User's Guide

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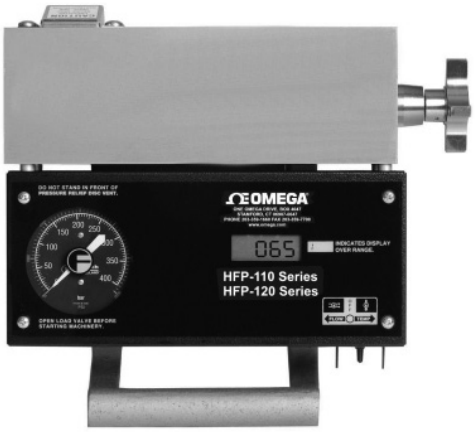

Series HFP
Portable Hydraulic Testers

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Introduction

The Omega HFP Series Portable Hydraulic Testers are designed to provide fast diagnostic troubleshooting of hydraulic systems and components. These compact, self-contained testers feature laboratory accuracy and provide flow, temperature, pressure and optional power measurements simultaneously from one point.

Omega offers two models, each available in a choice of up to 5 flow ranges and 3 port sizes:

HFP-110 and HFP-120 Series Digital Hydraulic Tester

Features:

- Accuracy of ±1% of full flow range
- 3-1/2 digit LCD display for flow and temperature
- Helical tube pressure gauge
- One toggle switch to control power and select flow and temperature
- Loading valve with fingertip control of pressure up to 6000 PSI (414 Bar)
- Platinum resistive temperature sensor
- Pressure surge protection

HFP-100 Series Digital Hydraulic Tester & Dynamometer

Features:

- Accuracy of ±1% of full flow range
- 3-1/2 digit LCD displays
- Digital pressure readings
- Membrane switch to select flow, temperature, pressure or power
- Front panel switch to select U.S. or metric readings
- Loading valve with fingertip control of pressure up to 6000 PSI (414 Bar)
- Platinum resistive temperature sensor
- Pressure surge protection

Specifications

Material

Housing:	6013-T351 Anodized aluminum
Turbine Rotor:	T416 Stainless steel
Rotor Supports:	6061-T6 Aluminum
Seals:	Buna N standard PFTE and EPR optional
Ball Bearings:	440 C Stainless steel
Hub Cones:	6061-T6 Aluminum alloy
Temperature Probe:	12L14 Steel, electroless nickel plate
Valve	
for 15/30 GPM Models:	Cold rolled steel body with 303 SS stem
for 60/85/200 GPM Models:	12L14 steel body with 303 SS stem
Sleeve for 200 GPM Model:	D.O.M. steel tube
Poppet:	12L14 Steel, hardened
Straightening Sections	
for 15/30 GPM Models:	CA360 Brass
for 60/85/200 GPM Models:	6061-T6 Aluminum
Cones:	2024-T4 Aluminum
Ports:	SAE Straight thread O-ring boss, female, J1926/1; BSPP ISO1179
Magnetic Pick-up	
Body:	12L14 steel, electroless nickel plate
Nut:	12L14 steel, electroless nickel plate
Electronic Case & Cover:	Cold rolled steel, zinc plate with clear seal, epoxy black paint

Performance

Flow Accuracy:	±1% of full scale
Repeatability:	±0.2%
Pressure Rating:	6000 PSI (414 Bar) maximum with a 3:1 safety factor
Turbine Response:	≤200 ms
Fluid Temperature:	-4 to +300 °F (-20 to +150 °C)
Ambient Temperature:	-4 to +131 °F (-20 to +55 °C)
Flow Readout:	Linearity and zero shift = ±1 digit
Operating Pressure:	up to 6000 PSI (414 Bar, 41.4 MPa, 420 kg/cm^2)
Pressure Drop:	See Δ P charts on page 16
Fluid Temperature:	up to 300 °F (150 °C)
Readout Accuracy:	±1 digit
Battery Type:	AA size alkaline, ~50 hrs of service

Part Number Designations

PART NUMBER	NOMINAL PORT SIZE	FLOW RATE	POWER HP (kW)
HFP-111P, HFP-111B	SAE 12	1 - 15 GPM	
HFP-112P, HFP-112B	SAE 12	2 - 30 GPM	
HFP-113P, HFP-113B	SAE 16	3 - 60 GPM	
HFP-114P, HFP-114B	SAE 16	4 - 85 GPM	
HFP-115P, HFP-115B	SAE 24	7 - 199.9 GPM	
HFP-121P, HFP-121B	G 3/4	4 - 56 LPM	
HFP-122P, HFP-122B	G 3/4	7.5 - 113.6 LPM	
HFP-123P, HFP-123B	G 1	12 - 227 LPM	
HFP-124P, HFP-124B	G 1	15 - 321 LPM	
HFP-125P, HFP-125B	G 1-1/2	26 - 757 LPM	
HFP-101	SAE 12	1 - 15 GPM / 4 - 56 LPM	52.5 (39)
HFP-102	SAE 12	2 - 30 GPM / 7.5 - 113.6 LPM	105 (78)
HFP-103	SAE 16	3 - 60 GPM / 12 - 227 LPM	210 (157)
HFP-104	SAE 16	4 - 85 GPM / 15 - 321 LPM	298 (222)
HFP-105	SAE 24	7 - 199.9 GPM / 26 - 757 LPM	700 (522)

