

FLUKE®

Calibration

***GB-H-152-70M and
GB-H-152-100M***
**Gas Booster
Packages**
Operation and Maintenance Manual

⚠ Warning

- **This equipment described in this manual is designed and manufactured for the intended purpose of generating high pressure gas and regulating a high gas pressure output. Certain precautions need to be followed during installation and operation of this device. Reading and understanding the material is essential to the safe and correct operation of the unit.**
- **Pressurized equipment is potentially dangerous. The equipment described in this manual generates and controls very high gas pressures. It should not be operated by anyone who has not thoroughly familiarized themselves with this manual. Additional training in general and pressure specific safety procedures will help assure protection from harm or damage to personnel or property. Responsibility for the proper and safe operation of this instrument rests with the user.**
- **Do not use oxygen. This instrument is not compatible with the use of oxygen. Hydrocarbon elastomers and lubricants are present.**
- **High pressure liquids and gases are potentially hazardous. Energy stored in these liquids and gases can be released unexpectedly and with extreme force. High pressure systems should be assembled and operated only by personnel who have been instructed in proper safety practices.**

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Document No. 3152380
110823
Printed in the USA.

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About This Manual

Manual Conventions

⚠ Caution

“Caution” is used in throughout the manual to identify conditions or actions that could cause harm to the GB-H-152 or to the devices that are connected to the GB-H-152.

⚠ Warning

“Warning” is used in throughout the manual to identify actions that could pose a hazard to the user of the GB-H-152.

Note

“Note” is used throughout the manual to identify operating and applications advice and additional explanations.

Notes

1. Introduction

1.1 Product Overview

GB-H-152-70M and GB-H-152-100M are gas booster packages intended to be used to provide the gas pressure supplies required by Fluke Calibration PPCH-G controller/calibrators for high pressure gas.

Both models include a pneumatically driven, piston type, self-cycling gas booster with regulated output to provide the PPCH-G high pressure supply. The gas booster boosts a lower pressure usually supplied from a bottle, to higher pressure. The high pressure gas is stored in an accumulator volume to assure stable supply to the PPCH-G. GB-H-152-70M has a maximum output pressure of 100 MPa (15 000 psi). GB-H-152-100M has a maximum output of 120 MPa (18 000 psi).

Both models also include an independent low pressure output to supply the PPCH-G drive air requirement.

With a GB-H-152 gas booster, all of the PPH-G pressure supply requirements are taken care of in one simple package requiring only the connection of a test gas source and a drive air supply to power the booster.

