



## Ashcroft Model A4A Precision Pressure Gauge Installation and Maintenance Manual





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### 1.0 PURPOSE AND SCOPE OF MANUAL

This manual is provided by Ashcroft Inc. to guide users of the Ashcroft Model A4A precision pressure gauge in:

- (1) Installation
- (2) Routine operations

The instructions in this manual are designed to be performed by qualified instrument maintenance personnel.

Ashcroft Inc. does not recommend trouble-shooting or repairs beyond the scope of this manual. Problems which cannot be remedied by following the instructions in this manual should be referred to the manufacturer.

## For Additional Assistance Contact Customer Service at:

Ashcroft Inc.  
250 East Main Street  
Stratford, CT 06614  
Phone: (203) 378-8281  
Fax: (203) 385-0402

### 1.1 SAFETY PRECAUTIONS

Bourdon tube pressure gauges must be selected and used in accordance with recognized industry codes and safety practices. This is necessary in order to avoid the possibility of misuse or misapplication which could result in personal injury or property damage. Personnel responsible for selection and installation should also be familiar with the safety recommendations of ASME B40.1 that apply to elastic pressure elements and their application in general and specific services. ASME B40.1 is available from:

ASME  
345 47th Street  
New York, NY 10017

The primary considerations in gauge selection are:

#### 1. Pressure

Select a range so that the maximum applied pressure will never exceed the upper range limit. ASME B40.1 recommends gauges be selected so that normal operation will occur between 25-75% of the full scale range of the gauge.

#### 2. Vibration

Excessive vibration could cause loosening of components resulting in loss of instrument accuracy or failure to provide valid data. Remote mounting can often protect a gauge from damage due to vibration.

#### 3. Pulsation

Excessive pressure pulsation could result in fatigue failure of the pressure element. Commercially available pressure snubbers can be used to protect a gauge from damage due to pressure pulsation.

#### 4. Temperature

Operation of the instrument in an environment where temperatures are in excess of design ratings may result in loss of accuracy and failure. Optional temperature compensation is recommended for gauges to be used in areas that are not temperature controlled.

#### 5. Process

Pressure boundary materials (Bourdon tube and socket) must be resistant to the process media. Failure to assure compatibility between the pressure media and boundary materials may result in pressure sensing element deterioration or failure. Instruments used on high pressure gas or in potentially hazardous service, such as oxygen, should be carefully selected in accordance with the recommendations of ASME B40.1.

**See also Section 3.2**



Ashcroft A4A Dial Gauge

## 2.0 PRODUCT DESCRIPTION – THEORY OF OPERATION - CONSTRUCTION

The Ashcroft A4A is a mechanical pressure gauge. This is a device that measures pressure via the movement of an elastic element which is subjected to the pressure to be measured. This element is “powered” only by the pressure itself. It requires no external power source to perform its function.

### 2.1 THEORY OF OPERATION

The Ashcroft A4A precision pressure gauge consists of a Bourdon tube elastic element, a movement, case, dial and pointer. The accuracy of a pressure gauge is contingent on the performance capabilities of the sensing element, movement and the accuracy of the scale graduations which are imprinted on the dial.

A mechanical pressure gauge measures pressure by converting the movement of the elastic element into the movement of a pointer across a dial.

The Ashcroft A4A precision pressure gauge incorporates a highly engineered Bourdon tube as a pressure sensing element. A Bourdon tube is a piece of tubing that has been bent into a circular shape. Depending on the pressure range the Ashcroft A4A gauge may include a single or multi-coil Bourdon tube.

During the measurement process pressure is introduced to the inside of the Bourdon tube via the externally accessible process connection. When pressure is applied to the Bourdon tube it straightens out a small amount (vacuum actually pulls the free end of the coil in tighter). Since the process connection is locked into position by the mounting of the Bourdon tube into the gauge case, the movement caused by the application of pressure or vacuum is limited to the loose end or the tip of the tube. This tube movement is commonly called deflection or tip travel.

The tip travel is converted to a pressure measurement via a system of gears that drive a pointer. The gear system is commonly referred to as the gauge movement.

The pointer moves with the application of pressure or vacuum over a dial imprinted with information including pressure

range, engineering units, graduations and other pertinent information.

The main differences between an Ashcroft A4A gauge and other “precision pressure gauges” can be found in the Bourdon tube and the quality of the other components used in the gauge. The process of making a Bourdon tube for the A4A gauge takes 15 days to complete and produces the most highly developed pressure sensing element of its type. In the A4A gauge this tube is combined with a movement which incorporates precision brass gears and miniature stainless steel ball bearings to provide the most accurate conversion of tip travel to pointer movement possible. These components are all mounted in a heavy duty cast aluminum case which provides a rigid base. As a result of the rigid mounting platform the A4A is immune to inaccuracy caused by pipe strain and case flexing. In many other gauges these are common problems often caused by stresses generated during the installation process.

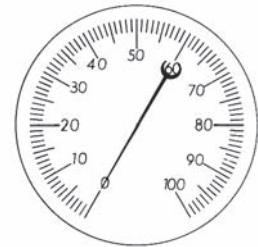
## 2.2 TYPES OF ASHCROFT A4A PRECISION PRESSURE GAUGES

The Ashcroft A4A is available in four standard dial sizes, 6” 8-1/2”, 12” and 16” and pressure ranges from 15 through 100,000 psi. Dials are provided with the required divisions to meet specification and may be graduated to read in standard English or metric units of pressure. Special dials in other pressure related engineering units or with dual scales to eliminate need for conversion, are available upon application.

The Ashcroft A4A is available to measure gauge, absolute and compound pressures as well as vacuum. Since the absolute A4A gauge does not have a hard vacuum reference it must be set to the prevailing barometric pressure by the operator. A brief description of the available pressure types follows:

### Gauge Pressure

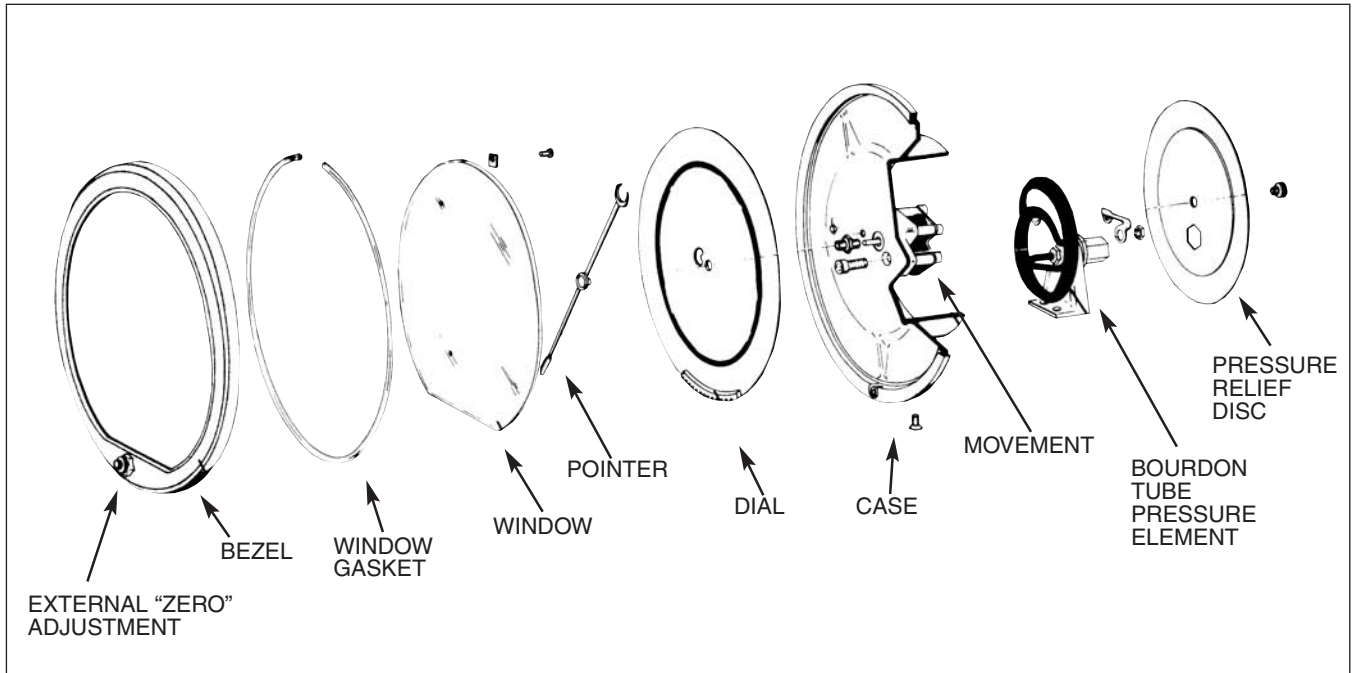
Measures and indicates pressure using ambient pressure as a reference point. Provides the pressure measurement as a differential between the pressure input and the prevailing barometric pressure.