Dimensions

SERIES	DIMENSIONS Length (A) × Depth (B) × Height (C)		WEIGHT LBS (KG)
	INCHES	mm	
HFP-111, HFP-121	11.3 × 3.5 × 11.0	287 × 89 × 279	13.85 (6.3)
HFP-112, HFP-122	11.3 × 3.5 × 11.0	287 × 89 × 279	13.85 (6.3)
HFP-113, HFP-123	11.5 × 3.5 × 11.0	292 × 89 × 279	16.50 (7.5)
HFP-114, HFP-124	11.5 × 3.5 × 11.0	292 × 89 × 279	16.50 (7.5)
HFP-115, HFP-125	12.3 × 4.0 × 11.8	311 × 101 × 298	20.00 (9.1)
HFP-101	11.3 × 3.5 × 11.0	287 × 89 × 279	13.85 (6.3)
HFP-102	11.3 × 3.5 × 11.0	287 × 89 × 279	13.85 (6.3)
HFP-103	11.5 × 3.5 × 11.0	292 × 89 × 279	16.50 (7.5)
HFP-104	11.5 × 3.5 × 11.0	292 × 89 × 279	16.50 (7.5)
HFP-105	12.3 × 4.0 × 11.8	311 × 101 × 298	20.00 (9.1)

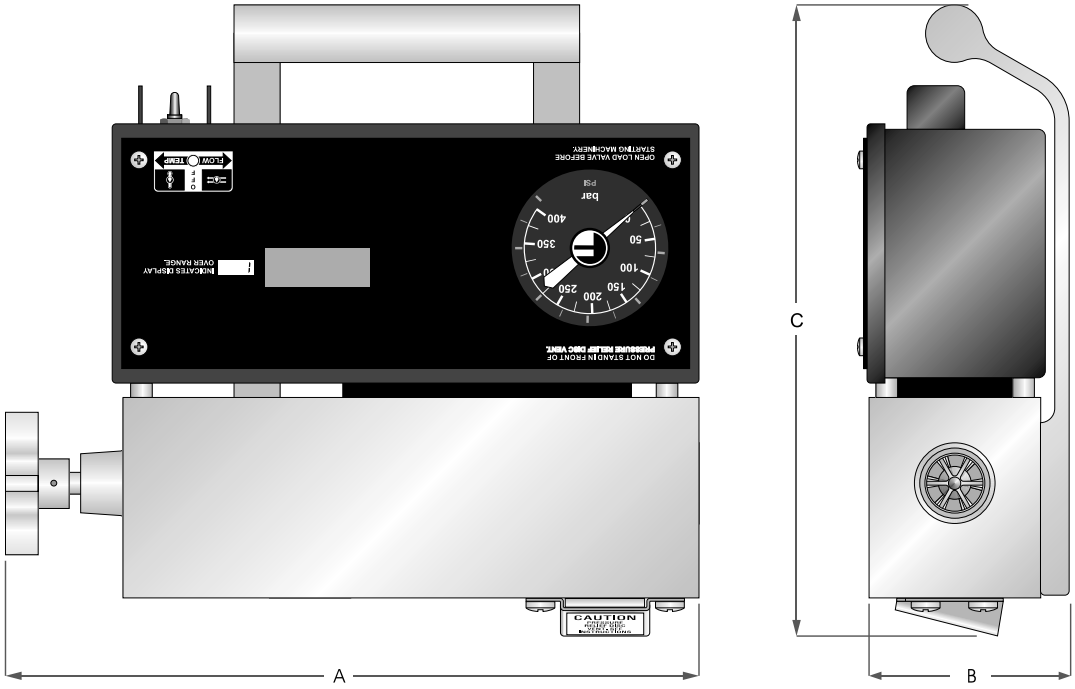


Figure 1 - *Hydraulic Tester Dimension Illustration*

CAUTION

Read instructions thoroughly before installing the tester. If you have any questions regarding product installation or maintenance, call the factory for more information.

INSTALLATION

CAUTION

The information in this manual is for general application only. Any guidelines furnished by the manufacturer of the machine's hydraulic components should be followed. Specific systems may require specific test procedures.