1.2 Location and Description of Components

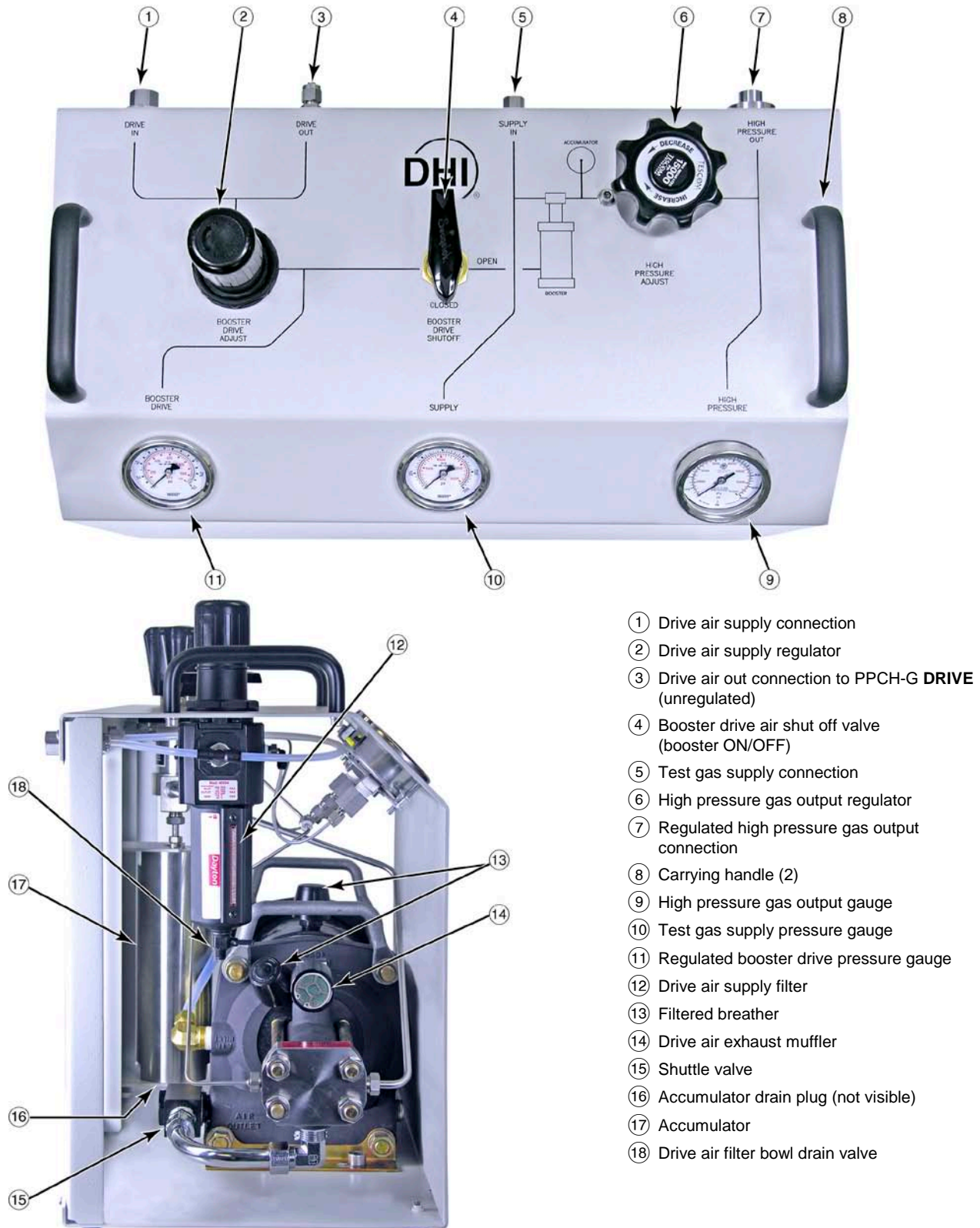


Figure 1. GB-H-152 Top and Side Views

1.3 System Schematic

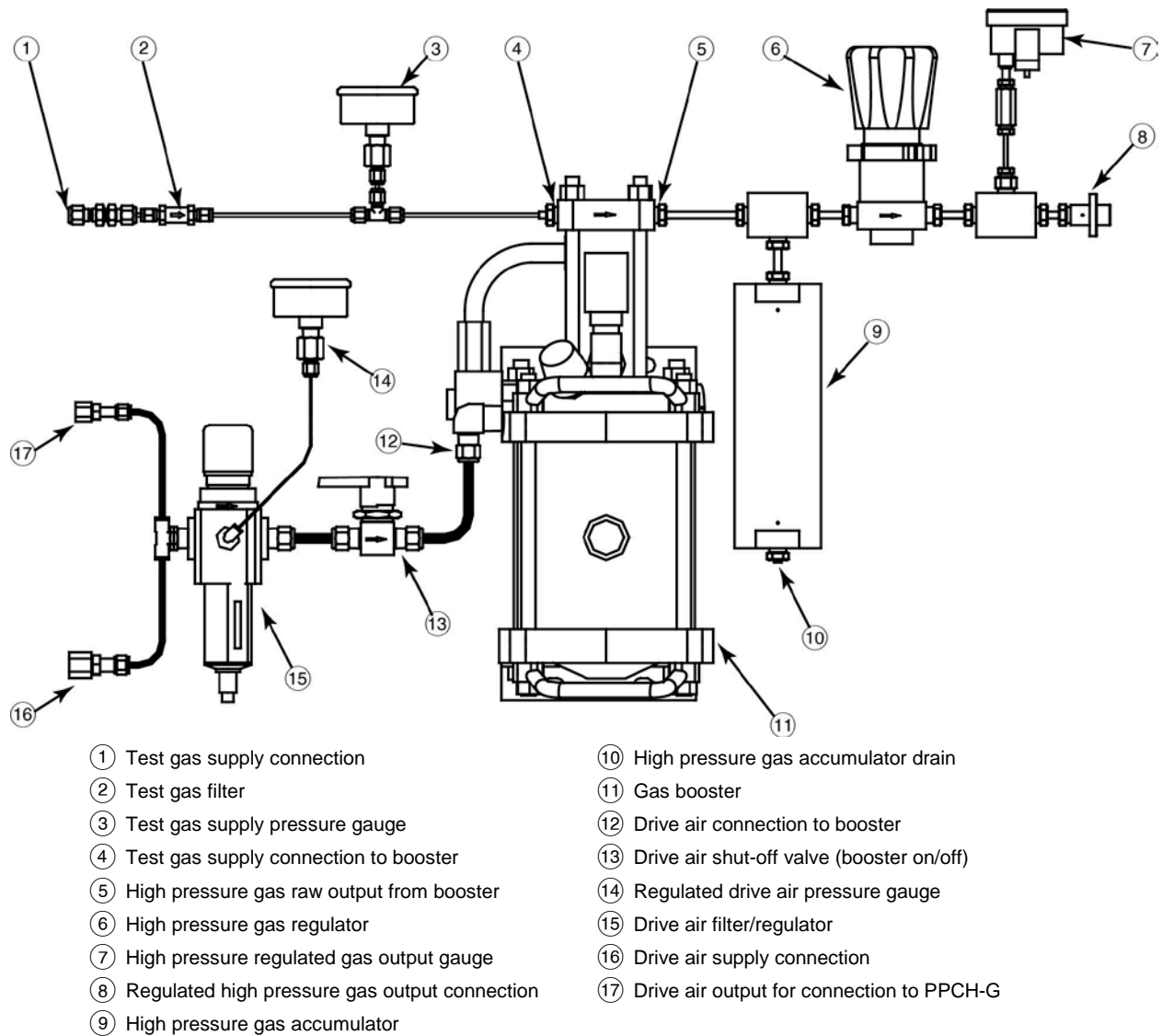


Figure 2. System Schematic

1.4 Specifications

Dimensions	50 cm (20 in.) H x 57 (22.5 in.) W x 30 (12 in.) D
Weight (shipping)	44.4 kg (98 lb)
Drive air pressure supply	
Range	0.15 to 1 MPa (20 to 150 psi)
Flow	425 to 2 125 slm (15 to 75 scfm)
Test gas pressure supply	
Range	4.8 to 40 MPa (700 to 6 000 psi)
Flow	140 to 560 slm (5 to 20 scfm)
Output pressure	
GB-H-152-70M	0.70 to 100 MPa (400 to 15 000 psi)
GB-H-152-100M	0.35 to 120 MPa (200 to 17 400 psi)
Operating media	air, helium, nitrogen
Pressure connections	
Drive air supply	1/4 in. NPT F
Shop drive out	1/4 in. Swage
Test gas pressure supply	1/8 in. NPT F
High pressure gas out	DH500F (DH500 is a gland and collar type fitting for ¼ in. (6.35 mm) coned and left hand threaded tube. DH500 is equivalent to AE F250C, HIP HF4, etc.)
Nominal gas booster piston ratio	152:1
High pressure accumulator volume	150 cc (9.2 in. ³)

Note

Due to a policy of continual product improvement, all specifications are subject to change without notice.

