Fermilab

Particle Physics Division
Mechanical Department Calibration
Standards/Procedures

Number: MD-CALPROC-006 **Date:** 6/26/2009

Manufacturer: Ashcroft

Model: Calibration of Pressure Gauges

Reviewer(s): James E. Tweed

This Procedure is used for:

Calibration of Ashcroft mechanical gauges.

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.

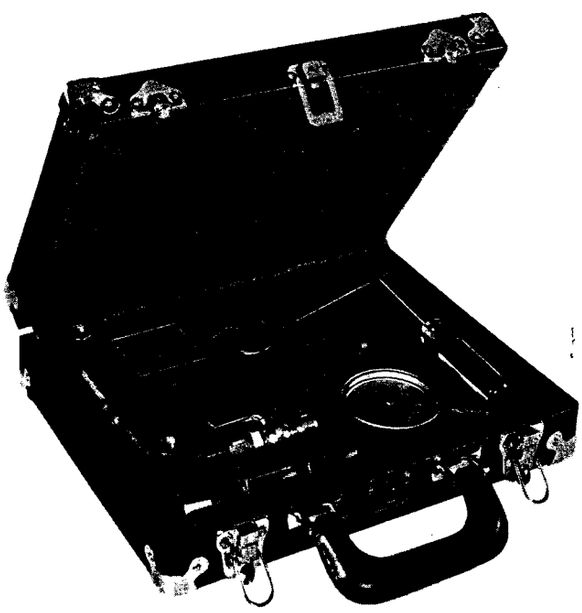
An efficient filtering system is recommended to remove oil from the air lines (even though this is not mandatory when checking conventional gauges only). Oil in air lines sometimes lodges in the gauge socket and causes low pressure gauges to indicate erratically. In addition, air breaking through a film 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.



INSPECTORS' GAUGE TESTING SET
Figure No. 1328

INSPECTORS GAUGE TESTING 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.

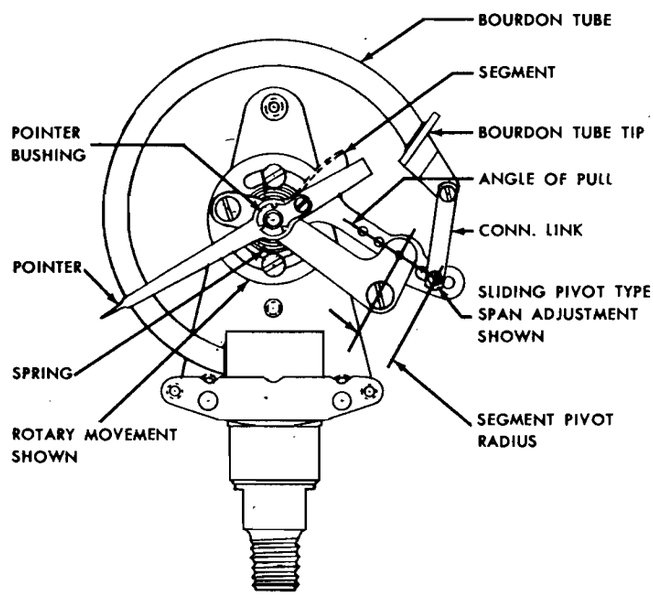
Tools and fittings.

Any light oil is recommended for use with the testing set.

CALIBRATION OF PRESSURE GAUGES

The movement and linkage may be worn if the gauge has been in service for some time, especially on an application which includes vibration and/or pressure pulsation. Under these conditions inspection of gauge operating conditions should be made. It may be found that complete replacement of the movement and linkage is needed, or the parts cleaned or that a calibration adjustment is all that's required. Most frequently, only a pointer adjustment is needed to regain gauge accuracy and is listed first. The additional adjustments are listed in a sequence that is recommended when more extensive adjustments are necessary including replacement of movement and linkage.

The following view identifies the gauge component parts and terminology used in calibrating pressure gauges.



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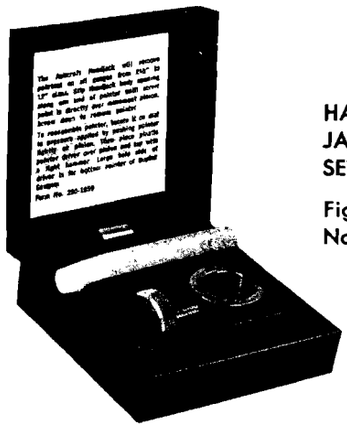
MISCELLANEOUS SMALL TOOLS FOR GAUGES



HAND
JACK
SET

Figure
No. A3220

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

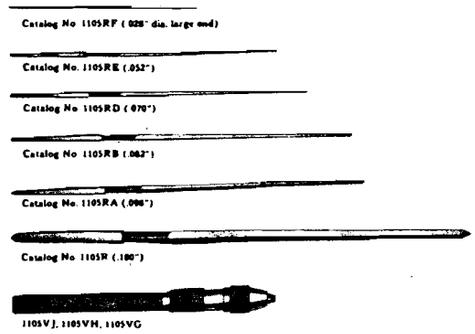
WIGGLER
Figure No. 1165W

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 applying force to the case.

