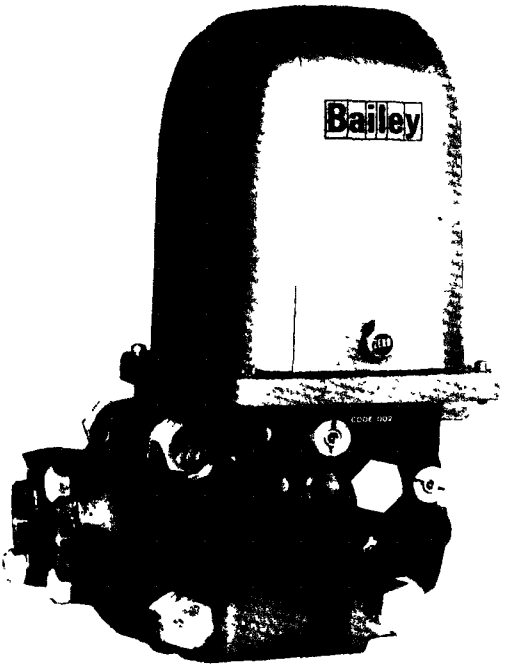
Product Instruction P21-19

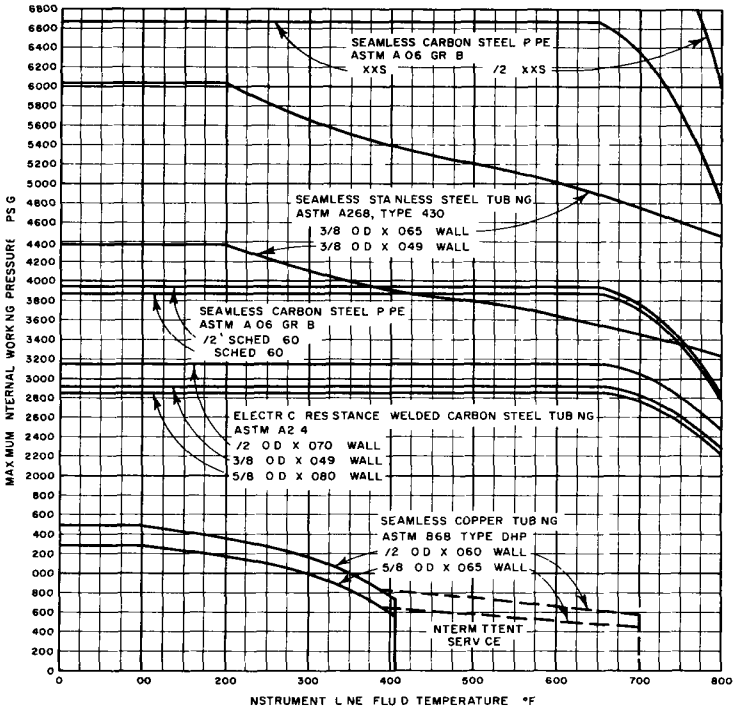


Differential Pressure Transmitter Type BK

Bailey Babcock & Wilcox

LIST OF ILLUSTRATIONS

INDEX



NOTES

1 The curve representing the rating of the tubing selected must lie above the intersection of lines representing the actual expected maximum sustained temperature and pressure

2 Tubing materials, dimensions and specifications are those of tubing stocked by Bailey Meter Company In some cases larger sizes are recommended Several commercial pipe sizes have been shown for convenience

3 If other materials or sizes of wall thicknesses are used allowable working pressures must be calculated as provided for in the code

4 Temperatures are instrument line fluid temperatures In steam service tubing preceding blowdown valves shall be suitable for saturated steam temperature at the design main line pressure

5 Copper tubing may be used in dead end steam or water service up to design pressures and temperatures shown by the dotted curves provided that the temperature within the lines for continuous service does not exceed 406F

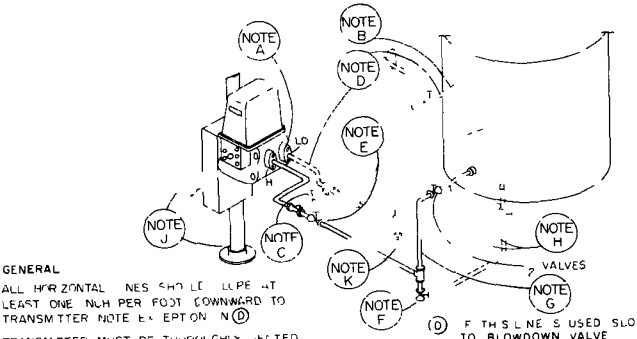
6 Pressure and or temperature may exceed the normal design conditions occasionally provided the pressure does not exceed the allowable value for the temperature involved by more than

(1) 15% during 10% of the operating period
(2) 20% during 1% of the operating period

7 The recommended minimum wall thickness for socket welded tubing is 065"

8 Tubing wall thicknesses are not calculated to provide additional thickness that may be required for mechanical strength Tubing should be continuously supported in conduit trays or channels

FIGURE 4 Instrument Piping Selection Chart, Based on Pressure Piping Code, ANSI B31 1.0



GENERAL

ALL HOR ZONTAL NES SHO LD SLOPE AT LEAST ONE NCH PER FOOT DOWNWARD TO TRANSM TTER NOTE E EPT ON N (D)

TRANSM TTER MUST BE THOROUGHLY VENTED TO AVO D MEASUREMENT ERRORS

NOTES

(A) OPEN VESSEL LEVEL AT ATMOSPHER C PRESSURE LOW PRESSURE JNNE TON OPEN T ATMOSPHERE

(B) CLOSED VESSEL LEVEL PRESSURIZED NSTALLA JONNE TON TO TOP OF TANK ABOVE LIQUID LEVEL

(C) EQUAL ZNG VALVE

(D) F TH S LNE S USED SLOPE DOWNWARD TO VESSEL AND TO BLOWDOWN VALVE

(E) /4 /2 VALVES

(F) /2 BLOWDOWN VALVES

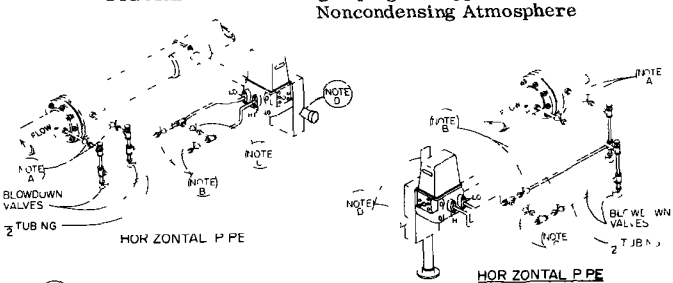
(G) /2 P PE OR 5/8 OD TUB NG (TO BLOWD WN VALVE)

(H) CONNECT ON N S DE OR BOTTOM OF TANK F LTER SCREENS RECOMMENDED FOR BOTTOM OF TANK CONNECT ONS

(J) /2 2 SUPPORT P PE NOT BY B M CO)

(K) ONDENSAT ON COLLECT ON PO NT DRA N AS NECESSARY

FIGURE 5 Connecting Piping for Type BK□□□1 Open or Closed Tank, Noncondensing Atmosphere



HOR ZONTAL P PE

GENERAL

MOUNT TRANSM TTER BELOW PR MARY ELEMENT CONNECT ONS

ALL HOR ZONTAL LNES SHOULD SLOPE AT LEAST ONE NCH P R FOOT DOWNWARD T TRANSM TTER

TRANSM TTER M ST BE THOROUGHLY VENTED TO AVO D ERRORS N MEASUREMENT

ALL VALVES AT PR SSURE C NNECT NS SHOULD BE N NEARLY VERT AL POS TON

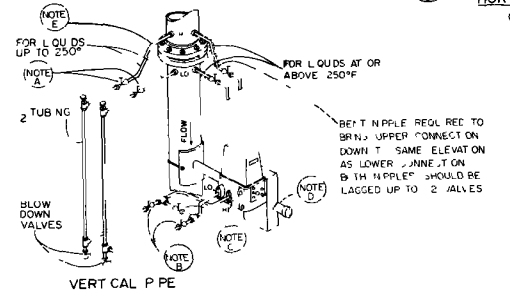
A ½ VALVES STEMS UP OR AT SL GHT ANGLE STA CER FOR C EARANCE

B ADD T NAL SET OF VALVES REQUIRED FOR LON JNNECT NG LNES OR WHEN DES RABLE TO MOUNT UNT AT FLOOR LEVEL TO PERMIT SERV NG

C EQUAL Z NG VALVE

D ½ 2 SUPP HT S P PE NOT BY B M CO

E NPPLES TO SIDE OF FLANGE LAGGING AS APPLICABLE)



BENT NPPLE REQU RED TO BRNG UPPER CONNECT ON DOWN T SAME ELEVAT ON AS LOWER CONNECT ON B TH NPPLES SHOULD BE LAGGED UP TO 2 VALVES

FIGURE 6 Connecting Piping for Liquid Measurement

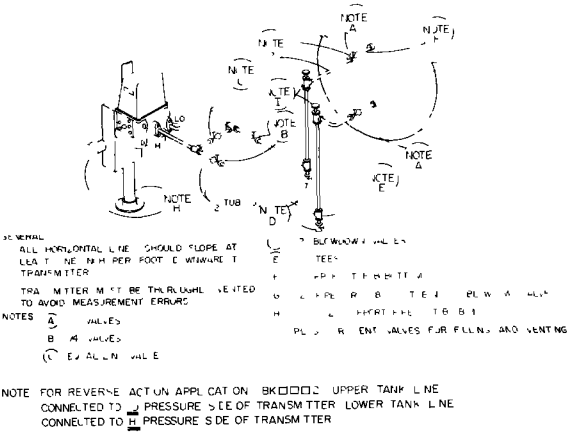


FIGURE 7 Connecting Piping for Type BK□□□2 Closed Tank, Condensing Atmosphere

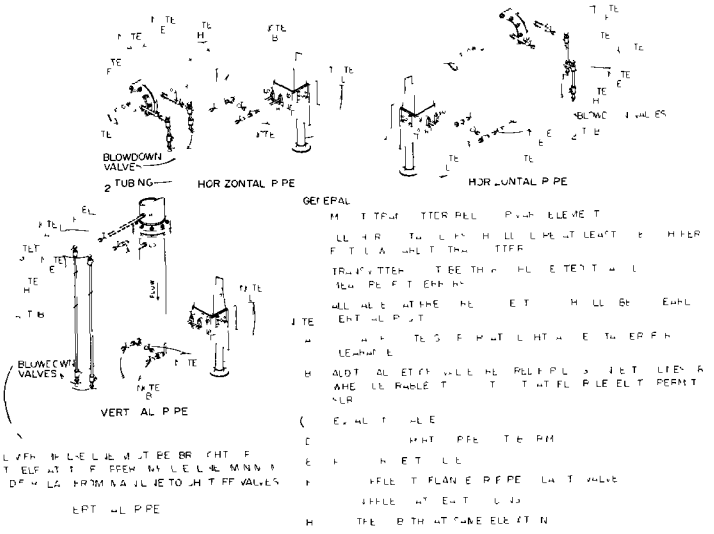
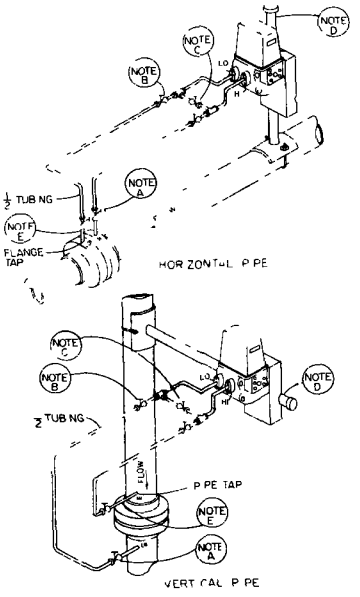


FIGURE 8 Connecting Piping for Steam Measurement



NOTES

GENERAL
MOUNT TRANSMITTER ABOVE PRIMARY ELEMENT CONNECTIONS

MAKE PRIMARY ELEMENT CONNECTIONS ON TOP OF FLANGE IN HORIZONTAL FLOW

ALL HORIZONTAL CONNECTING LINES SHOULD SLOPE AT LEAST ONE INCH PER FOOT DOWNWARD TO MAIN LINE

A 1/2 VALVES STEMS UP OR AT SLIGHT ANGLE STAGGERED FOR CLEARANCE

B ADDITIONAL SET OF VALVES REQUIRED FOR LONG CONNECTING LINES OR WHEN DESIRABLE TO MOUNT UNIT AT FLOOR LEVEL TO PERMIT SERVICING

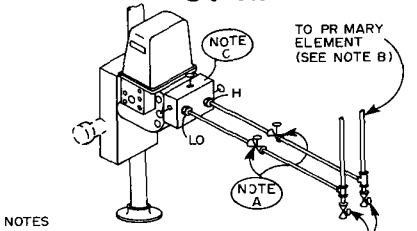
C EQUALIZING VALVE

D) 2 2 SUPPORTING PIPE (NOT BY B M CO)

E) 2 NIPPLES TO FLANGE OR PIPE PRESSURE TAP

FIGURE 9 Connecting Piping for Gas Measurement

OPERATING THE TRANSMITTER



NOTES

A 1/2 VALVES OPEN ONLY AFTER LINES HAVE BEEN REFILLED WITH CONDENSATE AFTER BLOWDOWN

B SEE FIGURES 5 THRU 9

C MANIFOLD VALVE 2 1/8" SPACING

FIGURE 10 Commercial Manifold Piping

PLACING TRANSMITTER IN SERVICE

WARNING: Do not subject Type BK8 or BK9 Transmitter to pressure greater than 1500 psig. Isolate Transmitter from system during hydrostatic test of piping requiring over 1500 psig. Pressures in excess of rating may damage the force beam sealing diaphragm.