2. Installation

2.1 Unpacking and Inspection

GB-H-152-70M and GB-H-152-100M are delivered enclosed in plastic film and secured in place in a wooden crate. All ports are plugged, the drive air valve is closed and pressure regulators are set to zero.

Remove the instrument from the shipping crate and plastic bag. Take care not to lose or discard the accessories that are included.

Remove all plastic plugs from the fittings and inspect for damage and contamination.

Inspect for any missing components or accessories using Table 1. Should any items be missing, contact Fluke Calibration or your local supplier.

Table 1. GB-H-152-70M and GB-H-152-100M Parts List

DESCRIPTION		PART #
1 ea.	GB-H-152-70M gas booster package or GB-H-152-100M gas booster package	3071829 or 3071818
ACCESSORIES:		
1 ea.	Operation and Maintenance Manual	3152380
INTERCONNECTIONS KIT:		3125049
1 ea.	Tube weld, 1.5 m (60 in.) x 1/8 in. (3 mm) with DH500 tips (coiled)	3314220
1 ea.	Adaptor, 1/8 in. M x 1/4 in. Swage	3068676
200 cm.	1/4 in. PFA tubing	3232378
1 ea.	Nut, 1/4 in. Swage	3132930
1 ea.	Ferrule, front, 1/4 in. Swage	3132948
1 ea.	Ferrule, rear, 1/4 in. Swage	3132953

2.2 Site Requirements

Two sources of compressed gas are required to operate the gas booster package: 1) shop drive air supply to power the booster; 2) high pressure gas that the booster will compress to higher pressures. Due to the different flow rate and cleanliness requirements for each of these supplies, they should come from two separate sources. It is not recommended that hazardous gases be used unless appropriate precautions are taken.

1) Shop drive air supply:

The shop air drive supply powers the booster and may be used for the PPCH-G **DRIVE** connection. The booster high pressure output is approximately 152 times the drive air supply assuming the test gas supply pressure is high enough.

Shop drive air requirements are:

Pressure:

- For operation up to 50 MPa (7 500 psi): 0.4 MPa (60 psi) minimum
- For operation up to 80 MPa (11 600 psi): 0.55 MPa (80 psi) minimum
- For operation up to 100 MPa (15 000 psi) (maximum of GB-H-152-70M: 0.66 MPa (96 psi) minimum
- For operation up to 120 MPa (17 400 psi) (maximum of GB-H-152-100M: 0.80 MPa (116 psi) minimum

Note

As the booster package includes an accumulator and high pressure regulator, it is preferable to generate the highest pressure that can be achieved and regulate it down to the appropriate supply pressure for the PPCH-G range to which the booster is connected. The higher the pressure in the accumulator and upstream of the high pressure regulator, the greater the reserve of high pressure to assure an stable supply of pressure to the PPCH-G. Do not exceed 100 MPa (15 000 psi) with GB-H-152-70M or 120 MPa (18 000 psi) with GB-H-152-100M. To assure pressure is within these limits, do not set booster drive adjust regulator greater than 0.66 MPa (96 psi) with GB-H-152-70M or 0.80 MPa (116 psi) with GB-H-152-100M.

Flow rate: 425 slm (15 scfm) minimum

Cleanliness: Not critical, use 60 micron filter

Humidity: 20 to 50 % RH. Do not use dry gas. Do not use hazardous gases.

2) High pressure instrument gas supply:

High pressure instrument gas is boosted by the booster and supplied to the PPCH-G **SUPPLY** port.

High pressure instrument gas supply requirements are:

Pressure: Minimum booster output pressure/25. Recommended minimum is 4 MPa (600 psi) with GB-H-152-70M and 5 MPa (750 psi) with GB-H-152-100M Maximum 40 MPa (6 000 psi)

Flow rate: 140 slm (5 scfm) minimum

Gas quality: Use clean, dry, non-corrosive instrument grade gases only. Filtration of 10 micron with a dew point of -20 to 5 °C is recommended. Inlet gas temperature should be between 10 and 47 C.

2.3 Installation and Setup

2.3.1 Installation Considerations

Installation of the GB-H-152 depends on the specific application. For a detailed description of the theory of operation see Section 3.1. Refer to Section 2.3 before attempting installation.

A variety of factors must be considered when determining where to locate the GB-H-152. Factors include, but are not limited to:

- the high pressure being generated and associated safety concerns
- the source of gas supplies (drive air supply and high pressure instrument gas supply)
- noise level
- exhaust of drive air out of the muffler
- vibration during use
- access to the unit for operation of the regulators and valve
- point of use of output pressures

2.3.2 Installation

To install the GB-H-152, follow the steps below (numerical references refer to Figure 2):

- ❶ Place the GB-H-152 in the desired location.
- ❷ Close both regulators (2) and (6) by rotating the knobs counter-clockwise until no spring force is felt.

