

**E212**

**ENERPAC** 

# **WORKHOLDING CATALOG**

**A global resource of workholding solutions**

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\* These models are only shown in imperial versions in this catalog.  
Contact Enerpac to order metric models.



Refer to the "Yellow Pages" of this catalog for:

- Safety instructions
- Basic hydraulic information
- Advanced hydraulic technology
- FMS (Flexible Machining Systems) technology
- Conversion charts and hydraulic symbols

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Whether your workpiece needs to be clamped, punched, pressed, positioned or pulled, Enerpac Workholding is there to provide innovative solutions to increase your product quality and production output.

All over the world, Enerpac Workholding products are used to provide powerful clamping and positioning force to every type of manufacturing process. Enerpac cylinders are used for punching and clamping in automotive manufacturing. Work supports prevent deflection in aerospace production machining. From the simplest fixture to robotic assisted machining centers, Enerpac cylinders provide the holding and support force to keep the world moving.

Enerpac power units provide the power needed to clamp parts consistently again and again. Incorporating the latest technology and highest quality components, along with the widest variety of accessories, Enerpac power units are designed for every application.



# of Enerpac

## 10 Good Reasons to Work with Enerpac

### *Dealing with us couldn't be easier!*

2D and 3D CAD files of Enerpac Workholding products are available on-line ([www.enerpac.com](http://www.enerpac.com)). This service includes swing cylinders, work supports, and other clamping cylinders, along with all accessories. Catalogs in other languages and service information, including spare parts lists, are also available through the Enerpac website.

1. **Expert Design**
2. **Quality**
3. **Innovative Products**
4. **Reliability**
5. **Service Excellence**
6. **Availability**
7. **Value**
8. **Application Support**
9. **Global Vision**
10. **Worldwide Experience**



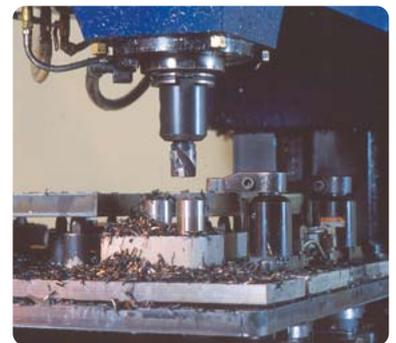
#### **Total Quality**

Every product we produce is individually tested to the most exacting standards. Only in this way, can we guarantee that we will meet the quality, price, and performance requirements of the markets we serve around the globe. An ISO 9001 certificate confirms that Enerpac's manufacturing and quality control procedures are precisely adhered to.



#### **Logistics Excellence**

Enerpac is a truly global partner, meeting the needs of local and multi-national customers. Maintaining service excellence in the changing world of modern distribution is one of Enerpac's missions. This demands the highest expertise in logistics around the world.



#### **The right products for the job**

The key to optimizing productivity is finding the right clamping products for the job. Take the time to page through the new Enerpac Workholding catalog, and discover how easy it is to arrive at the right selection of products for your job. Our Yellow Pages Section provides helpful applications and design information.

ISO 9001 Quality System Certified  
ENERPAC, Columbus WI USA



# ENERPAC®

Hydraulic Technology Worldwide

# A Guide to your new Enerpac Workholding Catalog

**The New Enerpac Workholding catalog;**

**... helps you design more efficient workholding fixtures,  
... is a global resource of workholding solutions.**

**This catalog is set-up  
in two main sections:**

**1 Imperial hydraulic product data section**

All Enerpac hydraulic workholding products shown with imperial based specifications and dimensions.

**2 Yellow Pages section**

Your guide to safety, basic hydraulics and application suggestions.

**Selecting the right product  
for your application:**

- 1.** Select your main product category from the *main index* on page 3. This index shows page numbers of product offerings in the catalog.
- 2.** From here you go to the selected product *range overview*. For an example see pages 8 and 9 for the swing cylinders and work supports overview. On this page you will find the main groups with regard to functional and mounting style options.
- 3.** Proceed to pages 10 and 11 to narrow down your selection with regard to function, mounting style and clamping capacity. These application & selection pages offer a brief overview of an entire range of products within one group. Note that these pages have *yellow* columns on both sides of the spread.
- 4.** Once you have made your product selection you can proceed to the product data pages, 12 and onwards, of the specific product series of your choice. These pages have *gray* columns on both sides of the spread.

## Range overview

### ENERPAC

## Swing cylinders & Work supports

**Swing Cylinders**  
Enerpac's complete line of swing cylinders provide maximum clamping force in the smallest possible package. With several mounting and operation styles available, Enerpac can fit any clamping need you can think of. Our unique patented clamp arm design has industry exclusive, and makes Enerpac's swing cylinders the most reliable, most durable, made to the highest quality standards. Enerpac swing cylinders will provide maximum performance and trouble free operation.

**Work Supports**  
Enerpac's line of work support cylinders give you maximum holding force in a compact package incorporating innovative material combinations, for work supports before the heaviest load-up pressures in the industry. Also, the use of corrosion resistant materials makes Enerpac work supports stand-up time and time again to even the most adverse applications.

**Technical support**  
Refer to the "Yellow Paper" for details on:  
 • Safety instructions  
 • Absolut hydraulic technology  
 • ISO 15723 Hydraulic System  
 • Mounting  
 • Operation  
 • Spare parts

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## Application & selection pages

- Product or range photo including basic description of the products function.
- Listing of main product features and benefits.
- Selection criteria from a functional standpoint.
- Selection criteria from a mounting standpoint.
- Main selection chart, showing product function, mounting option and capacity.
- Product related options and accessories.

### Swing cylinders Application & selection

**Compact and full featured design**

- Compact design allows for efficient fixture layout
- Range of mounting styles for greater design flexibility
- Double and single-acting cylinders to suit a variety of hydraulic systems
- Choice of gasket styles to meet system requirements
- All cylinders are available as left and right hand models
- Large bore and long stroke up to 10, 20, 32 and 50 inches
- ISO 15723 Hydraulic System design

**Select your swing cylinder type:**

- Single-acting**
  - Single-acting cylinders are used when the system requires, and does not require, return stroke energy.
  - They are used to clamp and hold work in place.
  - They are used to clamp and hold work in place.
  - They are used to clamp and hold work in place.
- Double-acting**
  - Used when greater control is required during the clamping cycle.
  - When loading, temperature is critical.
  - Double-acting cylinders are designed to provide hydraulic pressure in both directions.
  - They are used to clamp and hold work in place.
  - They are used to clamp and hold work in place.
- Quick-Lock-Positive locking**
  - Enerpac Quick-Lock-Positive locking cylinders are designed to provide hydraulic pressure in both directions.
  - They are used to clamp and hold work in place.
  - They are used to clamp and hold work in place.

**Select your mounting method:**

- SU series, Upper flange mounting**
  - Double-acting cylinders for threaded or threaded port connection
  - Easy installation with only 2 or 4 mounting bolts
- SL series, Lower flange mounting**
  - Double-acting cylinders for threaded or threaded port connection
  - Easy installation with only 2 or 4 mounting bolts
- ST series, Threaded body mounting**
  - Single-acting cylinders for threaded or threaded port connection
  - Easy installation with only 2 or 4 mounting bolts
- SC series, Cartridge mounting**
  - Double-acting cylinders for threaded or threaded port connection
  - Easy installation with only 2 or 4 mounting bolts

**Product selection**

Series	Stroke	Model number	Model number
SU series	10"	300-01	300-02
	20"	300-03	300-04
	32"	300-05	300-06
	50"	300-07	300-08
SL series	10"	300-09	300-10
	20"	300-11	300-12
	32"	300-13	300-14
	50"	300-15	300-16
ST series	10"	300-17	300-18
	20"	300-19	300-20
	32"	300-21	300-22
	50"	300-23	300-24
SC series	10"	300-25	300-26
	20"	300-27	300-28
	32"	300-29	300-30
	50"	300-31	300-32

**Options**

- Clamp arm
- Work supports
- Accessories

**Important**

- Single-acting cylinders can be mounted port.
- The upper flange swing cylinders are designed to be used with the standard ISO 15723 Hydraulic System.
- In case there is a lack of mounting space, the cylinders that are provided have mounting options and details.
- Do not exceed maximum flow rates.

## Product data pages

- Application schematic including real life application example.
- Product selection.
- Detailed dimensional data.
- Product dimensional drawings.
- Installation specifications.

### Swing cylinders - Upper flange models

**Minimal mounting height**  
...when space is at a premium

- Low profile mounting allows for efficient fixture layout
- Double-acting cylinders for threaded or threaded port connection
- Easy installation with only 2 or 4 mounting bolts
- ISO 15723 Hydraulic System design
- ISO 15723 Hydraulic System design

**Product selection**

Series	Stroke	Model number	Model number
SU series	10"	300-01	300-02
	20"	300-03	300-04
	32"	300-05	300-06
	50"	300-07	300-08
SL series	10"	300-09	300-10
	20"	300-11	300-12
	32"	300-13	300-14
	50"	300-15	300-16
ST series	10"	300-17	300-18
	20"	300-19	300-20
	32"	300-21	300-22
	50"	300-23	300-24
SC series	10"	300-25	300-26
	20"	300-27	300-28
	32"	300-29	300-30
	50"	300-31	300-32

**Dimensions in inches (mm)**

Series	Stroke	Model number	Model number
SU series	10"	300-01	300-02
	20"	300-03	300-04
	32"	300-05	300-06
	50"	300-07	300-08
SL series	10"	300-09	300-10
	20"	300-11	300-12
	32"	300-13	300-14
	50"	300-15	300-16
ST series	10"	300-17	300-18
	20"	300-19	300-20
	32"	300-21	300-22
	50"	300-23	300-24
SC series	10"	300-25	300-26
	20"	300-27	300-28
	32"	300-29	300-30
	50"	300-31	300-32

**Installation dimensions in inches**

**Options**

- Clamp arm
- Work supports
- Accessories

**Important**

- Single-acting cylinders can be mounted port.
- The upper flange swing cylinders are designed to be used with the standard ISO 15723 Hydraulic System.
- In case there is a lack of mounting space, the cylinders that are provided have mounting options and details.
- Do not exceed maximum flow rates.

# Swing cylinders

## Swing Cylinders

Enerpac's complete line of swing cylinders provide maximum clamping force in the smallest possible package. With several mounting and operation styles available, Enerpac can fit any clamping need you can think of. Our unique patented clamp arm design is an industry exclusive, and makes Enerpac's swing cylinder line more versatile than ever before. Made to the highest quality standards, Enerpac swing cylinders will provide maximum performance and trouble free operation.

## Work Supports

Enerpac's line of work support cylinders gives you maximum holding force in a compact package. Incorporating innovative material combinations, our work supports feature the lowest lock-up pressures in the industry. Also, the use of corrosion resistant materials enables Enerpac work supports to stand up time and time again to even the most abrasive applications.



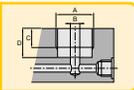
## Technical support

Refer to the "Yellow Pages" of this catalog for:

- Safety instructions
- Basic hydraulic information
- Advanced hydraulic technology
- FMS (Flexible Machining Systems) technology
- Conversion charts and hydraulic symbols

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# & Work supports

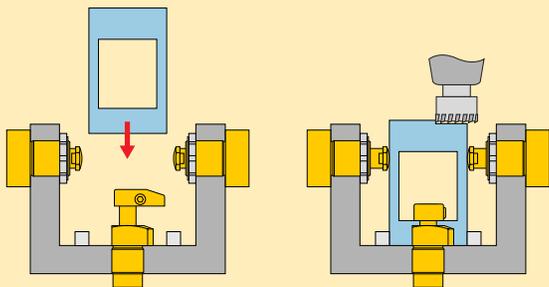
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# Swing cylinders *Application & selection*

Shown: SCRD-122, SULD-21, WPFL-50



► Enerpac swing cylinders allow unobstructed part fixturing and placement. The plunger rod and the attached clamp arm rotate 90 degrees in either a clockwise or counter clockwise direction, then travel down an additional distance to clamp against the fixtured part. Upon release of clamping pressure, the clamp arm rotates back 90 degrees in the opposite direction to allow for part removal and new part placement.



■ *Swing cylinders used in conjunction with work supports and other Enerpac components to positively hold the workpieces during machining operations.*



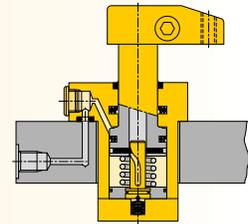
## Compact and full featured design

- Compact design allows for efficient fixture layout
- Variety of mounting styles to meet design needs
- Double and single-acting cylinders to suit a variety of hydraulic requirements
- Choice of porting styles to meet system and design requirements
- All cylinders are available as left and right turning models
- Large ball and cam design on 11, 21, 51 and 121 models allows swing rotation to be changed easily
- Kick-out mechanism on 92, 201, and 351 models prevents damage to cylinder from high flow rates or misapplication

## **i** Select your swing cylinder type:

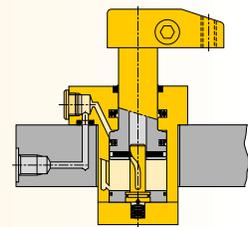
### Single-acting

- The obvious choice when there are few system restrictions, and there are not many units retracting simultaneously
- Fewer valving requirements which results in a less complex circuit
- Innovative clamp arm design allows quick and secure arm positioning



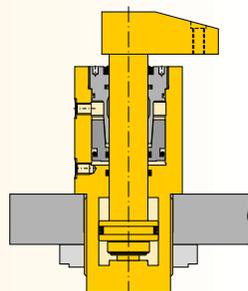
### Double-acting

- Used when greater control is required during the unclamp cycle
- When timing sequences are critical: less sensitive to system back pressures, resulting from long tube lengths or numerous components being retracted at the same time
- Innovative clamp arm design allows quick and secure arm positioning



### Collet-Lok® Positive locking

- Enerpac Collet-Lok® positive locking cylinders are designed to mechanically hold the workpiece while hydraulic pressure is removed. After machining, hydraulic pressure is applied to unclamp the workpiece
- Used when live hydraulics are not available during the clamp cycle or when parts must be held for long periods of time
- This design is an industry exclusive



For Collet-Lok® positive locking swing cylinders, see **20**

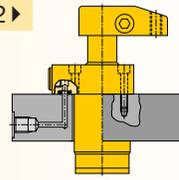


## Select your mounting method:

### SU series, Upper flange mounting

- Flexible design allows for manifold or threaded oil port connection
- Fixture hole does not require tight tolerances
- Easy installation with only 3 or 4 mounting bolts

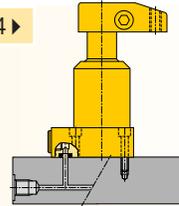
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### SL series, Lower flange mounting

- Flexible design allows for manifold or threaded port connection
- No fixture hole required
- Easy installation with only 3 or 4 mounting bolts

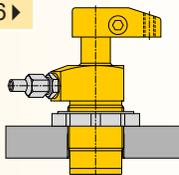
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### ST series, Threaded body mounting

- Body thread for precise cylinder height positioning
- Threaded oil port connection
- Can be threaded directly into the fixture and secured in position by means of standard flange nuts

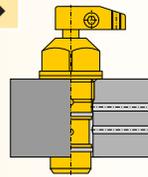
16 ▶



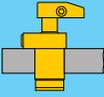
### SC series, Cartridge mounting

- Minimal space required on fixture
- External plumbing not required
- Allows close positioning of adjoining units
- Cylinder can be completely recessed in fixture

18 ▶



## Product selection

Clamping force <sup>1)</sup>	Stroke		Upper flange	Lower flange	Threaded body	Cartridge
	lbs	in clamping total				
<b>▼ Single-acting</b>			Model number <sup>2)</sup>			
475	.32	.65	SURS-21	SLRS-21	STRS-21	SCRS-22
1100	.39	.89	SURS-51	SLRS-51	STRS-51	SCRS-52
1800	.47	.87	SURS-92	SLRS-92	STRS-92	-
2400	.50	1.12	SURS-121	SLRS-121	STRS-121	SCRS-122
3900	.55	1.10	SURS-201	SLRS-201	STRS-201	-
7450	.63	1.18	SURS-351	SLRS-351	STRS-351	-
<b>▼ Double-acting</b>			Model number <sup>2)</sup>			
300	.26	.51	SURD-11	SLRD-11	STRD-11	-
500	.32	.65	SURD-21	SLRD-21	STRD-21	SCRD-22
1250	.39	.89	SURD-51	SLRD-51	STRD-51	SCRD-52
2025	.47	.87	SURD-92	SLRD-92	STRD-92	-
2025	1.26	1.65	SURDL-92	-	-	-
2600	.50	1.12	SURD-121	SLRD-121	STRD-121	SCRD-122
2600	1.25	1.87	SURDL-121	-	-	-
4200	.55	1.10	SURD-201	SLRD-201	STRD-201	-
7600	.63	1.18	SURD-351	SLRD-351	STRD-351	-
7600	1.25	1.83	SURDL-351	-	-	-
<b>▼ Collet Lok<sup>®</sup> Positive locking</b>			Model number <sup>2)</sup>			
1000	.32	.94	-	WPFR-50	-	-
2000	.47	1.10	-	WPFR-100	WPTR-100	-
8500	.39	1.65	-	WPFR-300	WPTR-300	-

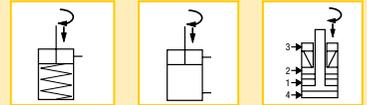
<sup>1)</sup> With standard clamp arm. Clamp arms are sold separately (122).  
Clamping forces for single-acting models are reduced in order to overcome return spring force.  
<sup>2)</sup> For left turning swing cylinders replace the R in the model number for an L.  
Note: Call Enerpac to order models with metric thread and BSPP port connections.

Force: 300 - 8500 lbs

Stroke: .51 - 1.87 inch

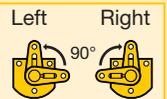
Pressure: 500 - 5000 psi

- E** Cilindros giratorios
- F** Vérins de bridage pivotants
- D** Schwenkspannzylinder



## Options

Available as both left and right turning



Clamp arms

22 ▶



Work supports

30 ▶



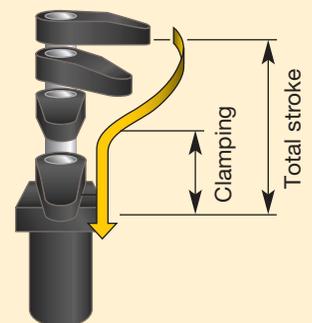
Accessories

72 ▶



## Important

Actual clamping may only take place when the cylinder has completed its 90° swing.



All swing cylinders have swing angle repeatability of  $\pm 1^\circ$ .

Other swing angles available upon request.  
Contact Enerpac for info.

# Swing cylinders - Upper flange models

Shown: SURS-201, SURS-51

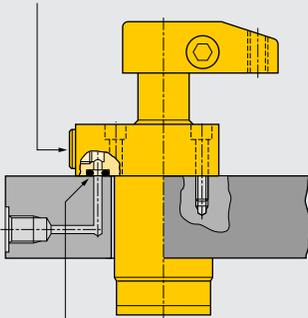


Swing cylinders  
Work supports

## SU series

The Enerpac upper flange swing cylinders are designed for integrated manifold mounting solutions. Hydraulic connections are made through SAE or BSPP oil connection or the standard integrated O-ring ports.

SAE oil connection



Integrated O-ring port

■ Enerpac upper flange swing clamps integrated into a fully automated machining system.



## Minimal mounting height

...when space is at a premium

- Flexible design allows for manifold or threaded port connection
- Low profile mounting style allows body to be below mounting surface
- Simple mounting preparation and easy installation – 3 or 4 mounting bolts
- Double oil connection – threaded port or manifold mount
- Symmetrical rectangular flange design enables clamping at three sides of the cylinder
- 30, 45, and 60 degree swing angles available on request

## Product selection

Clamping force <sup>1)</sup>	Stroke		Left turning 90°	Right turning 90°	Cylinder effective area		Oil capacity		Max. oil flow <sup>1)</sup>	Standard clamp arm Sold separately 22 ▶
	lbs	in			in <sup>2</sup>	in <sup>3</sup>	in <sup>3</sup> /min			
	Clamp	Total			Un-clamp	Un-clamp	Un-clamp	Un-clamp		
▼ Single-acting Model number <sup>2)</sup>										
475	.32	.65	SULS-21	SURS-21	.12	–	.08	–	12	CAS-21
1100	.39	.89	SULS-51	SURS-51	.28	–	.25	–	25	CAS-51
1800	.47	.87	SULS-92	SURS-92	.49	–	.42	–	60	CAS-92
2400	.50	1.12	SULS-121	SURS-121	.63	–	.70	–	100	CAS-121
3900	.55	1.10	SULS-201	SURS-201	1.10	–	1.22	–	140	CAS-201
7450	.63	1.18	SULS-351	SURS-351	1.92	–	2.27	–	240	CAS-351
▼ Double-acting Model number <sup>2)</sup>										
300	.26	.51	SULD-11	SURD-11	.07	.15	.04	.08	10	CAS-11
500	.32	.65	SULD-21	SURD-21	.12	.24	.08	.16	12	CAS-21
1250	.39	.89	SULD-51	SURD-51	.28	.59	.25	.53	25	CAS-51
2025	.47	.87	SULD-92	SURD-92	.49	1.25	.42	1.08	60	CAS-92
2025	1.26	1.65	SULD-92	SURD-92	.49	1.25	.81	1.86	60	CAS-92
2600	.50	1.12	SULD-121	SURD-121	.63	1.23	.70	1.40	100	CAS-121
2600	1.25	1.87	SULD-121	SURD-121	.63	1.23	.97	2.30	100	CAS-121
4200	.55	1.10	SULD-201	SURD-201	1.10	2.35	1.22	2.60	140	CAS-201
7600	.63	1.18	SULD-351	SURD-351	1.92	3.68	2.27	4.35	240	CAS-351
7600	1.25	1.83	SULD-351	SURD-351	1.92	3.68	3.53	6.77	240	CAS-351

<sup>1)</sup> With standard clamp arm. Clamp arms are sold separately (22). Clamping forces for single-acting models are reduced in order to overcome return spring force.

<sup>2)</sup> For models with straight plunger movement, replace L or R with S.

Note: Call Enerpac to order models with BSPP port connections.

## Dimensions in inches [⊕]

Left turning models	A	B	C	C1	D	D1	D2	F	H	K	M
					∅			∅			
▼ Single-acting											
SULS-21	4.41	2.32	1.04	1.69	1.10	1.86	1.77	.39	.43	.63	–
SULS-51	5.31	2.71	1.08	1.97	1.37	2.13	2.25	.63	.39	.75	–
SULS-92	5.67	3.00	1.10	1.97	1.88	2.76	2.13	.98	.51	.98	.61
SULS-121	6.75	3.37	1.06	2.18	1.87	2.63	2.88	.87	.39	1.19	–
SULS-201	6.57	3.46	1.10	2.20	2.46	3.35	2.76	1.26	.51	1.18	.93
SULS-351	7.46	3.97	1.10	2.28	3.02	3.94	3.50	1.50	.51	1.58	1.10
▼ Double-acting											
SULD-11	3.67	2.09	1.10	1.61	1.00	1.78	1.65	.31	.44	.47	–
SULD-21	4.41	2.32	1.04	1.69	1.10	1.86	1.77	.39	.43	.63	–
SULD-51	5.31	2.71	1.08	1.97	1.37	2.13	2.25	.63	.39	.75	–
SULD-92	5.67	3.00	1.10	1.97	1.88	2.76	2.13	.98	.51	.98	–
SULD-92	7.24	3.78	1.10	2.75	1.88	2.76	2.13	.98	.51	.98	–
SULD-121	6.75	3.37	1.06	2.18	1.87	2.63	2.88	.87	.39	1.19	–
SULD-121	9.00	4.12	1.06	2.93	1.87	2.62	2.88	.87	.39	1.19	–
SULD-201	6.56	3.45	1.10	2.20	2.46	3.35	2.76	1.26	.51	1.18	–
SULD-201	7.45	3.96	1.10	2.28	3.02	3.94	3.50	1.50	.51	1.58	–
SULD-351	8.69	4.58	1.10	2.93	3.02	3.94	3.50	1.50	.51	1.58	–

Note: Dimensions shown with standard clamp arm.

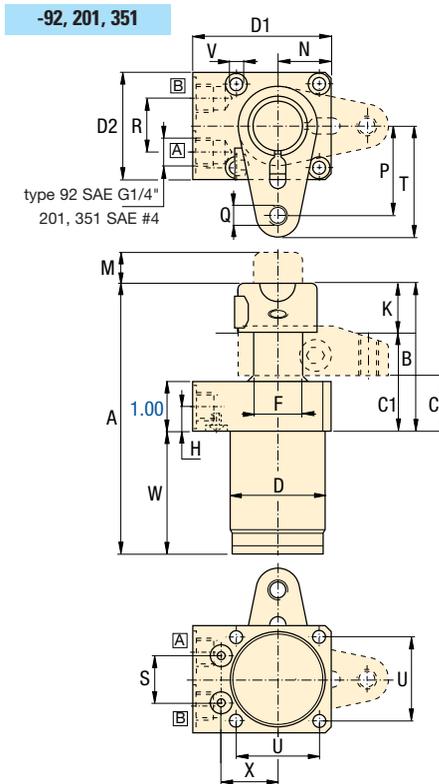
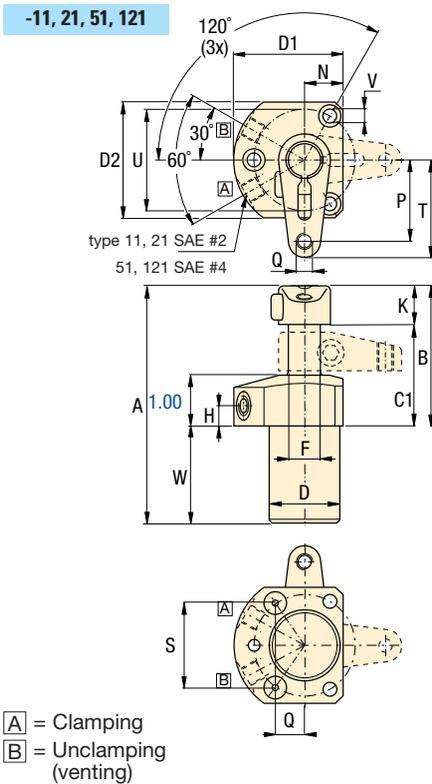
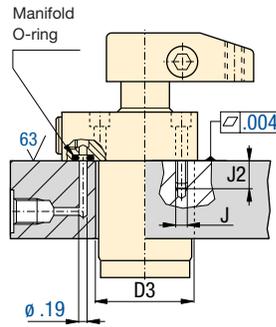


**Installation dimensions in inches**

Clamping force <sup>1)</sup> lbs	Fixture hole Ø D3	Mounting thread J UNF	Min. depth J2	Manifold O-ring <sup>2)</sup> ARP No. or Inside Ø x thickness
300	1.010	#8-36	.49	568-010
500	1.110	#10-32	.65	568-010
1250	1.380	.250-28	.65	568-011
2025	1.895	M6	.59	.17 X .139
2600	1.880	.312-24	.80	568-011
4200	2.475	.312-24	.67	.17 X .139
7600	3.035	.375-24	.74	.17 X .139

<sup>1)</sup> With standard clamp arm.  
<sup>2)</sup> Polyurethane, 92 Durometer

Note: Mounting bolts and O-rings included.

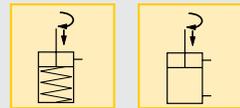


	N	P	Q	R	S	T	U	V	W	X	lbs	Right turning models
	UN						ø					
<b>Single-acting ▼</b>												
	.61	.96	.250-20	-	0.825	1.20	Ø1.58	.225	2.09	0.714	1.0	<b>SURS-21</b>
	.75	1.58	.312-18	-	1.614	1.90	Ø1.97	.268	2.60	0.565	2.5	<b>SURS-51</b>
	1.06	1.77	M10X1,5	1.02	.934	2.20	1.65	.270	2.68	1.128	4.4	<b>SURS-92</b>
	1.00	2.00	.375-16	-	2.048	2.40	Ø2.50	.347	3.38	0.717	3.5	<b>SURS-121</b>
	1.38	2.17	.500-13	1.02	1.145	2.80	2.16	.335	3.11	1.382	7.7	<b>SURS-201</b>
	1.75	2.68	.625-11	1.02	1.370	3.30	2.76	.425	3.48	1.634	12.1	<b>SURS-351</b>
<b>Double-acting ▼</b>												
	.53	.79	#10-32	-	0.790	.98	Ø1.38	.190	1.58	0.684	1.0	<b>SURD-11</b>
	.61	.96	.250-20	-	0.825	1.20	Ø1.58	.225	2.09	0.714	1.0	<b>SURD-21</b>
	.75	1.58	.312-18	-	1.614	1.90	Ø1.97	.268	2.60	0.565	2.5	<b>SURD-51</b>
	1.06	1.77	M10X1,5	1.02	.934	2.20	1.65	.270	2.68	1.128	4.4	<b>SURD-92</b>
	1.06	2.00	M10X1,5	1.02	.934	2.20	1.65	.270	3.46	1.128	5.7	<b>SURDL-92</b>
	1.00	2.00	.375-16	-	2.048	2.40	Ø2.50	.347	3.38	0.717	3.5	<b>SURD-121</b>
	1.00	2.00	.375-16	-	2.048	2.40	Ø2.50	.347	4.88	0.717	4.0	<b>SURDL-121</b>
	1.38	2.17	.500-13	1.02	1.145	2.80	2.16	.335	3.11	1.382	7.7	<b>SURD-201</b>
	1.75	2.68	.625-11	1.02	1.370	3.30	2.76	.425	3.48	1.634	12.1	<b>SURD-351</b>
	1.75	2.68	.625-11	1.02	1.370	3.30	2.76	.425	4.11	1.634	15.1	<b>SURDL-351</b>

Note: U = Bolt circle

- Force: 300 - 7600 lbs
- Stroke: .51 - 1.87 inch
- Pressure: 500 - 5000 psi

- E** Cilindros giratorios
- F** Vérins de bridage pivotants
- D** Schwenkspannzylinder



**Options**

- Clamp arms** [22](#)
- Work supports** [30](#)
- Collet-Lok® swing cylinders** [20](#)
- Accessories** [72](#)

**Important**

Single-acting cylinders can be vented through the manifold port.

The upper flange swing cylinder has a bolt pattern which is identical to its lower flange equivalent, enabling interchangeability.

In case there is a risk of machining coolants and debris being inhaled via the breather vent, it is recommended to pipe this port to an area outside the fixture that is protected from machining coolants and debris.

Do not exceed maximum flow rates.

Swing cylinders  
 Work supports  
 Linear cylinders  
 Power sources  
 Valves  
 System components  
 Yellow pages

# Swing cylinders - Lower flange models

Shown: SLRD-51, SLRS-201

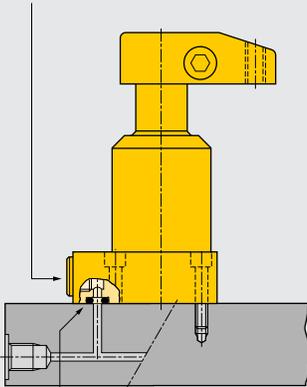


Swing cylinders  
Work supports

## SL series

Enerpac lower flange series swing cylinders can be bolted to the fixture, allowing easy installation of the unit and does not require machined fixture holes. Hydraulic connections are made through SAE or BSPP oil connection or the standard integrated O-ring ports.

SAE oil connection



Integrated O-ring port

Lower flange swing cylinders mounted to the face of the fixture.



## No fixture hole required

...cylinder can be bolted directly to fixture

- Flexible design allows for manifold or threaded port connection
- No fixture hole preparation required
- Easiest mounting preparation in the swing cylinder line
- Symmetrical rectangular flange design enables clamping at three sides of the cylinder
- Allows extra large parts to be clamped
- 30, 45 and 60 degree swing angles available on request

## Product selection

Clamping force <sup>1)</sup>	Stroke		Left turning 	Right turning 	Cylinder effective area		Oil capacity		Max. oil flow <sup>1)</sup> in <sup>3</sup> /min	Standard clamp arm Sold separately 
	lbs	Clamp			Total	in <sup>2</sup>	Un-clamp	in <sup>3</sup>		
<b>▼ Single-acting</b>										
Model number <sup>2)</sup>										
475	.32	.65	<b>SLLS-21</b>	<b>SLRS-21</b>	.12	-	.08	-	12	<b>CAS-21</b>
1100	.39	.89	<b>SLLS-51</b>	<b>SLRS-51</b>	.28	-	.25	-	25	<b>CAS-51</b>
1800	.47	.87	<b>SLLS-92</b>	<b>SLRS-92</b>	.49	-	.42	-	60	<b>CAS-92</b>
2400	.50	1.12	<b>SLLS-121</b>	<b>SLRS-121</b>	.63	-	.70	-	100	<b>CAS-121</b>
3900	.55	1.10	<b>SLLS-201</b>	<b>SLRS-201</b>	1.10	-	1.22	-	140	<b>CAS-201</b>
7450	.63	1.18	<b>SLLS-351</b>	<b>SLRS-351</b>	1.92	-	2.27	-	240	<b>CAS-351</b>
<b>▼ Double-acting</b>										
Model number <sup>2)</sup>										
300	.26	.51	<b>SLLD-11</b>	<b>SLRD-11</b>	.07	.15	.04	.08	10	<b>CAS-11</b>
500	.32	.65	<b>SLLD-21</b>	<b>SLRD-21</b>	.12	.24	.08	.15	12	<b>CAS-21</b>
1250	.39	.89	<b>SLLD-51</b>	<b>SLRD-51</b>	.28	.59	.25	.52	25	<b>CAS-51</b>
2025	.47	.87	<b>SLLD-92</b>	<b>SLRD-92</b>	.49	1.25	.42	1.08	60	<b>CAS-92</b>
2600	.50	1.12	<b>SLLD-121</b>	<b>SLRD-121</b>	.63	1.23	.70	1.40	100	<b>CAS-121</b>
4200	.55	1.10	<b>SLLD-201</b>	<b>SLRD-201</b>	1.10	2.35	1.22	2.60	140	<b>CAS-201</b>
7600	.63	1.18	<b>SLLD-351</b>	<b>SLRD-351</b>	1.92	3.68	2.27	4.35	240	<b>CAS-351</b>

<sup>1)</sup> With standard clamp arm. Clamp arms are sold separately () 22). Clamping forces for single-acting models are reduced in order to overcome return spring force.

<sup>2)</sup> For models with straight plunger movement, replace L or R with S.

Note: Call Enerpac to order models with BSPP port connections.

## Dimensions in inches

Left turning models	A	C	C1	D	D1	D2	F	H	K	M
					∅	∅				
<b>▼ Single-acting</b>										
<b>SLLS-21</b>	4.41	3.13	3.78	1.10	1.86	1.77	.39	.54	.63	-
<b>SLLS-51</b>	5.31	3.68	4.57	1.37	2.13	2.25	.63	.55	.75	-
<b>SLLS-92</b>	5.94	4.09	4.96	1.88	2.76	2.13	.98	.49	.98	.61
<b>SLLS-121</b>	6.75	4.44	5.56	1.87	2.63	2.88	.87	.62	1.19	-
<b>SLLS-201</b>	6.88	4.48	5.63	2.51	3.35	2.76	1.26	.49	1.18	.93
<b>SLLS-351</b>	7.77	4.85	5.94	3.14	3.94	3.50	1.50	.49	1.58	1.10
<b>▼ Double-acting</b>										
<b>SLLD-11</b>	3.75	2.77	3.28	1.00	1.78	1.65	.31	.54	.47	-
<b>SLLD-21</b>	4.41	3.13	3.78	1.10	1.86	1.77	.39	.54	.63	-
<b>SLLD-51</b>	5.31	3.68	4.57	1.37	2.13	2.25	.63	.55	.75	-
<b>SLLD-92</b>	5.94	4.09	4.96	1.87	2.76	2.13	.98	.49	.98	-
<b>SLLD-121</b>	6.75	4.44	5.56	1.87	2.63	2.88	.87	.62	1.19	-
<b>SLLD-201</b>	6.88	4.48	5.63	2.51	3.35	2.76	1.26	.49	1.18	-
<b>SLLD-351</b>	7.77	4.85	5.94	3.14	3.94	3.50	1.50	.49	1.58	-

Note: Dimensions shown with standard clamp arm.