Install the portable tester at any location in the hydraulic circuit with the flow from "IN" to "OUT" as marked near the ports of the flow meter. It is advisable to keep any elbows, tees, valves, etc. at least 12 inches (31 cm) away from the inlet and outlet ports to preserve the accuracy of the flow measurement. Use quick disconnect couplings for easy connections and to keep tester sealed and clean when not in use.

Diagrams illustrating Typical Test Placements for the testers are located in the Test Procedures section beginning on page 10.

OPERATION

WARNING

All testers are shipped with the loading valve in the closed position. The loading valve must be opened fully before initiating flow and testing of the hydraulic circuit. Turn the loading valve handle counterclockwise to the fully open position. Failure to open the loading valve fully can result in injury to personnel and/or damage to the equipment.

The HFP-110 and HFP-120 Series Testers utilize a 3 position, single toggle switch to turn on the power and to select to display either flow or temperature readings. These models are factory calibrated for either U.S. or metric readings.

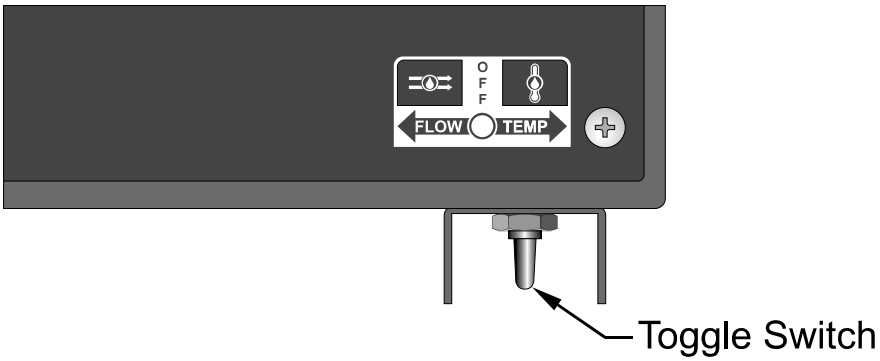


Figure 2 - *Toggle Switch*

The HFP-100 Series Testers can be changed in the field between U.S. and metric readings via a slide switch located in the center of the front panel. Use a small pointed object to slide this switch to the desired position.

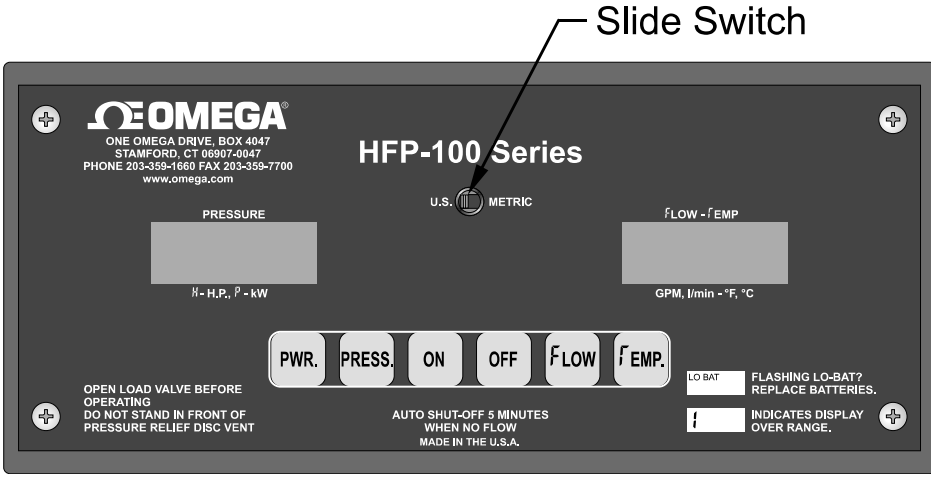


Figure 3 - *Slide and Membrane Switches*

After the selecting U.S. or metric, power and display options are made via the membrane switches. When the “ON” switch is pressed, pressure will show in the left display and flow in the right display. To view temperature in the right LCD, simply press the “TEMP.” switch. To view Power in the left LCD, press the “PWR.” switch.

Flow is identified by the F symbol and the T symbol indicates temperature. Horsepower readings will be followed by the H symbol and kilowatt by a P symbol.

NOTE: If no flow has been present for five minutes, the power saver circuit will automatically shut the HFP-100 off. Pressing the “ON” switch will restore power.

To prolong battery life on all testers, select the “OFF” option by returning the toggle switch to the “OFF” position on the HFP-110 and HFP-120 Series or pressing “OFF” on the membrane switch of the HFP-100 Series when the tester is not being used.

Once the tester has been installed, the pressure can be regulated by operation of the loading valve.

ALWAYS START WITH THE LOADING VALVE OPEN

WARNING

Turn the loading valve handle counterclockwise to open before starting machinery. Injury to personnel and/or damage to the equipment can result if the loading valve is fully closed. DO NOT STAND IN FRONT OF THE BURST DISC VENT. The burst disc performance can vary with incorrect installation. See Burst Disc on page 14.