Note

The drive adjust (2) and high pressure adjust (6) regulators have a stop that prevents continued counter-clockwise rotation.

The drive adjust regulator (2) has a locking mechanism to prevent accidental adjustment. To unlock, pull the knob up.

- ❸ Close the booster drive shutoff valve (4).
- ❹ Connect shop drive air supply to the 1/4 in. NPT F **DRIVE IN** port using tubing of appropriate pressure rating.

⚠ Warning

Maximum input pressure to the booster drive adjust regulator (2) is 1.7 MPa (250 psig). Pressures above this level may result in a failure that could damage the instrument and/or cause personal injury. Using connecting tubing rated for working pressures below 1.7 MPa (250 psig) is not recommended.

- ❺ Connect the test gas supply to the 1/8 in. NPT F **SUPPLY IN** port (6) using tubing of appropriate pressure rating.

⚠ Warning

Maximum input pressure to the SUPPLY IN port (5) is 40 MPa (6 000 psig). Pressure above this level may result in a failure that could damage the instrument and/or cause personal injury.

Note

Pressure present at the **SUPPLY IN** port (5) will be present at the inlet port of the high pressure adjust regulator (6). To prevent gas pressure from reaching the **HIGH PRESSURE OUT** port (7), ensure that the high pressure adjust regulator is closed (backed off).

- ⑥ If desired, connect the 1/4 in. Swage **DRIVE OUT** connection (3) to the drive air point of use with appropriately rated tubing.

If connecting to the PPCH-G **DRIVE** port, use the hardware provided in the GB-H-152 interconnect kit:

- Install the 1/8 in. M x 1/4 in. Swage adaptor in the PPCH-G **DRIVE** port.
- Remove the 1/4 in. Swage plug from the GB-H-152 **DRIVE OUT** port.
- Connect the PPCH-G **DRIVE** port to the GB-H-152 **DRIVE OUT** port with the 2 m. of 1/4 in. PFA tubing (cut the tube to a shorter length if desired). Use the supplied Swage 1/4 in. nut and front and rear ferrules for the **DRIVE OUT** end of the tube. Take care to align the ferrules correctly.

Note

If the DRIVE OUT port is not being used, leave it capped.

- ⑦ Connect the DH500F **HIGH PRESSURE OUT** port (7) to the high pressure gas point of use with tubing of appropriate pressure rating (able to handle the maximum pressure that the booster will generate). Working pressure rating should be at least 100 MPa (15 000 psig) for GB-H-152-70M and 140 MPa (20 000 psig) for GB-H-152-100M.

When using the GB-H-152 with a PPCH-G pressure controller/calibrator use the hardware provided in the GB-H-152 interconnect kit:

Connect the 1.5 m, 1/8 in. nipple with DH500 tips between the GB-H-152 **HIGH PRESSURE OUT** port and the PPCH-G **SUPPLY** port. The DH500 glands and collars are delivered installed in the female ports. Remove the orange plastic plug, slip the gland onto the DH500 tip, install the collar onto the DH500 tip and thread the gland into the female DH500 fitting. Torque gland to 15 Nm (11 lb ft).

⚠ Caution

- **Do not bend tubing with radius less than 50 mm (2 in.) or pressure capacity may be reduced.**
- **Using connecting tubing with a working pressure below the maximum pressure generated by the booster may result in a failure in the tubing that could cause damage to the instrument and/or cause personal injury.**
- ⑧ If the shop drive air used to operate the GB-H-152 is to be vented to a location other than where the booster is being used or to reduce the noise level of the operating booster, proceed as follows:
 - Ⓐ Remove the drive air exhaust muffler (14). The drive air exhaust muffler (14) and booster exhaust port are both 1/2 in. NPT F connected via a 1/2 in. NPT nipple. Therefore, the fitting available for connection is a 1/2 in. NPT M (when using the nipple) or female (when not using the nipple).
 - Ⓑ Connect a hose with an I.D. of at least 13 mm (1/2 in.) and maximum length of 16 m (50 ft.) to the booster fitting (1/2 in. NPT M or F). A hose length of greater than 16 m (50 ft) can be used provided the I.D. of the hose is increased.
 - Ⓒ Connect the loose end of the hose to an appropriate termination point.

3. Operation

3.1 General Operating Principle and Information

Note

Numerical references in this section refer to Figure 2.

The purpose of the GB-H-152 booster package is to provide a regulated high pressure gas output with enough flow to assure a continuous supply to a high pressure gas controller/calibrator such as PPCH-G when it is increasing pressure. The system generates high pressure using a pneumatically operated gas booster pump (11), a drive air regulator and shutoff valve (15, 13) and an accumulator volume (9). Pressure ports are provided to connect the drive air input (16), test gas input (1) and high pressure output (8). A drive air output connection (17) is also provided as a convenient way to connect drive air to another point of use such as the **DRIVE** port of a PPCH-G pressure controller/calibrator. The system is contained in one compact unit and is ready to operate once gas supplies are connected and regulators are properly adjusted.

3.1.1 Pneumatically Operated Gas Booster Pump (11)

The booster pump is a Pascal press utilizing two pistons connected together on the same axis having a nominal area ratio of 152:1. The booster is a two-stroke, single stage reciprocating pump that generates gas pressures 152 times greater than the shop drive air applied to the pump.