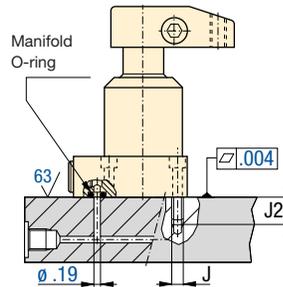


**Installation dimensions** in inches

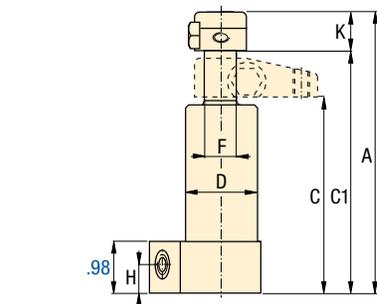
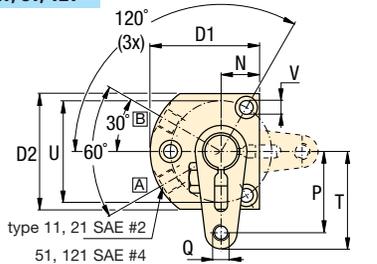
Clamping force <sup>1)</sup> lbs	Mounting thread J	Minimum thread depth J2	Manifold O-ring <sup>2)</sup> ARP No. or Inside Ø x thickness
300	#8-36 UNF	.49	568-010
500	#10-32 UNF	.65	568-010
1250	.250-28 UNF	.65	568-011
2025	M6	.59	.17 x .139
2600	.312-24 UNF	.80	568-011
4200	.312-24 UNF	.67	.17 x .139
7600	.375-24 UNF	.74	.17 x .139

<sup>1)</sup> With standard clamp arm.  
<sup>2)</sup> Polyurethane, 92 Durometer

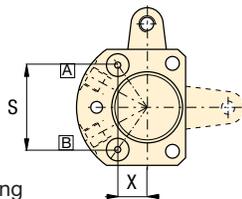
Note: Mounting bolts and O-rings included.



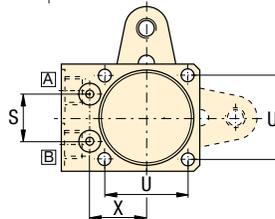
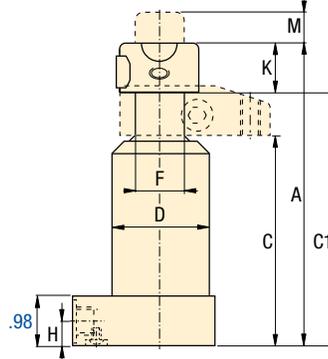
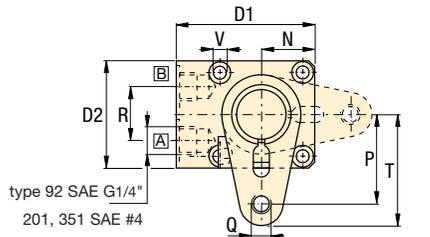
**-11, 21, 51, 121**



**A** = Clamping  
**B** = Unclamping (venting)



**-92, 201, 351**



	N	P	Q	R	S	T	U	V	X	lbs	Right turning models	
	UN										Ø	
<b>Single-acting</b> ▼												
	.61	.96	.250-20	-	0.825	1.22	Ø1.58	.22	0.174	1.0	SLRS-21	
	.75	1.58	.312-18	-	1.614	1.89	Ø1.97	.27	0.565	2.5	SLRS-51	
	1.06	1.77	M10X1,5	1.02	.934	2.20	1.65	.27	1.128	4.4	SLRS-92	
	1.00	2.00	.375-16	-	2.048	2.43	Ø2.50	.35	0.717	3.5	SLRS-121	
	1.38	2.17	.500-13	1.02	1.145	2.76	2.16	.33	1.382	7.7	SLRS-201	
	1.75	2.68	.625-11	1.02	1.370	3.27	2.76	.42	1.634	12.1	SLRS-351	
<b>Double-acting</b> ▼												
	.53	.79	#10-32	-	0.790	.98	Ø1.38	.19	0.684	1.0	SLRD-11	
	.61	.96	.250-20	-	0.825	1.22	Ø1.58	.22	0.714	1.0	SLRD-21	
	.75	1.58	.312-18	-	1.614	1.89	Ø1.97	.27	0.565	2.5	SLRD-51	
	1.06	1.77	M10X1,5	1.02	.934	2.20	1.65	.27	1.128	4.4	SLRD-92	
	1.00	2.00	.375-16	-	2.048	2.43	Ø2.50	.35	0.717	3.5	SLRD-121	
	1.38	2.17	.500-13	1.02	1.145	2.76	2.16	.33	1.382	7.7	SLRD-201	
	1.75	2.68	.625-11	1.02	1.370	3.27	2.76	.42	1.634	12.1	SLRD-351	

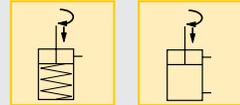
Note: U = Bolt circle

Force: 300 - 7600 lbs

Stroke: .51 - 1.18 inch

Pressure: 500 - 5000 psi

- E** Cilindros giratorios
- F** Vérins de bridage pivotants
- D** Schwenkspannzylinder



**Options**

**Clamp arms**  
22 ▶

**Work supports**  
30 ▶

**Collet-Lok® swing cylinders**  
20 ▶

**Accessories**  
72 ▶

**Important**

Single-acting cylinders can be vented through the manifold port.

The lower flange swing cylinder has a bolt pattern which is identical to its upper flange equivalent, enabling interchangeability.

In case there is a risk of machining coolants and debris being inhaled via the breather vent, it is recommended to pipe this port to an area outside the fixture that is protected from machining coolants and debris.

Do not exceed maximum flow rates.

Swing cylinders  
Work supports  
Linear cylinders  
Power sources  
Valves  
System components  
Yellow pages

# Swing cylinders - Threaded body models

Shown: STRD-51, STRD-201



Swing cylinders  
Work supports

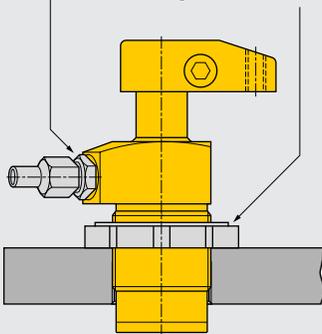
## ST series

Enerpac threaded body swing cylinders are threaded directly into the fixture.

The cylinder height is adjusted to the appropriate height, and then locked in place using a flange nut (□ 72).

SAE oil connection

Flange nut



■ Threaded body swing cylinders allow the clamp to be buried in the fixture to minimize the required area, while the height remains adjustable.



## Cylinders can be threaded directly into fixture ...can be secured at any height

- Body thread for precise cylinder height positioning
- Threaded port connection
- Easy installation and removal
- Greatest flexibility in fixture design
- 30, 45 and 60 degree swing angles available on request

## Product selection

Clamping force <sup>1)</sup>	Stroke		Left turning 90°	Right turning 90°	Cylinder effective area		Oil capacity		Max. oil flow <sup>1)</sup>	Standard clamp arm Sold separately □ 22 ▶
	lbs	Clamp			Total	in <sup>2</sup>	Un-clamp	in <sup>3</sup>		
▼ Single-acting Model number <sup>2)</sup>										
475	.32	.65	<b>STLS-21</b>	<b>STRS-21</b>	.12	-	.08	-	12	<b>CAS-21</b>
1100	.39	.89	<b>STLS-51</b>	<b>STRS-51</b>	.28	-	.25	-	25	<b>CAS-51</b>
1800	.47	.87	<b>STLS-92</b>	<b>STRS-92</b>	.49	-	.42	-	60	<b>CAS-92</b>
2400	.50	1.12	<b>STLS-121</b>	<b>STRS-121</b>	.63	-	.70	-	100	<b>CAS-121</b>
3900	.55	1.10	<b>STLS-201</b>	<b>STRS-201</b>	1.10	-	1.22	-	140	<b>CAS-201</b>
7450	.63	1.18	<b>STLS-351</b>	<b>STRS-351</b>	1.92	-	2.27	-	240	<b>CAS-351</b>
▼ Double-acting Model number <sup>2)</sup>										
300	.26	.51	<b>STLD-11</b>	<b>STRD-11</b>	.07	.15	.04	.08	10	<b>CAS-11</b>
500	.32	.65	<b>STLD-21</b>	<b>STRD-21</b>	.12	.24	.08	.15	12	<b>CAS-21</b>
1250	.39	.89	<b>STLD-51</b>	<b>STRD-51</b>	.28	.59	.25	.52	25	<b>CAS-51</b>
2025	.47	.87	<b>STLD-92</b>	<b>STRD-92</b>	.49	1.25	.42	1.08	60	<b>CAS-92</b>
2600	.50	1.12	<b>STLD-121</b>	<b>STRD-121</b>	.63	1.23	.70	1.40	100	<b>CAS-121</b>
4200	.55	1.10	<b>STLD-201</b>	<b>STRD-201</b>	1.10	2.35	1.22	2.60	140	<b>CAS-201</b>
7600	.63	1.18	<b>STLD-351</b>	<b>STRD-351</b>	1.92	3.68	2.27	4.35	240	<b>CAS-351</b>

<sup>1)</sup> With standard clamp arm. Clamp arms are sold separately (□ 22). Clamping forces for single-acting models are reduced in order to overcome return spring force.

<sup>2)</sup> For models with straight plunger movement, replace L or R with S.

Note: Call Enerpac to order models with metric thread and BSPP port connections.

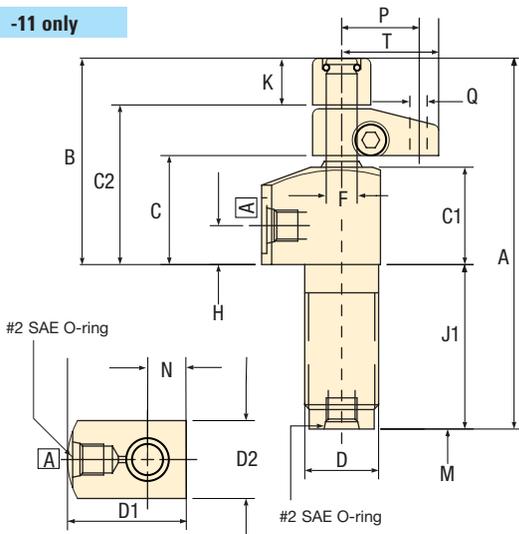
## Dimensions in inches [□ 72]

Left turning models	A	B	C	C1	C2	D	D1	D2	F	H	J1
						∅			∅		
▼ Single-acting											
<b>STLS-21</b>	4.41	2.32	1.04	1.69	.98	1.125-16 UNF	1.55	1.30	.39	.39	2.09
<b>STLS-51</b>	5.31	2.71	1.08	1.97	.98	1.375-18 UNF	1.87	1.50	.63	.38	2.60
<b>STLS-92</b>	5.67	3.20	1.30	2.17	1.18	M48 X 1,5	2.46	1.89	.98	.51	1.69
<b>STLS-121</b>	6.75	3.37	1.06	2.18	1.00	1.875-16 UNF	2.38	2.00	.87	.38	3.38
<b>STLS-201</b>	6.57	3.74	1.38	2.48	1.26	2.500-16 UNF	2.99	2.56	1.26	.51	2.06
<b>STLS-351</b>	7.46	4.24	1.38	2.56	1.27	3.125-16 UNF	3.48	3.15	1.50	.51	2.57
▼ Double-acting											
<b>STLD-11</b>	3.75	2.09	1.10	1.61	.98	.750-16 UNF	1.20	.79	.31	.39	1.47
<b>STLD-21</b>	4.41	2.32	1.04	1.69	.98	1.125-16 UNF	1.55	1.30	.39	.39	2.09
<b>STLD-51</b>	5.31	2.71	1.08	1.97	.98	1.375-18 UNF	1.87	1.50	.63	.38	2.60
<b>STLD-92</b>	5.67	3.20	1.30	2.17	1.18	M48 X 1,5	2.46	1.89	.98	.51	1.69
<b>STLD-121</b>	6.75	3.37	1.06	2.18	1.00	1.875-16 UNF	2.38	2.00	.87	.38	3.38
<b>STLD-201</b>	6.57	3.74	1.38	2.48	1.26	2.500-16 UNF	2.99	2.56	1.26	.51	2.06
<b>STLD-351</b>	7.46	4.24	1.38	2.56	1.27	3.125-16 UNF	3.48	3.15	1.50	.51	2.57

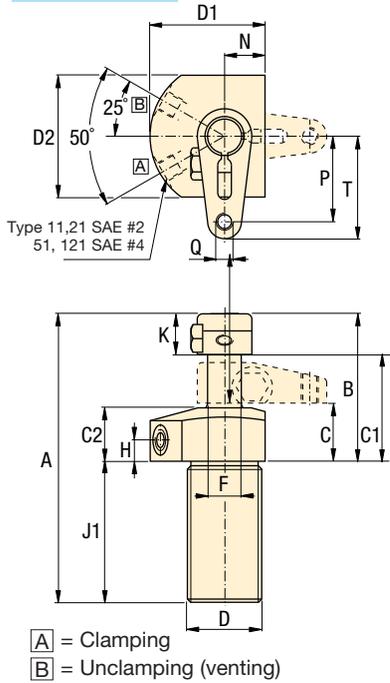
Note: Dimensions shown with standard clamp arm.



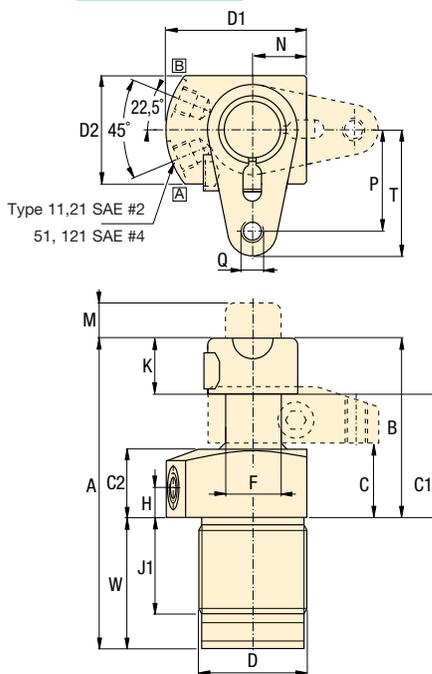
-11 only



21, 51, 121



-92, 201, 351

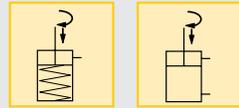


Force: 300 - 7600 lbs

Stroke: .51 - 1.18 inch

Pressure: 500 - 5000 psi

- E** Cilindros giratorios
- F** Vérins de bridage pivotants
- D** Schwenkspannzylinder



**Options**

Clamp arms

22 ▶



Work supports

30 ▶



Collet-Lok® swing cylinders

20 ▶



Accessories

72 ▶



**Important**

Single-acting cylinders can be vented through the manifold port.

In case there is a risk of machining coolants and debris being inhaled via the breather vent, it is recommended to pipe this port to an area outside the fixture that is protected from machining coolants and debris.

Do not exceed maximum flow rates.

	K	M	N	P	Q	T	W	lbs	Right turning models
									Single-acting ▼
	.63	-	.61	.96	.250-20 UNC	1.22	-	1.1	STRS-21
	.75	-	.75	1.58	.312-18 UNC	1.89	-	2.5	STRS-51
	.98	.61	.94	1.77	M10 X 1,5	2.20	2.48	4.4	STRS-92
	1.19	-	1.00	2.00	.375-16 UNC	2.43	-	3.5	STRS-121
	1.18	.93	1.28	2.17	.500-13 UNC	2.76	2.83	7.1	STRS-201
	1.58	1.10	1.57	2.68	.625-11 UNC	3.27	3.21	12.1	STRS-351
									Double-acting ▼
	.47	-	.39	.79	#10-32 UNF	.98	-	1.0	STRD-11
	.63	-	.61	.96	.250-20 UNC	1.22	-	1.1	STRD-21
	.75	-	.75	1.58	.312-18 UNC	1.89	-	2.5	STRD-51
	.98	-	.94	1.77	M10 X 1,5	2.20	2.48	4.4	STRD-92
	1.19	-	1.00	2.00	.375-16 UNC	2.43	-	3.5	STRD-121
	1.18	-	1.28	2.17	.500-13 UNC	2.76	2.83	7.7	STRD-201
	1.58	-	1.57	2.68	.625-11 UNC	3.27	3.21	12.1	STRD-351

# Swing cylinders - Cartridge models

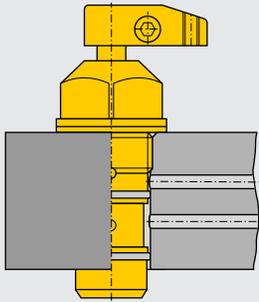
Shown: SCRD-122, SCRD-52



## SC series

Enerpac cartridge swing cylinders are designed for integrated manifold mounting. This eliminates the need for fittings and tubing on the fixture.

Cartridge swing cylinders simplify mounting and optimize clamping effectiveness.



Hydraulic fixture with components on two faces for more efficient production.

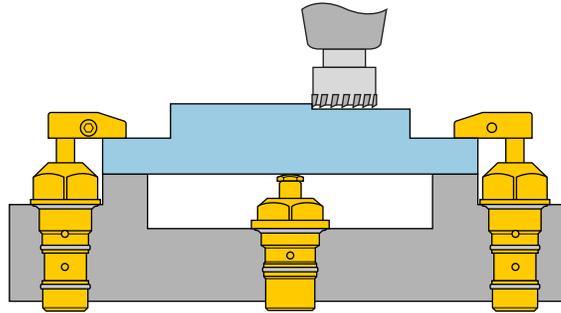


## Eliminates the need for tubing and fittings

...cylinders can be designed into narrow fixture plates as thru-hole mounting is fully functional

- Minimal space required on fixture
- Can be completely recessed in fixture
- External plumbing not required
- Allows close positioning of adjoining units
- 30, 45 and 60 degree swing angles available on request

Enerpac compact design cartridge model swing cylinders used in conjunction with a cartridge model work support in a typical clamping application.



## Product selection

Clamping force <sup>1)</sup>	Stroke		Left turning	Right turning	Cylinder effective area		Oil capacity		Max. oil flow <sup>1)</sup>	Standard clamp arm
	lbs	in			in <sup>2</sup>	in <sup>3</sup>				
	Clamp	Total			Clamp	Un-clamp	Clamp	Un-clamp	in <sup>3</sup> /min	Sold separately □ 22 ▶
▼ Single-acting			Model number <sup>2)</sup>							
475	.32	.65	<b>SCLS-22</b>	<b>SCRS-22</b>	.12	-	.08	-	12	<b>CAS-21</b>
1100	.39	.89	<b>SCLS-52</b>	<b>SCRS-52</b>	.28	-	.25	-	25	<b>CAS-51</b>
2400	.50	1.12	<b>SCLS-122</b>	<b>SCRS-122</b>	.63	-	.70	-	100	<b>CAS-121</b>
▼ Double-acting			Model number <sup>2)</sup>							
500	.32	.65	<b>SCLD-22</b>	<b>SCRD-22</b>	.12	.24	.08	.15	12	<b>CAS-21</b>
1250	.39	.89	<b>SCLD-52</b>	<b>SCRD-52</b>	.28	.59	.25	.52	25	<b>CAS-51</b>
2600	.50	1.12	<b>SCLD-122</b>	<b>SCRD-122</b>	.63	1.23	.70	1.40	100	<b>CAS-121</b>

<sup>1)</sup> With standard clamp arm. Clamp arms are sold separately (□ 22). Clamping forces for single-acting models are reduced in order to overcome return spring force.

<sup>2)</sup> For models with straight plunger movement, replace L or R with S.

## Dimensions in inches [ ]

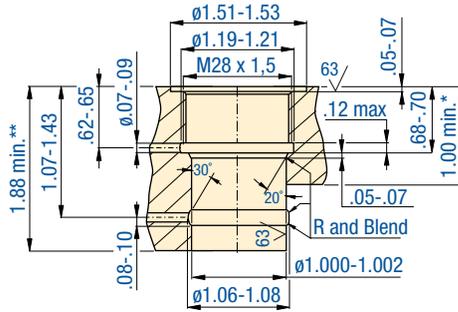
Left turning models	A	B	C	C1	C2	D1	D2	E	F
						Ø	Ø	hexagon	
▼ Single-acting									
<b>SCLS-22</b>	4.41	2.18	.90	1.55	.84	1.50	1.00	1.38	.39
<b>SCLS-52</b>	5.31	3.00	1.36	2.25	1.27	2.25	1.37	2.00	.63
<b>SCLS-122</b>	6.75	3.69	1.38	2.50	1.32	3.00	2.25	2.75	.87
▼ Double-acting									
<b>SCLD-22</b>	4.41	2.18	.90	1.55	.84	1.50	1.00	1.38	.39
<b>SCLD-52</b>	5.31	3.00	1.36	2.25	1.27	2.25	1.37	2.00	.63
<b>SCLD-122</b>	6.75	3.69	1.38	2.50	1.32	3.00	2.25	2.75	.87

Note: Dimensions shown with standard clamp arm.

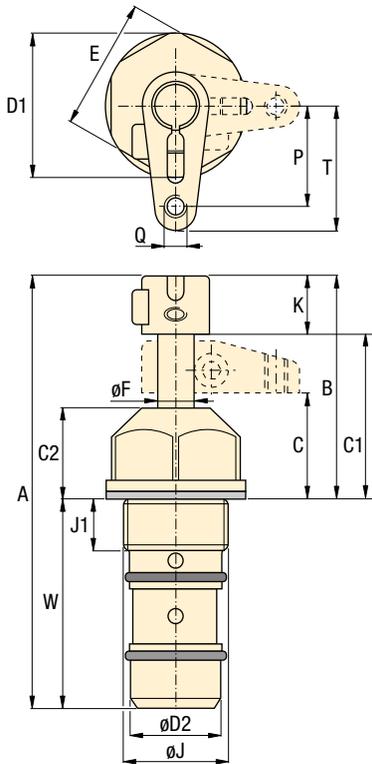


**A** Installation dimensions  
in inches

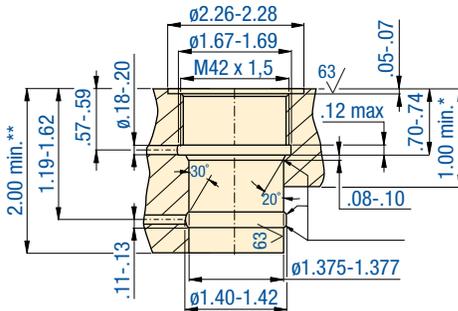
**-22 models**



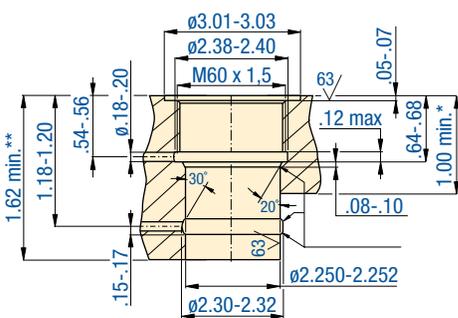
**-22, 52, 122 models**



**-52 models**



**-122 models**



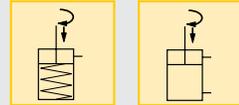
\* Minimum plate height for single-acting models.  
\*\* Minimum plate height for double-acting models.

Force: 475 - 2600 lbs

Stroke: .65 - 1.12 inch

Pressure: 500 - 5000 psi

- E** Cilindros giratorios
- F** Vérins de bridage pivotants
- D** Schwenkspannzylinder



**B** Options

Clamp arms

22 ▶



Work supports

30 ▶



Collet-Lok®  
swing cylinders

20 ▶



Accessories

72 ▶



Sequence  
valves

116 ▶



**!** Important

In case there is a risk of machining coolants and debris being inhaled via the breather vent, it is recommended to pipe this port to an area outside the fixture that is protected from machining coolants and debris.

Do not exceed maximum flow rates.

# Swing cylinders - Collet-Lok® design

Swing cylinders  
Work supports

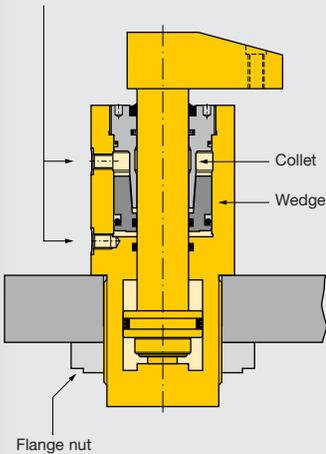
Shown: WPFR-100, WPTR-100



## WP series

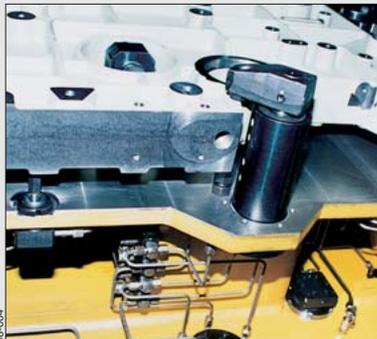
Enerpac Collet-Lok® cylinders are designed to mechanically hold the workpiece after hydraulic pressure is removed. Clamping capacities range from 1000 lb. to 8500 lb.

SAE oil connection



Hydraulic pressure pushes the collet up a wedge, locking the plunger in the clamping position.

■ Lower flange Collet-Lok® swing cylinder mounted on a pallet.



## Ideal when live hydraulics are not available

...clamping is maintained mechanically so live hydraulics are not required during the machining cycle

- Double acting Collet-Lok® action allows fully automated operation
- Additional level of safety since live hydraulics are not required
- Collet-Lok® swing cylinders can either be mounted by the flange, or threaded into the fixture

## Selection chart

Clamping force <sup>1)</sup> lbs	Stroke in		Left turning 90° 	Right turning 90° 	Cylinder effective area in <sup>2</sup>		Oil capacity in <sup>3</sup>		Max. oil flow <sup>1)</sup> in <sup>3</sup> /min	Standard clamp arm Sold separately 
	Clamp	Total			Clamp	Un-clamp	Clamp	Un-clamp		
<b>▼ Lower flange</b>										
			Model number							
1000	.32	.94	WPFL-50	WPFR-50	.25	.71	.24	.67	122	CA-540
2000	.47	1.10	WPFL-100	WPFR-100	.50	1.11	.55	1.22	305	CA-1050
8500	.39	1.65	WPFL-300	WPFR-300	2.05	3.45	3.40	5.70	600	CA-3070
<b>▼ Threaded body</b>										
			Model number							
2000	.47	1.10	WPFL-100	WPTR-100	.50	1.11	.55	1.22	305	CA-1050
8500	.39	1.65	WPFL-300	WPTR-300	2.05	3.45	3.40	5.70	600	CA-3070

<sup>1)</sup> Using standard clamp arm.  
Clamp arms are sold separately ( 22).

Note: - Call Enerpac for models with metric thread and BSPP port connections.  
- Minimum working pressure for Collet-Lok® system is 1400 psi.

## Collet-Lok® sequence

- Step 1**  
Pressurize port #1.  
Plunger turns 90° and clamps part.
- Step 2**  
Keep port #1 pressurized.  
Pressurize port #2.  
Plunger will be locked in clamped position.
- Step 3**  
Depressurize port #1 and #2.  
Uncouple cylinder from hydraulic power source.  
Part will be held in place.
- Step 4**  
Pressurize port #3.  
Plunger will be unlocked and the clamp force released.
- Step 5**  
Keep port #3 pressurized.  
Pressurize port #4.  
Plunger will extend and turn to its original position.

## Product dimensions in inches [ ]

Left turning models	A	B	C	C1	D	D1	F	H1	H2	H3
<b>▼ Lower flange</b>										
WPFL-50	7.91	6.97	5.79	.98	2.28	3.35	.75	.39	.50	-
WPFL-100	8.78	7.68	6.50	.98	2.68	3.94	.88	.39	.50	-
WPFL-300	12.63	11.02	9.17	.98	3.54	5.19	1.38	.43	.50	-
<b>▼ Threaded body</b>										
WPTR-100	8.39	7.29	3.68	3.56	1.875-16 UN	2.76	.88	1.24	2.63	2.96
WPTR-300	12.21	10.55	4.78	4.53	3.125-16 UN	3.66	1.38	1.50	3.60	3.96

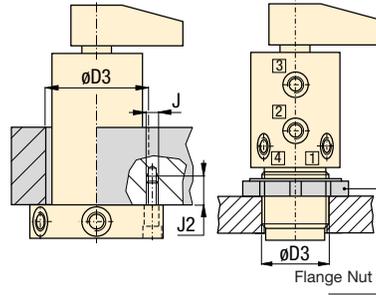
Note: Dimensions shown with standard clamp arm.



**Installation dimensions**  
in inches

Clamping force <sup>1)</sup> lbs	Fixture hole ØD3	Mounting thread J mm	Minimum depth J2
<b>▼ Lower flange</b>			
1000	2.301 ±.012	M6 X 1,00	.68
2000	2.701 ±.012	M8 X 1,25	.72
8500	3.565 ±.012	M10 X 1,50	.72
<b>▼ Threaded body</b>			
2000	1.875-16 UN	-	-
8500	3.125-16 UN	-	-

<sup>1)</sup> With standard clamp arm.

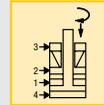


**Oil port functions**

- 1 90° Rotation and Clamp
- 2 Locks system
- 3 Unlocks system
- 4 Unclamp and 90° rotation

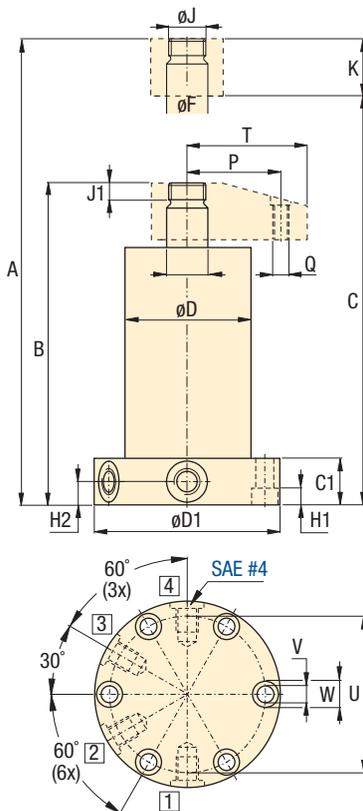
<b>Force: 1000 - 8500 lbs</b>
<b>Stroke: .94 - 1.65 inch</b>
<b>Pressure: 1400 - 5000 psi</b>

- E Cilindros giratorios
- F Vérins de bridage pivotants
- D Schwenkspannzylinder

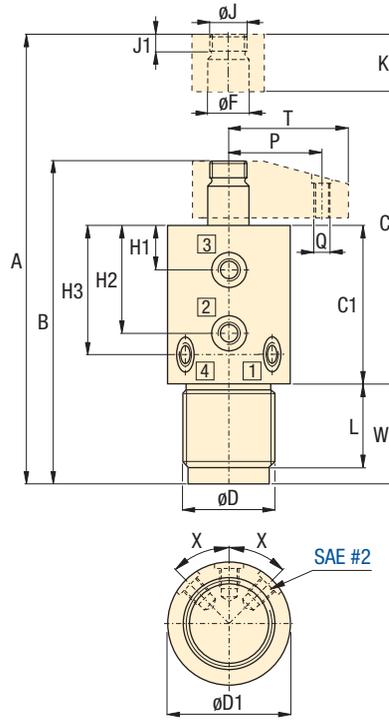


**FMS Flexible Machining Systems**  
See Yellow Pages (168)

**WPF models**



**WPT models**



X = 45° WPT-100 models  
X = 30° WPT-300 models

**Options**

- Clamp arms  [22](#)
- Collet-Lok® work supports  [36](#)
- Positive clamping cylinders  [66](#)
- Autocouplers  [126](#)
- Sequence valves  [116](#)
- Accessories  [72](#)

**Important**

For proper application, clamp force, pressures and timing, consult Enerpac for support.

J	J1	K	L	P	Q	T	U	V	W	lbs	Right turning models
UN					UNC						
<b>Lower flange ▼</b>											
.625-18	.31	1.18	-	1.57	.312-18	2.13	2.76	.35	.55	5.1	WPFR-50
.750-16	.35	1.18	-	1.97	.375-24	2.52	3.31	.35	.55	7.7	WPFR-100
1.250-12	.39	1.85	-	2.76	.625-18	3.66	4.41	.43	.55	26.5	WPFR-300
<b>Threaded body ▼</b>											
.750-16	.35	1.18	1.63	1.97	.375-24	2.52	-	-	1.18	6.6	WPTR-100
1.250-12	.39	1.85	3.35	2.76	.625-18	3.66	-	-	1.18	24.2	WPTR-300

# Clamp arms *for swing cylinders*

Swing cylinders  
Work supports

Shown: CAL-122, CAS-121



## Patented Design

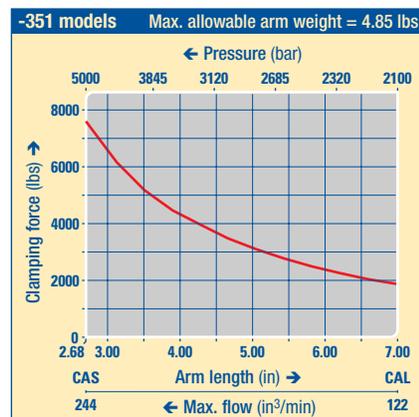
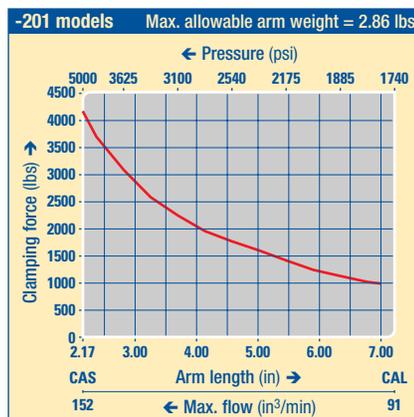
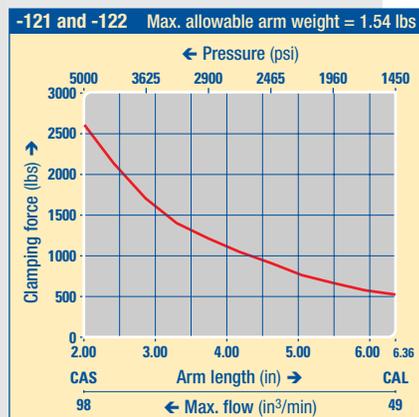
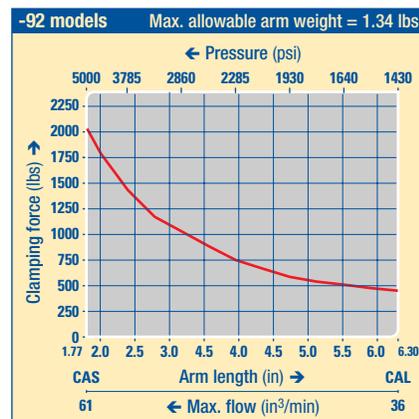
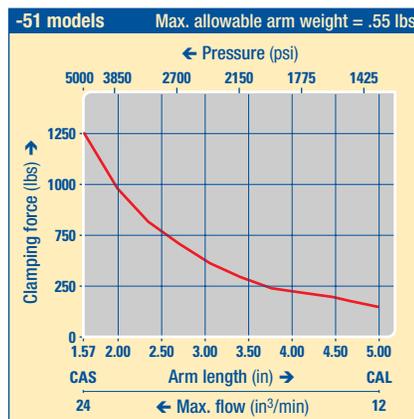
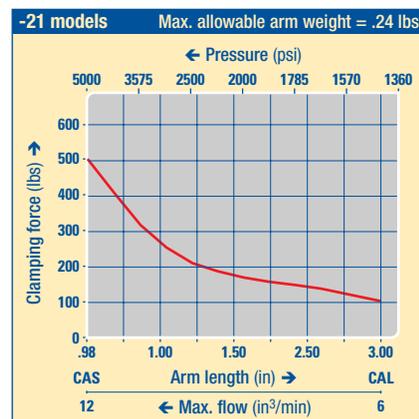
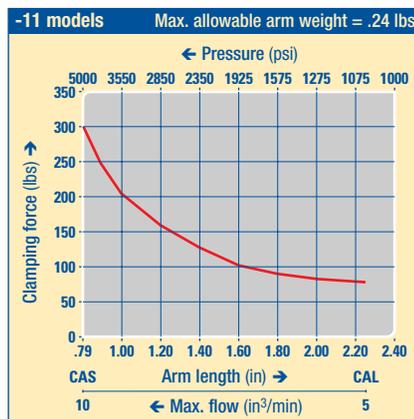
- Easy and precise location of the clamp arm in any position
- Arm can be easily installed and fastened while the cylinder is mounted in the fixture to allow exact arm positioning
- Vise not required for fastening arms

## Pressure vs clamping force

The use of different length clamp arms requires reduction in applied pressure and resulting clamp force. The charts below show this relationship.

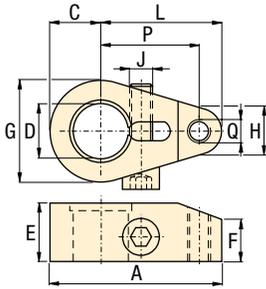
▶ Clamp arms are used to transmit the force generated by the swing cylinder to the workpiece. Enerpac's patented clamp arm design attaches to the hydraulic swing cylinder, allowing parts to be clamped at various distances from the hydraulic cylinder. Clamp arms are available in a variety of lengths, or you can use custom machining dimensions to create your own clamp arm configuration.

Other swing angles available upon request. Contact Enerpac for info.

