

L1999 Rev. A 02/03

Repair Parts Sheets for this product are available from the Enerpac web site at www.enerpac.com, or from your nearest Authorized Enerpac Service Center or Enerpac Sales office.

1.0 IMPORTANT RECEIVING INSTRUCTIONS

Visually inspect all components for shipping damage. Shipping damage is not covered by warranty. If shipping damage is found, notify carrier at once. The carrier is responsible for all repair and replacement costs resulting from damage in shipment.

SAFETY FIRST

2.0 SAFETY ISSUES



Read all instructions, warnings and cautions carefully. Follow all safety precautions to avoid personal injury or property damage during system operation. Enerpac cannot be responsible for damage or injury resulting from unsafe product use, lack of maintenance or incorrect product and/or system operation. Contact Enerpac when in doubt as to the safety precautions and operations. If you have never been trained on high-pressure hydraulic safety, consult your distribution or service center for a free Enerpac Hydraulic safety course.

Failure to comply with the following cautions and warnings could cause equipment damage and personal injury.

A **CAUTION** is used to indicate correct operating or maintenance procedures and practices to prevent damage to, or destruction of equipment or other property.

A **WARNING** indicates a potential danger that requires correct procedures or practices to avoid personal injury.

A **DANGER** is only used when your action or lack of action may cause serious injury or even death.



WARNING: Wear proper personal protective gear when operating hydraulic equipment.



WARNING: Stay clear of loads supported by hydraulics. A cylinder, when used as a load lifting device, should never be used as a load holding device. After the load has been raised or lowered, it must always be blocked mechanically.



DANGER: To avoid personal injury keep hands and feet away from cylinder and workpiece during operation.



WARNING: Do not exceed equipment ratings. Never attempt to lift a load weighing more than the capacity of the cylinder. Overloading causes equipment failure and possible personal injury. The cylinders are designed for a max. pressure of 350 bar [5,000 psi]. Do not connect a jack or cylinder to a pump with a higher pressure rating.



Never set the relief valve to a higher pressure than the maximum rated pressure of the pump. Higher settings may result in equipment damage and/or personal injury.



WARNING: The system operating pressure must not exceed the pressure rating of the lowest rated component in the system. Install pressure gauges in the system to monitor operating pressure. It is your window to what is happening in the system.



CAUTION: Avoid damaging hydraulic hose. Avoid sharp bends and kinks when routing hydraulic hoses. Using a bent or kinked hose will cause severe back-pressure. Sharp bends and kinks will internally damage the hose leading to premature hose failure.



Do not drop heavy objects on hose. A sharp impact may cause internal damage to hose wire strands. Applying pressure to a damaged hose may cause it to rupture.



IMPORTANT: Do not lift hydraulic equipment by the hoses or swivel couplers. Use the carrying handle or other means of safe transport.



CAUTION: Keep hydraulic equipment away from flames and heat. Excessive heat will soften packings and seals, resulting in fluid leaks. Heat also weakens hose materials and packings. For optimum performance do not expose equipment to temperatures of 65 °C [150 °F] or higher. Protect hoses and cylinders from weld spatter.



DANGER: Do not handle pressurized hoses. Escaping oil under pressure can penetrate the skin, causing serious injury. If oil is injected under the skin, see a doctor immediately.



WARNING: Only use hydraulic cylinders in a coupled system. Never use a cylinder with unconnected couplers. If the cylinder becomes extremely overloaded, components can fail catastrophically causing severe personal injury.



IMPORTANT: Hydraulic equipment must only be serviced by a qualified hydraulic technician. For repair service, contact the Authorized ENERPAC Service Center in your area. To protect your warranty, use only ENERPAC oil.



WARNING: Immediately replace worn or damaged parts by genuine ENERPAC parts. Standard grade parts will break causing personal injury and property damage. ENERPAC parts are designed to fit properly and withstand high loads.

3.0 DESCRIPTION

These pull cylinders are designed to push/pull in a straight direction with no side loading. Single- and double-acting models are available in most capacities. Plunger bolts are not supplied with cylinders. Plunger bolts must be quality Grade 8 (8.8 DIN 912).