### Vacuum Gauge

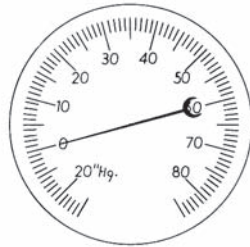
Measures and indicates pressure below ambient, using ambient pressure as the reference point. All readings taken with a vacuum gauge are negative. The largest vacuum level achievable at any given time is the negative equivalent of the prevailing barometric pressure at the start of the test cycle.





### Compound Gauge

Measures and indicates pressure above and below ambient pressure, using ambient pressure as a reference point. A compound gauge is a combination of a gauge pressure and a vacuum pressure gauge.



### Absolute Pressure Gauge

Measures and indicates pressure above zero absolute pressure, using absolute zero pressure as a reference point. All measurements made with an absolute pressure gauge will be positive as it is impossible to generate a pressure below that of zero absolute pressure.



### NOTES:

1. Ambient pressure equals pressure surrounding the measuring element, generally atmospheric pressure.
2. The Ashcroft A4A absolute pressure gauge does not incorporate automatic barometric pressure compensation. The barometric pressure at the time of use must be set by using the External Dial Adjuster.

### Optional Features

Where specified, gauges have been equipped with automatic thermal compensator, slotted link for protection against sudden pressure release, peak load indicating pointers or other optional features. See Section 2.3.5 for Complete Details on Available Options.

## 2.3 CONSTRUCTION

### 2.3.1 CASE AND BEZEL

#### Solid Front Case

A solid front case of cast aluminum protects the operator

when working with high pressure systems. In the event of tube rupture through excessive over pressure, protection is provided by this wall as pressure release will be directed out the back of the gauge, away from the operator

#### Blow-Out Safety Back

A light gauge stainless steel disc, covering the entire back of the gauge case, is spring-loaded against a seal machined in the periphery of the case. An abnormal rise of pressure within the gauge case causes this disc to flex outward, releasing the pressure.

#### Bezel

A hinged bezel protecting the dial and pointer is equipped with an external dial zero adjustment. It is also the mounting for the lens.

#### External dial Zero Adjustment

A zero adjustment knob on the front of the gauge case makes it possible to set dial zero to atmospheric pressure or other benchmarks required.

#### Limit Stops

High and low pressure limit stops are mounted on the interior of the gauge case, restraining tube tip travel within the rated operating range of the gauge. The limit stops protect the movement from becoming disengaged due to excessive tip travel. They do not protect the Bourdon tube from damage to over-pressure.

### 2.3.2 BOURDON TUBE SYSTEM

The Ashcroft A4A Bourdon tube is a product of more than 40 years of intensive, continuous research. The "unitized" one-piece tube system is an outstanding example of modern technology.

Through exclusive Ashcroft A4A Bourdon tube designs and manufacturing techniques, uniform stress distribution is provided in a wide range of tubes of varying cross sectional configurations. All A4A tubes are formed from a single piece of seamless tube material.

Tubes of 403 stainless steel are standard for ranges of 50 psi and above. Beryllium Copper may be supplied for low



**Ashcroft A4A multi-coiled Bourdon tube**

pressures and special applications. See Section 7.1 for additional information.

The Bourdon tube used in the Ashcroft A4A Gauge is a “Unitized” single or multi-coil element which is approximately three times the length of tubes used in competitive gauges. The greater length results in a much lower deflection rate, minimizes stress and virtually eliminates hysteresis, creep and fatigue effect.

The unitized tube design eliminates soldered, welded or threaded joints which further provides for controlled distribution of stress during the tube forming operations. Internal traps in which foreign matter may accumulate are also eliminated. The interior of the Ashcroft A4A tube may be easily cleaned by positive flow through flushing through the standard tip flushing (bleeder cap) connector.

#### **Heat Treatment**

All Ashcroft A4A Bourdon tubes are heat treated in high vacuum to maintain internal cleanliness and optimize mechanical properties.

#### **Ultra-High Pressure Gauges**

Ashcroft laboratories pioneered and continues to lead in the development of precision Bourdon tubes for ultra-high pressure gauges in ranges to 100,000 psi.

#### **External Bleeder Cap**

In order to achieve optimal accuracy the Bourdon tube should be bled prior to initiating operation. If the gauge is to be used on a gaseous media oil trapped in the Bourdon tube should be purged from the tube. If the gauge is to be used in liquid service trapped gas should be removed from the Bourdon tube. Both activities are facilitated by the bleeder cap (flushing connector) which is an integral part of the Bourdon tube. The bleeder cap is accessed by removing the blow out disc from the back of the gauge.

#### **Pressure Connection**

Pressure connections may be either bottom or back locations. A complete listing of the available connections is provided in the specifications section (7.0) of this manual.

#### **Tip Piece Assembly**

The tip piece assembly is pivotally mounted on the free end of the Bourdon tube. It comprises a quadrant and clamp arrangement to permit adjustment of its angular position, and a quadrant slide upon which the connecting link is pivoted. It is used to establish the angular relationship of the connecting link and the sector slide which controls linearity in the pointer movement.

#### **Connecting Link**

The Connecting Link transmits motion from the tip piece assembly to the sector slide of the movement.

### **2.3.3 MOVEMENT ASSEMBLY**

#### **Integral Movement**

The solid front case provides a single rigid support for all moving parts of the gauge, maintaining critical alignment under all conditions. No significant calibration error will occur in the Ashcroft A4A gauge, as a result of distortion or shifting of supporting parts or components during the installation process.

#### **Miniature Stainless Steel Ball Bearings**

Friction and wear are minimized and sensitivity improved at the pinion shaft by precision miniature stainless steel ball bearings. Smooth action at this critical point in the movement assures an immediate, accurate response to minute pressure changes. This makes the Ashcroft A4A gauge the most sensitive instrument of its type.

#### **Gear Sector and Drive**

The gear sector drives the pointer pinion directly in the Ashcroft Model A4A precision pressure gauge. The pointer pinion is spring loaded against backlash by a hair spring. For maximum accuracy it is important that the original tooth relationship be maintained throughout the system. If, for any reason, the gears are to be disengaged they should first be marked to assure correct re-engagement.

#### **Hair Spring**

The hair spring takes up backlash in the gearing and maintains the smooth sensitive action of the movement. This spring has been pre-set to approximately 2 turns counter clockwise with zero pressure applied. Lack of hair spring tension will result in erratic pointer motion. Should this occur, the gears may be disengaged, observing the precautions noted above, the hair spring tightened, and the gears re-engaged.

#### **Sector Slide (course span adjustment)**

The sector slide is mounted on the gear sector. It permits adjustment of the ratio of pointer travel to Bourdon tube motion by altering the multiplication through the “Micro-Slide” adjustment. This adjustment controls the pointer travel or range of the gauge (see figure 5.2).

#### **Micro Slide Adjustment (fine span adjustment)**

The micro slide adjustment provides convenient and simplified development in calibration methods. When required, precise recalibration adjustment may be made in the total effective length of the sector slide. The micrometer screw attached to the slide may be adjusted to 0.0005” when extremely minute corrections are necessary. The pre-loaded adjustment spring stabilizes the calibration setting against accidental shock (see figure 5.2).

### Tip Piece Adjustment

The unique quadrant and slide design of the Ashcroft A4A adjustable tip piece permits simple and accurate adjustment of the angular relationship between the connecting link and sector slide. This adjustment controls linearity; coupled with the range adjustment it may be used to readily recalibrate the gauge (see figure 5.2).

### Thermal Compensator (optional)

Holds the gauge in calibration to the  $\pm 0.1\%$  accuracy rating through ambient temperature ranges from  $-25^{\circ}\text{F}$  to  $+125^{\circ}\text{F}$ .

## 2.3.4 DIAL AND POINTER

### Concentric Dial Mounting

The dial is supported at the center by a dial pivot which passes through the solid front gauge case and extends into an aligning recess in the base casting of the movement. This provides concentricity of the dial and pointer shaft of the movement, assuring maximum accuracy.

### Dial

Black dial graduations on a white background are clearly defined and highly legible assuring the resolution necessary to obtain accurate measurements. All dials are generated on a state of the art computer based design system. All Ashcroft gauges include a mirror band which allows for the elimination of parallax reading errors.

