TRANSIT CAR "6000" SERIES RUNNING MAINTENANCE AND SERVICING MANUAL

CHAPTER 4 FRICTION BRAKE EQUIPMENT

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY (WMATA)

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4-1-3	1.0	4-1-31	1.0
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CHAPTER INDEX

SECTION 1. GENERAL DESCRIPTION AND THEORY OF OPERATION

4-1-1. INTRODUCTION

This section describes the WMATA 6000 transit car friction brake equipment.

4-1-2. ACRONYMS AND ABBREVIATIONS

The following acronyms and abbreviations are used in this chapter and listed in Table 4-1-1. Standard abbreviations are used whenever practical.

Table 4-1-1. Acronyms and Abbreviations

Acronyms and Abbreviations	Definitions
AMV	Apply Magnet Valve
ASU	Air Supply Unit
ATC	Automatic Train Control
ATP	Automatic Train Protection
ATS	Automatic Train Supervision
AW	Assigned Weight
AW0	Tare weight 156,840 lb per married pair
AW1	Maximum normal load 178,760 lb per married pair
AW2	Maximum full load 206,960 lb per married pair
AW3	Maximum crush load 224,060 lb per married pair
AW4	Maximum weight 230,060 lb per married pair
BC	Brake Cylinder
BCCO	Brake Cylinder Cut-out
BCO	Brake Cut-Out
BCTP	Brake Cylinder Test Point
BP	Brake Pipe
BPPS	Brake Pipe Pressure Switch
BPT	Brake Pipe Transducer
BPTP	Brake Pipe Test Point
BSR	Brake Supply Reservoir

4-1-4. FRICTION BRAKE THEORY OF OPERATION (CONT)

Safety and Security Considerations

The brake system is designed so that two FB.ECUs, each controlling a TCU, provide independent truck control. Through this configuration, a single failure of one of the FB.ECUs or TCUs will lead to a reduction of braking effort of not more than 25 percent (of the total braking effort on a per married pair basis).

The brake system is configured so that both FB.ECUs of a car are monitoring the BC pressure of each truck of the car through independent pressure transducers. In case an FB.ECU detects a pressure differential of more than 12 psi between front and rear brake cylinders, a white status light is illuminated (white light condition). If a white light condition exists, the external white light relay also prevents the amber (brakes applied) status light from being illuminated.

The loss of one FB.ECU or the detection of failure from DIA_WHITE_LIGHT GROUP (as defined in the Event Code List) will also cause a white light condition. Due to the system configuration of four FB.ECUs per married pair, a loss of a single FB.ECU results in a loss of only 25 percent of braking effort on a per married pair basis. A loss of two FB.ECUs on a car results in an automatic emergency brake application by opening the normally open relays in the emergency loop. These normally open relays will be checked for faulty contacts when the car has been at B4 for one hour. A switch on the seat well cut-out cock provides a manual override for operation in a degraded mode.

System Constraints

Refer to Table 4-1-5 for vehicle constraints.

Table 4-1-5. Vehicle Constraints

Kind of vehicle	Motorcar, paired
Truck arrangement	2 trucks per car
Motor on truck mechanically coupled	No
Number of wheelslide units per vehicle	2
Wheel diameter, new	28.0 in.
Wheel diameter axle differential	0.25 in.
Wheel diameter truck differential	0.50 in.
Wheel diameter, worn	25.0 in.
Weight of vehicle, empty	A Car, 78,750 lb, and B Car 79,200 lb
Weight of vehicle:	
AW0	155,000 lb (max.)
AW1	12,150 lb
AW2	26,250 lb

4-2-6. PNEUMATIC CONTROL TROUBLESHOOTING PROCEDURES (CONT)

Table 4-2-5. Pneumatic Control Troubleshooting (Cont)