The HFP Series Testers are equipped with a poppet style loading valve.

Pressure is displayed as follows:

HFP-110 and HFP-120	-	the gauge indicates pressure at the inlet port
HFP-100	-	pressure is displayed on the LCD. A minimum of 200 PSI (14 kg/cm^2) is required to activate the display. PSI will increment in 10s (i.e. 200, 210, 220, etc.); kg/cm^2, bars or MPa will increment in single units (i.e. 141, 142, 143, etc.)

On all models, the battery voltage is affected by cold temperatures. Allow time for the circulating oil to warm the tester before critical measurements are taken. On the HFP-110 and HFP-120 Series, a LO BAT signal on the display indicates a low battery condition. On the HFP-100 Series, a flashing colon (:) on the display indicates a low battery condition. Replace the batteries with 4 “AA” alkaline batteries. See Battery Replacement on page 15.

Test Procedures

WARNING

All testers are shipped with the loading valve in the closed position. The loading valve must be opened fully before initiating flow and testing of the hydraulic circuit. Turn the loading valve handle counterclockwise to the fully open position. Failure to open the loading valve fully can result in injury to personnel and/or damage to the equipment.

CAUTION

The information in this manual is for general application only. Any information furnished by the manufacturer of the machine’s hydraulic components should be followed. Specific systems may require specific test procedures.

General Information

The HFP-110 and HFP-120 Series Testers are designed to measure flow, pressure and temperature. The HFP-100 Series Testers are also designed to measure power.

The power measurements are derived from the product of flow and pressure. When using a HFP-110 or an HFP-120 Series Tester, power can be calculated using the formulas on page 19.

Standard Test Conditions

1. Install the tester as described in one of the following test procedures:
   a. Pump Test
   b. “Tee” Test
   c. Control Valve, Cylinder and Hydraulic Motor Test
   d. Relief Valves in Separate Housings
   e. Relief Valves
2. Open the loading valve fully by turning the handle counterclockwise.
3. Start the pump and adjust it to rated speed.
4. To raise the system temperature, close the tester loading valve to develop a pressure somewhat below the relief valve pressure. Maintain until the desired temperature is reached.
5. Open the tester’s loading valve fully and proceed with the required test procedure.
6. The tester will display flow, pressure, temperature and power readings.

Pump Test

A tee must be installed between the pump discharge port and the return line to the tank. Be sure the fluid path is only through the pump, the hydraulic test unit, and back to the tank.

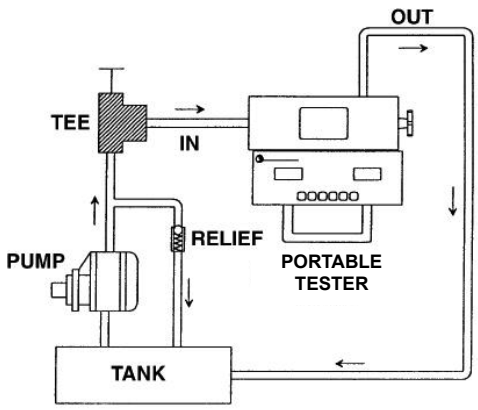


Figure 4 - *Pump Test*

1. Plug the line to the control valve.
2. Open the tester loading valve fully to read maximum pump flow at zero pressure.
3. Close the loading valve to increase pressure from zero pressure to rated or maximum pump pressure to determine pump condition.
4. The pump flow at rated pressure can now be checked against the pump manufacturer's specifications. A decrease in flow from zero pressure to maximum pressure indicates the pump condition. A pump that delivers a constant low flow at zero pressure and at maximum pressure suggests suction problems.

"Tee" Test

A tee must be installed between the pump and control valve and connected to the "IN" port of the PFM tester. The "OUT" port of the tester is connected to the tank. Pumps and relief valves can be isolated from the system and checked with the "Tee" Test.

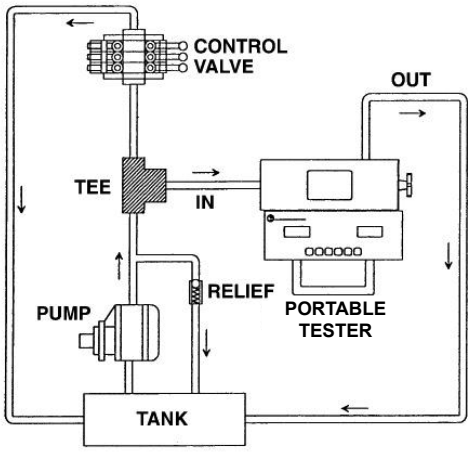


Figure 5 - "*Tee*" *Test*

WARNING

Increase pressure slowly. The relief valve may now be isolated from the hydraulic circuit, and system pressures higher than the relief valve setting can result in injury to personnel and/or damage to the equipment.