Each gauge carries an individual serial number on the dial to facilitate identification.

For standard dial graduations see Graduation Tables (Appendix A).

### Pointer

The reading end of the knife-edge pointer provides a plane which is perpendicular to the mirror band on the dial face aiding in the elimination of parallax errors.

### External Dial Zero Adjustment

A zero adjustment knob on the front of the gauge case allows for easy zeroing of the gauge. This same adjustment system allows an operator to set the gauge to display barometric pressure, when setting up an absolute A4A gauge or to set the dial to some other predetermined pressure pre-load. One knob rotates the dial, not the pointer, through approximately 30 degrees of arc; the other knob locks the bezel. A friction brake, acting on the dial, prevents accidental rotation.

Where a constant value is to be carried through a series of readings, such as a tare\*, this adjustment eliminates the need for computing values at each reading.

\*A tare value is a pressure pre-load which may not need to be reflected in the measured value. For example, in weighing operations the pressure generated by the weighing platform is often tared or zeroed out prior to beginning the measurement process.

## 2.3.5 OPTIONAL FEATURES

### Special Scales

The Ashcroft A4A gauge may be ordered with special scales to indicate pressure or pressure equivalent units in any scale desired. Commonly used scales include standard English (psi, inches of water, etc), metric (kg/cm<sup>2</sup>, bar, mm Hg, etc) or SI (Pascal) units, feet of water (fresh-sea), force on ram, absolute, vacuum, compound (vacuum-pressure) or dual scale.

### Special Ranges

The Ashcroft A4A precision pressure gauge is available in a wide variety of standard pressure ranges from 15 through 100,000 psi. A list of the standard ranges is provided in Appendix B. Most any non-standard pressure range between 15 and 100,000 psi or metric equivalent can be provided on a custom basis.

### Thermal Compensator (Patented)

The thermal compensator is comprised of a bimetallic bar which forms part of the linkage between the tip of the Bourdon tube and the gear segment slide of the gauge movement. Deflection of the bimetallic bar, resulting from a change in ambient temperature, causes the point at which motion is imparted to the gear segment slide, to move in an arc. This results in a change in both the angular position and effective length of the slide. The length of the bimetallic bar is trimmed specifically to offset the thermal characteristics of the Bourdon tube with which it is used.

Correction for ambient temperature change is completely automatic and requires no adjustment of the compensator, pointer or dial for any temperature variation from  $-25^{\circ}\text{F}$  to  $+125^{\circ}\text{F}$ .

**Important Note:** The bimetallic bar is matched to the specific Bourdon tube for which it has been configured. The bimetallic link cannot be removed for use in another gauge. In addition, any damage to a temperature compensated gauge that results in the need to replace the Bourdon tube will also necessitate the replacement of the thermal compensation option. This can only be accomplished at the factory.

### Slotted Link

The slotted link option is designed to protect gauges from movement damage which could result in applications that produce sudden, violent release of system pressure. When gauges are used for burst or tensile testing, comprehensive strength testing or similar applications, a sudden release of pressure is the norm. In these types of applications a slotted link prevents violent flutter of the pointer and possible damage to the gauge movement.

### Peak Load Indicator

It is often necessary to retain the highest or lowest measured value during a pressure cycle or test. The peak load indicator is available to simplify the recording of this information. The peak load indicator is a red tracking pointer, often referred to as a lazy hand. Movement of the pointer actuates the peak load indicator in either a positive or negative direction. The red pointer will remain at the highest or lowest measured value during the pressure cycle. An exterior knob permits convenient resetting for subsequent pressure cycles. The peak load indicator has been carefully engineered so that it will not diminish the  $\pm 0.1\%$  accuracy of the A4A gauge.

### Carrying Case

Sturdy, impact resistant, black grain finish carrying cases, with protective insert, for carrying any size Ashcroft A4A bottom connected gauge are available.

## 3.0 INCOMING INSPECTION

### 3.1 UNPACKING GAUGE

Every Ashcroft A4A gauge is carefully packaged to prevent shipping damage.

After unpacking, visually inspect the gauge for any damage that may have occurred during shipment.

If damage is observed consult factory for further instructions. Ashcroft A4A gauges are shipped with a small piece of plastic sponge between the pointer hub and the inside of the glass. This prevents the pointer from “whipping” during shipment. When your new gauge is unpacked, this cushion should be removed and discarded.

To remove this cushion first remove the inner small chrome knob at the bottom of the bezel by unscrewing it in a counterclockwise direction. Next lift the bottom of the bezel and slide it off the upper hinge pin.

Note: When replacing the bezel gently turn the outer dial adjustment knob (large chrome knob) to assure that the gear teeth on the adjuster mesh with the rack on the dial.

All Ashcroft A4A gauges are accurately calibrated to  $\pm 0.1\%$  of full scale or better, against standards that are traceable to the National Institute of Standards of Technology. A certified copy of test results is furnished with each gauge. Standard conditions for calibration conform to NIST Monograph 8.

To check gauge accuracy after unpacking, follow instructions in Section 5.0 – Calibration.

### **Important Information**

Gauges for use with corrosive or hazardous media such as mercury or radioactive solutions should be tested with a non-corrosive non-hazardous medium such as air, water or oil prior to acceptance. Faults found after an instrument has been contaminated will be the sole responsibility of the user.

Contaminated instruments may not be returned to the factory without written authorization. Failure to obtain authorization may inadvertently result in injury to Ashcroft Inc. personnel and/or property damage. Contaminated gauges returned without prior written approval will be returned to the sender unrepaired.

### **3.2 INSTALLATION** **\*\*\* WARNING \*\*\***

Where the gauge is to be used with oxygen, it should be clearly specified and the gauge will be so marked either on the dial for 8½, 12 and 16 inch gauges or on the back of the gauge for the 6 inch dial size. In these cases, special precautions are taken to eliminate all traces of organic matter which might otherwise cause an explosion hazard.

The gauge should not be used with elements or compounds deleterious to the wetted materials.

Gauges are factory calibrated in an upright or vertical position, unless otherwise specified on the order. Gauges should always be mounted in the same position as calibrated to eliminate possibility of positional error. If gauges are to be mounted in other than vertical position the order should specify the angle in which to be mounted to permit factory calibration in the same position.

Mounting dimensions are given in the dimensional drawings and charts in Appendix C.

### **4.0 OPERATION**

All Ashcroft A4A pressure gauges are precision instruments and certain precautions must be observed in their operation.

#### **4.1 BLEEDING THE SYSTEM**

The gauge should be mounted in an upright position when connected to a liquid pressure system and the bleeder (flushing connector) should be operated before readings are taken. Accurate readings on a liquid pressure system are impossible unless all air or other gas has been evacuated.

All Ashcroft A4A gauges are equipped with a bleeder valve (flushing connector) as an integral part of the Bourdon tube.

When operating the bleeder valve (flushing connector) support the free end of the Bourdon tube with fingers to prevent disengagement of the gear teeth or possible bending of the link or tip piece. To operate the bleeder, the valve is opened slightly and pressure applied to the gauge to force fluid through the tube and out the valve. To avoid getting fluid in the movement assembly it is recommended that a tube or some type of shield be used to direct the liquid flow away from the gauge case and movement. Since some oil may have accumulated near the bleeder valve tube after factory calibration, the fluid should be permitted to flow for several seconds. Any air or gas present in the gauge should then escape followed by a steady flow of the pressure medium. The bleeder may then be closed.

It is good procedure to apply full pressure on the gauge for several minutes before each period of use. The pressure should then be removed and the dial zero adjusted, if necessary.

#### **4.2 SETTING DIAL TO ZERO OR TARE OR VALUE**

All Ashcroft A4A gauges are equipped with a dial adjuster and friction brake. The dial adjuster is operated from the front cover of the case and moves the dial – not the pointer – through approximately 30 degrees of rotation. This adjustment is used to set zero, tare out a pressure pre-load or, with absolute gauges to set the pointer to the prevailing barometric pressure. In tests involving an initial pressure which is ordinarily carried through the calculations as a tare, resetting of the dial will simplify the calculations by eliminating the tare figure entirely.

#### **4.2.1 SETTING DIAL TO PREVAILING BAROMETRIC PRESSURE (ABSOLUTE GAUGES ONLY)**

The dial adjuster is also used to allow an A4A gauge to simulate the performance of an absolute pressure gauge. To do this the gauge operator must determine the prevailing barometric pressure from an accepted source (such as an in-house barometer or a nearby airport). Once this is known the operator, using the dial adjuster, rotates the dial so that with the gauge connection vented to atmosphere the pointer is directed to the prevailing barometric. Once this is accomplished, the external adjustment locking nut should be tightened. With the pointer set to barometric pressure prior to connecting the process connection to the pressure input the gauge will measure pressure in terms of absolute pressure. Periodically, to adjust for changing barometric pressure, the process connection of the gauge must be vented to atmosphere and the dial adjusted to display the prevailing barometric pressure.