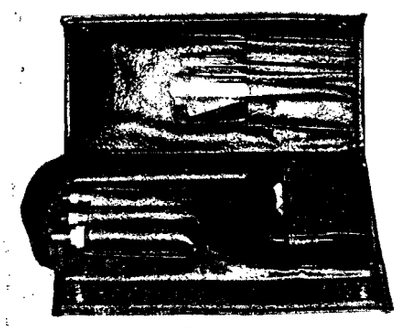
Note: Even though Gauges are heavier and more rugged than many other fine devices, they are still precision instruments and should be handled as such. Proper treatment of them results in long, accurate and economical service life.



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.



GAUGE TOOL KIT
Figure 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
Figure 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

Calibration that can be corrected by repositioning the pointer relative to the scale is called "rezeroing" the gauge. Some gauges are furnished with easily adjustable pointer reset devices that do not require removal of the pointer from the movement. Pointer reset devices are of the following types:

a) Adjustable pointers include the micrometer adjustable geared type and the friction type with a knurled bushing or with a screw driver slotted bushings.

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.

Where non-adjustable pointers are used, it is necessary to loosen the pointer with a pointer remover and retighten at the required position.

Adjustment for Sluggishness

Clean all bearings and gear teeth. Adjust the hairspring as recommended in the following steps, taking special care not to 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.

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 to 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 tightly wound at the 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.

Span Adjustment

A span adjustment is required when the pointer motion is uniform as uniform pressure changes are applied but the pointer goes excessively beyond or is short of the maximum scale value when the maximum range pressure is applied. To correct this condition the segment pivot radius requires adjustment. To reduce the pointer travel the pivot radius is increased. To increase the pointer travel the pivot radius is decreased.

The change in radius is accomplished in a number of ways depending on the movement design. Some designs utilize a separate piece that can be moved when the lock screws are loosened; others by a sliding pivot whose position can be locked in place.

In the low cost gauges the radius is adjusted by bending the metal crank.

Linearity Adjustment

This adjustment is required when the motion of the pointer either slows down or speeds up at the end of the range as the pressure is increased in uniform increments. The condition is readily corrected when the gauge includes a rotary movement. To speed up the motion of the pointer at the end of the range the movement is rotated in the downward direction which causes the angle between the connection link and the centerline of the segment to become larger. To slow the motion at the high end of the range the movement is rotated upward. Readjustment of the segment pivot radius is often required in conjunction with linearity adjustments.

Gauge designs that do not include a rotary design movement will require bending of the Bourdon tube tip or the substitution of a different length connection link to accomplish the needed change in angle of pull.

movement should move pointer in the direction of error - if midpt. is low adjust limit so pointer is lower

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.

Significant Calibration Features of the Ashcroft Duragauge Gauge

The Ashcroft Duragauge gauge provides the highest sustained accuracy and durability available in a production pressure gauge today. A recent added improvement is the utilization of a rotary movement that includes a thin coating of Teflon-S on the bearing surfaces to lower friction and provide a highly durable wear resistant surface. The movement design also incorporates a curved segment tail that greatly simplifies calibration for 4½" size gauges and lowers the calibration time of larger size gauge. The design eliminates the interaction between linearity and span adjustment on 4½" size gauge and reduces the interaction on larger size gauges.

The Duragauge gauge also includes a micrometer pointer to permit accurate re-zero adjustment.

CALIBRATION OPERATIONS

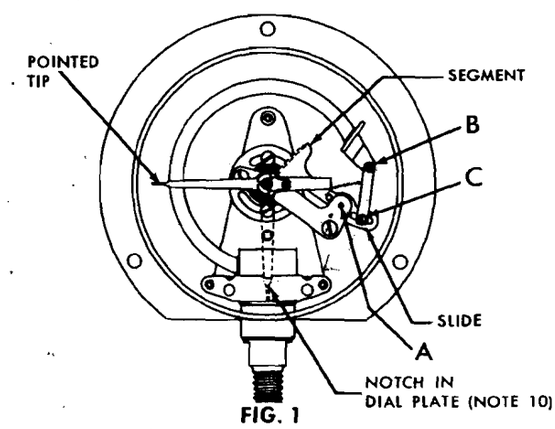


FIG. 1
POINTER AT 6 & 9 O'CLOCK POSITION

Straight Pressure Ranges:

1. Position movement bottom plate in system back plate locating hole and lightly secure movement with the two mounting screws.
2. With the gauge at a pressure corresponding to the lowest scale values, rotate movement until the distance between the segment shaft hole (A), and the

tube tip link hole (B) is the same as the distance between holes (B) and (C) in the link. Tighten the movement mounting screws.

3. With (B) disconnected, rotate the segment upward to disengage segment from pinion and wind hairspring until it just begins to distort; then re-engage segment and secure link to tip with link screw.

4. At zero pressure and with dial removed place pointer on the pinion shaft in the horizontal position with pointer tip at 9 O'clock. (See Fig. 1.)

5. Apply pressure equal to full range and adjust slide until pointer tip is centered in the notch on the dial mounting plate at 6 O'clock. (See Fig. 1.)

6. Reduce pressure to zero and adjust pointer if necessary to 9 O'clock position. If pointer adjustment was required repeat #5.