The pump operates automatically, provided drive air is supplied to the drive air regulator (15) and the regulator is set to at least 140 kPa (20 psig). Operation is continuous until the outlet pressure is 152 times the drive air pressure. Then the opposing forces within the pump reach equilibrium and the pump stalls. For example, with the drive air pressure set to 0.6 MPa (90 psig), the pump runs until the instrument gas pressure downstream of the booster reaches $152 \times 0.6 = 91.2$ MPa (13 224 psig). Note that the high pressure section of the pump has a nominal compression ratio of 25:1. Therefore, the pressure generated by the booster cannot be greater than the test gas supply pressure $\times 25$. If the test gas supply pressure is not high enough to reach the desired output pressure, the booster will run continuously but the pressure will not increase.

1. The drive section (low pressure) of the booster consists of a piston, cylinder, air cycling valve, pilot valve and vent section. This section provides the reciprocating action and compression force needed to operate the booster and generate the high pressure gas. Drive air is channeled to the appropriate side of the piston (compression or suction stroke) by the air cycling valve. When the piston reaches full stroke, a pilot valve is mechanically activated causing the air cycling valve to change position. Shop drive air is routed to the opposite side of the piston reversing piston direction where a second pilot valve is activated repeating the process.

2. The instrument gas section (high pressure) consists of a small piston and an inlet/outlet check valve assembly. The small piston moves forward and backward with the air drive piston. During the suction stroke (backward movement), the outlet check valve closes and the inlet check valve opens letting instrument gas enter the compression chamber. During the compression stroke, the inlet check valve closes and the outlet check valve opens letting compressed gas out of the pump.

The compression ratio of the high pressure piston is 25:1. Maximum output pressure is limited by the test gas supply pressure. For example, with 4 MPa (600 psi) applied, maximum output pressure cannot exceed $4 \times 25 = 100$ MPa (15 000 psi).

3.1.2 Booster Drive Shutoff Valve (13)

The shutoff valve is a ball-type, 90° turn valve. It is used to prevent flow of regulated drive air to the booster. This valve can be considered a booster ON/OFF switch.

3.1.3 Accumulator (9)

The accumulator is a stainless steel cylinder with an internal volume of 150 cc (9.2 in.³) The accumulator serves as a reservoir of high pressure gas so the gas boosted to high pressure can be stored. This helps to provide a continuous flow of high pressure gas to the pressure controller the GB-H-152 supplies when the pressure controller is increasing pressure.

A DH500 fitting and plug on the bottom of the accumulator cylinder act as a drain to purge the cylinder should liquids accumulate in it. (The GB-H-152 supply gas should be dry; the drain does not imply that it is acceptable to supply moist test gas to the booster).

3.1.4 Drive Air Regulator/Filter (15)

The drive air pressure regulator (15) is a self-venting type regulator with an outlet pressure control range of 0 to 1 MPa (150 psig). Maximum inlet pressure is 1.7 MPa (250 psig). The control knob is pulled out to make adjustments; pushed in to lock into position and prevent accidental changes.

The regulator also includes a filter and a filter bowl drain tap.

The regulator should be adjusted from a lower pressure to a higher pressure. This is due to the tendency of a pressure regulator to drift in the opposite direction of the pressure adjustment. Adjusting the regulator in this way will help avoid an overpressure condition due to regulator drift.

⚠ Caution

The drive air adjust regulator (15) output should never be adjusted to greater than 0.8 MPa (100 psi) on GB-H-152-70M or 0.9 MPa (130 psi) for the GB-H-152-100M. Higher drive air pressure can result in a booster output pressure that exceeds the maximum working pressure ratings of system components.

3.1.5 High pressure Regulator (6)

The high pressure regulator (6) is constructed of 303 stainless steel, Kel-F, Buna-N, and Teflon wetted materials. It is a venting type regulator with an outlet pressure control range of 2 to 100 MPa (300 to 15 000 psig) for the GB-H-152-70M and 3 to 120 MPa (450 to 18 000 psig) for the GB-H-152-100M. Maximum inlet pressure is equal to the maximum outlet pressure.

The regulator should be adjusted from a lower pressure to a higher pressure. This is due to the tendency of a pressure regulator to drift in the opposite direction of the pressure

adjustment. Adjusting the regulator in this way will help avoid an overpressure condition due to regulator drift.

3.1.6 Gauges (3, 7, 14)

There are three gauges:

The booster drive pressure gauge (14) indicates the pressure set by the drive air regulator (15).

The test gas supply gauge (3) indicates the pressure connected to the **SUPPLY IN** port (1).

The high pressure gauge (7) indicates the pressure set by the high pressure regulator (6) and present at the **HIGH PRESSURE OUT** port.

3.2 Setting High Pressure Output Equal To or Less Than the Supply Pressure

Note

All previous sections (especially Section 2.3) should be read, understood and instructions carried out before continuing.

It is not necessary to operate the gas booster pump when setting pressures up to the value of the test gas supply. The gas booster pump will not stop the flow of gas to the input of the high pressure regulator. Test gas supply pressure is always present at the inlet of the high pressure regulator whenever it is supplied to the GB-H-152.

3.2.1 Increasing Pressure

- 1 Close the high pressure adjust regulator by rotating the knob counter-clockwise until no spring force is felt.
- 2 Apply instrument gas to the **SUPPLY** port.

Warning

Ensure the supply does not exceed 40 MPa (6 000 psi). Pressures above this range may result in a failure that could damage the instrument and/or cause personal injury.