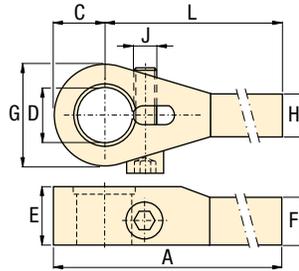




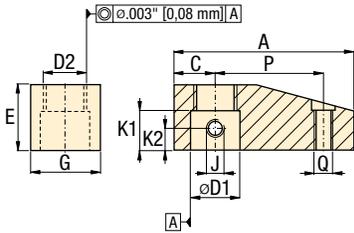
**CAS models** Standard clamp arms



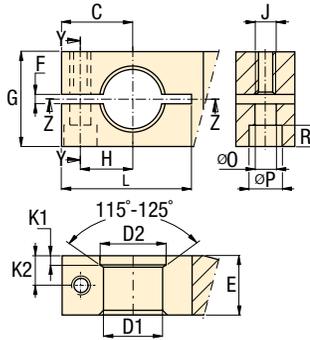
**CAL models** Long clamp arms



**CA models** Positive locking



**Custom design** (for SU, SL, ST and SC models only)



**Dimensions** in inches

Clamp force lbs	Model number	A	C	D	E	F	G	H	J	L	P	Q	lbs
-----------------	--------------	---	---	---	---	---	---	---	---	---	---	---	-----

▼ Standard clamp arms

300	<b>CAS-11</b>	1.28	.30	.313-.317	.47	.29	.59	.39	#10-32 UNF	.98	.79	#10-32	.1
500	<b>CAS-21</b>	1.60	.38	.392-.396	.63	.40	.76	.50	.250-28 UNF	1.22	.98	.250-20	.1
1250	<b>CAS-51</b>	2.39	.50	.628-.632	.75	.45	1.00	.62	.312-24 UNF	1.89	1.57	.312-18	.8
2025	<b>CAS-92</b>	2.99	.79	.982-.986	.98	.63	1.57	.89	M10X1,25	2.20	1.77	M10X1,5	.7
2600	<b>CAS-121</b>	3.13	.70	.873-.877	1.19	.63	1.39	.82	.375-24 UNF	2.43	2.00	.375-16	1.0
4200	<b>CAS-201</b>	3.71	.95	1.257-1.261	1.18	.82	1.90	1.20	.500-20 UNF	2.76	2.17	.500-13	1.0
7600	<b>CAS-351</b>	4.65	1.38	1.494-1.498	1.58	1.16	2.76	1.24	.625-18 UNF	3.27	2.68	.625-11	3.0

▼ Long clamp arms

300	<b>CAL-11</b>	2.85	.30	.313-.317	.47	.30	.59	.34	#10-32 UNF	2.55	-	-	.2
500	<b>CAL-22</b>	2.85	.30	.392-.396	.63	.40	.76	.44	M6X1	3.25	-	-	.2
1250	<b>CAL-52</b>	5.81	.50	.628-.632	.75	.45	1.00	.55	M8X1	5.31	-	-	1.0
2025	<b>CAL-92</b>	7.09	.79	.982-.986	.98	.63	1.57	.71	M10X1,25	6.30	-	-	1.2
2600	<b>CAL-122</b>	7.06	.70	.873-.877	1.19	.63	1.39	.72	M10X1,5	6.36	-	-	1.5
4200	<b>CAL-202</b>	7.95	.95	1.257-1.261	1.18	.82	1.90	1.00	M12X1,25	7.00	-	-	1.5
7600	<b>CAL-352</b>	8.47	1.38	1.494-1.498	1.58	1.33	2.76	1.18	M16X1,50	7.09	-	-	4.2

Clamp force lbs	Model number	A	C	D1	D2	E	G	J	K1	K2	P	Q	lbs
-----------------	--------------	---	---	----	----	---	---	---	----	----	---	---	-----

▼ Positive locking clamp arms

1000	<b>CA-540</b>	2.84	.71	.749-.750	.63-18	1.18	1.26	.313-24	.75	.39	1.57	.313-24	1.2
2000	<b>CA-1050</b>	3.27	.75	.878-.879	.75-16	1.18	1.38	.313-24	.71	.39	1.97	.375-24	1.2
8500	<b>CA-3070</b>	5.04	1.38	1.377-1.378	1.25-12	1.85	2.32	.313-24	1.26	.67	2.76	.625-18	5.0

Clamp force lbs	C	D1 <sup>1)</sup>	D2	E	F	G	H	J	K1	K2	L	O	P	R
-----------------	---	------------------	----	---	---	---	---	---	----	----	---	---	---	---

▼ Custom design clamp arms<sup>2)</sup> (Recommended machining dimensions)

300	.61	.313-.317	.387-.389	.48	.08-.12	.60	.30	#10-32 UNF	.10-.12	.30	.82-.97	.22	.38	.06
500	.61	.393-.394	.495-.497	.63	.06-.12	.79	.37	M5X0,8	.122-.138	.33	.98-1.10	.22	.49	.22
1250	.79	.623-.631	.727-.729	.75	.06-.12	1.18	.53	M6X1,0	.161-.177	.39	1.38-1.57	.26	.43	.26
2025	1.18	.984-.985	1.096-1.100	.98	.06-.12	1.57	.87	M8X1,25	.154-.165	.49	2.17-2.36	.35	.55	.35
2600	1.12	.8756-.8766	1.002-1.006	1.18	.06-.12	1.38	.70	.375-24 UNF	.272-.287	.50	2.05-2.25	.39	.63	.31
4200	1.38	1.260-1.261	1.398-1.402	1.18	.06-.12	2.36	.98	M10X1,5	.201-.217	.59	2.44-2.64	.43	.67	.43
7600	1.57	1.496-1.497	1.634-1.638	1.57	.06-.12	2.76	1.18	M10X1,5	.193-.209	.79	3.15-3.35	.43	.67	.43

<sup>1)</sup> Surface roughness for D1 should be 63 micro inches.

<sup>2)</sup> Not for use with positive locking cylinders.

Force: 300 - 8500 lbs

Pressure: 500 - 5000 psi

- E** Brazos de amarre
- F** Bras de bridage
- D** Spannarme

**Options**

Gauges

134 ▶



Flow control valves

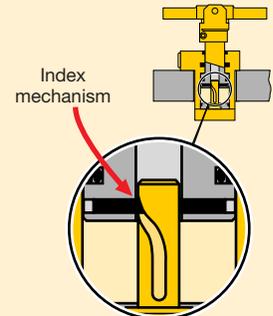
118 ▶



**Important**

**Do not exceed maximum oil flow.**

If flow rates are exceeded, swing cylinder indexing mechanism may be permanently damaged.



When designing custom clamp arms, the flow rates must be further reduced. This rating should be in proportion to the mass and the centre of gravity of the clamp arm.

**Example:**

If the mass of the arm is twice that of the long arm, flow rates must be reduced by 50%.

# Pivoting T-Arms *for double-acting swing cylinders*

Shown: CAC-202, CAPT-202; CAC-352, CAPT-352



**▶** Clamp arms are used to transmit the force generated by the swing cylinder to the workpiece. The T-arm clamps two workpieces simultaneously with one swing cylinder. Enerpac recommend to use the pivoting T-arms with double-acting swing cylinders of the SU, SL, ST and SC-series.

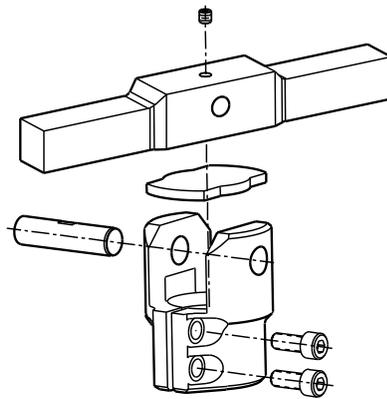
## Clamping two workpieces with one cylinder

...quick and precise clamp arm positioning

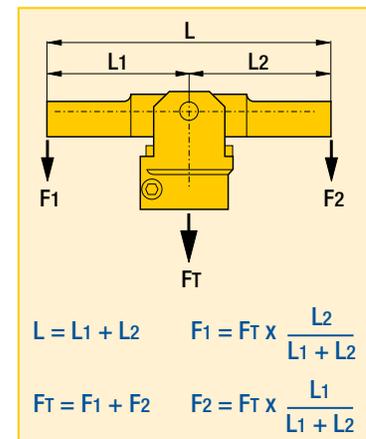
- Easy and precise location of the clamp arm in any position
- Arm can be easily installed and fastened while the cylinder is mounted in the fixture to allow exact arm positioning
- Vise not required for fastening arms

## **i** Allowable flow vs arm length

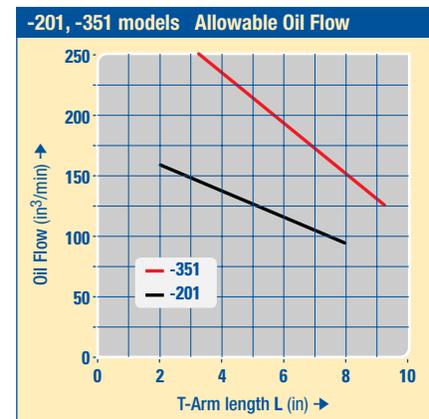
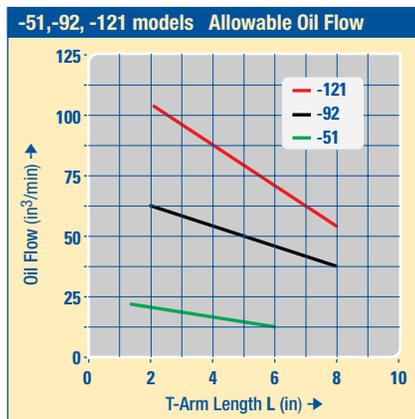
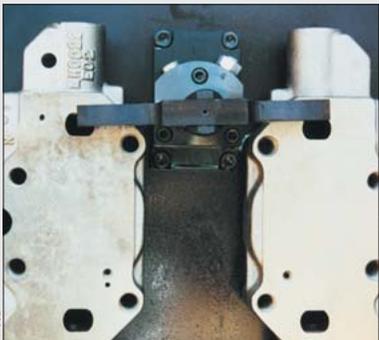
The distribution of the clamp arm force is based upon the length of the T-arm as measured from the pivoting point.



## **⚠** Important



■ Two workpieces are clamped simultaneously with one double-acting swing cylinder by using the Enerpac pivoting T-arm.

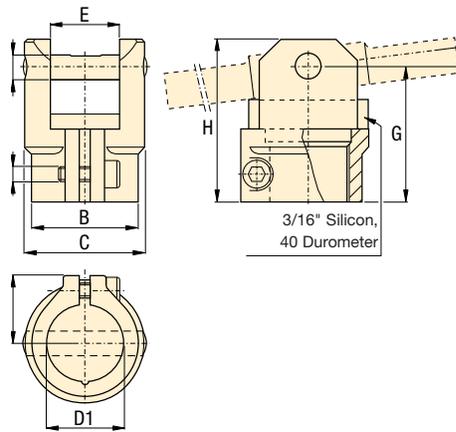




Shown: CAC-202



### CAC models Collars for T-arms



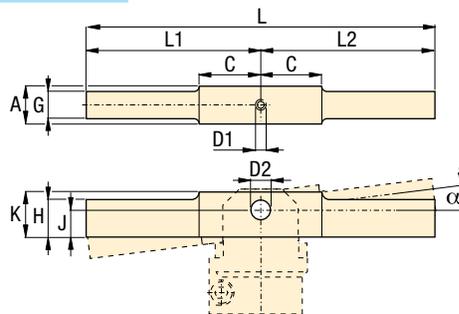
### Collars – Dimensions in inches [D]

Clamp. force lbs	Model number	Max. Tilt Angle $\alpha$	A	B	C	D1	D2	E	F	G	H	lbs
			mm									
▼ Collars for T-Arms												
1250	CAC-52	20°	.65	.95	1.10	.63	.24	.63	M4X0,7	1.26	.88	.20
2025	CAC-92	14°	.87	1.36	1.54	.99	.32	.89	M5X0,8	1.70	115.72	.44
2600	CAC-122	14°	.87	1.36	1.54	.88	.32	.89	M5X0,8	1.70	115.72	.44
4200	CAC-202	10°	1.07	1.84	2.15	1.26	.39	1.13	M6X1,0	2.02	138.60	1.03
7600	CAC-352	10°	1.34	2.15	2.48	1.50	.55	1.39	M8X1,25	2.50	173.80	1.76

Shown: CAPT-202



### CAPT models T-arms (for SU, SL, ST and SC swing cylinders)



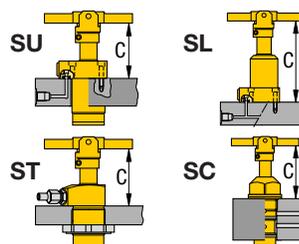
### T-Arms – Dimensions in inches [D]

Clamp. force lbs	Model number	A	C	D1*	D2	G	H	J	K	L	L1	L2	lbs
		mm											
▼ Pivoting T-Arms													
1250	CAPT-52	.61	1.00	M3X0,5	.237-.241	.50	.50	.39	.75	6.00	3.00	3.00	.59
2025	CAPT-92	.87	1.50	M4X0,7	.316-.320	.72	.72	.59	.87	8.01	4.00	4.00	1.45
2600	CAPT-122	.87	1.50	M4X0,7	.316-.320	.72	.72	.59	.87	8.01	4.00	4.00	1.45
18,7	CAPT-202	1.12	1.25	M6X1,0	.395-.399	.87	.87	.64	1.13	8.01	4.00	4.00	2.11
4200	CAPT-352	1.37	.99	M6X1,0	.552-.556	1.18	1.18	.73	1.37	9.01	4.50	4.50	3.92

\* Note: D1 equals set screw thread size. Set screw must be long enough to secure the pivot pin.

### Installation dimensions in inches [D]

Clamping force kN	Swing cyl. and T-arm model	SU-series C	SL-series C	ST-series C	SC-series C
▼ T-arm installation dimensions - Fully unclamped position					
1250	52	2.90	5.50	2.90	3.19
2025	92	3.13	6.13	3.32	-
2600	122	3.55	6.93	3.55	3.87
4200	202	3.57	6.99	3.57	-
7600	352	4.04	7.84	4.31	-



Force: 300 - 8500 lbs

Pressure: 500 - 5000 psi

- E** Brazos de amarre
- F** Bras de bridage
- D** Spannarme

### Options

Gauges

134 ▶



Flow control valves

118 ▶



Download CAD files from [www.enerpac.com](http://www.enerpac.com)



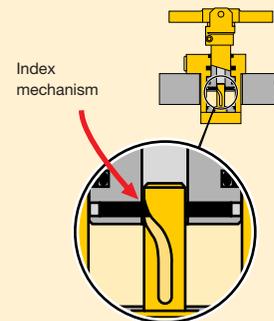
Other swing angles available upon request. Contact Enerpac for info.

### Important

For high cycle applications use double-acting cylinders.

### Do not exceed maximum oil flow.

If flow rates are exceeded, swing cylinder indexing mechanism may be permanently damaged.



When designing custom clamp arms, the flow rates must be further reduced. This rating should be in proportion to the mass and the centre of gravity of the clamp arm.

### Example:

If the mass of the arm is twice that of the long arm, flow rates must be reduced by 50%.

Shown: SC-3, SC-1



Swing cylinders  
Work supports

## SC series

These swing cylinders rotate 90° as they begin their stroke, continuing without rotation for the final clamping stroke. Cylinders can be changed to left swing, right swing, or pull applications by loosening the side plug and then rotating the plunger to a desired position.

The **SC-1** and **SC-3** have a retract spring for single acting operation. The **SC-4** is only for double-acting operation and has no return spring.

## Changeable swing function

...with 360° fully adjustable clamp arm

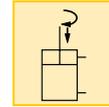
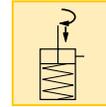
- Changeable swing function: clamp arm movement can be adjusted to left or right swing or straight pull function
- 88-92° clamp arm swing arc
- Easy installation: built in mountings and brackets
- Compact design for use in limited space applications
- Easy and precise locating of arm for clamp positioning
- Single or double-acting cylinders to suit variety of hydraulic requirements

**Force: 300 - 2100 lbs**

**Stroke: .19 - .50 inch**

**Pressure: 1500 - 3000 psi**

- Ⓔ Cilindros giratorios
- Ⓕ Vérins de bridage pivotants
- Ⓓ Schwenkspannzylinder



Arm length in	Max. pressure psi	Clamping force lbs
<b>▼ SC-1</b>		
-	3000	2640
<b>2.00<sup>2)</sup></b>	3000	2164
<b>3.00</b>	3000	1960
<b>4.00</b>	3000	1740
<b>5.00</b>	2400	1200
<b>6.00</b>	2000	840
<b>▼ SC-3</b>		
-	3000	700
<b>1.00<sup>2)</sup></b>	3000	500
<b>2.00</b>	2000	250
<b>▼ SC-4</b>		
<b>.75<sup>2)</sup></b>	3000	300
<b>1.50</b>	1500	25

## Selection chart

Clamping force <sup>1)</sup>	Stroke		Model number	Cylinder effective area		Oil Capacity	
	in	in		in <sup>2</sup>	in <sup>3</sup>		
lbs	Clamp	Total		Pull	Push	Pull	Push
2164	.50	1.50	<b>SC-1</b>	.98	1.767	1.47	2.65
500	.25	.75	<b>SC-3</b>	.245	.442	.184	.331
300	.19	.56	<b>SC-4</b>	.137	.246	.027	.138

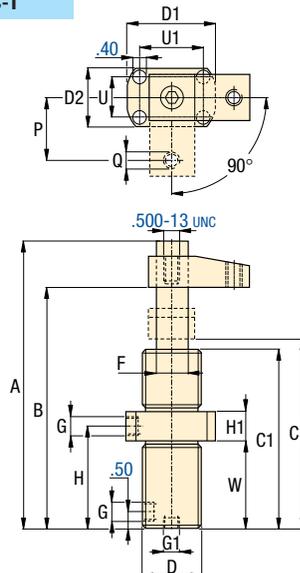
<sup>1)</sup> With standard clamp arm (included with cylinder).

Note: - Long clamps arms can be fabricated by the user.

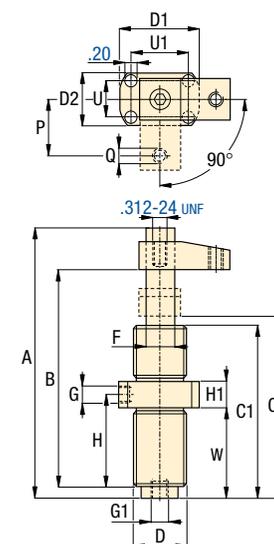
- For long clamp arms, use VFC series flow control valves.

<sup>2)</sup> Standard clamp arm (included).

**SC-1**



**SC-3, -4**



## Product dimensions in inches [Ⓜ]

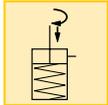
Model	A	B	C	C1	D	D1	D2	F	G	G1	H	H1	P	Q	U	U1	W	lbs
					UN				NPT	NPT				UN				
<b>SC-1</b>	8.88	7.37	5.87	5.74	1.875-16	2.90	1.88	1.00	.250-18	.125-27	3.31	.88	2.00	.38-16	1.28	2.06	2.87	6
<b>SC-3</b>	5.27	4.26	3.71	3.48	1.00-12	2.00	1.13	.50	.125-27	.125-27	2.15	.63	1.00	.250-20	.75	1.50	2.03	2
<b>SC-4</b>	4.30	3.13	2.83	2.50	.750-16	1.52	.88	.375	.0625-27	.0625-27	1.44	.60	.75	10-32	.60	1.13	1.40	1

Force: 1375 - 4375 lbs

Stroke: .25 - .43 inch

Pressure: 1200 - 2500 psi

- E** Cilindros giratorios
- F** Verins de bridage pivotants
- D** Schwenkspannzylinder

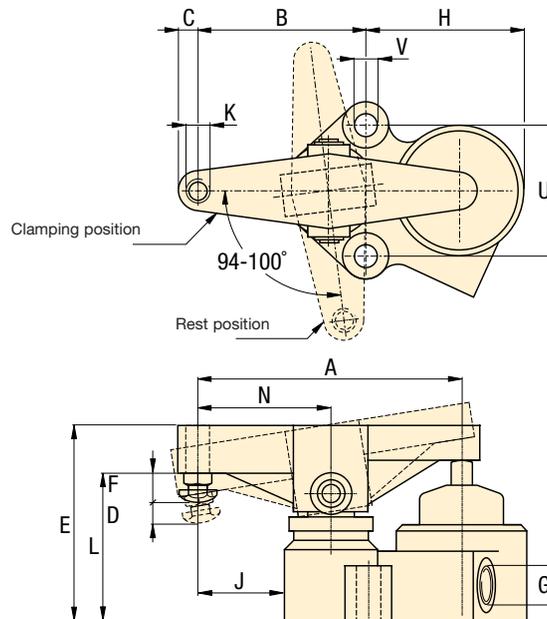


## Adjustable clamping stroke

...turns clockwise or counter clockwise

- Adjustable bolt in clamp arm for clamping stroke adjustment
- Low profile, ideal for limited space applications
- Quick swing action allows clamp arm to swing free of cutter and reclamp after it has passed
- 94-100° clamp arm swing arc

ASC-30, -100



## Selection chart

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8
Cylinder capacity	Stroke	Model number	Operating pressure	Cylinder effective area	Oil capacity	Max. oil flow	
lbs	in		psi	in <sup>2</sup>	in <sup>3</sup>	in <sup>3</sup> /min	lbs
1375	.25	ASC-30	1200 - 2500	.55	.30	115	6
4375	.43	ASC-100	1200 - 2500	1.76	1.22	115	18

## Product dimensions in inches [ ]

Model number	A	B	C	D	E	F	G	H	J	K	L	N	U	V
	NPT						UN						Ø	
ASC-30	5.00	3.38	.50	.25	3.50	.75	.125-27	2.75	1.63	.500-13	2.75	2.50	2.50	.41
ASC-100	7.00	4.50	.53	.43	5.25	.73	.125-27	4.25	2.25	.500-13	4.00	3.50	3.50	.63

Shown: ASC-30



## ASC series

Clamping arm rotates 97° clockwise or counter clockwise (requires easily changed rotation spring) to position itself over the workpiece. Then, a vertical plunger exerts an upward thrust on the back end of the swing arm providing a powerful downward pressure to clamp the workpiece.

## Important

For high-cycle applications use double-acting cylinders.

View of a machining fixture with ASC-30 clamping cylinders.



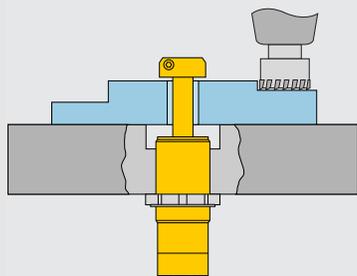
# Three position swing cylinder *Application & selection*

Shown: WTR-24



## WTR series

The three position swing cylinder rotates 90° only after the plunger has completely extended. This feature allows the clamp to be mounted beneath the workpiece, where the clamp travels through the part for clamping.

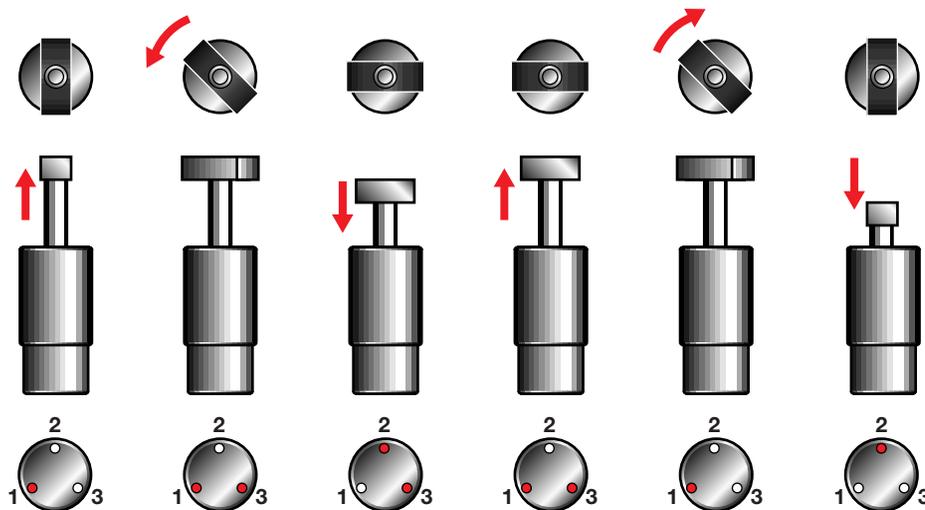


## Unobstructed part loading

- Plunger rotates only when cylinder is fully extended, to minimize obstructions
- Ideal for mounting beneath the fixture, as the clamp does not rotate until the workpiece has been cleared
- Stainless steel body for additional corrosion resistance
- Three port design for fewer hydraulic connections
- Fully threaded body for easy installation
- Standard two sided clamp arm included
- Clamp arm design makes mounting easy

## Operation sequence

The three position swing cylinder is ideal for parts which have a through hole. The clamp allows completely unobstructed part loading.



### Step 1

Pressurize port #1. Plunger extends through workpiece.

### Step 2

Keep port #1 pressurized. Pressurize port #3. Plunger makes 90° flat rotation.

### Step 3

Keep port #3 pressurized. Pressurize port #2. Plunger retracts: clamp force is applied.

### Step 4

Keep port #3 pressurized. Pressurize port #1. Plunger extends: clamp force is released.

### Step 5

Keep port #1 pressurized. Depressurize port #3. Plunger makes 90° flat rotation.

### Step 6

Pressurize port #2. Plunger retracts through workpiece.

## Selection chart

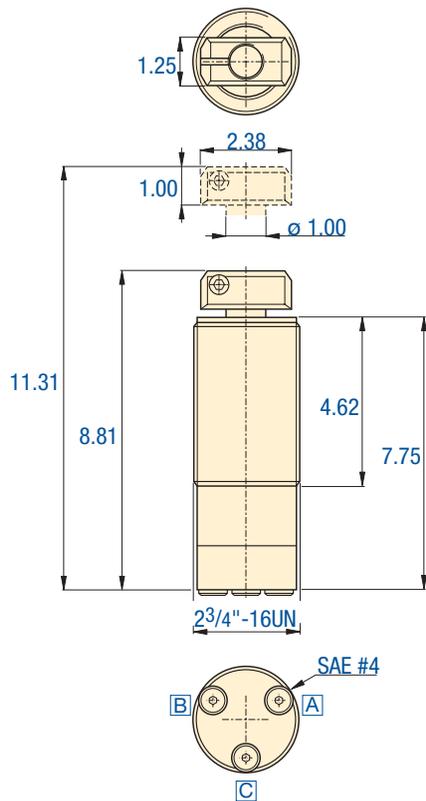
Clamping Force <sup>1)</sup>	Stroke	Model number <sup>2)</sup>	Cylinder effective area		Oil capacity		Max. Oil flow	Maximum cycle rate
			in <sup>2</sup>	in <sup>3</sup>				
lbs	in		Clamp.	Unclamp.	Clamp.	Unclamp.	in <sup>3</sup> /min	cycles /min
5000	2.50	<b>WTR-24</b>	.98	1.77	2.5	4.4	116	4

<sup>1)</sup> When using optional CA-28 clamp arm, max. operating pressure is 2000 psi.

<sup>2)</sup> Standard clamp arm included.



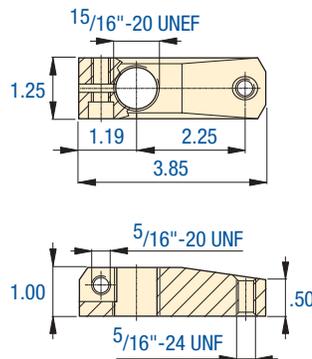
WTR-24



- A = Advance
- B = Retract
- C = Rotate 90°

**Optional CA-28 clamp arm**

The WTR-24 has a two sided clamp arm standard included. The CA-28 clamp arm can be used to secure the workpiece on one side only, though the clamping pressure must be reduced to 2000 psi maximum.

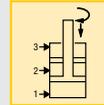


Force: 1960 - 5000 lb

Stroke: 2.50 inch

Pressure: 2000 - 5000 psi

- E Cilindros giratorios
- F Vérins de bridage pivotants
- D Schwenkspannzylinder



**Options**

High pressure filters

137 ▶



Fittings

138 ▶



Valves

104 ▶



**Important**

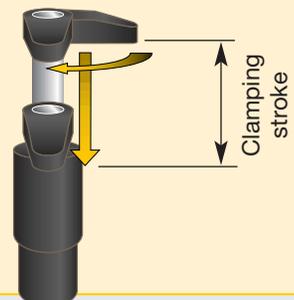
It is highly recommended that system filtration be used to ensure reliable operation.

Do not exceed maximum pressure and flow rates.

For recommended valving schemes, please refer to our "Yellow pages".

141 ▶

Clamp arm movement: 90° ± 3° flat rotation.



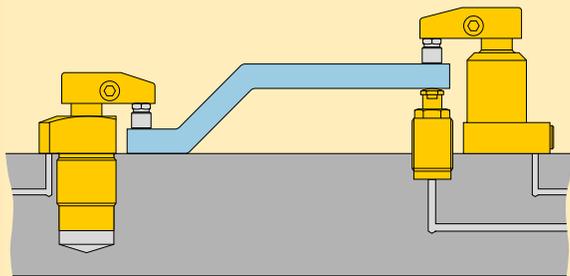
# Work supports *Application & selection*

Shown: WPFS-100, WFL-111, WFC-72, WFL-441



▶ The Enerpac work support is a hydraulic means of positively supporting the workpiece to minimize deflections.

The work support automatically adjusts to the contour of the workpiece, and then locks in position. This support then adds rigidity to the fixtured component to minimize machining variations.



■ Lower flange work supports, placed close to the machining area to minimize deflection of the workpiece.

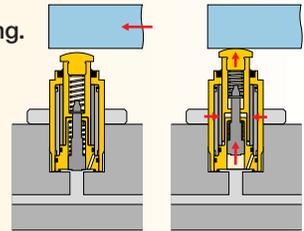
## Wide range of sizes and types to efficiently support workpiece

- Low pressure lock-up capability enables the use of machine tool hydraulic systems
- High rated support capacities allows for more compact fixture design
- Corrosion resistant materials, compatible with most coolants and environments
- Threaded and manifold air vent ports allow fixturing that prevents coolants from being drawn into the system
- Minimized deflection increases machining accuracy
- Multiple mounting configurations allows design flexibility
- Collet-Lok® positive locking models: Hydraulic actuation / mechanical holding allows for palletized systems which do not permit live hydraulics

## i Select your work support method:

### WF series, Hydraulic advance

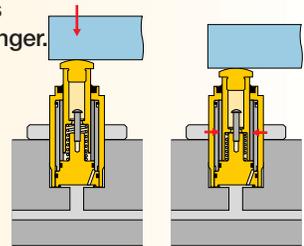
- Retracted plunger allows unobstructed workpiece loading.
- Internal hydraulic plunger advances allowing external plunger to advance under spring load. Bronze sleeve squeezes and holds plunger in fixed position.



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### WS series, Spring advance

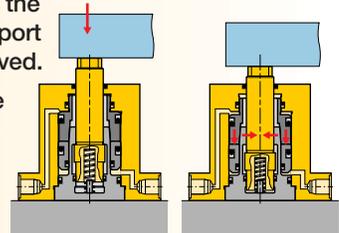
- Workpiece weight compresses the spring of the extended plunger.
- When pressurized, the internal bronze sleeve squeezes and holds the plunger in fixed position.
- Can be operated as air advance.



34 ▶

### WP series, Collet-Lok® positive locking

- Unique in the industry. Allows the work support to maintain support after pressure has been removed.
- Extremely low deflections due to the structural design of the collet system.
- Low lockup pressure.



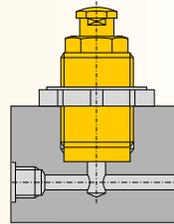
36 ▶



## Select your mounting method:

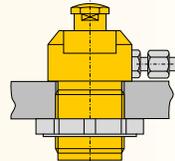
### Manifold mount

- Does not require external plumbing
- Compact design, when space is at a premium
- Internal plunger thread for optional contacts



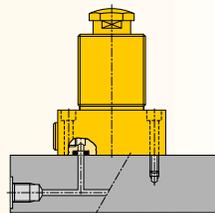
### Threaded body

- Ability to adjust height
- Plumbed from either side or bottom
- Internal plunger thread for optional contacts



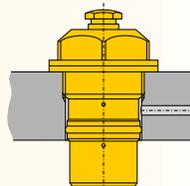
### Lower flange

- Plumbed directly or manifold mounted
- No fixture hole required
- Easy to assemble or disassemble
- Internal plunger thread for optional contacts



### Cartridge style

- Does not require external plumbing
- Allows close clustering of work supports
- Compact design, when space is at a premium
- Internal plunger thread for optional contacts



## Product selection

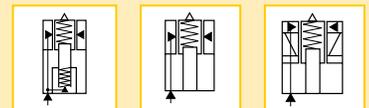
Maximum support force	Stroke	Manifold mount	Threaded body	Lower flange	Cartridge style
lbs	in				
<b>▼ Hydraulic advance</b>					
Model number					
1650	.38	WFM-71	WFT-71	-	WFC-72
2500	.38	-	-	WFL-111	WFC-112
5000	.41	-	-	WFL-221	WFC-222
7500	.53	-	-	WFL-331	-
10,000	.65	-	-	WFL-441	-
<b>▼ Spring advance</b>					
Model number					
1650	.38	WSM-71	WST-71	-	WSC-72
2500	.38	-	-	WSL-111	WSC-112
5000	.41	-	-	WSL-221	WSC-222
7500	.53	-	-	WSL-331	-
10,000	.65	-	-	WSL-441	-
<b>▼ Positive locking</b>					
Model number					
2000	.39	-	WPTS-100	WPFS-100	-
4000	.39	-	WPTS-200	WPFS-200	-
10,000	.79	-	-	WPFS-450	-

Force: 1650 - 10,000 lbs

Stroke: .38 - .79 inch

Pressure: 700 - 5000 psi

- E** Cilindros de soporte
- F** Vérin anti-vibreur
- D** Abstützzylinder



## Options

### Swing cylinders

[10](#)



### Accessories

[72](#)



### In line filters

[137](#)



### Sequence valves MVP5

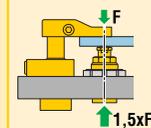
[116](#)



## Important

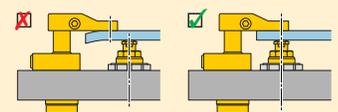
### Warning!

Support force and clamping force must be matched. Support force should be at least 150% of clamping force.



Do not exceed maximum flow rates to avoid premature lockup.

Always center load over work support.



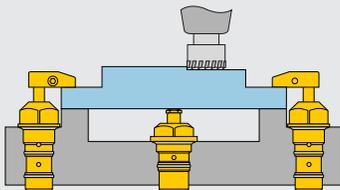
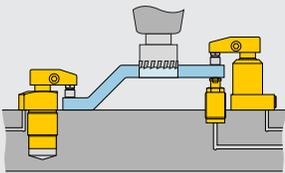
# Work supports - Hydraulic advance

Shown: WFM-71, WFL-111



## WF series

Enerpac work supports provide either additional non-fixed location points to the clamps, or support to larger or thin section workpiece components, always in order to minimize workpiece deflection during machining.



In order to load the workpiece sideways over the work supports, hydraulic advanced models are being used.



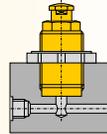
## For unobstructed part loading

- Plunger stays retracted until pressure is applied allowing unobstructed loading
- Low pressure lock-up capability enables the use of machine tool hydraulic systems
- High rated support capacities allows for more compact fixture design
- Corrosion resistant materials – compatible with most coolants and environments
- Threaded and manifold air vent ports allow fixturing that prevents coolants and debris from being ingested into the mechanism
- Minimized deflection increases machining accuracy
- Multiple mounting configurations for design flexibility
- Contact bolt included

## Four mounting styles

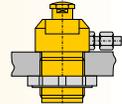
### WFM series, Manifold models

Eliminates the need for fittings and tubing on the fixture.



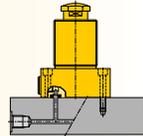
### WFT series, Threaded models

Offers the flexibility of side or bottom porting.



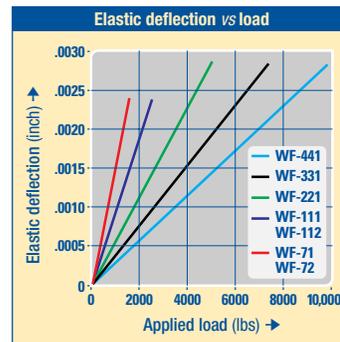
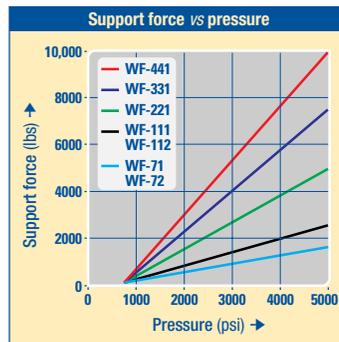
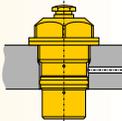
### WFL series, Lower flange models

Plumbed directly – no fixture hole required.



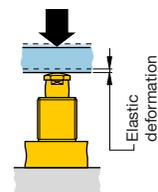
### WFC series, Cartridge models

Can be designed onto narrow fixture plates as thru-hole mounting is fully functional.



### Deflection chart:

Elastic deformation of the work support resulting from the application of load.

