oxygen Gauges

Dead Weight Testers made for testing Oxygen Gauges can use hydraulic fluids such as water or acceptable fluorocarbons.

Oil cannot be used because it is explosive with oxygen.

When water is used as the testing fluid, a thin film of fluorocarbon grease (Kel-F) coating the piston provides satisfactory lubrication. Kel-F grease is supplied by Ashcroft and can be reordered as Part S-417. Care must be taken to use only a ***very thin*** film of grease or sticky action will result. A very thin film should be applied to the piston and then most of it wiped off with a clean lint-free cloth.

If Kel-F grease is not available, a little mild soap (Ivory) should be mixed with the water to provide some lubrication for the piston and cylinder assembly. The use of soapy water, however, causes gumming. This necessitates frequent removal of the piston, which should be wiped dry and have a new soapy water solution applied. When the Tester is out of use, the piston and cylinder should be removed, cleaned and dried.

When the Tester is used for oxygen applications, the minimum usable pressure is raised to 20 psi. for the low pressure piston and to 100 psi for the high pressure piston.

Ashcroft Portable Test Pump

Figure 4

Catalog No. 1327 Series*

Sometimes it is more convenient to make calibrations to a Test Gauge rather than to a Dead Weight Tester. The Ashcroft Type 1327 Test Pump is specifically designed for this service. Instructions for the 1305 Dead Weight Tester apply to the Type 1327 Test Pump as the same parts are used, except that the Test Pump has a Test Gauge in place of the piston and cylinder assembly on the 1305 Tester.

It is furnished, conveniently boxed, with one or more Test Gauges.

A separate Maintenance Manual is available to cover the 1305 and 1327 Dead Weight Tester and Pump.

Ashcroft Vacuum Gauge Tester

Easy to operate and highly accurate, Ashcroft Vacuum Gauge Testers consist of a hand operated vacuum pump and a mercury column to indicate vacuum.

---

* See Ashcroft Gauge Catalog 300B, Page 65.

The mercury column shows graduations of 0 to 31 inches of mercury on one side of the scale and 0 to 780 millimeters of mercury on the other side. The reservoir of the Tester should be filled with approximately 3 pounds of double distilled mercury. Since it is impossible to produce a perfect vacuum with a hand pump, it is suggested that gauges be tested up to about 28 inches vacuum.

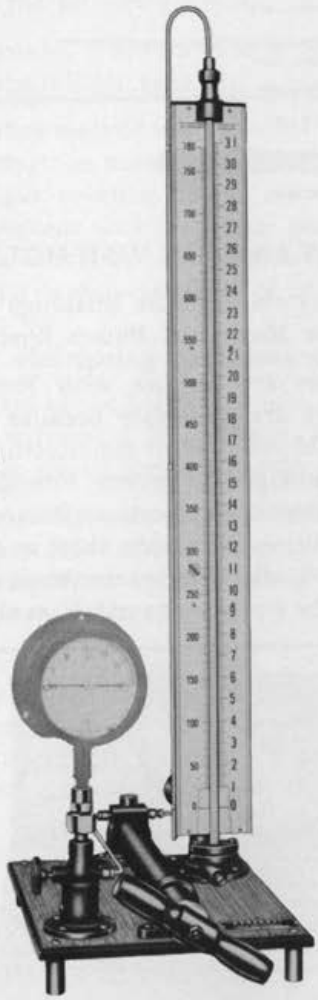


Figure 5

ASHCROFT VACUUM GAUGE TESTER
Catalog No. 1332*

These precision Testers are furnished with a complete tool kit. The Test Gauge in the illustration is not supplied.

PRESSURE SUPPLY

A compressed air supply is a convenient source of pressure for checking and calibrating gauges. A small needle valve is required between the compressed air line and the gauges and another to vent the gauges. Operation of these valves will allow precise setting of the pressure to the reference gauge.

* See Ashcroft Gauge Catalog 300B, Page 66.

An efficient filtering system is recommended to remove oil from the air lines (even though this is not mandatory when checking conventional gauges only). Oil in air lines sometimes lodges in the gauge socket and causes low pressure gauges to indicate erratically. In addition, air breaking through a film of oil in the gauge socket causes the pointer to move in small jumps. This can make it appear as though the gauge movement teeth are defective. This condition is especially noticeable on pneumatic receiver gauges.

If no compressor is available, industrial air pressure tanks may be used as a pressure source. This air is usually quite clean and a filtering system is not necessary.

If a motor driven vacuum pump is available, it may be more convenient to use than the 1332 Vacuum Tester. A motor driven pump will create a more perfect vacuum. A vacuum mercury column or test gauge would be needed as a standard.

Inspectors Gauge Testing Set

The 1328 Ashcroft Gauge Testing Set is specially designed for Inspectors and Travelling Engineers. It weighs about 12 pounds, is easily carried complete, and is used for testing pressure gauges up to 500 psi.

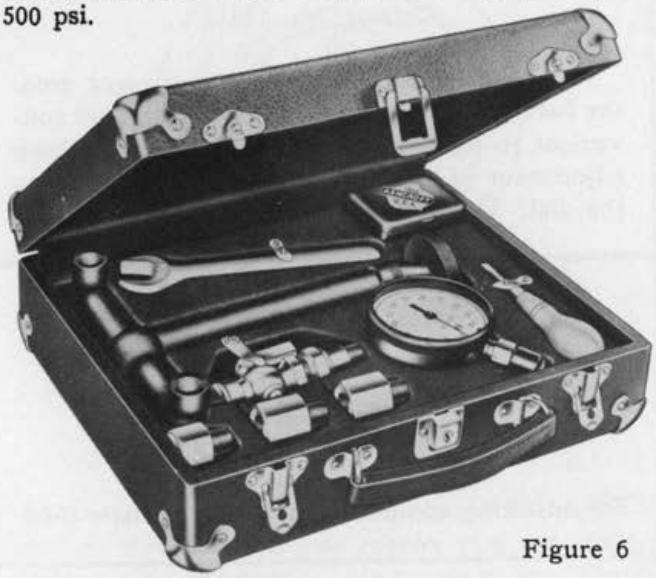


Figure 6

INSPECTORS' GAUGE TESTING SET
Catalog No. 1328

Set consists of these units:

Black finished test pump with two connections.

Ashcroft Pocket Test Gauge, Catalog No. 1084P, graduated 0 to 300 psi, 3 inch dial size. Other pressures to order.

Tools and Fittings.

Any light oil is recommended for use with the Testing Set.

HAND JACK SET

Catalog No. 1105D

Figure 7

Used to remove and drive pointers on pinion shafts. Consists of Gauge Pointer Remover.

Figure 8

REAR CALIBRATION SCREW DRIVER
Catalog No. 1105S

For recalibrating Ashcroft Duragauges from the back of the movement. Some find it more convenient to remove the case and this tool allows adjustment of the movement without removing the dial.

Figure 9

WIGGLER
Catalog No. 1105W

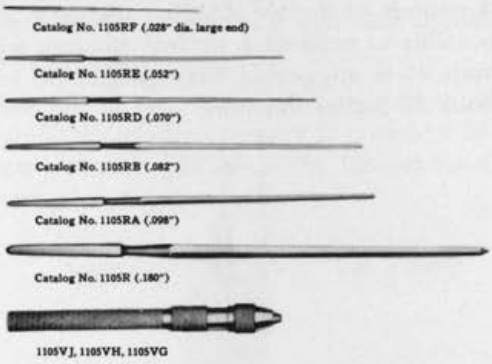
For adjusting connection links to eliminate bind.

WRENCHES

A good selection of Wrenches should be available to ensure the proper connection of gauges. Gauges should be connected by applying force to the wrench flats on the socket. They should never be connected by appyling force to the case.

Note: Even though Gauges are heavier and more rugged than many other fine devices, they are still precision instruments and should be handled as such. Proper treatment of them results in long, accurate and economical service life.

Figure 10



REAMERS AND PIN VISE HOLDERS

For Reaming Pointer Bushings to Fit on Movement Pinion Shaft

These Reamers are for use with Replacement Pointers. They are necessary because it is impractical to hold pinion shaft manufacturing tolerances close enough to permit interchangeable pre-reamed pointers. Replacement Pointers should be reamed to fit on the pinion shaft at a suitable height above the dial. Six reamer sizes are available to cover the entire range of pinion shaft sizes.

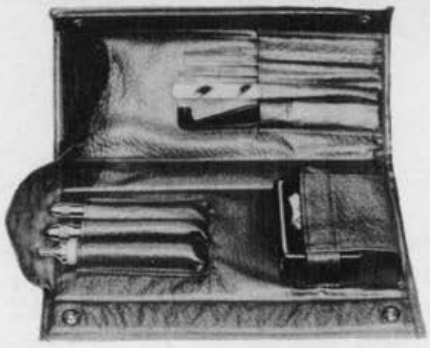


Figure 11

GAUGE TOOL KIT
Catalog No. 1105T

For complete gauge maintenance. Kit includes Hand Jack Set, Rear Calibration Screw Driver, five Reamers, two Pin Vise Holders, Wiggler and Tweezer. All packed in a neat Carrying Case.

TWEEZERS
Catalog No. T-1105TW
For Adjusting Hairsprings

Proper hairspring adjustment is essential to accurate gauge functioning. Hairsprings must be level and set so coils will not rub each other when they are wound.

Pointer Adjustment

Some gauges are furnished with pointer reset devices. We recommend that pointer reset devices be used only to reset pointer position. They do not provide for complete calibration. Pointer reset devices are of the following types:

a. Adjustable Pointers include the geared type and the friction type with a knurled bushing.

b. Another method used to reset pointers is by rotating the movement. Here, a cam causes a slight rotation of the movement with a consequent shift in pointer position. This is not a complete recalibration as pointer resetting is only one part of calibration.

Hairspring Adjustment

The function of the hairspring is to take up clearance in the movement and linkage. Its perfect adjustment is a vitally important step in calibration.

a. Hairsprings should be adjusted with a tweezer. Set them perfectly level so that when wound up approximately 360° they will not distort.

b. Wind hairsprings tight enough to have torque throughout the whole range. Most Ashcroft gauges have the hairspring fully wound at zero pressure position. This is the safest position because should parts wear, due to unusual pulsation or vibration, the pointer will shift in a plus direction. Thus, more pressure will be indicated than that which actually exists in the pressure vessel.

c. Hairsprings on most Ashcroft Gauges are fastened to the movement column by a tapered pin. This permits easy field replacement.

Rotary Geared Movement Adjustment

So broad a term as "Movement Adjustment" must (for the sake of clearness) be divided into specific categories. They are:

1. Resetting the pointer
2. Adjustment for sluggishness
3. Adjustment to correct the angle of pull
4. Adjustment to correct too fast or too slow pointer action
5. Calibration from outside the case
6. Calibration to "better than normal" accuracy
7. Rough calibration

THESE CONDITIONS ARE HANDLED IN THE FOLLOWING MANNER:

1. RESETTING THE POINTER

Micrometer and adjustable pointers are easily reset without removing from the movement. Where non-adjustable pointers are used, it is necessary to loosen the pointer with a pointer remover and retighten at the required position.