SYMPTOM PROBABLE CAUSE CORRECTIVE ACTION
SERVICE BRAKES APPLY AT EXCESSIVE BRAKING RATE FOR ONE TRUCK, BRAKE ON ONE TRUCK IS DRAGGING, OR SERVICE BRAKES WILL NOT RELEASE ON ONE TRUCK (CONT)
4. KR-6 RELAY VALVE HAS FAILED
Step 1. Troubleshoot KR-6 relay valve (refer to Table 4-2-15).
SERVICE BRAKES WILL NOT RELEASE
1. KR-6 RELAY VALVE HAS FAILED
Step 1. Troubleshoot KR-6 relay valve (refer to Table 4-2-15).
2. THE RELEASE MAGNET VALVE IN THE ANALOG CONVERTER HAS FAILED AND WILL NOT EXHAUST
Step 1. Troubleshoot analog converter (refer to Table 4-2-16).
3. AN ELECTRICAL CONNECTION HAS FAILED
Step 1. Troubleshoot the connections in all wiring between the analog converter and the ECU.

4-2-7. BRAKE PIPE PRESSURE TROUBLESHOOTING PROCEDURES

Table 4-2-6 identifies the malfunctions associated with brake pipe air pressure. To help navigate through this troubleshooting table, a symptom index has been provided which lists the symptoms in alphanumeric order and refers to the page where the symptom begins.

SYMPTOM INDEX

Table 4-2-25. Diagnostic Message Table (Cont)

Ref. No.	Code	Node	t_{come} (Sec.)	t_{go} (Sec.)	Message --- Simulation	Group Msg	Priority
					Relay Messages		
32	R10	5	0	0	ERR_EB01_5_RELAY1 FBR relay No. 2 defective. Change board. --- not possible; change of HW necessary.	N	2
33	R20	5	0	0	ERR_EB01_5_RELAY2 FBR relay No. 3 defective. Change board. --- not possible; change of HW necessary.	N	2
34	R30	5	0	0	ERR_EB01_5_RELAY3 FBR relay No. 1 defective. Change board. --- not possible; change of HW necessary.	N	2
35	R60	5	3	1	ERR_EB01_5_BLUE_RELAY6 Relay No. 6 defective. Change board. --- not possible; change of HW necessary.	N	1
36	R70	5	0	0	ERR_EB01_5_EMR_RELAY7 Relay No. 7 defective. Change board. --- not possible; change of HW necessary.	N	1
37	R80	5	3	1	ERR_EB01_5_TL7_RELAY8 Relay No. 8 defective. Change board. --- not possible; change of HW necessary.	N	1
					Wheelslide Messages		
38	11' '	2	0	0	ERR_WSP_FSI_1 (basis signal message) Refer to Table 4-2-25.	N	1
39	12' '	2	0	0	ERR_WSP_DV_1 (signal message) Refer to Table 4-2-25. Check wiring and sensor. Finally change board MB03. --- Disconnect the sensor at MB03 Pin z26 resp. dismantle sensor and move the vehicle for 1 minute. (Attention: wheel flats!)		

4-3-1. ST03 SERVICE TERMINAL OPERATING INSTRUCTIONS (CONT)