1. Make certain that all connecting tubing is correctly installed (Figures 5 thru 9) and that all valves are closed.

2. Apply supply air to Booster Relay on Transmitter.

3. Open equalizing valve (C) in pressure line to Transmitter (Some level applications on open or closed tanks with noncondensing atmospheres may not use an equalizing valve In this case, ignore reference to equalizing valve and LO pressure piping in following procedure).

4. If blowdown valves are installed:

a. Open one blowdown valve slowly. Allow to blow a sufficient length of time to clear line (usually not more than 15 seconds). Close blowdown valve.

b. Repeat step 4a with other blowdown valve.

5 If blowdown valves are not installed:

a. Disconnect connecting piping at HI and LO connections at Transmitter

b Slowly open instrument valve in HI pressure line to Transmitter Allow to blow a sufficient length of time to clear line (usually not more than 15 seconds). Close instrument valve in HI pressure line.

c Repeat step 5b with valve in LO pressure line

d. Reconnect piping at HI and LO Transmitter connections.

6 If Transmitter measures steam flow, allow time for steam in connecting lines to condense and for connecting lines to reach normal operating temperature before proceeding to step 7.

7. Slowly open instrument valve in HI pressure line to Transmitter and allow pressure to build up on both sides of diaphragm capsule.

8. Liquid applications only crack vent valves V1 and V2 (1/4 turn to unseat) and allow trapped air to escape. Close vent valves (See Figure 11 for location of vent valves.)

9 Booster output pressure should be 3 psi (27 or 15 psi for reverse action units. Type BK□□□2) Adjust zero adjustment (Fig 17)as necessary until output is correct

NOTE: On level applications with one side of diaphragm vented, Booster output pressure will not be 3 psi Output pressure will be increased in proportion to head on high pressure connection

10 Slowly open instrument valve in LO pressure line to Transmitter

11 Close equalizing valve (C) Transmitter is now in service

REMOVING FROM SERVICE

1 Open equalizing valve (C) in pressure line to Transmitter

2 Close instrument valves in HI and LO pressure lines to Transmitter

3 Open vent valves V1 and V2, or remove plugs in bottom of diaphragm capsule

4 Turn off air supply to Booster Relay

5 Transmitter is now out of service

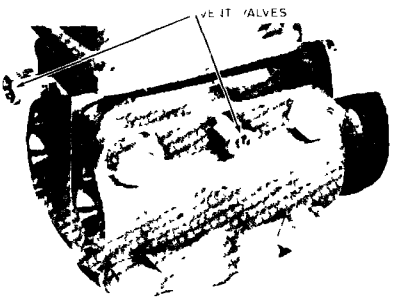


FIGURE 11 - Location of Vent Valves

ROUTINE SERVICING

CONNECTING TUBING AND PIPING

1. Keep all tubing and piping connections tight. Check tubing and piping for leakage while under pressure with a leak detecting solution.

2. Maintain a regulated air supply, free of dirt, oil and moisture to Booster Relay.

3 Periodically blow down connecting piping as outlined below

WARNING: Do not blow down lines into the Transmitter. Blowdown temperature may damage the Transmitter.

BLOWING DOWN CONNECTING PIPING

A. Flow Measurement

Follow the procedure below to blow down connecting lines if installation includes blow down piping.

1. Close instrument valves in HI and LO pressure lines to Transmitter and open equalizing valve.

2. Open one blowdown valve slowly to prevent sudden strain on connecting line. Allow a sufficient length of time to clear line (usually not more than 15 seconds is required). Close valve

3. Repeat step 2 with other blowdown valve

4. If Transmitter measures steam, allow time for steam in connecting lines to condense and to reach normal operating temperature before placing Transmitter in service.

5 Slowly open instrument valve in LO pressure line to Transmitter. Close equalizing valve. Slowly open instrument valve in HI pressure line. Transmitter should respond immediately.

Follow the procedure below to blow down connecting lines if installation does not include blowdown piping Refer to Figures 5 6, or 7 as applicable

1 Close instrument valves in HI and LO pressure lines to Transmitter and open equalizing valve.

2 Crack unions or fittings below instrument valves and bleed off pressure in diaphragm.

3 Disconnect connecting lines from instrument at unions or fittings on Transmitter manifold or connecting piping

4 Swing connecting lines away so blow down is not directed at Transmitter (If connecting lines cannot be moved easily temporarily add short lengths of tubing to direct blowdown away from Transmitter.)

5 Open one instrument valve slowly to avoid sudden strain on connecting line Allow line to blow a sufficient length of time to clear line (usually not more than 15 seconds is required). Close valve

6. Repeat step 5 with other instrument valve.

7. If Transmitter measures steam allow time for steam in connecting lines to condense and reach normal operating temperature before placing Transmitter in service.

8 Reconnect connecting lines Slowly open instrument valve in LO pressure line to Transmitter Close equalizing valve. Slowly open instrument valve in HI pressure line Transmitter should respond immediately.

B Level Measurement

Open or Closed Tank, Non-Condensing Atmosphere

1 Refer to Figure 8 Close instrument valve (E)

2 Open blowdown valve (F) slowly to prevent sudden strain on connecting line. Allow to blow a sufficient length of time to clear line (usually not more than 15 seconds is required). Close blowdown valve.

3 Slowly open shutoff valve (E) Transmitter should respond immediately

Closed Tank Condensing Atmosphere

1 Refer to Figure 9 Close instrument valves (B) and open equalizing valve (C).

2. Open one blowdown valve (D) slowly to prevent sudden strain on connecting line Allow to blow a sufficient length of time to clear line (usually not more than 15 seconds is required) Close blowdown valve

3 Repeat procedure in step 2 for other blowdown valve

4 Allow time for steam in connecting lines to condense (or refill manually thru filling plugs shown in Figure 9) and for connecting lines to reach normal operating temperature before placing Transmitter in service

5 Slowly open shutoff valve (B) in low pressure line (marked HI) Close equalizing valve (C) Slowly open shutoff valve in high pressure line marked LO) Transmitter should respond immediately.

BOOSTER RELAY

1 Periodically inspect nozzle tip (Figure 17) and vane for deposits of oil, dirt etc. Clean with a suitable solvent

2 Periodically replace felt pad air filters as follows:

a Turn OFF supply air to Booster Relay and disconnect supply air and output lines (Figure 3).

b Remove wire mesh disc Item 28, Figure 27) and felt pads (Item 27) with pick or similar instrument.

c. Replace felt pads Replace wire mesh discs

NOTE: When replacing mesh discs make certain there is a disc under felt pad in supply connection.

d Reconnect supply air and output lines to Booster Relay

TROUBLESHOOTING

1. If Transmitter is inoperative or if operation is faulty first check Transmitter calibration as outlined under 'Pre Service Adjustments , page 19 If correct output readings still cannot be obtained proceed as follows (see Figure 17):

a Visually inspect for any missing screws or broken parts at sealing diaphragm vane adjustment screw spring pivot hinge and restoring bellows

b Check that all screws are tight If any screws in areas around spring pivot hinge tension strip mounting feet, nozzle set screw, vane spacer, mounting plate restoring bellows and force beam are found to be loose refer to Complete Calibration Procedures ' page 20

c Check that when Transmitter is in operation, only contact between the force beam and restoring beam is at fulcrum

If it is suspected that the Transmitter is mechanically defective or the Booster Relay is faulty refer to Fault Correction Chart page 17.

DISASSEMBLING THE TRANSMITTER

NOTE: Make certain Transmitter is disconnected from pressure source before removing and replacing diaphragm or diaphragm capsule

Replacing Measuring Diaphragm Type BK7□□□ (Refer to Figures 16 and 26)

1. Remove pipe plug (25) from housing.

2 Insert 3/16 inch Allen wrench thru pipe plug hole and loosen (do not remove) connector clamp nut.

3 Remove Booster Relay

4. Remove mounting bolts (30) holding diaphragm assembly to pressure housing. and pull assembly away from housing.

5 Loosen and remove all diaphragm clamp bolts

6. Pry outer housing away from inner housing. (Use screw driver or similar instrument.)

NOTE: Gasket, diaphragm. and center assembly remain connected to inner housing Do not damage parts during this operation.

7. Remove two hanger strap screws (Figure 16) holding diaphragm center hanger straps to inner housing (located at top of housing reach by folding down upper portion of diaphragm).

8. Pull gasket, diaphragm, and diaphragm to diaphragm center assembly. Force out nylon sleeves. and discard

10 Remove jam nut on diaphragm center assembly.

11. Remove damaged diaphragm. Insert new nylon sleeves in replacement diaphragm and install in center assembly. Align diaphragm as shown in Figure 16

12. Reassemble diaphragm assembly by reversing steps 3 thru 10(see Table II ,page 32, for torque values). Do not tighten connector clamp nut or replace pipe plug.

13. Repeat steps 7 thru 11 under 'Calibration Procedures Type BK7' on page 20 to correctly position connector

14. Perform calibration as outlined under 'Pre-Service Adjustments' on page 19.

Replacing Diaphragm Capsule - Type BK□□□ and BK9□□□ (Refer to Figure 27)

1 Remove pipe plug (8) from diaphragm assembly

2. Insert 3/16 inch Allen wrench thru pipe plug hole and loosen (do not remove) connector clamp nut

3. Remove four screws and bolts holding front housing to base housing Remove front housing.

4. Pull diaphragm capsule assembly from base housing (This assembly must be replaced as a unit; it cannot be repaired.) Remove and examine diaphragm housing seals (Item 4, Figure 27) replace if damaged

NOTE: This assembly must be replaced as a unit; it cannot be repaired.

5. Place diaphragm housing seals in position on new diaphragm capsule assembly. Insert diaphragm capsule assembly, with connector, between D-washer and force beam nut. Lightly tighten connector clamp nut allowing capsule unit to assume its own rotational position (see Figure 24).