1. Pump Test
   a. Plug the line to the control valve.
   b. Open the tester loading valve fully to read maximum pump flow at zero pressure.
   c. Close the loading valve to increase pressure from zero pressure to rated or maximum pump pressure to determine pump condition.
   d. The pump flow at rated pressure can now be checked against the pump manufacturer's specifications. A decrease in flow from zero pressure to maximum pressure indicates the pump condition. A pump that delivers a constant low flow at zero pressure and at maximum pressure suggests suction problems.

2. Relief Valve Test (For relief valve in separate housing, see page 13)
   a. Put a control valve into a power output mode with the output flow blocked, such as a cylinder at the end of its stroke.
   b. Close the tester loading valve while viewing the pressure. Pressure will increase until the relief valve opens. Record the pressure at this point. Repeat to check the relief valve adjustment.

Control Valve, Cylinder and Hydraulic Motor Test

1. Put one control valve in an operating position. (Only one control valve should be in an operating position at any one time.)

2. Slowly close the tester loading valve to achieve the pressure obtained in Step 3 under Pump Test or Step 1.c. under "Tee" Test and record the flow. Repeat for all operating positions of all control valves.
   a. If all components are in good operating condition, pressure and flow measurements should be the same as in Step 3 of the Pump Test.
   b. If a decrease in flow in any control valve position is noted, leakage is indicated. See Step 3 below for the test routine to determine which control valve is at fault.
   c. If the decrease in flow is the same with the control valve(s) in all positions, it indicates that the relief valve is at fault. (Note: This can also indicate some other leak is present in the control valve such as a defective casting, damaged seals, or worn valve position detents - but always check the relief valve FIRST.)

3. To locate the fault in the control valve, cylinder or motor, disconnect cylinder and plug connection.
   a. Place the control valve handle in the position where greatest decrease of flow was noted.
   b. Close the tester loading valve to achieve the test pressure and record the flow.
   c. If the same decrease in flow is noted as in test performed in Step 2.b. above, then the control valve is at fault. HOWEVER, if the flow readings are now higher and comparable to the other control valves, then a faulty cylinder or motor is indicated.

Relief Valve in Separate Housing

1. Install the tester in a "Tee" Test configuration to the line connecting the pump and relief valve. Plug any extra outlets.
2. Close the tester loading valve and watch the pressure and flow.

a. Reconnect the control valve to the tee. Put a control valve into a power output mode with the output flow blocked, such as a cylinder at the end of its stroke.

b. Close the tester loading valve while watching the pressure. Pressure will increase until the relief valve opens. Record the pressure at this point. Repeat to check the relief valve adjustment.

Relief Valves

Often relief valves will start to open before they reach their full pressure flow settings. This can be noted by comparing the pressure and flow rate readings made in Step 3 under "Tee" Test. Any great decrease in flow rate from tests made in Step 3 under "Tee" Test indicates a faulty relief valve.

MAINTENANCE / TROUBLESHOOTING

The HFP Series Testers are designed to give years of trouble-free service. However, if trouble is suspected, a few simple checks can be made.

Load Valve

If the valve fails to load the system, remove the valve body and check for foreign material, worn parts or seals.

Flow

The absence of any flow reading may indicate a blockage of the turbine. Remove the retaining ring from the inlet port and carefully remove the turbine assembly. Remove any material that may be preventing easy rotation of the rotor.

Reassemble and attempt a flow reading again. If the tester still fails to indicate flow, it is recommended to return the tester to the factory. For return procedures, contact Omega.

Burst Discs and Burst Disc Bodies

The burst discs are designed to rupture at a specified pressure. The testers have a single burst disc that vents externally when ruptured. If rupture occurs, the burst discs must be replaced.

WARNING

If you do not have the proper tools to accomplish this task, it is highly recommended that you return the tester(s) to the factory for replacement of the burst disc housing and the burst discs. Injury to personnel and/or damage to equipment may result if the burst discs are installed improperly.

The following tools and parts will be needed:

- Phillips head screw
- 3/4" open end box wrench
- 0-50 (or greater) pound-inch torque wrench
- Awl
- Burst disc body, P.N. F2138
- Burst disc, P.N. F1614-6000