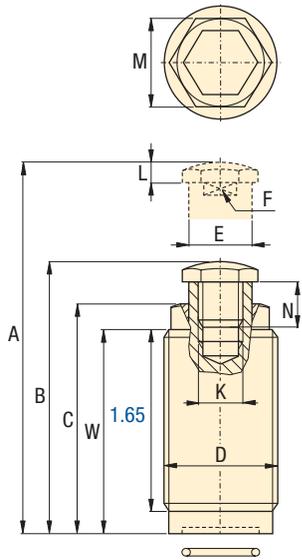


## Product selection

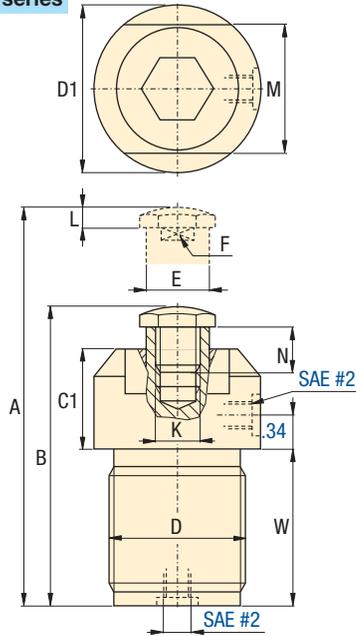
Max. support force	Support plunger stroke	Manifold mount	Threaded body	Lower flange	Cartridge style	Operating pressure		Plunger contact spring force		Oil capacity	Max. oil flow
						psi min.	psi max.	lbs ext.	lbs retr.		
1650	.38	WFM-71	WFT-71	-	WFC-72	700	5000	2.0	5.8	.04	40
2500	.38	-	-	WFL-111	WFC-112	700	5000	3.4	5.2	.06	60
5000	.41	-	-	WFL-221	WFC-222	700	5000	2.1	19.5	.19	190
7500	.53	-	-	WFL-331	-	700	5000	4.0	17.5	.24	240
10,000	.65	-	-	WFL-441	-	700	5000	3.3	22.0	.30	300



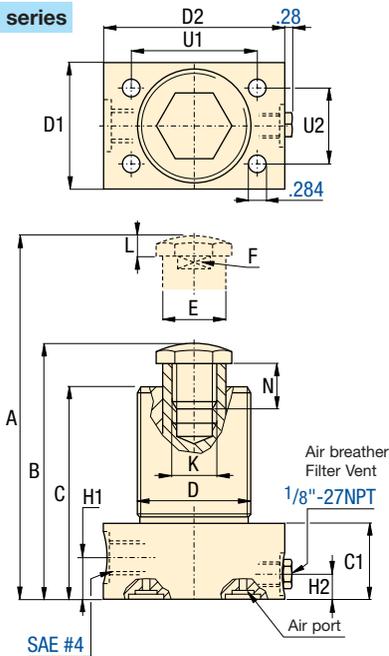
WFM series



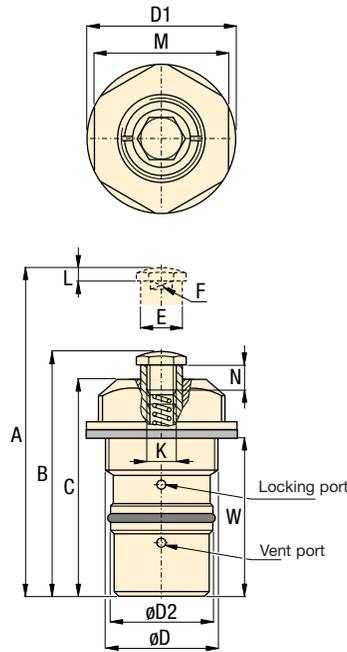
WFT series



WFL series



WFC series

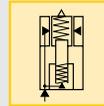


Force: 1650 - 10,000 lbs

Stroke: .38 - .65 inch

Pressure: 700 - 5000 psi

- E** Cilindros de soporte
- F** Vérin anti-vibreur
- D** Abstützylinder



Options

Accessories

72 ▶



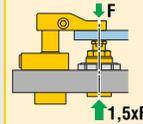
In-line filters

137 ▶



Important

**Warning!**  
Support force and clamping force must be matched. Support force should be at least 150% of clamping force.



Do not exceed maximum flow rates to avoid premature lockup.

Always center load over work support.

Product dimensions in inches [ ]

Mounting dimensions 38 ▶

Model number	A	B	C	C1	D	D1	D2	E	F	H1	H2	K	L	M	N*	U1	U2	W	kg		
	mm																				
WFM-71	3.00	2.62	2.16	-	1.250-16 UN	-	-	.591	.51	-	-	M10X1,5	.18	.94	.53	-	-	1.96	.5		
WFT-71	3.51	3.13	-	1.02	1.375-18 UNEF	1.71	-	.591	.51	-	-	M10X1,5	.18	1.34	.53	-	-	1.65	.5		
WFL-111	3.91	3.53	3.10	1.08	1.375-18 UNEF	1.50	2.38	.629	.49	.56	.70	M10X1,5	.18	-	.73	1.62	.94	-	1.4		
WFL-221	4.02	3.61	3.07	1.04	2.625-20 UN	2.75	3.25	1.496	1.00	.54	.52	M20X2,5	.24	-	.31	2.18	2.18	-	4.8		
WFL-331	4.40	3.87	3.46	1.06	2.88	3.00	3.50	1.771	1.18	.53	.42	M20X2,5	.24	-	.31	2.44	2.44	-	6.3		
WFL-441	5.07	4.42	4.05	1.18	3.38	3.50	4.00	2.165	1.44	.53	.42	M20X2,5	.24	-	.62	2.94	2.94	-	9.5		
WFL-72	3.20	2.82	2.46	-	M33X1,5	1.62	1.16	.591	.51	-	-	M10X1,5	.18	1.50	.53	-	-	1.98	.9		
WFC-112	4.03	3.65	3.23	-	M42X1,5	2.25	1.44	.630	.49	-	-	M10X1,5	.18	2.00	.73	-	-	2.38	2.0		
WFC-222	4.44	4.03	3.60	-	M60X1,5	3.00	2.21	1.496	1.00	-	-	M20X2,5	.24	2.75	.31	-	-	2.70	4.0		

\* Note: Dimension N is factory set. May change on types 221, 331 and 441 due to adjusted contact spring force.  
Note: For manifold mounting dimensions 38.

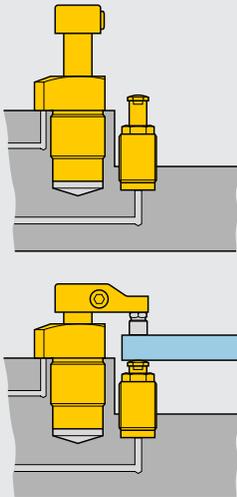
# Work supports - Spring advance

Shown: WSL-111, WST-71



## WS series

Enerpac work supports provide either additional non-fixed location points to the clamps, or support to larger or thin section workpiece components, always in order to minimize workpiece deflection during machining.



Spring advance work supports with extended plungers, waiting for the next workpiece.



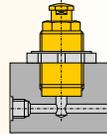
## Spring advance work support contacts workpiece as it is loaded into fixture

- Low pressure lock-up capability enables the use of machine tool hydraulic systems
- High rated support capacities allows for more compact fixture design
- Corrosion resistant materials, compatible with most coolants and environments
- Threaded and manifold air vent ports allow fixturing that prevents coolants from being drawn into the system
- Minimized deflection increases machining accuracy
- Multiple mounting configurations allows design flexibility
- Can be operated as air advance by removing the spring and applying air pressure on the vent port

## Mounting style

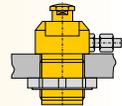
### WSM series, Manifold mount

Eliminates the need for fittings and tubing on the fixture.



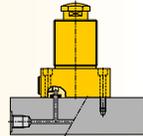
### WST series, Threaded body

Offers the flexibility of side or bottom porting.



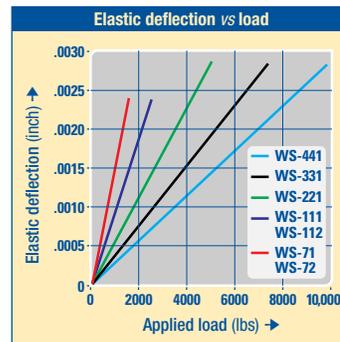
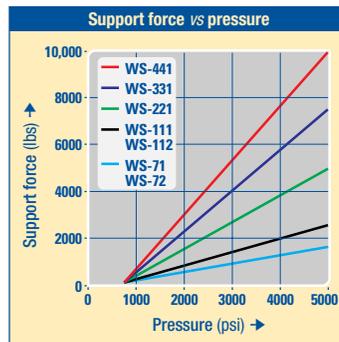
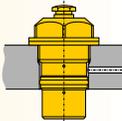
### WSL series, Lower flange

Plumbed directly – no fixture hole required.



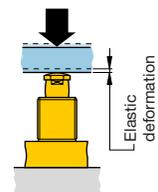
### WSC series, Cartridge mount style

Can be designed onto narrow fixture plates as thru-hole mounting is fully functional.



## Deflection chart:

Elastic deformation of the work support resulting from the application of load.

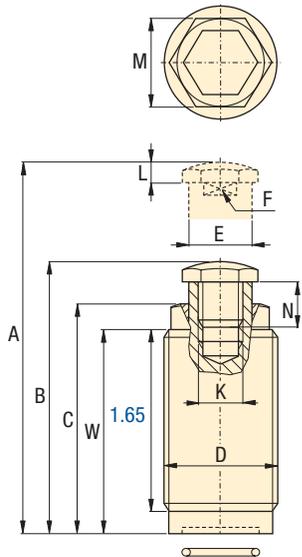


## Product selection

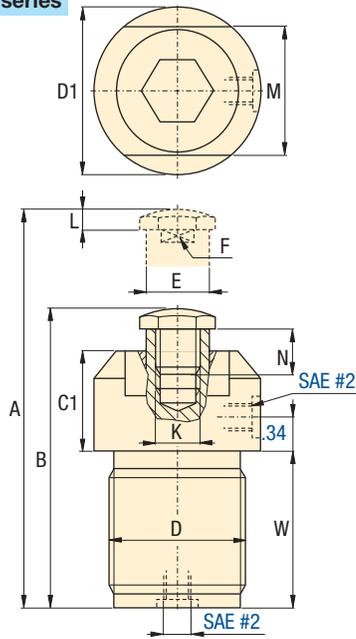
Max. support force lbs	Support plunger stroke in	Manifold mount	Threaded body	Lower flange	Cartridge style	Operating pressure psi		Plunger contact spring force lbs		Oil capacity in <sup>3</sup>	Max. oil flow in <sup>3</sup> /min
		WSM-71	WST-71	-	WSC-72	min.	max.	ext.	retr.		
1650	.38	WSM-71	WST-71	-	WSC-72	700	5000	2.0	5.8	.04	40
2500	.38	-	-	WSL-111	WSC-112	700	5000	3.4	5.2	.06	60
5000	.41	-	-	WSL-221	WSC-222	700	5000	2.1	19.5	.19	190
7500	.53	-	-	WSL-331	-	700	5000	4.0	17.5	.24	240
10,000	.65	-	-	WSL-441	-	700	5000	3.3	22.0	.30	300



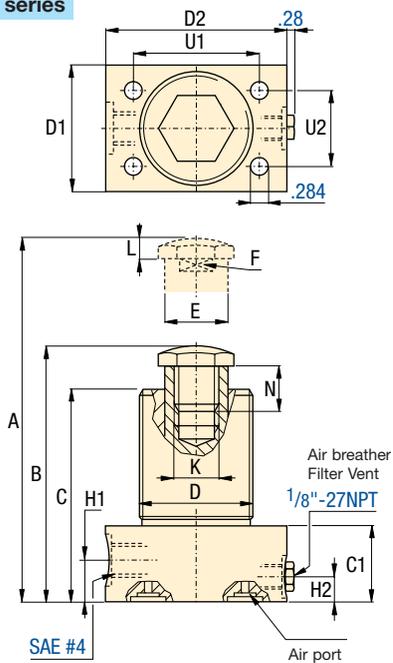
WSM series



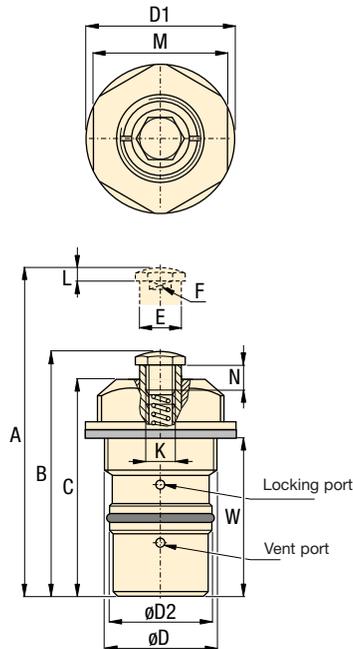
WST series



WSL series



WSC series

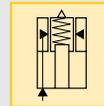


Force: 1650 - 10,000 lbs

Stroke: .38 - .65 inch

Pressure: 700 - 5000 psi

- E** Cilindros de soporte
- F** Vérin anti-vibreur
- D** Abstützzylinder



Options

Accessories



72 ▶

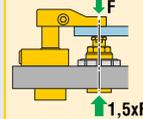
In line filters



137 ▶

Important

**Warning!**  
Support force and clamping force must be matched. Support force should be at least 150% of clamping force.



Do not exceed maximum flow rates to avoid premature lockup

Always center load over work support.

Product dimensions in inches [ ]

Mounting dimensions 38 ▶

Model number	A	B	C	C1	D	D1	D2	E	F	H1	H2	K	L	M	N*	U1	U2	W	lbs
	(mm)																		
WSM-71	3.00	2.62	2.16	-	1.250-16 UN	-	-	.591	.51	-	-	M10X1,5	.18	.94	.53	-	-	1.96	.5
WST-71	3.51	3.13	-	1.02	1.375-18 UNEF	1.71	-	.591	.51	-	-	M10X1,5	.18	1.34	.53	-	-	1.65	.5
WSL-111	3.35	2.97	2.54	.94	1.375-18 UNEF	1.50	2.38	.629	.49	.44	.30	M10X1,5	.18	-	.73	1.62	.94	-	1.4
WSL-221	3.80	3.39	2.95	.98	2.625-20 UN	2.75	3.25	1.496	1.00	.48	.40	M20X2,5	.24	-	.31	2.18	2.18	-	4.8
WSL-331	4.28	3.75	3.36	1.06	2.88	3.00	3.50	1.771	1.18	.53	.42	M20X2,5	.24	-	.31	2.44	2.44	-	6.3
WSL-441	4.98	4.33	3.95	1.18	3.38	3.50	4.00	2.165	1.44	.53	.42	M20X2,5	.24	-	.62	2.94	2.94	-	9.5
WSC-72	3.20	2.82	2.46	-	M33X1,5	1.62	1.16	.591	.51	-	-	M10X1,5	.18	1.50	.53	-	-	1.98	.9
WSC-112	3.36	2.98	2.56	-	M42X1,5	2.25	1.44	.630	.49	-	-	M10X1,5	.18	2.00	.73	-	-	2.38	2.0
WSC-222	3.85	3.44	3.00	-	M60X1,5	3.00	2.21	1.496	1.00	-	-	M20X2,5	.24	2.75	.31	-	-	2.70	4.0

\* Note: Dimension N is factory set. May change on types 221, 331 and 441 due to adjusted contact spring force.  
Note: For dimensions manifold mounting dimensions 38.

# Work supports - Collet-Lok® design

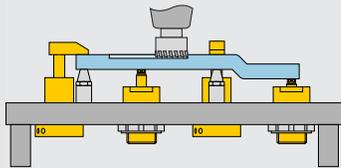
Shown: WPFS-100, WPTS-100



3B-049

## WP series

Enerpac work supports provide either additional non-fixed location points to the clamps, or support to larger or thin section workpiece components, always in order to minimize workpiece deflection during machining. The Collet-Lok® design does not require hydraulic system pressure to maintain support position.



■ While pallet No. 1 is in the machining chamber, a new work piece is loaded on to pallet No. 2.

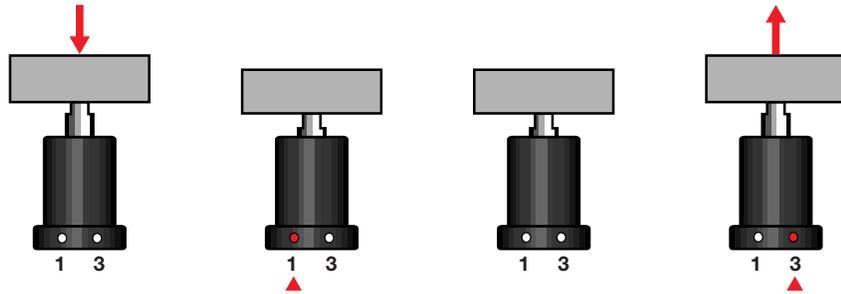


3B-047

## Hydraulically locked, mechanically maintained work support

- Collet-Lok® design allows the work support to maintain support position after the hydraulic pressure is removed
- Collet Lok® maintains a higher level of safety, as it is not dependent on hydraulic supply pressure
- Low deflection: lowest deflection of any work support available
- Threaded or flanged body increases mounting flexibility

## Collet-Lok® sequence



### Step 1

Install the workpiece on the support cylinder. The plunger position will adjust to the contour of the workpiece.

### Step 2

Pressurize oil port #1. The plunger will be locked in the supporting position.

### Step 3

Depressurize oil port #1. Cylinder can be uncoupled from hydraulics and still support the workpiece.

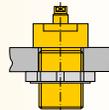
### Step 4

Pressurize oil port #3. The plunger will be unlocked. When the workpiece is removed, plunger will extend into its original position.

## Mounting style

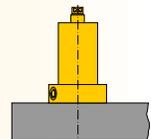
### WPT series, Threaded models

Offers the flexibility of side or bottom porting.



### WPF series, Flange models

Plumbed directly, no fixture hole required.



## Product selection

Max. support force	Support plunger stroke	Flange models	Threaded models	Operating pressure		Locking system displacement		Plunger contact spring force	Max. oil flow
				psi	psi	in <sup>3</sup>	in <sup>3</sup>		
lbs	in			min.	max.	lock	unlock	lbs	in <sup>3</sup> /min
2000	.39	WPFS-100	-	1450	5000	.24	.24	4.50	400
4000	.39	WPFS-200	-	1450	5000	.37	.37	7.90	400
10,000	.79	WPFS-450	-	1450	5000	1.10	1.10	67.5	400
2000	.39	-	WPTS-100	1450	5000	.24	.24	3.37	400
4000	.39	-	WPTS-200	1450	5000	.37	.37	6.74	400



Force: 2000 - 10,000 lbs

Stroke: .39 - .79 inch

Pressure: 1450 - 5000 psi

- E** Cilindros de soporte
- F** Vérin anti-vibreur
- D** Abstützylinder

**Options**

**Collet-Lok® swing cylinders** [20]

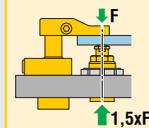
**Autocouplers** [126]

**Positive clamping cylinders** [66]

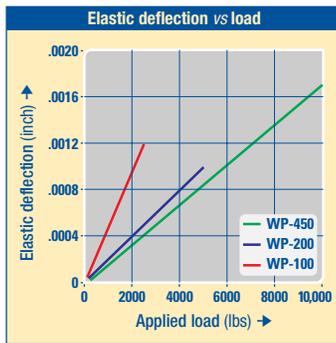
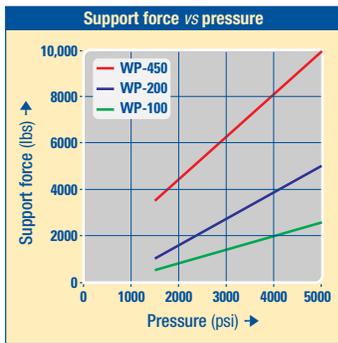
**Sequence valves** [116]

**Important**

**Warning!**  
Support force and clamping force must be matched. Support force should be at least 150% of clamping force.

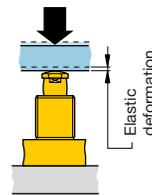


For proper application, clamp force, pressures and timing, consult Enerpac for support.

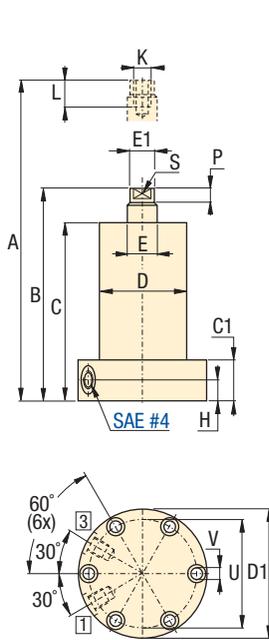


**Deflection chart:**

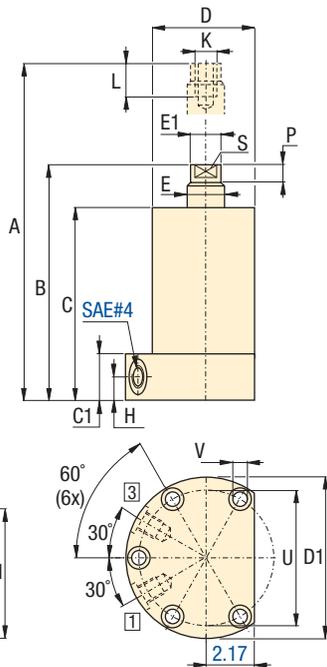
Elastic deformation of the work support resulting from the application of load.



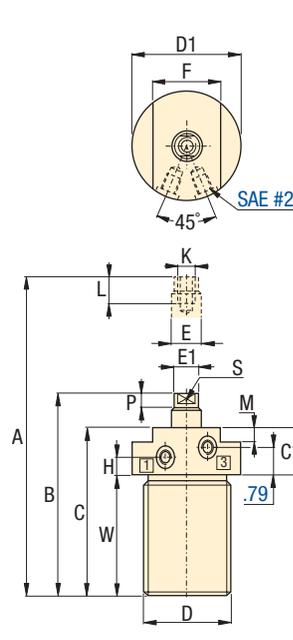
WPFS-100, -200



WPFS-450



WPTS-100, -200

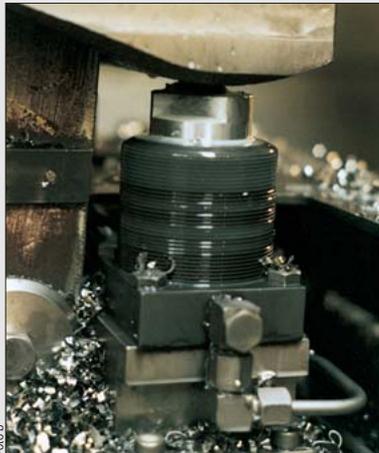


**Product dimensions** in inches [⊕]

Model number	A	B	C	C1	D	D1	E	E1	F	H	K	L	M	P	S	U	V	W	lbs	
unf																				
<b>▼ Flange models</b>																				
WPFS-100	4.88	4.49	4.17	.98	2.99	4.33	.62	.55	-	.49	.313-24	.59	-	.20	.47	3.70	.35	-	8.8	
WPFS-200	4.88	4.49	4.17	.98	3.62	5.12	.98	.90	-	.49	.500-20	.79	-	.20	.75	4.41	.35	-	13.2	
WPFS-450	7.60	6.81	6.34	.98	5.12	6.50	1.97	1.89	-	.49	.750-16	1.18	-	.39	1.18	5.79	.43	-	35.2	
<b>▼ Threaded models</b>																				
WPTS-100	4.84	4.45	4.13	1.50	2.375-12	2.94	.62	.55	2.16	.62	.313-24	.59	.79	.20	.47	-	-	-	2.63	6.6
WPTS-200	4.92	4.53	4.13	1.50	3.125-16	3.74	.98	.90	2.75	.62	.500-20	.79	.79	.26	.75	-	-	-	2.63	8.8

# Mounting dimensions *for work supports*

Shown: WFL-111 holding a casting in place.



## Mounting work supports

Enerpac work supports are offered in a wide variety of mounting styles. Dimensions for fixture holes and cavity preparation are specified for each mounting style separately.

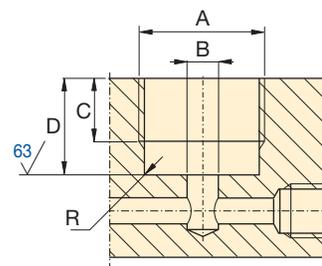
■ *The combination of Enerpac swing cylinders and work supports guarantee clamping without deformation.*



## Manifold work support mounting dimensions

Eliminates the need for fittings and tubing on the fixture. Use a flange nut to secure your Manifold work support.

WFM/WSM



### Product Dimensions in inches [Ⓜ]

Model number	A	B	C	D	R	Manifold O-ring <sup>1)</sup>
		ø				
▼ For manifold mount work supports						
WFM-71	1.250-16 UN 2B	.37-.39	.58-.60	.93-.95	.015	ARP-017
WSM-71	1.250-16 UN 2B	.37-.39	.58-.60	.93-.95	.015	ARP-017

<sup>1)</sup> Polyurethane 92 duro.

## Threaded work support mounting dimensions

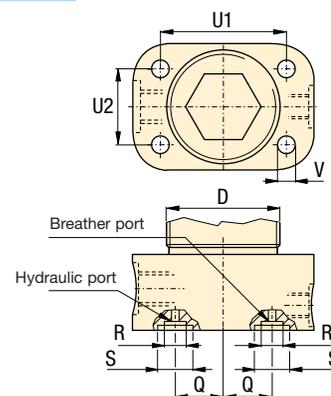
Threaded body work supports can be mounted directly into a fixture. The thread size (D) can be found in the dimension charts on Ⓜ33 (WFT) and Ⓜ35 (WST models). Use a flange nut to secure your threaded work support in the required position.

## Lower flange work support mounting dimensions

Lower flange work supports can be bolted straight onto a fixture, or can be mounted into a fixture. Flange nuts can be used to secure the cylinders at the required height.

**Note:** It is critical to keep breather port open to clean dry location.

WFL/WSL series



### Product Dimensions in inches [Ⓜ]

Model number	D	Q	R	S	U1	U2	V	Manifold O-ring <sup>1)</sup>
			ø	ø				
▼ For lower flange work supports								
WFL-111	1.375-18UNEF	.57	.23	.37	1.62	.94	.284	ARP-010
WFL-221	2.625-20UN	1.08	.34	.56	2.18	2.18	.284	ARP-110
WFL-331	2.88	1.20	.34	.56	2.44	2.44	.284	ARP-110
WFL-441	3.38	1.44	.34	.56	2.94	2.94	.284	ARP-110
WSL-111	1.375-18UNEF	.57	.23	.34	1.62	.94	.284	ARP-010
WSL-221	2.625-20UN	1.08	.34	.56	2.18	2.18	.284	ARP-110
WSL-331	2.88	1.20	.34	.56	2.44	2.44	.284	ARP-110
WSL-441	3.38	1.44	.34	.56	2.94	2.94	.284	ARP-110

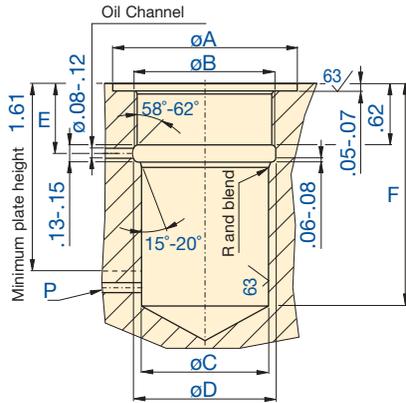
<sup>1)</sup> Polyurethane 92 duro.



**Cartridge work support mounting dimensions**

Can be designed onto narrow fixture plates as thru-hole mounting is fully functional.

**WFC/WSC**



**Dimensions in inches** [ ]

Model number	A	B (mm)	C	D	E	F min.	Ventilation below F required
<b>▼ Hydraulic advance</b>							
WFC-72	1.68-1.70	M33X1,5	1.182-1.184	1.31-1.33	.62-.68	2.08	-
WFC-112	2.26-2.28	M42X1,5	1.499-1.501	1.67-1.69	.69-.75	2.46	•
WFC-222	3.01-3.03	M60X1,5	2.249-2.251	2.38-2.40	.69-.72	2.80	•
<b>▼ Spring advance</b>							
WSC-72	1.68-1.70	M33X1,5	1.182-1.184	1.31-1.33	.62-.68	2.08	-
WSC-112	2.26-2.28	M42X1,5	1.499-1.501	1.67-1.69	.69-.75	1.80	•
WSC-222	3.01-3.03	M60X1,5	2.249-2.251	2.38-2.40	.69-.72	2.20	•

Note: Ventilation required on WFC-112, 222 below 1.61 inch when mounted in blind cavity.

**Positive locking work support mounting dimensions**

Positive locking work support mounting dimensions are indicated in the dimension chart on 37. For threaded models, use a flange nut to secure the work support in the required position.

Force: 1650 - 10,000 lbs

Stroke: .38 - .65 inch

Pressure: 700 - 5000 psi

**E** Cilindros de soporte

**F** Vérin anti-vibreur

**D** Abstützzylinder

**Options**

**Accessories**

72 ▶



**In-line filters**

137 ▶



**Fittings**

138 ▶



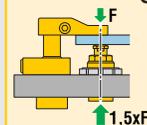
**Swing cylinders**

10 ▶



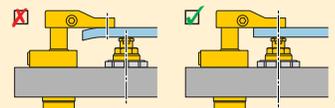
**Important**

**Warning!**  
Support force and clamping force must be matched. Support force should be at least 150% of clamping force.



Do not exceed maximum flow rates to avoid premature lockup.

Always center load over work support.



# Linear cylinders

## Linear Cylinders

A wide variety of styles and features make Enerpac's linear cylinder line the most complete in the industry. Ranging from compact short stroke spring return cylinders to heavy-duty industrial grade double acting automation cylinders, Enerpac has the cylinder to meet every application need. Whether you have to push it, pull it, clamp it, punch it, stamp it, press it, or hold it in place for days at a time, Enerpac has the cylinder to meet your need.



## Technical support

Refer to the "Yellow Pages" of this catalog for:

- Safety instructions
- Basic hydraulic information
- Advanced hydraulic technology
- FMS (Flexible Machining Systems) technology
- Conversion charts and hydraulic symbols

 141 ▶

	▼ series	▼ page	
<b>Pull cylinder range overview</b>		<b>42 - 43</b>	
Upper flange pull cylinders	PU	44 - 45	
Lower flange pull cylinders	PL	46 - 47	
Threaded body pull cylinders	PT	48 - 49	
Positive locking push cylinders ( <i>Collet-Lok</i> <sup>®</sup> )	WP	50 - 51	
<b>Linear cylinders</b>		<b>52 - 71</b>	
Threaded cylinders	CST, CDT	52 - 53	
Special threaded cylinders	CYDA WRT, WMT	54 - 55	
Manifold cylinders	CSM	56 - 57	
Block cylinders	CSB CDB	58 - 61	
Pull down clamps	ECH ECM	62 - 63	
Hollow plunger cylinders	CY, HCS QDH, RWH	64 - 65	
Positive clamping cylinders	MRS	66 - 67	
Single-acting universal cylinders	BRW, MRW, RW	68 - 69	
Double-acting universal cylinders	RD, AD	70 - 71	
<b>Cylinder accessories</b>		<b>72 - 73</b>	

# Pull cylinders *Application & selection*

Swing cylinders  
Work supports

Linear cylinders

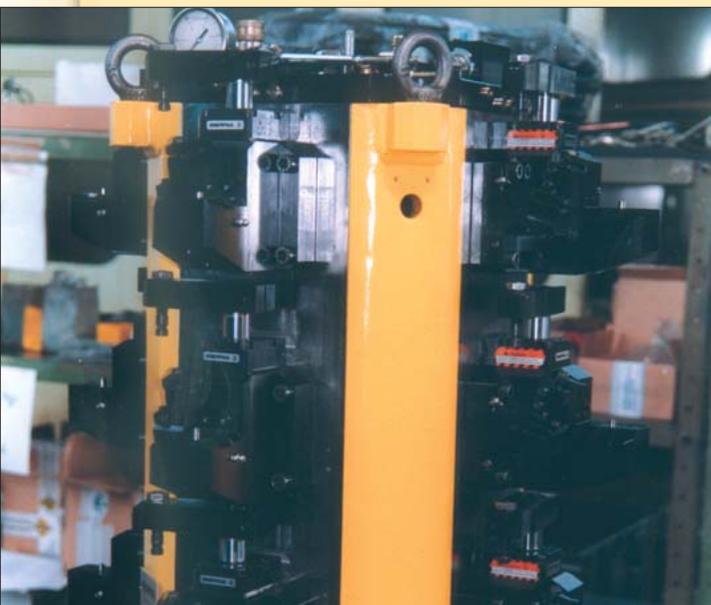
Shown: PLSS-121, WPTC-110, PUSD-121



Hydraulic pull cylinders utilize hydraulic pressure to hold down parts in a fixture. The guided plunger maintains orientation during the full clamping cycle, eliminating the need for an external guide. Internally threaded plunger ends accept various custom attachments to assist in the clamping process.

Enerpac offers both single and double-acting pull cylinders, with capacities ranging from 600 to 9600 lbs. for pulling and 1,200 to 18,400 lbs for pushing applications.

Hydraulic fixture with pull and swing cylinders, manifold and threaded cylinders for positioning and holding the work piece during milling process of gun breeches.



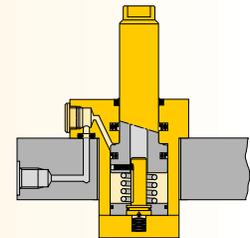
## Compact and full featured design

- Guided linear plunger movement
- Compact design allows for efficient fixture layout
- Variety of mounting styles to meet design needs
- Internal plunger thread and flats across plunger top allow easy mounting of attachments
- Choice of porting styles to meet system and design requirements
- Single and double-acting cylinders to suit a variety of hydraulic requirements

## Select your pull cylinder type:

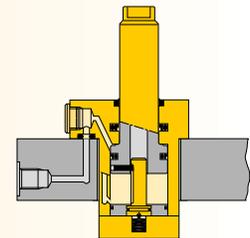
### Single-acting

- The obvious choice when there are few system restrictions, and there are not many units retracting simultaneously
- Fewer valving requirements which results in a less complex circuit



### Double-acting

- When greater control is required during the unclamp cycle
- When heavy attachments are being used
- When timing sequences are critical: less sensitive to system back pressures resulting from long tube lengths or numerous components being retracted at the same time



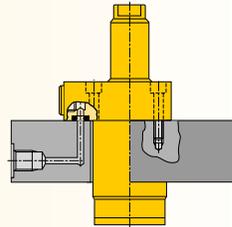
For Collet-Lok® push cylinders, see 50 ▶



## Select your mounting method:

### PU series, Upper flange mounting

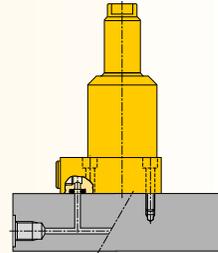
- Flexible design allows for manifold or threaded oil port connection
- The fixture hole does not require tight tolerances
- Easy installation with only 3 or 4 mounting bolts



44 ▶

### PL series, Lower flange mounting

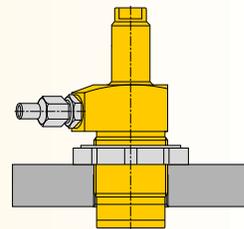
- Flexible design allows for manifold or threaded port connection
- No fixture hole required
- Easy installation with only 3 or 4 mounting bolts



46 ▶

### PT series, Threaded body mounting

- Body thread for precise cylinder height positioning
- Threaded oil port connection
- Can be threaded directly into the fixture and secured in position by means of standard flange nuts



48 ▶

Pull force: 600-9600 lbs

Push force: 1200-18,400 lbs

Stroke: .65-1.18 inch

Pressure: 500-5000 psi

**E** Cilindros de tracción

**F** Verins traction

**D** Zugzylinder



## Product selection

Cylinder capacity		Stroke in	Upper flange	Lower flange	Threaded body
lbs Pull	lbs Push				
<b>▼ Single-acting</b>			Model number		
575	–	.65	<b>PUSS-21</b>	<b>PLSS-21</b>	<b>PTSS-21</b>
1250	–	.89	<b>PUSS-51</b>	<b>PLSS-51</b>	<b>PTSS-51</b>
2950	–	1.12	<b>PUSS-121</b>	<b>PLSS-121</b>	<b>PTSS-121</b>
<b>▼ Double-acting</b>			Model number		
600	1200	.65	<b>PUSD-21</b>	<b>PLSD-21</b>	<b>PTSD-21</b>
1400	2950	.89	<b>PUSD-51</b>	<b>PLSD-51</b>	<b>PTSD-51</b>
2475	6300	.87	<b>PUSD-92</b>	<b>PLSD-92</b>	<b>PTSD-92</b>
3150	6150	1.12	<b>PUSD-121</b>	<b>PLSD-121</b>	<b>PTSD-121</b>
9600	18,400	1.18	<b>PUSD-351</b>	<b>PLSD-351</b>	<b>PTSD-351</b>

Note: - Call Enerpac to order models with metric thread and BSPP port connections.  
- Pull forces for single-acting cylinders reduced to overcome spring force.