6. Replace front housing and tighten nuts finger tight.

7 Loosen connector clamp nut and tighten mounting screws and nuts to torque specified in Table II on page 32.

8 Reset initial output of Transmitter as outlined under 'Resetting Initial Output' below.

Resetting Initial Output - Types BK8□□□ and BK9□□□

1. Apply supply pressure to Booster Relay of Transmitter.

2. Adjust output pressure to 3 psig by turning zero spring adjustment (Reset suppression spring nut if error exceeds 1 psi)

NOTE: Steps 3 and 4 may be omitted if previously performed during diaphragm capsule replacement

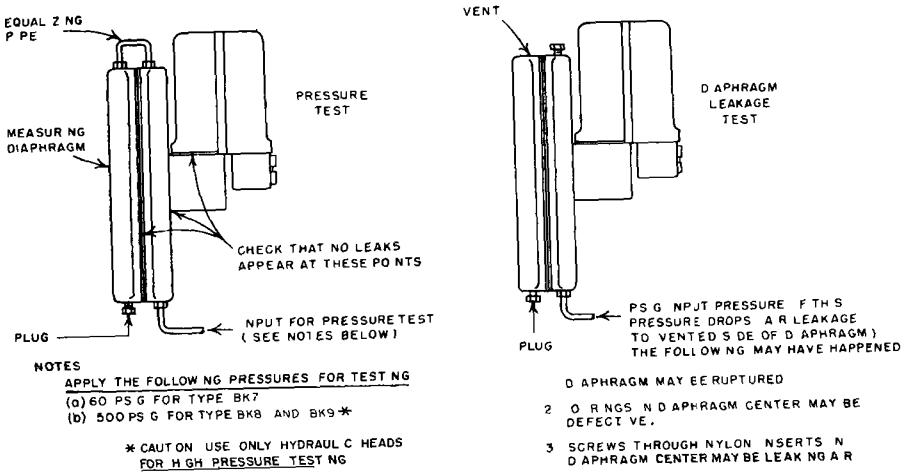


FIGURE 12 Diaphragm Pressure Test

3. Insert diaphragm capsule assembly with connector between D washer and force beam nut. Lightly tighten connector clamp nut (see Figure 27)

4 Install front or lower housing and tighten mounting nuts finger tight.

5 Loosen connector clamp nut, and tighten mounting nuts to torque specified in Table II on page 32.

6. Tighten connector clamp nut to torque specified in Table II. (Output of Transmitter must remain within 0.5 psig limit during this operation. If not loosen connector clamp nut and retighten until output remains constant.) If output still shifts remove front housing, pull out and rotate capsule 180° and repeat above procedure

7. Pressure test assembly as outlined in Figure 12 following listed precautions

8 Calibrate Transmitter as outlined under Pre Service Adjustments , page 19

Replacing Restoring Bellows (Figure 25 Item 26)

1 Remove mounting screws (18) holding Booster Relay to mounting plate 12). Remove Relay (Figure 24)

2 Remove screw holding manifold clamp (25) to mounting plate (45)

3 Loosen set screw (56) holding bellows to restoring beam.

4. Remove screws holding spring and bellows support (20) to mechanism frame

5 Lift spring and bellows support, with restoring bellows attached from mechanism frame.

6 Remove screw (24) holding bellows to support Replace bellows (26).

7. Reverse steps 1 thru 6 to replace assembly (see Table II on page 32).

8 Calibrate Transmitter as outlined under Pre Service Adjustments on page 19

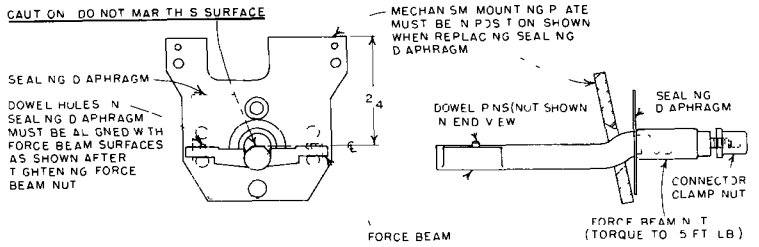


FIGURE 13 - Alignment of Sealing Diaphragm

Replacing Sealing Diaphragm
(Figures 13 and 25)

1 Remove pipe plug in bottom of high pressure side of housing

2. Insert 3/16 inch Allen wrench into housing and unclamp capsule from mechanism.

3. Remove Booster (insure O rings remain on manifold face of Booster).

4 Loosen flat head screw holding airline manifold clamp (25).

5. Remove four socket head screws (44) holding spring support assembly (39) to force beam (43).

6. Remove nozzle vane (54), clamp plate (55) and vane spacer (53) as a subassembly by removing two No. 4-40 screws holding vane spacer (53) to nozzle bracket assembly (47).

7 Remove nozzle air line assembly (50) by loosening No. 4-40 screw in nozzle clamp block (51).

8 Remove three socket head screws (13) and (11), holding mechanism frame (4), to mounting plate (45). Lift off frame subassembly

9. Remove four socket head screws (40), holding tension strips, etc, to base Remove tension strip assemblies (42)

10. Remove vane and bracket subassembly from force beam Force beam subassembly cannot be removed unless capsule or diaphragm assembly is removed:

a. For Type BK□□1 and BK□□2 units Remove four bolts holding housing together. Remove capsule.

b. For Type BK□□0 units. Remove four socket head screws holding diaphragm assembly to housing block. Remove diaphragm assembly.

11. Remove force beam connecting clamp nut (16) and washer (15) in Figure 27.

12 Remove force beam subassembly

13. Grip one tension strip mounting ear (on force beam) in vise, and unscrew force beam nut (29 in Figure 26; 14 in Figure 27).

14. Remove sealing diaphragm and replace with new part

15. Replace and tighten force beam nut.

NOTE: Alignment of parts is important (see Figure 13). Sight thru pair of holes in mounting plate to maintain alignment of tension strip mounting surfaces on upper section of force beam. Correct tightening torque is important (see Table II on page 32)

16. Reverse above procedure to reassemble unit Do not tighten connector clamp nut.

17. Perform Pre-Service Adjustments as outlined on page 19

REPLACING THE BOOSTER RELAY

Replacing Booster Relay (Figure 24)

1. Remove Transmitter from service as outlined under Operating the Transmitter'

2 Remove two screws (Item 18, Figure 24) securing Booster Relay to Transmitter housing

3 Install new Booster Relay unit on Transmitter housing using screws used in step 2.

4 Recalibrate Booster Relay as outlined under Calibrating the Booster Relay', page 27, before returning to service.

Vane Nozzle Alignment (Figure 14)

1 Check that vane is parallel to plane of nozzle tip as follows:

a. With Booster Relay at balance, press lightly with pointed instrument above and below nozzle tip.

b. If pressure at either point produces the effect shown in Sketch B Figure 14, either (1) vane is not parallel to nozzle tip or (2) there is a burr on nozzle tip

c. If vane is not parallel to nozzle tip, bend vane slightly. If burr is present, rub fine emery cloth lightly across nozzle tip

2 With zero differential and no load on suppression spring, turn vane adjustment

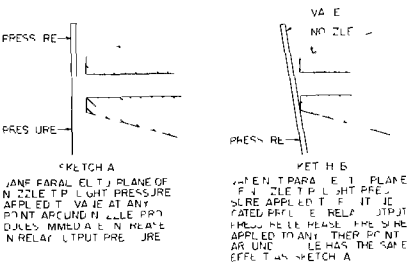


FIGURE 14 Vane Nozzle Alignment

screw (Figure 17) until output is 3 psig

3 Perform Pre Service Adjustments' page 21

Vane Spring Loading (Figure 19)

1 With no supply pressure and vane adjustment screw not touching vane, vane should contact nozzle with a tension of 12 to 15 grams. (Do not back off vane adjustment screw to make this check.)

2 If vane does not contact nozzle remove vane, bend vane spring, replace vane, and check.

3 When correct relationship is obtained, turn vane adjustment screw (zero differential) until output is 3 psig

4. Perform Pre Service Adjustments, page 19.

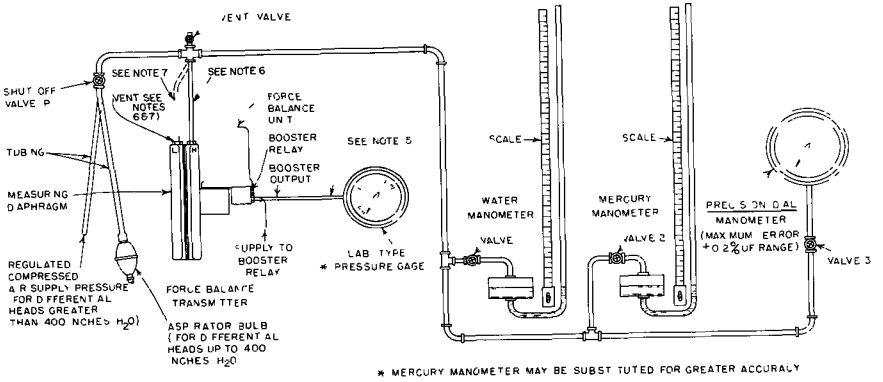
Fault Correction Chart

TRANSMITTER FAULT	PROBABLE CAUSE	CORRECTIVE ACTION
1. Output from Booster Relay does not increase to about full supply pressure when force beam is pushed toward restoring bellows.	a Supply and output connec tions to Booster Relay are incorrect.	a. Connect as shown in Figure 3
	b. Dirty nozzle orifice in Booster Relay.	b. Depress nozzle orifice plunger.
	c. Vane - nozzle relation-ship incorrect.	c Refer to "Vane-Nozzle Alignment", page 16.
	d. Burr on nozzle tip.	d. Rub a fine emery cloth lightly across nozzle tip to remove possible burr
	e. Nozzle alignment in correct.	e. Refer to "Vane-Nozzle Alignment", page 16.
	f. Nozzle air line leaking.	f. Check that Booster is mounted securely.
	g. Booster calibration incorrect.	g. Calibrate Booster (see page 27).
	h. Vane spring loading incorrect.	h. Refer to "Vane Spring Loading", page 16.
2. Output from Booster Relay does not drop to zero when force beam is pushed away from restoring beam causing vane to move away from the nozzle.	a. Supply and output con-nections to Booster Re lay are incorrect.	a. Connect as shown in Figure 3
	b. Dirty nozzle.	b. Check nozzle tip and clean with a suitable solvent.
	c. Nozzle air line is pinched off.	c. Check visually. Reposi-tion as necessary.
	d Booster Relay orifices dirty.	d. Depress nozzle orifice plunger.
	e Booster calibration incorrect.	e. Calibrate Booster (see page 27).
3. Output readings are non linear	a. Leakage from output line or restoring bellows.	a. Replace line or bellows.
	b. Incorrect vane alignment	b. Refer to 'Vane Nozzle Alignment", page 16
	c. Dirty nozzle orifice in Booster Relay.	c. Depress nozzle orifice plunger

Bailey

FAULT CORRECTION CHART (Continued)

TRANSMITTER FAULT	PROBABLE CAUSE	CORRECTIVE ACTION
3 (Continued)	d Booster calibration incorrect.	d. Check Booster calibration (see page 27)
	e. Diaphragm capsule or measuring diaphragm cracked, capsule improperly installed, or silicone fluid is leaking.	e. Replace capsule or diaphragm as outlined under 'Replacing Diaphragm Capsule', or 'Replacing Measuring Diaphragm', page 13.
	f. Zero adjusting nut positioned so that zero spring is fully compressed during normal operation.	f. Calibrate Transmitter as outlined on page 20 or 24, as applicable.
4. Output readings indicate hysteresis.	a. Vane adjustment screw is rough.	a. Smooth vane contact surface of screw with very fine sand paper
	b. Booster calibration incorrect.	b. Check Booster calibration (see page 27).
	c. Damaged diaphragm capsule, diaphragm, connector, or sealing diaphragm.	c. Replace as outlined under Replacing Measuring Diaphragm Capsule', or "Replacing Sealing Diaphragm", page 15.
5. Transmitter output indicates erratic operation.	a Air leakage.	a. Tighten or replace parts as necessary.
	b Moisture or oil deposits in air passages.	b. Clean orifices with suitable solvent.
BOOSTER FAULT	PROBABLE CAUSE	CORRECTIVE ACTION
1 Booster Relay output pressure does not immediately increase when flow of air from nozzle is blocked.	a. Clogged nozzle orifice.	a. Depress nozzle orifice plunger.
	b. Leakage around sections of Booster casing.	b. Replace Booster Relay.
	c. Dirty filters (see Figure 27).	c. Remove and replace filters as outlined under Routine Servicing , page 11.
	d. Booster calibration incorrect.	d. Check Booster calibration (see page 27).



* MERCURY MANOMETER MAY BE SUBST TUTED FOR GREATER ACCURACY

NOTES
- LSE ONLY MANOMETER S REQU RED FOR MAX MUM NSTRUMENT D FFERENT AL HEAD READ NG
2 FOR GREATER SENS T V TY (LOW MAX MUM D FFERENT AL) USE NCL NED WATER MANOMETER
3 FOR P P NG SPEC F CAT ONS SEE NSTRUCT ON SECT ON G B 3 NSTRUMENT LON ECT NG P P NG
1 SEE CAL BRAT ON N TH S NSTRUCT ON SECT ON FOR DETA LED NSTRUCT ONS
- T B NG FROM TRANSM TTER TO CAPE MUST BE AT LEAST 5 0 LONG F OUTPUT PRESSURE DOES NOT STAB L ZE ADD A VOLUME CHAMBER N TH S L N
6 FOR OPEN OR CLOSED TANK NON CONDENS NG ATMOSPHERE MAKE CONNECT ON TO H S DE OF D APHRAGM AND VENT L S DE
7 FOR CLOSED TANK CONDENS NG ATMOSHHERE MAKE CONNECT ON TO L S DE OF D APHRAGM AND VENT H S DE OF D APHRAGM

FIGURE 15 - Typical Calibration Setup

CALIBRATING THE TRANSMITTER

PRE SERVICE ADJUSTMENTS

1. Connect Transmitter in calibration setup (Figure 15). Position Transmitter in same position as that of final installation. Connect accurate water manometer to measuring diaphragm as indicated

2. Connect accurate laboratory type pressure gage in Booster Relay output pressure line. Make required Booster supply connection. Remove cover from Transmitter.