2. ADJUSTMENT FOR SLUGGISHNESS

Clean all bearing and gear teeth. Adjust the hairspring so that all back lash is eliminated. Do not overtighten as too much tension causes friction and drag. Check link for binding and bend the link slightly with a "wiggler" if needed. Test for freeness of parts by deflecting the segment and letting it spring back. Free parts will vibrate and produce a characteristic sound. This test is run without a pointer.

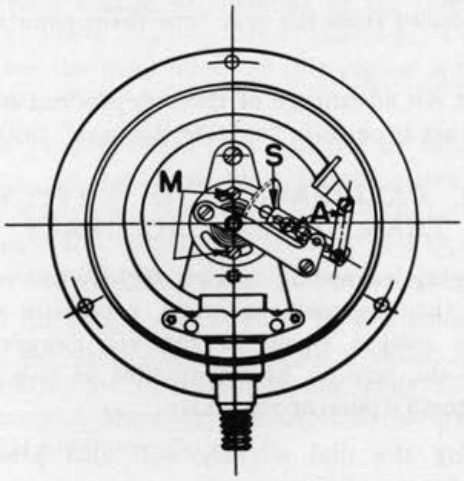


Figure 12

ROTARY GEARED MOVEMENT

Move slide "S" in or out to change the ratio of motion. Recalibration may require that the motion under a given pressure is either more or less. Therefore, slide "S" is moved to compensate. "A" indicates "angle of pull." "M" indicates screws that hold movement. "A" equals 76° approx.

3. ADJUSTMENT TO CORRECT THE ANGLE OF PULL

Even when the gauge slide is set to the best location, the angle of pull "A" must be just right or the pointer will travel too fast at either the low or high end of the scale. By loosening screws "M" the whole movement can be rotated to set the desired angle "A". If angle "A" is acute, the pointer will travel faster on the first part of the scale and slower on

the last part. Sometimes in order to get the correct angle of pull the Bourdon tube tip must be bent to right or left, although it is better to do this by rotating the movement or by putting in a new link.

4. TOO FAST OR TOO SLOW POINTER ACTION

Loosen the screws holding slide "S". When the pointer has moved too fast, push out slide "S". When the pointer has moved too slow, push slide "S" in. When properly set, tighten slide screws. This is the adjustment of span. This adjustment, together with the resetting of the pointer (zero), is the most important.

5. CALIBRATION WITH CASE REMOVED

Ashcroft Duragauges have slide and movement screws that can be adjusted from the back as well as from the front. The backs of these screws have multiple spline recesses (Bristol type) that can be turned with the rear calibration screw driver (Part 1105S). This permits gauge calibration from the back and eliminates removing the dial. When tightening screws from the rear turn them counterclockwise.

NOTE: An advantage of the independent mounted dial is that it permits "outside the case" calibration.

6. CALIBRATION TO "BETTER THAN NORMAL" ACCURACY

Changing hairspring tension slightly can result in "better than normal" accuracy, especially on low pressure gauges (such as receiver gauges). Try shifting the tension by an amount of one or two pinion teeth (plus or minus).

Shifting the dial slightly will also produce a certain degree of change.

7. ROUGH CALIBRATION

Rough calibration is a proven time saver and can be achieved on all gauges. This is accomplished after some experience has been gained in first setting the correct angle of pull and hairspring tension. As it is done without reference to a dial, it eliminates the trouble of installing and removing the dial after every adjustment.

Place the pointer on the pinion shaft in a horizontal position with pressure at zero. Then apply full range pressure. When the slide is close to the final correct position, the pointer rotates ¾ of a circle to a vertical position. Make adjustments of the slide until the pointer arc is correct.

Final and more precise adjustments can be made with the dial in place when the rough setting is achieved. Frequently a calibrator will find that following this rough calibration procedure, and after placing the pointer in the correct position on a low pressure value, the gauge will already be within ½ of 1%.

NOTE: The movement and linkage may be worn if the gauge has been in service for some time, or has been used on services with pulsation or vibration. If so, the complete movement and linkage should be replaced. Even slight wear that is difficult to see can cause roughness in the movement and make calibration very difficult.

The Ashcroft Maxisafe Duragauge

The Ashcroft Maxisafe Duragauge is noted for safety, accuracy, convenient maintenance and reduced calibration time. By simply turning the rear cover knob, the internal workings and all adjustments are exposed. It is not necessary to remove the dial. These features drastically lessen calibration time.

BENT POINTERS—CORRECTIVE MEASURES

BENT POINTERS are usually caused by a sudden increase or decrease of pressure. Gauges can be protected from this type of damage by the use of a link that is slotted at one end.

Figures 13 and 14 show this construction. Note that the hairspring assembly is of vital importance. A slotted link should never be used if pulsating pressures are involved because the pointer may whip around and read considerably in error.

ARRANGED FOR SUDDEN DECREASE

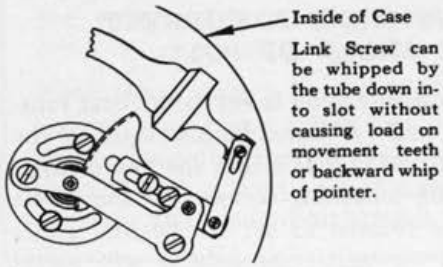


Figure 13

SLOTTED LINK

HAIRSPRING KEEPS PARTS IN PROPER ENGAGEMENT UNDER NORMAL IMPULSES

ARRANGED FOR SUDDEN INCREASE

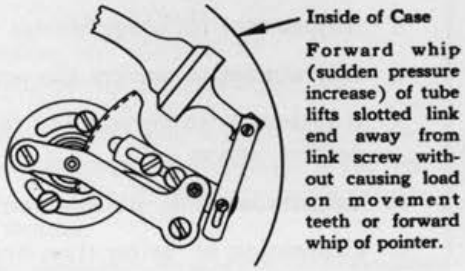


Figure 14

Pointers bent or indented by hitting the bottom edge of the stop pin are an indication that the gauge has been subjected to considerable over-pressure. For safety, the condition should be corrected or a higher range gauge should be used.

BENT POINTERS may indicate the need for throttling devices*. The Ashcroft Gauge Saver is recommended. An important advantage of this Saver is that it will not plug. When the Gauge Saver cannot be used (because of temperatures over 150°F. or because of service which will damage the Neoprene bulb) a Chemical Seal with dampening felts can be used. On clean liquids and on gases, other types of throttling devices can be used.

HOW TO MAKE ASHCROFT PRESSURE GAUGES LAST LONGER AND STAY ACCURATE WITH MINIMUM MAINTENANCE

Gauge Selection

Gauges are precision instruments. Handle them carefully.

Select a standard range gauge that is graduated to about double the average working pressure. This assures reserve strength to make the gauge last longer and the pointer will be easier to read at about top center of the dial.

Be sure to select gauges with the proper Bourdon tube metal and joint metal for the particular application.

The Ashcroft Duragauge and Maxisafe Gauges are noted for long life. It will be found that it is much more economical to use these gauges because of much longer, trouble-free service-life.

Gauge Installation

Always use a wrench on the square shank of the gauge socket to screw the gauge in place. Never apply force against the gauge case.

To screw a fitting to the gauge, hold a wrench on the socket flats. Do not twist against the gauge socket screws which hold the gauge mechanism in the case.

When installing a gauge on a wall or panel be certain that it is connected free from piping strains. Make sure the mounting surface is flat or insert washers under the flange of the gauge case to obtain three-point suspension. Preferably, the last length of piping leading up to the gauge should be flexible tubing. This insures that the gauge is free of piping strain.

Stem mounting eliminates problems of piping strain and is most economical.

Install gauges where they will not be affected by mechanical vibration, as this will wear out any gauge quickly. If possible, mount the gauge on a nearby wall and use flexible tubing to connect the gauge to a badly vibrating machine.

Protect gauges from frequent pressure pulsations by using throttle screws in the socket of the gauge, needle valves, pulsation dampeners, or Ashcroft gauge savers (See Pgs. 20, 21, 22, 23).

When mounting a gauge to indicate steam pressures, install a siphon filled with water between the gauge and the line. When the system is subject to occasional vacuum, provide a leg of piping which cannot be emptied by the vacuum effect. A drain cock or plug should be installed at the bottom of this leg to allow cleaning out of sediment. To compensate for the head effect of this piping leg, reset the pointer of the gauge.

Locate gauges where they will not be subject to high heat. In addition, high temperatures make gauges inaccurate (See Chart Page 12). Low cost gauges with soft soldered joints must not be heated or the joint will lose strength.

Install the gauge where it will be safe from moisture and corrosive fumes, if at all possible. Should this condition be unavoidable, ask your Distributor or contact Manning, Maxwell & Moore, Inc., for special recommendations.

Proper Gauge Use

Apply pressure slowly by gradually opening the gauge cock or valve. Quick opening of a gauge cock or valve places a severe strain on the Bourdon tube which may affect accuracy.

When the service has sudden pressure applications, use a needle valve or the Ashcroft gauge saver to throttle the pressure change.

Sudden pressure release has the same bad effects as sudden pressure application. It can be compensated for in the same way (See paragraph above).

Avoid over-pressure. Be sure that the apparatus has a relief valve and that the range of the gauge is higher than the set pressure of the relief valve.

Replace broken dial covers immediately. This will help keep dirt out of movement bearings and gear teeth.

* See pages 74 and 75 of Ashcroft Gauge Catalog 300B.

HEAT AFFECTS GAUGE ACCURACY

Approximate error or change in calibration of a Bourdon tube type Pressure Gauge caused by changes in temperature.

