

PFM Portable Hydraulic Testers

PFM6, PFM6BD, and PFM8





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Installation & Operation Manual

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INTRODUCTION

Flo-tech 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.

Flo-tech offers three models, all available in a choice of up to 5 flow ranges and 3 port sizes:

PFM6 Digital Hydraulic Tester

Features:



- Accuracy of ±1% of full flow range
- 31/2 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
- Internal over pressure burst disc protection

PFM6BD Bi-directional Hydraulic Tester

Features:

C mean cannot be made a	Flo-check*

- Bi-directional testing
- Low pressure drop
- Accuracy of ±1% of full flow range
- 3¹/₂ 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
- Internal over pressure burst disc protection

PFM8 Digital Hydraulic Tester & Dynamometer

Features:



- Accuracy of ±1% of full flow range
- 3½ 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
- Internal over pressure burst disc protection

SPECIFICATIONS

MATERIAL					
Housing: 6013-T351 Anodized aluminum					
Turbine Rotor:	T416 Stainless steel				
Rotor Supports:	6061-T6 Aluminum				
Contra	Buna N standard				
Seals:	Viton [®] and EPR optional				
Ball Bearings:	440 C Stainless steel				
Hub Cones:	6061-T6 Aluminum alloy				
Temperature Probe:	12L14 Steel, electroless nickel plate				
	PFM6/8 SERIES TESTERS				
	Cold rolled steel body with 303 SS stem (for 15/30 Models)				
Valve:	12L14 steel body with 303 SS stem (for 60/85/200 Models)				
Sleeve for 200 Model:	D.O.M. steel tube				
Poppet:	12L14 Steel, hardened				
	CA360 Brass (for 15/30 Models)				
Straightening Sections:	6061-T6 Aluminum (for 60/85/200 Models)				
Cones:	2024-T4 Aluminum				
Valva	121 14 steel body with 202 SS stem				
	12L14 steel body with 303 SS stem				
Spool/Sleeve.					
Cones.	2024-T4 Aluminum				
	SAF Straight thread Q-ring boss female, 11926/1:				
Ports:	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				
	PEREORMANCE				
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/cm²)				
Pressure Drop:	See ΔP charts on page 22				
Fluid Temperature:	up to 300 °F (150 °C)				
Readout Accuracy:	±1 digit				
Battery Type:	AA size alkaline, ~50 hrs. of service				

Table1: Specifications

CALIBRATION

Testers are calibrated with a 32 cSt (150 SUS) hydraulic oil. Standard calibration is done using 5 points and is traceable to NIST, ISO 9001. An optional 10 point calibration can be performed for increased accuracy.

SERIES/MODEL NUMBER DESIGNATIONS

SERIES	MODEL NUMBER *	NOMINAL PORT SIZE	FLOW RATE	POWER HP (KW)	
PFM6-15	F5080 (CE) - XXX	SAE 12	1 - 15 GPM		
PFM6-30	F5079 (CE) - XXX	5079 (CE) - XXX SAE 12 2 - 30 GPM			
PFM6-60	F5078 (CE) - XXX SAE 16		3 - 60 GPM	N/A	
PFM6-85	F5077 (CE) - XXX	F5077 (CE) - XXX SAE 16 4 - 85 GPM			
PFM6-200	F5076 (CE) - XXX	SAE 24	SAE 24 7 - 199.9 GPM		
	I				
PFM6-15	F5110 (CE) - XXX	G 3⁄4	4 - 56 LPM		
PFM6-30	F5111 (CE) - XXX	G 3⁄4	7.5 - 113.6 LPM		
PFM6-60	F5112 (CE) - XXX	G 1	12 - 227 LPM	N/A	
PFM6-85	F5113 (CE) - XXX G 1 15 - 321 LPM				
PFM6-200	F5114 (CE) - XXX	G 1½	26 - 757 LPM		
	·		·		
PFM6BD-60	F5082 (CE) - XXX SAE 16 3 - 60 GPM / 12 - 227 LPM				
PFM6BD-85	F5083 (CE) - XXX	SAE 16	4 - 85 GPM / 15 - 321 LPM	N/A	
PFM6BD-200	F5084 (CE) - XXX	SAE 24	7 - 199.9 GPM / 26 - 757 LPM		
PFM8-15	F5061	SAE 12	1 - 15 GPM / 4 - 56 LPM	52.5 (39)	
PFM8-30	M8-30 F5058 SAE 12		2 - 30 GPM / 7.5 - 113.6 LPM	105 (78)	
PFM8-60	F5052 SAE		3 - 60 GPM / 12 - 227 LPM	210 (157)	
PFM8-85	F5053	SAE 16	4 - 85 GPM / 15 - 321 LPM	98 (222)	
PFM8-200	F5054	SAE 24	7 - 199.9 GPM / 26 - 757 LPM	700 (522)	
* Beplace XXX with PSL BAB. KG/CM2 or MPA to specify complete model number					