## Options

### Accessories

72 ▶



### Collet-Lok® push cylinders

50 ▶



### Work supports

30 ▶



### Swing cylinders

10 ▶



### Sequence Valves

116 ▶



# Pull cylinders - Upper flange models

Shown: PUSS-51, PUSD-121



Swing cylinders  
Work supports

Linear cylinders

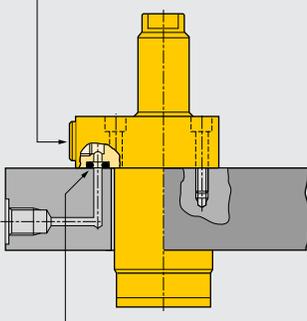
99-063

## PU series

Upper flange pull cylinders are designed for integrated manifold mounting solutions.

Hydraulic connections are made through SAE or BSPP oil connection or the standard integrated O-ring ports.

SAE oil connection



Integrated O-ring port

■ Enerpac upper flange pull cylinders in a fixture for gun breech production.



99-063.2

## Minimal mounting height

...when space is at a premium

- Guided linear plunger movement
- Flexible design allows for manifold or threaded port connection
- Low profile mounting style allows body to be below mounting surface
- Internal plunger thread allows easy mounting of attachments
- Simple mounting preparation
- Easy to machine fixture hole: does not require tight tolerances
- Easy assembly: 3 or 4 mounting bolts
- Double oil connection: threaded port or manifold mount

## Product selection

Cylinder capacity		Stroke	Model number	Cylinder effective area		Oil capacity	
Pull	lbs Push	in		Pull	in <sup>2</sup> Push	Pull	in <sup>3</sup> Push
<b>▼ Single-acting</b>							
575	-	.65	<b>PUSS-21</b>	.12	-	.08	-
1250	-	.89	<b>PUSS-51</b>	.28	-	.25	-
2950	-	1.12	<b>PUSS-121</b>	.63	-	.70	-
<b>▼ Double-acting</b>							
600	1200	.65	<b>PUSD-21</b>	.12	.24	.08	.16
1400	2950	.89	<b>PUSD-51</b>	.28	.59	.25	.53
2475	6300	.87	<b>PUSD-92</b>	.49	1.25	.42	1.08
3150	6150	1.12	<b>PUSD-121</b>	.63	1.23	.70	1.40
9600	18,400	1.18	<b>PUSD-351</b>	1.92	3.68	2.27	4.35

Note: - Call Enerpac to order models with BSPP oil connections.  
- Pull forces for single-acting cylinders reduced to overcome spring force.

## Dimensions in inches [ ]

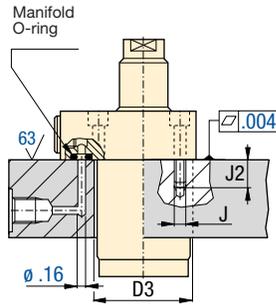
Model number	A	B	C1	D	D1	D2	E	E1	F	H
					ø			ø	ø	ø
<b>▼ Single-acting</b>										
<b>PUSS-21</b>	4.23	3.58	.98	1.10	1.86	1.77	.39	.33	.28	.43
<b>PUSS-51</b>	5.06	4.17	.98	1.37	2.13	2.25	.63	.59	.52	.39
<b>PUSS-121</b>	6.31	5.19	1.00	1.88	2.63	2.88	.87	.82	.68	.38
<b>▼ Double-acting</b>										
<b>PUSD-21</b>	4.23	3.58	.98	1.10	1.86	1.77	.39	.33	.28	.43
<b>PUSD-51</b>	5.06	4.17	.98	1.37	2.13	2.25	.63	.59	.52	.39
<b>PUSD-92</b>	5.12	4.25	.98	1.88	2.76	2.12	.98	.93	.71	.51
<b>PUSD-121</b>	6.31	5.19	1.00	1.88	2.63	2.88	.87	.82	.68	.38
<b>PUSD-351</b>	7.73	6.52	.98	3.02	3.94	3.50	1.50	1.42	1.12	.51



**Installation dimensions** in inches

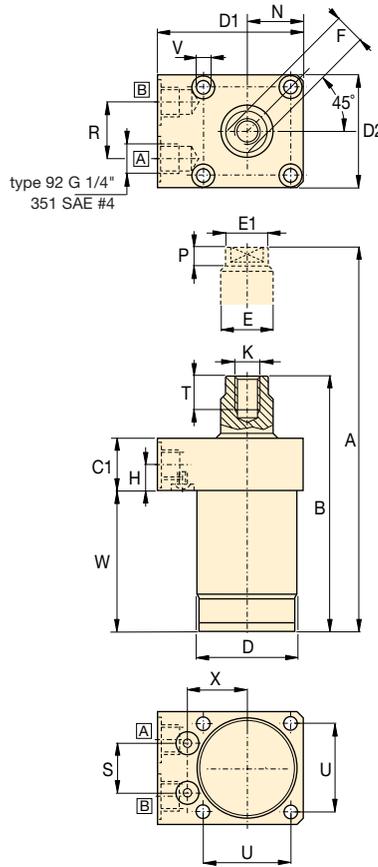
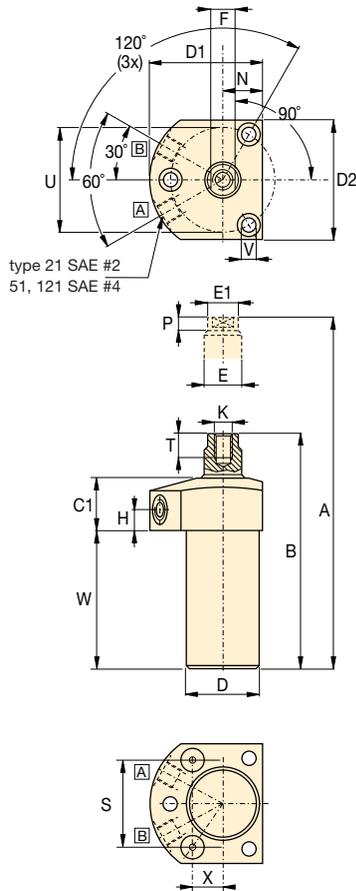
Pull Force lbs	Fixture hole Ø D3	Mounting thread J UNF	Min. depth J2	Manifold O-ring <sup>1)</sup> ARP No. or Inside Ø x thickness
600	1.12	#10-32	.65	568-010
1400	1.39	.250-28	.65	568-011
2475	1.93	M6	.59	.17 X .139
3150	1.89	.312-24	.80	568-011
9600	3.06	.375-24	.74	.17 X .139

<sup>1)</sup> O-ring material: polyurethane, 92 Durometer



**-21, 51, 121**

**-92, -351**



**A** = Pull  
**B** = Push (venting)

	K	N	P	R	S	T	U	V	W	X	lbs	Model number
<b>Single-acting ▼</b>												
#10-32 UNF	.61	.19	1.02	.825	.31	1.58	.22	2.09	.225	1.0		<b>PUSS-21</b>
.312-24 UNF	.75	.23	1.02	1.614	.62	1.97	.27	2.60	.268	2.5		<b>PUSS-51</b>
.500-20 UNF	1.00	.38	1.02	2.048	.75	2.50	.27	3.38	.347	3.5		<b>PUSS-121</b>
<b>Double-acting ▼</b>												
#10-32 UNF	.61	.19	1.02	.825	.31	1.58	.22	2.09	.225	1.0		<b>PUSD-21</b>
.312-24 UNF	.75	.23	1.02	1.614	.62	1.97	.27	2.60	.268	2.5		<b>PUSD-51</b>
M10 x 1,50	1.06	.41	1.02	.93	.63	1.65	.27	2.67	1.13	4.4		<b>PUSD-92</b>
.500-20 UNF	1.00	.38	1.02	2.048	.75	2.50	.27	3.38	2.048	3.5		<b>PUSD-121</b>
M16 x 2	1.75	.51	1.02	1.36	1.22	2.76	.42	3.49	1.64	11.3		<b>PUSD-351</b>

Note: U= bolt circle

- Pull force:** 600-9600 lbs
- Push force:** 1200-18,400 lbs
- Stroke:** .65-1.18 inch
- Pressure:** 500-5000 psi

- E** Cilindros de tracción
- F** Verins traction
- D** Zugzylinder



**Options**

**Accessories** [72](#)

**Collet-Lok® push cylinders** [50](#)

**Swing cylinders** [10](#)

**Sequence Valves** [116](#)

**Important**

Single-acting cylinders can be vented through the manifold port.

The upper flange pull cylinder has a bolt pattern which is identical to its lower flange equivalent, enabling interchangeability.

In case there is a risk of machining coolants and debris being inhaled via the breather vent, it is recommended to pipe this port to an area outside the fixture that is protected from machining coolants and debris.

Linear cylinders Power sources Valves System components Yellow pages

# Pull cylinders - Lower flange models

Shown: PLSD-51, PLSD-121



Swing cylinders  
Work supports

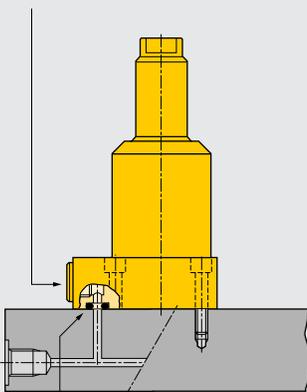
Linear cylinders

99-064

## ▶ PL series

The lower flange cylinders are designed for integrated manifold mounting solutions. Hydraulic connections are made through SAE or BSPP oil connection or the standard integrated O-ring ports.

SAE oil connection



Integrated O-ring port

## Minimal mounting height

...when space is at a premium

- Guided linear plunger movement
- Flexible design allows for manifold or threaded port connection
- Low profile mounting style allows body to be below mounting surface
- Internal plunger thread allows easy mounting of attachments
- Easiest mounting preparation in the line
- Easy to machine fixture hole: does not require tight tolerances
- Easy assembly: 3 or 4 mounting bolts
- Double oil connection: threaded port or manifold mount

## 🌐 Product selection

Cylinder capacity		Stroke	Model number	Cylinder effective area		Oil capacity	
Pull	lbs Push	in		Pull	in <sup>2</sup> Push	Pull	in <sup>3</sup> Push
<b>▼ Single-acting</b>							
575	-	.65	<b>PLSS-21</b>	.12	-	.08	-
1250	-	.89	<b>PLSS-51</b>	.28	-	.25	-
2950	-	1.12	<b>PLSS-121</b>	.63	-	.70	-
<b>▼ Double-acting</b>							
600	1200	.65	<b>PLSD-21</b>	.12	.24	.08	.16
1400	2950	.89	<b>PLSD-51</b>	.28	.59	.25	.53
2475	6300	.87	<b>PLSD-92</b>	.49	1.25	.42	1.08
3150	6150	1.12	<b>PLSD-121</b>	.63	1.23	.70	1.40
9600	18,400	1.18	<b>PLSD-351</b>	1.92	3.68	2.27	4.35

Note: - Call Enerpac to order models with BSPP port connections.  
- Pull forces for single-acting cylinders reduced to overcome spring force.

## Ⓐ Dimensions in inches [⊕]

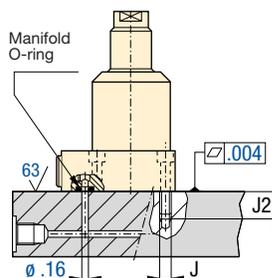
Model number	A	B	C	C1	D	D1	D2	E	E1	F	H
					∅			∅			
<b>▼ Single-acting</b>											
<b>PLSS-21</b>	4.23	3.58	3.07	.98	1.1	1.86	1.77	.39	.34	.28	.54
<b>PLSS-51</b>	5.06	4.17	3.33	.98	1.37	2.13	2.25	.63	.59	.52	.55
<b>PLSS-121</b>	6.31	5.19	4.38	1.00	1.88	2.63	2.88	.87	.82	.68	.62
<b>▼ Double-acting</b>											
<b>PLSD-21</b>	4.23	3.58	3.07	.98	1.1	1.86	1.77	.39	.34	.28	.54
<b>PLSD-51</b>	5.06	4.17	3.33	.98	1.37	2.13	2.25	.63	.59	.52	.55
<b>PLSD-92</b>	5.43	4.75	4.00	.98	1.88	2.76	2.12	.98	.93	.71	.51
<b>PLSD-121</b>	6.31	5.19	4.38	1.00	1.88	2.63	2.88	.87	.82	.68	.62
<b>PLSD-351</b>	8.02	6.83	4.77	.98	3.15	3.94	3.50	1.50	1.42	1.12	.49



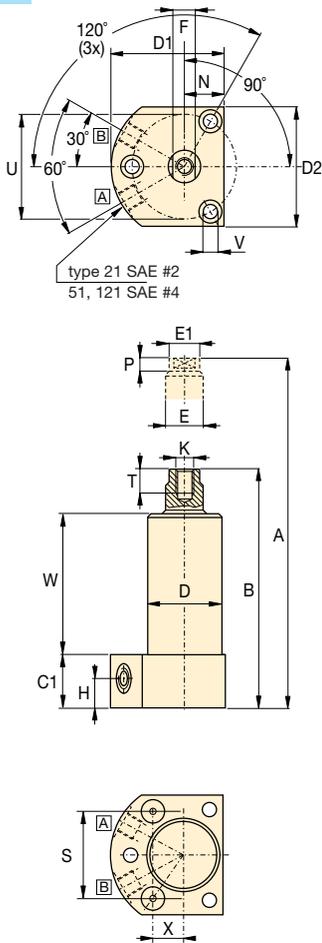
**Installation dimensions** in inches

Pull Force lbs	Mounting thread J UNF	Minimum depth J2	Manifold O-ring <sup>1)</sup> ARP No. or Inside Ø x thickness
600	#10-32	.65	568-010
1400	.250-28	.65	568-011
2475	M6	.59	.17 x .139
3150	.312-24	.80	568-011
9600	.375-24	.74	.17 x .139

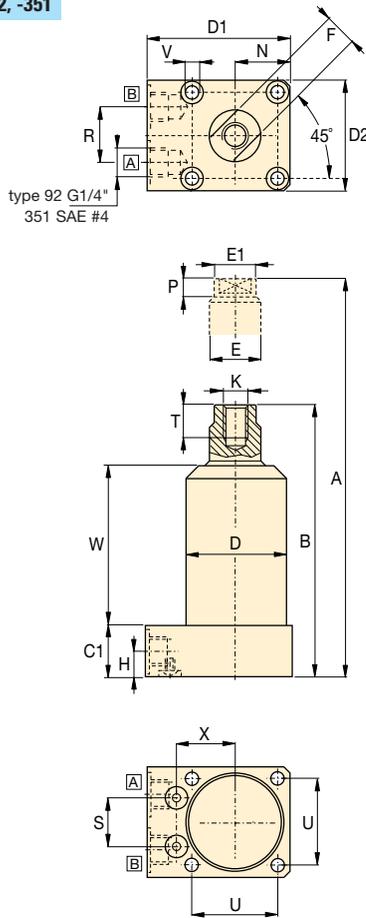
<sup>1)</sup> O-ring material: polyurethane, 92 Durometer



**-21, 51, 121**



**-92, -351**



**A** = Pull  
**B** = Push (venting)

	K	N	P	R	S	T	U	V	W	X	lbs	Model number
<b>Single-acting ▼</b>												
#10-32 UNF	.61	.19	1.02	.825	.31	1.58	.22	2.13	.225	1.0		<b>PLSS-21</b>
.312-24 UNF	.75	.23	1.02	1.614	.62	1.97	.27	2.69	.268	2.5		<b>PLSS-51</b>
.500-20 UNF	1.00	.38	1.02	2.048	.75	2.50	.27	3.48	.347	3.5		<b>PLSS-121</b>
<b>Double-acting ▼</b>												
#10-32 UNF	.61	.19	1.02	.825	.31	1.58	.22	2.13	.225	1.0		<b>PLSD-21</b>
.312-24 UNF	.75	.23	1.02	1.614	.62	1.97	.27	2.69	.268	2.5		<b>PLSD-51</b>
M10 x 1.50	.41	1.06	1.02	.93	.63	1.65	.27	3.09	1.13	4.4		<b>PLSD-92</b>
.500-20 UNF	1.00	.38	1.02	2.048	.75	2.50	.27	3.48	.347	3.5		<b>PLSD-121</b>
M16 x 2	1.75	.51	1.02	1.36	1.22	2.76	.42	3.87	1.64	12.3		<b>PLSD-351</b>

- Pull force: 600-9600 lbs**
- Push force: 1200-18,400 lbs**
- Stroke: .65-1.18 inch**
- Pressure: 500-5000 psi**

- E** Cilindros de tracción
- F** Verins traction
- D** Zugzylinder



**Options**

- Accessories** [72](#)
- Collet-Lok® push cylinder** [50](#)
- Swing cylinders** [10](#)
- Sequence Valves** [116](#)

**Important**

Single-acting cylinders can be vented through the manifold port.

The lower flange pull cylinder has a bolt pattern which is identical to it's upper flange equivalent, enabling interchangeability.

In case there is a risk of machining coolants and debris being inhaled via the breather vent, it is recommended to pipe this port to an area outside the fixture that is protected from machining coolants and debris.

# Pull cylinders - Threaded body models

Swing cylinders  
Work supports

Linear cylinders

Shown: PTSS-21, PTSD-51



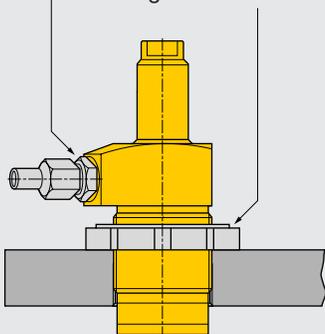
## PT series

The threaded body pull cylinders can be bolted to the fixture. This allows easy installation or removal of the unit and does not require machined fixture holes.

The cylinder is adjusted to the appropriate height, and then locked in place using a flange nut (□ 72).

SAE oil connection

Flange nut



■ Threaded body pull cylinder with modified clamp arm, mounted on a frame-straightening fixture.



## Threaded directly into the fixture

...can be secured at any height

- Guided linear plunger movement
- Threaded port connection
- Internal plunger thread allows easy mounting of attachments
- Simple mounting preparation
- Easy installation and removal
- Greatest flexibility in fixture design

## Product selection

Cylinder capacity		Stroke	Model number	Cylinder effective area		Oil capacity	
Pull	lbs Push	in		Pull	in <sup>2</sup> Push	Pull	in <sup>3</sup> Push
<b>▼ Single-acting</b>							
575	-	.65	<b>PTSS-21</b>	.12	-	.08	-
1250	-	.89	<b>PTSS-51</b>	.28	-	.25	-
2950	-	1.12	<b>PTSS-121</b>	.63	-	.70	-
<b>▼ Double-acting</b>							
600	1200	.65	<b>PTSD-21</b>	.12	.24	.08	.16
1400	2950	.89	<b>PTSD-51</b>	.28	.59	.25	.53
2475	6300	.87	<b>PTSD-92</b>	.49	1.25	.42	1.08
3150	6150	1.12	<b>PTSD-121</b>	.63	1.23	.70	1.40
9600	18,400	1.18	<b>PTSD-351</b>	1.92	3.68	2.27	4.35

Note: - Call Enerpac to order models with metric thread and BSPP port connections.  
- Pull forces for single-acting cylinders reduced to overcome spring force.

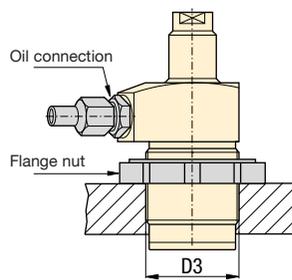
## Dimensions in inches [⊕]

Model number	A	B	C	C1	D	D1	D2
					∅		
<b>▼ Single-acting</b>							
<b>PTSS-21</b>	4.23	3.58	3.07	.98	1.125-16 UN	1.55	1.30
<b>PTSS-51</b>	5.06	4.17	3.33	.98	1.375-18 UNEF	1.97	1.50
<b>PTSS-121</b>	6.31	5.19	4.38	.98	1.875-16 UN	2.38	2.00
<b>▼ Double-acting</b>							
<b>PTSD-21</b>	4.23	3.58	3.07	.98	1.125-16 UN	1.55	1.30
<b>PTSD-51</b>	5.06	4.17	3.33	.98	1.375-18 UNEF	1.97	1.50
<b>PTSD-92</b>	5.12	4.25	3.66	.98	M48 x 1,5	2.46	1.89
<b>PTSD-121</b>	6.31	5.19	4.38	.98	1.875-16 UN	2.38	2.00
<b>PTSD-351</b>	7.73	6.52	4.48	.98	3.125-16 UN	3.48	3.15



**Installation dimensions**  
in inches

Pull force lbs	Fixture hole thread size D3
600	1.125-16 UNF
1400	1.375-18 UNEF
2475	M48 x 1,5
3150	1.875-16 UNF
9600	3.125-16 UN



- Pull force:** 600-9600 lbs
- Push force:** 1200-18,400 lbs
- Stroke:** .65-1.18 inch
- Pressure:** 500-5000 psi

- E** Cilindros de tracción
- F** Verins traction
- D** Zugzylinder



Linear cylinders

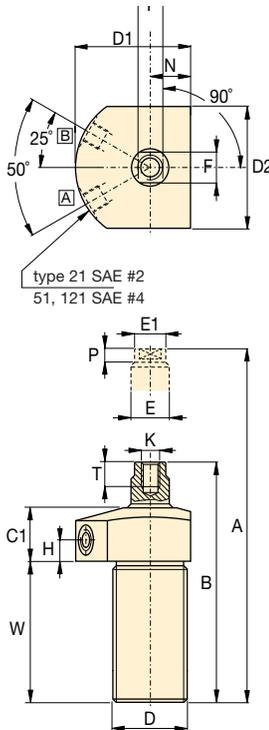
Power sources

Valves

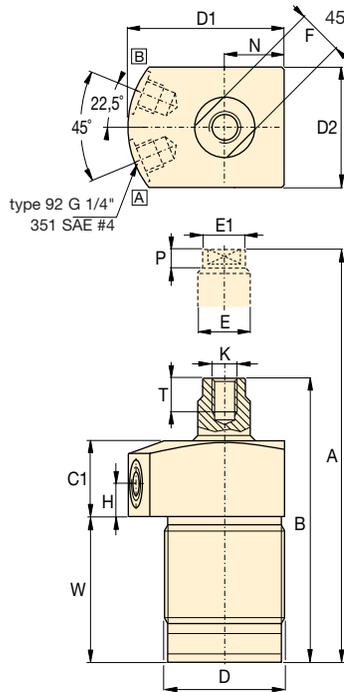
System components

Yellow pages

**-21, 51, 121**



**-92, -351**



**A** = Pull  
**B** = Push (venting)

**Options**

**Accessories** 72 ▶

**Collet-Lok® push cylinders** 50 ▶

**Swing cylinders** 10 ▶

**Sequence valves** 116 ▶

**Important**

Single-acting cylinders can be vented through the manifold port.

In case there is a risk of machining coolants and debris being inhaled via the breather vent, it is recommended to pipe this port to an area outside the fixture that is protected from machining coolants and debris.

	E	E1	F	H	K	N	P	T	W	lbs	Model number
<b>Single-acting ▼</b>											
	.39	.34	.28	.39	#10-32 UNF	.61	.19	.31	2.09	1.0	<b>PTSS-21</b>
	.63	.59	.52	.39	.312-24 UNF	.75	.23	.62	2.60	2.5	<b>PTSS-51</b>
	.87	.82	.68	.38	.500-20 UNF	1.00	.38	.75	3.38	3.5	<b>PTSS-121</b>
<b>Double-acting ▼</b>											
	.39	.34	.28	.39	#10-32 UNF	.61	.19	.31	2.09	1.0	<b>PTSD-21</b>
	.63	.59	.52	.39	.312-24 UNF	.75	.23	.62	2.60	2.5	<b>PTSD-51</b>
	.98	.93	.71	.51	M10 x 1,5	.94	.41	.63	2.47	4.4	<b>PTSD-92</b>
	.87	.82	.68	.38	.500-20 UNF	1.00	.38	.75	3.38	3.5	<b>PTSD-121</b>
	1.50	1.42	1.12	.52	M16 x 2	1.57	.51	1.22	3.22	10.4	<b>PTSD-351</b>

# Push cylinders - Collet-Lok® design

Swing cylinders  
Work supports

Linear cylinders

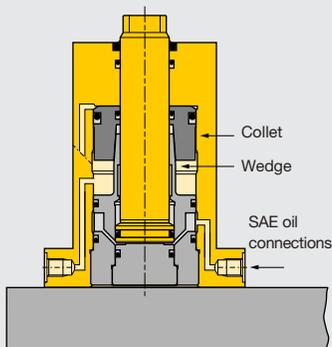
Shown: WPTC-110, WPFC-210



## WP series

Collet-Lok® positive locking push cylinders are designed to mechanically hold the workpiece after hydraulic pressure is removed.

Push capacities range from 2500 lb. to 8800 lb.



Hydraulic pressure pushes the collet up a wedge, locking the plunger in the clamping position.

■ Lower flange Collet-Lok® push cylinder used for positioning a motorcycle frame.



## Ideal when live hydraulics are not available

...clamping is sustained mechanically so live hydraulics are not required during the machining cycle

- Double-acting Collet-Lok® action allows fully automated operation
- Additional level of safety since live hydraulics are not required
- Collet-Lok® push cylinders can either be mounted by the flange, or threaded into the fixture
- The Collet-Lok® design is an industry exclusive

## Collet-Lok® sequence



**Step 1**  
Pressurize port #1. Plunger extends and clamps workpiece.



**Step 2**  
Keep port #1 pressurized. Pressurize port #2. Plunger will be locked in clamped position.



**Step 3**  
Depressurize port #1 and #2. Cylinder should now be uncoupled from hydraulic power source and will maintain the clamped position.



**Step 4**  
Pressurize port #3. Plunger will be unlocked and the plunger will be released to its original position.

## Product selection

Max. push force	Hydr. plunger stroke	Model number		Operating pressure		Hydraulic effective area		Oil capacity		Max. oil flow
		Lower flange	Threaded body	min.	max.	in <sup>2</sup> adv.	adv.	in <sup>3</sup> unlock	retr.	
2500	.59	WPFC-110	WPTC-110	725	5000	.50	.30	.37	.24	600
5000	.59	WPFC-210	WPTC-210	725	5000	.99	.61	.61	.37	600
8800	.59	WPFC-410	WPTC-410	725	5000	1.76	1.03	.98	.67	600

Maximum cycle rate: 8 cycles/min.

Note: Call Enerpac to order models with metric thread and BSPP port connections.

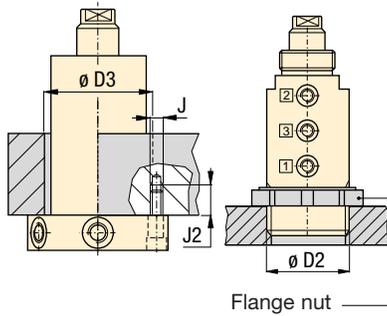
## Dimensions in inches [Ⓜ]

Model number	A	B	C	C1	D	D1	D2	E	E1	F
▼ Lower flange										
WPFC-110	6.08	5.49	5.16	-	2.76	3.94	-	.62	.59	-
WPFC-210	6.79	6.20	5.87	-	3.07	4.33	-	.87	.79	-
WPFC-410	7.30	6.71	6.22	-	3.66	5.12	-	1.25	1.10	-
▼ Threaded body										
WPTC-110	6.06	5.47	5.12	.75	2.375-12 UN	2.52	1.500-12 UNF	.62	.59	1.81
WPTC-210	6.73	6.14	5.83	.71	2.750-16 UN	2.91	1.875-16 UN	.87	.79	2.16
WPTC-410	7.26	6.67	6.18	.91	3.500-12 UN	3.62	2.375-12 UN	1.25	1.10	2.95



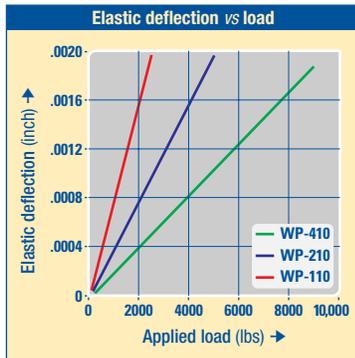
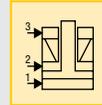
**Installation dimensions** in inches

Push force lbs	Fixture hole $\phi D3$	Mounting thread J	Minimum depth J2
<b>▼ Lower flange</b>			
2500	2.79	M6	.68
5000	3.10	M8	.72
8800	3.69	M10	.72
<b>▼ Threaded body</b>			
2500	2.375 12 UN	-	-
5000	2.750 16 UN	-	-
8800	3.500 12 UN	-	-



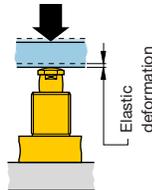
<b>Push force:</b> 2500-8800 lbs
<b>Stroke:</b> .59 inch
<b>Pressure:</b> 725-5000 psi

- E** Cilindros de empuje
- F** Vérins pousseurs
- D** Gesicherter Druckzylinder

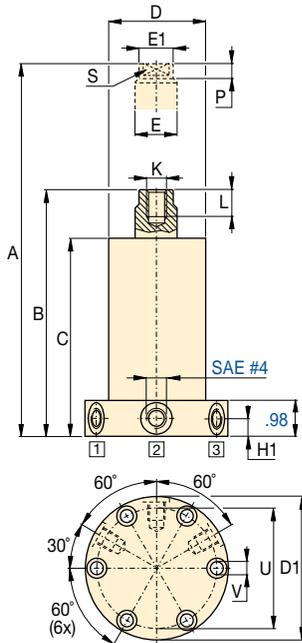


**Deflection chart:**

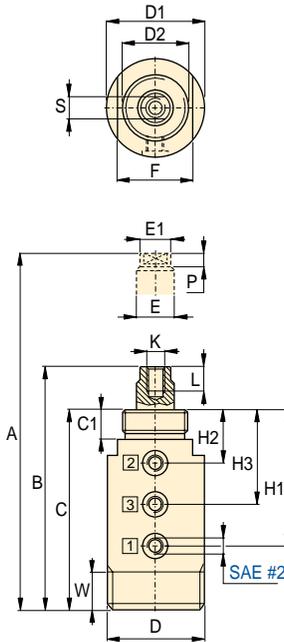
Elastic deformation of the plunger resulting from the application of load.



**WPFC**



**WPTC**



**Oil port functions**

- 1** Clamp
- 2** Lock
- 3** Unlock/Retract

H1	H2	H3	K	L	P	S	U	V	W	lbs	Model number
<b>Lower flange ▼</b>											
.49	-	-	.313-24 UNF	.59	.27	.47	3.31	.28	-	8.8	<b>WPFC-110</b>
.49	-	-	.375-24 UNF	.79	.35	.63	3.70	.35	-	11.0	<b>WPFC-210</b>
.49	-	-	.625-18 UNF	1.18	.43	.94	4.41	.43	-	18.7	<b>WPFC-410</b>
<b>Threaded body ▼</b>											
3.78	1.30	2.56	.313-24 UNF	.59	.27	.47	-	-	.73	6.6	<b>WPTC-110</b>
4.37	1.26	2.83	.375-24 UNF	.79	.35	.63	-	-	.79	7.5	<b>WPTC-210</b>
4.57	1.50	3.03	.625-18 UNF	1.18	.43	.94	-	-	.98	15.4	<b>WPTC-410</b>

**Options**

**Auto couplers** [126 ▶](#)

**Sequence valves** [116 ▶](#)

**Accessories** [72 ▶](#)

**Swing cylinders** [10 ▶](#)

**Important**

For proper application, clamp force, pressures and timing, consult Enerpac for support.

# Threaded cylinders *Application & selection*

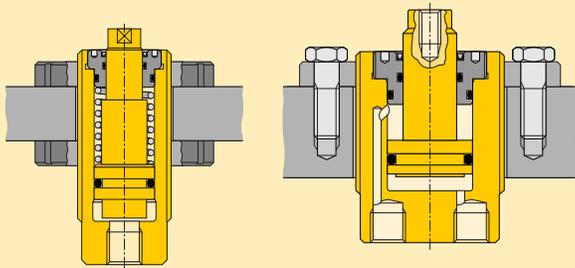
Shown: CST-9381, CST-571, CST-18251, CDT-18131, CDT-40251



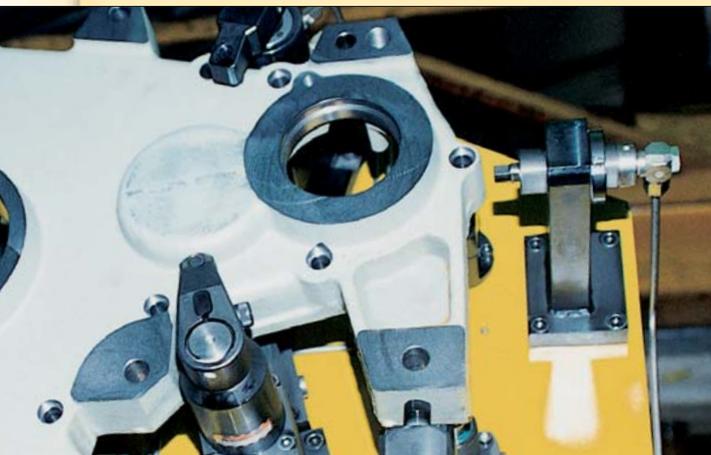
Swing cylinders  
Work supports

Linear cylinders

▶ Threaded cylinders are designed for workpiece positioning, holding and ejecting applications where space is at a premium. Double-acting models are also suited to manufacturing applications, such as production punching.



■ Threaded cylinder, mounted with horizontal bracket to position the workpiece against the stops. Enerpac swing cylinders are then activated to clamp the work piece before machining operations begin.



## High clamping forces in a compact body

- Minimum cylinder diameter combined with maximized clamping forces
- Threaded body allows fine positioning and easy installation
- Nitro carburized bodies and internal plunger wipers allow maintenance-free, high-cycle performance
- Center-tapped plungers will hold workpiece contact buttons
- Single-acting models with spring return simplify hydraulic tubing requirements
- Double-acting models are recommended for high-cycle applications

## Product selection

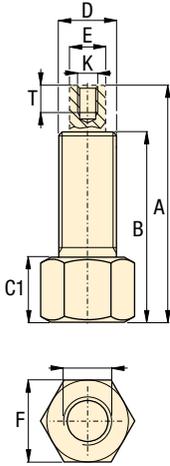
Cylinder capacity at 5000 psi	Nominal stroke	Model number	Effective area		Oil capacity		
			in <sup>2</sup>		in <sup>3</sup>		
lbs push pull	in		push	pull	push	pull	
<b>▼ Single-acting</b>							
380	-	0.28	<b>CST-271</b>	0.08	-	0.02	-
380	-	0.39	<b>CST-2101</b>	0.08	-	0.03	-
380	-	0.51	<b>CST-2131</b>	0.08	-	0.04	-
1190	-	0.28	<b>CST-571</b>	0.24	-	0.07	-
1190	-	0.51	<b>CST-5131</b>	0.24	-	0.12	-
1190	-	0.75	<b>CST-5191</b>	0.24	-	0.18	-
1190	-	0.98	<b>CST-5251</b>	0.24	-	0.24	-
1190	-	1.50	<b>CST-5381</b>	0.24	-	0.36	-
1950	-	0.28	<b>CST-971</b>	0.39	-	0.11	-
1950	-	0.51	<b>CST-9131</b>	0.39	-	0.20	-
1950	-	0.75	<b>CST-9191</b>	0.39	-	0.29	-
1950	-	0.98	<b>CST-9251</b>	0.39	-	0.38	-
1950	-	1.50	<b>CST-9381</b>	0.39	-	0.58	-
3950	-	0.51	<b>CST-18131</b>	0.79	-	0.40	-
3950	-	0.98	<b>CST-18251</b>	0.79	-	0.78	-
3950	-	1.50	<b>CST-18381</b>	0.79	-	1.18	-
3950	-	1.97	<b>CST-18501</b>	0.79	-	1.56	-
6110	-	0.59	<b>CST-27151</b>	1.22	-	0.72	-
6110	-	0.98	<b>CST-27251</b>	1.22	-	1.20	-
6110	-	1.97	<b>CST-27501</b>	1.22	-	2.40	-
8800	-	0.51	<b>CST-40131</b>	1.76	-	0.90	-
8800	-	0.98	<b>CST-40251</b>	1.76	-	1.73	-
8800	-	1.50	<b>CST-40381</b>	1.76	-	2.63	-
8800	-	1.97	<b>CST-40501</b>	1.76	-	3.46	-
<b>▼ Double-acting</b>							
3900	2330	0.51	<b>CDT-18131</b>	0.79	0.47	0.40	0.24
3900	2330	0.98	<b>CDT-18251</b>	0.79	0.47	0.78	0.46
3900	2330	1.50	<b>CDT-18381</b>	0.79	0.47	1.18	0.70
3900	2330	1.97	<b>CDT-18501</b>	0.79	0.47	1.56	0.93
6110	4080	0.59	<b>CDT-27151</b>	1.22	0.82	0.72	0.48
6110	4080	0.98	<b>CDT-27251</b>	1.22	0.82	1.20	0.81
6110	4080	1.97	<b>CDT-27501</b>	1.22	0.82	2.40	1.61
8800	5870	0.51	<b>CDT-40131</b>	1.76	1.17	0.90	0.60
8800	5870	0.98	<b>CDT-40251</b>	1.76	1.17	1.73	1.15
8800	5870	1.50	<b>CDT-40381</b>	1.76	1.17	2.63	1.75
8800	5870	1.97	<b>CDT-40501</b>	1.76	1.17	3.46	2.30

Note: - Seal material: Buna-N, Polyurethane.