4.0 MODEL NUMBER CODE

1 Cylinder	4 Action
P = Pull Cylinder	S = Single-acting
	D = Double-acting
2 Series	5 Capacity
T = Threaded Body	2 = 600 lbs/2,7 kN
U = Upper Flange	5 = 1400 lbs/6,2 kN
L = Lower Flange	12 = 3150 lbs/14 kN
3 Type	35 = 9600 lbs/42,7 kN
S = Straight	6 Threads
	1 = Imperial

5.0 PRELIMINARY INFORMATION



WARNING: Failure to read and follow these instructions may lead to system malfunction or product failure and could invalidate your warranty.

1. High flow rates can lead to excessive cylinder speed which can cause cylinder damage. Hydraulic pressure and cylinder speed must be adjusted to match the particular cylinder. The push/pull force also varies with the system pressure. Refer to the operating specifications above.
2. Flow controls with return checks may be required to reduce pull cylinder speed to the recommended rate. The return checks help minimize back pressure that could lead to an unclamp malfunction on single-acting systems.
3. When using single-acting pull cylinders, limit the return flow back pressure to 50 psi maximum. Large diameter tubing (3/8" OD or larger) and flow controls with free flow return checks help minimize back pressure. Consult Enerpac for proper system design.

Cylinder Specifications

Series	-21 Series	-51 Series	-121 Series	-351 Series
Capacity [lbs (kN)]	600 (2,7)	1400 (6,2)	3150 (14)	9600 (42,7)
Body Style	Threaded Body, Lower Flange, or Upper Flange Mounting			
Cylinder Type	Single-acting and Double-acting			Double-acting
Hydraulic Stroke [in. (mm)]				
clamp/unclamp	0.65 (16,5)	0.89 (22,6)	1.12 (28,4)	1.18 (30,0)
Effective Area [in ² (cm ²)]				
clamp	0.12 (0,77)	0.28 (1,81)	0.63 (4,06)	1.92 (12,39)
unclamp	0.24 (1,55)	0.59 (3,81)	1.23 (7,94)	3.68 (23,74)
Oil Capacity [in ³ (cm ³)]				
clamp	0.08 (1,31)	0.25 (4,10)	0.70 (11,47)	2.27 (37,20)
unclamp	0.16 (2,62)	0.53 (8,69)	1.40 (22,95)	4.35 (71,28)
Max. Pressure [psi (bar)]	5000 psi (350 bar)			
Max. Flow @ 5000psi (350 bar)				
[in ³ /min (cm ³ /min)]	24 (393)	50 (820)	200 (3278)	480 (7867)

6.0 SPECIFICATIONS

Cylinder Specifications (See table below)

7.0 MOUNTING SPECIFICATIONS

Mounting Threaded Body Cylinders

Threaded body cylinders can be threaded into a tapped hole, secured to the fixture using a mounting flange, threaded into the fixture and secured with a jam nut, or mounted through a clearance hole and secured with jam nuts. See Figure 1.