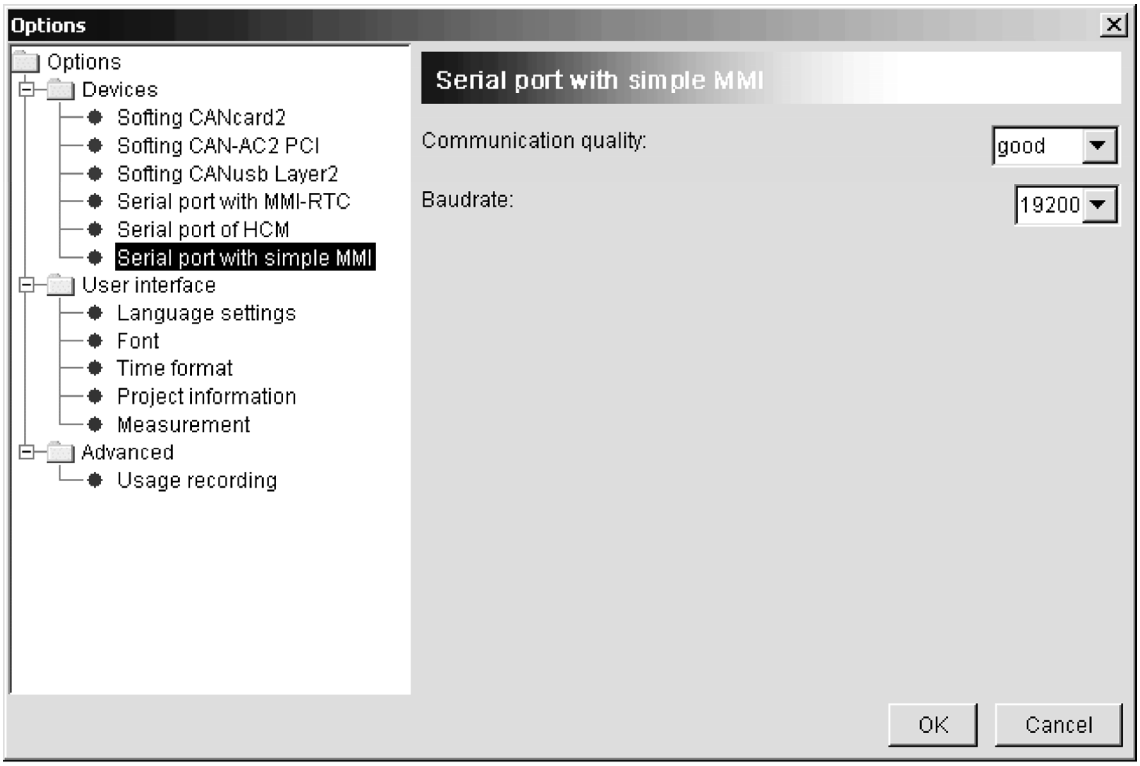

Figure 4-3-40. Serial Data Rate Selection Screen

4-3-1.3.3.3 Data Recording (Figure 4-3-41)

Data displayed on a screen, i.e. data that is being sent over the serial link to the ECU, can be recorded in *cmv format. This is initiated from either the **Tools** menu or the data recording button (refer to Figure 4-3-38). The initial selection starts the recording and a subsequent selection ends the recording. When the recording has ended, the screen shown in Figure 4-3-41 will be displayed.

Before starting data recordings, it is useful to first create a folder in the directory in which recordings are to be saved. The program requires a specific folder; it will not save to a root directory directly. The files are saved as **signalsX.csv**, where X is a serial number starting with 0. Renaming the file once it is saved allows the user to easily identify the type and source of the data recording.

4-5-9. SUPPLY RESERVOIR INSPECTION (CONT)

Inspect Supply Reservoir (Figure 4-5-8)

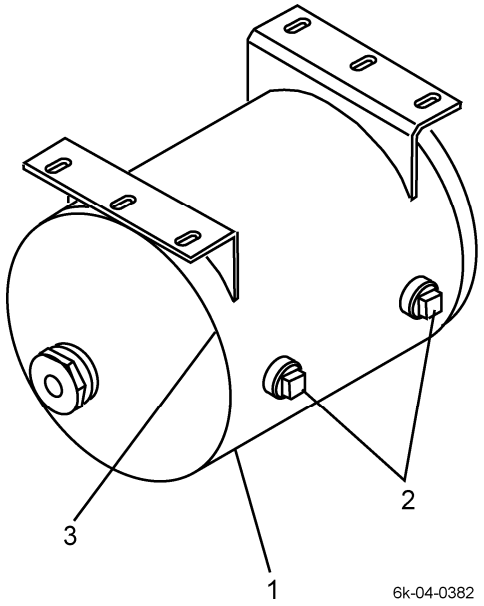

Figure 4-5-8. Supply Reservoir Inspection

1. Inspect supply reservoir (1) for obvious visible damage such as dents, scratching, scoring, corrosion, or missing parts. If reservoir is extensively damaged or missing parts, remove reservoir and replace with new item (refer to Paragraph 4-5-10).