7. At zero pressure remove pointer and attach dial.

8. Apply pressure equal to mid scale figure interval and place pointer on pinion shaft at mid scale figure interval.

9. Apply pressure and check calibration at intermediate points.

10. Apply the same recalibration procedure for Maxisafe gauges that do not require dial removal. The 6 O'clock position is obtained by aligning the pointer with the Ashcroft Shield on the dial.

Vacuum and Compound Ranges:

The same procedure described for calibrating straight pressure ranges is to be used except the movement is to be positioned with full vacuum applied. Also, the correct pointer travel is to be gaged by utilizing the dial as a reference for all adjustments.

SPECIAL CALIBRATION PROCEDURE FOR LIQUID FILLED GAUGE

The Ashcroft liquid filled gauges are designed for service on applications where experience has shown that reduced performance of non-liquid filled gauges occurs. Such installations usually involve atmospheric corrosion or where excessive wear occurs the reduced performance is caused by instrument vibration and/or pressure pulsation. The tests of liquid filled gauges have demonstrated that they have marked improvement in long term performance on applications of this type, however, some change in accuracy is expected. The following are special instructions that are applicable where recalibration of these instruments are required.

Procedure for 45-1279 L Liquid Filled Duragauge Gauges

1. Hold the gauge in the horizontal position with the dial facing up and remove the ring, window and related parts by unscrewing the three ring assembly screws.

2. Hold the gauge over a large mouth container and drain the liquid by removing the plug and tilting the gauge.

3. Calibration correction requiring only a "Zero" adjustment may be made at this point without any further disassembly. A screwdriver is all that is needed to reposition the micrometer adjustable pointer.

4. When linearity adjustments are required, the pointer and dial must be removed. Remove the pointer with a pointer jack. To remove the dial use a razor to cut thru the sealant bead around the edge of the dial. Remove all dial mounting screws and lift dial.

   Note: Shave sealant from the edge of the dial and from the inside of the case.

5. Calibrate the gauge following the procedure included in section headed "Calibration of Pressure Gauges". **Important** — Care must be exerted to prevent foreign particles from entering the inside of the case. Gauges filled with glycerine may be washed with water; those filled with silicone may be washed with petroleum ether.

6. Apply a bead of RTV sealant around the upper 220° of the dial and under the top dial mounting screw. Use Dow Corning RTV 732 for glycerine filled gauges and allow 3 hours for curing. Use Dow Corning RTV 733 for silicone filled gauges. Allow 72 hours for curing. Assemble glass and ring by tightening screws uniformly to 25 In. Lbs.

7. With the gauge held in the vertical position fill the gauge slowly with a new liquid or with used liquid that has been filtered thru No. 90 filter paper.

   Note: Some of the blue coloring will be filtered out during the filtering process. The proper amount of filling will occur when the liquid has risen a little above the dial center and begins to overflow the fill hole. Approximately 12 ounces of liquid is required.

8. Insert the filler plug and tilt the gauge so that the air is transferred to the rear of the dial.

Procedures for 2½" and 3½" — 1009 L Liquid Filled Gauges

1. Loosen the ring using a strap wrench or equivalent.

2. Hold the gauge over a large mouth container and drain the liquid from the case.

3. Calibration correction requiring only a "zero" adjustment may be made at this point without any additional disassembly. A suitable screwdriver is all that is needed to reposition the pointer.

4. When linearity adjustments are required the system with dial attached must be removed from the case. Remove the system to case mounting screws, cut the sealant around the socket shank and force the system from the case. Trim away the sealant from the socket and case before reassembly.

5. Calibrate the gauge following the procedures included in section headed "Calibration of Pressure Gauges". **Important:** Care must be exerted to prevent foreign particles from entering the inside of the case. Gauges filled with glycerine may be washed with water; those filled with silicone may be washed with petroleum ether.

6. To reassemble the case apply a continuous bead of Dow Corning RTV 3145 sealant for glycerine filled gauges and RTV 733 sealant for silicone filled gauges, around the socket shank, also in and around the tapped mounting holes. Tighten the case mounting screws. Allow 12 hours for curing RTV 3145 and 72 hours for curing RTV 733.

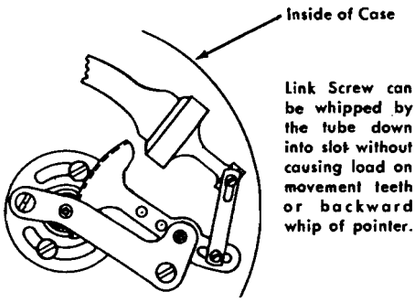
7. Tighten ring to case using a strap wrench. Hold the gauge in the vertical position and slowly fill the gauge with the filling fluid until the liquid rises to a level ⅜" below the top of the dial. Fill with new liquid or used liquid that has been filtered thru No. 90 filter paper. Replace the plug.

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. When ordering new gauges for service that includes rapid pressure changes include the specification "gauge to be furnished with slotted link for sudden decrease pressure" or — for sudden "increase pressure".

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.