#### **4.3 GENERAL OPERATING CONSIDERATIONS**

The Ashcroft A4A gauge is “Test” or “Master” gauge and if properly cared for should retain its inherent accuracy indefinitely. However, where gauges are used for highly critical work over a long period of time, it is good practice to check them at regular intervals against a deadweight tester. The procedure for testing and adjusting is given in Section 5.0.

#### **Pressure Surges**

Utmost precaution must be taken at all times to protect the gauge from high pressure surges or shocks. The sudden application or removal of pressure will cause the pointer to whip around and, by its inertia, to damage the movement, or may move the pointer on its shaft. This effect can be min-



imized or eliminated through the use of commercially available pressure snubbers.

When the application for which the gauge is to be used involves the sudden release of pressure, the "Slotted Link" option should be specified at the time of order to protect the movement assembly.

### Temperature Error

Ashcroft A4A gauges are typically used where temperatures are maintained within close limits. In cases where extreme temperature variations will be encountered, corrections may be calculated and applied to the gauge readings. When temperatures rise the Bourdon tube reads faster and when they drop it reads slower at a rate of one percent per 50°F. In these cases, the automatic bimetallic thermal compensation option is recommended for greater accuracy and convenience. When equipped with the bimetallic compensator, the gauge accuracy will be maintained through temperature from -25°F to +125°F.

### Loose Pointer

Gauge error may be caused by a loose pointer. If pointer shift is suspected, simply release pressure and check that the pointer returns to the zero position. If an adjustment is necessary first position the zero adjust mechanism in the middle of its full range of adjustability. Once this is accomplished, move the pointer to the proper position and, using your fingers, press it firmly onto the shaft. The pointer should never be hammered or tapped in place.

## 5.0 CALIBRATION

### 5.1 CALIBRATION STANDARDS

In order to properly check and adjust the calibration of a precision gauge, a reliable standard of reference is required. Care should be taken in the selection of a dead-weight tester since the resulting operation of the precision dial gauge can be no more accurate than the standard on which it is based.

A primary pressure standard with accuracy of  $\pm 0.025$  percent of reading or better is recommended to properly check or calibrate the Ashcroft A4A. Corrections for local gravity effects, air buoyancy and temperature should be applied to the pressure standard to compensate for environmental conditions.

**Note:** If a secondary transfer standard is used, it should be of the same range as the instrument being tested and have accuracy of  $\pm 0.025$  percent of span or better.

If you would prefer, NIST traceable recalibration of your Ashcroft A4A Precision Pressure Gauge can be performed at the Ashcroft Inc., Stratford, CT facility. Priority Recertification can be arranged to assure the gauge is calibrated and shipped for return to your facility within 5 days of receipt at the Stratford Operation. Contact Ashcroft Inc. Customer and Support Service at (203) 378-8281 for further details on available calibration services.

### 5.2 CALIBRATION CHECK

Apply full pressure on the gauge for several minutes and then release the pressure. Re-zero the gauge, if necessary.

Using an appropriate pressure standard generate pressures and take readings at zero to full scale in 10% increments, both upscale and downscale. If the error exceeds the amount permissible for the intended service, follow the recalibration procedure (Section 5.3).

## 5.3 RECALIBRATION PROCEDURE

Prior to beginning calibration on a fluid media the Bourdon tube must be completely free of entrapped gas or, if calibration is to be done on a gas system, the Bourdon tube must be free of any liquid.

### 5.3.1 Linearity Test

#### Step 1-

Load the gauge to full scale pressure and return to zero.

#### Step 2-

Adjust the pointer to zero with the dial centered. If necessary, remove pointer then center the zero adjust mechanism and replace pointer.

#### Step 3-

Load the gauge to one-half scale pressure and record the reading.

#### Step 4-

Load the gauge to full scale pressure and record the reading. If linearity is normal, the reading at full scale pressure should be double the reading at one-half scale pressure so as to produce a straight line relationship.

If the readings are not linear, recalibration procedure as follows is indicated:

### 5.3.2 Linearity Adjustment

#### Step 1-

First the gauge must be "straight lined". That is to make the readings linear or proportional to the load. At this point the actual value of the readings at any given load is secondary. Once linearity has been established, range adjustment to bring the full scale reading into agreement with the full scale load will complete the calibration.

Unscrew the zero adjust locking knob and remove the two knobs and then remove the bezel and window by lifting the bottom up and away from the gauge face.

#### Step 2-

Remove the back blow out cover by unscrewing the knurled knob on the center back of the gauge and lifting away the stainless steel blow out disc.

#### CAUTION:

Prior to proceeding it is recommended that the tooth relationship between the sector and its mating pinion be marked (see figure 5.1). If the sector and pinion are accidentally disengaged these marks will assist in proper re-engagement. For optimum performance the original tooth engagement should be maintained.

#### Step 3-

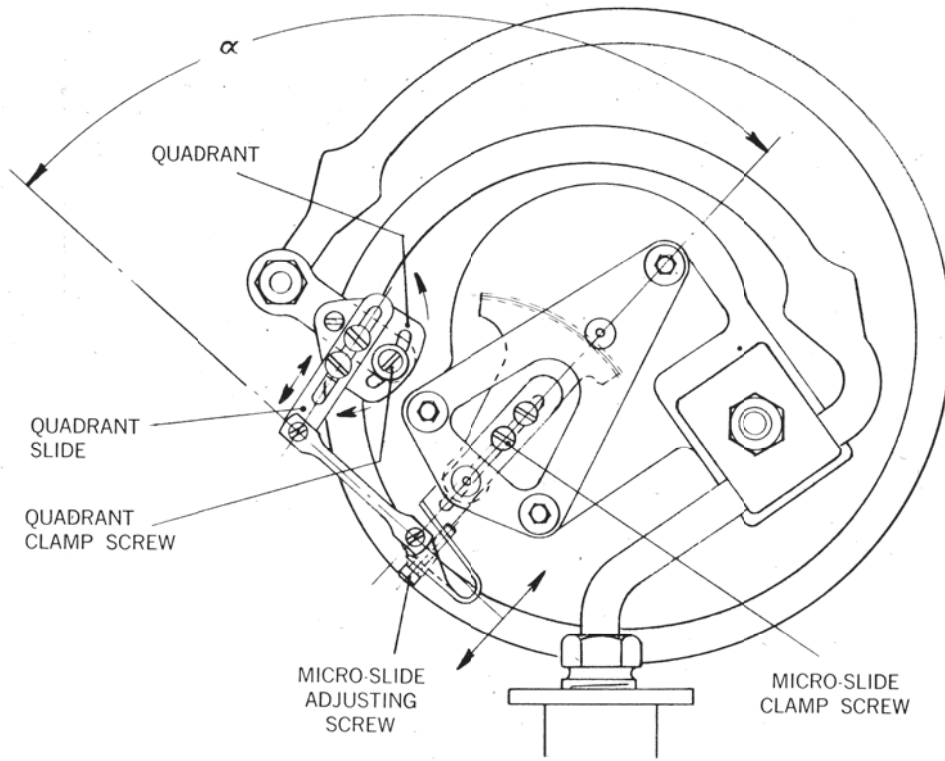
To compensate for a full scale reading greater than twice the one-half scale reading:

#### Consult Figures 5.1 & 5.2

Loosen the two clamping screws on the quadrant slide and slide it upward, thereby decreasing the angle. Or, if the error is slight, rotate the pointer and pinion shaft counter clockwise to indicate about twice the extent of the error. Holding the pointer in this position, release the quadrant clamp screw permitting the Bourdon tube to adjust its position, then re-clamp. This also results in a decrease in angle.