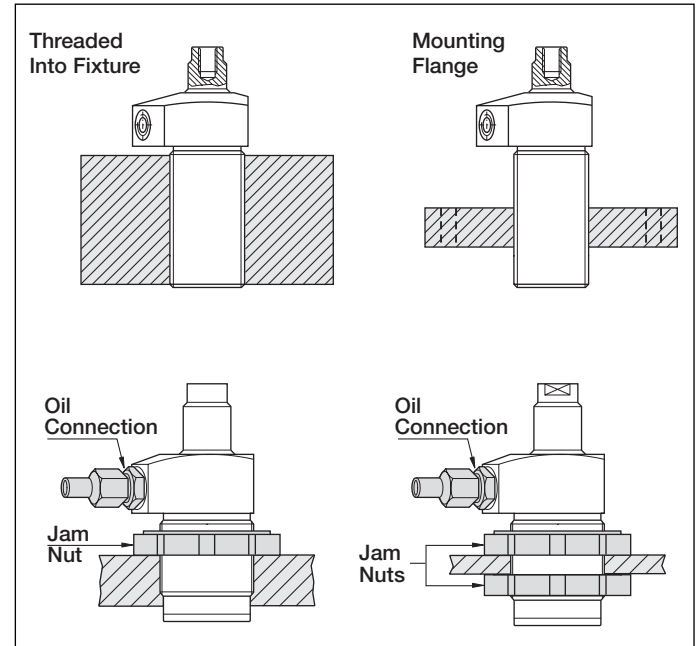


Figure 1

When a threaded body pull cylinder is being installed in a fixture, the thread engagement should be no less than the thread engagement for the standard Enerpac mounting flange. If a cylinder is being mounted using just the lower portion of the threads, the engagement should be increased for additional support. See table below for minimum thread engagement.

Cylinder Capacity lbs (kN)	Minimum Thread Engagement in (mm)	
600 (2,2)	0.50	(13)
1400 (5,6)	0.50	(13)
3150 (11,6)	0.63	(16)
9600 (35)	1.25	(30)

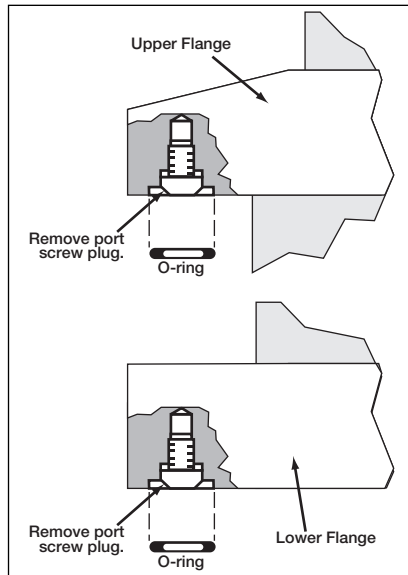
Mounting Upper and Lower Flange Cylinders



WARNING: The fixture must be capable of withstanding 5,000 psi (350 bar) hydraulic working pressure when cylinders are manifold mounted.

Before manifold mounting the pull cylinder, remove the port screw plugs and copper gaskets or o-rings.

Prior to mounting and bolting down the pull cylinder, lubricate the o-rings provided and install them in the counter-bore around the port. Be sure that the o-ring does not get pinched or damaged during mounting as leakage could result. To prevent leakage from the manifold mounting, provide a fixture mounting surface with flatness within 0.003" (0.08 mm) and a surface roughness not to exceed 32 \sqrt{r} rms (0,8 μ m).



Manifold Specifications (See chart below)

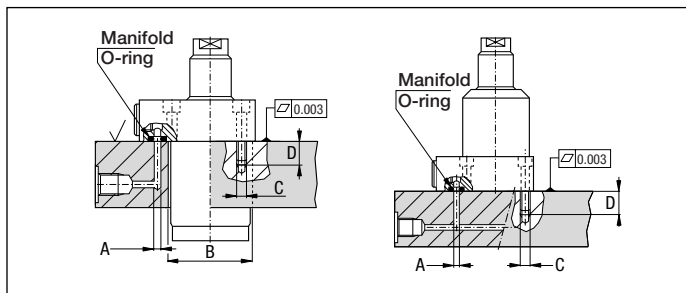


Figure 2

Manifold Specifications

Cylinder Capacity	Max. Oil Channel Ø A	Fixture Hole Ø B	Mounting Threads C	Minimum Thread Depth D	Lubricated Mounting Bolt Torque	Manifold O-ring Dim. Int. Ø x W
600 lbs 2,7 kN	0.156" 4 mm	1.15 ± .03 29,2 ± 0,8	10-32 UNF	0.63" 16 mm	40-48 in lbs 4,5-5,4 Nm	0.239 x 0.070" 6,07 x 1,78 mm
1400 lbs 6,2 kN	0.156" 4 mm	1.42 ± .03 36,0 ± 0,8	.24-28 UNF	0.75" 19 mm	9-11 ft lbs 12,2-14,9 Nm	0.301 x 0.070" 7,65 x 1,78 mm
3150 lbs 14 kN	0.156" 4 mm	1.93 ± .03 49,1 ± 0,8	.312-24 UNF	0.88" 22 mm	18-22 ft lbs 24,4-29,8 Nm	.301 x .070" 7,65 x 1,78 mm
9600 lbs 42,7 kN	0.156" 4 mm	3.05 ± .01 77,5 ± 0,3	.375-24 UNF	0.75" 19 mm	45-54 ft lbs 61-73 Nm	0.171 x 0.139" 4,34 x 3,53 mm