2. Check all vehicle pneumatic pipe connections to supply reservoir (1). Tighten all loose connections. If loose connections cannot be tightened, remove reservoir and replace with new item (refer to Paragraph 4-5-10).

3. Pressurize brake system and apply leak detection solution to pneumatic pipe connections, inspection ports (2), and weld seams (3).

WARNING

High pressure air is vented when the brake cylinder cutout valve is closed. Wear safety goggles and ear protection and exercise caution when working near venting air. Failure to observe this safety precaution can lead to personal injury.

4. If bubbles form at pneumatic pipe connections, turn off electrical power to Air Supply Unit, vent Main Reservoir pipe, and exhaust air pressure in supply reservoir by repeatedly applying and releasing full service brakes until brake cylinder pressure no longer rises. When supply reservoir pressure has been exhausted, disconnect and reseal vehicle pneumatic pipe connections and repeat leak check.

4-5-48. LEVELING VALVE REPLACEMENT

Activities
Remove Leveling Valve
Install Leveling Valve

Applicable Car(s)
A Car and B Car

Equipment Condition
Compressed Air Supply Shut Off
Brake System Depressurized

References
IPC Figure 4-1
IPC Figure 7-5

Special Tools
None

Supplies
Valve, Leveling, Knorr Brake, P/N 807700

Test Equipment
None

WARNING

Isolate the leveling valve from the compressed air supply and depressurize the pneumatic system before working on this device. Failure to observe this safety precaution can lead to personal injury.

4-6-3. FRICTION BRAKE EQUIPMENT PORTABLE TEST UNIT

4-6-3.1 Introduction

4-6-3.1.1 General Description

The friction brake system equipment is tested using the pneumatic Portable Test Unit (PTU) (refer to Figure 4-6-1). The PTU is specifically designed to aid in troubleshooting, testing, and adjusting the friction brake system equipment supplied by the Knorr Brake Corporation. The PTU performs the following functions:

- Testing the low air and brake pipe pressure switches
- Testing the Truck Control Units (TCU) and adjusting the load limiting valve (requires use of the Service Terminal (ST). Refer to Paragraph 4-3-1 for ST operating instructions)
- Testing the pressure transducers (requires use of the ST)
- Testing the anti-skid (dump) valves (requires use of the ST)
- Testing the pressure gauges (requires use of the ST)
- Testing the Emergency Pipe Control Unit (EPCU)