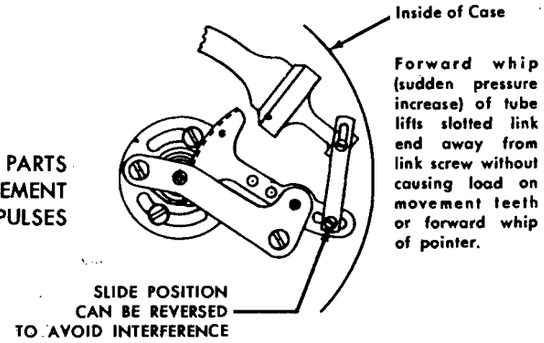
ARRANGED FOR SUDDEN DECREASE



SLOTTED LINK

HAIRSPRING KEEPS PARTS IN PROPER ENGAGEMENT UNDER NORMAL IMPULSES

ARRANGED FOR SUDDEN INCREASE



To convert gauge in the field, specify gauge size, direction of pressure surge and gauge range. Both movement and link change is required for sudden decrease service.

The figures show the gauge construction with slotted link. 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.

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.

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.

Ashcroft Duragauge gauges and solid front 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. 18, 19, 20, 21)

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 Dresser-Industrial Valve & Instrument Division 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.

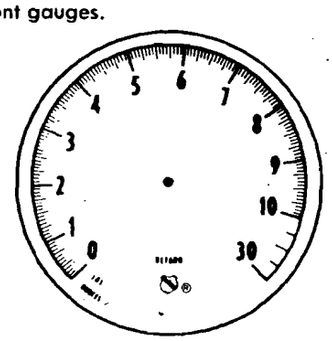
Replace broken dial covers immediately. This will help keep dirt out of movement bearings and gear teeth.

GAUGES WITH RETARD MOVEMENTS

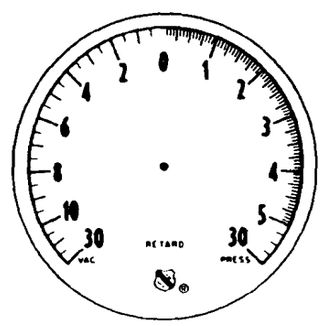
A retard gauge is one in which a portion of the total scale reading is spread out over approximately 90% of the dial. This is attained in the following manner:

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

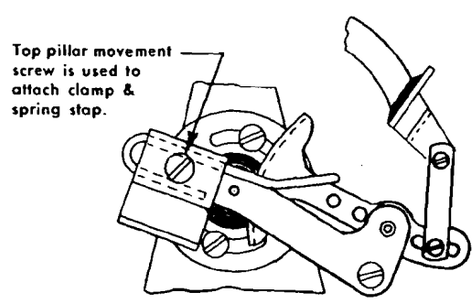
Retard movements are available for Ashcroft Duragauge and solid front gauges.



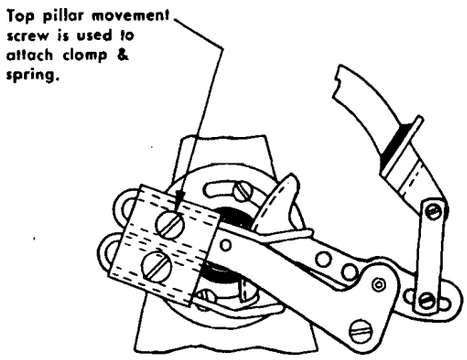
SINGLE RETARD
0 to 30 psi Dial



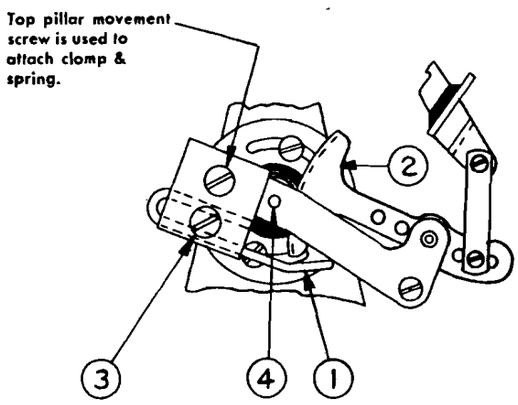
COMPOUND RETARD
30 psi and 30" Vac. Dial



ASHCROFT DURAGAUGE GAUGE SINGLE RETARD
(Vacuum)



ASHCROFT DURAGAUGE GAUGE
COMPOUND RETARD



ASHCROFT DURAGAUGE GAUGE SINGE RETARD
(Pressure)

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.

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 Dresser-Industrial Valve & Instrument Division 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 corrosion due to misapplication of material, high overpressure, shock pressure or large and frequent pressure pulsation.

Maximum Safety

The solid front gauge 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 Duraguage also features quick and easy access to operating parts — without removing the dial.

As an added safety feature a blowout disc is installed in conventional Ashcroft Gauges such as the Duragauge. A special synthetic rubber disc is used which is especially designed for Refinery gauge appli-

cations. 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 Affect

Rarely will full service line temperature be attained in the Bourdon tube itself. This is because the line to the gauge tube is a 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.