8.0 INSTALLATION

Hydraulic Connections

To make port connections, install fittings rated for 5000 psi (350 bar).

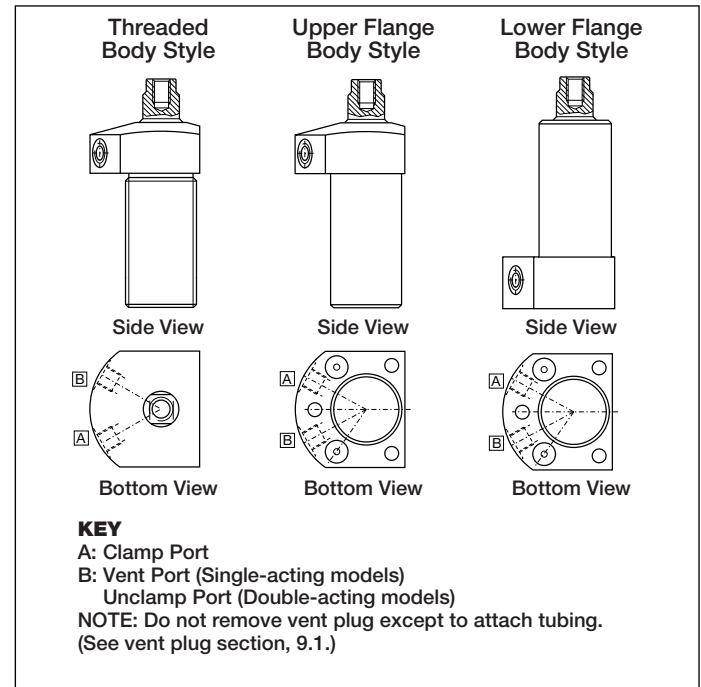
Cylinder Ports

Cylinder Capacity		5000 psi (350 bar) Fitting
600 lbs	2,7 kN	#2 SAE
1400 lbs	6,2 kN	#4 SAE
3150 lbs	14 kN	#4 SAE
9600 lbs	42,7 kN	#4 SAE

DO NOT use thread sealant. Sealing is accomplished by using an o-ring on the fitting boss. Lubricate the o-ring prior to assembly.

NOTE: when designing your hydraulic circuit, consider the factors listed in "Preliminary Information," Section 5.0, on page 2. For more information about plumbing hydraulic circuits, see your Enerpac Workholding Catalog.

Port Identification



9.0 OPERATION



CAUTION: To ensure maximum cylinder performance and safety; be sure all hydraulic connections, hoses and fittings are properly sealed and fully tightened.

Be sure all items are rated to withstand system pressures. Under-rated components will not withstand higher pressure. Using underrated components will lead to equipment damage and possible personal injury.

9.1 Vent Plug

Single-acting cylinders have a vented plug on the left side of the cylinder when you are facing the hydraulic ports. To prevent entry of chips and coolant, the vent plug must not be removed. If the vent plug is subjected to a continuous coolant flood condition, attach tubing to the port using an SAE fitting and run the tubing to a non-contaminated area of the fixture.