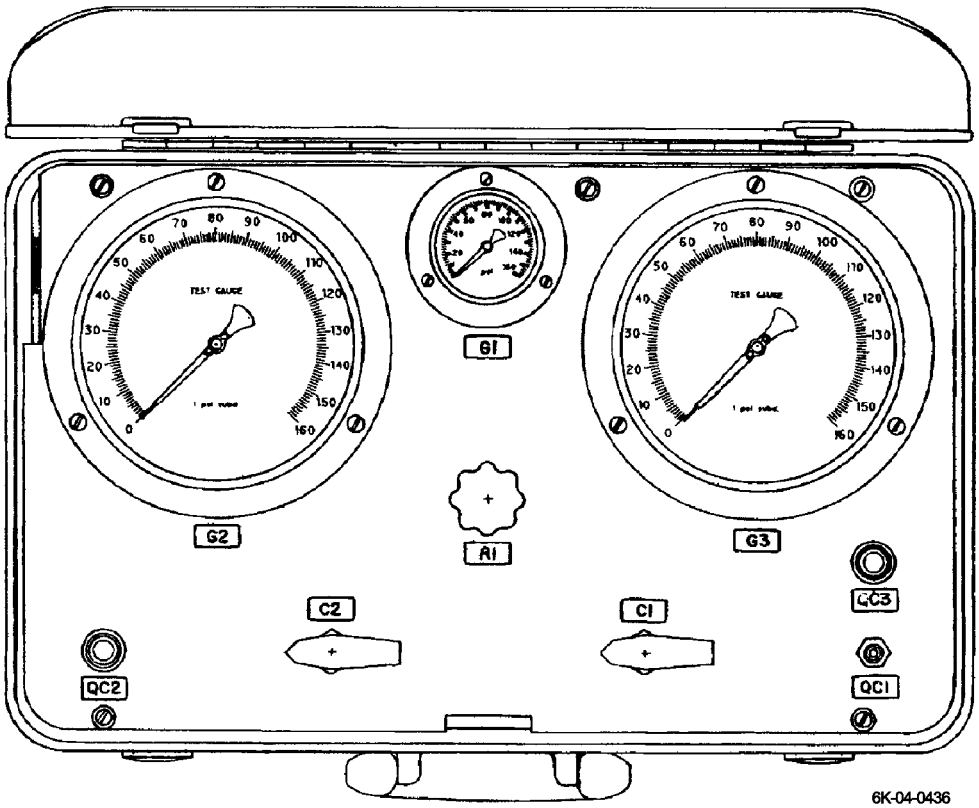

Figure 4-6-1. Portable Test Unit

The PTU is contained in a portable suitcase-style housing having overall dimensions of 13 in. x 21 in., weighing approximately 25 lb., and includes all cables, connectors, and associated equipment necessary to interface with the test points.

4-6-15. AIR DRYER PISTON VALVE HEATER TEST

Activities
Test Air Dryer Piston Valve Heater

Applicable Car(s)
A Car and B Car

Equipment Condition
Wheels Chocked

References
None

Special Tools
None

Supplies
None

Test Equipment
None

4-6-15. AIR DRYER PISTON VALVE HEATER TEST (CONT)

Test Air Dryer Piston Valve Heater (Figure 4-6-16)