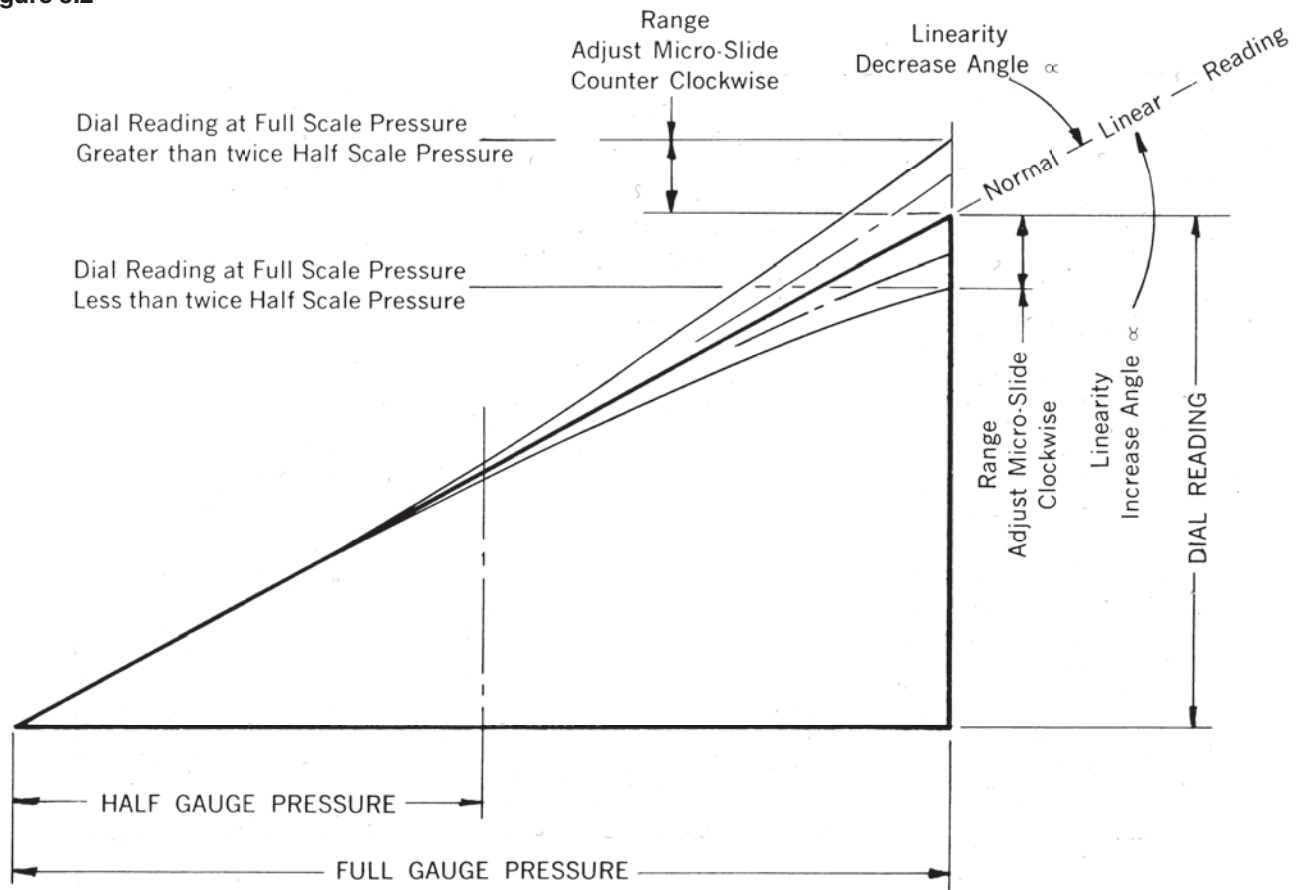
To compensate for a full scale reading less than twice the one-half scale reading use the same procedure outlined in step 3 except as follows:

Figure 5.1



Model "A4A"

Figure 5.2



### Consult Figures 5.1 & 5.2

Move the quadrant slide outward, thereby increasing the angle, or rotate the pointer and pinion shaft clockwise to indicate about twice the amount of the error. Holding the pointer in this position release the quadrant clamp screw permitting the Bourdon tube to adjust its position, then re-clamp. This also results in an increase in angle.

#### Step 4-

Reset the pointer to zero and repeat the linearity check to evaluate the adjustment. Repeat procedure until linearity is established within the desired tolerance.

### 5.3.3 Range Test

#### Step 1-

Load the gauge to full scale pressure by dead weight and note the reading on the gauge. If the full scale reading is not correct within the required tolerance proceed as follows:

#### Step 2-

If the pointer indicates greater pressure than the dead weight, turn the Micro-Slide adjusting screw counter-clockwise. If the pointer indicates less pressure than the dead weight, turn the Micro-Slide adjusting screw clockwise.

Should the range adjustment be excessive, loosen the two Micro-Slide clamping screws and move the slide inward to increase the range and outward to decrease the range.

Adjustment of the Micro-Slide screw changes the amount of pointer travel between zero and full scale. It is necessary after each adjustment to return the pressure to zero, re-adjust the pointer to zero and repeat to determine the effectiveness of the adjustment.

Adjustment of the Micro-Slide screw requires a movement of approximately 180 degrees in order to have a pointer show a change of ? of one percent of full scale reading on most gauge dials. To correct some gauges an adjustment of as little as 0.0005" or a turn of approximately  $10^9$  of the Micro-Slide screw is required. The adjusting screw may be operated with a small Allen wrench.

### 5.3.4 Final Adjustment

The range and linearity adjustments are interdependent. With linearity established, fine readjustment may be made in range and linearity re-checked to bring both adjustments within the desired limits of accuracy.

### 5.3.5 Check For Hysteresis

#### Step 1-

Connect the gauge to the deadweight tester in a vertical operating position.

#### Step 2-

If the gauge has been drained, fully or partially, air may be entrapped in the Bourdon tube and this trapped air must be removed through the bleeder valve (flushing connector) to insure positive, accurate response.

If the gauge has been used with and contains mercury, care should be taken to avoid contamination of brass tubing and fittings on the tester.

Gauges used in pneumatic systems should, of course, be cleaned of oil, water or similar entrapped matter before testing.

#### Step 3-

Set the pointer to zero using the dial adjustment.

#### Step 4-

Applying pressure slowly, load the gauge to one-half scale pressure and record the reading.

#### Step 5-

Load to full scale pressure.

#### Step 6-

Release to one-half scale pressure and compare the down-scale reading to the upscale reading.

If the second reading is higher than the first it may be caused by either hysteresis or friction. With dead weight still at one-half load, tap the gauge gently. If the pointer returns to substantially the original one-half load reading, the difference in readings was caused by friction. If the amount of tap is not excessive it might be considered satisfactory for use. It is normal procedure to tap an instrument to observe its sensitivity. If the tap is excessive it is usually remedied by cleaning the movement mechanism with solvent such as ether, carbon tetrachloride, etc.

If after tapping the gauge the pointer still reads higher than the first reading, the cause is hysteresis. Increased hysteresis effect may be brought about by crystallization of the Bourdon tube due to excessive cycling. A similar condition may result from exposure to excessively high pressure causing a partial fracture of the tube. In cases where the Bourdon tube has been found to have unacceptable levels of hysteresis a new tube is required. It is recommended that gauges requiring a new Bourdon tube be returned to the factory for repair.

Note: If a new Bourdon tube is required for a gauge that has the optional bimetallic thermal compensation a new thermal compensation will be required.

## 6.0 POINTER REPLACEMENT

### 6.1 GUIDE TO POINTER REPLACEMENT

A "perfect" gauge can be defined as a gauge which yields a reading which is exactly equal to the actual pressure which is being applied. Plotted on a graph, these points can be connected to form a straight line, indicating perfect "linearity". If a point was plotted that did not fall along this line, it can be said that this is a "non-linear" reading. Most pressure instruments exhibit some inherent non-linearity characteristics, due mainly to a disproportionate movement of the sensing element (Bourdon tube) under different pressures.

Prior to correction, an Ashcroft A4A precision pressure gauge will generally, in the first half of the scale, indicate a higher pressure reading than the actual applied pressure (called "running fast"), and will be the fastest at ? scale. The gauge will usually read perfectly at midpoint, run "slow" in the second half of the scale (slowest at ? scale) and read perfectly at full scale.

In order to maintain high accuracy, some form of compensation must be employed to overcome the additional inaccuracy caused by non-linearity. There are two methods of compensation for non-linearity in Ashcroft A4A gauges:

#### 1-Non-Linear Dials

These gauges are manufactured with balanced pointers and dials on which the graduations have been plotted to coincide with the position of the pointer at specific pressure points. The placement of the graduations is determined by the use of readings recorded during the preliminary calibration of each gauge. These readings will then be programmed into a computer linked to a photo-plotter, which will produce a negative image of the dial. A positive dial is then produced from this negative.

If the gauge is adjusted considerably or if movement parts are replaced, it will probably be impossible to re-use the existing dial, and a new dial will have to be plotted as part of the calibration.