- 3 Plug the high pressure output circuit to prevent gas flow (circuit is dead ended).
- 4 Adjust the high pressure adjust regulator by rotating the knob clockwise until the desired pressure is indicated on the high pressure. To correctly set the pressure, gas flow must not occur. If flow is present in the circuit when the regulator is adjusted, the pressure will increase when flow is reduced. If the setpoint is exceeded, see Section 3.3.2.

3.2.2 Decreasing Pressure

Note

The high pressure adjust regulator is a venting type. Therefore, it is possible to regulate pressure down without gas flow through the regulator.

- 1 Adjust the pressure down using the high pressure adjust regulator by rotating the knob counter-clockwise until a pressure below the setpoint is achieved as indicated on the high pressure gauge.

- ② Set the pressure to the final setpoint by rotating the knob clockwise until the desired pressure is indicated on the high pressure gauge.

3.3 Setting High Pressure Output Greater Than Supply Pressure

Note

- All previous sections (especially Section 2.3) should be read, understood and instructions carried out before continuing.
- Emergency shut-down of the gas booster pump can be performed at any time by closing the booster drive shutoff valve. This stops generation of gas pressure by the pump but **DOES NOT NECESSARILY** reduce pressure at the HIGH PRESSURE OUT port.

3.3.1 Setting Booster Drive Pressure

- ① Close the booster drive air shutoff valve.
- ② Close the high pressure adjust regulator by rotating the knob counter-clockwise until no spring force is felt.
- ③ Calculate the required drive air pressure needed to generate the desired high pressure (drive air powers the booster pump.) To calculate the appropriate regulator setting: divide the booster ratio of 152 into the desired maximum output pressure. For example, for a maximum output pressure of 80 MPa (12 000 psi), divide 152 into 80. This yields 0.53 MPa (77 psig) which is the pressure that the booster drive adjust regulator should be set to.

Note

It is usually desirable to have the high pressure generated by the booster be significantly higher than the desired high pressure output of the GB-H-152. The benefits are storing high pressure gas to assure a constant high pressure output when needed and minimizing output fluctuation in the regulator. The disadvantage is that an overpressure condition could occur at the output if the operator improperly sets the high pressure adjust regulator.

- ④ Adjust the booster drive regulator by rotating the knob clockwise until the desired pressure is indicated on the booster drive gauge.

Caution

Maximum drive pressure should not exceed 0.7 MPa (100 psig) in the GB-H-152-70M and 0.9 MPa (130 psig) in the GB-H-152-100M. Pressure in excess of this range may result in an overpressure condition on the inlet side of the high pressure adjust regulator.

- ⑤ Open the booster drive shut-off valve. The booster will begin operating when the valve is opened. Exhausting gas noise may startle the operator. Be prepared for this operation.

3.3.2 Increasing Pressure

- ❶ Close or plug the high pressure out circuit to prevent gas flow (circuit is dead ended).
- ❷ Adjust the high pressure adjust regulator by rotating the knob clockwise until the desired pressure is indicated on the high pressure gauge. To correctly set the pressure, gas flow must not occur. If flow is present in the circuit when the regulator is adjusted, the pressure will increase when flow is reduced.

3.3.3 Decreasing Pressure

Note

The high pressure adjust regulator is a venting type. Therefore, it is possible to regulate pressure down without gas flow through the regulator.

- ❶ Adjust the pressure down using the high pressure adjust regulator by rotating the knob counter-clockwise until a pressure below the setpoint is achieved as indicated on the high pressure gauge.
- ❷ Set the pressure to the final setpoint by rotating the knob clockwise until the desired pressure is indicated on the high pressure gauge.

Notes

4. Maintenance and Adjustments

4.1 Maintenance

The only maintenance required for the GB-H-152 booster package is (numerical references refer to Figure 2):

1. Drain drive air filter bowl: When there is visible liquid accumulation, open the tap (18) on the filter bowl (12) and drain out the liquid. Reduce pressure before opening the tap.
2. Drain high pressure accumulator: If it is suspected moisture may have entered the high pressure circuit (usually by a moist test gas supply), check for liquid at the high pressure accumulator drain port and drain if necessary. It is imperative that the high pressure circuit be free of pressure when the operation is performed. Loosen the drain port gland and remove the drain put plug. When draining is complete, reinstall the plug. Torque gland to 15 Nm (11 lb ft).

Notes

5. Troubleshooting

5.1 General Information

Note

Numerical references in this section refer to Figure 2.

Several predictable problems can arise when using a GB-H-152 booster package. They are described and addressed in this section.

⚠ Caution

It is recommended that individuals responsible for performing troubleshooting procedures described in this section become familiar with the system. Please see the introductory WARNING, Section 2.3, 3.1 for important information.

5.2 Booster Will Not Run

The booster is a pneumatically operated pump. The reciprocating action is caused by an imbalance of forces within the pump due to the opposing drive air pressure and the test gas supply that is being boosted. If the booster is not operating, it means that all forces are equal or that the pistons are seized.

- Check that the booster drive shutoff valve (4) is open. If not, fully open the valve.
- Check that drive air pressure supply is actually present at the DRIVE IN port (1). If not, ensure gas is supplied at the proper pressure and flow value (see Section 2.2).
- Check that the booster drive adjust regulator (2) is set to a pressure of 0.15 MPa (20 psig) or higher and that minimum drive air flow requirements are met (see Section 2.2).
- Check that the high pressure adjust regulator (6) is not closed. If closed, set it to the desired pressure; see Section 3.2.1 or 3.3.2.
- Check that there are no gas leaks in the drive air circuit. Repair any leaks.
- Check that gas is not continuously venting from the booster exhaust muffler (14). If gas is venting through the muffler, see Section 5.8.
- Check that the booster is not in a stall state. If booster is stalled, determine reason and remedy. A stall state occurs when the pressure in the high pressure section of the booster is equal to the pressure in the low pressure section times the booster ratio (152:1). A stall can only occur if the high pressure circuit is plugged. See Section 3.1.1 and Figure 2 for additional information on the gas booster.

