Product Instruction P21-19

Differential Pressure Transmitter
Type BK

Bailey Babcock & Wilcox
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1. The curve representing the rating of the tubing selected must lie above the intersection of the 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 400°F.

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 0.05".

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 HORIZONTAL LINES SHOULD SLIP AT LEAST ONE NOH PER FOOT DOWNWARD TO TRANSMITTER NOTE E XCEPT NOTE N.
TRANSMITTER MUST BE THOROUGHLY VENTED TO AVOID MEASUREMENT ERRORS.

NOTES
A. OPEN JUSSLE LEVEL AT ATMOSPHERE PRESSURE
B. CLOSED JUSSLE LEVEL PRESSURE
C. JUSSLE TO TOP OF TANK ABOVE LIQUID LEVEL
D. EQUALIZE WITH VALVE
E. THIS LINE IS USED SLOPE DOWNWARD TO VESSEL AND TO BLOWDOWN VALVE
F. 1/2 VALVES
G. BLOWDOWN VALVES
H. 1/2 P PE OR 5/8 OD ENDC TO BLOWDOWN VALVE
I. CONNECT ON N 3 DE OR BOTTOM OF TANK TITER SCREENS RECOMMENDED FOR BOTTOM OF TANK CONNECTIONS
J. 1/2 SUPPORT P PE NUT BY B M CO
K. ONSAT OF COLLECTOR POINT DRAIN AS NECESSARY

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

GENERAL
MOUNT TRANSMITTER BELOW PRIMARY ELEMENT CONNECTIONS
ALL HORIZONTAL LINES SHOULD SLIP AT LEAST ONE NOH PER FOOT DOWNWARD TO TRANSMITTER
TRANSMITTER MUST BE THOROUGHLY VENTED TO AVOID MEASUREMENT ERRORS
ALL VALVES AT PRESSURE CONNECTIONS SHOULD BE NEARLY VERTICAL POSITION
A 1/2 VALVES SHOULD BE UP OR AT SLIGHT ANGLE
B. ACTUAL SET OF NOH AS REQUIRED FOR LINES INSTALLING LINES OR WHEN DESIRABLE TO MOUNT UNIT AT FLOOR LEVEL TO PERMIT SERVICING
C. EQUALIZE WITH VALVE
D. 1/2 P PE NOT BY B M CO
E. NIPPLES TO SIDE OF FLANGE LACING AS APPLICABLE

FIGURE 6 Connecting Piping for Liquid Measurement
FIGURE 7  Connecting Piping for Type BKL Closed tank, Condensing Atmosphere
FIGURE 9  Connecting Piping for Gas Measurement

OPERATING THE TRANSMITTER

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□□□□). 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 blowdown 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 dia phragm.

3. Disconnect connecting lines from instrument at unions or fittings on Trans mitter 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 to reach normal operating temperature before placing Transmitter in service.

B. Level Measurement

Open or Closed Tank, Non-Condensing Atmosphere

1. Refer to Figure 5 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
Type Bk Transmitter

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
9. Remove jam nut on diaphragm center assembly.
10. 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.
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 1-800 and repeat above procedure.

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

   • 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 (15).

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.
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 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's present, rub fine emery cloth lightly across nozzle tip.

2. With zero differential and no load on suppression spring, turn vane adjustment screw (Figure 17) until output is 3 psig.


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.