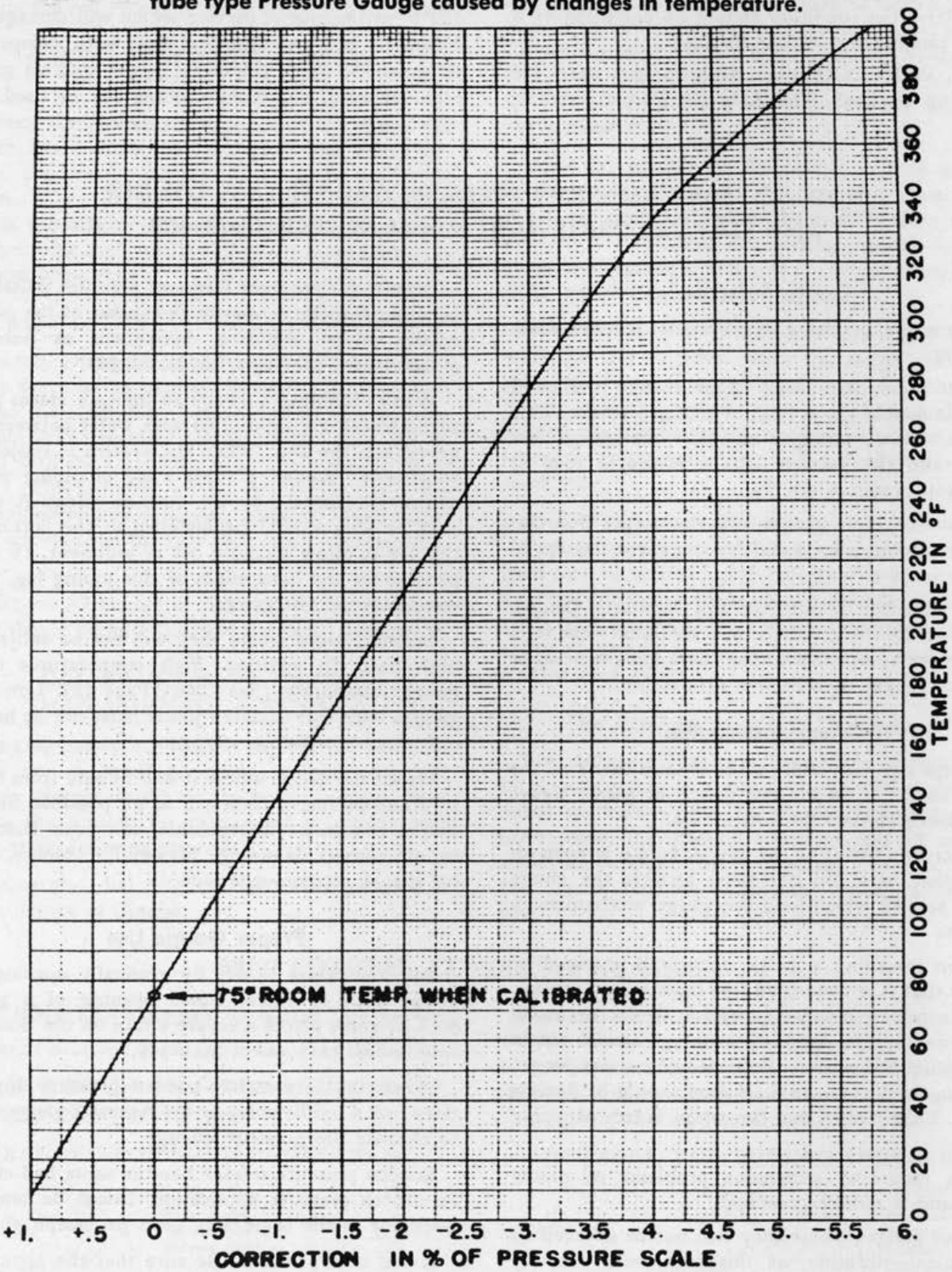


Figure 15

EXAMPLE: Gauge working at 500 psi pressure and at 280° F. temperature would have a —3% correction and would read 3% or 15 psi fast. Temperatures over 150° F. are not recommended.

GAUGES WITH RETARD MOVEMENTS

A retard gauge is one in which a portion of the total scale reading is spread out over approximately 90% of the dial. This is attained in the following manner:

A spring is attached to the gauge movement assembly so that, at the required point in the range of the gauge, the gauge movement arm comes in contact with the spring. This increases the proportionality of pressure to pointer rotation. The increased proportionality can be seen as a compressed portion of the dial scale.

Retard movements are available for all Duragauge and Maxisafe Gauges.

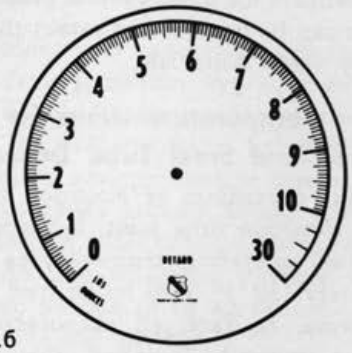


Figure 16

SINGLE RETARD
0 to 30 psi Dial

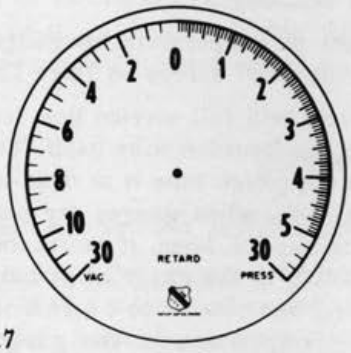


Figure 17

COMPOUND RETARD
30 psi and 30" Vac. Dial

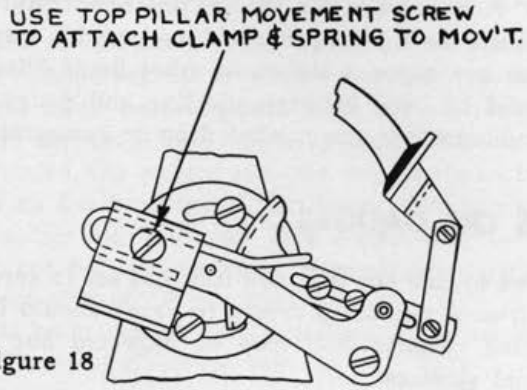


Figure 18

DURAGAUGE SINGLE RETARD
(Vacuum)

The Retard Movement feature enables the gauge reader to see his normal range of pressures on an expanded scale and, it still provides the means to read pressures well outside the normal operating range.

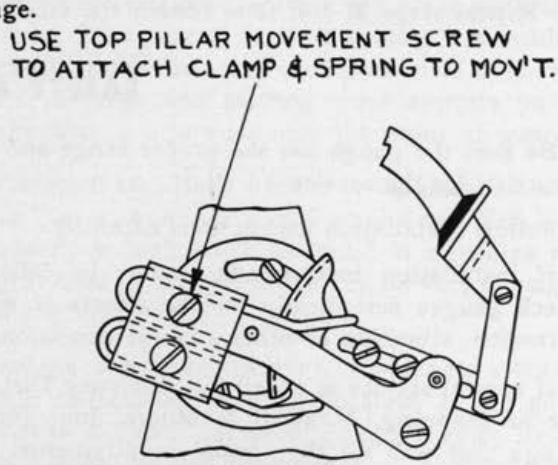


Figure 19

DURAGAUGE COMPOUND RETARD

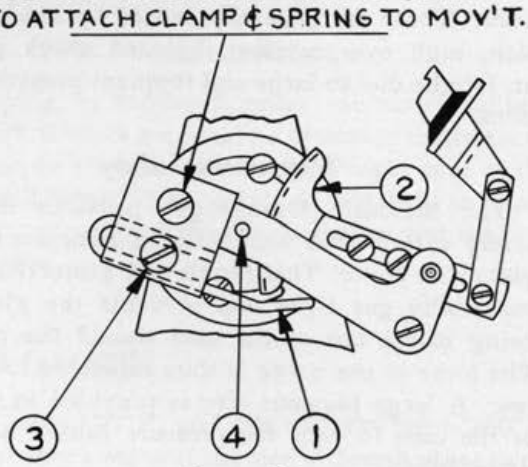


Figure 20

DURAGAUGE SINGLE RETARD
(Pressure)

TO CALIBRATE THE RETARD GAUGE

A. Calibrate the scale up to the retard portion in the usual manner. Make sure that the retard spring (1) does ***not*** contact the movement segment (2).

B. The retard portion of the scale is calibrated by adjusting the retard spring (1) to contact the movement segment at the exact start of the retard scale. The wire spring may be bent slightly to adjust the point of contact.

C. Increase the pressure to the top of the range. If the pointer runs over the pressure marked on the dial:

1. Reduce the pressure.

2. Loosen screw (3) that holds spring (1).
3. Move spring (1) a small amount toward the pinion (4).

(If the pointer runs below the top of the dial, pull out the spring).

D. Repeat steps B and C to obtain the contact of the spring at the start of the retard portion of the dial and to obtain the correct strength of the retard spring by adjustment of its length. Fine adjustment of the spring can be made with the wiggler tool (Catalog No. 1105W). Do not expect the retard portion of the scale to be as accurate as the unretarded range.

SAFETY RECOMMENDATIONS

Be sure the gauge has the proper range and construction for the service.

Follow installation instructions carefully.

If installation instructions cannot be followed, check gauges periodically for the effects of water, corrosion, vibration or other adverse conditions.

If special service is called for, ask your Distributor or Manning, Maxwell & Moore, Inc., for the gauge that will fill the special requirements.

NOTE: A good gauge, properly selected and installed, should never fail by rupture of the Bourdon tube. However, on rare occasions, some failures do occur. These are generally caused by hidden corrosion, high overpressure, repeated shock pressure, or, fatigue due to large and frequent pressure pulsations.

Maximum Safety

The Maxisafe Duragauge* provides maximum safety with a solid wall between Bourdon tube and glass dial cover. This tough and protective wall is essentially gas tight and prevents the glass from being blown out of the case should the tube fail. The force of the break is thus expended toward the rear. A large blowout disc is provided in the back of the case to vent the pressure caused by a ruptured tube.

The Maxisafe Duragauge also features quick and easy access to operating parts—without removing the dial.

As an added safety feature a blowout disc can be installed in conventional Ashcroft Gauges such as the Duragauge. A special synthetic rubber disc is available which is especially designed for Refinery gauge applications. This disc has greater corrosion resistance than metal blowouts, and makes a more practical dust and moisture proof seal. It is applied in a 1" diameter hole drilled in the wall or back of the gauge case. This disc blows out at low pressure —well below the breaking pressure of even plain glass for gauge sizes up to 8½".

As a substitute for glass covers, plastic or shatterproof glass can be provided to attain the advantages afforded by these materials.

Temperature Limits for Bronze and Steel Tube Duragauges

No gauge, regardless of Bourdon tube material or type of Bourdon tube joint, is recommended for use in actual operating temperatures higher than approximately 150 °F. This holds true for all gauge manufacturers. In fact, all manufacturers recommend that a siphon be installed when a gauge is to be used on high temperature steam or liquid services**. This procedure provides both additional safety and accuracy.

The effect of temperature on gauge accuracy is shown by the chart curves on Page 12.

Only rarely will full service line temperature be attained in the Bourdon tube itself. This is because the line to the gauge tube is at dead-end and cools. For that reason, when gauges are piped into high temperature service lines, it is recommended that the line leading to the gauge be as long as possible. A connecting line about 5 to 6 feet long will usually reduce the temperature of the gauge to approximately normal atmospheric temperature.

This generally keeps gauge temperature below 150° F. even when the process line temperature may be quite high. When the fluid measured is steam, or other hot vapor, a siphon or other liquid-filled tube should be used between the line and gauge. This should provide the needed drop in temperature.