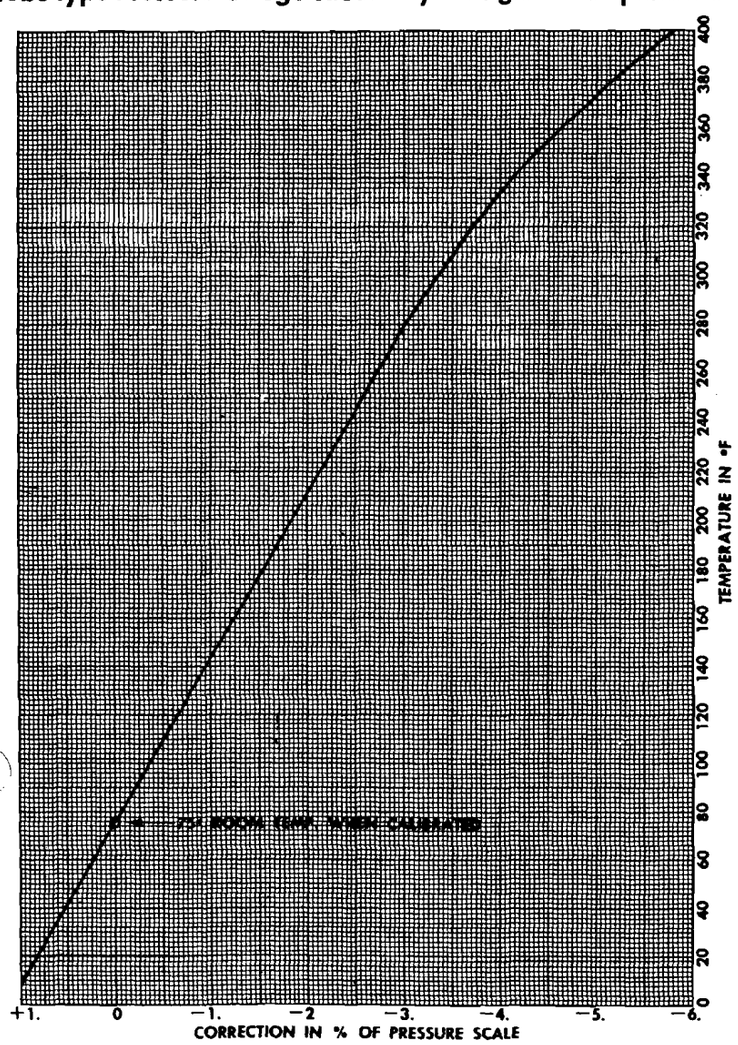
This generally keeps gauge temperature below 150°F even when the process line temperature may be quite high. When the fluid measured is steam, or another hot vapor, a siphon or other liquid-filled tube should be used between the line and the gauge. This should provide the needed drop in temperature.

The effect of temperature on gauge accuracy is shown by the following graph.

Other than discoloration of the dial and hardening of the gasketing that will occur as ambient temperatures exceed 150°F, metal and phenol case gauges, that are not liquid-filled, can withstand continuous ambient temperatures to 350°F.

HEAT AFFECTS GAUGE ACCURACY

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



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.

Adequate line length between the gauge and process fluids that are cold will also allow the gauge to operate at ambient temperatures. Where ambient temperature is low, gauge heaters are recommended to minimize the temperature changes affect on accuracy.

CALIBRATION CHANGES ON GAUGES

Drift

Presure elements of all Ashcroft Gauges are given a stress relieving heat treatment that prevents drift due to aging. Gauges that have been overpressured in service 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.

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 diaphragm 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, especially the Ashcroft Liquid Filled Duragauge.

Mishandling

Dropping, or hitting a guage 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. Ashcroft Duragauge gauge dials identify the material of the system and sockets are stamped with catalog suffix letter code for material.

Bourdon tube joints are designed to meet specific service requirements. Ashcroft Duragauge gauges 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.

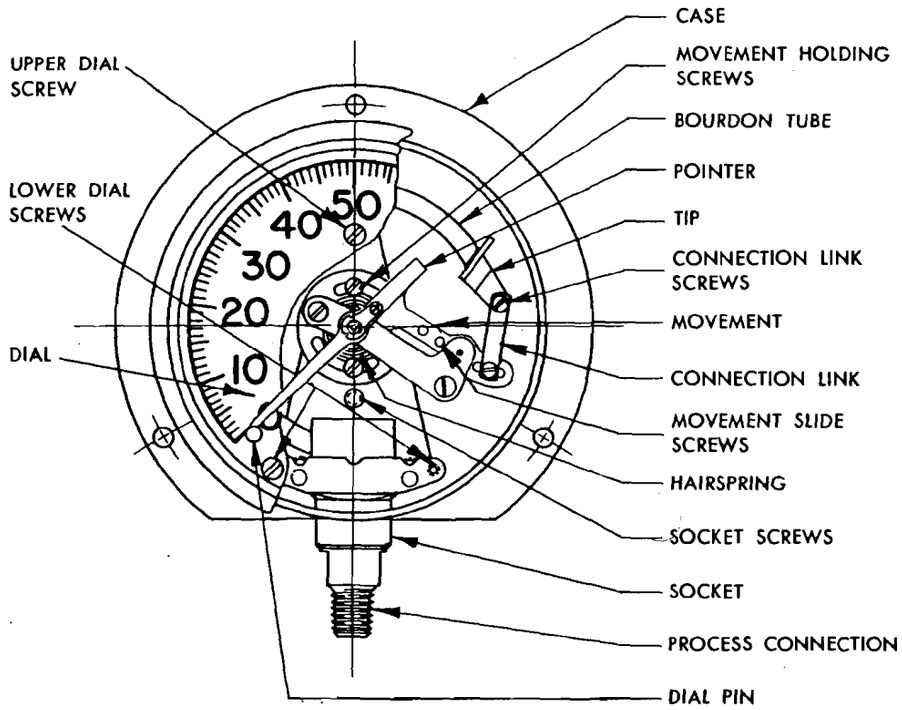
The Lower Connection Gauge Illustration (See Page 14) shows gauge parts and standard names. Use these names to facilitate the ordering of parts and to eliminate any misunderstanding in describing gauge construction.