3. Apply differential pressure (or suppression head) that should produce a 3 psig output. If Transmitter output is not correct, adjust as follows:

a. Adjust zero spring (Figure 17) if error is less than 1 psi.

b. Adjust suppression spring nut (Figure 17) if error is greater than 1 psi.

4. Apply differential pressure (or suppression head) that should produce output of 27 psig (Type BK□2□□) or 15 psig (Type BK□1□□). If Transmitter output is not correct, adjust range adjustment screw (clockwise to decrease range) to correct value (Figure 17) To prevent damage to threads on screw, remove applied differential before making any major range adjustments Minor adjustments with full differential pressure are permissable.

5. Repeat steps 3 and 4 above until Transmitter output pressures are correct.

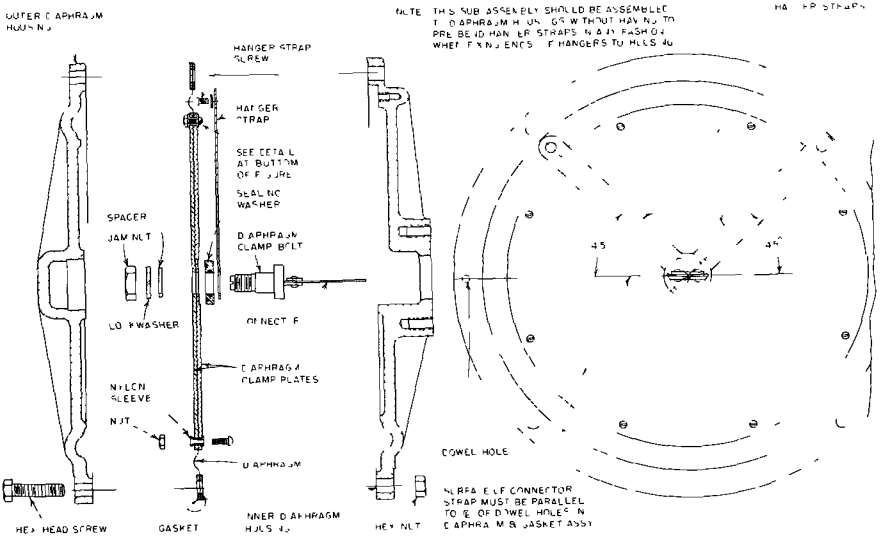


FIGURE 16 - Measuring Diaphragm, Type BK7 Transmitter

6 Check linearity by applying pressure to diaphragm in 10% increments thru range of applied differential pressure. Transmitter output pressure should vary proportionally (10% change in applied differential should produce 10% change in Transmitter output 2 4 psi for Type BK□2□□, 1. 2 psi for Type BK□1□□). If linearity of output pressure is not within acceptable limits (±0. 12 psi for Type BK□2□□, ±0. 06 psi for Type BK□1□□), proceed to step 7.

7. If in steps 1 thru 6 only minor adjustments have been made and calibration is satisfactory. place Transmitter in service as outlined under "Operating the Transmitter', page 9

If Transmitter cannot be calibrated or linearity of output pressure is not within acceptable limits, refer to Fault Correction Chart or to 'Complete Calibration Procedures' below.

COMPLETE CALIBRATION PROCEDURES

If the Type BK Transmitter cannot be calibrated as outlined under 'Pre Service Adjustments', or if Transmitter has been disassembled for parts replacement or repair, refer to the applicable 'Calibration Procedure' below.

Calibration Procedure - Type BK7

1. Connect Transmitter in calibration setup as shown in Figure 15. Do not connect pressure lines to diaphragm or apply air supply to Booster Relay at this time.

NOTE: Before continuing "Calibration Procedure", check Transmitter for damaged parts or obvious leaks Insure that all bolts and screws are tight (see "Troubleshooting", page 12) Then proceed as follows.

2. Remove suppression spring (15 or 16, Figure 25) from Transmitter by removing five screws (23 and 24) holding spring and bellows support to mechanism frame and set screw (22) holding adjusting nut in spring and bellows support. Replace spring and bellows support.

3. Refer to Figures 25 and 26 Remove pipe plug in high pressure side of diaphragm housing. Insert Allen wrench and turn connector clamp nut one half turn to disconnect diaphragm capsule.

4. Set adjustable fulcrum (36) to scale reading on restoring beam which corresponds to required differential pressure range.

5. Apply air supply to Booster Relay.

6. Transmitter output pressure should be 3. 0 psig. If not, turn zero spring adjustment (27) to obtain 3. 0 psig output. If 3. 0 psig pressure cannot be obtained:

a. Turn OFF supply air to Transmitter.

b. Turn zero spring adjustment (27) until fulcrum (36) just clears force beam.

c. Adjust center line of vane to coincide with vane adjustment screw by loosening screws (52) and positioning vane.

d. Adjust vane to be parallel to fulcrum surface with vane adjustment screw (37). Turn on supply air and readjust vane adjustment screw so vane is parallel to force beam and/or restoring beam. (Output pressure should be 3. 0 psig; zero adjusting spring coils must not be touching.)

e. If above parallel relationship can not be attained, loosen screw in nozzle clamp block and reposition nozzle until beams are parallel. Repeat step (6d) to obtain 3. 0 psig output.

7. Apply 2 psig to low pressure side of measuring diaphragm.

8. Manually move force beam to left (toward diaphragm assembly) so that vane moves about 1/8-inch away from end of nozzle. Hold in this position.

9. Tighten connector clamp nut and disconnect pressure to low pressure side of measuring diaphragm.

10. Check clearance travel of measuring diaphragm center assembly Turn off supply air and remove two pipe plugs in bottom of diaphragm housing. Remove snubbers if included in bottom ports. Manually move force beam in both directions; there should be equal travel of approximately 1/16 inch free motion of upper end of force beam from neutral position.

11 Turn on supply air. With zero differential on Transmitter, manually move force beam in one direction, release, and note output pressure from Booster Relay. Deflect beam slightly in opposite direction, release, and again note output pressure. These pressures should repeat If pressures do not repeat, continue with step 12 If pressures are correct, proceed to step 20.

12. If repeatability is unobtainable, remove four screws holding spring support plate to force beam and check that upper ends of tension strips are free over dowel pins. File holes in tension strips, if necessary.

13. If repeatibility still cannot be obtained, strap hangers within the diaphragm assembly may be twisted, causing misalignment of diaphragm center structure.

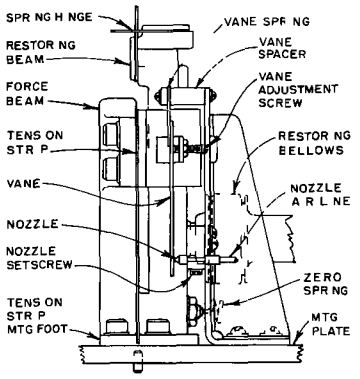
14. To check if diaphragm center assembly is canted within diaphragm housing, or center assembly clamp plates are touching over-pressure stops (refer to Figure 16):

a. Do not disconnect diaphragm center assembly (Figure 16) from Transmitter.

b. Loosen and remove all hex head screws from diaphragm assembly.

c. Use screw driver or similar instrument to pry outer housing away from inner housing; make separation between outer housing and adjacent gasket.

d. Apply pressure with one finger to upper and lower parts of clamp plates-check whether center assembly travels equal distance in each direction before hitting over-



pressure stops. As an alternate procedure, lay a straight edge across faces of diaphragm housing, and measure if distances from periphery of diaphragm clamp plates (Figure 16) to straight edge are about equal

15. If diaphragm center assembly is canted, peel back upper portion of gasket assembly and loosen two hanger strap screws Reposition center assembly until equal clearances are obtained.

16. If clearances behind clamp plates (step d) appear equal:

a. Manually press center assembly against over pressure stops Remove hanger strap screws; then, maintaining pressure on center assembly, check whether holes in hanger straps line up properly with holes in inner diaphragm housing.

b. If holes do not line up properly, twist has been made in hanger straps.

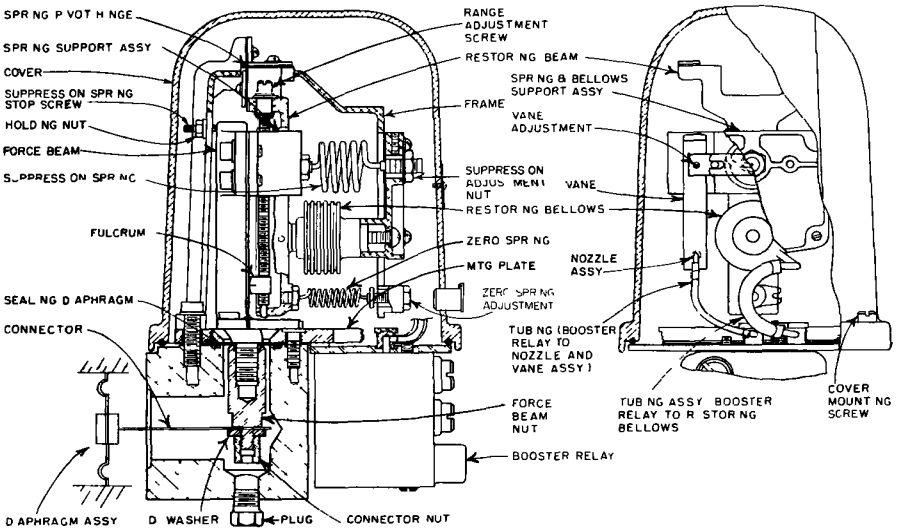


FIGURE 17 - General Assembly, Type BK Transmitter

If twist is slight, file holes in the hanger straps slightly to obtain proper alignment. If twist is too large to correct by this method, proceed with step 17 below.

17 Remove center assembly from Transmitter as follows:

a. Remove pipe plug (Figure 17) from pressure housing.

b. Insert Allen wrench thru pipe plug hole and loosen, but do not completely unscrew, connector clamp nut

c Pull diaphragm center assembly and gaskets (Figure 17) from inner diaphragm.

18. To align hanger straps:

a. Loosen jam nut; then reposition hanger straps as shown in Figure 16. Tighten jam nut to torque of 20 ft-lb

b. Reassemble diaphragm center assembly to inner diaphragm housing, check alignment as outlined in step 14d, page 21 Install hanger strap screws.

19. Reassemble diaphragm assembly and reset output as outlined on page 21 in steps 7 thru 11.

20. Turn OFF air supply to Booster Relay.

21. Remove five screws holding spring and bellows support to mechanism frame and bellows.

22. Add suppression spring. Lock nut on one end of threaded spring should be tightened to fix one end of spring to spring support assembly. Slots in guide bar on suppression spring should be parallel to base plate.

23. Add suppression nut (Item 14 or 19, Figure 25) and replace spring and bellows support plate. Insure that pins are not mis aligned with slots in guide bar on suppression spring.

24. Turn ON air supply.

25. Apply minimum differential pressure (including suppression) to appropriate side of measuring diaphragm capsule and adjust suppression spring tension to obtain desired output value (see Table I)

TABLE I

TYPE	APPLIED DIFFERENTIAL PRESSURE	OUTPUT PRESSURE	
BK□□□1	Minimum	3 psig	3 psig
	Maximum	27 psig	15 psig
BK□□□2	Minimum	27 psig	15 psig
	Maximum	3 psig	3 psig

26 Apply maximum differential pressure Output should be desired value (see Table I).

NOTE: Minor range change may occur when suppression spring is added to Transmitter. Range screw may have to be turned slightly to obtain desired output value with maximum differential applied to measuring diaphragm

27. Check calibration of Transmitter by applying differentials equivalent to 0. 20, 40, 60, 80 and 100%. If Transmitter output was linear when checked without suppression but is now non-linear:

a. Apply minimum differential; output should be as indicated in Table I.

b Change output pressure about 1 psi, using zero spring adjustment.

c. Recorrect output pressure to desired output value with suppression spring adjustment.

d. Check linearity. Repeat steps as necessary

NOTE: If Transmitter has worked satisfactorily without suppression spring but now has a non linear output or hysteresis, the probable causes are: (1) adding suppression spring has caused available clearance within capsule to change (procedure outlined above will correct), or (2) dowel pins are bearing in slots of suppression spring guide bar (suppression spring is not aligned properly or slots must be enlarged.)

28. If calibration is satisfactory, place Transmitter in service. If calibration still cannot be achieved, check Booster Relay as outlined under 'Calibrating the Booster Relay' on page 27.

Calibration Procedure Type BK8 and BK9

When Transmitter is in use, pressure in chamber beneath sealing diaphragm varies between atmospheric and maximum service pressure in tank or drum, resulting in slight upward movement of sealing diaphragm, force beam, and attachments In order that error is not introduced, this movement must be parallel to plane of vane. Type BK8 and BK9 units are aligned at the factory. (Type BK7 units do not require alignment.)