Burst Disc Replacement Procedure

1. Position the tester block so that the pressure relief plate is accessible as shown in Figure 6.

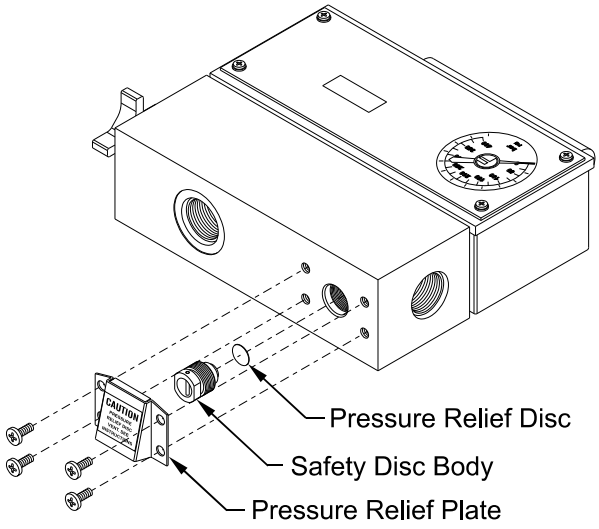


FIGURE 6 - *Burst Disc*

2. Remove the four Phillips head screws holding the pressure relief plate from the tester block. Once the plate is removed, the burst disc body will be exposed.
3. Using the torque wrench, remove the burst disc body from the tester block.
4. With the awl, remove the burst disc from the burst disc body port.
5. Insert the new burst disc into the burst disc body port. Ensure that it is seated flush within the base of the well. Be careful not to scratch the surface of the burst disc.
6. Insert the burst disc body into the burst disc body port and hand tighten into the test block. If required, use a new burst disc body, P.N. F2138.
7. Set the torque wrench to 25 foot-pounds (37.3 N-m). If using a direct reading torque wrench, go to step 8.
8. Torque the burst disc body into the tester block. Torque to 25 foot-pounds (37.3 N-m).

CAUTION

Do not over torque the burst disc housing. Applying too much torque will damage the burst disc and cause the disc to rupture prematurely.

Battery Replacement

All testers utilize four AA size alkaline batteries. These batteries will normally provide approximately 50 hours of service before a low battery condition is indicated. On the HFP110 and HFP 120 Series Testers, a LO BAT signal on the display indicates a low battery condition. On the HFP-100 Series Tester, a flashing colon (:) on the display indicates a low battery condition. When a low battery condition has been displayed, immediately remove discharged batteries from the tester to prevent battery holder corrosion.

To change the batteries, remove the 4 screws on the cover assembly. Pull the cover slowly upward to clear the internal components. The batteries are located on the bottom of the case. See **Figure 7**. When installing the new batteries, ensure that they are centered in the holder and making contact at both ends. Replace the cover and secure the 4 screws.

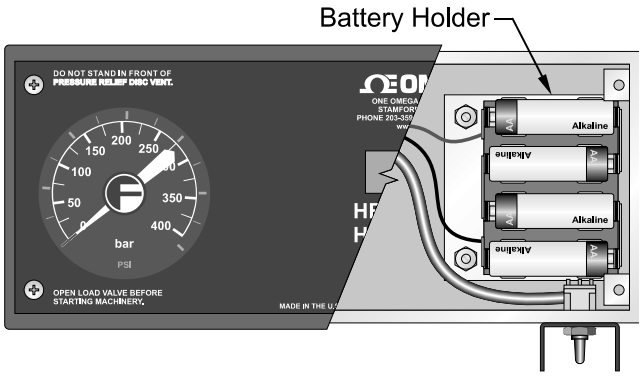
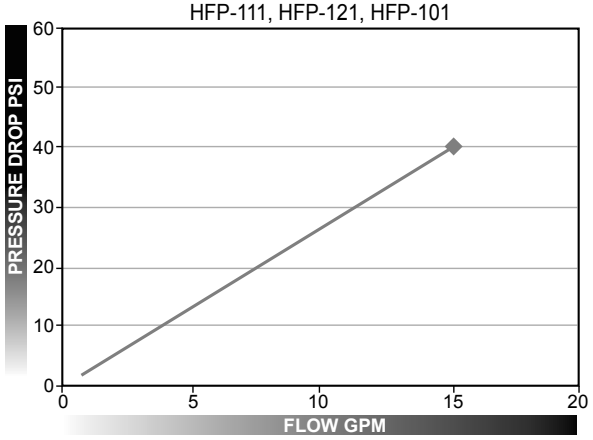