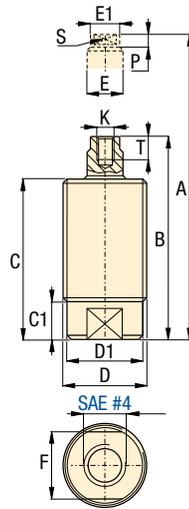
- Minimum operating pressure for single-acting models (to overcome return spring force) is 580 psi.



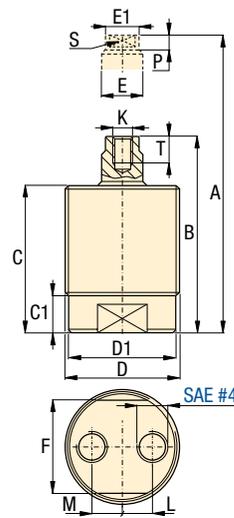
### CST-271, -2101, -2131



### Other CST models



### CDT models



**Force: 380-8800 lbs**

**Stroke: .28-1.97 inch**

**Pressure: 580-5000 psi**

- E** Cilindros roscados
- F** Vérins corps filetés
- D** Einschraubzylinder



### Options

**Accessories**

72 ▶



## Product dimensions in inches [ ]

Model number	A Ext. height	B Retr. height	C	C1	D Ø	D1 Ø	E Ø	E1 Ø	F	K thread	L	M	P	S	T	 lbs
<b>▼ Single-acting</b>																
<b>CST-271</b>	1.89	1.61	-	0.59	.500-20 UN	-	0.19	-	0.63	#6-32 UN	-	-	-	-	0.19	0.2
<b>CST-2101</b>	2.05	1.65	1.65	0.59	.500-20 UN	-	0.19	-	0.63	#6-32 UN	-	-	-	-	0.19	0.3
<b>CST-2131</b>	2.54	2.03	-	0.59	.500-20 UN	-	0.19	-	0.63	#6-32 UN	-	-	-	-	0.19	0.3
<b>CST-571</b>	2.29	2.01	1.85	0.30	.750-16 UN	0.71	0.31	0.28	0.63	#8-32 UN	-	-	0.16	0.24	0.28	0.3
<b>CST-5131</b>	2.86	2.35	2.19	0.30	.750-16 UN	0.71	0.31	0.28	0.63	#8-32 UN	-	-	0.16	0.24	0.28	0.4
<b>CST-5191</b>	3.28	2.53	2.36	0.30	.750-16 UN	0.71	0.31	0.28	0.63	#8-32 UN	-	-	0.16	0.24	0.28	0.5
<b>CST-5251</b>	3.87	2.89	2.76	0.30	.750-16 UN	0.71	0.31	0.28	0.63	#8-32 UN	-	-	0.16	0.24	0.28	0.7
<b>CST-5381</b>	5.17	3.67	3.50	0.30	.750-16 UN	0.71	0.31	0.28	0.63	#8-32 UN	-	-	0.16	0.24	0.28	0.9
<b>CST-971</b>	2.53	2.25	2.03	0.41	1.000-12 UN	1.02	0.47	0.43	0.63	.250-28 UN	-	-	0.22	0.35	0.31	0.6
<b>CST-9131</b>	3.01	2.50	2.28	0.41	1.000-12 UN	1.02	0.47	0.43	0.63	.250-28 UN	-	-	0.22	0.35	0.31	0.7
<b>CST-9191</b>	3.86	3.11	2.89	0.41	1.000-12 UN	1.02	0.47	0.43	0.63	.250-28 UN	-	-	0.22	0.35	0.31	0.8
<b>CST-9251</b>	4.41	3.41	3.19	0.41	1.000-12 UN	1.02	0.47	0.43	0.63	.250-28 UN	-	-	0.22	0.35	0.31	0.9
<b>CST-9381</b>	5.61	4.11	3.89	0.41	1.000-12 UN	1.02	0.47	0.43	0.63	.250-28 UN	-	-	0.22	0.35	0.31	1.0
<b>CST-18131</b>	3.27	2.76	2.50	0.49	1.313-16 UN	1.22	0.63	0.59	1.06	.313-24 UN	-	-	0.26	0.50	0.47	1.2
<b>CST-18251</b>	4.51	3.53	3.27	0.49	1.313-16 UN	1.22	0.63	0.59	1.06	.313-24 UN	-	-	0.26	0.50	0.47	1.3
<b>CST-18381</b>	5.91	4.41	4.02	0.49	1.313-16 UN	1.22	0.63	0.59	1.06	.313-24 UN	-	-	0.26	0.50	0.47	1.5
<b>CST-18501</b>	7.01	5.04	4.65	0.49	1.313-16 UN	1.22	0.63	0.59	1.06	.313-24 UN	-	-	0.26	0.50	0.47	1.7
<b>CST-27151</b>	3.46	2.87	2.62	0.53	1.625-16 UN	1.52	0.71	0.67	1.38	.375-16 UN	-	-	0.26	0.56	0.47	1.4
<b>CST-27251</b>	4.67	3.69	3.43	0.53	1.625-16 UN	1.52	0.71	0.67	1.38	.375-16 UN	-	-	0.26	0.56	0.47	2.0
<b>CST-27501</b>	7.71	5.74	5.45	0.53	1.625-16 UN	1.52	0.71	0.67	1.38	.375-16 UN	-	-	0.26	0.56	0.47	2.9
<b>CST-40131</b>	3.53	3.02	2.70	0.69	1.875-16 UN	2.38	0.87	0.75	1.63	.500-13 UN	-	-	0.31	0.68	0.59	2.2
<b>CST-40251</b>	4.76	3.78	3.46	0.69	1.875-16 UN	2.38	0.87	0.75	1.63	.500-13 UN	-	-	0.31	0.68	0.59	2.6
<b>CST-40381</b>	6.47	4.98	4.69	0.69	1.875-16 UN	2.38	0.87	0.75	1.63	.500-13 UN	-	-	0.31	0.68	0.59	3.3
<b>CST-40501</b>	7.45	5.48	5.16	0.69	1.875-16 UN	2.38	0.87	0.75	1.63	.500-13 UN	-	-	0.31	0.68	0.59	3.9
<b>▼ Double-acting</b>																
<b>CDT-18131</b>	3.19	2.68	2.42	0.63	1.875-16 UN	1.73	0.63	0.59	1.61	.313-24 UN	0.53	0.39	0.26	0.50	0.47	2.4
<b>CDT-18251</b>	4.21	3.23	2.97	0.63	1.875-16 UN	1.73	0.63	0.59	1.61	.313-24 UN	0.53	0.39	0.26	0.50	0.47	2.9
<b>CDT-18381</b>	9.44	3.74	3.48	0.63	1.875-16 UN	1.73	0.63	0.59	1.61	.313-24 UN	0.53	0.39	0.26	0.50	0.47	3.4
<b>CDT-18501</b>	10.38	4.21	3.95	0.63	1.875-16 UN	1.73	0.63	0.59	1.61	.313-24 UN	0.53	0.39	0.26	0.50	0.47	3.9
<b>CDT-27151</b>	3.25	2.74	2.46	0.67	2.125-16 UN	2.02	0.71	0.67	1.87	.375-16 UN	0.65	0.39	0.26	0.56	0.47	2.6
<b>CDT-27251</b>	4.23	3.25	2.97	0.67	2.125-16 UN	2.02	0.71	0.67	1.87	.375-16 UN	0.65	0.39	0.26	0.56	0.47	3.1
<b>CDT-27501</b>	6.17	4.22	3.95	0.67	2.125-16 UN	2.02	0.71	0.67	1.87	.375-16 UN	0.65	0.39	0.26	0.56	0.47	4.1
<b>CDT-40131</b>	3.49	2.98	2.66	0.69	2.500-16 UN	2.38	0.87	0.83	2.25	.500-13 UN	0.80	0.39	0.31	0.68	0.59	4.0
<b>CDT-40251</b>	4.43	3.45	3.13	0.69	2.500-16 UN	2.38	0.87	0.83	2.25	.500-13 UN	0.80	0.39	0.31	0.68	0.59	4.6
<b>CDT-40381</b>	5.45	3.96	3.64	0.69	2.500-16 UN	2.38	0.87	0.83	2.25	.500-13 UN	0.80	0.39	0.31	0.68	0.59	5.6
<b>CDT-40501</b>	6.76	4.79	4.47	0.69	2.500-16 UN	2.38	0.87	0.83	2.25	.500-13 UN	0.80	0.39	0.31	0.68	0.59	6.6

# Threaded cylinders *Application & selection*

Shown: WRT-22, CYDA-15, WMT-39



Swing cylinders  
Work supports

Linear cylinders

▶ Threaded cylinders for workpiece positioning, holding and ejecting applications where space is at a premium. The advance and retract mode of double-acting models allow installation of clamping accessories to the plunger for pull and push action. Cylinders can be mounted with horizontal bracket to position the workpiece against the stops. Ideal for supporting or positioning a part.

## Fine positioning and convenient installation

...can be fixtured into manual strap or bridge clamp assemblies

- Maximum clamping force in a compact design
- Threaded body allows exact positioning and easy installation
- Center-tapped plungers allow a variety of attachments
- Single-acting spring return models simplify hydraulic tubing requirements
- Double-acting models are ideal for applications requiring powered pulling or fast automated control
- Removable base allows CYDA-15 to be threaded into a custom manifold

## i Single or double-acting

### Single-acting

- The obvious choice when there are few system restrictions, and there are not many units retracting simultaneously
- Fewer valving requirements which results in a less complex circuit

### Double-acting

- Used when greater control is required during the unclamp cycle
- When timing sequences are critical
- Less sensitive to system back pressures, resulting from long tube lengths or numerous components being retracted at the same time

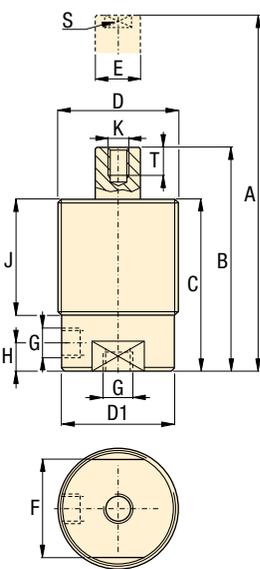
## Product selection

Cylinder capacity at maximum pressure	Stroke		Model number	Effective area		Oil capacity		Operating pressure
	in			in <sup>2</sup>		in <sup>3</sup>		
	push	pull		push	pull	push	pull	
<b>▼ Single-acting</b>								
3900	-	.50	<b>WRT-21</b>	.79	-	.02	-	150-5000
3900	-	1.00	<b>WRT-22</b>	.79	-	.04	-	150-5000
<b>▼ Double-acting</b>								
1200	600	1.56	<b>CYDA-15</b>	.41	.20	.62	.31	150-3000
3900	2700	.50	<b>WMT-39</b>	.79	.54	.39	.27	150-5000
3900	2700	1.00	<b>WMT-40</b>	.79	.54	.79	.54	150-5000

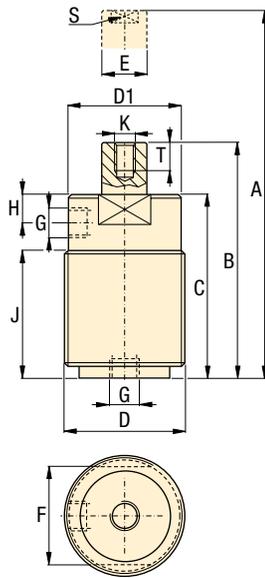
Note: - Seal material CYDA-15: Buna-N, Polyurethane  
- Seal material WMT and WRT series: Buna-N, Polyurethane, Teflon.



**WRT**

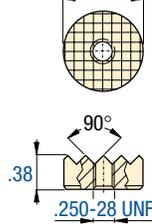


**WMT**



**AWG**

AWG-2  $\phi$  .63  
AWG-4  $\phi$  1.00



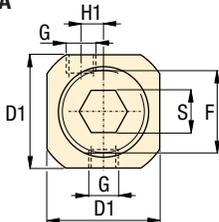
Model number	Fits on cylinder series
AWG-2	WMT, WRT
AWG-4	WMT, WRT

<b>Force:</b> 600-3900 lbs
<b>Stroke:</b> .50-1.56 inch
<b>Pressure:</b> 150-5000 psi

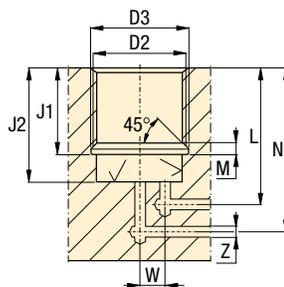
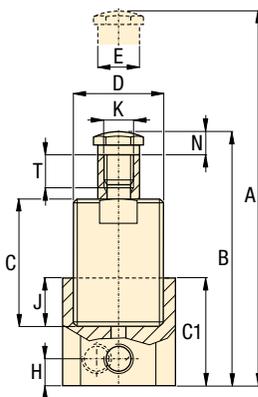
- E** Cilindros roscados
- F** Vérins corps filetés
- D** Einschraubzylinder



**CYDA**



Manifold dimensions using CYDA-15 without base



Surface roughness must be 63 micro-inches

**Manifold dimensions in inches**

Cylinder capacity lbs	D2	D3	J1	J2	L	M	N	W	Z
1200	1.000-12	1.02	.775-.790	1.00	1.19	.12	1.94	.259	.09

**Product dimensions in inches**

Model number	A	B	C	C1	D	D1	E	F	G	H	H1	J	K	N	S	T	lbs
<b>Single-acting</b>																	
WRT-21	3.75	3.25	2.95	-	1.375-18	1.23	.75	.50	SAE #2	.62	-	1.7	.250-28	-	.50	.32	1.2
WRT-22	4.75	3.75	3.45	-	1.375-18	1.23	.75	.50	SAE #2	.62	-	2.2	.250-28	-	.50	.32	1.4
<b>Double-acting</b>																	
CYDA-15	5.97	4.41	2.97	1.75	1.000-12	1.25	.50	.88	.125-27 NPT	.38	.20	1.00	.312-24	.31	.50	.50	1.2
WMT-39	3.76	3.26	2.99	-	1.375-18	1.30	.56	1.06	.125-27 NPT	.73	-	2.05	.250-28	-	.50	.39	1.0
WMT-40	4.78	3.78	3.51	-	1.375-18	1.30	.56	1.06	.125-27 NPT	.73	-	2.56	.250-28	-	.50	.39	1.2

**Options**

Cylinder accessories 

# Manifold cylinders *Application & selection*

Shown: CSM-10131, CSM-571, CSM-18251

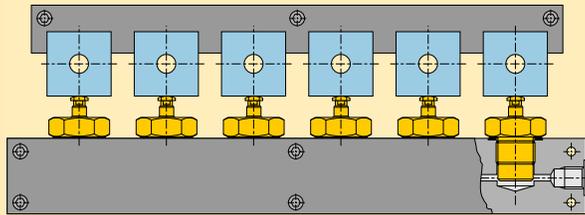


Swing cylinders  
Work supports

Linear cylinders

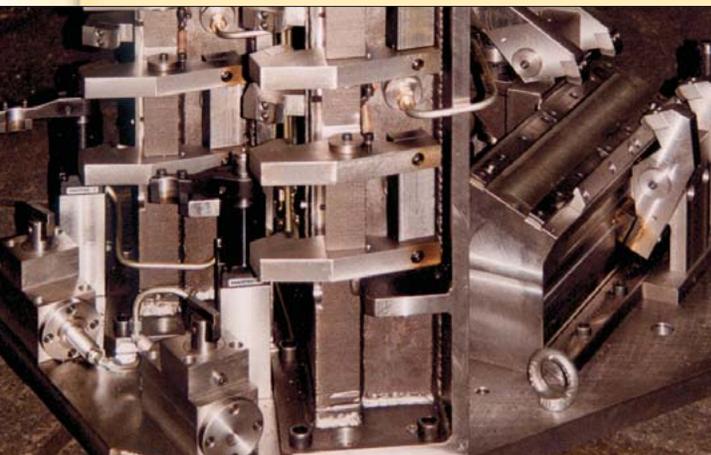
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▶ These compact, fixture-integrated cylinders are designed for workpiece positioning, holding and ejecting applications where space is at a premium. No exposed tubing.



Six CSM series manifold cylinders are used to clamp piston blocks for machining. The hydraulic flow to the cylinders is side-ported in order to minimize the required manifold thickness.

■ Threaded cylinders are used here to position engine manifolds for drilling, tapping and mill finish.

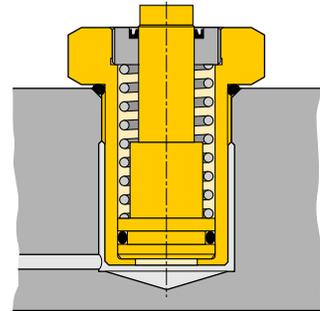


## Compact, fixture-integrated positioning and holding

- Design eliminates the need for fittings and tubing, minimizing space requirements and facilitating easy removal of chips and dirt
- Minimal cylinder height enables extremely compact fixture designs
- Cylinder body is fully recessed within the fixture allowing the workpiece to be positioned near-flush with the fixture surface, saving space
- Nitro carburized bodies and internal plunger wipers allow maintenance-free, high cycle performance
- Center-tapped plungers will hold workpiece contact buttons
- Standard SAE bodies make manifold cavity preparation easy

## i Manifold mount

Manifold cylinders are designed to be screwed directly into a manifold or fixture. Enerpac's manifold cylinders feature SAE dimensions, enabling the use of standard SAE porting tools for easy cavity preparation. An SAE O-ring, included with each cylinder, provides an effective seal between the cylinder and manifold.



## Product selection

Cylinder capacity at 5000 psi	Stroke	Model number	Effective area	Oil capacity
lbs	in		in <sup>2</sup>	in <sup>3</sup>
380	0.28	<b>CSM-271</b>	0.08	0.02
380	0.51	<b>CSM-2131</b>	0.08	0.04
1190	0.28	<b>CSM-571</b>	0.24	0.07
1190	0.51	<b>CSM-5131</b>	0.24	0.12
2590	0.28	<b>CSM-1071</b>	0.50	0.14
2590	0.51	<b>CSM-10131</b>	0.50	0.26
2590	0.75	<b>CSM-10191</b>	0.50	0.38
3900	0.51	<b>CSM-18131</b>	0.79	0.40
3900	0.98	<b>CSM-18251</b>	0.79	0.77
6110	0.59	<b>CSM-27151</b>	1.22	0.72
6110	0.98	<b>CSM-27251</b>	1.22	1.20

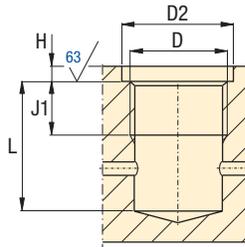
Note: - Seal material: Buna-N, Polyurethane.



**Installation dimensions** in inches [⚙️]

Model number	D thread SAE	D2 min. Ø	H max.	J1 min.	L min.
CSM-271	SAE#6 (0.563-18 UN)	0.97	0.039	0.50	1.02
CSM-2131	SAE#6 (0.563-18 UN)	0.97	0.039	0.50	1.43
CSM-571	SAE#10 (0.875-14 UN)	1.34	0.059	0.55	1.00
CSM-5131	SAE#10 (0.875-14 UN)	1.34	0.059	0.55	1.35
CSM-1071	SAE#12 (1.062-12 UN)	1.63	0.059	0.63	1.18
CSM-10131	SAE#12 (1.062-12 UN)	1.63	0.059	0.63	1.42
CSM-10191	SAE#12 (1.062-12 UN)	1.63	0.059	0.63	1.97
CSM-18131	SAE#16 (1.312-12 UN)	1.91	0.078	0.63	1.59
CSM-18251	SAE#16 (1.312-12 UN)	1.91	0.078	0.63	2.35
CSM-27151	SAE#20 (1.625-12 UN)	2.27	0.125	0.75	1.65
CSM-27251	SAE#20 (1.625-12 UN)	2.27	0.125	0.75	2.38

**Installation dimensions**



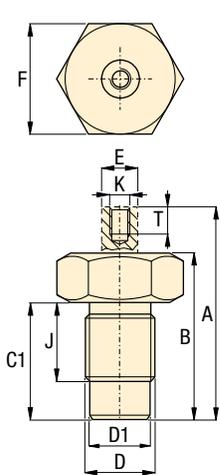
Note: O-rings included. For additional cavity machining information, refer to SAE standards for straight internal thread, O-ring boss, or call Enerpac's Technical Service Department.

- Force: 380-6110 lbs
- Stroke: .28-.98 inch
- Pressure: 580-5000 psi

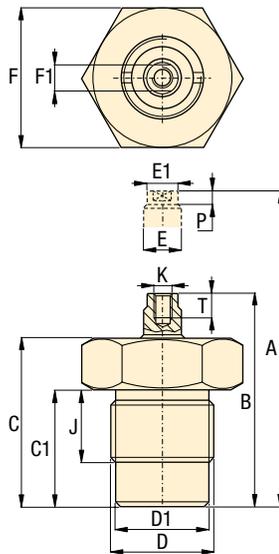
- E** Cilindros para colector
- F** Vérins pour bloc foré
- D** Einbauszylinder



**CSM-271, -2131**



**other models**



**Product dimensions** in inches [⚙️]

Model number	A Ext. height	B Retr. height	C	C1	D thread	D1 Ø	E Ø	E1	F	F1	J	K thread	P	T	⚖️ lbs
CSM-271	1.56	1.28	-	0.98	.563-18 UN	0.47	0.19	-	0.75	-	0.47	#6-32 UN	-	0.19	0.2
CSM-2131	2.20	1.69	-	1.38	.563-18 UN	0.47	0.19	-	0.75	-	0.47	#6-32 UN	-	0.19	0.3
CSM-571	1.78	1.50	1.34	0.93	.875-14 UN	0.75	0.27	0.27	1	0.25	0.51	#8-32 UN	0.16	0.28	0.4
CSM-5131	2.34	1.83	1.67	1.26	.875-14 UN	0.75	0.27	0.27	1	0.25	0.51	#8-32 UN	0.16	0.28	0.6
CSM-1071	2.15	1.87	1.65	1.14	1.062-12 UN	0.94	0.47	0.43	1.25	0.38	0.59	.312-24 UN	0.22	0.39	1.1
CSM-10131	2.62	2.11	1.89	1.38	1.062-12 UN	0.94	0.47	0.43	1.25	0.38	0.59	.312-24 UN	0.22	0.39	1.3
CSM-10191	3.47	2.72	2.50	1.99	1.062-12 UN	0.94	0.47	0.43	1.25	0.38	0.59	.312-24 UN	0.22	0.39	1.4
CSM-18131	2.88	2.37	2.11	1.55	1.312-12 UN	1.18	0.63	0.59	1.61	0.63	0.63	.312-24 UN	0.26	0.47	1.1
CSM-18251	4.11	3.13	2.89	2.30	1.312-12 UN	1.18	0.63	0.59	1.61	0.63	0.63	.312-24 UN	0.26	0.47	1.3
CSM-27151	3.15	2.56	2.31	1.60	1.625-12 UN	1.52	0.71	0.67	2.17	0.59	0.79	.375-16 UN	0.26	0.47	1.50
CSM-27251	4.29	3.31	3.06	2.33	1.625-12 UN	1.52	0.71	0.67	2.17	0.59	0.79	.375-16 UN	0.26	0.47	2.00

**Options**

Accessories  
Contact bolts

72 ▶



**Important**

Tighten manifold cylinders according to specifications in the instruction sheet.

Return springs in single acting cylinders should not be used to pull back heavy attachments consistently.

# Block cylinders *Application & selection*

Shown: CDB-10162, CDB-70502, CSB-18252



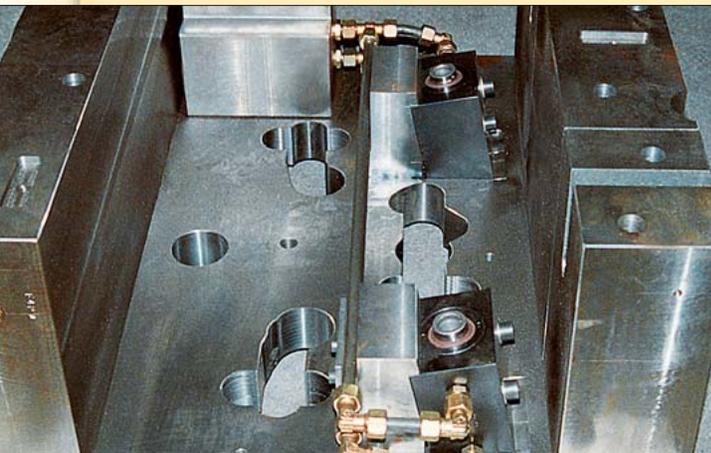
Swing cylinders  
Work supports

Linear cylinders

9P-022

▶ Block cylinders are used for punching, pressing, riveting and bending applications. In general, these cylinders are used for moving, positioning, lifting, opening and closing.

■ The versatile Enerpac block cylinders, fixture mounted for clamping applications.



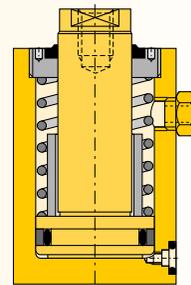
## Versatile, all purpose cylinder

- Six clamping capabilities enable you to choose the right size for your application
- Variety of strokes, to meet design needs
- Double acting and single-acting (spring return), allows selection of cylinder that best conforms to your hydraulic system
- Oil connection alternatives: cylinders incorporate both manifold mount and plumbed options to meet your fixturing needs
- Compact cylinder design does not require large amounts of space on your fixture
- Integral wiper ring, keeps contaminants out of cylinder to extend life

## **i** Select your block cylinder type

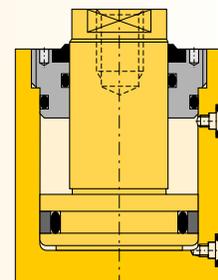
### CSB series, Single-acting

- Internal threaded plunger
- Manifold O-ring ports
- Black oxide base
- Hard chrome-plated plunger
- BSPP oil port
- Strong return spring
- Filtered vent plug



### CDB series, Double-acting

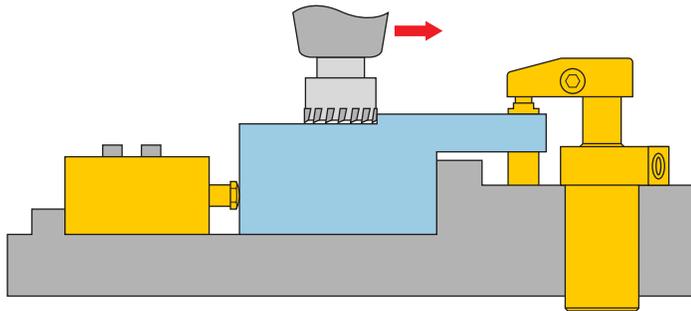
- Internal threaded plunger
- Manifold O-ring ports
- Black oxide base
- Hard chrome-plated plunger
- BSPP oil port





**i Application example**

Block cylinder positions workpiece against fixed point with further clamping coming from an Enerpac swing cylinder.



- Force: 2400-60850 lbs
- Stroke: .63-2.20 inch
- Pressure: 580-5000 psi

- E** Cilindros tipo bloque
- F** Vérins cube
- D** Blockzylinder



**Product selection imperial**

Piston Ø	Rod Ø	Clamping force at 5000 psi		Stroke	Model number	Cylinder effective area		Cylinder oil capacity		Minimum spring return force	
		push	pull			push	pull	push	pull	lbs	lbs
in	in	lbs	lbs	in		in <sup>2</sup>	in <sup>2</sup>	in <sup>3</sup>	in <sup>3</sup>	lbs	lbs
						push	pull	push	pull		
<b>▼ Single-acting</b>											
.79	.47	2400	-	.71	<b>CSB-10182</b>	.48	-	.35	-	24	2.6
.98	.63	3800	-	.98	<b>CSB-18252</b>	.76	-	.75	-	35	4.0
1.57	.98	9750	-	.98	<b>CSB-40252</b>	1.95	-	1.92	-	85	5.9
1.97	1.26	15,200	-	.98	<b>CSB-70252</b>	3.04	-	3.00	-	96	9.7
<b>▼ Double-acting</b>											
.79	.47	2400	1550	.63	<b>CDB-10162</b>	.48	.31	.31	.20	-	2.0
.79	.47	2400	1550	1.42	<b>CDB-10362</b>	.48	.31	.69	.44	-	2.6
.98	.63	3800	2250	.79	<b>CDB-18202</b>	.76	.45	.60	.35	-	2.9
.98	.63	3800	2250	1.97	<b>CDB-18502</b>	.76	.45	1.50	.90	-	4.0
1.57	.98	9750	4900	.98	<b>CDB-40252</b>	1.95	.98	1.92	.96	-	4.2
1.57	.98	9750	4900	1.97	<b>CDB-40502</b>	1.95	.98	3.83	1.93	-	5.7
1.97	1.26	15,200	9000	.98	<b>CDB-70252</b>	3.04	1.80	3.00	1.77	-	7.1
1.97	1.26	15,200	9000	1.97	<b>CDB-70502</b>	3.04	1.80	5.99	3.54	-	9.5
3.15	1.97	38,900	23,700	.98	<b>CDB-180252</b>	7.80	4.74	7.66	4.67	-	20.5
3.15	1.97	38,900	23,700	1.97	<b>CDB-180502</b>	7.80	4.74	15.33	9.34	-	25.4
3.94	2.48	60,850	36,650	2.20	<b>CDB-280562</b>	12.17	7.33	26.83	16.18	-	40.1

**Options**

- Contact bolts**  [72](#)
- Fittings**  [138](#)
- Valves**  [104](#)
- Pressure gauges**  [134](#)
- Pressure switches**  [132](#)
- High pressure filters**  [137](#)

# Block cylinders *Dimensions & options*

Shown: CDB-10162, -70502, CSB-18252

Swing cylinders  
Work supports

Linear cylinders



## ▶ CDB, CSB series

These compact block cylinders are easily mounted in horizontal or vertical position for a range of special tooling applications.

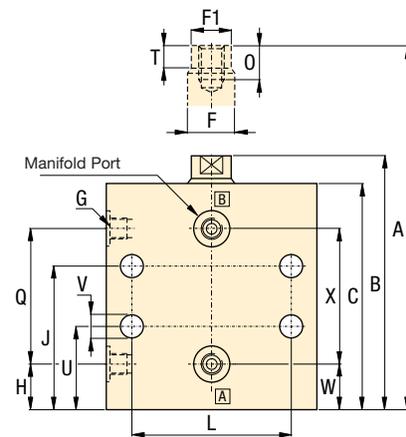
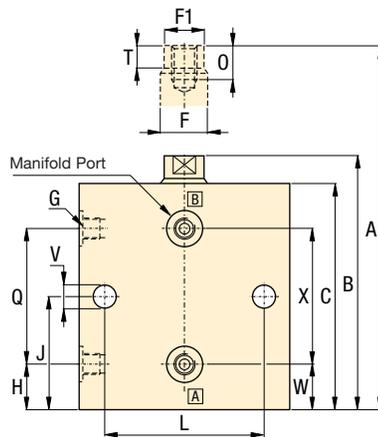
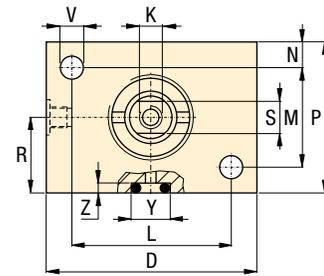
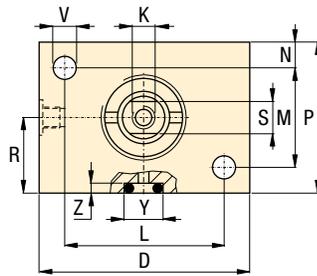
They can be used for positioning, clamping, pushing, pressing or punching operations. The plunger has an internal thread to accommodate accessories such as contact bolts.

■ Block cylinder used for punching applications.



CDB-10162, -18202, -40252, -70252, -180252

All other models



## Ⓐ Product dimensions in inches [ⓂⓅ]

Model number	A	B	C	D	F	F1	G	H	J	K	L	M
					∅	∅				∅		
▼ Single-acting												
CSB-10182	3.94	3.23	2.91	2.36	.47	.43	G1/8"	.47	1.73	M6 x 1,0	1.77	.98
CSB-18252	4.92	3.94	3.62	2.56	.63	.59	G1/8"	.47	2.24	M8 x 1,25	1.97	1.18
CSB-40252	5.12	4.13	3.66	3.15	.98	.94	G1/8"	.35	2.24	M16 x 2,0	2.36	1.38
CSB-70252	5.63	4.65	4.09	3.94	1.26	1.22	G1/4"	.47	2.52	M20 x 2,5	3.15	1.77
▼ Double-acting												
CDB-10162	3.03	2.40	2.17	2.36	.47	.43	G1/8"	.47	.97	M6 x 1,0	1.77	.98
CDB-10362	4.65	3.23	2.91	2.36	.47	.43	G1/8"	.47	1.75	M6 x 1,0	1.77	.98
CDB-18202	3.54	2.76	2.44	2.56	.63	.59	G1/8"	.47	1.06	M8 x 1,25	1.97	1.18
CDB-18502	5.91	3.94	3.62	2.56	.63	.59	G1/8"	.47	2.24	M8 x 1,25	1.97	1.18
CDB-40252	4.13	3.15	2.68	3.15	.98	.94	G1/8"	.35	1.26	M16 x 2,0	2.36	1.38
CDB-40502	6.10	4.13	3.66	3.15	.98	.94	G1/8"	.35	2.24	M16 x 2,0	2.36	1.38
CDB-70252	4.53	3.54	2.99	3.94	1.26	1.22	G1/4"	.51	1.42	M20 x 2,5	3.15	1.77
CDB-70502	6.61	4.65	4.09	3.94	1.26	1.22	G1/4"	.47	2.51	M20 x 2,5	3.15	1.77
CDB-180252	5.16	4.17	3.50	5.51	1.97	1.93	G1/4"	.59	1.63	M30 x 3,5	4.33	3.15
CDB-180502	7.28	5.31	4.65	5.51	1.97	1.93	G1/4"	.47	2.78	M30 x 3,5	4.33	3.15
CDB-280562	8.19	5.98	5.24	6.69	2.48	2.44	G1/4"	.71	3.06	M36 x 4,0	5.31	3.54



### **i** Installation instructions

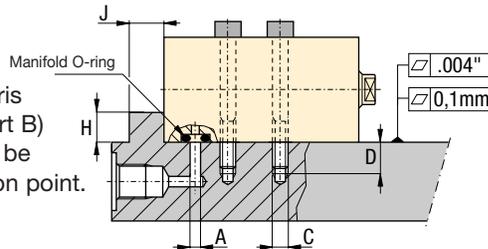
When operating above 2000 psi in applications as shown in the figure below, provide cylinder back-up using a support to eliminate shear loads on the mounting bolts.

#### Manifold mounting

When hydraulic connections are made through the standard integrated O-ring ports as shown in figure, the sealing surface must have a roughness of 63 micro-inches.

#### Single-acting cylinders

If the risk of machining coolants or debris being entering via the breather vent (port B) exists, it is recommended that this port be connected to a clean, remote termination point.



### **A** Installation dimensions in inches [ ]

Clamping capacity	Oil channel diameter	Mounting thread	Min. thread length	Torque (bolt type 12.9 DIN 912)	Min. support dimensions <sup>1)</sup>		Manifold O-ring <sup>2)</sup>	
					H	J	Inside Ø x thickness	ARP no.
lbs	ø A	C	D	Ft.lbs	H	J	Inside Ø x thickness	ARP no.
2400	.20	M6	.43	13	.20	.25	.31 x .06	568-011
3800	.20	M8	.51	30	.20	.31	.31 x .06	568-011
9750	.20	M10	.63	63	.20	.38	.31 x .06	568-011
15,200	.20	M12	.75	107	.20	.50	.31 x .06	568-011
38,900	.31	M16	.94	260	.39	.63	.38 x .09	568-110
60,850	.31	M20	1.10	498	.39	.81	.38 x .09	568-110

<sup>1)</sup> When operating pressure exceeds 2000 psi.  
<sup>2)</sup> Manifold O-rings included.