CALIBRATION CHANGES ON GAUGES

Drift

Pressure elements of all Ashcroft Gauges are given a stress relieving heat treatment that prevents drift due to aging. Gauges that have been overpressured so that the Bourdon tube has set (a zero shift seen as a failure to return to zero) should be discarded because drift may be expected due to internal stresses.

* See Ashcroft Gauge Catalog 300B, Page 20.

** See Page 23.

Overpressure

When a gauge is overpressured to the extent of causing a pointer position shift of equal value all over the dial, the condition is known as "Set." If this occurs, the system should be discarded and replaced.

Bourdon Tube Corrosion

Corrosion of a Bourdon tube will result in a weakening of the tube, causing an error of indication that is greater at the high end of the scale than at the low end. For example, error on a 100 psi range may be +2 at 10 psi, +10 at 50 psi and +18 at 90 psi. Frequently corrosion proceeds so quickly that the tube will rupture before a change in indication is detected.

Bourdon tubes may fail from corrosion, overpressure fatigue from pulsation, hydrogen embrittlement or pressure shock. These conditions are often difficult to find, the first indication being rupture of the tube. Corrective and preventive measures for failures of these types include proper Bourdon tube material selection, adequate pressure ranges, overpressure stops and throttling devices. Shock pressure may also be caused by an operator who opens or closes valves too quickly.

After failure, a metallurgical examination of the tube should show whether trouble occurred because of corrosion or mechanical difficulties. If failure is due to corrosion, a more suitable tube material should be chosen or, in some cases, a chemical attachment should be used. Recommendations of this type can be made by Ashcroft when complete service details are supplied.

Gear Teeth and Bearing Wear

Gear teeth and bearing wear can cause calibration changes. This type of wear is usually the result of vibration, pulsation, or a combination of both. Evidence of teeth and bearing wear appears on the mechanism as a powder near the point of wear.

Vibration amplitude itself may be of such a small value that it cannot be seen with the eye. Yet, if the frequency is high (such as found in a turbine running at 3600 or 7200 RPM), it can be very damaging to a pressure gauge.

Gauges subjected to high frequency vibration should be isolated if at all possible. If the gauge cannot be isolated, dustproof gauges may be treated with a high quality instrument oil that will help lengthen their life. A more certain solution is to use the higher quality Ashcroft Duragauge in place of a lower quality gauge.

Mishandling

Dropping, or hitting a gauge can cause calibration shift. Gauges are genuine precision instruments and must be treated accordingly. Proper care of the gauge will lengthen its service to you, help to retain its accuracy and to lower maintenance and replacement costs.

REPLACEMENT PARTS FOR GAUGES

Gauge System Assemblies

When replacing a gauge system be sure to use the same system material originally used in the gauge —unless service shows that another material should be chosen.* Duragauge dials identify the material of the system and sockets are stamped with catalog suffix letter code for material.

Ashcroft Bourdon tube joints are designed to meet specific service requirements. Ashcroft Duragauges have welded joints with the exception of bronze and beryllium copper systems which are silver brazed. On welded systems weld material is the same as the base metal. On lower quality gauges soft solder may be used. Soft solder joint systems must not be used on high temperature application as joint strength is not adequate. Although gauges should be protected against temperatures exceeding 150° F., welded joints will stand 750° F., silver brazed joints 450° F., and soft soldered joints 250° F. for short times without rupture although other parts of the gauge will be destroyed and calibration will be lost.

When replacing a gauge system be sure to use the proper pressure rated system. This is identified on the system by the stamped range value.

The Lower Connection Gauge Illustration (See Page 16) shows gauge parts and standard names. Use these names to facilitate the ordering of parts and to eliminate any misunderstanding in describing gauge construction.

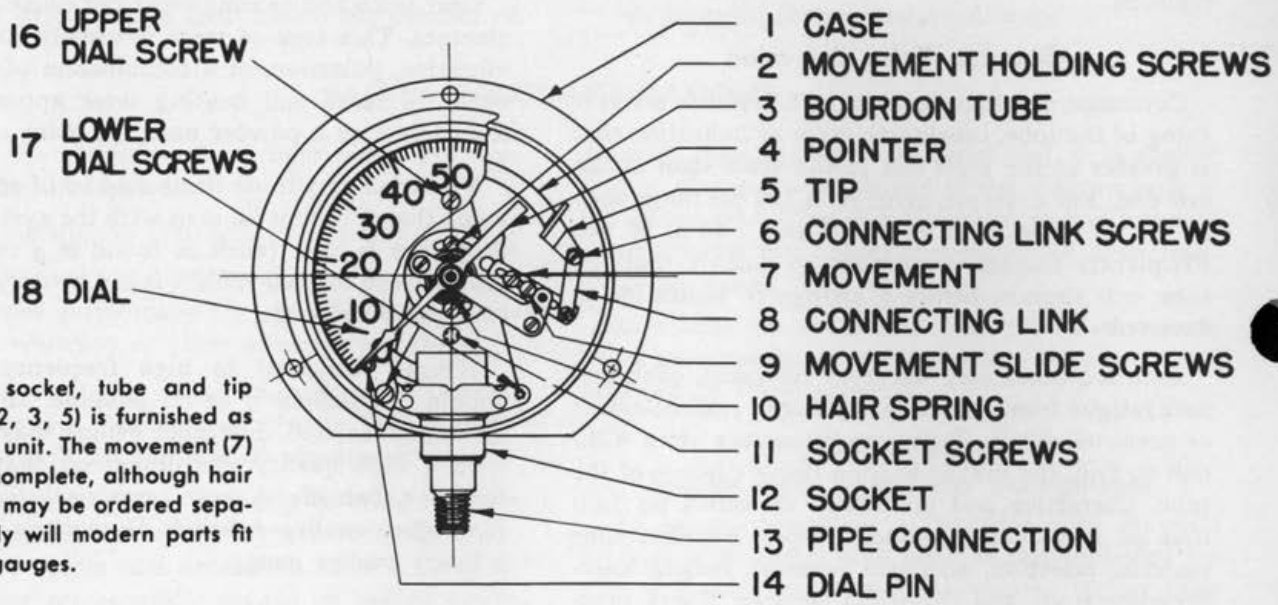
Specify as much of this data as possible:

- Size (Dial diameter)
- Case material (Iron, Alumalife, Phenol)
- Ring design (Slip, Threaded, Snap, Hinged)
- Connection location (Lower, Back)
- Connection size (¼", ½", etc.)
- Bourdon Tube (Material)
- Dial Range
- Class of Gauge
- Catalog Number if possible; otherwise mention whether parts are for Duragauge, Quality Gauge or Special Application Gauge.

* Pages 14 and 15 of Ashcroft Gauge Catalog 300B tabulate the materials.

NAMES OF GAUGE PARTS

LOWER CONNECTION GAUGE



NOTE: The socket, tube and tip assembly (12, 3, 5) is furnished as one integral unit. The movement (7) is supplied complete, although hair springs (10) may be ordered separately. Rarely will modern parts fit in old style gauges.

Figure 21

WITH SLIP RING

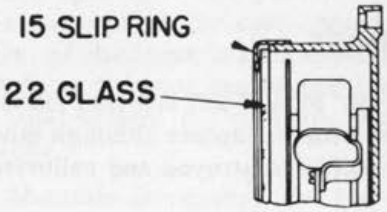


Figure 22

WITH SNAP RING

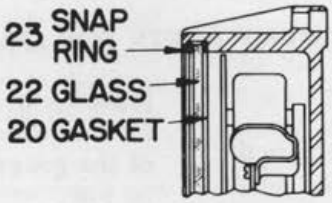


Figure 23

WITH THREADED METAL RING

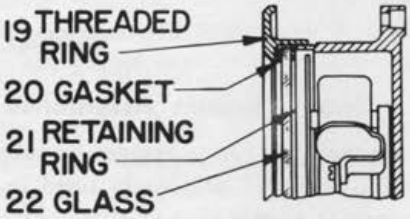


Figure 24

WITH THREADED PHENOL RING

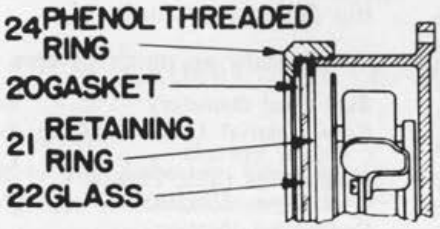


Figure 25

WITH HINGED RING

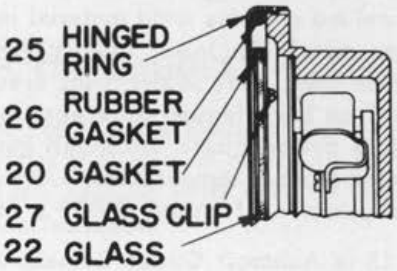


Figure 26

MOVEMENT ASSEMBLIES FOR GAUGES

Ratio of Movement

When movements are replaced be sure that the proper ratio of movement is used. On Ashcroft Duragauges the ratio is stamped on the segment of the movement. With a little experience it is easy to recognize the ratio by the size of the pinion gear.

Material

The proper material is of prime importance in the selection of movement assemblies. Brass movements will not wear as well as Ashcroft Nylon or Stainless Steel movements do in Duragauges. The proper link and link screw must be used. A high quality movement will not stand up if a low quality link or link screw is used.

Replacement Pointers

Replacement pointers received from the manufacturer must be reamed so that when driven on a pinion they will be at the correct height (1/16" to 1/8") above the dial. A complete selection of reamers (6 sizes in Catalog No. 1105 Series) is shown on Page 8.

Gauge Movement Ratios

Gauge sizes to 3½" inclusive — 12:1 Ratio
"Quality" Gauges, All Sizes — 12:1 Ratio
"Duragauges" — As listed below in Table

Duragauge Type in Terms of Tube Material	Maximum Dial Graduation P.S.I.	Movement Ratio		
		12:1	16:1	25:1
All Materials	500	x		
4½" Thru 12" Sizes—Bronze Only	1000	x		
6" Size and Larger—All Materials Except Bronze	Over 500 to 14,999 inclusive		x	
4½" Size—All Materials Except Bronze	Over 500 to 20,000 inclusive		x	
6" Size and Larger—All Materials Except Bronze	15,000 and over			x

ASHCROFT TYPE 1165 & 1166 ELECTRIC WARNING CONTACTS

Electrical Ratings

The Ashcroft Type 1165 and 1166 Electric Contacts have been checked for continuity and are ready for rated voltage. The Contacts are rated ¼ amp. at 220V and ½ amp., at 110V AC or DC, non-inductive. Lower voltages are frequently more convenient. Relays should be used to carry heavy current.