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.

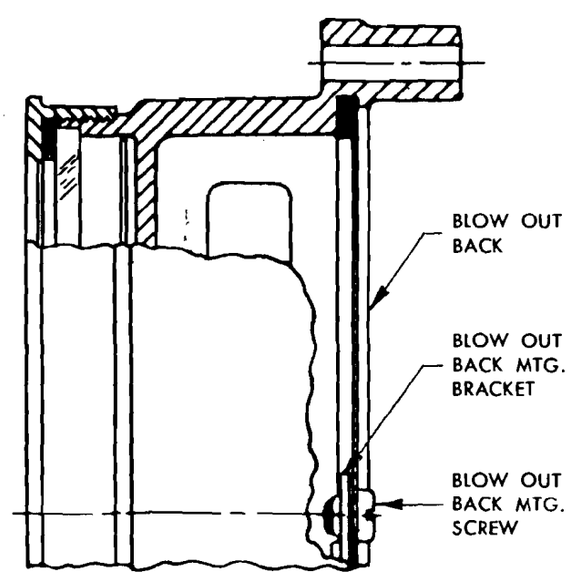
GAUGE PARTS

LOWER CONNECTION GAUGE SHOWN

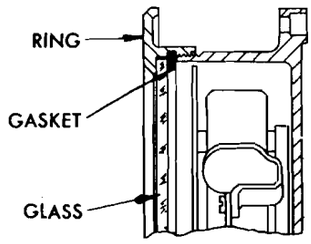


NOTE: The socket, tube and tip is furnished as one integral unit. The movement is supplied complete.

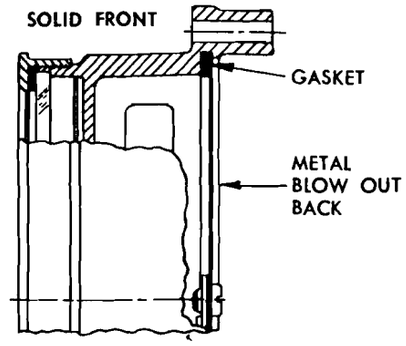
SPECIAL PARTS FOR SOLID FRONT DURAGAUGE



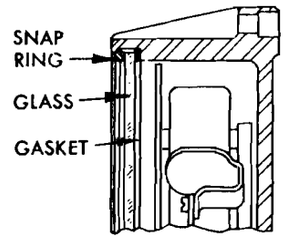
4½" & 6" GAUGE WITH THREADED METAL RING



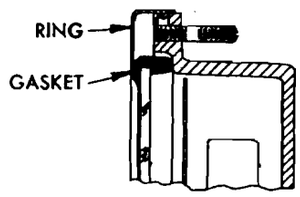
SOLID FRONT



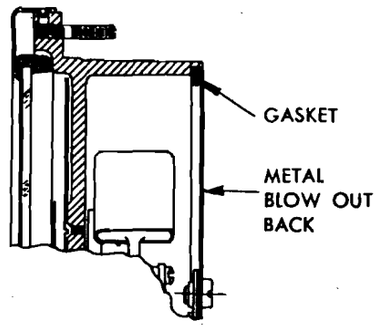
WITH SNAP RING



4½" & 6" GAUGE WITH HINGED RING

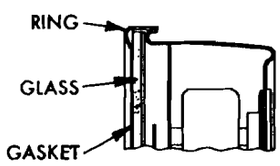


SOLID FRONT

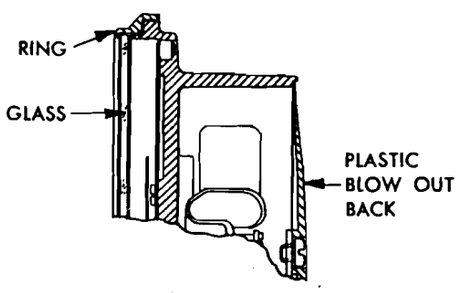


WITH BAYONET LOCK

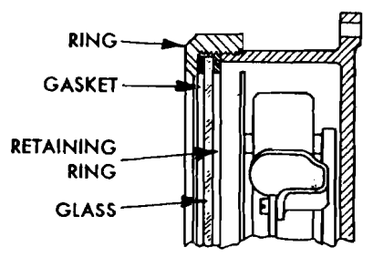
ST. ST.