## Fault Correction Chart

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<th>PROBABLE CAUSE</th>
<th>CORRECTIVE ACTION</th>
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<td>1. Output from Booster Relay does not increase to about full supply pressure when force beam is pushed toward restoring bellows.</td>
<td>a. Supply and output connections to Booster Relay are incorrect.</td>
<td>a. Connect as shown in Figure 3</td>
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<td>b. Dirty nozzle orifice in Booster Relay.</td>
<td>b. Depress nozzle orifice plunger.</td>
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<td>c. Vane - nozzle relationship incorrect.</td>
<td>c. Refer to &quot;Vane-Nozzle Alignment&quot;, page 16.</td>
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<td>d. Burr on nozzle tip.</td>
<td>d. Rub a fine emery cloth lightly across nozzle tip to remove possible burr</td>
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<td>e. Nozzle alignment in correct.</td>
<td>e. Refer to &quot;Vane-Nozzle Alignment&quot;, page 16.</td>
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<td>f. Nozzle air line leaking.</td>
<td>f. Check that Booster is mounted securely.</td>
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<td>g. Booster calibration incorrect.</td>
<td>g. Calibrate Booster (see page 27).</td>
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<td>h. Vane spring loading incorrect.</td>
<td>h. Refer to &quot;Vane Spring Loading&quot;, page 16.</td>
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<td>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.</td>
<td>a. Supply and output connections to Booster Relay are incorrect.</td>
<td>a. Connect as shown in Figure 3</td>
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<td></td>
<td>b. Dirty nozzle.</td>
<td>b. Check nozzle tip and clean with a suitable solvent.</td>
</tr>
<tr>
<td></td>
<td>c. Nozzle air line is pinched off.</td>
<td>c. Check visually. Reposition as necessary.</td>
</tr>
<tr>
<td></td>
<td>d. Booster Relay orifice is dirty.</td>
<td>d. Depress nozzle orifice plunger.</td>
</tr>
<tr>
<td></td>
<td>e. Booster calibration incorrect.</td>
<td>e. Calibrate Booster (see page 27).</td>
</tr>
<tr>
<td>3. Output readings are nonlinear</td>
<td>a. Leakage from output line or restoring bellows.</td>
<td>a. Replace line or bellows.</td>
</tr>
<tr>
<td></td>
<td>b. Incorrect vane alignment</td>
<td>b. Refer to 'Vane Nozzle Alignment&quot;, page 16</td>
</tr>
<tr>
<td></td>
<td>c. Dirty nozzle orifice in Booster Relay.</td>
<td>c. Depress nozzle orifice plunger.</td>
</tr>
</tbody>
</table>
### FAULT CORRECTION CHART (Continued)

<table>
<thead>
<tr>
<th>TRANSMITTER FAULT</th>
<th>PROBABLE CAUSE</th>
<th>CORRECTIVE ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 (Continued)</td>
<td>d. Booster calibration incorrect.</td>
<td>d. Check Booster calibration (see page 27)</td>
</tr>
<tr>
<td></td>
<td>e. Diaphragm capsule or measuring diaphragm cracked, capsule incorrectly installed, or silicone fluid is leaking.</td>
<td>e. Replace capsule or diaphragm as outlined under 'Replacing Diaphragm Capsule', or 'Replacing Measuring Diaphragm', page 13.</td>
</tr>
<tr>
<td></td>
<td>f. Zero adjusting nut positioned so that zero spring is fully compressed during normal operation.</td>
<td>f. Calibrate Transmitter as outlined on page 20 or 24, as applicable.</td>
</tr>
</tbody>
</table>

4. Output readings indicate hysteresis.

<table>
<thead>
<tr>
<th></th>
<th>a. Vane adjustment screw is rough.</th>
<th>a. Smooth vane contact surface of screw with very fine sand paper</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>b. Booster calibration incorrect.</td>
<td>b. Check Booster calibration (see page 27).</td>
</tr>
<tr>
<td></td>
<td>c. Damaged diaphragm capsule. diaphragm, connector, or sealing diaphragm.</td>
<td>c. Replace as outlined under 'Replacing Measuring Diaphragm Capsule', or 'Replacing Sealing Diaphragm', page 15.</td>
</tr>
</tbody>
</table>

5. Transmitter output indicates erratic operation.

<table>
<thead>
<tr>
<th></th>
<th>a. Air leakage.</th>
<th>a. Tighten or replace parts as necessary.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>b. Moisture or oil deposits in air passages.</td>
<td>b. Clean orifices with suitable solvent.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BOOSTER FAULT</th>
<th>PROBABLE CAUSE</th>
<th>CORRECTIVE ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Booster Relay output pressure does not immediately increase when flow of air from nozzle is blocked.</td>
<td>a. Clogged nozzle orifice.</td>
<td>a. Depress nozzle orifice plunger.</td>
</tr>
<tr>
<td></td>
<td>b. Leakage around sections of Booster casing.</td>
<td>b. Replace Booster Relay.</td>
</tr>
<tr>
<td></td>
<td>c. Dirty filters (see Figure 27).</td>
<td>c. Remove and replace filters as outlined under 'Routine Servicing', page 11.</td>
</tr>
<tr>
<td></td>
<td>d. Booster calibration incorrect.</td>
<td>d. Check Booster calibration (see page 27).</td>
</tr>
</tbody>
</table>
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 psi 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 27) or 15 psig (Type BK 15). 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 permissible.