Accuracy

Due to the slight drag of parts of the Electric Contacts, an additional ½ of 1% is added to gauge accuracy. The accuracy is only slightly affected when a contact is not made. The two contact arms can be set as close together or as far apart as wished. The make and break points are the same (within about ½%) for either of the contacts.

Mounting

Wall mounting Duragauges or Maxisafe Duragauges equipped with Type 1165 Electric Contact is the same as mounting standard gauges. Each gauge contact ring assembly provides a ½" NPT female connection for attaching flexible electrical conduit.

Flush mounting Duragauges or "Maxisafe Duragauges," Series 1077, 1377, etc. equipped with Type 1166 Electric Contacts requires panel modifications in accordance with the Panel and Gauge Modification Table on Page 18.

Application of Type 1165 Electrical Contact to wall mounted Duragauges, Maxisafe Duragauges and Quality gauges, and Series 1079, 1379, 1010, etc. in the field.

1. Accommodations for contact lead wires are provided in ring assembly.
2. Modify the 8½" gauge pointer as shown in Figure 27 drawing. No modifications are required of 4½" and 6" sizes.
3. Assemble contact ring assembly to the case by placing the yoke of the electric contacts over the tail end of the gauge pointer at zero pressure.
4. Mount ring assembly and tighten set screws.

Application of Type 1166 Electrical Contact to flush-mounted Duragauges and Maxisafe Duragauges, Series 1077 and 1377 in the field.

1. Modify the 8½" pointer per directions in Figure 27. No modifications are required of 4½" and 6" sizes.

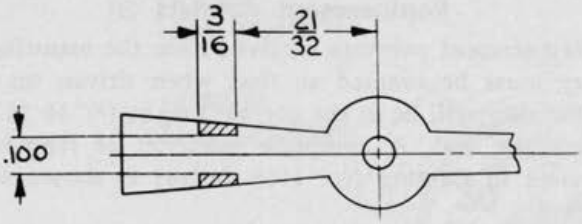


Figure 27

8½" POINTER MODIFICATION

2. Make an additional hole through the gauge case and the mounting panel — of the size and location shown in Panel and Gauge Modification Table for the passage of the contact leads.
3. Pass the contact leads through the holes in the gauge case and panel.
4. Assemble the ring assembly to the gauge by placing the yoke of the electric contacts over the gauge pointer at zero pressure.
5. Mount ring assembly and tighten thumb screw.

PANEL AND GAUGE MODIFICATION TABLE

Gauge Size	A	B (Lead Hole)	
		Panel	Gauge
4½"	2 39/64"	¼"	¼"
6"	3 23/64"	¼"	¼"
8½"	4 39/64"	¼"	¼"

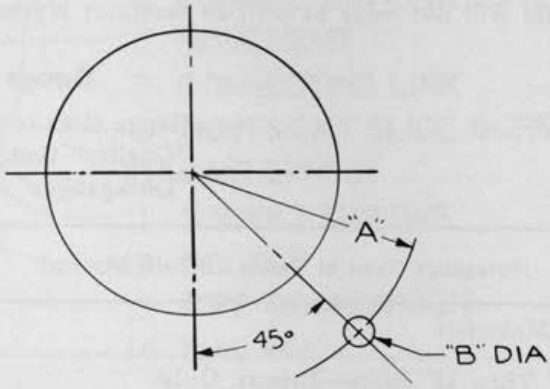
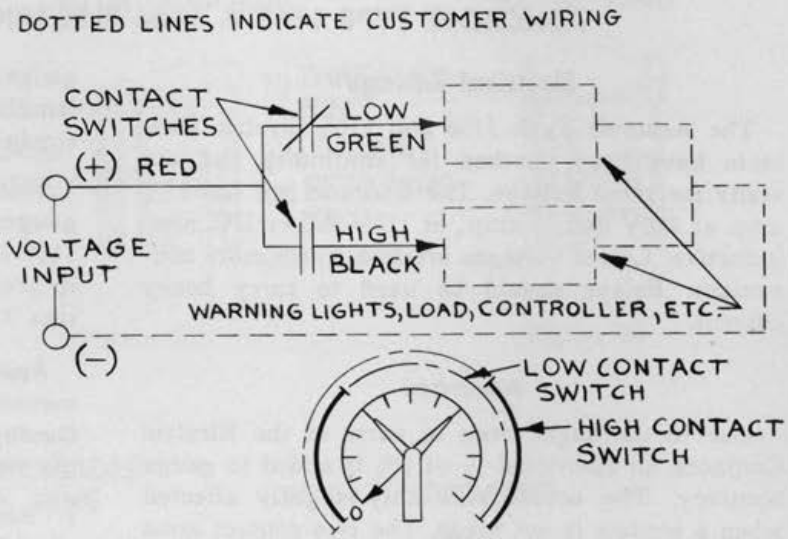


Figure 28

WIRING

These Schematic Wiring Diagrams illustrate contact arrangements for both the 1165 and 1166 Electrical Contacts. They indicate wire color code and the higher and lower contact settings.

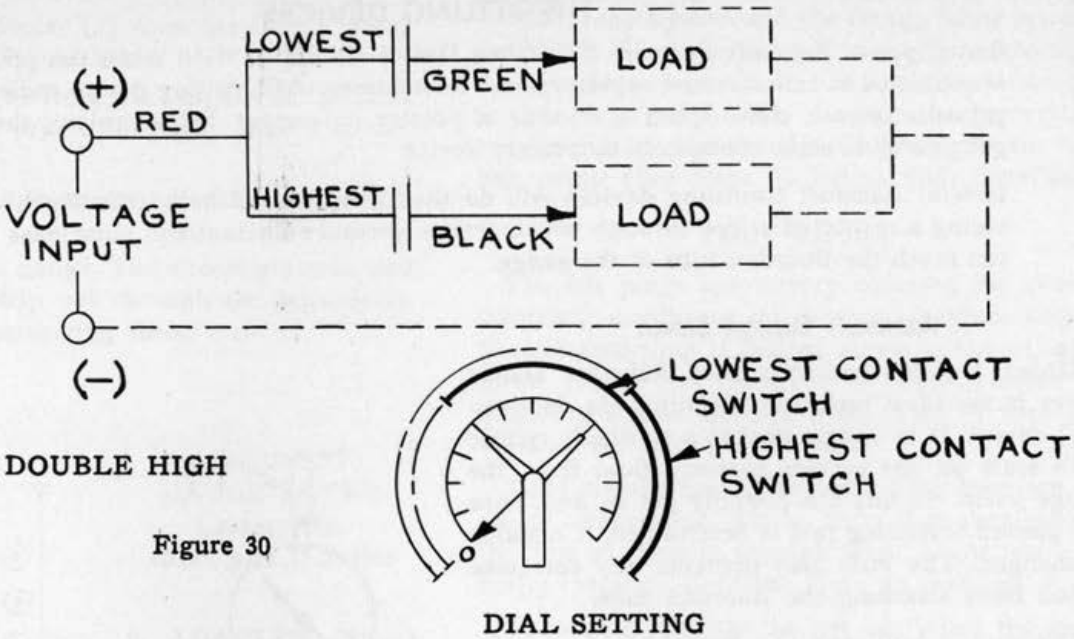


HIGH AND LOW

Figure 29

DIAL SETTING

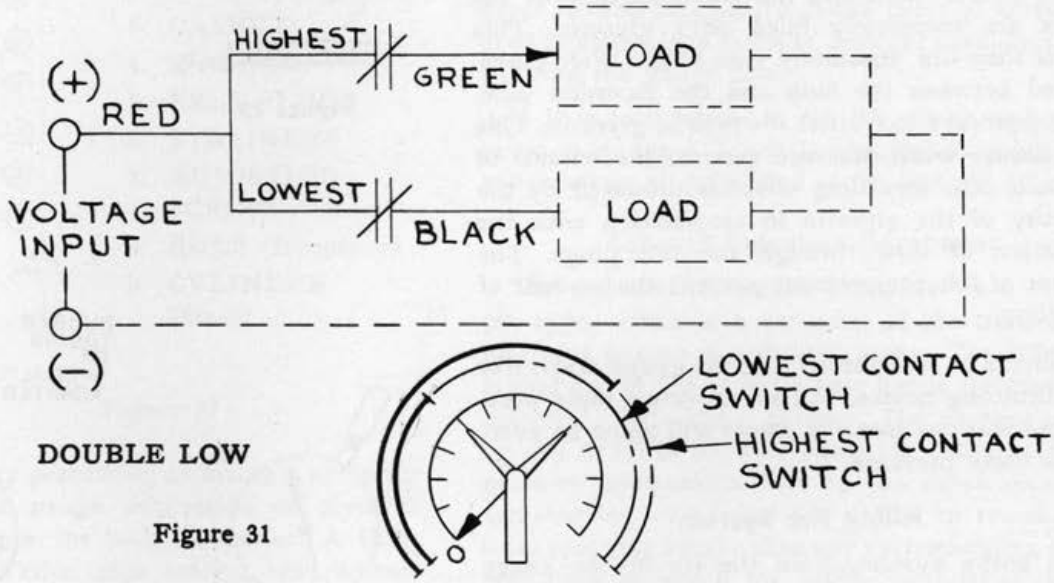
Broken lines indicate contact open.
Solid lines indicate contact closed.



DOUBLE HIGH

Figure 30

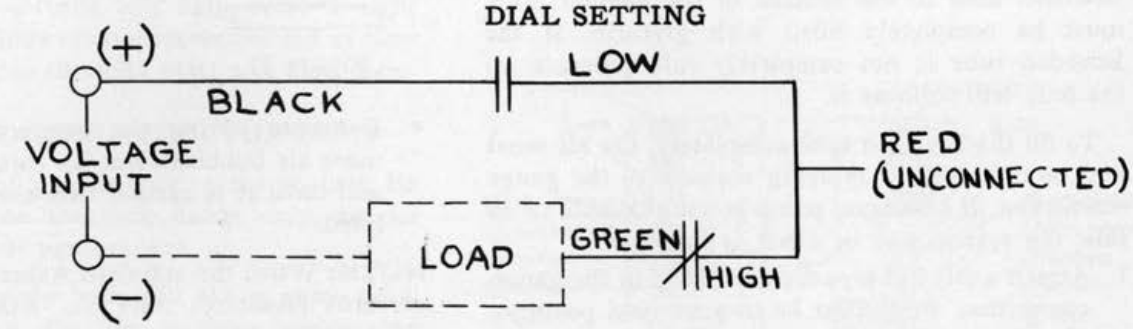
DIAL SETTING



DOUBLE LOW

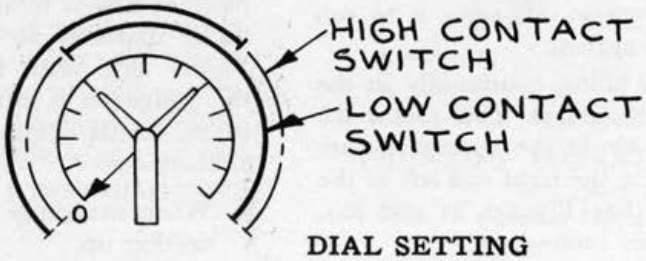
Figure 31

DIAL SETTING



OFF HIGH AND LOW

Figure 32



DIAL SETTING

THROTTLING DEVICES

Some type of Ashcroft Pressure Throttling Device should be used when the pressure gauge is subjected to constant and rapid pressure fluctuations. A throttling device radically reduces pressure impact, slows speed and range of pointer movement, helps prolong the life of the gauge and, in some types, acts as a safety device.