5.3 Booster Runs Too Slowly

A slow running booster can be confused with the problem described in Section 5.4. A slow running booster means that the pump itself is running slowly which also causes the pressure to be generated slowly.

- Check that booster drive shutoff valve (4) is fully open. If not, open valve fully.

- Check that the booster drive adjust regulator (2) is set to a pressure of 0.15 MPa (20 psig) or higher and that minimum flow requirements are met (see Section 1.4, 2.2).
- Check there are no restrictions in the shop drive air supply circuit. Remove any restrictions. If a filter is installed on the shop drive air circuit, it may cause a flow restriction.
- Check that there are no leaks in the shop drive air circuit. Repair any leaks.

5.4 Pressure Generates Too Slowly or Not At All

A slow running booster will cause the pressure to be generated slowly. Ensure the booster is running properly before continuing (see Section 5.2).

- Check that the test gas (high pressure) supply to the **SUPPLY IN** port is not below 4.8 MPa (700 psi). If the supply is too low, increase supply pressure. Speed of pressure generation is directly related to the pressure of the test gas supply. For example, pressure is generated twice as quickly with the test gas supply at 14 MPa (2 000 psi) than with the supply at 7 MPa (1 000 psi).
- Check that there are no restrictions in the test gas supply line to the booster. If a restriction exists, remove it. Possible restrictions include a valve not fully opened, a regulator with a low flow constant (CV), an inline filter, small diameter tubing, etc.
- Check that the booster inlet and outlet check valves in the high pressure booster piston are operating properly. Close the booster drive shutoff valve (4). Adjust the high pressure Regulator (6) to zero pressure by rotating the knob counter-clockwise until no spring force is felt.
- Open the booster drive shutoff valve (4). The booster should cycle several times then stall. If the booster does not stall when the test gas supply pressure is above 2 MPa (300 psi) and the shop drive air pressure is below 0.25 MPa (40 psig), the check valves are the most likely cause. Contact a Fluke Calibration Authorized Service Provider if faulty check valves are suspected.

5.5 Booster Runs Continuously

The booster is a pneumatically operated pump. The reciprocating action is caused by an imbalance of forces within the pump due to the opposing drive air pressure and the high pressure instrument gas supply that is being boosted. If the booster runs continuously, it means that forces do not equalize.

- Check that the test gas supply is present at the **SUPPLY IN** port (5) and is at least 1/25 of the desired booster output pressure. Generally, test gas supply needs to be at least 4 MPa (600 psi). If not, ensure that supply meets required specifications (see Section 2.2).
- Check that the high pressure circuit connected to the **HIGH PRESSURE OUT** port is not open to atmosphere.
- Check that there are no leaks in the high pressure line from the output of the booster at the check valve to the point-of-use. Repair any leaks. If driver air supply pressure is above 0.25 MPa (40 psig), adjust to below this limit. If booster stops running, increase test gas supply.
- Check that the inlet and outlet check valves in the high pressure booster piston are operating properly. Close the booster drive shutoff valve (4). Adjust the high pressure regulator (6) to zero pressure by rotating the knob counter-clockwise until no spring force is felt.
- Open the booster drive shutoff valve (4). The booster should cycle several times then stall. If the booster does not stall when the test gas supply pressure is above 20 MPa (300 psi) and the drive air pressure is below 0.25 MPa (40 psig), the check valves are the most likely cause. Contact a Fluke Calibration Authorized Service Provider if faulty check valves are suspected.

5.6 Cannot Achieve Pressure

- Check that the test gas supply is high enough. Test gas supply must be at least 1/25 of desired booster output.
- Check that drive air is set to the correct value and that it is supplied to the booster (see Section 2.3.2).
- Check that no leaks exist in the pressure circuit from the instrument gas supply to the point-of-use. Repair any leaks.

5.7 Leaks

Pressure leaks are the most common problem found in pressure handling equipment. Normally the first step is to determine if the leak is within the GB-H-152 or outside of the unit.

To determine if the leak is within the unit, you must disconnect it at the **HIGH PRESSURE OUT** port and plug the port (a DH500 plug is provided in the GB-H-152 accessories). Establish conditions similar to those under which the leak was observed and determine if the leak is still present. For small leaks, it may be necessary to install an appropriate pressure sensing device at the **HIGH PRESSURE OUT** port. In some cases, it is useful to perform simple leak checks on the most common outside sources before disconnecting the test system. Note that leaks inside the GB-H-152 are unusual unless there has been some disassembly.

Because of the close fitting components and short tubing runs, some users may find it beneficial to return the GB-H-152 to a Fluke Calibration Authorized Service Provider for repair rather than performing the troubleshooting and repair themselves (see Table 2).

More than one leak can exist in a system. Fixing one leak does not guarantee a leak tight system. Therefore, continue executing the troubleshooting procedures until all leaks are located and corrected. Since it is impractical to produce a troubleshooting guide that will cover every conceivable leak, the source of your leak may not be covered in this guide.