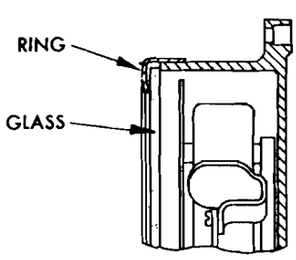
PLASTIC — SOLID FRONT



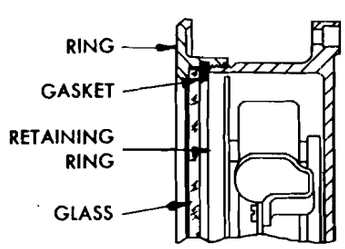
WITH THREADED PHENOL RING



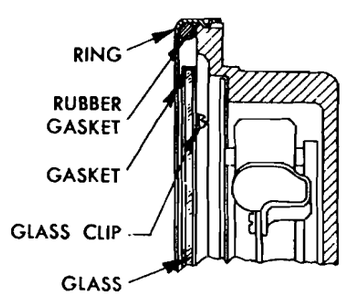
WITH SLIP RING



8½" GAUGE & OVER WITH THREADED METAL RING



8½" AND OVER WITH HINGED RING



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 Stainless Steel movements. Duragauge movements are stainless steel with Teflon "S" coated contact surfaces for greater wear resistance. 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 7.

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 (Drawn Tubes)	1000	x		
4½" Size — (Bored Tubes)	Over 1000 to 20,000 inclusive		x	
6" Size and Larger (Bored Tubes)	Over 1000 to 14,999 inclusive		x	
6" Size and Larger—Beryllium Copper Only	100 to 500 inclusive	x		
	Over 500 to 20,000 inclusive		x	
6" Size and Larger—All Materials Except Beryllium Copper	15,000 and 20,000 inclusive			x
6" Size 1382	30,000 to 100,000 inclusive		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 operation. The contacts are rated at:

Volts	Amps.
120 AC	½ IND.
24 DC	½ RES.

Accuracy

Due to the slight drag of parts of the Electric Contacts, an additional ½ of 1% accuracy tolerance is added to the gauge for up to 20% rotation of a single contact except ranges 30 psi and under, which require up to 3% added tolerance. The accuracy is only slightly affected when the contacts are not rotated. 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.

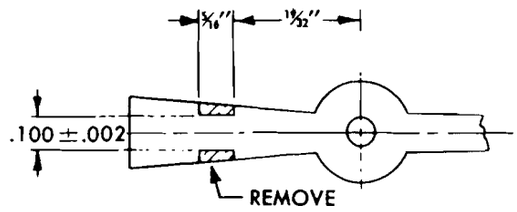
Flush mounting Ashcroft Duragauge or "solid front gauges," Series 1077, 1377, etc. equipped with Type 1166 Electric Contacts requires panel modifications in accordance with the Panel and Gauge Modification Table on Page 16.

Application of Type 1165 Electrical Contact to wall mounted Ashcroft Duragauge gauges, solid front and Quality gauges, and Series 1079, 1379, 1010, etc. in the field.

1. Accommodations for contact lead wires are provided in ring assembly.
2. On gauges with wide tail section that do not permit the yoke to fit freely modify the pointer as illustrated on page 16, or ream the furnished spare pointer to fit and substitute on gauge assembly.
3. Assemble contact ring assembly to the case by placing the yoke of the electric contacts over the tail end of the gauge pointer.
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.

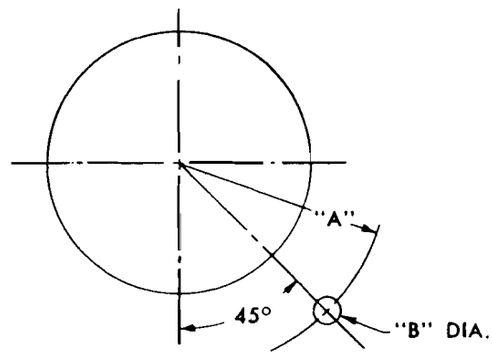
1. On gauges with wide tail section that do not permit the yoke to fit freely modify the pointer as shown in figure 27 drawing or ream the furnished spare pointer to fit and substitute on gauge assembly.



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.
5. Mount ring assembly and tighten thumb screw.

PANEL AND GAUGE MODIFICATION TABLE

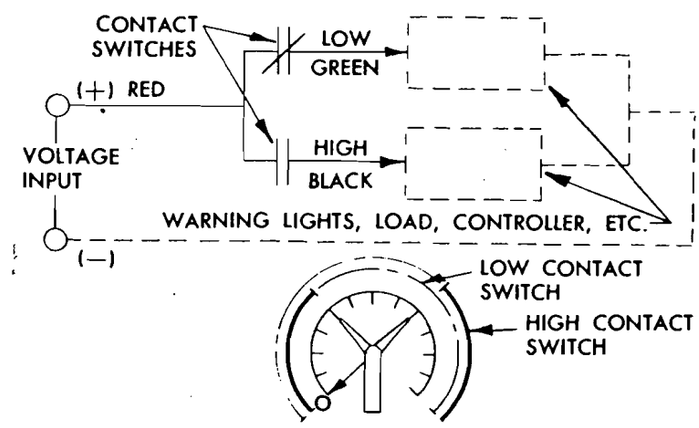
Gauge Size	A	B (Lead Hole) Panel	B (Lead Hole) Gauge
4½"	2 39/64"	¼"	¼"
6"	3 23/64"	¼"	¼"
8½"	4 39/64"	¼"	¼"



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.