Several Ashcroft throttling devices will do this. They are all based fundamentally on providing a restricted orifice through which service pressure fluctuations must pass before they can reach the Bourdon tube of the gauge.

Ashcroft Gauge Saver

Under proper conditions, the Ashcroft Gauge Saver is the ideal pressure throttling (or dampening) device. It is unique in that a synthetic rubber bulb seals off the service pressure fluid from the gauge itself. No dirt can possibly get in, and, once the desired throttling rate is determined, it remains unchanged. The bulb also prevents any corrosive action from attacking the Bourdon tube.

The rubber bulb and the Bourdon tube of the gauge are completely filled with glycerin. This means they are absolutely free of air. Felt plugs, located between the bulb and the Bourdon tube, are compressed to restrict the flow of glycerin. This flow occurs when pressure acts on the outside of the bulb. The throttling effect is produced by the viscosity of the glycerin in conjunction with the restriction of flow through the felt plugs. The amount of felt compression governs the amount of throttling.

It should be understood that the gauge saver, like any throttling device, will so cut down rapid pressure fluctuations that the gauge will show an average or mean pressure.

Filling the System

The entire system, from the tip of the gauge Bourdon tube to the bottom of the adapter bulb, must be completely filled with glycerin. If the Bourdon tube is not completely full, pressure on the bulb will collapse it.

To fill the Bourdon tube completely, the air must first be removed by applying vacuum to the gauge connection. If a vacuum pump is not available to do this, the system can be filled as follows:

1. Attach a piece of pipe about 6" long to the gauge connection. Pipe must be in a vertical position. (See Figure 33).
2. Fill the pipe with glycerin, allowing it to run down into the gauge system.
3. While gauge system is filling, continually jar the gauge gently on a soft surface. This forces the glycerine to displace air in the spring. Rotate the gauge a few times to the right and left as the glycerin is going in (See Figures 34 and 35). You will see air bubbles coming up.

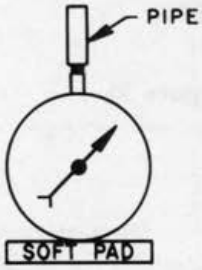


Figure 33

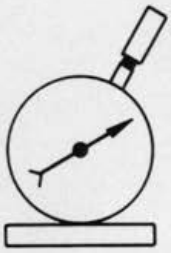


Figure 34

Figure 35

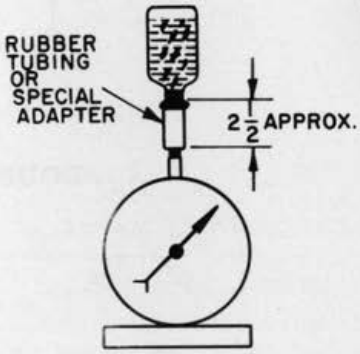


Figure 36

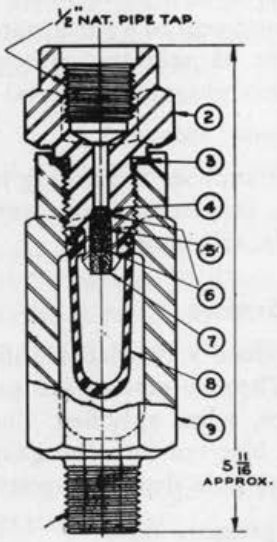
4. Continue jarring the gauge and fill until no more air bubbles come up through the glycerin, and until it is certain that the gauge system is filled.

NOTE: When the standard Ashcroft 2 oz. bottle of glycerin (Ashcroft Part No. AGA41) is used, it can be attached to the gauge connection by a short piece of rubber tubing. Tubing should be about ½" inside diameter for a ¼" gauge connection. (See Figure 36). With the bottle attached, gently jar the gauge on a soft surface. Air bubbles will rise in the bottle. Continue jarring until no more air bubbles rise.

5. When the gauge is filled, set it aside with connection up.

FILLING THE GAUGE SAVER

1. Unscrew the adapter (2) from the Gauge Saver cylinder. (See Figure 37).
2. Pull the bulb (5) from the adapter. If the bulb seems to stick, pry it off gently with a screwdriver.
3. Fill the adapter to the top of the threads with glycerin.
4. Screw it on the gauge. The excess glycerin will overflow and drip out through the felts (4B), thus properly saturating them.



ASHCROFT
GAUGE SAVER
Catalog No.
1073C and D Series

2. ADAPTER (Steel)
3. GASKET
4. WASHER
5. FELT PLUGS
6. STRAINERS
7. ADJUSTING SCREW
8. BULB (Neoprene)
9. CYLINDER (Steel)

Figure 37

NOTE: Take every precaution to insure a perfectly tight joint at the gauge connection as glycerin leakage can collapse the bulb in service. A little nylon thread or Teflon pipe sealing tape wound around the male threads will help make a tight joint. Pipe compounds are not recommended as they might be forced into the felts (4B) and clog them.

FILLING AND REPLACING THE BULB

1. Fill the bulb and push it back on the adapter. Be sure to push on the bulb flange only, so the glycerin will not squeeze out.

NOTE: Replacing the bulb will set up some pressure on the gauge. On low pressure gauges the pointer will move above zero. When this happens, pressure must be released. This is easily done by squeezing the bulb just enough to force out a few drops of glycerin until the gauge pointer returns to zero. While doing this keep the gauge upright. This insures that the weight of the glycerine and the internal parts will not exert a misleading effect on the pointer.

2. Screw the cylinder on the adapter.

The Gauge System and the Gauge Saver are now completely filled. Be sure all connections are tight. Any pressure on the bulb will now be transmitted to the gauge mechanism through the glycerin. If convenient, try out the throttling adjustment on a test pump (See Page 6) before final installation.

FELT PLUGS

The felt plugs are factory adjusted for average throttling conditions on medium pressure service. If more throttling is desired, screw in the adjusting screw (4). If less throttling is needed, loosen the adjusting screw. Usually from ¼ to ½ turn provides all the variation required.

Felts should not be so loose that they are not under compression, nor so tight that they prevent the flow of glycerin through them. Looseness gives faulty readings, tightness gives no readings at all.

Throttling felts can be left out when the gauge saver is used as a safety device only, or when it is used to stop sticky fluids or harmful chemicals from entering the gauge tube.

If it is impractical to fill the gauge and gauge saver, order the Ashcroft Duragauge, complete with gauge saver, already filled at the factory.

Ashcroft Pulsation Dampener

The Ashcroft Pulsation Dampener is a moving pin type, which is a variation of the fixed orifice hole type known as a throttle screw. The difference is that the orifice is not a hole but is the clearance between a hole and a plunger. The plunger moves up and down in the hole under the influence of the pressure fluctuations. The up and down motion is self-cleaning and helps the device to remain free from plugging longer than any corresponding orifice area type in which the orifice boundaries do not move.

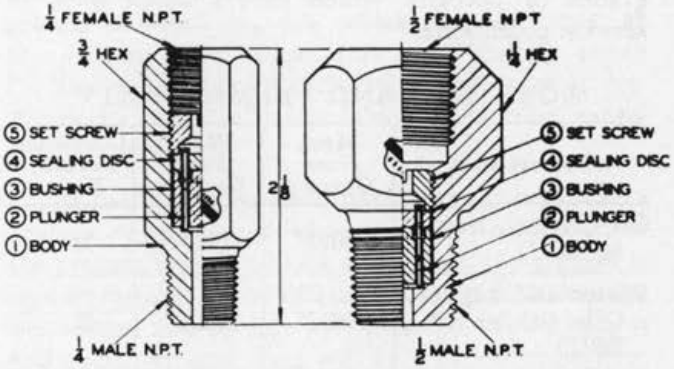


Figure 38

ASHCROFT PULSATION DAMPENER
(U. S. Patent 2,370,965)
Catalog No. 1106 Series

The clearance between the plunger and the hole is just sufficient to provide the proper throttling action under certain conditions.

Since no throttling device is effective under all conditions (such as scope and rapidity of pressure fluctuations, and viscosity of pressure medium), **five** different size holes are provided. They are numbered 1 to 5 in the bushing (3). The plunger may be transferred easily from one hole to another, depending on how much dampening is required.

The sealing disc (4) seals off all holes except the one in use. Number 1 hole has the smallest diameter and provides the largest dampening effect because it has the least clearance between plunger and hole. All dampeners are shipped with the plunger in the No. 3 hole.

The ¼" size is only made in brass; and both ¼" and ½" sizes in free cutting 18% chrome, 8% nickel stainless steel. The dampener operates in any position.

Ashcroft Chemiquip Pressure Snubber

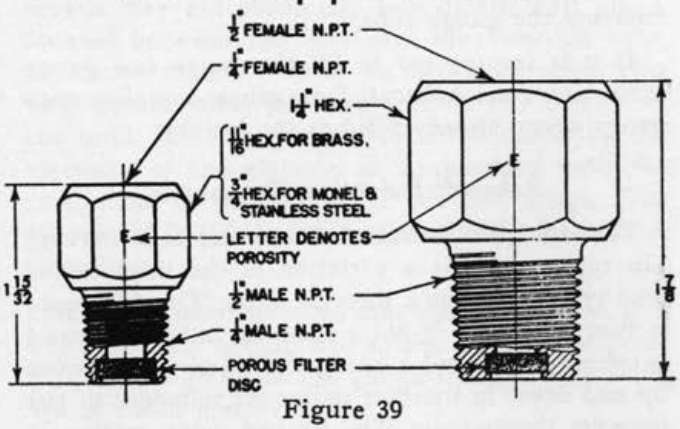


Figure 39

Catalog No. 1112 Series

The heart of the Ashcroft Chemiquip Pressure Snubber is a ⅜" diameter by ⅛" thick porous metal filter disc. The disc is available in four standard grades of porosity which covers about 95% of service conditions.