N	O	P	Q	R	S	T	U	V	W	X	Y	Z	Model number
min.													
													Single-acting ▼
.31	.39	1.57	1.77	.79	.35	.22	.94	.28	.47	1.77	.43	.05	CSB-10182
.31	.47	1.77	2.36	.91	.51	.24	1.06	.35	.47	1.97	.43	.05	CSB-18252
.39	.98	2.17	2.44	1.06	.87	.37	1.06	.39	.39	2.36	.43	.05	CSB-40252
.39	1.18	2.60	2.68	1.30	1.06	.43	1.14	.47	.59	2.55	.43	.05	CSB-70252
													Double-acting ▼
.28	.39	1.57	.98	.79	.35	.22	-	.28	.47	.98	.43	.05	CDB-10162
.31	.39	1.57	1.77	.79	.35	.22	.94	.28	.47	1.77	.43	.05	CDB-10362
.31	.47	1.77	1.18	.91	.51	.24	-	.35	.47	1.18	.43	.05	CDB-18202
.31	.47	1.77	2.36	.91	.51	.24	1.06	.35	.47	2.36	.43	.05	CDB-18502
.39	.98	2.17	1.50	1.06	.87	.37	-	.39	.37	1.50	.43	.05	CDB-40252
.39	.98	2.17	2.44	1.06	.87	.37	1.06	.39	.39	2.46	.43	.05	CDB-40502
.43	1.18	2.60	1.54	1.30	1.06	.43	-	.47	.47	1.57	.43	.05	CDB-70252
.39	1.18	2.60	2.68	1.30	1.06	.43	1.14	.47	.59	2.56	.43	.05	CDB-70502
.59	1.77	4.33	1.77	2.17	1.61	.57	-	.67	.59	1.77	.43	.07	CDB-180252
.59	1.77	4.33	3.03	2.17	1.61	.57	1.22	.67	.79	2.76	.43	.07	CDB-180502
.71	1.97	4.92	3.15	2.44	1.97	.67	1.50	.83	.71	3.15	.43	.07	CDB-280562

Force: 2400-60,850 lbs

Stroke: .63-2.20 inch

Pressure: 580-5000 psi

- E** Cilindros tipo bloque
- F** Vérins cube
- D** Blockzylinder



Linear cylinders  
Power sources  
Valves  
System components  
Yellow pages

### **i** Options

Contact bolts  [72](#)

Fittings  [138](#)

Pressure gauges  [134](#)

High pressure filters  [137](#)

### **!** Important

Linear cylinder support is required at operating pressures above 2000 psi. Follow the instructions on this page.

# Pull down clamps *Application & selection*

Shown: ECM-20, ECH-202, ECM-5, ECH-52

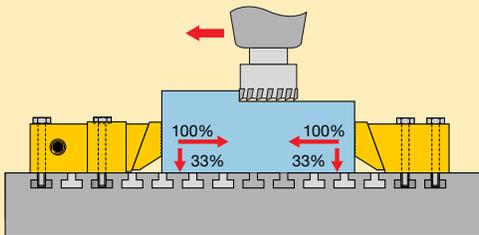


Swing cylinders  
Work supports

Linear cylinders

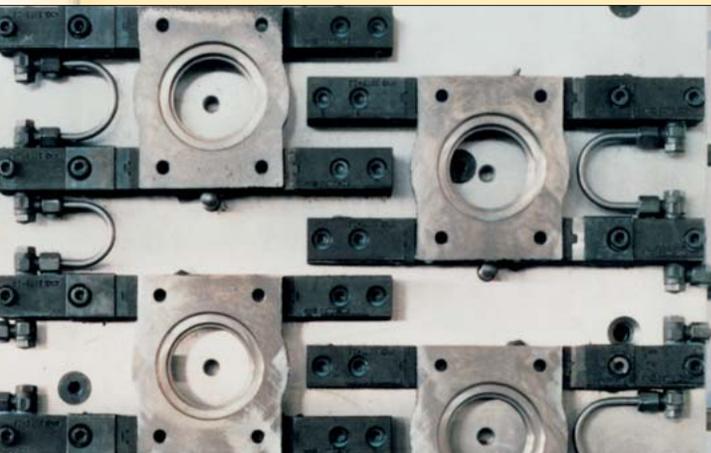
99-106

► Enerpac pull down clamps are designed to allow unobstructed top face machining. Independent horizontal and vertical movement achieves high lateral and pull down forces to hold the workpiece firmly down against the machine table or fixture. The pull down forces are approximately 33% of the clamping force.



The pull down clamps can be permanently mounted using the supplied mounting bolts. Optional T-nuts can be used for adapting to varying workpiece sizes.

■ Enerpac hydraulic pull down clamps and their mechanical counter parts used to manufacture tie-rod cylinder end caps.



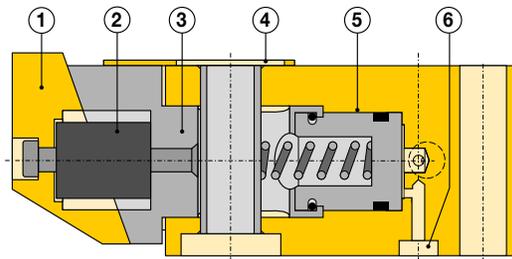
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## Low profile clamp

...for unobstructed top face machining

- Independent horizontal and vertical movement for a true pull down effect
- Compact size and low height allows more flexible and economic mounting than comparable dedicated vise
- Manifold and BSPP porting
- Investment high-alloy cast, heat-treated clamping jaw and plunger
- Contamination resistant design for low maintenance, removable guard for chip removal
- Oil ports on both sides for mounting flexibility
- Optional mechanical counter hold provides pull down on end stop for large parts
- Mounting bolts included for ease of installation

## **i** Pull down clamp operation



The moveable jaw (1) and the flexible connection design (2) allows lateral movement and eliminate any bending moment. Roller finished cylinder bore (3) improves seal life. The removable guard (4) prevents the entry of chips and allows easy cleaning. Heat treated, centerless ground plunger (5) for extremely close tolerances and long life. The clamps feature both manifold mount (6) and plumbed oil connection.

## **i** Product selection

### ▼ Hydraulic pull down clamps

Lateral clamping force at 5000 psi	Pull down force at 5000 psi	Stroke	Model number	Effective area	Oil capacity	Mounting bolts <sup>1)</sup> (included)
lbs	lbs	in		in <sup>2</sup>	in <sup>3</sup>	mm
870	290	.20	<b>ECH-52</b>	.18	.03	M8 x 45
3900	1300	.31	<b>ECH-202</b>	.78	.24	M12 x 80

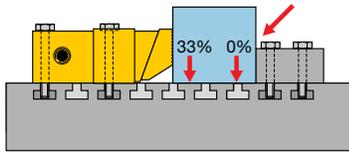
### ▼ Mechanical counter holds

Holding force	For pull down clamp model number	Model number	Mounting bolts included <sup>1)</sup>	Replaceable ribbed jaws model number
lbs			mm	
870	ECH-52	<b>ECM-5</b>	M8 x 35	ECJR-5
3900	ECH-202	<b>ECM-20</b>	M12 H 65	ECJR-20

<sup>1)</sup> Torque M8 with 18 Ft.lbs, M12 with 63 Ft.lbs. The use of T-nuts requires longer bolts.

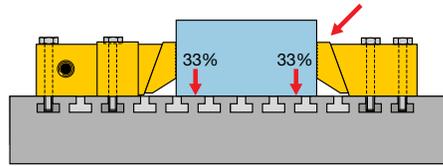


**i Pull down force**



**Fixed stop set-up**

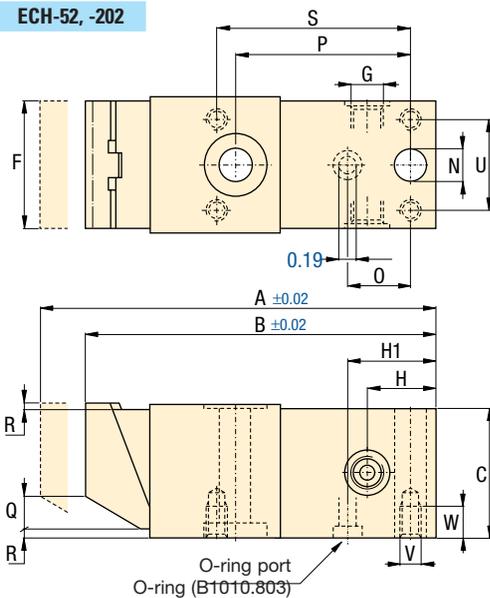
A very workable set-up for workpieces that are not larger or wider than twice the width of the edge clamp. The pull down force of the hydraulic actuated edge clamp is sufficient to pull down and hold the product during actual machining.



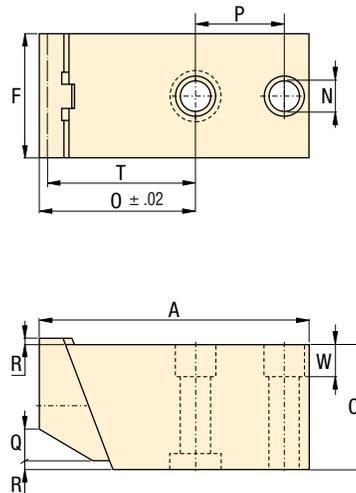
**Counter hold set-up**

For workpieces larger than twice the width of the edge clamp used, it is recommended to install a mechanical counter hold. The counter hold also produces a pull down force equal to 1/3 of the lateral force of the hydraulic edge clamp applied. In this way the grip on the workpiece is very tight. Another advantage of this set-up is the repeated accuracy of machining results.

**ECH-52, -202**



**ECM-5, -20**

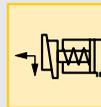


**Product dimensions** in inches [Ⓜ]

Model number	A	B	C	F	G	H	H1	N	O	P	Q	R	S	T	U	V	W	lbs
	mm																	
<b>▼ Hydraulic pull down clamps</b>																		
<b>ECH-52</b>	4.14	3.94	1.18	1.18	G1/8"	.75	.74	.33	.46	2.09	.12	.08	2.32	-	.87	M5 x 0,8	.24	1.5
<b>ECH-202</b>	5.62	5.31	1.97	1.97	G1/4"	.98	.93	.49	.54	2.64	.55	.12	2.91	-	1.42	M8 x 1,25	.47	5.5
<b>▼ Mechanical counter holds</b>																		
<b>ECM-5</b>	3.11	-	1.18	1.18	-	-	-	.33	1.65	1.02	.12	.08	-	1.61	-	-	.31	1.3
<b>ECM-20</b>	4.02	-	1.97	1.97	-	-	-	.49	2.36	1.18	.55	.12	-	2.32	-	-	.51	4.1

- Force:** 870-3900 lbs
- Stroke:** .20-.31 inch
- Pressure:** 225-5000 psi

- E** Garras de empuje oblicuo
- F** Crampons plaqueurs
- D** Niederzugspanner



**Options**

**Fittings**  [138](#)

**Threaded cylinders**  [52](#)

**Positive clamping cylinders**  [66](#)

**! Important**

Threaded push cylinders (CST, CDT, CSM series) or spring loaded cylinders (MRS-series) can be used to hold the workpiece against the side locators during part clamping.

Do not allow the clamping jaw to extend below the lower surface of the clamp body.

# Hollow plunger cylinders *Application & selection*

Shown: HCS-20, RWH-121, RWH-202

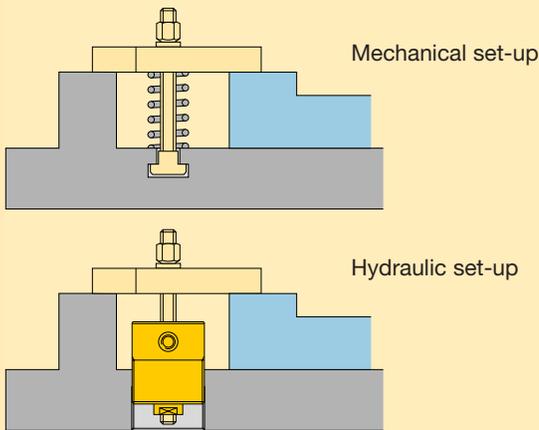


Swing cylinders  
Work supports

Linear cylinders

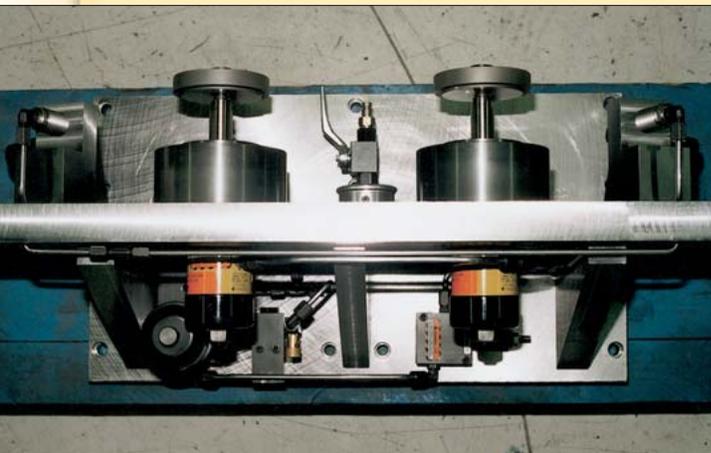
39-043

▶ These cylinders are regularly used for upgrading mechanical clamping to faster and easier hydraulic clamping. Other typical applications include production pressing, punching and crimping operations.



Traditional mechanical elements in a clamping fixture are replaced by a hollow plunger hydraulic cylinder.

■ Two Enerpac RWH-121 hollow cylinders mounted at the back side of a fixture.



39-016

## For high force push & pull applications on and around the fixture

- Load can be attached to either end of the cylinder, providing a choice of push or pull actions - both realizing full cylinder capacity
- Very high cylinder capacities contained within small dimensions allow compact fixture designs
- Spring return operation allows for easy unloading of the workpiece
- Threaded collars and base mounting holes allow mounting flexibility, including table-top surfaces and T-slots
- Nickel-plated plungers, plunger wipers and internal venting prevent corrosion and support longer operation life on all HCS models
- The CY series hollow plunger cylinders can be manifold mounted (except for CY-1254-25)

## Product selection

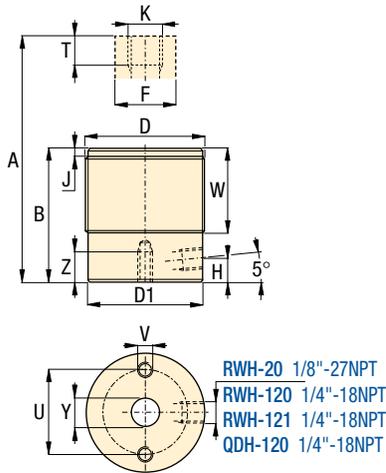
Cylinder capacity <sup>1)</sup>	Stroke	Center hole diameter	Model number	Effective area	Oil capacity	Operating pressure
2610	.25	.39	<b>CY1254-25</b>	.87	.22	3000
4000	.31	.53	<b>RWH-20</b>	1.33	.41	3000
4000	.31	.53	<b>RWH-20-U001</b>	1.33	.41	3000
4830	.39	.43	<b>HCS-20</b>	.96	.38	5000
7410	.31	.76	<b>CY2129-25</b>	2.47	.77	3000
7410	.63	.76	<b>CY2129-5</b>	2.47	1.56	3000
12,660	.47	.51	<b>HCS-50</b>	2.52	1.19	5000
13,320	.63	.89	<b>CY2754-5</b>	4.44	2.80	3000
13,800	.31	.77	<b>QDH-120</b>	2.76	.86	5000
13,800	.31	.77	<b>RWH-120</b>	2.76	.86	5000
13,800	1.00	.77	<b>RWH-121</b>	2.76	2.76	5000
18,180	.55	.67	<b>HCS-80</b>	3.63	1.99	5000
23,500	.50	1.06	<b>RWH-200</b>	4.74	2.37	5000
23,500	2.00	1.06	<b>RWH-202</b>	4.74	9.48	5000
25,490	.63	.83	<b>HCS-110</b>	5.06	3.19	5000
36,000	.50	1.31	<b>RWH-300</b>	7.22	3.60	5000
36,000	1.00	1.31	<b>RWH-301</b>	7.22	7.22	5000
36,000	2.50	1.31	<b>RWH-302</b>	7.22	18.00	5000

<sup>1)</sup> At maximum operating pressure.

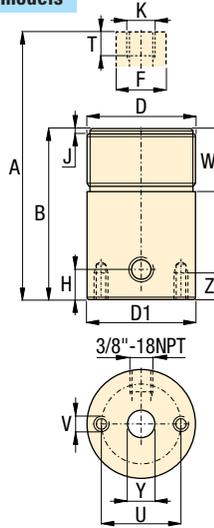
Note: Seal material Buna-N, Polyurethane, Teflon.



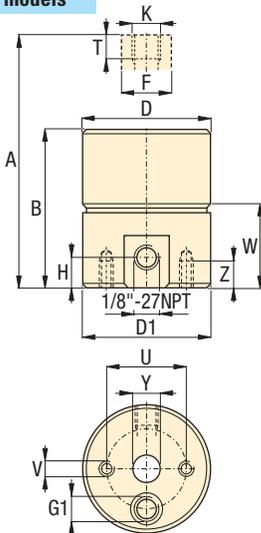
### RWH-20, 120, 121, QDH-20



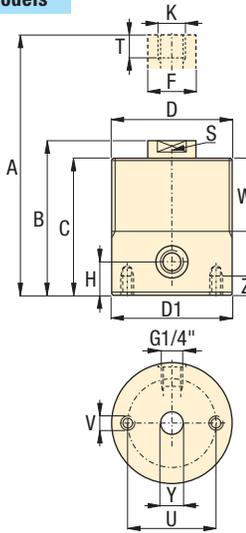
### other RWH models



### CY models



### HCS models



Force: 2610-36,000 lbs

Stroke: .25-2.50 inch

Pressure: 800-5000 psi

- E** Cilindros de émbolo hueco
- F** Vérins a piston creux
- D** Hohlkolbenzylinder



### Options

Flange nuts



### ! Important

Use Grade 8 (DIN12.9) bolt quality or better for pulling.  
Use Grade B7 (DIN10.9) threaded rod quality or better for pulling applications.

RWH cylinders can be used up to 10,000 psi maximum working pressure (except RWH-20).

### Product dimensions in inches [Ⓜ]

Model number	A	B	C	D Ø	D1 Ø	F Ø	H	J	K Ø	S	T	U Ø	V Ø	W	Y Ø	Z	lbs
CY1254-25	2.25	2.00	-	1.75	1.75	.56	.29	-	.375-16 UNC	-	.62	1.25	.250-20 UNC	.91	.39	.38	1.0
RWH-20	2.38	2.06	-	1.875-16 UN	1.79	1.00	.28	.12	0.53	-	.88	1.38	.250-20 UNC	1.50	.500-20 UNF	.25	1.4
RWH-20U001	2.38	2.06	-	1.875-16 UN	1.79	1.00	.28	.12	.500-20 UNF	-	.88	1.38	.250-20 UNC	1.50	.53	.25	1.4
HCS-20	3.31	2.92	2.60	M58 x 1,5	2.28	.63	.43	-	M10 x 1,5	.55	1.02	1.57	M6 x 1,0	1.57	.43	.39	2.4
CY2129-25 <sup>1)</sup>	2.31	2.00	-	2.63	2.63	1.13	.31	-	.750-10 UNC	-	1.13	1.75	.375-16 UNC	.75	.76	.38	2.5
CY2129-5 <sup>1)</sup>	3.36	2.73	-	2.63	2.63	1.13	.31	-	.750-10 UNC	-	1.13	1.75	.375-16 UNC	1.48	.76	.44	3.0
HCS-50	3.78	3.31	2.95	M65 x 1,5	2.56	1.10	.55	-	M12 x 1,75	.87	.96	1.77	M8 x 1,25	1.77	.51	.47	3.3
CY2754-5 <sup>1)</sup>	3.63	3.00	-	3.50	3.50	1.25	.31	-	.875-9 UNC	-	1.20	2.12	.375-16 UNC	1.55	.89	.44	6.0
QDH-120	2.50	2.19	-	2.750-16 UN	2.75	1.38	.39	.19	.750-10 UNC	-	.63	2.00	.312-18 UNC	1.19	.77	.25	3.0
RWH-120	2.50	2.19	-	2.750-16 UN	2.75	1.38	.39	.19	.750-16 UNF	-	.63	2.00	.312-18 UNC	1.19	.77	.25	3.1
RWH-121	4.19	3.19	-	2.750-16 UN	2.75	1.38	.53	.19	.750-16 UNF	-	1.00	2.00	.312-18 UNC	1.19	.77	.25	4.8
HCS-80	4.29	3.74	3.35	M75 x 1,5	2.95	1.26	.67	-	M16 x 2,0	.94	1.28	2.16	M8 x 1,25	1.97	.67	.47	5.1
RWH-200	5.31	4.81	-	3.875-12 UN	3.88	2.13	.98	.19	1.562-16 UN	-	.75	3.25	.375-16 UNC	1.50	1.06	.38	13.6
RWH-202	8.31	6.00	-	3.875-12 UN	3.88	2.13	.98	.19	1.562-16 UN	-	.75	3.25	.375-16 UNC	1.50	1.06	.38	17.0
HCS-110	4.72	4.09	3.66	M90 x 2,0	3.54	1.57	.75	-	M20 x 2,5	1.26	1.43	2.56	M10 x 1,5	2.36	.83	.59	7.9
RWH-300	5.50	4.62	-	4.500-12 UN	4.50	2.50	.85	.19	1.812-16 UN	-	.88	3.62	.375-16 UNC	1.66	1.31	.62	19.0
RWH-301	6.12	5.12	-	4.500-12 UN	4.50	2.50	.85	.19	1.812-16 UN	-	.88	3.62	.375-16 UNC	1.66	1.31	.62	21.5
RWH-302	9.12	6.62	-	4.500-12 UN	4.50	2.50	.85	.19	1.812-16 UN	-	.88	3.62	.375-16 UNC	1.66	1.31	.62	24.0

<sup>1)</sup> For these models G1 = manifold and .125-27 NPTF

# Positive clamping cylinders *Application & selection*

Shown: MRS-1, MRS-1001, MRS-5001

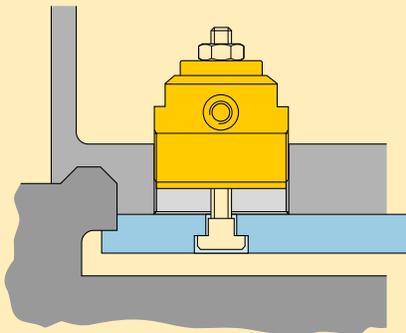


Swing cylinders  
Work supports

Linear cylinders

▶ These cylinders are designed for prolonged clamping applications in moveable machine parts, tools, fixtures, pallets and workpieces.

The mechanical clamping force of this cylinder is ideal for FMS applications. Hydraulic pressure is used to release the workpiece and is not required to maintain the clamping force on the workpiece. Internal high strength springs produce the required clamping force.



■ When pressure is released, the Enerpac MRS cylinders clamp the workpiece by pushing it against the frame that is attached to the fixture.

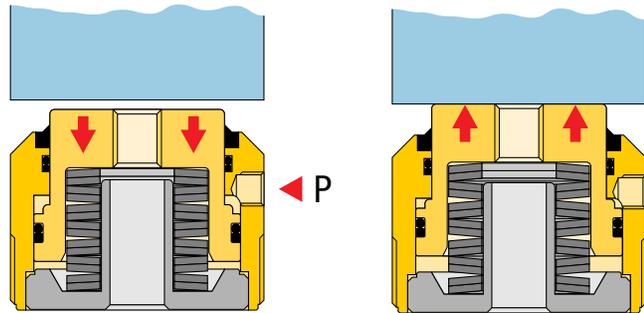
## Ideal for palletized applications

- Heavy disk springs maintain the clamping force - hydraulic pressure is used for release
- Single acting design allows easy setup of hydraulic system
- Hollow plunger design allows easy retrofit for mechanical clamping
- Custom buttons can be fitted into the plunger for clamping directly against a workpiece
- Threaded body allows easy cylinders mounting directly into fixture plate
- Internal threaded plunger allows accessories to be used easily for retrofit applications

## i Positive clamping operation

The applied clamping force is determined by how far the cylinder's plunger is being retracted when engaging contact with the workpiece (referred to as the **effective clamping stroke**).

Use the diagrams on the next page as a guide to your fixture set-up. Note that in order to load and unload the workpiece, the plunger must be retracted somewhat further than the effective clamping stroke.



### Hydraulic pressure applied

- Plunger retracts
- Work piece is released
- New work piece is loaded

### Hydraulic pressure released

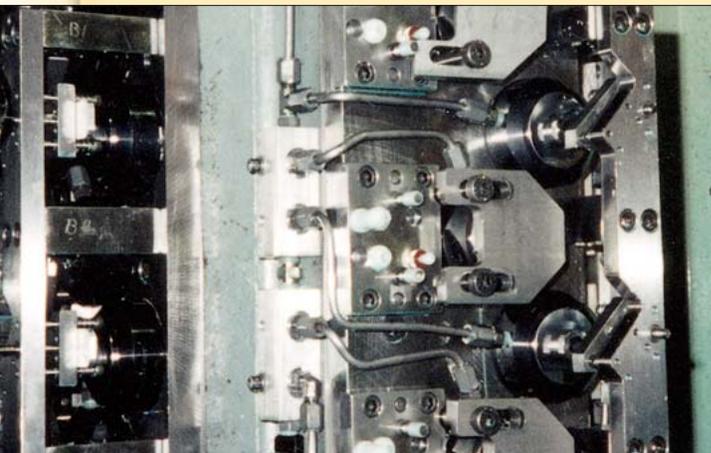
- Springs apply force
- Workpiece is clamped
- Machining can take place

## i Product selection

Cylinder capacity at 5000 psi	Effective clamping stroke	Model number	Required operating pressure <sup>1)</sup>	Max. tensioning stroke	Oil capacity
lbs	in		psi	in	in <sup>3</sup>
2700	.09	<b>MRS-1</b>	5000	.09	.05
6000	.09	<b>MRS-2</b>	5000	.09	.26
11,500	.09	<b>MRS-5</b>	5000	.09	.50
1900	.10	<b>MRS-1001</b>	2000	.20	.54
3700	.10	<b>MRS-2001</b>	2700	.20	.73
5800	.10	<b>MRS-3001</b>	2600	.20	1.22
8500	.12	<b>MRS-5001</b>	3400	.22	1.35

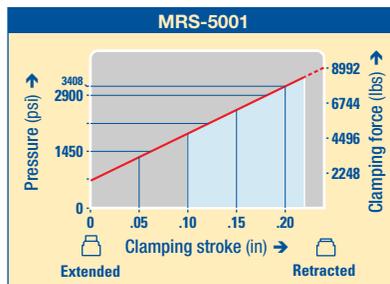
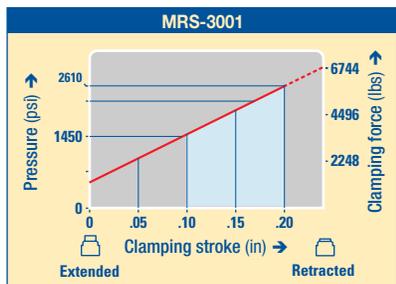
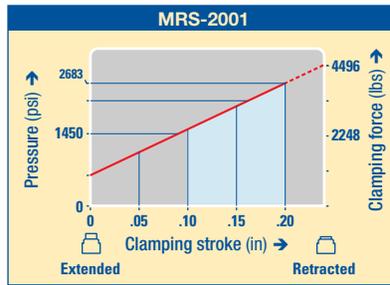
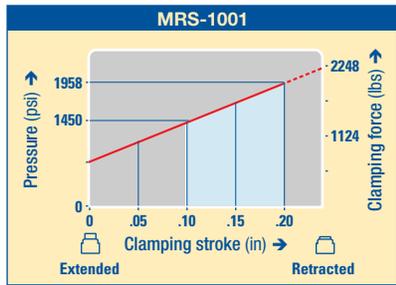
<sup>1)</sup> Minimum operating pressure to fully retract the plunger.

Note: Seal material Buna-N, Polyurethane.



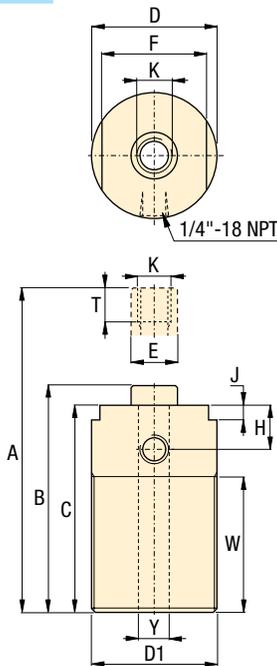


**i** Stroke/force diagrams for MRS-1001, -2001, -3001, -5001

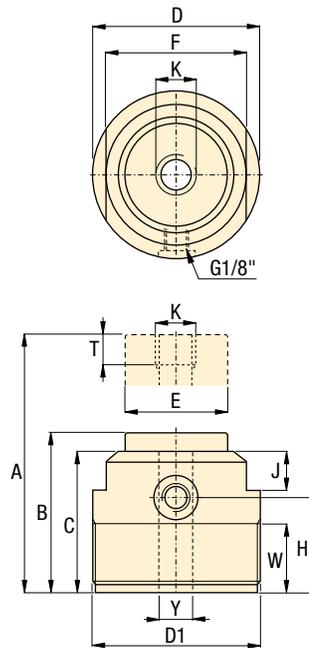


= Suggested clamping range

**MRS-1, 2, 5**



**other MRS models**



**A** Product dimensions in inches  $\left[ \begin{matrix} \text{triangle} \\ \text{circle} \end{matrix} \right]$

Model number	A	B	C	D	D1	E	F	H	J	K	T	W	Y	lbs
MRS-1	3.35	3.26	3.11	1.42	M36 x 1,5	.50	1.18	.71	.24	M8 x 1,25	1.42	1.97	.35	1.1
MRS-2	3.54	3.46	3.31	1.89	M48 x 1,5	.68	1.57	.79	.28	M10 x 1,50	1.50	1.97	.43	2.0
MRS-5	4.92	4.83	4.69	2.36	M60 x 2,0	.87	1.97	.83	.28	M16 x 2,0	1.57	3.35	.67	4.0
MRS-1001	2.44	2.24	2.09	2.56	M65 x 1,5	1.57	2.17	1.38	.59	M12 x 1,75	.79	.98	.51	2.6
MRS-2001	2.56	2.36	2.24	3.15	M80 x 2,0	2.16	2.56	1.50	.59	M 16 x 2,0	.79	1.14	.67	4.6
MRS-3001	2.91	2.72	2.60	3.74	M95 x 2,0	2.36	3.15	1.81	.67	M20 x 2,5	.79	1.46	.83	6.6
MRS-5001	3.78	3.56	2.66	3.74	M95 x 2,0	2.36	3.15	1.81	.67	M20 x 2,5	.79	1.46	.83	7.7

Force: 1900-11,500 lbs

Stroke: .09-.22 inch

Pressure: 2000-5000 psi

- E** Cilindros de amarre
- F** Vérins de bridage positif
- D** Federspannzylinder



**i** Options

**Buttons** 72 ▶

**Flange nuts** 72 ▶

**Collet-Lok® work supports** 36 ▶

**!** Important

Be sure to refer to the force/stroke chart when selecting cylinders for an application. Piece parts with a large variation at the clamping point may be prone to having variations in clamping force.

Depending on the cycle usage of the application and amount of deflection, the internal disk springs may need to be replaced at scheduled intervals.

# Universal cylinders - Single-acting *Application & selection*

Swing cylinders  
Work supports

Linear cylinders

Shown: RW-50, RW-104, MRW-50F



▶ Used when high cylinder forces or long strokes are required in a confined area. Can handle a wide range of production tooling applications.

■ Enerpac RW-101 cylinders used in a high pressure toggle style clamping set-up.



## Heavy duty cylinders

...handle a variety of applications

- High pressure design when additional force is required
- Long stroke lengths in a compact design, well suited for welding applications
- Collar mounting threads and base mounting holes allow flexible mounting options
- Cylinders are provided with hardened saddles for additional plunger protection
- Snap-in saddles are easily removed for adapting to different plunger devices
- Chrome plated plunger with bronze upper and lower bearing provides a long cylinder life

## i Block and cylindrical models

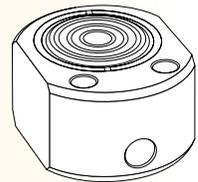
### Cylindrical models

- Long stroke
- Flexible in fixture design
- Variety of attachments



### Block models

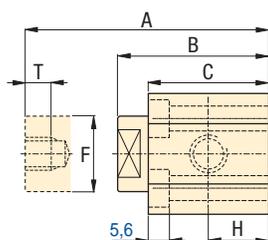
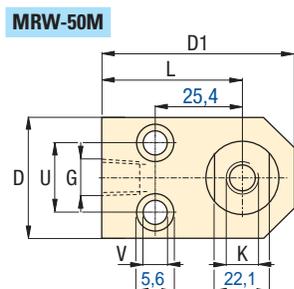
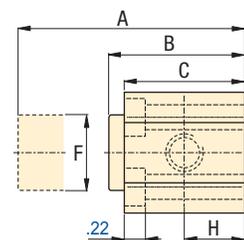
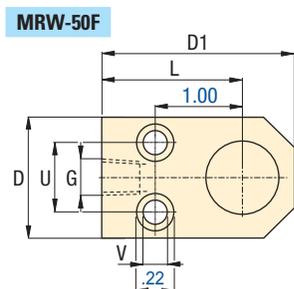
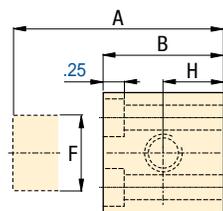
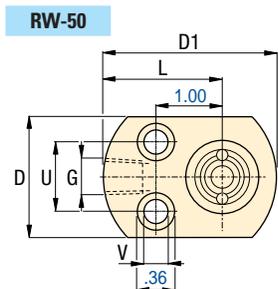
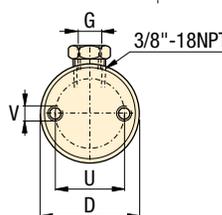
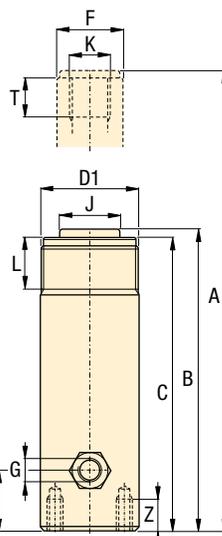
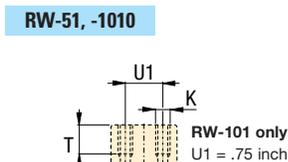
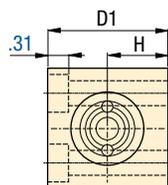
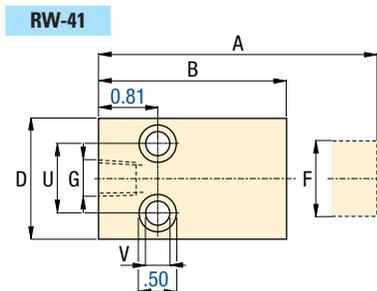
- Easily mounted
- Compact design



## i Product selection

Cylinder capacity at 5000 psi	Stroke	Model number	Effective area	Oil capacity	Operating pressure
<b>▼ Block models</b>					
4970	.62	<b>RW-41</b>	.99	.62	85-8000
4970	.62	<b>RW-50</b>	.99	.62	600-10,000
4970	.59	<b>MRW-50F</b>	.99	.62	85-10,000
4970	.59	<b>MRW-50M</b>	.99	.62	85-10,000
<b>▼ Cylindrical models</b>					
4970	1.00	<b>RW-51</b>	.99	.99	600-10,000
4970	3.00	<b>RW-53</b>	.99	2.97	600-10,000
4970	5.00	<b>RW-55</b>	.99	4.95	600-10,000
11,180	1.00	<b>RW-101</b>	2.23	2.23	600-10,000
11,180	2.13	<b>RW-102</b>	2.23	4.75	600-10,000
11,180	4.13	<b>RW-104</b>	2.23	9.21	600-10,000
11,180	6.13	<b>RW-106</b>	2.23	13.67	600-10,000
11,180	10.13	<b>RW-1010</b>	2.23	22.59	600-10,000

Note: Seal material: Buna-N, Polyurethane, Teflon.



- Force: 4970-11,180 lbs
- Stroke: .62-10.13 inch
- Pressure: 600-5000 psi

- E** Cilindros universales
- F** Vérins universels
- D** Universelle Linearzylinder



**Options**

Cylinder accessories  72 ▶

**Important**

These cylinders are intended for medium cycle applications. The return spring is intended for retracting the plunger and heavy devices should not be attached to it.

Plungers should be shielded in welding applications to prevent splatter from sticking to chrome plating.

Do not use these cylinders continuously at full stroke or damage to return spring may result.