NOTE: Factory alignment is for 750 psig (mid range) operating pressure unless unit is ordered calibrated to a specific operating pressure (For special units, see Calibration Data Sheet.)

Static realignment is required if mid range operating pressure is other than 750 psig or after any of following operations:

a. Readjustment of vane adjustment screw;

b. Readjustment of nozzle in its bracket;

c. Movement of base of tension strip assembly (Item 42, Figure 25);

d. Loosening of socket head screws (11) and (13) holding mechanism frame to base housing (Figure 25);

e Changing range adjustment any appreciable amount; or

f. Complete disassembly of Transmitter

NOTE: To check "Static Alignment" use the following procedure. Transmitter should be as received from factory. If continuing 'Pre-Service Adjustments', omit references to suppression spring.

1 Check that pipe plug is tightened securely into measuring diaphragm assembly below the force beam

2. With atmospheric pressure on both sides of capsule, obtain an output pressure from the Transmitter within the range span of the instrument. For low suppression, no adjustment need be made However with high suppression, the suppression spring adjustment (Figure 17) should be turned to obtain some output pressure.

3. Apply HYDRAULICALLY the maximum service pressure to both sides of measuring diaphragm using teed connections.

WARNING: This pressure must be applied hydraulically due to danger of explosion when using highly compressed gases.

4. Note whether there has been a change in Transmitter output pressure. If the amount of change, within the range of static pressure for which accuracy is required see Example below), is beyond required tolerances, continue with the following procedure If the amount of change is negligible, repeat 'Pre Service Adjustments'.

EXAMPLE: Output change between atmospheric and maximum operating service pressure of 1000 psig might be 0 5 psi. Static alignment would be desired if it is necessary that the Transmitter transmit accurately over a wide range of static pressure. If, however, accuracy is only required for static pressures between 900 1100 psig, and output change in this range was only 0 1 psi, static alignment might be considered unnecessary, and the instrument merely zero adjusted to a 3. 0 psig output when put into service and under service pressure.

5. If static alignment is satisfactory and if the suppression spring adjustment has been turned prior to starting this test, the required initial suppression differential should be applied and the suppression spring readjusted to obtain required output pressure. If static alignment is not satisfactory, continue with step 6.

6. Remove service pressure from diaphragm.

7. With both sides of measuring diaphragm open to atmosphere, adjust zero adjustment spring until output pressure is 3.0 psig.

8. With output of Transmitter at 3.0 psig, remove pipe plug in bottom of high pressure side of diaphragm housing. Insert Allen wrench thru pipe plug hole and tighten connector clamp nut securely (see Table of Torque Values). Output pressure of Transmitter should remain at 3.0 (±0.5) psig. If change is greater than 0.5 psig, loosen connector clamp nut and retighten, turning Allen wrench carefully so it does not push force beam from its neutral position. Replace pipe plug in bottom of diaphragm housing.

9. With diaphragm capsule clamped properly, apply an equalized operating service pressure simultaneously to both sides of measuring diaphragm capsule. If output pressure changes less than 0.5 psig, adjust vane adjustment screw to obtain 3.0 psi when elevated static pressure is impressed on capsule.

a. For decrease in output pressure with increase in static pressure, turn vane screw counterclockwise a small amount.

NOTE: Vane screw is an extremely sensitive adjustment. Make adjustments in small increments.

b. For increase in output pressure with increase in static pressure, turn vane screw clockwise a small amount.

c. Release static pressure and observe output pressure with zero static pressure. Readjust zero adjustment spring to obtain 3.0 psig.

d. Repeat procedure until no change in output is noted when checking at atmospheric and at operating static pressure.

10. If change in output pressure due to application of static pressure is greater than 0.5 psi, or output drops to zero, or output remains above minimum range value with zero spring adjustment at minimum setting, readjust tension strip feet (Item 42, Figure 25) as outlined below:

a. Remove service pressure from diaphragm. Loosen screws holding tension strip feet to mounting plate. Force feet in proper direction to reduce error in output pressure as follows:

(1) For decrease in output pressure, move tension feet toward restoring bellows.

(2) For increase in output pressure, move tension feet away from restoring bellows.

NOTE: When screws on tension strip feet are loosened, output pressure may change; this change will be recovered when screws are tightened. Movement of tension feet will cause another change in output pressure which will not be recovered, and amount of this change is an indication of amount that tension strip feet were moved (thus an aid in static alignment procedure).

b. Tighten tension strip mounting screws to 40 in lb.

11. Apply service pressure to diaphragm. If output pressure changes by less than 0.5 psig, adjust output pressure to 3.0 psig with vane adjustment screw. If error is too large to correct with this adjustment, repeat step 10. If output still changes by an amount greater than 0.5 psig, diaphragm capsule must be repositioned. Refer to "Replacing Diaphragm Capsule."

12 If vane adjustment screw has been turned more than 1/4 turn or if tension strip feet have been moved to achieve static alignment, connector clamp nut should be unclamped and reclamped for best perform

ance. After reclamping, static alignment should be rechecked. Once static alignment has been achieved, vane, vane adjustment screw, nozzle, and tension strip feet should not be touched.

13. Diaphragm capsule is now clamped to force balance mechanism With zero differential on measuring diaphragm, Transmitter output should read 3.00 psi. Apply maximum differential (disregard initial suppression)to high pressure side of diaphragm capsule. Transmitter output should read 15 psig (± 06 psig) for Type BK□1□□ unit and 27 psig (±. 12 psig) for Type BK□2□□ unit. If not, turn range adjustment screw (down to increase maximum output) to reposition fulcrum for desired output value.

14 Remove differential and rezero unit, if required, to obtain 3.00 psi. Apply maximum differential and check maximum output value.

15. Repeat steps (13) and (14) until minimum and maximum output values are obtained.

16. Check differential values at 20, 40, 60 and 80% to insure Transmitter output pressure is linear.

17. Turn OFF air supply to Booster Relay

18. Remove five screws holding spring and bellows support to mechanism frame and bellows.

19 Add suppression spring. Lock nut on threaded spring should be tightened to fix one end of spring to spring support assembly. Slots in guide bar on suppression spring should be parallel to base plate.

20. Add spring adjustment nut (Item 14 or 19, Figure 25) and replace spring and bellows support plate Insure that pins are not misaligned with slots in guide bar on suppression spring.

21. Turn ON air supply.

22 Apply minimum differential pressure (including suppression) to appropriate side of measuring diaphragm capsule and adjust suppression spring tension to obtain desired output value (see Table I)

23. Apply maximum differential pressure Output should be desired value (see Table I)

NOTE: Minor range change may occur when suppression spring is added to Transmitter. Range screw may have to be turned slightly to obtain desired output value with maximum differential applied to measuring diaphragm.

24. Check calibration of Transmitter by applying differentials equivalent to 0, 20, 40, 60, 80, and 100%. If Transmitter output was linear when checked without suppression but is now non linear:

Apply minimum differential, output should be as indicated in Table I

b Change output pressure approximately 1 0 psi, using zero spring adjustment

c. Recorrect output pressure to desired value with suppression spring adjustment

d. Check linearity. Repeat steps as necessary.

NOTE: If transmitter works without a suppression spring, but has a non linear output or hysteresis, probable causes are: (1) adding suppression spring caused available clearance within capsule to change (above procedure will correct). (2) dowel pins are bearing in slots of suppression spring guide bar (suppression spring not properly aligned or slots are enlarged)

25. If calibration still cannot be achieved, check Booster Relay as outlined under 'Calibrating the Booster Relay ' below. If calibration is satisfactory, place Transmitter in service.

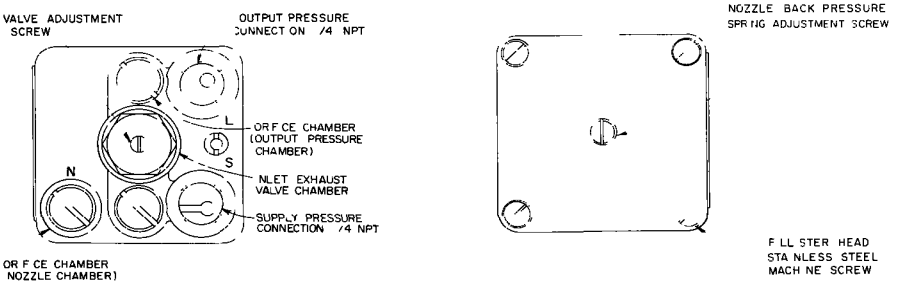


FIGURE 18 - Booster Relay Adjustment

Calibrating the Booster Relay

The Booster Relay has two adjustments. The valve adjustment, Figure 18, adjusts the inlet valve seat to balance effective areas of chamber 1 and chamber 4 diaphragms for an even reset rate. This adjustment is sealed with Loctite cement (Grade C) after factory calibration. Do not change this adjustment unless absolutely necessary. If the Relay has been disassembled, or the valve adjustment setting has been changed for any reason, check calibration of the unit as outlined below. The second adjustment determines nozzle back pressure.

1. Remove Relay from Transmitter.

2. Attach calibration block (Figure 19) to Relay using screws removed in step 1. Connect in calibration setup shown in Figure 20. Connect mercury manometer to Booster Relay output pressure connection (marked L' on Relay). Connect another mercury manometer to tee fitting in piping to input connection of calibration block. Calibration block, Part No. 5320549-1. may be purchased from Bailey Meter Co.

3. Apply supply pressure of 18 psi (for 3 15 range) or 30 psi (for 3 27 range) to supply connection (marked 'S' on Relay).

4. Apply 2 5 psi to calibration block input connection to simulate nozzle back pressure. Adjust nozzle back pressure screw (Figure 18) to obtain a Booster output between 3 psi and 5 psi. Increase input pressure to calibration block by 0. 1 psi.

a. If Booster output pressure does not increase to 15 psi (for 3 15 range) or 27 psi (for 3 27 range), or if output pressure slows down (decelerates) as it increases. turn the valve adjustment screw (Figure 18) clockwise a small amount.

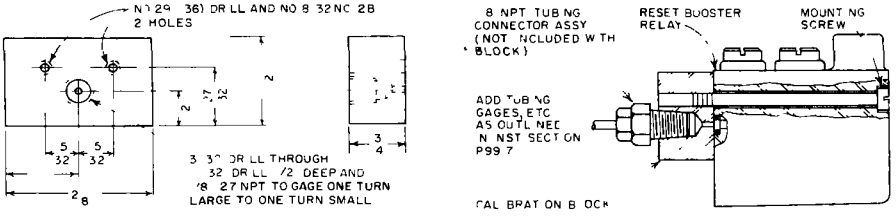


FIGURE 19 - Booster Relay Calibration Block, Part No. 5320549 1

b. If rate of output pressure speeds up (accelerates), turn valve adjustment screw counterclockwise a small amount.

5. Repeat step 4 until output pressure changes at a constant rate. The difference between the nozzle back pressure which causes a constant rise and that which causes a constant drop should be about 0.1psi and should occur between 2.1 psi and 2.3 psi.

6 If Booster Relay cannot be calibrated as described above, fault may be caused by leakage. Refer to 'Troubleshooting' to check Booster Relay for leakage.

7 When correct calibration is obtained, remount Booster on Transmitter

8. Perform steps under "Pre Service Adjustments", page 19.

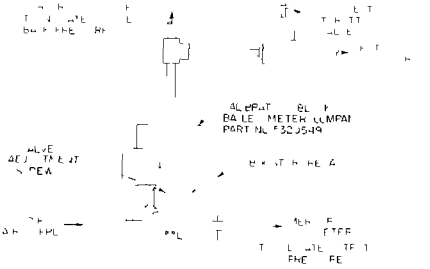


FIGURE 20 Suggested Calibration

HOW THE TRANSMITTER OPERATES

TYPE BK DIFFERENTIAL PRESSURE TRANSMITTER

The Type BK Transmitter, shown schematically in Figure 21, measures differential pressure and transmits a pneumatic output signal proportional to the applied differential pressure. The measured differential pressure can represent either level or flow

The Transmitter consists essentially of a measuring diaphragm capsule connected to a force balance restoring mechanism with a vane-nozzle position detector. An output pressure (produced by a Booster Relay described on page 29), proportional to the applied differential, is the balancing force of the force balance mechanism

Pressure is applied to both sides of the measuring diaphragm capsule. When the differential pressure applied to the measuring diaphragm is constant, the measuring diaphragm is centered within its housing and the vane nozzle relationship is such that nozzle back pressure remains constant, maintaining the vane and nozzle at their "at balance ' position.