PORE SIZE AND PERMEABILITY

For use with	Mean Pore Opening	Max. Pore Opening	Chemiquip Porosity Desig.
Oil (Heavy, over 50 SSU)	.0025"	.005"	D
Water and Light Oils (under 50 SSU)	.0013"	.0025"	E
Air, Steam & Gases	.0004"	.0009"	G
Mercury Manometer	.0002"	.0006"	HX
——	Approx.	Approx.	——

TO CLEAN SNUBBERS

All snubbers can be washed in solvents such as carbon tetrachloride, benzine, naphtha, etc. For chemical cleaning of various metals, these solutions are effective:

Brass: 1 part caustic soda to 6 parts water. Boil from 15 to 45 minutes.

Stainless Steel: 1 part caustic soda to 6 parts water or 1 part nitric acid to 6 parts water. Boil from 15 to 45 minutes. (Choose solution in which plugging material is most soluble)

Monel: 1 part caustic soda to 6 parts water or 1 part hydrochloric acid to 6 parts water. Boil from 15 to 45 minutes. (Choose solution in which plugging material is most soluble).

NOTE: After boiling, wash snubber in running tap water for about 45 minutes. Do not force tap water through the snubber as this will plug it.

Throttle Screws

The simplest way to produce a restricted orifice is with a throttle screw. Throttle screws are provided with Ashcroft Gauges, when specified. They have a small hole and are inserted into the gauge socket inlet. The size of the hole depends upon:

1. Viscosity of the pressure fluid
2. Rapidity of pressure fluctuations
3. Amount of throttling effect desired

CONSIDER THESE VARIABLES WHEN CHOOSING A THROTTLE SCREW:

A. The greater the viscosity of the pressure medium, the larger the orifice.

B. The greater the pulsation frequency, the smaller the orifice.

C. The greater the pressure, the smaller the orifice.

D. The amount of pointer travel desired.

E. The volume of the Bourdon tube.

Due to these variables, it is usually necessary to test several hole sizes to get the right one. A series of six hole sizes covers the average services encountered. Sizes are: .006", .0135", .020", .031", .040" and .070".

If proper hole size is unknown, contact your Distributor or Manning, Maxwell & Moore, Inc. Furnish kind of pressure fluid with viscosity data (if possible) and the frequency of pressure fluctuations per minute. This will aid greatly in selecting the most efficient throttle screw.

The major disadvantage of any throttle screw is the possibility of the hole plugging up, causing the gauge to stop functioning.

STANDARD MATERIAL IS BRASS EXCEPT FOR AMMONIA SERVICE

Campbell Micro-Bean

Catalog No. 1110 Series

The Micro-Bean is instantly adjustable to all conditions of flow, viscosity and surface tension. A very slight taper on the micro valve stem fits into a tapered hole in the body. The degree of dampening is easily adjusted by turning the micro valve. A filter is built into the Micro-Bean to keep dirt from plugging the dampening valve. The adjustment is not critical.*

Ashcroft Steel Needle Valve

Catalog No. 7001, 7002, 7003 and 7004 Series

The Ashcroft Steel Needle Valve provides a means of getting the exact orifice needed for any specific service.** Even though this ideal orifice may be so restricted that it may eventually plug up, the needle valve can easily be opened to allow the pressure fluid to clear away the obstruction. It should be reset to the proper throttling position. Operators are cautioned about changing the valve setting.

HOW TO DECIDE WHICH TYPE OF THROTTLING DEVICE TO USE

- The Ashcroft Gauge Saver gives the best service and should be used whenever possible.
- The Pulsation Dampener is the most universally suitable because it provides five possibilities of throttling effect and has a self-cleaning action.
- The Chemiquip Pressure Snubber may be used where systems have some solid inclusions.
- The Throttle Screw is the simplest way to get a restricted orifice but finding the correct hole size is somewhat complicated. There is the possibility, also, of hole plugging.
- The Campbell Micro-Bean allows quick adjustment of the degree of dampening.
- The Needle Valve has the widest range of general application where corrosive conditions do not prohibit its use.

THE GAUGE SIPHON

The use of a gauge siphon, sometimes known as a pigtail because of its shape, has long been standard practice on gauges installed on steam lines. The use of a siphon in these installations is to reduce the temperature of the pressure gauge below that of the steam being measured. If a siphon were not used, steam from the process would enter the socket and Bourdon tube of the pressure gauge, condense on the relatively cool metal and the condensate would then drain back into the process line allowing more steam to enter the Bourdon tube. Because of the very rapid heat transfer of condensing steam, and due to the continual circulation of steam into the gauge, the Bourdon tube would rapidly be heated to the temperature of saturated steam at the pressure being measured. These temperatures are higher than are desirable in a pressure gauge and can cause unsafe conditions when non-welded Bourdon tube joints are used because of the weakening of the joint by the excessive temperature.

When a siphon is installed, and the installation is operated properly, the gauge will be protected from excessive temperature. As the valve connecting the gauge to the line is opened slowly, steam will slowly enter the siphon and condense ***in the siphon*** to form water. Within a short time, this water will completely fill the Bourdon tube and most of the length of the siphon. This will completely block the entrance of steam to the pressure gauge. Steam will still enter the lower portion of the siphon and condense there, heating this portion to the temperature of the steam. The length of water filled siphon leading up to the pressure gauge is not heated directly by the process steam, but only by the conduction of heat along the siphon from the hot end up to the gauge. Tests and field practices have shown that the temperature very rapidly drops along a liquid filled siphon so that only six inches to one foot of liquid filled pipe will drop the temperature from several hundred degrees, which may be found at the process, to a temperature only slightly above the air temperature surrounding the pressure gauge. Thus, the pressure gauge is protected from excessive temperatures.

The use of a siphon will not always prevent overheating of the gauge when it is first connected to the process line. If a block valve from the process is opened rapidly, steam will immediately rush through the siphon and up into the Bourdon tube where it will condense, and there will be a period of perhaps one or two minutes when the Bourdon tube will be heated to the process temperature before the condensate from the steam will fill the Bourdon tube and the gauge end of the siphon. This condition can be dangerous and can cause harm to the pressure

---

* See Ashcroft Gauge Catalog 300B, Page 79.

** See Ashcroft Gauge Catalog 300B, Page 78.

gauge. Opening the block valve slowly, while at the same time cooling the siphon by the application of water, or wet rags, will insure that the steam condenses in the siphon and not in the gauge until enough condensate has been formed to block the entry of steam to the gauge. Another recommended way of installing a siphon to prevent the initial surge of steam into the gauge is to fill the gauge system and the siphon with water at installation and prior to opening the valve connecting it to the process. This is the most foolproof system and is recommended.

While the gauge siphon is used primarily for steam measurement, it should be used on measurement of all condensable, hot vapors. Various fluids other than water are used for heat transfer by boiling them and conducting the vapor to a radiator or kettle to be heated where they will condense and release the heat. Some of the more common fluids, other than water, which are used for this application are Dowtherm and Mercury. The reasons for using siphons on these condensable vapors are exactly the same as for using a siphon on steam.

The most common way to provide a liquid seal between the condensable vapor and the pressure gauge is a siphon, but other configurations of the connecting piping are acceptable and are occasionally more convenient. All that is required is that there be a low point in the tubing connecting the process to the pressure gauge where the condensate from the vapor can collect and form a liquid seal to prevent entry of the vapors into the pressure gauge. This low point should be a foot or more away from the gauge.

INSTALLATION OF GAUGES TO HOT LIQUID AND GAS LINES

There are frequent questions as to the proper method of connecting a pressure gauge to a hot process line carrying liquid or hot gas, but not a condensable vapor. There are several acceptable ways to make this connection so that the pressure gauge will not be overheated. Perhaps the most foolproof installation is by the use of a chemical seal and capillary line between the process fluid and the pressure gauge. Even a relatively short capillary line of one foot will prevent the high temperature of the chemical seal from reaching the pressure gauge. There are times when a chemical seal and line are preferable to a siphon for use on steam. The most common example is where the water filled gauge might freeze.

The most common installation of a pressure gauge to a hot line is simply through a conventional length of connecting piping. As there is not the very high rate of heat transfer which occurs with the condensation of a vapor, there is only the very slow rate of heat transfer through the piping and liquid, just as there is in the liquid filled portion of a gauge siphon. Tests have shown that a water filled length of ½" connecting pipe only 1 foot long will reduce a process temperature of 200° F. down to approximately 120° F. at an atmospheric temperature of 80° F. Even with a process temperature as high as five or six hundred degrees F., 3 or 4 feet of ½" connecting pipe is normally sufficient to reduce the temperature at the pressure gauge to an acceptable value. The use of connecting tubing or piping smaller than ½" size will reduce the length required to get the necessary cooling.

LIQUID FILLING PROCEDURES FOR CHEMICAL GAUGES AND ATTACHMENTS

Three rules are vital to the proper filling of Ashcroft Chemical Gauges and attachments. They are:

1. The fill fluid must completely fill the gauge and top part of the seal.
2. The fill fluid must be uncontaminated with other fluids which will boil or decompose to form gas at the operating temperature.
3. The seal diaphragm must be operating in its free position.

These rules are most important for low pressure ranges, especially vacuum ranges, and for seals that are to be operated at high temperatures. Failure to obtain good fill will result in temperature errors and loss of accuracy. It can also cause nonlinearity of calibration.

The seal must not leak! Take special care to be absolutely certain of this. The small amount of liquid in the seal means that even the smallest leak will allow the fill to escape, making the seal inoperative.

Two Ways to Fill Chemical Seals

1. WITH EVACUATION

The best, and most universal, filling procedure is to evacuate the seal assembly and allow the fill to flow into the completed unit. Apply a few pounds pressure, if necessary, to drive the fill into the assembly.

On both evacuation and filling, it is important to equalize the pressure across the diaphragm. This prevents deforming of the diaphragm when the fill is let in.