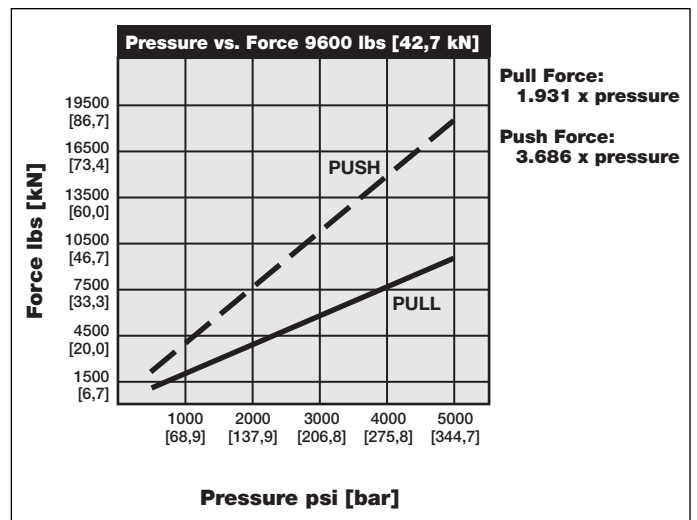
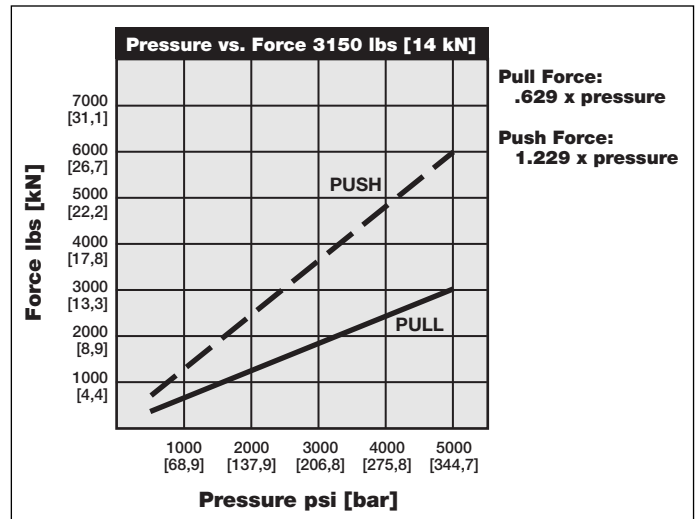
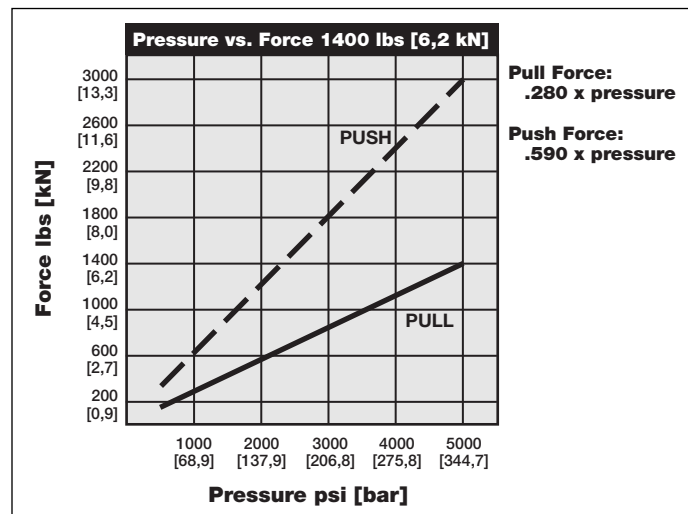
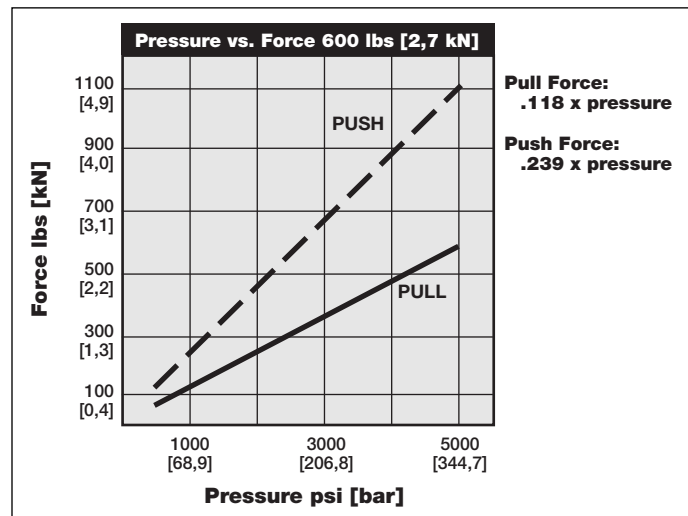
9.2 Pressure and Flow Settings