5. Repeat steps 3 and 4 above until Transmitter output pressures are correct.
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 BK7, 1.2 psi for Type BK2). If linearity of output pressure is not within acceptable limits (±0.12 psi for Type BK7, ±0.06 psi for Type BK2), 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 cannot 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 repeatability 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 BR 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. Locknut 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 misaligned 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>
<thead>
<tr>
<th>TABLE I</th>
</tr>
</thead>
<tbody>
<tr>
<td>TYPE</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>---------</td>
</tr>
<tr>
<td>BK111</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>BK12</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

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 the 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 23);

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 tee 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 and 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 feel 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 (± 0.6 psig) for Type BK1 unit and 27 psig (± 1.2 psig) for Type BK2 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:

   a. 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.
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 seated 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. 5320519-1, may be purchased from Bailey Meter Co.

3. Apply supply pressure of 15 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 18 - Booster Relay Adjustment

FIGURE 19 - Booster Relay Calibration Block, Part No. 5320519-1
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 0.1 psi 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

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**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.
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 P. In addition, distance x, 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.
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 has then 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

<table>
<thead>
<tr>
<th>AMBIENT TEMPERATURE</th>
<th>NOMINAL</th>
<th>REFERENCE (RANGE)</th>
<th>NORMAL</th>
<th>OPERATIVE LIMITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMBIENT TEMPERATURE</td>
<td>75°F</td>
<td>CALIB TEMP ±2 5°F</td>
<td>40°F TO 140°F</td>
<td>0°F TO 180°F</td>
</tr>
<tr>
<td>SUPPLY PRESSURE</td>
<td>TYPE BK6100</td>
<td>18 PSIG</td>
<td>16 TO 20 PSIG</td>
<td>40 PSIG MAX</td>
</tr>
<tr>
<td>SUPPLY PRESSURE</td>
<td>TYPE BK6200</td>
<td>30 PSIG</td>
<td>28 TO 35 PSIG</td>
<td>40 PSIG MAX</td>
</tr>
</tbody>
</table>

**AMBIENT TEMPERATURE EFFECT**

60% 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

<table>
<thead>
<tr>
<th>PART NAME</th>
<th>LOCATION</th>
<th>TORQUE VALUE MAX SERVICE PRESSURE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>50 psig</td>
</tr>
<tr>
<td>Force Beam Nut</td>
<td>Holding Force Beam to Sealing Diaphragm</td>
<td>15 ft-lb</td>
</tr>
<tr>
<td>Connector Clamp Nut</td>
<td>Holding Diaphragm Connector to Force Beam Nut</td>
<td>75 in lb</td>
</tr>
<tr>
<td>No 10 32 Screws</td>
<td>Internal Fasteners in Force Balance Unit</td>
<td>28 in-lb</td>
</tr>
<tr>
<td>No 6 32 Screws</td>
<td>Internal Fasteners in Force Balance Unit</td>
<td>12 in  lb</td>
</tr>
<tr>
<td>No. 10 32 Nut</td>
<td>Holding Zero Spring to Restoring Beam</td>
<td>28 in  lb</td>
</tr>
<tr>
<td>Bellows Screw</td>
<td>Holding Restoring Bellows to Mechanism Frame</td>
<td>28 in  lb</td>
</tr>
<tr>
<td>Hinge Screw</td>
<td>Holding Hinge and Restoring Beam to Mechanism Frame</td>
<td>12 in  lb</td>
</tr>
<tr>
<td>5/16 18 Stainless</td>
<td>Holding Diaphragm Assembly to Pressure Housing</td>
<td>135 in lb</td>
</tr>
<tr>
<td>Socket Hd. Screw</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nut &amp; Bolt</td>
<td>Holding Halves of Diaphragm Assembly Together</td>
<td>10 in  lb</td>
</tr>
<tr>
<td>No. 10 32 Socket</td>
<td>Holding Mounting Plate and Sealing Diaphragm to</td>
<td>40 in  lb</td>
</tr>
<tr>
<td>Hd. Screw</td>
<td>Pressure Housing or Diaphragm Assembly</td>
<td></td>
</tr>
<tr>
<td>3/8-16 Hex Hd.</td>
<td>Holding Two Bolt Flange to Diaphragm Assembly</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Cap Screw</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1/4-20 Screw</td>
<td>Holding Mechanism to Frame</td>
<td>55 in  lb</td>
</tr>
<tr>
<td>8-32 Fillister</td>
<td>Holding Booster Relay to Mounting Plate</td>
<td>18 in  lb</td>
</tr>
<tr>
<td>Head Screw</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connector</td>
<td>Attaching Connector Strap to Diaphragm Capsule</td>
<td>Not Applicable</td>
</tr>
</tbody>
</table>
FIGURE 23 - Transmitter Range Charts
EXPLANATION OF NOMENCLATURE