Table2: Model Number Designations

DIMENSIONS



Figure 1: Hydraulic Tester Dimension Illustration

C₁ - PFM6 and PFM8 Series

C, - PFM6BD Series

	DIMENSIONS LENGTH (A)			
SERIES	INCHES	INCHES MM		
PFM6-15	11.3 × 3.5 × 9.8	$287 \times 89 \times 249$	13.85 (6.3)	
PFM6-30	11.3 × 3.5 × 9.8	$287 \times 89 \times 249$	13.85 (6.3)	
PFM6-60	11.5 × 3.5 × 9.8	$292 \times 89 \times 249$	16.50 (7.5)	
PFM6-85	11.5 × 3.5 × 9.8	$292 \times 89 \times 249$	16.50 (7.5)	
PFM6-200	12.3 × 4.0 × 10.3	311 × 101 × 262	20.00 (9.1)	
PFM6BD-60	11.3 × 3.5 × 10.1	287 × 89 × 256	16.50 (7.5)	
PFM6BD-85	11.3 × 3.5 × 10.1	287 × 89 × 256	16.50 (7.5)	
PFM6BD-200	11.8 × 4.0 × 10.6	300 × 101 × 268	20.00 (9.1)	
PFM8-15	11.3 × 3.5 × 9.8	$287 \times 89 \times 249$	13.85 (6.3)	
PFM8-30	11.3 × 3.5 × 9.8	$287 \times 89 \times 249$	13.85 (6.3)	
PFM8-60	11.5 × 3.5 × 9.8	$292 \times 89 \times 249$	16.50 (7.5)	
PFM8-85	11.5 × 3.5 × 9.8	292 × 89 × 249	16.50 (7.5)	
PFM8-200	12.3 × 4.0 × 10.3	11 × 101 × 262	20.00 (9.1)	

Table3: Dimensions



Caution - Read instructions thoroughly before installing the tester. If you have any questions regarding product installation or maintenance, call your local supplier or 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 PFM6, PFM6BD or PFM8 tester at any location in the hydraulic circuit with the flow from "IN" to "OUT" as marked near the ports of the flow meter. The "IN" and "OUT" ports on the PFM6BD indicate the primary flow direction. 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.

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 PFM6 and PFM6BD 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.

The PFM8 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. See *Figure 3*.

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.



Figure 2: PFM6 and PFM6BD Toggle Switch

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

NOTE: If no flow has been present for five minutes, the power saver circuit will automatically shut the PFM8 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 PFM6 and PFM6BD models or pressing "OFF" on the membrane switch of the PFM8 model 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.



Caution - The PFM6BD is not designed for high pressure "deadhead" (loading valve fully closed) applications, in the reverse direction. Usage under this condition could lead to loading valve failure. Under such conditions, maximum operating pressure is limited to 2000 PSI (138 Bar).

The PFM6 and PFM8 testers are equipped with a poppet style loading valve. The PFM6BD testers utilize a spool design loading valve to accommodate bi-directional flow. The spool design requires more turns to go from total open to total close.



Figure 3: PFM8 Slide and Membrane Switches

Pressure is displayed as follows:

PFM6	the gauge indicates pressure at the inlet port
PFM6BD	the gauge indicates pressure at the inlet port dependent on the direction of flow
PFM8	the 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 10's (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 PFM6 and PFM6BD, a LO BAT signal on the display indicates a low battery condition. On the PFM8, a flashing colon (:) on the display indicates a low battery condition. Replace the batteries with 4 "AA" alkaline batteries. See Battery Replacement on page 21.

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 PFM6 and PFM6BD testers are designed to measure flow, pressure and temperature. The PFM8 testers are also designed to measure power.

The power measurements are derived from the product of flow and pressure. When using a PFM6 or PFM6BD, power can be calculated using the formulas on page 23.

Standard Test Conditions

- 1. Install the PFM 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 value to develop a pressure somewhat below the relief value 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

AWARNING

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.
 - b. 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 17)
 - 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



Figure 6: Control Valve, Cylinder and Hydraulic Motor Test (PFM6BD)

- 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. 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 PFM 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, see the Return Goods Authorization section of the manual.