## 2-Counter-Weighted Pointer

With this method, we begin by producing a "linear" dial. (A dial upon which the graduations are evenly spaced). Next, we take a "balanced" pointer and remove the half moon at the end of the tail. By removing the half moon, the pointer is no longer balanced because the tail end is now lighter than the indicating (knife edge) end. This will cause the heavy pointer tip to "sag" or read "slow" in the first half of the scale and read "fast" in the second half of the scale, actually over-compensating for the original non linearity condition.

To achieve the required effect, which is to flatten out the S curve, a counterweight is added to the tail end of the pointer to add back some of the weight that was lost when the half moon was removed.

By adding a counterweight, also called a "poise" onto the tail-end of the pointer gravity can be used to force the tail of the pointer "downward", which conversely deflects the tip of the pointer "upward". In the first half of the scale, the counterweight will cause the gauge to read faster. In the second half of the scale, the counterweight will cause the gauge to read slower. Since the gauge was reading slow in the first half of the scale, the faster readings caused by the counterweight will compensate for the non-linearity. Conversely, the second half of the scale which was reading fast, will be slowed by the counterweight.

In fact, because of the gravitational effect is decreased as the pointer approaches a vertical position (due to the decreased moment of inertia), the counterweight will cause no effect on the pointer at mid-scale, which is always plotted in the 12 o'clock position on the dial. This is ideal, as no compensation is necessary at mid-scale. The counterweight will cause the greatest effect at 9 scale (9:00) and 3 scale (3:00), which is where the most compensation is required. Properly set, the amount of compensation caused by the counterweight will exactly offset the amount of inherent non-linearity as shown by the "S" curve.

### Notes:

1-It is important to note that the counterweight can only be effective when the gauge is used in the vertical or near vertical operating position. Gauges used in the horizontal position will always require non-linear dials.

2-Gauges with 6" dials do not have pointers with half moon tails. Instead, the tail end of the pointer is wider than the indicating end. The counterbalance offset is accomplished by trimming the tail end of the pointer until the desired counterbalance effect is achieved.

The following general rules can be used to help determine whether a gauge has a linear or non-linear dial.

## Ashcroft A4A Gauges with Non-Linear Dials

- All vacuum and compound gauges
- All absolute gauges 75 psi or less
- All gauges calibrated in the horizontal position
- Some dual scale gauges
- All gauges originally equipped with "crescent moon" pointer tail tips

## Ashcroft A4A Gauges with Linear Dials

-All that are other than above

-All gauges originally equipped with counter weighted pointers

**Note:** When performing linearization via pointer trimming it is important that the trimming be done carefully so as not to remove too much material which would result in the need to discard the pointer and start the process over.

## 7.0 SPECIFICATIONS, RANGES & DIMENSIONS

### 7.1 STANDARD SPECIFICATIONS

Unless otherwise specified all gauges are calibrated for vertical mounting. If installation is other than vertical, the order must specify mounting positions to assure proper accuracy. A certified copy of test results, traceable to the National Institute of Standards and Technology, is furnished with each gauge. Standard conditions for calibration conform to NIST Monograph 8.

<b>Accuracy</b>	±0.1% of span
<b>Sensitivity</b>	±0.01% of span
<b>Repeatability</b>	±0.02% of full scale
<b>Hysteresis</b>	Not greater than ±0.1% of span after application of maximum scale pressure
<b>Pressure Types</b>	Gauge, compound, absolute* and vacuum
<b>Pressure Ranges</b>	From 0-15 psi through 0-100,000 psi
<b>Bourdon Tube Material</b>	Bourdon tubes are available in the following materials:

#### STANDARD

Beryllium Copper for ranges from 0-15 through 0-40 psi  
 AISI 403 stainless steel standard for range 0-50 psi through 0-100,000 psi

#### OPTIONAL

Beryllium Copper for ranges from 0-50 through 0-10,000 psi.  
 AISI 403 stainless steel for ranges 0-15 psi through 0-40 psi

### Standard Process

<b>Connections</b>	¼ NPT female back for ranges to 10,000 psi. 9/16-18 UNF-2B female back connections for ½ inch high pressure tubing for ranges over 10,000 psi
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### Optional Process

<b>Connections</b>	¼ NPT female, bottom
	⅜ NPT male, back or bottom
	¼ NPT male, back or bottom
	⅜ NPT female, back or bottom
	⅝-18 UNF-2B female, bottom or back or bottom for ranges below 10,000 psi
	MS 33656-4 male, back or bottom
	Mil-G-18997D male, back or bottom
	MS 33649-4 female, back or bottom
	MS 16142 female, back or bottom

\*The Ashcroft A4A Absolute Pressure Gauge does not incorporate Automatic barometric pressure compensation. The barometric pressure at the time of use must be set into the gauge by using the External Dial Adjuster.

## **8.0 WARRANTY AND SHIPPING INSTRUCTIONS**

### **8.1 WARRANTY AND LIMITATION OF LIABILITY**

All Ashcroft A4A products and parts carry a warranty against defective material and workmanship for a period of one (1) year from the date of shipment.

A complete warranty and limitation of liability statement is provided on the standard Ashcroft A4A quotation form. Copies of this form are provided with quotations and are available upon request.

### **8.2 SHIPPING INSTRUCTIONS FOR RETURN TO THE FACTORY**

Pack securely to prevent possible damage in shipment. If possible, using original packaging provided with the A4A from Ashcroft Inc.

Ship Package To:

**Ashcroft Inc.  
250 East Main Street  
Stratford, CT 06614, USA  
Attention: Heise Service Center**

**IMPORTANT** – Obtain written authorization in order to return instruments that have been used with or in contact with corrosive or otherwise hazardous materials such as mercury, radioactive solutions or toxic chemicals.

Please furnish the following information with the returned instrument:

Company Name  
Phone Number  
Person to Contact  
Address  
Model  
Serial Number  
Symptoms

## **9.0 TO ORDER A GAUGE**

### **9.1 NECESSARY INFORMATION TO ORDER AN ASHCROFT A4A PRECISION PRESSURE GAUGE**

Please specify the following Gauge Attributes:

1. Model A4A
2. Dial Size (6", 8?", 12" and 16")
3. Pressure Range
4. Confirm Bourdon tube material
5. Pressure Type (gauge, vacuum, compound or absolute)
6. Process Connection, type, gender & location
7. Options desired