CAUTION: It is very important that you use the correct pressure and flow settings. Operating outside these limits will cause damage to the cylinder. Damage caused by exceeding rated pressure and maximum flow is NOT COVERED BY WARRANTY.

9.3 Push/Pull Forces vs. System Pressure

NOTE: Push forces are for double-acting cylinders only.



10.0 MAINTENANCE

Maintenance is required when wear or leakage is noticed. Occasionally inspect all components to detect any problem requiring service and maintenance. Enerpac offers ready-to-use Repair Parts Kits. *Repair Parts Sheets* are available with assembly drawing and parts list. Contact Enerpac.



IMPORTANT: Consult the Repair Parts Sheet for service information as to correct assembling and disassembling. Incorrect maintenance and service such as wrong torque values may cause product malfunctions and/or personal injury.

11.0 TROUBLESHOOTING

The following information is intended to be used only as an aid in determining if a problem exists. For repair service, contact your Distributor or Authorized Enerpac Service Center.

Problem	Possible Cause	Solution
1. Cylinder will not clamp/unclamp.	A. Pump release valve open B. No oil in pump reservoir C. Air in system D. Couplers not fully tightened E. Blocked hydraulic line F. Spring broken in cylinder	A. Close pump release valve B. Fill pump reservoir C. Remove air from hydraulic system D. Re-tighten couplers E. Check valves, fittings and tubing F. Replace spring
2. Cylinder advances part way.	A. Oil level in pump too low B. Plunger binding	A. Fill pump reservoir B. Replace damaged parts – refer to <i>Repair Parts Sheet</i>
3. Cylinder clamps/unclamps slower than normal.	A. Leaking connection B. Restricted hydraulic line C. Pump malfunction	A. Re-tighten fittings, couplers and tubing B. Check valves, fittings and tubing C. Refer to pump <i>Instruction Sheet</i>
4. Cylinder clamps/unclamps but will not hold pressure.	A. Seals damaged B. Leaking connection C. Pump malfunction	A. Replace seals – refer to <i>Repair Parts Sheet</i> B. Re-tighten fittings, couplers and tubing C. Refer to pump <i>Instruction Sheet</i>
5. Cylinder leaks oil.	A. Seals damaged B. Plunger worn or damaged	A. Replace seals – refer to <i>Repair Parts Sheet</i> B. Replace damaged parts – refer to <i>Repair Parts Sheet</i>

Enerpac Worldwide Locations

Africa

ENERPAC Middle East FZE
P.O. Box 18004
Jebel Ali, Dubai
United Arab Emirates
Tel: +971 (0)4 8872686
Fax: +971 (0)4 8872687

Australia

ENERPAC, Applied Power Australia Ltd.
Block V Unit 3, Regents Park Estate
391 Park Road, Regents Park NSW 2143
(P.O. Box 261) Australia
Tel: +61 297 438 988
Fax: +61 297 438 648

Brazil

Power Packer do Brasil Ltda.
Rua dos Inocentes, 587
04764-050 - Sao Paulo (SP)
Tel: +55 11 5687 2211
Fax: +55 11 5686 5583
Toll Free in Brazil:
Tel: 000 817 200 6718
vendasbrasil@enerpac.com

Canada

Actuant Canada Corporation
6615 Ordan Drive, Unit 14-15
Mississauga, Ontario L5T 1X2
Tel: +1 905 564 5749
Fax: +1 905 564 0305
Toll Free:
Tel: +1 800 268 4987
Fax: +1 800 461 2456
Technical Inquiries:
techservices@enerpac.com