Burst Discs and Burst Disc Bodies

The burst discs are designed to rupture at a specified pressure. The PFM6 and PFM8 testers have a single burst disc that bypasses flow around the loading valve when ruptured. The PFM6BD testers provide protection from excessive pressure in either direction with two internal burst discs that when ruptured by-pass flow around the loading valve. 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:1

5%" open end box wrench					
0-80 (or greater) pound-inch torque wrench					
Burst discs					
PFM6 -	P.N. F1614-7500 (1 each)				
PFM6BD -	P.N. F1614-7500 (2 each)				
PFM8 -	P.N. F1614-7500 (1 each)				
Optional					
O-Ring -	P.N. F3137-015 (1 each)				
Backup Ring -	P.N. F1015-015 (1 each)				

Burst Disc Procedure for PFM6 and PFM8 Testers

- 1. Position the tester block to expose the internal burst disc body as shown in *Figure 7*.
- 2. Loosen the burst disc body from the flow meter block.
- 3. Remove the burst disc body from the flow meter block.
- 4. Remove the ruptured burst disc from the flow meter block and discard.
- 5. Clean out the burst disc port. Remove any debris from the sealing surfaces.
- 6. Rotate the tester to face the burst disc port upwards and drop in a new burst disc. Make sure it lies flat on the sealing surface entrance. Lubricate the O-ring on the burst disc housing and insert it back into the block. Tighten the burst disc housing down to form the disc against the sealing surface.
- 7. Using a torque wrench, tighten the burst disc body in the block to 35 foot-pounds (50.8 Nm).



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.



Figure 7: PFM6 and PFM8 Burst Disc

Burst Disc Procedure for PFM6BD

- 1. Position the PFM6BD to expose the internal burst disc body as shown in *Figure 8*.
- 2. Loosen the burst disc body from the flow meter block.
- 3. Remove the burst disc body from the flow meter block.
- 4. Remove the ruptured burst discs from the flow meter block and discard. Retain the support ring.
- 5. Clean out the burst disc port and the support ring. Remove any debris from the sealing surfaces.
- 6. Rotate the tester to face the burst disc port upwards and drop in a new burst disc. Make sure it lies flat on the sealing surface entrance. Drop in the support ring and follow it with the second burst disc. Lubricate the O-ring on the burst disc housing and insert it back into the block. Tighten the burst disc housing down to form the disc against the sealing surfaces.
- 7. Using a torque wrench, tighten the burst disc body in the block to 60 foot-pounds (81.4 Nm).

ACAUTION

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.



Figure 8: PFM6BD Burst Discs

Battery Replacement

All PFM 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 PFM6 and PFM6BD, a LO BAT signal on the display indicates a low battery condition. On the PFM8, 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 9*. 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.





FLOW VS PRESSURE DROP CHARTS **AP CAPTURED USING LOADING VALVES**



FLOW, GPM



Ò

HYDRAULIC FORMULAS AND VISCOSITY INFORMATION

Flow Rate Formulas

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

K-Factor (K) = $\frac{Hz \times 60}{GPM}$ Time Base (TB) = $\frac{GPM}{Hz}$

Flow Rate Related Formulas

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

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

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

Power Formulas

H.P. =
$$\frac{\text{LPM x Bar}}{447.4}$$
 H.P. = $\frac{\text{LPM x Bar}}{447.4}$ kW = $\frac{\text{LPM x Bar}}{600}$

FLUID VISCOSITY CONVERSION TABLE

		SAYBOLT UNIVERSAL SECONDS (SUS)	ISO-VG	CENTISTOKE	CENTIPOISE ¹	TYPICAL BRANDS/LIQUIDS AT 100 °F
Γ		31	2	1.0	0.876	Water
	ate	35	3	2.5	2.19	
	libra	40	5	4.2	3.68	-
h US	o ca sors	45	5/7	5.9	5.17	
-tec 00 S	ed to Sen	50	7	7.5	6.57	Kerosene
Flo to 5	v use	55	7/10	8.8	7.71	Atlantic Richfield/Duro 55 Hydraulic Oil
e for 25 ·	sity ers a	60	10	10.5	9.20	Monsanto/Skydrol - 500 A
ange rs is	visco Test	70	10/15	13.2	11.56	Mobil/Aero HFA Hydraulic Oil
y Ra nso	, biu	80	15	15.7	13.75	No. 4 Fuel Oil
osit d Se	- Flu	90	22	18.2	15.94	Stauffer Chemical/Fyrquel 90
Visc and		100	22	20.6	18.05	Conoco/Syncon Synthetic AW Hydraulic Oil
:1% sters		150	32	32.0	28.03	Mobil/DTE 24 Hydraulic Oil
Tes H		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 Gravit					entiStokes × Specific Gravity = CentiPoise	

Table4: Viscosity Conversion

RETURN GOODS AUTHORIZATION

When returning equipment for service, a Returned Goods Authorization (RGA) number must be obtained from our Service Department. Please contact them by phone at 800-433-5263 or 262-639-6770 or by e-mail to info@flo-tech.com

All returns go to the following address and must include the RGA number on the outside of the box:

Flo-tech 8635 Washington Avenue Racine, WI 53406-3738 USA Attn: RGA # xxx-xxxx

WASTE AND ELECTRONIC EQUIPMENT (WEEE) DIRECTIVE



In the European Union, this label indicates that this product should not be disposed of with household waste. It should be deposited at an appropriate facility to enable recovery and recycling.