When differential pressure applied to the measuring diaphragm increases, the measuring diaphragm moves away from the Transmitter, pulling the connector rod so that: (1) there is a slight rotation of the force beam, (2) moving the vane closer to the nozzle, (3) increasing nozzle back pressure, (4) causing an increase in Booster Relay output pressure, (5) which is applied to the restoring bellows, fastened between the frame and restoring beam, (6) causing the restoring beam to exert greater force on the force beam, (7) causing rotation of the force beam to its original position

The Booster Relay output pressure will continue to increase until the force beam (vane and nozzle) returns to an at balance" condition. The Booster output pressure stabilizes at this new higher pressure with the measuring diaphragm capsule centered in its housing

The force balance mechanism maintains output pressure and restoring pressure at a value that balances the moment of restoring force on the force beam against the moment of force from the measuring diaphragm

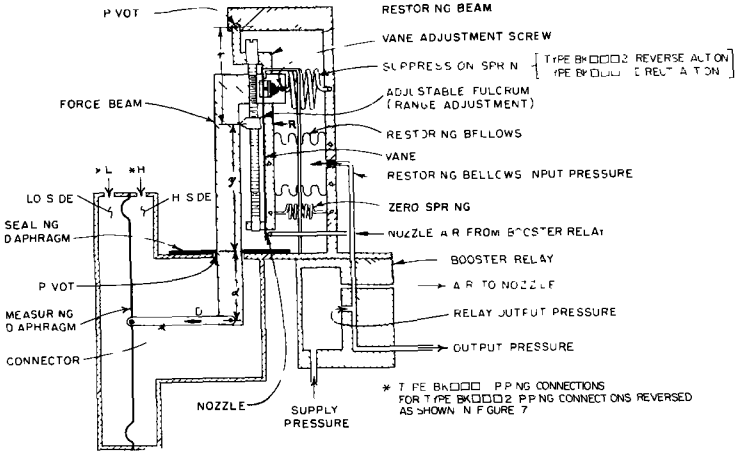


FIGURE 21 - Schematic of Type BK Differential Pressure Transmitter

The adjustable fulcrum is moved vertically on the restoring beam (Figure 21) to determine the range of applied differentials that will produce standard Booster Relay output ranges. This range adjustment setting determines the length of arm y (Figure 21). As y is made shorter, a larger restoring force is required to balance force Dd. In addition, distance r, on the restoring beam, is lengthened so that greater force from the restoring bellows is required to produce force R. Turning the range adjustment down increases Booster Relay output pressure; turning the adjustment up decreases the pressure when constant differential pressure is maintained on the measuring diaphragm.

Suppression Spring

When a suppression spring (Figure 21) is used, it acts to limit effective torque acting on the force beam (torque opposed by the restoring bellows) by setting up a torque on the force beam.

For closed tank measurement with condensing atmosphere, (with normally high and low pressure sides of diaphragm reversed) the suppression spring is in tension and acts to reverse Booster Relay output with respect to differential. Therefore, output pressure is minimum value at maximum differential.

For open or closed tank measurement with non-condensing atmosphere, the suppression spring nullifies the effect of the head (between Transmitter and minimum tank level) on the Transmitter. Therefore, the spring is in compression, acting in the same direction as the restoring bellows.

BOOSTER RELAY

The Booster Relay is shown schematically in Figure 22. Three diaphragms divide the inside of the unit into four air pressure chambers. The diaphragms move together because they are clamped at their centers by the diaphragm assembly. Since chambers 1 and 4 are connected and are equal in effective diaphragm area, their opposing forces on the diaphragm assembly balance each other. Chamber 2 is open to atmosphere. The operator spring exerts a force downward on the diaphragm assembly. Thus, since chamber 3 pressure exerts a force upward, the position of the diaphragm assembly is a direct function of chamber 3 pressure.

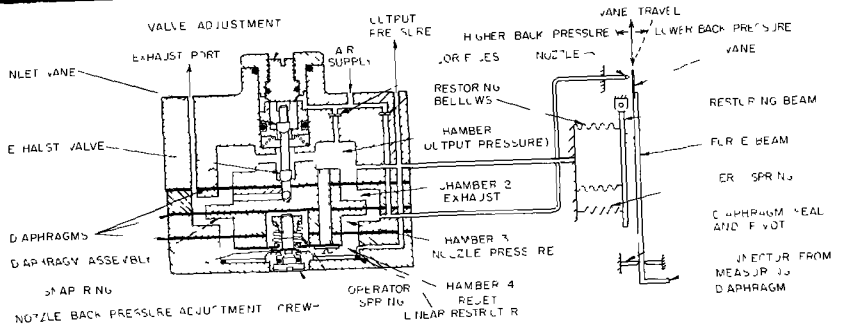


FIGURE 22 Schematic of Booster Relay

Supply air enters chamber 3 and the nozzle thru a pressure reducing orifice. The rate of air flow from the nozzle determines the magnitude of the pressure in chamber 3. At balance this pressure is about 2 psig, which is the pressure required to balance the downward force of the operator spring

When the applied differential pressure increases, rotation of the force beam moves the vane closer to the nozzle tip, retarding the flow of air from the nozzle and increasing the pressure in chamber 3. The pressure increase moves the diaphragm assembly up, opening the inlet valve and closing the exhaust valve. Supply air enters chamber 1 thru the inlet valve, causing the output pressure of the Booster Relay to begin to increase.

Chamber 1 pressure is also applied to the restoring bellows. As the pressure increases, the restoring bellows extends, moving the vane away from the nozzle The resultant increased rate of air flow from the nozzle causes the pressure in chamber 3 to begin to decrease

Chamber 1 pressure will continue to increase until the vane is restored to the 'at balance' position with respect to the nozzle which produces a pressure of 2 psig in chamber 3 The operator spring by then has moved the diaphragm assembly down to its original position, closing the inlet valve and causing the Booster Relay output pressure to stabilize at the new, increased value

When the applied differential pressure decreases, the operation of the Booster Relay as described above is reversed and the Booster Relay output pressure stabilizes at a new decreased pressure

SPECIFICATIONS

OPERATING CONDITIONS

INFLUENCE		NOMINAL	REFERENCE (RANGE)	NORMAL	OPERATIVE LIMITS
AMBIENT TEMPERATURE		75F	CALIB TEMP ±2 5F	40F TO 140F	0°F TO 180F
SUPPLY PRESSURE	TYPE BK□100	18 PSIG	CALIB PRESS ±0 25 PSI	16 TO 20 PSIG	40 PSIG MAX
	TYPE BK□200	30 PSIG	CALIB PRESS ±0 25 PSI	28 TO 35 PSIG	40 PSIG MAX

AMBIENT TEMPERATURE EFFECT — 0 02% SPAN PER DEGREE F DEVIATION FROM CALIBRATING TEMPERATURE IF SPAN IS AT LEAST 20% OF FULL RANGE

AIR SUPPLY PRESSURE EFFECT
AT REFERENCE PRESSURE 0%
PER PSIG DEVIATION FROM REFERENCE PRESSURE ±0 2%

REFERENCE PERFORMANCE CHARACTERISTICS (% RANGE SPAN)

ACCURACY	±0 5%
HYSTERESIS	0 5%
INDEPENDENT LINEARITY	±0 5%
REPEATABILITY	0 25%

DESIGN DATA

AIR CAPACITY (FOR 1 PSI DROP)	0 6 TO 0 9 SCFM
AIR CONSUMPTION (AT BALANCE ON DEAD END SERVICE)	0 1 SCFM (3 TO 15 PSIG) OR 0 15 SCFM (3 TO 27 PSIG)
CASE CLASSIFICATION	WEATHERPROOF
OVERRANGE PROTECTION	FULL RATED SERVICE PRESSURE (50 PSIG OR 1500 PSIG) TO EITHER SIDE OF DIAPHRAGM

TABLE II - TORQUE VALUE

PART NAME	LOCATION	TORQUE VALUE MAX SERVICE PRESSURE	
		50 psig	1500 psig
Force Beam Nut	Holding Force Beam to Sealing Diaphragm	15 ft-lb	15 ft-lb
Connector Clamp Nut	Holding Diaphragm Connector to Force Beam Nut	75 in lb	75 in-lb
No 10 32 Screws	Internal Fasteners in Force Balance Unit	28 in-lb	28 in lb
No 6 32 Screws	Internal Fasteners in Force Balance Unit	12 in lb	12 in-lb
No. 10 32 Nut	Holding Zero Spring to Restoring Beam	28 in lb	28 in lb
Bellows Screw	Holding Restoring Bellows to Mechanism Frame	28 in lb	28 in-lb
Hinge Screw	Holding Hinge and Restoring Beam to Mechanism Frame	12 in lb	12 in-lb
5/16 18 Stainless Socket Hd. Screw	Holding Diaphragm Assembly to Pressure Housing	125 in lb	Not Applicable
Nut & Bolt	Holding Halves of Diaphragm Assembly Together	10 in lb	50 ft lb
No. 10 32 Socket Hd. Screw	Holding Mounting Plate and Sealing Diaphragm to Pressure Housing or Diaphragm Assembly	40 in lb	40 in lb
3/8-16 Hex Hd. Cap Screw	Holding Two Bolt Flange to Diaphragm Assembly	Not Applicable	20 ft lb
1/4-20 Screw	Holding Mechanism to Frame	55 in lb	55 in-lb
8-32 Fillister Head Screw	Holding Booster Relay to Mounting Plate	18 in lb	18 in-lb
Connector	Attaching Connector Strap to Diaphragm Capsule	Not Applicable	30 in lb

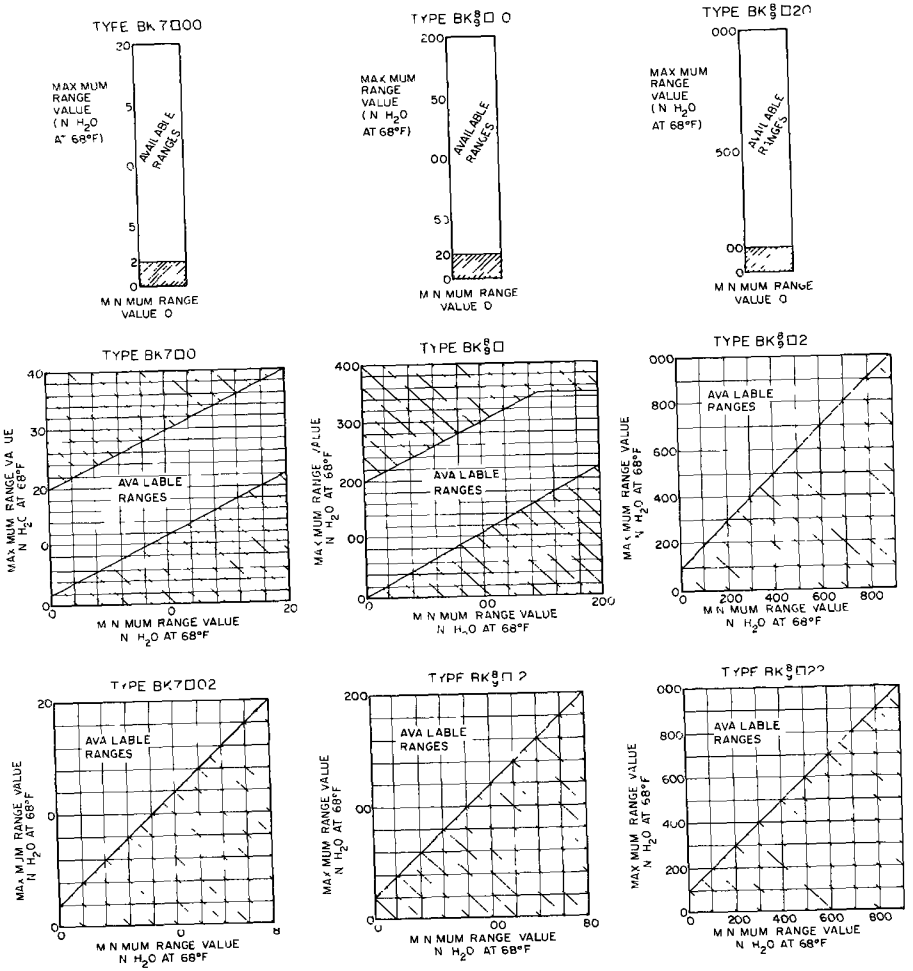
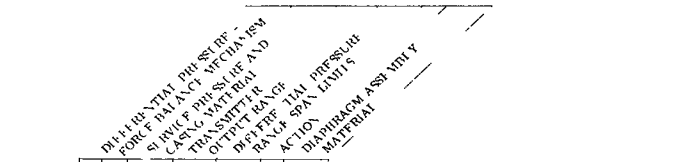