Differential Pressure Limits in of H2O

<table>
<thead>
<tr>
<th>REVERSE ACTION</th>
<th>DIRECT ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>RANGE SPAN</td>
<td>TOP VALUE</td>
</tr>
<tr>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>21</td>
</tr>
<tr>
<td>2</td>
<td>100</td>
</tr>
</tbody>
</table>

* 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 Spare Parts Kit part 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.)
### FIGURE 24  Parts Drawing P21-27, Type BK Differential Pressure Transmitter
FIGURE 25  Parts Drawing P21 28, Internal Mechanism for
## Type BK Transmitter

### Table: List of Parts

<table>
<thead>
<tr>
<th>Item</th>
<th>Part No</th>
<th>Name</th>
<th>Item</th>
<th>Part No</th>
<th>Name</th>
<th>Item</th>
<th>Part No</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6 32x5 16</td>
<td>PAN HD SEMS EXT, 8 REQD</td>
<td>18</td>
<td>1 4 REG</td>
<td>SPRING LOCK WASHER, BKC001 ONLY</td>
<td>38</td>
<td>2TS6</td>
<td>PALNUT TENSION NUT</td>
</tr>
<tr>
<td>2</td>
<td>682091 1</td>
<td>SPRING PIVOT CLAMP</td>
<td>19</td>
<td>682272 1</td>
<td>COM SPRING, ADJ NUT (BKC001 ONLY)</td>
<td>39</td>
<td>682202 1</td>
<td>SPRING SUPPORT ASSY</td>
</tr>
<tr>
<td>3</td>
<td>682092 1</td>
<td>SPRING PIVOT CLAMP</td>
<td>20</td>
<td>682301 1</td>
<td>SPRING AND BELLOWS SUPPORT</td>
<td>40</td>
<td>10 32x5 8</td>
<td>HEX SO HD CAP SCR</td>
</tr>
<tr>
<td>4</td>
<td>68259 1</td>
<td>MECHANISM FRAME</td>
<td>21</td>
<td>5316486 1</td>
<td>NYLON INSERT</td>
<td>41</td>
<td>NO 10 REG</td>
<td>SPRING LOCK WASHER, 13 REQD</td>
</tr>
<tr>
<td>5</td>
<td>5316486 1</td>
<td>NYLON INSERT 2 REQD</td>
<td>22</td>
<td>6 32x5 16</td>
<td>HEX SO HDLSC CUP PT SET SCR</td>
<td>42</td>
<td>682205 1</td>
<td>TENSION STRIP ASSY</td>
</tr>
<tr>
<td>6</td>
<td>6 32x5 16</td>
<td>HEX SO HDLSC CUP PT SET SCR</td>
<td>23</td>
<td>6 32x1 2</td>
<td>PAN HD SEMS EXT 4 REQD</td>
<td>43</td>
<td>682291 1</td>
<td>FORC BEAM</td>
</tr>
<tr>
<td>7</td>
<td>682494 1</td>
<td>STOP CLAMP (BKC001 ONLY)</td>
<td>24</td>
<td>10 32x5 8</td>
<td>PAN HD SEMS EXT</td>
<td>44</td>
<td>10 32x1 2</td>