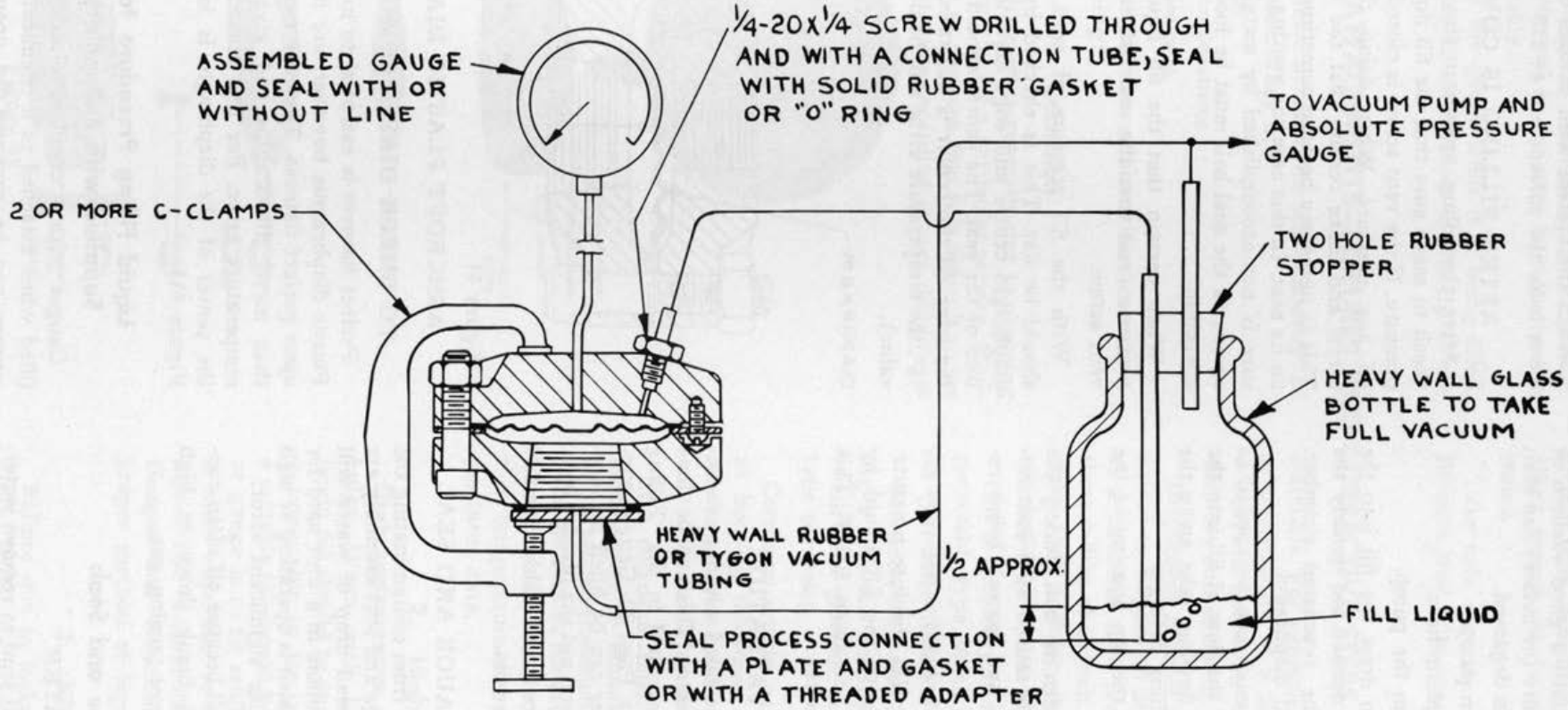


Figure 40

Simple Set-up for Filling Chemical Seals (Evacuation Method)
This set-up degasses the fill at the same time that the seal assembly is evacuated.

EVACUATION METHOD

1. Operate vacuum pump until a good vacuum of 1 mm HG absolute pressure (or better) has been drawn and until the fill is degassed.
2. Then shut off the vacuum pump.
3. Pinch shut the vacuum pump hose.
4. Disconnect the hose from the pump.
5. Open the hose slowly to draw the fill into the assembly. If the hose is opened too quickly the fill will "shoot" into the evacuated chamber. This could harm the seal diaphragm.

NOTE: A few pounds pressure can be applied to the evacuation line to speed the flow of fill into the gauge. When the fill stops flowing, take away the pressure and remove the filling fittings.

6. Install the vent plug in the top housing of the seal.

The fill liquid may be seen to boil during the evacuation procedure. This is caused by a contaminate (usually dissolved air and water) being released.

Glycerin and silicone oils are still, when they are pure, at pressures of 1 mm HG absolute pressure. If it takes too long to purify the fill liquid by vacuum, heat it (before use) to about 300° F. This will also drive off contaminates.

2. WITHOUT EVACUATION

The gauge and seal can be filled without evacuation if it is absolutely necessary. This can be done by following the method described in the "Filling the Gauge Saver" section on Page 20. Gauges supplied with a capillary bleeder can be filled by forcing the fill through the seal and out the bleeder hole.

Both these methods require considerable time and do not, usually, give best results.

CLEANLINESS OF GAUGE AND SEAL

To keep unwanted liquids from contaminating the fill, make sure that the gauge and seal assembly are absolutely clean. Even a small drop of water will form a large water vapor bubble in a unit used for vacuum measurements or which is operating at high temperatures. This will cause significant error.

Avoid contamination by oil because oil often contains water. Also, oil will break down at high temperatures to form an error-causing gas.

To Clean Gauge and Seal:

FOR WATER

Extra long evacuation will tend to remove water. Both gauge and seal should be pre-heated before evacuation.

FOR OIL

Wash the system with savasol or other solvent. Then bake the solvent out at 250° F. for one hour.

AFTER FILLING IS COMPLETED

After the filling operation (by any procedure) check to make sure that the fill liquid is not under pressure. If the vent screw is closed, open it to vent off any pressure. When doing this, remove the screw and make certain that the seal ball is free. This is necessary because sometimes the ball sticks on its seat. In this case the venting of internal pressure is not accomplished by merely loosening the screw, as the seal ball must be loosened for proper operation.

When certain that the fill liquid is not under pressure (and that the seal ball is free) close the vent screw.

With the fill pressure at zero, the diaphragm should be flat. This is checked by measuring the diaphragm center and edge distance from the bottom of the seal. The center should be within 1/16" of the edge (if the center is deformed by as much as 1/8", the temperature error will be double the normal value).

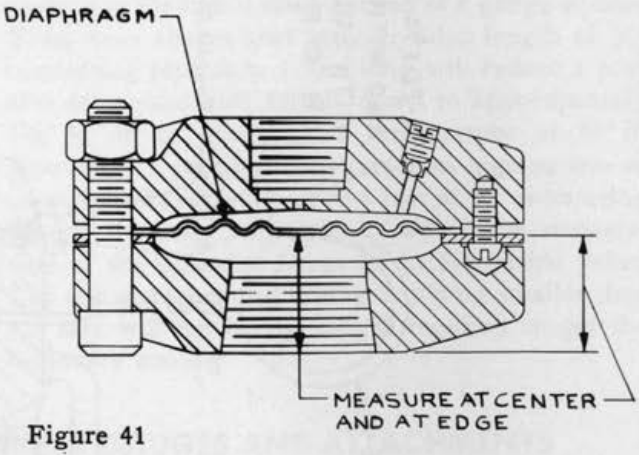


Figure 41

ASHCROFT PLASTIC DIAPHRAGM

TO CHECK DIAPHRAGM FLATNESS

Perfect flatness is essential to metal diaphragms. Plastic diaphragms however, are not so dependent upon perfect flatness. They are much more flexible than metal diaphragms and give a much lower temperature error. For this reason the location of the center of the diaphragm is less critical. (See Figure 41).

Liquid Filling Procedure for Gauges Supplied with a Capillary Bleeder

Gauges with a capillary bleeder* can be liquid filled when attached to a chemical seal. Air in the system can be removed by opening the bleeder

* See Ashcroft Gauge Catalog 300B, Pg. 82.

(which vents the tip of the Bourdon tube) and then forcing the fill liquid in through a special fitting. The fitting is attached to the vent hole in the top of the seal assembly.

Jar and rotate the gauge while it is being filled. This helps to get all air bubbles to the tip of the Bourdon tube where they will go out through the bleeder tube. When the fill has driven out all air, the filling fitting can be removed and the vent holes sealed.

Take care that the diaphragm is not deformed. Be sure that it is operating in its free position.

CHEMICAL ATTACHMENTS—FAILURES AND CORRECTIVE STEPS (LIQUID FILLED TYPES)

Three conditions account for the majority of diaphragm failures. They are:

1. Corrosion
2. High Temperatures
3. Filling leakage

Corrective measures to combat these causes include the following:

1. Corrosion

Diaphragm corrosion is generally due to choosing the incorrect material for a particular service. Modern chemistry is so complex that it is difficult to set up hard and fast rules regarding proper diaphragm materials. For example: A change in concentration or temperature of a chemical will cause corrosion which will not occur with the same chemical at a different concentration or temperature.

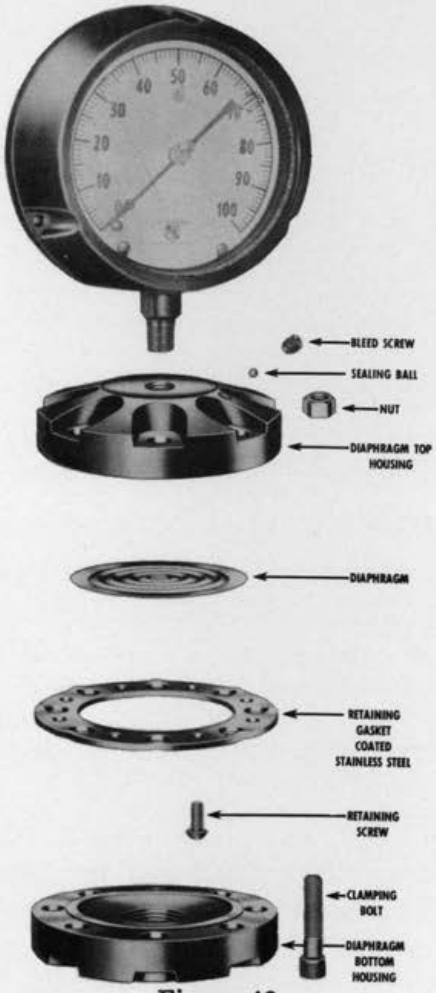


Figure 42

DIAPHRAGM SEAL — CLEANOUT TYPE
Catalog No. 1269

Diaphragm failures are seldom of a mechanical nature as diaphragm deflection (for the entire range of a Bourdon tube pressure gauge) is only a few thousandths of an inch. Never probe into the attachment with a sharp object such as a screw driver which can pierce the diaphragm.

If it is necessary to clean the attachment, use the removable type which permits the lower housing to be removed without disturbing the liquid seal.

Corrosion may also be due to the attachment being a different material from the piping. This can result in a galvanic cell effect that causes electrolytic corrosion.

Corrosion attacks on housings are seldom serious as housing thickness is many times greater than diaphragm thickness. Most metal diaphragms are only .005" thick for design reasons.

If a corrosion failure occurs consult your plant metallurgist or Manning, Maxwell & Moore, Inc. for a recommendation. When making such a request be sure to forward all possible service details. These should include: exact chemistry, concentration, temperature and pressure as well as additional pertinent data.

2. High Temperatures

High temperatures can cause the diaphragm to bulge. When such bulging occurs, the type of liquid fill should be examined. If the fill being used is unsuitable to the gauge operating temperature, a suitable fill should be used. When the attachment or gauge is to be refilled with another fill liquid it is most important to thoroughly clean out the old liquid. The "Liquid Filling Procedure for Chemical Gauges and Attachments" section explains the proper method of liquid filling.

3. Filling Leaking

Failure due to leakage of filling may be due to nicked gasketing surfaces or the gauge connection into the attachment may not be tight. Therefore, a new gasket or tightening is indicated.