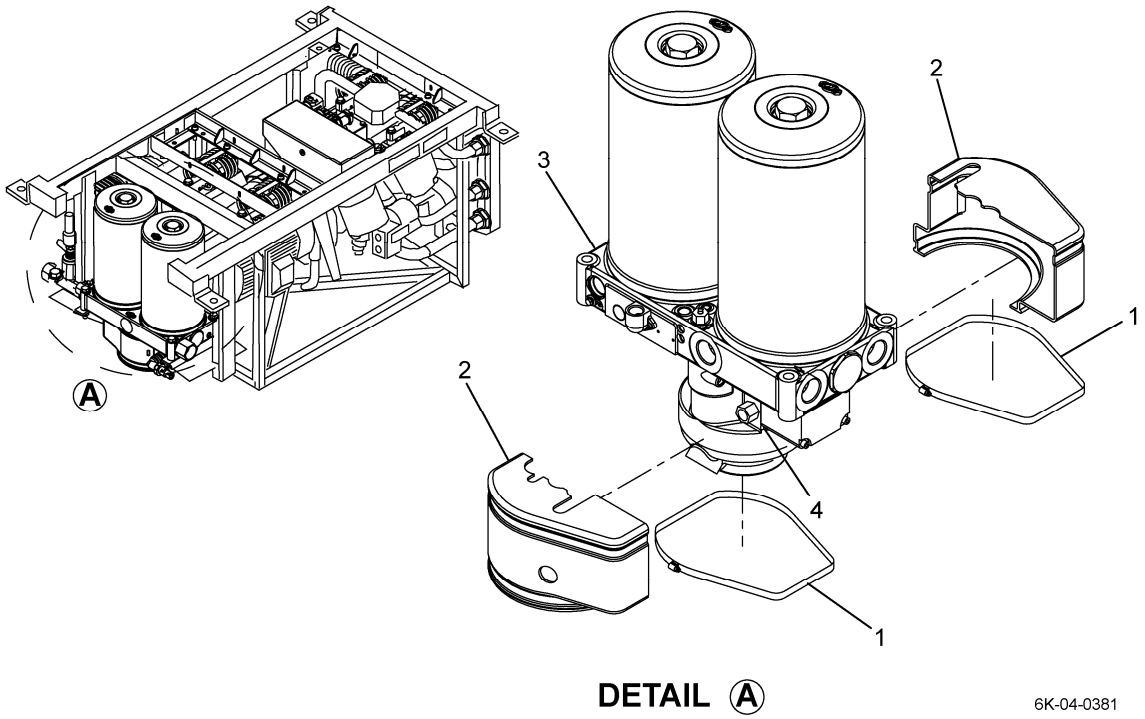

Figure 4-6-16. Air Dryer Piston Valve Heater Test

1. Remove two hose clamps (1) and two insulating covers (2) from air dryer assembly (3).
2. Start the air supply unit. With the air supply unit running, carefully check that the body of the piston valve (4) is warm to the touch.
3. If the piston valve (4) is not warm to the touch, replace the heater and thermostat.

End of Test

RECOMMENDED CHANGES TO USER MANUALS	**DATE:**
TO: *(Forward to Transit Authority Publications Manager) (Include ZIP Code)*	**FROM:** *(Maintenance Shop and location) (Include ZIP Code)*

PART I – SPECIFIC COMMENTS *List all comments, recommendations, or suggestions for improvement of specific pages of this publication. (Additional blank sheets may be used if more space is needed.)*

PUBLICATION:	**CHAPTER TITLE:**
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REV. NO.	PAGE NO.	PARA-GRAPH	LINE NO. *	FIGURE NO.	TABLE NO.	RECOMMENDED CHANGES and REASON *(Provide exact wording of recommended changes, if possible).*

**Reference to line numbers within the paragraph or subparagraph.*

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PRINTED NAME and TITLE	TELEPHONE, PLUS EXTENSION	SIGNATURE
APPROVAL	DATE OF APPROVAL	AUTHORIZED SIGNATURE and TITLE

LEGEND

1. Air supply unit (A car only)
2. Main reservoir
3. Supply reservoir
4. Suspension reservoir
5. Truck control unit
6. Emergency pipe control unit
7. Road horn
8. Horn magnet valve
9. Yard horn
10. Right brake caliper
11. Left brake caliper
12. Left brake caliper with handbrake

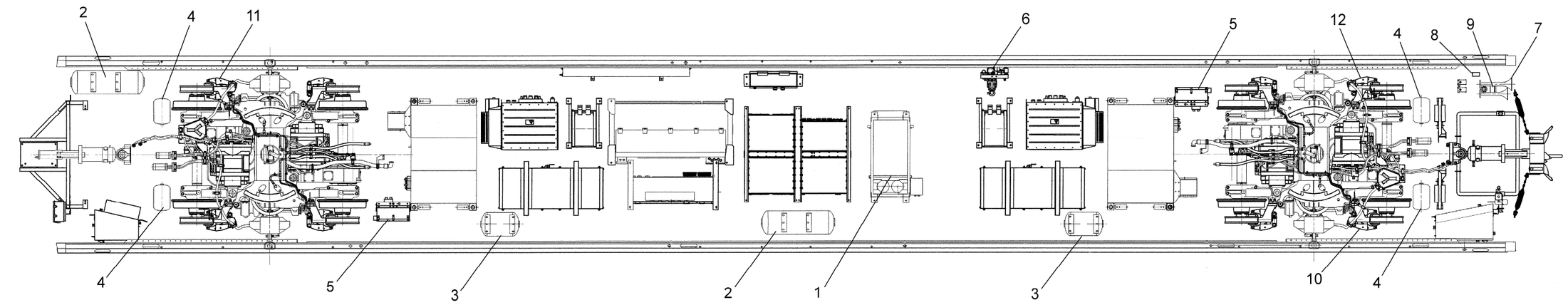

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Figure 4-FO-2. Friction Brake and Pneumatic System Components