<td>HEX SO HD CAP SCR 4 REQD</td>
</tr>
<tr>
<td>8</td>
<td>6 32x5 16</td>
<td>PAN HD SEMS EXT</td>
<td>25</td>
<td>682364 1</td>
<td>MANIFOLD CLAMP</td>
<td>45</td>
<td>682293 1</td>
<td>MOUNTING PLATE</td>
</tr>
<tr>
<td>9</td>
<td>6 32x5 16</td>
<td>PAN HD SEMS EXT</td>
<td>26</td>
<td>682594 1</td>
<td>BELLOWS BKC01 ONLY</td>
<td>46</td>
<td>682208 2</td>
<td>SEALING DIAPHAGM</td>
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<tr>
<td>10</td>
<td>6 32x1 2</td>
<td>HEX SO HDLSC OVAL PT SET SCR BKC001 ONLY</td>
<td>27</td>
<td>682284 1</td>
<td>ZERO SPRING ASSY</td>
<td>47</td>
<td>682282 1</td>
<td>NOZZLE BRKT ASSY</td>
</tr>
<tr>
<td>11</td>
<td>1 4 20X7 8</td>
<td>HEX SO HD CAP SCR</td>
<td>28</td>
<td>682066 1</td>
<td>ZERO SPRING ASSY</td>
<td>48</td>
<td>10 32x3 8</td>
<td>PAN HD SEMS EXT</td>
</tr>
<tr>
<td>12</td>
<td>1 4 REG</td>
<td>SPRING L&amp;WASH 1 REQD</td>
<td>29</td>
<td>10 32</td>
<td>HEX NUT</td>
<td>49</td>
<td>4 40x1 4</td>
<td>PAN HD SEMS EXT 3 REQD</td>
</tr>
<tr>
<td>13</td>
<td>1 4 20X1 2</td>
<td>HEX SO HD CAP SCR</td>
<td>30</td>
<td>682295 1</td>
<td>RESTORING BEAM</td>
<td>50</td>
<td>683245 1</td>
<td>NOZZLE AIRLNF</td>
</tr>
<tr>
<td>14</td>
<td>682278 1</td>
<td>TENSION SPRING, ADJ NUT (BKC002 ONLY)</td>
<td>31</td>
<td>682289 1</td>
<td>SPRING PIVOT HINGE 4 REQD</td>
<td>51</td>
<td>68224 1</td>
<td>CLAMP BLOCK</td>
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<tr>
<td>15</td>
<td>68229 1</td>
<td>EXTENSION SPRING ASSY (BKC002 ONLY)</td>
<td>32</td>
<td>682052 1</td>
<td>RANGE ADJ SCREW</td>
<td>52</td>
<td>4 40x1 4</td>
<td>HEX SO HD CAP SCR 5 REQD</td>
</tr>
<tr>
<td>16</td>
<td>682273 1</td>
<td>COMPRESSION SPRING ASSY (BKC003 ONLY)</td>
<td>33</td>
<td>197549 1</td>
<td>TYPE TRUARC RET RING 1 REQD</td>
<td>53</td>
<td>682599 1</td>
<td>VANE SPACR</td>
</tr>
<tr>
<td>17</td>
<td>1 4 28</td>
<td>HEX JAM NUT (BKC003 ONLY)</td>
<td>34</td>
<td>197344 18</td>
<td>SMALL WASHER</td>
<td>54</td>
<td>683249 1</td>
<td>NOZZLE VANE</td>
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<tr>
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</tbody>
</table>