China

Actuant China Ltd.
1F, 269 Fute N. Road
Waigaoqiao Free Trade Zone
Pudong New District
Shanghai, 200 131 China
Tel: +86 21 5866 9099
Fax: +86 21 5866 7156

Actuant China Ltd. (Beijing)
709A Xin No. 2
Diyang Building
Dong San Huan North Rd.
Beijing City, 100028 China
Tel: +86 10 845 36166
Fax: +86 10 845 36220

Central and Eastern Europe

ENERPAC B.V.
Storkstraat 25
P.O. Box 269, 3900 AG Veenendaal
The Netherlands
Tel: +31 318 535 936
Fax: +31 318 535 951

France

ACTUANT FRANCE S.A.
B.P. 200
Parc d'Activités
du Moulin de Massy
F-91882 Massy CEDEX
(Paris) France
Tel: +33 1 601 368 68
Fax: +33 1 692 037 50

Germany, Austria, Switzerland, Russia and CIS (excl. Caspian Sea Countries)

ENERPAC Applied Power GmbH
P.O. Box 300113
D-40401 Düsseldorf
Germany
Tel: +49 211 471 490
Fax: +49 211 471 49 28

India

ENERPAC Hydraulics (India) Pvt. Ltd.
Plot No. A/571
MIDC, TTC Industrial Area
Mahape-400 701
Navi Mumbai, India
Tel: +91 22 2778 1472
Fax: +91 22 2778 1473

◆ e-mail: info@enerpac.com

Italy

ENERPAC S.p.A.
Via Canova 4
20094 Corsico (Milano)
Tel: +39 02 4861 111
Fax: +39 02 4860 1288

Japan

Applied Power Japan Ltd.
1-1-11, Shimomae
Toda-shi
Saitama Pref.
Japan 335-0016
Tel: +81 484 430 1055
Fax: +81 484 430 1066

The Netherlands, Belgium, Luxembourg, Sweden, Denmark, Norway, Finland

ENERPAC B.V.
Storkstraat 25
P.O. Box 269, 3900 AG Veenendaal
The Netherlands
Tel: +31 318 535 911
Fax: +31 318 525 613
+31 318 535 848

Technical Inquiries Europe:
techsupport.europe@enerpac.com

Singapore

Actuant Asia Pte. Ltd.
25 Serangoon North Ave. 5
#03-01 Keppel Digihub
Singapore 554914
Thomson Road
P.O. Box 114
Singapore 915704
Tel: +65 64 84 5108
+65 64 84 3737
Fax: +65 64 84 5669
Technical Inquiries:
chee@actuant.com.sg

South Korea

Applied Power Korea Ltd.
3Ba 717, Shihwa Industrial Complex,
Jungwang-Dong, Shihung-Shi, Kyunggi-Do
Republic of Korea 429-450
Tel: +82 31 434 4506
Fax: +82 31 434 4507

◆ internet: www.enerpac.com

Spain, Portugal

ENERPAC
C/San José Artesano 8
Pol. Ind.
28108 Alcobendas
(Madrid) Spain
Tel: +34 91 661 11 25
Fax: +34 91 661 47 89

Middle East, Turkey, Caspian Sea, Greece

ENERPAC Middle East FZE
P.O. Box 18004
Jebel Ali, Dubai
United Arab Emirates
Tel: +971 (0)4 8872686
Fax: +971 (0)4 8872687

United Kingdom, Ireland

ENERPAC Ltd., P.O. Box 33
New Romney, TN28 8QF
United Kingdom
Tel: +44 01527 598 900
Fax: +44 01527 585 500

USA, Latin America and Caribbean

ENERPAC
P.O. Box 3241
6100 N. Baker Road
Milwaukee, WI 53209 USA
Tel: +1 262 781 6600
Fax: +1 262 783 9562

User inquiries:

+1 800 433 2766

Distributor inquiries/orders:

+1 800 558 0530

Technical Inquiries:

techservices@enerpac.com

All Enerpac products are guaranteed against defects in workmanship and materials for as long as you own them.
For your nearest authorized Enerpac Service Center, visit us at www.enerpac.com