# APPENDIX A STANDARD GRADUATION TABLES

Scale for All Units of Measure	6" A4A & 8 1/2" A4A				12" A4A				16" A4A				Scale for All Units of Measure
	Total Number of Divisions	Value per Division	Division Pattern	Numeral Value	Total Number of Divisions	Value per Division	Division Pattern	Numeral Value	Total Number of Divisions	Value per Division	Division Pattern	Numeral Value	
0-1	500	.002	1/5	.05	1000	.001	1/5	.05	1000	.001	1/5	.05	0-1
0-1.6	800	.002	1/5	.1	800	.002	1/5	.1	800	.002	1/5	.1	0-1.6
0-2	400	.005	1/2	.1	1000	.002	1/5	.1	1000	.002	1/5	.1	0-2
0-2.5	500	.005	1/2	.1	1000	.0025	1/4	.1	1250	.002	1/5	.1	0-2.5
0-3	600	.005	1/2	.2	600	.005	1/2	.2	1500	.002	1/5	.1	0-3
0-4	400	.01	1/5	.2	800	.005	1/2	.2	800	.005	1/2	.2	0-4
0-5	500	.01	1/5	.2	1000	.005	1/2	.2	1000	.005	1/2	.2	0-5
0-6	600	.01	1/5	.2	600	.01	1/5	.2	1200	.005	1/2	.2	0-6
0-7.5	750	.01	1/5	.5	750	.01	1/5	.5	1500	.005	1/2	.5	0-7.5
0-10	500	.02	1/5	.5	1000	.01	1/5	.5	1000	.01	1/5	.5	0-10
0-15	750	.02	1/5	1	750	.02	1/5	1	1500	.01	1/5	.5	0-15
0-16	800	.02	1/5	1	800	.02	1/5	1	800	.02	1/5	1	0-16
0-20	400	.05	1/2	1	1000	.02	1/5	1	1000	.02	1/5	1	0-20
0-25	500	.05	1/2	1	1000	.025	1/4	1	1250	.02	1/5	1	0-25
0-30	600	.05	1/2	2	600	.05	1/2	2	1500	.02	1/5	1	0-30
0-40	400	.1	1/5	2	800	.05	1/2	2	800	.05	1/2	2	0-40
0-50	500	.1	1/5	2	1000	.05	1/2	2	1000	.05	1/2	2	0-50
0-60	600	.1	1/5	2	600	.1	1/5	2	1200	.05	1/2	2	0-60
0-75	750	.1	1/5	5	750	.1	1/5	5	1500	.05	1/2	5	0-75
0-100	500	.2	1/5	5	1000	.1	1/5	5	1000	.1	1/5	5	0-100
0-150	750	.2	1/5	10	750	.2	1/5	10	1500	.1	1/5	5	0-150
0-160	800	.2	1/5	10	800	.2	1/5	10	800	.2	1/5	10	0-160
0-200	400	.5	1/2	10	1000	.2	1/5	10	1000	.2	1/5	10	0-200
0-250	500	.5	1/2	10	1000	.25	1/4	10	1250	.2	1/5	10	0-250
0-300	600	.5	1/2	20	600	.5	1/2	20	1500	.2	1/5	10	0-300
0-400	400	1	1/5	20	800	.5	1/2	20	800	.5	1/2	20	0-400
0-500	500	1	1/5	25	1000	.5	1/2	20	1000	.5	1/2	20	0-500
0-600	600	1	1/5	25	600	1	1/5	25	1200	.5	1/2	20	0-600
0-750	750	1	1/5	50	750	1	1/5	50	1500	.5	1/2	50	0-750
0-760	760	1	1/5	40	760	1	1/5	40	1520	.5	1/2	40	0-760
0-1000	500	2	1/5	50	1000	1	1/5	50	1000	1	1/5	50	0-1000
0-1500	750	2	1/5	100	750	2	1/5	100	1500	1	1/5	50	0-1500
0-1600	800	2	1/5	100	800	2	1/5	100	800	2	1/5	100	0-1600
0-2000	400	5	1/2	100	1000	2	1/5	100	1000	2	1/5	100	0-2000
0-2500	500	5	1/2	100	1000	2.5	1/4	100	1250	2	1/5	100	0-2500
0-3000	600	5	1/2	200	600	5	1/2	200	1500	2	1/5	150	0-3000
0-4000	400	10	1/5	200	800	5	1/2	200	800	5	1/2	200	0-4000
0-5000	500	10	1/5	250	1000	5	1/2	200	1000	5	1/2	200	0-5000
0-6000	600	10	1/5	250	600	10	1/5	250	1200	5	1/2	200	0-6000
0-7500	750	10	1/5	500	750	10	1/5	500	1500	5	1/2	500	0-7500
0-10000	500	20	1/5	500	1000	10	1/5	500	1000	10	1/5	500	0-10000
0-15000	750	20	1/5	1000	750	20	1/5	1000	1500	10	1/5	500	0-15000
0-20000	400	50	1/2	1000	1000	20	1/5	1000	1000	20	1/5	1000	0-20000
0-25000	500	50	1/2	1000	1000	25	1/4	1000	1250	20	1/5	1000	0-25000
0-30000	600	50	1/2	2000	600	50	1/2	2000	1500	20	1/5	1000	0-30000
0-40000	400	100	1/5	2000	800	50	1/2	2000	800	50	1/2	2000	0-40000
0-50000	500	100	1/5	2500	1000	50	1/2	2000	1000	50	1/2	2000	0-50000
0-60000	600	100	1/5	2500	600	100	1/5	2500	1200	50	1/2	2000	0-60000
0-75000	750	100	1/5	5000	750	100	1/5	5000	1500	50	1/2	5000	0-75000
0-100000	500	200	1/5	5000	1000	100	1/5	5000	1000	100	1/5	5000	0-100000

## Division Pattern

1/2



1/4



1/5



**APPENDIX B STANDARD RANGE SELECTION**

<b>PSIG</b>				
STANDARD BOURDON TUBE MATERIAL**	STANDARD RANGE PSIG	CC	CM	CMM
BERYLLIUM COPPER (J)	0-12/3-15	[shaded]	[shaded]	[shaded]
	0-15			
	0-20			
	0-25			
	0-30			
	0-40			
	0-50			
403 STAINLESS STEEL (V)	0-60	[shaded]	[shaded]	[shaded]
	0-75			
	0-100			
	0-150			
	0-200			
	0-250			
	0-300			
	0-400			
	0-500			
	0-600			
	0-750			
	0-1000			
	0-1500			
	0-2000			
	0-3000			
	0-4000			
	0-5000			
	0-6000			
	0-7500			
	0-10,000			
	0-15,000			
	0-20,000			
	0-25,000			
0-30,000				
0-40,000				
0-50,000				
0-60,000*				
0-75,000*				
0-100,000*				

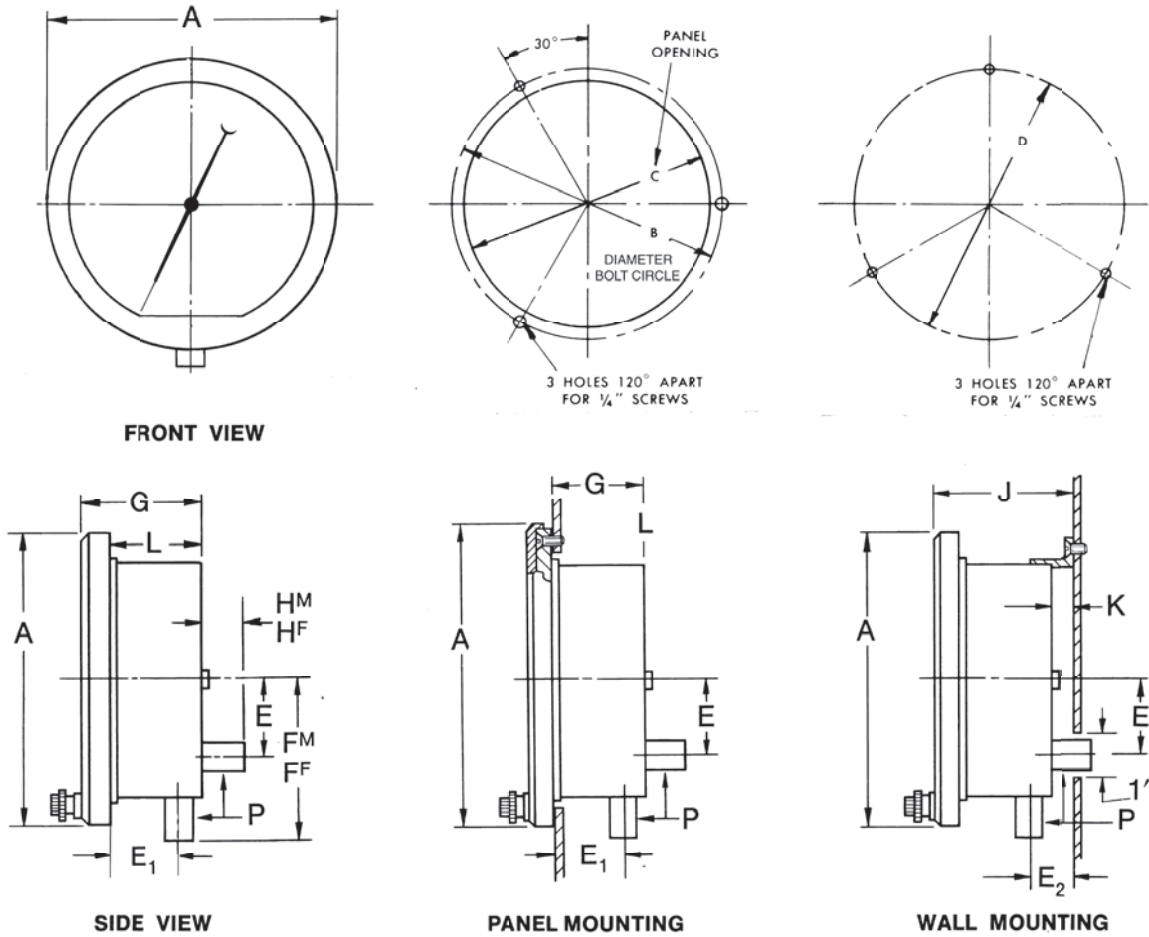
<b>Inches Mercury</b>				
STANDARD BOURDON TUBE MATERIAL**	STANDARD RANGE INCHES MERCURY	CC	CM	CMM
BERYLLIUM COPPER (J)	0-30	[shaded]	[shaded]	[shaded]
	0-40			
	0-50			
	0-60			
	0-75			
	0-100			
AISI 403 STAIN. STEEL (V)	0-125	[shaded]	[shaded]	[shaded]
	0-150			
	0-200			
	0-250			
	0-300			
	0-400			
	0-500			
	0-600			
	0-750			
	0-1000			
	<b>Vacuum</b>			
BERYLLIUM COPPER (J)	-30 to 0	[shaded]	[shaded]	[shaded]
<b>Compound</b>				
	<b>VAC-PRESSURE</b>	CC	CM	CMM
BERYLLIUM COPPER (J)	15" Hg - 15" Hg	[shaded]	[shaded]	[shaded]
	30" Hg - 30" Hg			
AISI 403 STAIN. STEEL (V)	30" Hg - 60" Hg	[shaded]	[shaded]	[shaded]
	30" Hg - 100" Hg			
BERYLLIUM COPPER (J)	30" Hg - 150" Hg	[shaded]	[shaded]	[shaded]
	30" Hg - 15 psi			
AISI 403 ST. STEEL (V)	30" Hg - 30 psi	[shaded]	[shaded]	[shaded]
	30" Hg - 60 psi			
	30" Hg - 100 psi			
	30" Hg - 150 psi			
AISI 403 ST. STEEL (V)	30" Hg - 300 psi	[shaded]	[shaded]	[shaded]
	30" Hg - 300 psi			
<b>Inches Water</b>				
STANDARD BOURDON TUBE MATERIAL**	STANDARD RANGE INCHES MERCURY	CC	CM	CMM
BERYLLIUM COPPER (J)	0-350	[shaded]	[shaded]	[shaded]
	0-400			
	0-450			
	0-500			
	0-600			
	0-750			
	0-800			
	0-1000			