* Items 13-15 on parts DWG P21 27

---

### Spare Parts Kits

<table>
<thead>
<tr>
<th>Kit No</th>
<th>Qty.</th>
<th>Item</th>
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<tr>
<td>256034</td>
<td>1</td>
<td>FOR BK21</td>
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<tr>
<td>256034</td>
<td>2</td>
<td>FOR BK22</td>
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**Type BK Differential Pressure Transmitter**
FIGURE 26  Parts Drawing P21 30,
## Type BK Transmitter

<table>
<thead>
<tr>
<th>ITEM</th>
<th>PART NO.</th>
<th>NAME</th>
<th>ITEM</th>
<th>PART NO.</th>
<th>NAME</th>
<th>ITEM</th>
<th>PART NO.</th>
<th>NAME</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>662100</td>
<td>DIAPHRAGM ASY (INCL</td>
<td>12</td>
<td>682025</td>
<td>NYLON SLEEVE 8 REQD</td>
<td>20</td>
<td>5311428</td>
<td>O RING</td>
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<tr>
<td></td>
<td></td>
<td>ITEMS 1 THRU L4)</td>
<td></td>
<td>682161</td>
<td>SEALING WASHER</td>
<td>21</td>
<td>NO 10</td>
<td>LKWASH 9 REQD</td>
</tr>
<tr>
<td>2</td>
<td>681978</td>
<td>DIAPHRAGM HOUSING</td>
<td>13</td>
<td>682161</td>
<td>Spacer</td>
<td>22</td>
<td>682443</td>
<td>GASKET 8 REQD</td>
</tr>
<tr>
<td>3</td>
<td>681985</td>
<td>DIAPHRAGM CLAMP PLATE 2 REQD</td>
<td>14</td>
<td>5 16 16</td>
<td>HEX NUT 12 REQD</td>
<td>23</td>
<td>682443</td>
<td>GASKET</td>
</tr>
<tr>
<td>4</td>
<td>681977</td>
<td>DIAPHRAGM HOUSING</td>
<td>15</td>
<td>5 16 16</td>
<td>1/4 HEV HD CAP SCR</td>
<td>24</td>
<td>683004</td>
<td>DIAPHRAGM FORCE BEAM</td>
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<tr>
<td>5</td>
<td>7 16 20</td>
<td>HEX JAM NUT</td>
<td>16</td>
<td>10 32 x 4</td>
<td>PAN HD PHILLIPS SCR</td>
<td>25</td>
<td>195213</td>
<td>CONNECTOR ASSY</td>
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<tr>
<td>6</td>
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<td>17</td>
<td>195148</td>
<td>SST PIPE PLUG 2 REQD</td>
<td>26</td>
<td>5311428</td>
<td>44 O RING</td>
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<tr>
<td>7</td>
<td>681981</td>
<td>STRAP RANGER 2 REQD</td>
<td>18a</td>
<td>682396</td>
<td>BRASS SURGE DAMPENER (STAMPED 2 ) 2 REQD</td>
<td>27</td>
<td>5311428</td>
<td>2 O RING</td>
</tr>
<tr>
<td>8</td>
<td>682170</td>
<td>DIAPHRAGM ASSY</td>
<td>18b</td>
<td>682396</td>
<td>BRASS SURGE DAMPENER (STAMPED 1 ) 2 REQD</td>
<td>28</td>
<td>682232</td>
<td>HOUSING</td>
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<tr>
<td>9</td>
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<td>O RING</td>
<td>19</td>
<td>7 16 SAE</td>
<td>MED PLAIN LKWASH</td>
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<td>682283</td>
<td>FORCE BEAM NUT</td>
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<tr>
<td>10</td>
<td>32 x 8</td>
<td>PAN HD MACH SCR 8 REQD</td>
<td></td>
<td></td>
<td></td>
<td>30</td>
<td>5 16 16</td>
<td>3 4 HEX SOC HD SET CAP SCR 4 REQD</td>
</tr>
</tbody>
</table>

**NOTE** SPECIFY NUMBER ON LABEL WHEN ORDERING PARTS

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

### Spare Parts Kit

<table>
<thead>
<tr>
<th>ITEM</th>
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<td>8</td>
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<tr>
<td>29</td>
<td>1</td>
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**Type BK7 Measuring Diaphragm Assembly.**
### Figure 27
Parts Drawing P21-29, Type BK8 and BK9 Measuring Diaphragm Assembly
FIGURE 28  Parts Drawing P21-9, Booster Relay Part No. 53249571

<table>
<thead>
<tr>
<th>ITEM</th>
<th>PART NO</th>
<th>NAME</th>
<th>ITEM</th>
<th>PART NO</th>
<th>NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5320414A1</td>
<td>FELT PAD 2 REQD</td>
<td>4</td>
<td>5316464A4</td>
<td>ORIFICE ASSY</td>
</tr>
<tr>
<td>2</td>
<td>532043A1</td>
<td>WIRE MESH 4 REQD</td>
<td>5</td>
<td>5316464A1</td>
<td>ORIFICE ASSY</td>
</tr>
<tr>
<td>3</td>
<td>5316478A1</td>
<td>ORIFICE CLEANOUT</td>
<td>6</td>
<td>5311426A1</td>
<td>O RING 2 REQD</td>
</tr>
<tr>
<td>7</td>
<td>5311428A2</td>
<td>O RING 2 REQD</td>
<td>7</td>
<td>5311428A2</td>
<td>O RING 2 REQD</td>
</tr>
</tbody>
</table>

Note: The above items in the quantities listed are available as spare parts kit PT No. 455078A1. Specify this number to order a complete kit.
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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Wolffsfe, Oh 44092

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