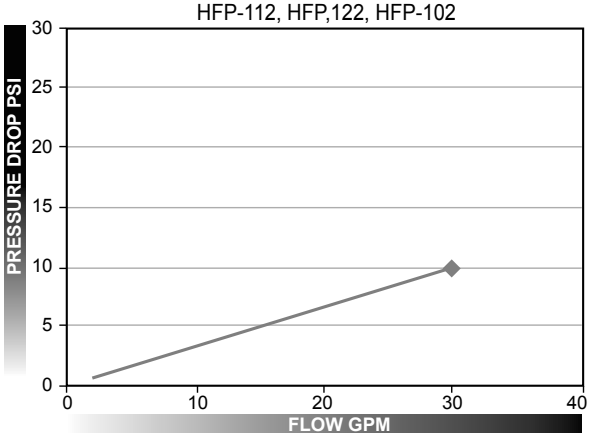
FIGURE 7 - *Battery Replacement*

Flow vs Pressure Drop Charts – ΔP Captured Using Loading Valves

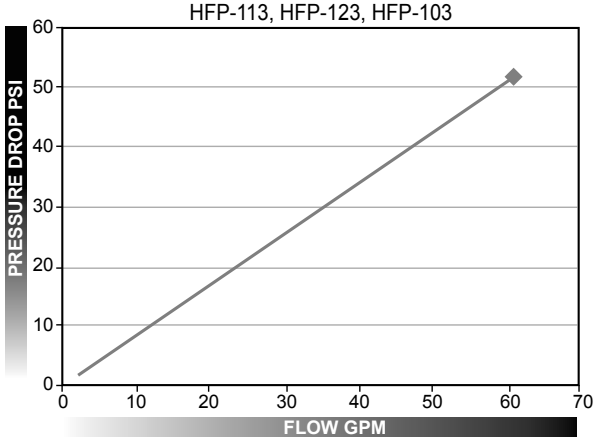
HFP-111, HFP-121, HFP-101



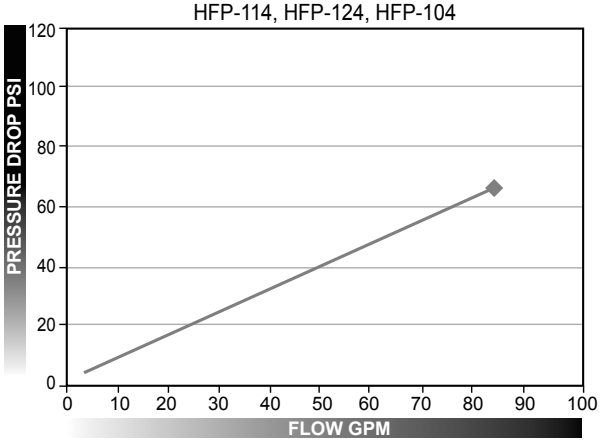
HFP-112, HFP,122, HFP-102



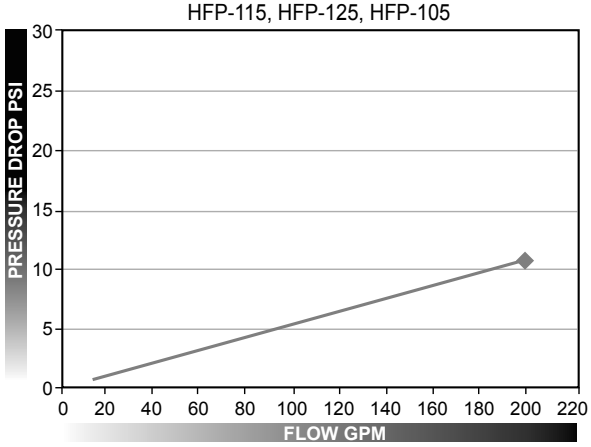
HFP-113, HFP-123, HFP-103



HFP-114, HFP-124, HFP-104



HFP-115, HFP-125, HFP-105



Hydraulic Formulas and Viscosity Information

Flow Rate Formulas

$$\text{Frequency (Hz)} = \frac{K \times GPM}{60} \qquad GPM = \frac{Hz \times 60}{K}$$

$$\text{K factor (K)} = \frac{Hz \times 60}{GPM} \qquad \text{Time Base (TB)} = \frac{GPM}{Hz}$$

Flow Rate Related Formulas

$$\text{Valve } C_V \text{ Factor} = \frac{\text{Flow Rate (GPM)} \times \sqrt{\text{Fluid Specific Gravity}}}{\sqrt{\Delta P \text{ across valve (PSI)}}}$$

$$\text{Cylinder Velocity} = \frac{0.3208 \times \text{Flow Rate (GPM)}}{\text{Net Cylinder Area (in}^2\text{)}}$$

$$\text{Fluid Motor Torque} = \frac{\text{Flow Rate (GPM)} \times \text{Pressure (PSIG)} \times 36.77}{\text{Rotational Speed}}$$

Power Calculations

$$\text{H.P.} = \frac{GPM \times PSI}{1714} \qquad \text{H.P.} = \frac{\text{liters/min} \times \text{Bar}}{447.4} \qquad kW = \frac{\text{liters/min} \times \text{Bar}}{600}$$

Fluid Viscosity Conversion Table

±1% Viscosity Range for Portable Testers is 25 to 500 SUS

Fluid viscosity used to calibrate Testers and Sensors.