FIGURE 23 - Transmitter Range Charts

EXPLANATION OF NOMENCLATURE



	PSIG	MATERIAL
"	50	ALUMINUM
8	1500	CARBON STL
9	1500	#316 STN

	DIAPH MATERIAL	CASING	RANGE
B	BUNA N THIOROL	BK7	0
S	STN #31"	BK8 9	1 2
D	DURA NICKEL	BK9	1 2
H	HAS TELLOY	BK9	1
M	K MONEL	BK9	1 2

	ACTION*	SUPPRESSION
0	DIRECT	WITHOUT
1	DIRECT	WITH
2	REVERSE	WITH

	1	3 TO 15 PSIG
	2	3 TO 2" PSIG

DIFFERENTIAL PRESSURE LIMITS IN OF H90

	REVERSE ACTION				DIRECT ACTION			
	RANGE SPAN		TOP VALUE	SUP	RANGE SPAN		TOP VALUE	SUP
	MIN	MAX	MAX	MAX	MIN	MAX	MAX	MAX
0	2	20	20	18	2	20	40	20
1	20	200	200	180	20	200	350	200
2	100	1000	1000	900	100	1000	1000	900

* DIRECT ACTION INCREASING D P INCREASING SIGNAL PRESSURE
REVERSE ACTION DECREASING D P INCREASING SIGNAL PRESSURE
AN X IN ANY NOMENCLATURE POSITION INDICATES THE UNIT IS SPECIAL IN THAT RESPECT AN X AS A SUFFIX INDICATES THE UNIT CONTAINS A SPECIAL FEATURE NOT COVERED BY NOMENCLATURE

REPLACEMENT PARTS

SPARE PARTS KITS

The Spare Parts Kits tabulated in Figures 24 thru 28 should be carried in stock. Specify the Spart Parts Kitpart number to order a complete kit

ORDERING INDIVIDUAL PARTS

Figures 24 thru 28 are Parts Drawings of the Type BK Differential Pressure Transmitter and Booster Relay. Normally, these drawings will apply to the instrument furnished. However, there may be individual differences in specific assemblies due to:

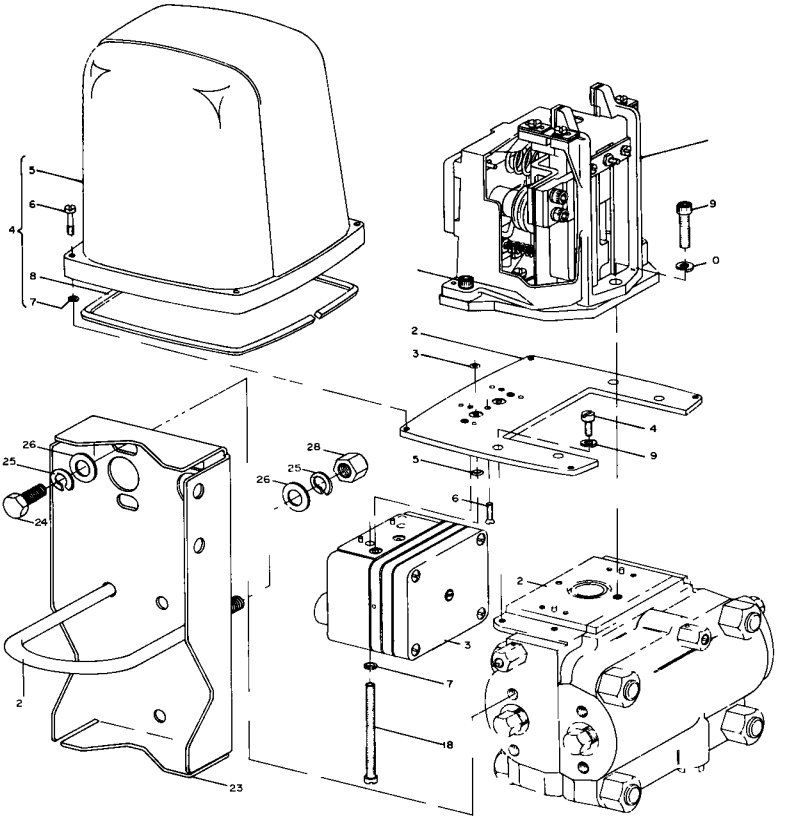
a. Design changes made since the printing of this Instruction Section, or

b. Special design of equipment furnished to make it suitable for special application.

Therefore, when ordering individual parts, assure the receipt of correct replacements by specifying on the order:

1. Complete nomenclature, serial number, part number, and code label number of equipment for which parts are desired, and

2. Parts Drawing on which each part is illustrated. (The Parts Drawing Number is given in the Figure caption.)



ITEM	PART NO	NAME
1	SEE PARTS DWG P2 28	TYPE BK TRANSMITTER INTERNAL MECH
2	SEE PARTS DWG P21 29	MEASUREMENT DIAPHRAGM ASSY TYPE BK8
	SEE PARTS DWG P21 30	MEASUREMENT DIAPHRAGM ASSY TYPE BK7
3	SEE PARTS DWG P21 9	BOOSTER RELAY ASSY
4	689081	COVER ASSY INCLUDES 5 & 20 22
5	682290 1	COVER
6	682354 1	RETAINING COVER SCR 4 REQD
8	35441 3	SEALING STRIP
9	1 4 20x7/8	HEX SOC HD CAP SCR
10	1 4 REG	SPRING LOCKWASHER 3 REQD
	1 4 20x2	HEX SOC HD CAP SCR 9 REQD
13*	531 428 10	O RING 9 REQD
14	0 2?x 8	FIL HD MACH SCR 4 REQD
15*	5311428 9	O RING 2 REQD
16	4 40x1 2	FLAT HD MACH SCR
17	NO 8 REG	SPRING LKWASH 8 REQD
18	8 32x2 1 2	FIL HD MACH SCR 2 REQD
19	NO 10 REG	SPRING LKWASH 4 REQD
20	1962387 1	ZERO LABEL NOT SHOWN
21	1951346 1	ZERO ADJ COVER NOT SHOWN
22		NAMEPLATE NOT SHOWN
23	662609	MOUNTING BRACKET
24	10 32x3 4	HEX HD CAP SCR 4 REQD FOR BK8 OR BK9
	3 8 16x3 4	HEX HD CAP SCR 4 REQD FOR BK7
25	7	SPRING LKWASH 4 REQD FOR BK8 OR BK9
	3 8	SPRING LKWASH 4 REQD FOR BK8 OR BK9
26	3 8	TYPE A PLAIN WASHER 4 REQD FOR TYPE BK8 OR BK9
27	689317	U BOLT
28	3 8 16	HEX NUT 2 REQD

* ITEMS INCLUDED IN SPARE PARTS KIT TABULATED ON PARTS DWG P2 28

FIGURE 24 Parts Drawing P21-27, Type BK Differential Pressure Transmitter

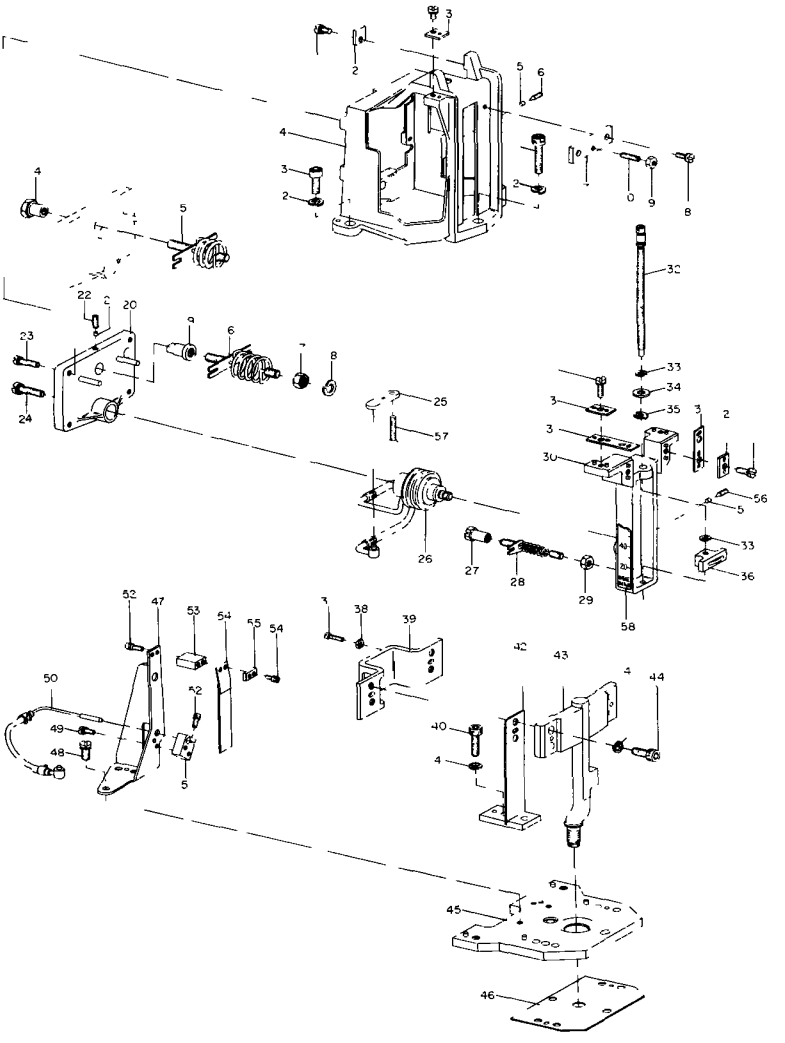


FIGURE 25 Parts Drawing P21 28, Internal Mechanism for

ITEM	PART NO	NAME
1	6 32x5 16	PAN HD SEMS EXT, 8 REQD
2	682091 1	SPRING PIVOT CLAMP 4 REQD
3	682092 1	SPRING PIVOT CLAMP 4 REQD
4	682595 1	MECHANISM FRAME
5	5316488 1	NYLON INSERT 2 REQD
6	6 32x5 16	HEX SOC HDLS CUP PT SET SCR
7	682494 1	STOP CLAMP (BK7□□1 ONLY)
8	6 32x5 16	PAN HD SEMS EXT 2 REQD (BK7□□1 ONLY
9	6 32	HEX NUT BK7□□1 ONLY)
10	6 32x1 2	HEX SOC HDLS OVAL PT SET SCR BK7□□1 ONLY
11	1 4 20x7 8	HEX SOC HD CAP SCR
12	1 4 REG	SPRING LKWASH 3 REQD
13	1 4 20x1 2	HEX SOC HD CAP SCR 2 REQD
14	682278 1	TENSION SPRING ADJ NUT BK□□□2 ONLY
15	682279 1	EXTENSION SPRING ASSY (BK□□□2 ONLY
16	682273 1	COMPRESSION SPRING ASSY BK□□□1 ONLY
17	1 4 28	HEX JAM NUT BK□□□½ ONLY)
18	1 4 REG	SPRING LOCKWASHER BK□□□½ ONLY)
19	682272 1	COM SPRING ADJ NUT (BK□□□1 ONLY)
20	682301 1	SPRING AND BELLOWS SUPPORT
21	5316488 1	NYLON INSERT BK□□□½ ONLY)
22	6 32x5 16	HEX SOC HDLS CUP PT SET SCR (BK□□□½ ONLY
23	6 32x1 2	PAN HD SEMS EXT 4 REQD
24	10 32x5 8	PAN HD SEMS EXT
25	682384 1	MANIFOLD CLAMP
26a	682594 2	BELLOWS BK01 ONLY)
26b	682594 1	BELLOWS (BK02 ONLY)
27	682284 1	ZERO ADJ NUT
28	682066 1	ZERO SPRING ASSY
29	10 32	HEX NUT
30	682295 1	RESTORING BEAM
31	682289 1	SPRING PIVOT HINGE 4 REQD
32	682052 1	RANGE ADJ SCREW
33	197549-1	E TYPE TRUARC RET RING 2 REQD
34	19734 18	SMALL WASHER
35	666328 1	DISC SHAFT SPRING WASH
36	682281 1	ADJ FULCRUM
37	682424 1	VANE ADJ SCREW
38	2T56	PALNUT TENSION NUT
39	682302 1	SPRING SUPPORT ASSY
40	10 32x5 8	HEX SOC HD CAP SCR 5 REQD
41	NO 10 REG	SPRING LOCKWASHER, 13 REQD
42	682305 1	TENSION STRIP ASSY 2 REQD
43	682291 1	FORCE BEAM
44	10 32x1 2	HEX SOC HD CAP SCR 4 REQD
45	682293 1	MOUNTING PLATE
46	682089 2	SEALING DIAPHRAGM
47	682282 1	NOZZLE BRKT ASSY
48	10 32x3 8	PAN HD SEMS EXT 1 REQD
49	4 40x1 4	PAN HD SEMS EXT 2 REQD
50	683245 1	NOZZLE AIRLINE
51	68834 1	CLAMP BLOCK
52	4 40x1 4	HEX SOC HD CAP SCR 5 REQD
53	682599 1	VANE SPACER
54	683249 1	NOZZLE VANE
55	682573 1	CLAMP PLATE
56	6 32x1 4	HEX SOC HDLS CONE PT SET SCREW
57	4 40x1 2	FLAT HD MACH SCR
58	682311 □*	RANGE SCALE