The following procedures may require you to tighten a leaking fitting. There are two precautions that need to be observed when doing this:

- Never tighten a fitting while it is under pressure. If pressure is in the system and the fitting should fail while tightening it, you or those around you may be injured.
- Do not over-torque the compression-type fittings that are inside the GB-H-152. To do so will damage them requiring their replacement.

Check all fittings and components for leaks. Use leak detection fluid for small leaks. Tighten loose fittings or replace damaged fittings. Repair or replace leaking regulators.

It is possible that a leak exists in the high pressure section of the gas booster. These leaks are very difficult to isolate and detect. If no leaks can be found following the above procedures, it is likely the problem is within the booster. Contact a Fluke Calibration Authorized Service Provider for assistance (see Table 2).

5.8 Gas Continuously Vents Through Exhaust Muffler

When the booster does not run and gas is venting through the muffler (14), the booster's air cycling valve (spool valve) is stuck between its toggle points. This is normally caused by a low drive air flow rate. There are two methods for restoring proper operation. It is recommended to perform them in the order below:

- ❶ Close the high pressure adjust regulator (6) and booster drive shutoff valve (4), then increase drive air pressure to about 0.5 MPa (75 psi). Open the booster drive shutoff valve (4) quickly. If the booster begins to operate normally, close the booster drive shutoff valve (4) and reset regulators to previous settings. Repeat the process until the booster begins normal operation.
- ❷ Close the high pressure adjust regulator (6) and booster drive shutoff valve (4), then increase shop drive air pressure to about 0.5 MPa (75 psi). Remove the exhaust muffler (14) and use your hand to plug the vent port. Quickly open the booster drive shutoff valve (4). When the build-up of pressure begins to leak past your hand, quickly remove it. If booster begins to operate normally, close the booster drive shutoff valve (4), reinstall the muffler and reset regulators to previous settings. Repeat the process until the booster begins normal operation.

6. Limited Warranty and Limitation of Liability

Each Fluke product is warranted to be free from defects in material and workmanship under normal use and service. The warranty period is one year and begins on the date of shipment. Parts, product repairs and services are warranted for 90 days. This warranty extends only to the original buyer or end-user customer of a Fluke authorized reseller, and does not apply to fuses, disposable batteries or to any product which, in Fluke's opinion, has been misused, altered, neglected, contaminated, or damaged by accident or abnormal conditions of operation or handling. Fluke warrants that software will operate substantially in accordance with its functional specifications for 90 days and that it has been properly recorded on non-defective media. Fluke does not warrant that software will be error free or operate without interruption.

Fluke authorized resellers shall extend this warranty on new and unused products to end-user customers only but have no authority to extend a greater or different warranty on behalf of Fluke. Warranty support is available only if product is purchased through a Fluke authorized sales outlet or Buyer has paid the applicable international price. Fluke reserves the right to invoice Buyer for importation costs of repair/replacement parts when product purchased in one country is submitted for repair in another country.

Fluke's warranty obligation is limited, at Fluke's option, to refund of the purchase price, free of charge repair, or replacement of a defective product which is returned to a Fluke authorized service center within the warranty period.

To obtain warranty service, contact your nearest Fluke authorized service center to obtain return authorization information, then send the product to that service center, with a description of the difficulty, postage and insurance prepaid (FOB Destination). Fluke assumes no risk for damage in transit. Following warranty repair, the product will be returned to Buyer, transportation prepaid (FOB Destination). If Fluke determines that failure was caused by neglect, misuse, contamination, alteration, accident or abnormal condition of operation or handling, including overvoltage failures caused by use outside the product's specified rating, or normal wear and tear of mechanical components, Fluke will provide an estimate of repair costs and obtain authorization before commencing the work. Following repair, the product will be returned to the Buyer transportation prepaid and the Buyer will be billed for the repair and return transportation charges (FOB Shipping Point).

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Since some countries or states do not allow limitation of the term of an implied warranty, or exclusion or limitation of incidental or consequential damages, the limitations and exclusions of this warranty may not apply to every buyer. If any provision of this Warranty is held invalid or unenforceable by a court or other decision-maker of competent jurisdiction, such holding will not affect the validity or enforceability of any other provision.

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P.O. Box 1186
5602 BD Eindhoven
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Table 2. Fluke Calibration Authorized Service Providers

Fluke Calibration Authorized Service Providers www.flukecal.com		
COMPANY	TELEPHONE, FAX AND EMAIL	NORMAL SUPPORT REGION
Fluke Calibration US Customer Service (Regional)	Tel: 1-877-355-3225 service@flukecal.com	North America
Fluke Do Brazil (Brazil)	Tel: (11) 3759-7600 Fax: (11) 3759-7630 info@fluke.com.br	South America
Minerva Meettechniek BV	Tel: +31/33.46.22.000 info@minervaipm.com	Europe, Middle East, Africa
europascal GmbH	Tel: +49 61 81 42 309 0 Fax: +49 61 81 42 309 22 service@europascal.de	Germany, Austria, and Switzerland
Ohte Giken Inc. Technology Center	Tel: 81/29.840.9111 Fax: 81/29.840.9100 tech@htegiken.co.jp	Japan
Fluke South East Asia PTE LTD	Tel: 65 6799-5588 Fax: 65 6799-5589 service.asean@fluke.com	Southeast Asia
Fluke Int'l Corporation	Tel: +86-10-400-810-3435, Ext 2 serviceinfo@fluke.com.cn	Peoples Republic of China
Fluke Australia Pty LTD	Tel: +61-2-9771-9300 sales@fluke.com.au	Pacific Rim