For information on how to recycle this product responsibly in your country, please visit:

www.racinefed.com/recycle/

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Materials and specifications subject to change without notice.



Badger Meter Warranty

Flo-tech Portable Hydraulic Testers

PRODUCTS COVERED

The Badger Meter warranty shall apply to the Flo-tech Portable Hydraulic Testers ("Product").

MATERIALS AND WORKMANSHIP

Badger Meter warrants the Product to be free from defects in materials and workmanship for a period of 12 months from the original purchase date.

PRODUCT RETURNS

Product failures must be proven and verified to the satisfaction of Badger Meter. The Badger Meter obligation hereunder shall be limited to such repair and replacement and shall be conditioned upon Badger Meter receiving written notice of any asserted defect within 10 (ten) days after its discovery. If the defect arises and a valid claim is received within the Warranty Period, at its option, Badger Meter will either (1) exchange the Product with a new, used or refurbished Product that is at least functionally equivalent to the original Product, or (2) refund the purchase price of the Product. DO NOT RETURN ANY PRODUCT UNTIL YOU HAVE CALLED THE BADGER METER CUSTOMER SERVICE DEPARTMENT AND OBTAINED A RETURN AUTHORIZATION.

Product returns must be shipped by the Customer prepaid F.O.B. to the nearest Badger Meter factory or distribution center. The Customer shall be responsible for all direct and indirect costs associated with removing the original Product and reinstalling the repaired or replacement Product. A replacement Product assumes the remaining warranty of the original Product or ninety (90) days from the date of replacement, whichever provides longer coverage.

LIMITS OF LIABILITY

This warranty shall not apply to any Product repaired or altered by any Product other than Badger Meter. The foregoing warranty applies only to the extent that the Product is installed, serviced and operated strictly in accordance with Badger Meter instructions. The warranty shall not apply and shall be void with respect to a Product exposed to conditions other than those detailed in applicable technical literature and Installation and Operation Manuals (IOMs) or which have been subject to vandalism, negligence, accident, acts of God, improper installation, operation or repair, alteration, or other circumstances which are beyond the reasonable control of Badger Meter. With respect to products not manufactured by Badger Meter, the warranty obligations of Badger Meter shall in all respects conform and be limited to the warranty extended to Badger Meter by the supplier.

THE FOREGOING WARRANTIES ARE EXCLUSIVE AND IN LIEU OF ALL OTHER EXPRESS AND IMPLIED WARRANTIES WHATSOEVER, INCLUDING BUT NOT LIMITED TO IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE (except warranties of title).

Any description of a Product, whether in writing or made orally by Badger Meter or its agents, specifications, samples, models, bulletins, drawings, diagrams, engineering sheets or similar materials used in connection with any Customer's order are for the sole purpose of identifying the Product and shall not be construed as an express warranty. Any suggestions by Badger Meter or its agents regarding use, application or suitability of the Product shall not be construed as an express warranty unless confirmed to be such, in writing, by Badger Meter.

EXCLUSION OF CONSEQUENTIAL DAMAGES AND DISCLAIMER OF OTHER LIABILITY

Badger Meter liability with respect to breaches of the foregoing warranty shall be limited as stated herein. Badger Meter liability shall in no event exceed the contract price. BADGER METER SHALL NOT BE SUBJECT TO AND DISCLAIMS: (1) ANY OTHER OBLIGATIONS OR LIABILITIES ARISING OUT OF BREACH OF CONTRACT OR OF WARRANTY, (2) ANY OBLIGATIONS WHATSOEVER ARISING FROM TORT CLAIMS (INCLUDING NEGLIGENCE AND STRICT LIABILITY) OR ARISING UNDER OTHER THEORIES OF LAW WITH RESPECT TO PRODUCTS SOLD OR SERVICES RENDERED BY BADGER METER, OR ANY UNDERTAKINGS, ACTS OR OMISSIONS RELATING THERETO, AND (3) ALL CONSEQUENTIAL, INCIDENTAL AND CONTINGENT DAMAGES WHATSOEVER.

Badger Meter Warranty

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