* □ PER ENG DATA

SPARE PARTS KITS

KIT NO 256034 1 FOR BK□1
KIT NO 256034 2 FOR BK□2

QTY	ITEM
2	5
2	13*
2	15*
1	26a BK□1
1	26b BK□2
1	46
1	54

*ITEMS 13 15 ON PARTS DWG P21 27

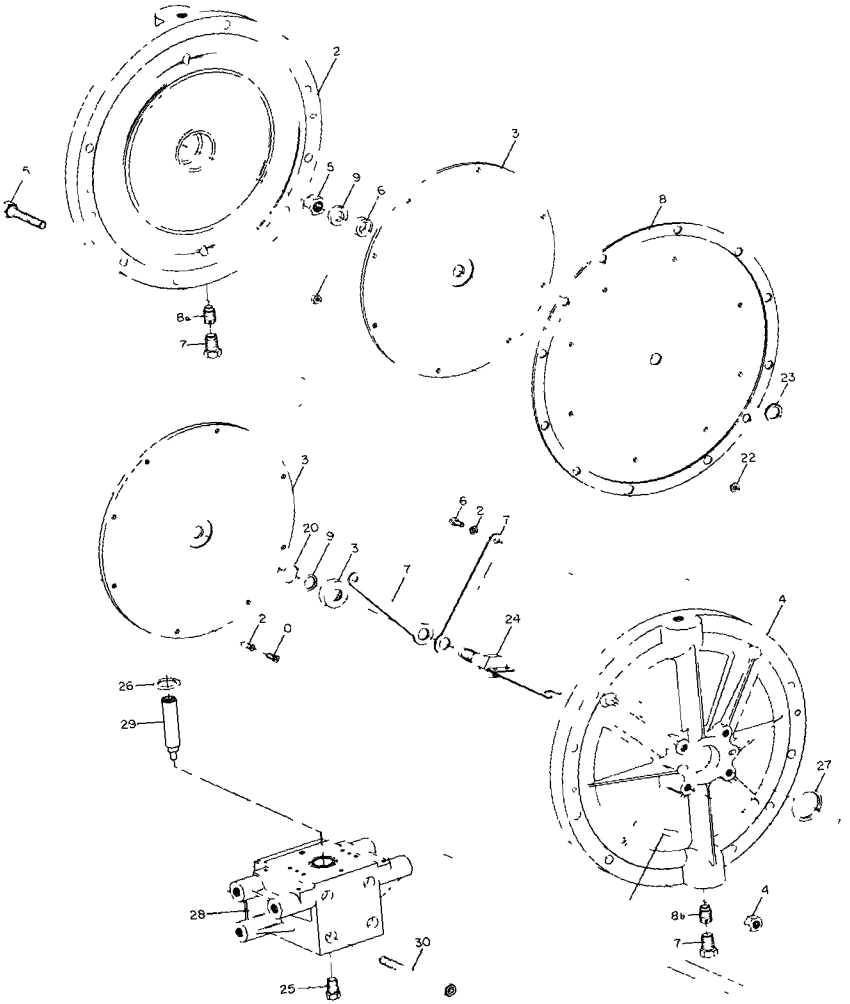


FIGURE 26 Parts Drawing P21 30,

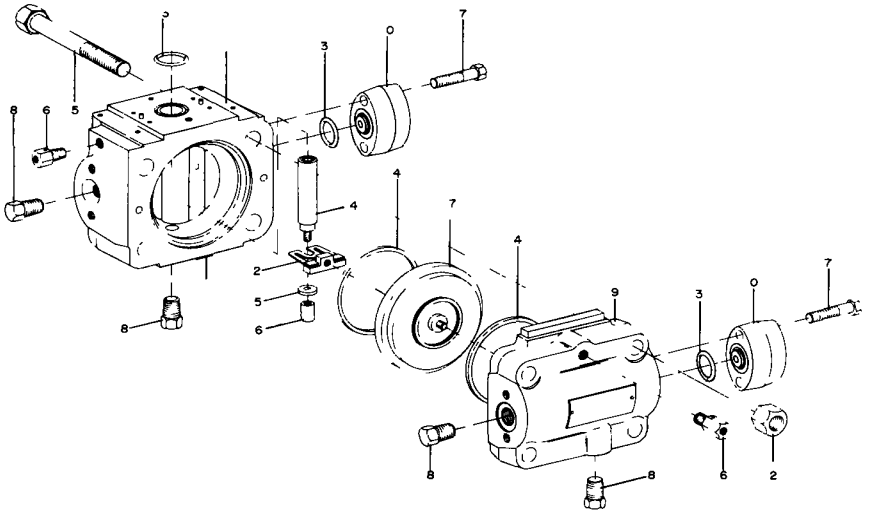
ITEM	PART NO	NAME
	662300 1	DIAPHRAGM ASSY (INCL ITEMS 1 THRU 24)
1	SEE NOTE	CODE LABEL
2	681978 1	DIAPHRAGM HOUSING
3	681985 1	DIAPH CLAMP PLATE 2 REQD
4	681977 1	DIAPHRAGM HOUSING
5	7 16 20	HEX JAM NUT
6	681983 1	SPACER
7	681981 1	STRAP HANGER 2 REQD
8	682170 1	DIAPHRAGM ASSY
9	5311428 7	O RING
10	6 32x3 8	PAN HD MACH SCR 8 REQD
11	6 32	HEX NUT 8 REQD
12	682025 1	NYLON SLEEVE 8 REQD
13	682161 1	SEALING WASHER
14	5 16 18	HEX NUT 12 REQD
15	5 16 18x1 1 4	HEX HD CAP SCR 12 REQD
16	10 32x1 4	PAN HD PHILLIPS SCR 2 REQD
17	195148 1*	SST PIPE PLUG 2 REQD
18a	682596 1	BRASS SURGE DAMPENER (STAMPED 2 1 2 REQD .045 DIA PIN
18b	682596 3	BRASS SURGE DAMPENER (STAMPED 1 1 2 REQD .039 DIA PIN)
19	7 16 SAE	MED PLAIN LKWASH
20	5311428 1	O RING
21	NO 10	LKWASH 9 REQD
22	682443 1	GASKET 8 REQD
23	682443 9	GASKET
24	683004 1	DIAPH FORCE BEAM CONNECTOR ASSY
25	195213 2	PIPE PLUG
26	5311428 44	O RING
27	5311428 45	O RING
28	682292 1	HOUSING
29	682383 1	FORCE BEAM NUT
30	5 16 18x2 3 4	HEX SOC HD SST CAP SCR 4 REQD

NOTE SPECIFY NUMBER ON LABEL WHEN ORDERING PARTS

*ASSEMBLED IN TOP OR BOTTOM OF DIAPHRAGM AS REQUIRED FOR TEST PURPOSES

SPARE PARTS KIT PART NO 256038 1	
ITEM	QTY
20	1
9	1
26	1
27	1
12	8
8	1
29	1

Type BK7 Measuring Diaphragm Assembly.



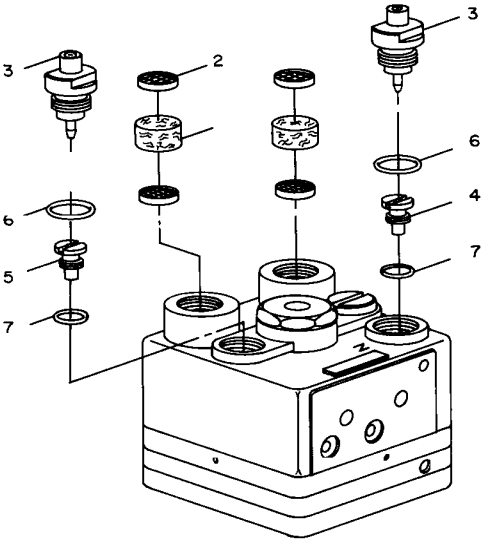
TYPE	ITEM 12	ITEM 13
BK8□1□S	683117 3	683122 1
BK8□2□S		683220 1
BK9□1□S	683117 1	683122 1
BK9□2□S		683220 1
BK9□1□M	683117 3	683122 3
BK8□2□M		683220 2
BK8□1□H	683117 4	683122 3
BK9□2□H		683220 3
BK9□1□D	683117 1	683122 4
BK9□2□D		683220 4

KIT NO 256037 1 FOR BK8 KIT NO 256037 2 FOR BK9	
QTY	ITEM
2	3
2	4
1	13
1	14a(BK8)
1	14b BK9
1	13

ITEM	PART NO	NAME
1	SEE NOTE	CODE LABEL
2	315521 2	HIGH STRENGTH NUT 4 REQD
3	1951201 3	O RING 2 REQD
4	682298 1	DIAPH HSG SEAL 2 REQD
5	682333 1	HIGH STRENGTH BOLT 4 REQD
6	682389 1	VENT VALVE ASSY 2 REQD
7	683303 1	HIGH STRENGTH BOLT 4 REQD
8	195148 1	PIPE PLUG (TYPE BK8) 4 REQD
	682332 1	PIPE PLUG (TYPE BK9) 4 REQD
9	682317 2	FRONT HOUSING (TYPE BK8
	682317 1	FRONT HOUSING (TYPE BK9
10	682321 2	FLANGE CONN TYPE BK8) 2 REQD
	682321 1	FLANGE CONN TYPE BK9) 2 REQD
11	682316 2	BASE HOUSING TYPE BK8)
	682316 1	BASE HOUSING (TYPE BK9
12	SEE TABLE	FLEXIBLE CONNECTOR ASSY
13	682334 1	DIAPHRAGM SEAL
4	682363 3	FORCE BEAM NUT (TYPE BK8)
	682363 4	FORCE BEAM NUT TYPE BK9
15	682362 1	D WASHER
16	682365 1	CONN CLAMP NUT
17	SEE TABLE	CAPSULE ASSY

NOTE SPECIFY NUMBER ON LABEL WHEN ORDERING PARTS

FIGURE 27 Parts Drawing P21 29, Type BK8 and BK9 Measuring Diaphragm Assembly



ITEM	PART NO	NAME	ITEM	PART NO	NAME
1	53204 4A1	FELT PAD 2 REQD	4	5316464A4	ORIFICE ASSY
2	53204 3A1	WIRE MESH 4 REQD	5	5316464A1	ORIFICE ASSY
3	5316478A1	ORIFICE CLEANOUT ASSY 2 REQD	6	5311428A11	O RING 2 REQD
			7	5311428A2	O RING 2 REQD

NOTE THE ABOVE ITEMS IN THE QUANTITIES LISTED ARE AVAILABLE AS SPARE PARTS KIT PT NO 456073A1 SPECIFY THIS NUMBER TO ORDER A COMPLETE KIT

FIGURE 28 Parts Drawing P21-9, Booster Relay Part No. 5324957 1

Product Warranty

Bailey Meter Company warrants the products manufactured by it to be free from defects in material and workmanship and will repair or replace, at its option, free of charge, f o b its factory such part or parts which prove defective within one year from date of shipment In respect to any products which are not an integral part of a product manufactured by the Company, the warranty given by the manufacturer thereof shall apply

Shipping Damage

We strongly recommend that you inspect and test your instrument as soon as you receive it If the instrument is damaged or operates improperly, notify the carrier for inspection of the shipment The carrier's claim agent will prepare a report of damage, a copy of which should be forwarded to your nearest Bailey District Office (see back cover for location) The District Office will then tell you how to have the instrument repaired or replaced

Service

The Bailey Meter Company is vitally concerned that your Bailey instrument provides continued, fine performance This instruction manual is designed to fully describe the correct installation, operation, and maintenance of your instrument under recommended conditions If the need arises, factory trained Service Engineers are on call for prompt, in plant maintenance Telephone or wire your nearby Bailey District Office to make arrangements for this service

Replacement Parts and Supplies

Complete parts drawings and recommended spare parts kit information are included in this instruction manual When replacement parts or supplies are required for maintenance of your Bailey instrument, contact your nearest Bailey District Office (see back cover for location) Always specify complete data on the instrument nameplate on your inquiry or order for parts Common parts are available for shipment within 48 hours on a speed order basis

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