**APPENDIX B STANDARD METRIC RANGES**

<b>Metric</b>							
STANDARD BOURDON TUBE MATERIAL**	STANDARD RANGE MILLIMETERS MERCURY			CC	CM	CMM	
BERYLLIUM COPPER (J)	0-760						
	0-1000						
	0-1250						
	0-1500						
AISI 403 STAIN. STEEL (V)	0-2500						
	0-3000						
	0-4000						
	0-5000						
BERYLLIUM COPPER (J)	bar	kPa	mPa				
	kg/cm <sup>2</sup>						
	kp/cm <sup>2</sup>						
	0.2-1	-	-				
	0-1	0-100	-				
	0-1.6	0-160	-				
AISI 403 STAINLESS STEEL (V)	0-2	0-200	-				
	0-2.5	0-250	-				
	0-3	0-300	-				
	0-4	0-400	-				
	0-5	0-500	-				
	0-6	0-600	-				
	0-7.5	0-750	-				
	0-10	0-1000	0-1				
	0-12	0-1250	0-1.25				
	0-16	0-1600	0-1.6				
	0-20	0-2000	0-2				
	0-25	0-2500	0-2.5				
	0-30	0-3000	0-3				
	0-40	0-4000	0-4				
	0-50	0-5000	0-5				
	0-60	0-6000	0-6				
	0-75	0-7500	0-7.5				
	0-100	0-10,000	0-10				
	0-125	-	0-12.5				
	0-160	-	0-16				
	0-200	-	0-20				
	0-250	-	0-25				
	0-400	-	0-40				
	0-500	-	0-50				
	0-600	-	0-60				
	0-750	-	0-75				
	0-1000	-	0-100				
	0-1250	-	0-125				
0-1600	-	0-160					
0-2500	-	0-250					
0-4000	-*	0-400					
0-6000	-*	0-600					
0-7000	-*	0-700					
<b>Vacuum</b>							
BERYLLIUM COPPER (J)	-1 to 0 -100 to 0						

**APPENDIX C GAUGE CASE DIMENSIONS**



**Model A4A**

Size	Dim. Units	A	B	C	D	E	E <sub>1</sub>	E <sub>2</sub>	F <sup>M</sup>	F <sup>F</sup>	G	H <sup>M</sup>	H <sup>F</sup>	J	K	L
6"	in.	7 <sup>7</sup> / <sub>8</sub>	7	6 <sup>1</sup> / <sub>2</sub>	7	2	1 <sup>7</sup> / <sub>8</sub>	1 <sup>1</sup> / <sub>4</sub>	4 <sup>5</sup> / <sub>8</sub>	4 <sup>5</sup> / <sub>16</sub>	3 <sup>1</sup> / <sub>4</sub>	1 <sup>3</sup> / <sub>8</sub>	1 <sup>1</sup> / <sub>16</sub>	3 <sup>7</sup> / <sub>8</sub>	5 <sup>5</sup> / <sub>8</sub>	2 <sup>15</sup> / <sub>32</sub>
	mm	200	177.8	165.1	177.8	50.8	47.6	31.8	117.5	109.5	82.3	34.9	27	98.4	15.9	62.7
8 <sup>1</sup> / <sub>2</sub> "	in.	10 <sup>5</sup> / <sub>16</sub>	9 <sup>3</sup> / <sub>8</sub>	8 <sup>15</sup> / <sub>16</sub>	9 <sup>1</sup> / <sub>2</sub>	2	1 <sup>7</sup> / <sub>8</sub>	1 <sup>1</sup> / <sub>4</sub>	5 <sup>23</sup> / <sub>32</sub>	5 <sup>13</sup> / <sub>32</sub>	3 <sup>1</sup> / <sub>4</sub>	1 <sup>3</sup> / <sub>8</sub>	1 <sup>1</sup> / <sub>16</sub>	3 <sup>7</sup> / <sub>8</sub>	5 <sup>5</sup> / <sub>8</sub>	2 <sup>15</sup> / <sub>32</sub>
	mm	261.9	238.1	228.6	241.3	50.8	47.6	31.8	145.3	137.3	82.3	34.9	27	98.4	15.9	62.7
12"	in.	13 <sup>21</sup> / <sub>32</sub>	12 <sup>3</sup> / <sub>4</sub>	12 <sup>3</sup> / <sub>8</sub>	9 <sup>1</sup> / <sub>2</sub>	2	1 <sup>7</sup> / <sub>8</sub>	1 <sup>1</sup> / <sub>4</sub>	5 <sup>23</sup> / <sub>32</sub>	5 <sup>13</sup> / <sub>32</sub>	3 <sup>1</sup> / <sub>4</sub>	1 <sup>3</sup> / <sub>8</sub>	1 <sup>1</sup> / <sub>16</sub>	3 <sup>7</sup> / <sub>8</sub>	5 <sup>5</sup> / <sub>8</sub>	2 <sup>15</sup> / <sub>32</sub>
	mm	346.9	329.9	314.3	241.3	50.8	47.6	31.8	145.3	137.3	82.3	34.9	27	98.4	15.9	62.7
16"	in.	17 <sup>23</sup> / <sub>32</sub>	16 <sup>3</sup> / <sub>4</sub>	16 <sup>3</sup> / <sub>8</sub>	9 <sup>1</sup> / <sub>2</sub>	2	1 <sup>7</sup> / <sub>8</sub>	1 <sup>1</sup> / <sub>4</sub>	5 <sup>23</sup> / <sub>32</sub>	5 <sup>13</sup> / <sub>32</sub>	3 <sup>1</sup> / <sub>4</sub>	1 <sup>3</sup> / <sub>8</sub>	1 <sup>1</sup> / <sub>16</sub>	3 <sup>7</sup> / <sub>8</sub>	5 <sup>5</sup> / <sub>8</sub>	2 <sup>15</sup> / <sub>32</sub>
	mm	450.1	425.5	415.9	241.3	50.8	47.6	31.8	145.3	137.3	82.3	34.9	27	98.4	15.9	62.7

<b>Inlet Pressure Connection* P</b>	<b>Male</b> – 1/8 Male NPT 1/4 Male NPT MS 33656-4	<b>Female</b> – 1/8 Female NPT 1/4 Female NPT	AND 10050-4 Aminco 45-11310 Autoclave F-250-C			
	<b>Weight</b>	Dial Size	6"	8 <sup>1</sup> / <sub>2</sub> "	12"	16"
	Net Weight	4 <sup>3</sup> / <sub>4</sub> lbs.	6 <sup>1</sup> / <sub>2</sub> lbs.	9 <sup>1</sup> / <sub>4</sub> lbs.	12 <sup>1</sup> / <sub>4</sub> lbs.	
	Shipping Weight	6 <sup>1</sup> / <sub>4</sub> lbs.	8 <sup>1</sup> / <sub>2</sub> lbs.	15 lbs.	18 <sup>1</sup> / <sub>4</sub> lbs.	

\*Standard Inlet Fittings: 1/4 NPT Female Back Connection for ranges up to and including 10,000 psi. AMINCO 45-11310 or AUTOCLAVE F-250-C for ranges over 10,000 psi.



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