DOTTED LINES INDICATE CUSTOMER WIRING

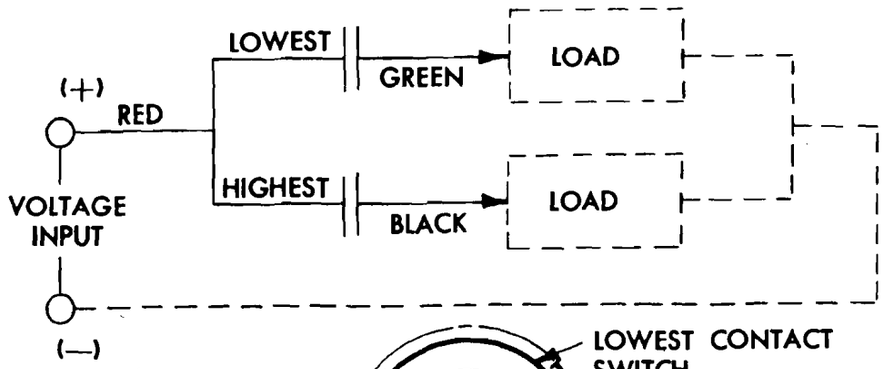


HIGH AND LOW

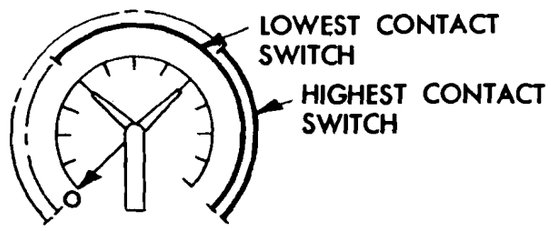
CONTACT CONDITIONS ARE SHOWN AT ZERO PRESSURE

DIAL SETTING

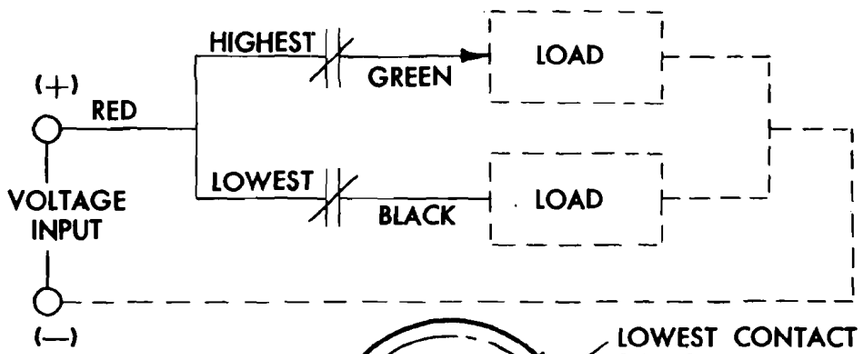
Broken lines indicate contact open.
Solid lines indicate contact closed.



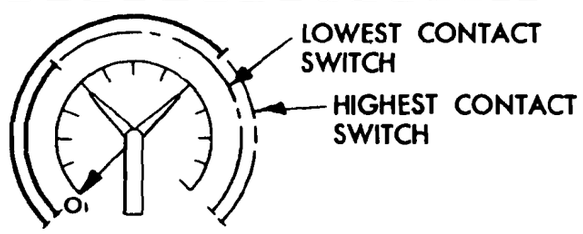
DOUBLE HIGH



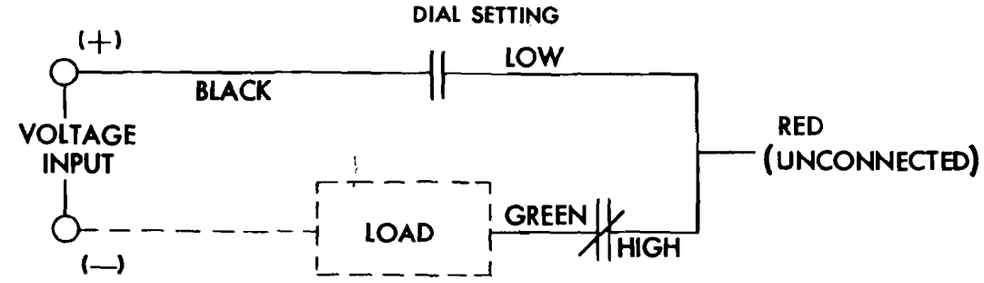
DIAL SETTING



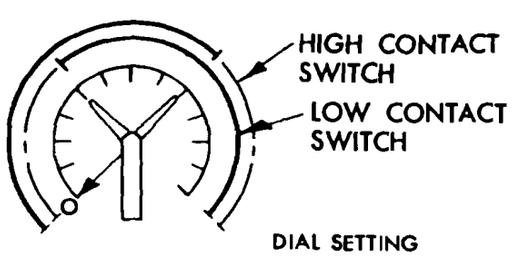
DOUBLE LOW



DIAL SETTING



OFF HIGH AND LOW



DIAL SETTING