Saybolt Universal Seconds (SUS)	ISO-VG	CentiStoke	CentiPoise[1]	Typical Brands/Liquids at 100 °F
31	2	1.0	0.876	Water
35	3	2.5	2.19	-
40	5	4.2	3.68	-
45	5/7	5.9	5.17	-
50	7	7.5	6.57	Kerosene
55	7/10	8.8	7.71	Atlantic Richfield/Duro 55 Hydraulic Oil
60	10	10.5	9.20	Monsanto/Skydrol - 500 A
70	10/15	13.2	11.56	Mobil/Aero HFA Hydraulic Oil
80	15	15.7	13.75	No. 4 Fuel Oil
90	22	18.2	15.94	Stauffer Chemical/Fyrquel 90
100	22	20.6	18.05	Conoco/Syncon Synthetic AW Hydraulic Oil
150	32	32.0	28.03	Mobil/DTE 24 Hydraulic Oil
200	46	43.2	37.84	Citco/Glycol FR-40XD (Oil in Water)
300	68	65.0	56.94	SAE 20 Crankcase Oil
400	68/100	86.0	75.34	Sunoco/Sunvis 41 Hydraulic Oil
500	100	108	94.61	SAE 30 Crankcase Oil
750	150	162	141.91	SAE 40 Crankcase Oil
1000	220	216	189.22	Mobil/Paper Machine Oil - Type K
1500	320	323	282.95	SAE 50 Crankcase Oil
2000	460	431	377.56	Amoco/American Industrial Oil - No. 460
3000	680	648	567.65	SAE 140 Gear Oil
4000	1000	862	755.11	SAE 250 Gear Oil

[1] CentiPoise are given for oil of 0.876 specific gravity. Relationship: CentiStokes × Specific Gravity = CentiPoise

NOTES

WARRANTY/DISCLAIMER

OMEGA ENGINEERING, INC. warrants this unit to be free of defects in materials and workmanship for a period of **13 months** from date of purchase. OMEGA's WARRANTY adds an additional one (1) month grace period to the normal **one (1) year product warranty** to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product.

If the unit malfunctions, it must be returned to the factory for evaluation. OMEGA's Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective, it will be repaired or replaced at no charge. OMEGA's WARRANTY does not apply to defects resulting from any action of the purchaser, including but not limited to mishandling, improper interfacing, operation outside of design limits, improper repair, or unauthorized modification. This WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of having been damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components in which wear is not warranted, include but are not limited to contact points, fuses, and triacs.

OMEGA is pleased to offer suggestions on the use of its various products. However, OMEGA neither assumes responsibility for any omissions or errors nor assumes liability for any damages that result from the use of its products in accordance with information provided by OMEGA, either verbal or written. OMEGA warrants only that the parts manufactured by the company will be as specified and free of defects. OMEGA MAKES NO OTHER WARRANTIES OR REPRESENTATIONS OF ANY KIND WHATSOEVER, EXPRESSED OR IMPLIED, EXCEPT THAT OF TITLE, AND ALL IMPLIED WARRANTIES INCLUDING ANY WARRANTY OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED. LIMITATION OF LIABILITY: The remedies of purchaser set forth herein are exclusive, and the total liability of OMEGA with respect to this order, whether based on contract, warranty, negligence, indemnification, strict liability or otherwise, shall not exceed the purchase price of the component upon which liability is based. In no event shall OMEGA be liable for consequential, incidental or special damages.

CONDITIONS: Equipment sold by OMEGA is not intended to be used, nor shall it be used: (1) as a "Basic Component" under 10 CFR 21 (NRC), used in or with any nuclear installation or activity; or (2) in medical applications or used on humans. Should any Product(s) be used in or with any nuclear installation or activity, medical application, used on humans, or misused in any way, OMEGA assumes no responsibility as set forth in our basic WARRANTY/DISCLAIMER language, and, additionally, purchaser will indemnify OMEGA and hold OMEGA harmless from any liability or damage whatsoever arising out of the use of the Product(s) in such a manner.

RETURN REQUESTS/INQUIRIES

Direct all warranty and repair requests/inquiries to the OMEGA Customer Service Department. BEFORE RETURNING ANY PRODUCT(S) TO OMEGA, PURCHASER MUST OBTAIN AN AUTHORIZED RETURN (AR) NUMBER FROM OMEGA'S CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS). The assigned AR number should then be marked on the outside of the return package and on any correspondence.

The purchaser is responsible for shipping charges, freight, insurance and proper packaging to prevent breakage in transit.

FOR **WARRANTY** RETURNS, please have the following information available BEFORE contacting OMEGA:

1. Purchase Order number under which the product was PURCHASED,
2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems relative to the product.

FOR **NON-WARRANTY** REPAIRS, consult OMEGA for current repair charges. Have the following information available BEFORE contacting OMEGA:

1. Purchase Order number to cover the COST of the repair,
2. Model and serial number of the product, and
3. Repair instructions and/or specific problems relative to the product.

OMEGA's policy is to make running changes, not model changes, whenever an improvement is possible. This affords our customers the latest in technology and engineering.

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