**Product dimensions** in inches [ ]

Model number	A	B	C	D	D1	F	G	H	J	K	L	T	U	V	Z	lbs
<b>▼ Block models</b>																
RW-41	3.18	2.56	-	1.62	1.62	1.00	.250-18	.81	-	-	-	-	1.00	.34	-	1.8
RW-50	2.25	1.63	-	1.62	2.31	1.12	.375-18	.75	-	-	1.50	-	1.12	.22	-	1.8
MRW-50F	2.20	1.61	1.61	1.62	2.56	1.00	.375-18	.81	-	-	1.75	-	1.12	.22	-	1.8
MRW-50M	2.60	2.01	1.61	1.62	2.56	1.00	.375-18	.81	-	M8X1,25	1.75	.24	1.12	.22	-	1.8
<b>▼ Cylindrical models</b>																
RW-51	5.34	4.34	4.09	1.50	1.500-16 UN	1.00	.250-18	.75	1.00	.750-16 UN	1.13	.56	1.00	.250-20 UN	.56	2.1
RW-53	9.50	6.50	6.25	1.50	1.500-16 UN	1.00	.250-18	.75	1.00	.750-16 UN	1.13	.56	1.00	.250-20 UN	.56	3.1
RW-55	13.50	8.50	8.25	1.50	1.500-16 UN	1.00	.250-18	.75	1.00	.750-16 UN	1.13	.56	1.00	.250-20 UN	.56	3.9
RW-101	4.53	3.53	3.28	2.25	2.250-14 UN	1.50	.250-18	.75	-	#10-24 UN	1.06	.25	1.56	.312-18 UN	.50	3.8
RW-102	6.91	4.78	4.53	2.25	2.250-14 UN	1.50	.250-18	.75	1.38	1.000-18 UN	1.13	.75	1.56	.312-18 UN	.50	4.9
RW-104	10.88	6.75	6.50	2.25	2.250-14 UN	1.50	.250-18	.75	1.38	1.000-18 UN	1.13	.75	1.56	.312-18 UN	.50	7.0
RW-106	15.88	9.75	9.50	2.25	2.250-14 UN	1.50	.250-18	.75	1.38	1.000-18 UN	1.13	.75	1.56	.312-18 UN	.50	9.6
RW-1010	23.88	13.75	13.50	2.25	2.250-14 UN	1.50	.250-18	.75	1.38	1.000-18 UN	1.13	.75	1.56	.312-18 UN	.50	13.8

# Universal cylinders - Double-acting *Application & selection*

Shown: RD-2510, RD-96, RD-256, RD-41, RD-166



Swing cylinders  
Work supports

Linear cylinders

▶ Used when high cylinder forces with a powered return stroke is required in a confined area.

Cylinders can push or pull a workpiece into position and the threaded plunger allows adapting standard clevis attachments.

■ Clamping application using Enerpac RD cylinders (with clevis eye attachments on both ends) for their high pressure capability and mounting flexibility.



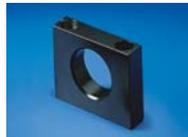
## Heavy duty cylinders

...provide push as well as pull forces

- High pressure design when additional force is required for push or pull applications
- Long strokes in a compact design are well suited for custom toggle style clamping
- Various features for mounting
- Threaded plunger allows a wide range of mounting adapter devices
- Chrome plated plunger provides a long cylinder life

## Optional cylinder attachments

For added cylinder flexibility, a selection of interchangeable mountings is available to fit plunger or cylinder threads.



### Foot mounting

Mounts onto cylinder collar thread. Retainer nut included.



### Flange mounting

Mounts onto cylinder collar thread. Retainer nut included.



### Retainer nut

Locking foot or flange mountings. Mounts onto cylinder base or collar threads. Included with foot and flange mountings.

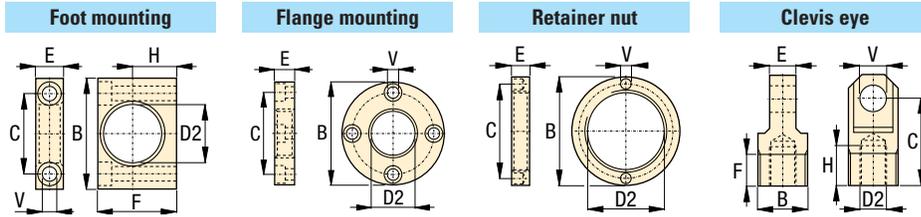


### Clevis eye

Threads onto plunger or base.

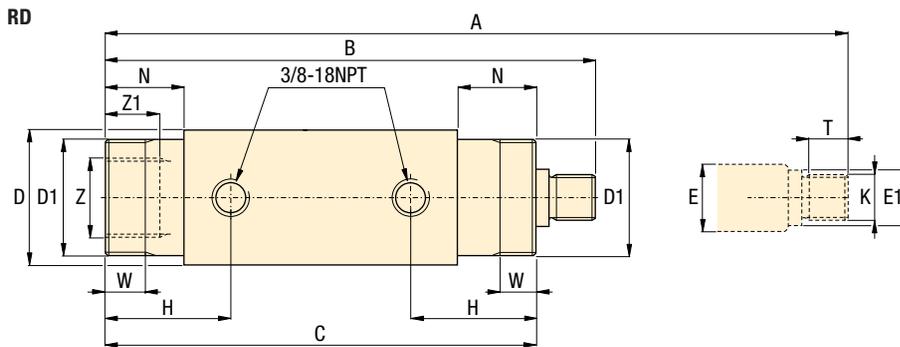
## Product selection

Cylinder capacity at 5000 psi		Stroke in	Model number	Effective area		Oil capacity	
push lbs	pull lbs			push in <sup>2</sup>	pull in <sup>2</sup>	push in <sup>3</sup>	pull in <sup>3</sup>
3900	1720	1.13	<b>RD-41</b>	.79	.34	.89	.40
3900	1720	3.13	<b>RD-43</b>	.79	.34	2.47	1.10
3900	1720	6.13	<b>RD-46</b>	.79	.34	4.84	2.10
9000	4910	1.13	<b>RD-91</b>	1.77	.98	2.00	1.10
9000	4910	3.13	<b>RD-93</b>	1.77	.98	5.54	3.00
9000	4910	6.13	<b>RD-96</b>	1.77	.98	10.88	6.00
9000	4910	10.13	<b>RD-910</b>	1.77	.98	17.94	9.90
15,500	8300	6.25	<b>RD-166</b>	3.15	1.66	19.67	10.40
15,500	8300	10.25	<b>RD-1610</b>	3.15	1.66	32.26	17.00
24,500	10,750	6.25	<b>RD-256</b>	4.92	2.15	30.73	13.40
24,500	10,750	10.25	<b>RD-2510</b>	4.92	2.15	50.40	22.00



**Cylinder attachments** in inches [⊕]

Cylinder capacity at 5000 psi lbs	10,000 psi lbs	D2	Model number	B	C	E	F	H	lbs	
									∅	
<b>▼ Foot mounting with retainer nut</b>										
3900	7800	1.38	AD-141	3.00	2.00	.76	2.25	1.25	.41	.9
9000	18,000	2.00	AD-171	4.00	2.88	1.00	3.25	1.75	.53	2.6
15,500	31,000	2.63	AD-181	5.00	3.76	1.38	4.00	2.06	.78	6.4
24,500	49,000	3.25	AD-191	6.26	4.62	1.76	4.88	2.50	1.03	9.9
<b>▼ Flange mounting with retainer nut</b>										
3900	7800	1.38	AD-142	3.88	3.09	.75	-	-	.41	2.2
9000	18,000	2.00	AD-172	4.75	3.88	1.00	-	-	.41	4.6
15,500	31,000	2.63	AD-182	5.63	4.56	1.38	-	-	.53	8.4
24,500	49,000	3.25	AD-192	6.50	5.34	1.75	-	-	.66	13.2
<b>▼ Retainer nut</b>										
3900	7800	1.375-12UN	AD-143	2.25	1.81	.38	-	-	.25	.2
9000	18,000	2.000-12UN	AD-173	3.00	2.50	.50	-	-	.27	.7
15,500	31,000	2.625-16UN	AD-183	3.63	3.12	.75	-	-	.27	1.3
24,500	49,000	3.250-16UN	AD-193	4.25	3.75	1.00	-	-	.27	1.8
<b>▼ Clevis eye</b>										
3900	7800	.500-20UN	AD-150	1.125-20UN	1.12	.63	.75	.94	.63	.5
9000	18,000	.750-16UN	AD-151	1.688-18UN	1.31	1.00	1.00	.94	.75	1.3
15,500	31,000	1.125-12UN	AD-152	3.188-16UN	1.88	1.25	1.00	1.19	1.00	2.9
24,500	49,000	1.500-12UN	AD-153	2.750-16UN	2.00	1.50	1.00	1.06	1.25	4.6



**Product dimensions** in inches [⊕]

Model number	A	B	C	D	D1	E	E1	H	K	N	T	W	Z	Z1	lbs
RD-41	8.44	7.31	6.38	2.00	1.375-12	.75	.69	1.84	.500-20	1.13	.75	.44	1.125-20	.35	4.8
RD-43	12.44	9.31	8.38	2.00	1.375-12	.75	.69	1.84	.500-20	1.13	.75	.44	1.125-20	.35	6.4
RD-46	18.44	12.31	11.38	2.00	1.375-12	.75	.69	1.84	.500-20	1.13	.75	.44	1.125-20	.35	9.0
RD-91	9.88	8.75	7.80	2.50	2.000-12	1.00	.94	2.25	.750-16	1.50	.75	.56	1.688-18	.55	9.0
RD-93	13.91	10.78	9.80	2.50	2.000-12	1.00	.94	2.25	.750-16	1.50	.75	.56	1.688-18	.55	11.0
RD-96	19.91	13.78	12.80	2.50	2.000-12	1.00	.94	2.25	.750-16	1.50	.75	.56	1.688-18	.55	14.0
RD-910	27.91	17.78	16.81	2.50	2.000-12	1.00	.94	2.25	.750-16	1.50	.75	.56	1.688-18	.55	19.0
RD-166	21.56	15.31	14.13	3.00	2.625-16	1.38	1.26	2.88	1.125-18	2.13	1.00	.88	2.187-16	.94	22.0
RD-1610	29.56	19.31	18.11	3.00	2.625-16	1.38	1.26	2.88	1.125-18	2.13	1.00	.88	2.187-16	.94	29.0
RD-256	22.94	16.69	15.63	3.63	3.250-16	1.88	1.77	3.50	1.500-12	2.75	1.00	1.13	2.750-16	1.02	36.0
RD-2510	30.94	20.69	19.61	3.63	3.250-16	1.88	1.77	3.50	1.500-12	2.75	1.00	1.13	2.750-16	1.02	46.0

**Force: 3900-24,500 lbs**

**Stroke: 1.13-10.25 inch**

**Pressure: 500-10,000 psi**

- E** Cilindros universales
- F** Vérins universels
- D** Universelle Linearzylinder



**Options**

**Cylinder accessories**

72 ▶

**Important**

Be certain that the mounting devices can handle forces in the push and pull direction.

RD series cylinders are designed for a maximum operating pressure of 10,000 psi.

When applying 10,000 psi cylinder capacities double as well.

# Cylinder accessories

Shown: Cylinder accessories



▶ These accessories are provided so that you can effectively position, mount and actuate Enerpac hydraulic cylinders according to your specific fixturing or production applications.

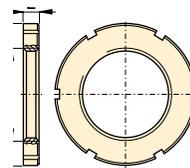
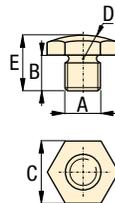
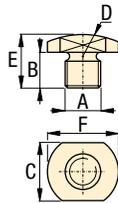
## For optimum mounting and fixture flexibility ...to match specific applications

- **Contact bolts**  
Allow cylinders to act as a datum point in your clamping applications, and protect the piston when cylinders are used for pushing applications
- **Cylindrical flange nuts**  
For mounting threaded body cylinders in any position
- **Mounting brackets**  
For bolting cylinders to suit the application

BS-21, -41, -42, -61, -62, -82

other BS models

FN



## Product dimensions in inches [Ⓜ]

A thread	Model number	B	C	D	E	F
▼ Spherical contact bolts						
#6-32 UN	BS-21	.20	.18	.18	.45	.25
#8-32 UN	BS-41	.28	.25	.24	.56	.31
M4 x 0,7	BS-42	.20	.24	.39	.31	.31
.250-28 UN	BS-61	.25	.35	.59	.39	.47
M6 x 1,0	BS-62	.25	.35	.59	.39	.47
.313-24 UN	BS-81	.27	.56	.79	.28	-
M8 x 1,25	BS-82	.25	.51	.79	.41	.63
.375-16 UN	BS-91	.50	.50	.50	.75	-
.500-13 UN	BS-101	.49	.87	1.18	.73	-
M10 x 1,5	BS-102	.25	.67	.91	.43	-

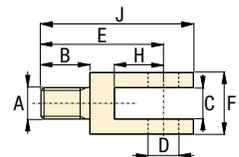
A thread	Model number	B	C
▼ Jam nuts			
0.500-20 UN	FN-121	1.10	0.24
M12 x 1,5	FN-122	1.10	0.24
0.750-16 UN	FN-201	1.42	0.31
M20 x 1,5	FN-202	1.42	0.31
1.000-12 UN	FN-251	1.75	0.38
1.125-16 UN	FN-281	1.75	0.38
M28 x 1,5	FN-282	1.97	0.39
1.125-16 UN	FN-301	1.97	0.39
M30 x 1,5	FN-302	1.97	0.39
1.313-16 UN	FN-331	1.88	0.25
1.375-18 UN	FN-351	1.88	0.25
M35 x 1,5	FN-352	2.17	0.43
1.625-16 UN	FN-421	2.25	0.33
M42 x 1,5	FN-422	2.44	0.47
1.875-16 UN	FN-481	2.50	0.50
M48 x 1,5	FN-482	2.95	0.51
2.125-16 UN	FN-551	3.13	0.38
M55 x 1,5	FN-552	3.15	0.51
2.500-16 UN	FN-651	3.25	0.38
M65 x 1,5	FN-652	3.74	0.55
3.125-16 UN	FN-801	4.13	0.50
M80 x 2,0	FN-802	4.53	0.63

■ Enerpac worksupport locked in position using an FN series self-locking flange nut.



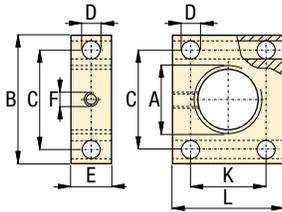
## Product dimensions in inches [Ⓜ]

A thread	Model number	B	C	D	E	F	H	J
▼ Yoke								
.312-24 UN	Y-3121	.50	.31	.31	1.25	.63	.50	1.88





**MF models**

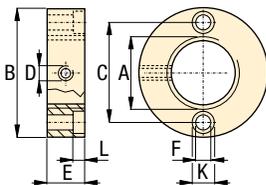


- E** Accesorios de cilindro
- F** Accessoires pour vérins
- D** Zubehör für Zylinder

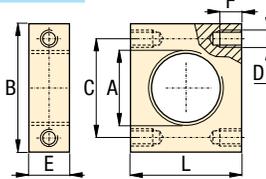
**Product dimensions** in inches [ ]

A thread	Model number	B	C	D ø	E	F	K	L
<b>▼ Mounting flanges – Rectangular</b>								
0.500-20 UN	<b>MF-121</b>	1.50	1.00	0.25	1.00	#10-24	1.00	1.50
M12 x 1,5	<b>MF-122</b>	1.57	0.98	0.25	0.98	M4 x 0,7	0.98	1.57
0.750-16 UN	<b>MF-201</b>	2.25	1.50	0.38	1.50	#10-24	1.50	2.25
M20 x 1,5	<b>MF-202</b>	2.56	1.75	0.40	1.57	M4 x 0,7	1.77	2.56
1.000-12 UN	<b>MF-251</b>	2.50	1.75	0.38	1.50	#10-24	1.75	2.50
1.125-16 UN	<b>MF-281</b>	2.75	2.00	0.38	1.50	#10-24	2.00	2.75
M28 x 1,5	<b>MF-282</b>	2.95	2.00	0.40	1.57	M4 x 0,7	2.00	2.95
1.313-16 UN	<b>MF-331</b>	3.00	2.25	0.38	1.50	#10-24	2.25	3.00
1.375-18 UN	<b>MF-351</b>	3.00	2.25	0.38	1.50	#10-24	2.25	3.00
M35 x 1,5	<b>MF-352</b>	3.15	2.25	0.40	1.57	M6 x 1,0	2.25	3.15
1.625-16 UN	<b>MF-421</b>	3.25	2.50	0.38	1.50	.25-20 UN	2.50	3.25
M42 x 1,5	<b>MF-422</b>	3.54	2.50	0.40	1.57	M6 x 1,0	2.50	3.54
1.875-16 UN	<b>MF-481</b>	3.50	2.75	0.38	1.50	.25-20 UN	2.75	3.50
M48 x 1,5	<b>MF-482</b>	3.74	2.75	0.40	1.57	M6 V 1,0	2.75	3.74
2.125-16 UN	<b>MF-551</b>	4.00	3.00	0.44	1.75	.25-20 UN	3.00	4.00
M55 x 1,5	<b>MF-552</b>	4.33	3.25	0.44	1.75	M6 x 1,0	3.25	4.33
2.500-16 UN	<b>MF-651</b>	4.50	3.50	0.44	1.75	.25-20 UN	3.50	4.50
M65 x 1,5	<b>MF-652</b>	4.53	3.50	0.44	1.75	M6 x 1,0	3.50	4.53
3.125-16 UN	<b>MF-801</b>	5.00	4.00	0.44	1.75	.25-20 UN	4.00	5.00
M80 x 2,0	<b>MF-802</b>	5.31	4.25	0.44	1.75	M6 x 1,0	4.25	5.31

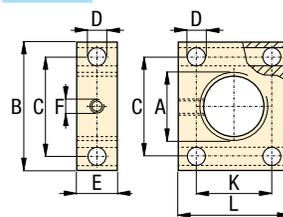
**AW-53, -121**



**AW-102**



**AW-51**



**Product dimensions** in inches [ ]

A thread	Model number	B	C	D thread	E	F thread	K	L
<b>▼ Mounting brackets – Cylindrical</b>								
1.500-16 UN	<b>AW-53</b>	3.00	2.25	.250-20 UN	.75	.28	.41	.31
2.750-16 UN	<b>AW-121</b>	4.50	3.00	.250-20 UN	.75	.34	.50	.38
<b>▼ Mounting brackets – Rectangular</b>								
2.250-14 UN	<b>AW-102</b>	3.25	3.00	.437-20 UN	1.25	.62	-	4.00
A thread	Model number	B	C	D ø	E	F thread	K	L
<b>▼ Mounting flanges – Rectangular</b>								
1.500-16 UN	<b>AW-51</b>	2.75	2.12	.41	1.00	.250-20 UN	1.62	2.25

# Power sources

## Power sources

Whether you need to run your parts once a day or 24 hours a day, Enerpac has the power source to help you get the job done. Power sources range from simple manual pumps to air operated, to fully customizable electric motor driven units.

With a wide variety of accessories to choose from, Enerpac power units are easily the most versatile and reliable in the industry.



## Technical support

Refer to the "Yellow Pages" of this catalog for:

- Safety instructions
- Basic hydraulic information
- Advanced hydraulic technology
- FMS (Flexible Machining Systems) technology
- Conversion charts and hydraulic symbols

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	▼ series	▼ page	
Turbo II air-hydraulic pumps	PA	76 - 77	
Air hydraulic pumps	PA AHP	78 - 79	
<b>Modular pump range overview</b>		<b>80 - 81</b>	
Basic pump units	WE	82	
Manifold kits	WMK	83	
Return line filter kit	PFK	84	
Heat exchanger kits	HE	84	
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Hand pumps	P, SP	95	
Air hydraulic boosters	AHB, B	96 - 97	
Activator wand & boosters	B, RA	98 - 99	
Pressure intensifiers	PID	100 - 101	

# Turbo II air-hydraulic pumps *Application & selection*

Shown: PAMG-5402NB, PACG-3102NB, PATG-3102NB, PATG-5105NB



**Turbo II air hydraulic pumps generate the hydraulic pressure you need using the air pressure you have available. The Air Saver Piston reduces air consumption and operating costs.**

They are ideal for providing the power and speed desired in simple clamping circuits. Turbo II air-hydraulic pumps are best suited to medium and lower cycle applications. At only 75 dBA, these new Turbo II series help to keep noise level to a minimum.

## Select the required output

### 3000 series

- Hydraulic to air ratio: 45:1

### 5000 series

- Hydraulic to air ratio: 60:1

**\*\* NOTE:** From 50-120 psi air inlet pressure. Performance is significantly diminished below 50 psi. Performance may vary compared to listed values due to seal friction, internal pressure drops and manufacturing tolerances. Be sure to allow some flexibility on air inlet pressure.

## Quick and powerful hydraulic supply in an economical air-powered unit

- On-demand stall-restart operation maintains system pressure, providing clamping security
- External adjustable pressure relief valve (behind sight glass)
- Internal pressure relief valve provides overload protection
- Reduced noise level to 75 dBA
- Operating air pressure: 50-125 psi – enables pump to start at low air pressure
- Reinforced heavy-duty lightweight reservoir for applications in tough environments
- Five valve mounting options provide flexibility in setup and operation
- Composite air piston seal allows operation on completely dry air supply
- Fully serviceable air motor assembly

## Select the required operation

### PATG series

- Momentary air inlet treadle for operation of single-acting cylinders
- Provides advance, hold and retract functions

### PACG series

- Momentary or continuous air inlet treadle
- A remote valve is required for operation of cylinders

### PASG series

- Momentary or continuous air inlet treadle
- Suitable for mounting any single- or double-acting valve with a DO3 mounting configuration

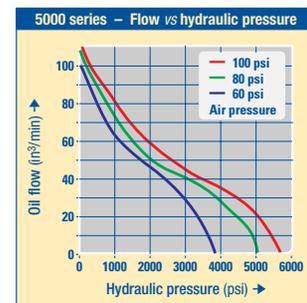
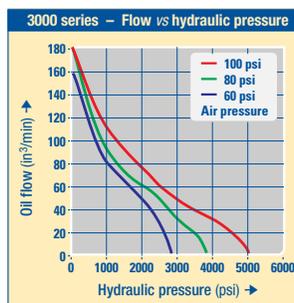
### PAMG series

- Momentary or continuous air inlet treadle
- Manual 4-way, 3-position, tandem center valve for single- or double-acting operation

### PARG series

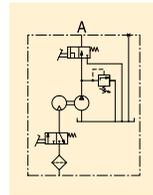
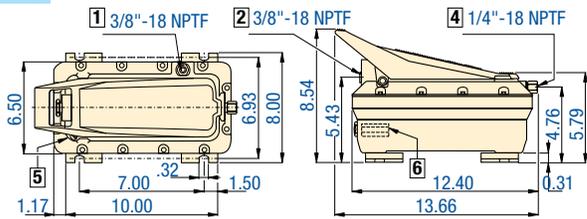
- Includes 15 ft. air pendant for remote control of single-acting cylinders
- Provides advance, hold and retract functions

## Output Oil Flow



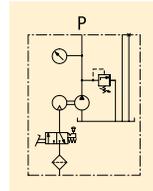
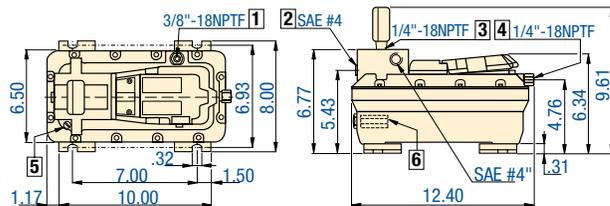


**PATG series**

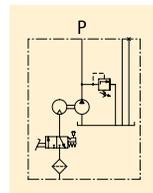
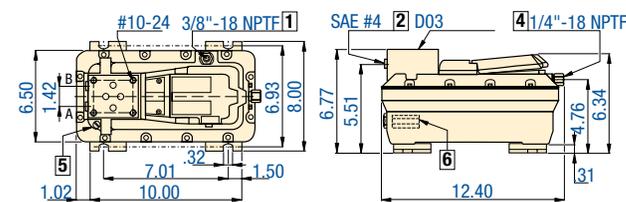


**PACG series**

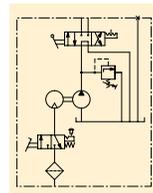
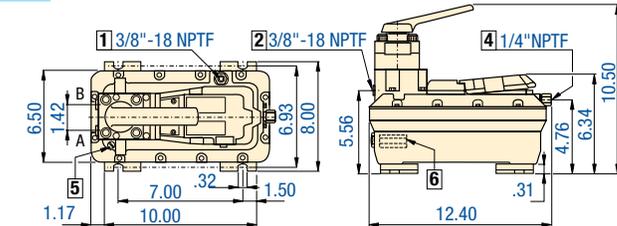
PACG series include pressure gauge G-2517L.



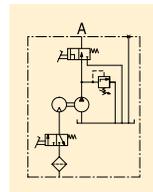
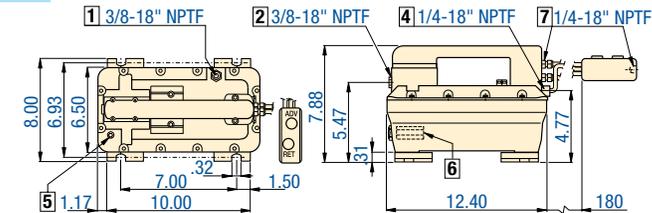
**PASG series**



**PAMG series**



**PARG series**



All dimensions shown in inches.

- 1 Auxiliary vent/tank fill port
- 2 Hydraulic output
- 3 Gauge mounting port
- 4 Swivel air input with filter
- 5 Filtered permanent tank vent
- 6 Adjustable pressure relief valve
- 7 Air pendant air input

**Product selection**

Pump type	3000 series model number	Oil flow <sup>1)</sup>	5000 series model number	Oil flow <sup>1)</sup>	Max. hydraulic pressure	Reservoir size <sup>2)</sup>	Usable oil capacity <sup>2)</sup>		Air pressure range	Air consumption	
		3000 series	5000 series	in <sup>3</sup>			scfm	lbs			
		in <sup>3</sup> /min		in <sup>3</sup> /min	psi	in <sup>3</sup>	hor. mount.	vert. mount.	psi	scfm	lbs
Serie PATG	PATG-3102NB	180	PATG-5102NB	120	5000	150	127	70	25-125	12	19
Serie PACG	PACG-3002SB	180	PACG-5002SB	120	5000	150	127	70	25-125	12	19
Serie PASG	PASG-3002SB	180	PASG-5002SB	120	5000	150	127	70	25-125	12	19
Serie PAMG	PAMG-3402NB	180	PAMG-5402NB	120	5000	150	127	70	25-125	12	25
Serie PARG	PARG-3102NB	180	PARG-5102NB	120	5000	150	127	70	25-125	12	23

<sup>1)</sup> At 0 psi hydraulic and 100 psi air pressure.

<sup>2)</sup> Turbo air-hydraulic pumps are also available with 305 in<sup>3</sup> reservoir. To order replace 2 in model number with 5.

- Oil Flow: 180 in<sup>3</sup>/min
- Pressure: 1250-5000 psi
- Sound Level: 75 dBA
- Air: 12 scfm
- Reservoir: 150-305 in<sup>3</sup>

- E Bombas hidroneumáticas
- F Pompes hydro-pneumatiques
- D Lufthydraulische pumpen

**Options**

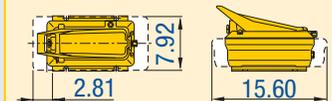
**Large reservoir models**



Enerpac Turbo II air-hydraulic pumps are also available with a 305 in<sup>3</sup> reservoir.

**Usable oil capacity**

Hor. mounted: 230 in<sup>3</sup>  
Vert. mounted: 180 in<sup>3</sup>



To order your Turbo II with a 305 in<sup>3</sup> reservoir, replace 2 in the model number with 5.

**Gauges and accessories**

134 ▶



**Regulator-filter-lubricator**

122 ▶



**Important**

For high cycle applications electric pumps are recommended.

Shown: PA-135, -136



▶ Compact, light weight, air driven power source. Treadle start on pump activates pump operation. Best choice for single-acting cylinders.

## Portable air hydraulic power

- Patented air saver design - minimal air usage for lower cost operation
- Quiet internal air muffler 80 dBa
- 360° swivel oil and air fittings for easier system setup
- External adjustable relief valve
- Built-in 3-way, 2 position valve provides advance-retract cycle operation for single-acting cylinders

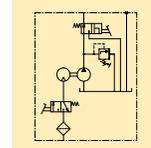
**Max. flow:** 60-120 in<sup>3</sup>/min

**Pressure:** 3000-5000 psi

**Air:** 12 scfm

**Reservoir:** 36.6 in<sup>3</sup>

- Ⓔ Bombas hidroneumáticas
- Ⓕ Pompes hydro-pneumatiques
- Ⓖ Lufthydraulische pumpen



## Options

**Regulator-filter-lubricator**

▶ 122 ▶



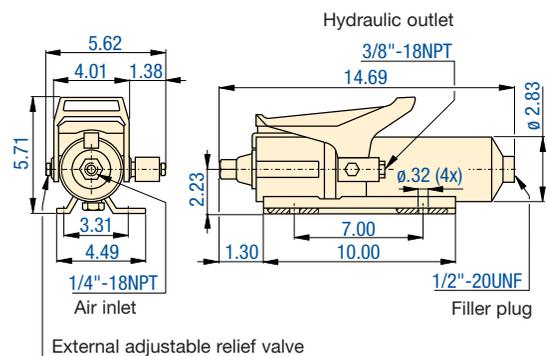
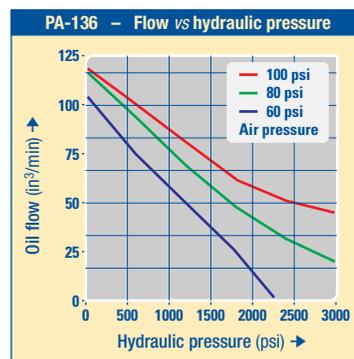
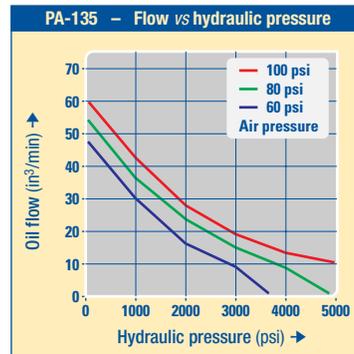
**Fittings**

▶ 138 ▶

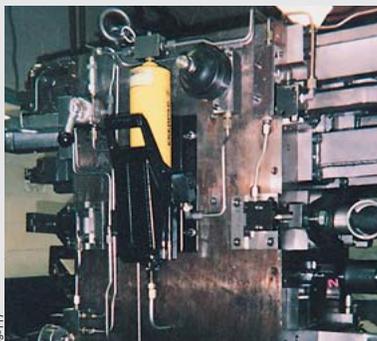


**Air valves**

▶ 122 ▶



■ These PA series air hydraulic pumps operate in all positions. Here, a PA-135 is mounted vertically to a clamping fixture.



## Product selection

Usable oil capacity	Max. oil flow <sup>1)</sup>	Max. hydraulic pressure	Model number	Valve function	Air pressure range	Air consumption	
					psi	scfm	lbs
36.6	60	5000	PA-135	Advance/Retract	60-100	12	14.3
36.6	120	3000	PA-136	Advance/Retract	60-100	12	14.3

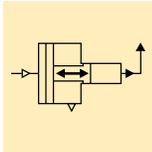
<sup>1)</sup> At 0 psi hydraulic pressure.

Note: Seal material: Buna-N, Teflon, Polyurethane.

[www.enerpac.com](http://www.enerpac.com)

- Max. flow: 24-38 in<sup>3</sup>/min
- Pressure: 4400-5000 psi
- Air consumption: 3 scfm
- Reservoir: 2.0 gal

- E** Bombas hidroneumáticas
- F** Pompes hydro-pneumatiques
- D** Lufthydraulische pumpen



## Options

VP series, Directional valves

104 ▶



Fittings

138 ▶



Directional air valves

122 ▶



## Important

Dry non-lubricated air is required for the AHP series pumps.

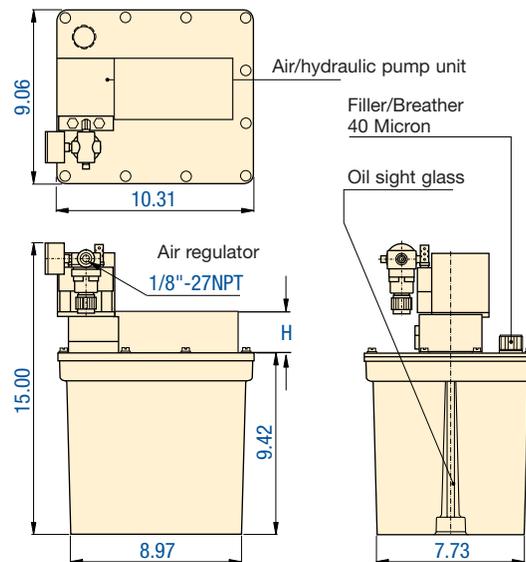
4-way remote valve is required to operate double-acting cylinders. A 3 way remote valve is required to operate single-acting cylinders.

## Modular design package

...allows for complete customization

- Two air to hydraulic ratios available to provide a wide pressure range
- Accepts a variety of valve styles, including D03, Enerpac VP series and standard Enerpac valves
- Pressure regulator supplied to ensure precise pressure monitoring
- Integrated oil level gauge allows system monitoring and preventative maintenance
- AHP-40S and AHP-60S can be used without pump mounted valve to power remote valve stacks
- G1/4" ports for easy plumbing (except AHP-40VP and AHP-60VP)
- Manifold included

### AHP series



## Product selection

Air to oil pressure ratio	Maximum oil flow	Maximum hydraulic pressure	Valve mounting pattern	Model number	H	Usable oil capacity	Air pressure range	
	in <sup>3</sup> /min	psi			in	gal	psi	lbs
1:44	38	4400	VM, VS-series	<b>AHP-40S</b>	2.05	2.0	20-125	45
1:44	38	4400	VP-series	<b>AHP-40VP</b>	2.05	2.0	20-125	45
1:44	38	4400	DO3 type	<b>AHP-40D</b>	2.05	2.0	20-125	45
1:64	24	5000	VM, VS-series	<b>AHP-60S</b>	2.56	2.0	20-125	45
1:64	24	5000	VP-series	<b>AHP-60VP</b>	2.05	2.0	20-125	45
1:64	24	5000	DO3 type	<b>AHP-60D</b>	2.56	2.0	20-125	45

Note: Seal material: Buna-N, Teflon, Polyurethane.  
Noise level: 80 dBa @ 100 psi air pressure

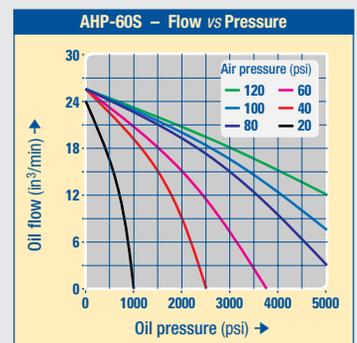
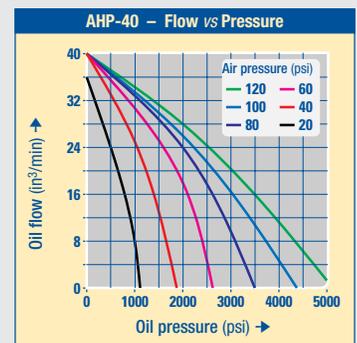
www.enerpac.com

© 2002

Shown: AHP-40D, AHP-40S, AHP-40VP



▶ These air/hydraulic pumps provide reliable consistent power to small and medium sized fixtures. The ability to add a variety of valves makes them ideal for any application – from simple to the most complex.



# Electric driven pumps *The Kit Concept*

Shown: WEH-4020JHL, WMK-21



Swing cylinders  
Work supports

Linear cylinders

Power sources

▶ Electric pumps are designed for applications where higher flows are required and for high cycle life. Can be configured to work with electronic system controls and customized to support a variety of high performance applications.

## ▼ Single & two-stage electric pumps

...customize them to your needs

- Easy to customize with modular standard kits to meet any requirement
- NEMA 4 rated, heavy-duty steel controls enclosure includes:
  - Power on/off selector
  - Industrial grade high cycle motor, starter and transformer
  - 24 VDC solenoid and remote pendant controls
  - Quick couple electrical connections for all accessory kits
- Easy to read integrated sight glass
- 40 micron filtered breather with splash guard
- Totally enclosed fan-cooled motors are ideal for use in many environments
- User adjustable external relief valve
- 79 max. dBA for quiet in-plant applications
- Multiple voltage options for a wide variety of applications

## Customize to your needs

...fits any clamping application

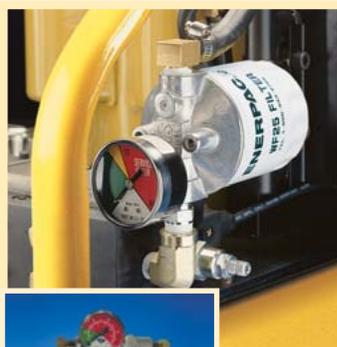
- New innovative modular design for demanding workholding applications
- Easy to customize with a variety of modular standard kits to meet any requirement
- Multiple voltage options
- Standard oversized filtered breather for easy reservoir fills without the need of special tools
- Large capacity (2.5, 5 and 10 gallon) reservoir minimizes heat build up, while reducing maintenance
- Easy to read integrated reservoir sight gauge

## Manifold and accessory kits to optimize your pump:



### Manifold Kits ▶ 83

- Necessary to mount valves, pressure switch, filter kit, heat exchanger and gauges to basic pump unit
- In single, two and four valve stations horizontal or up to 8 VP valve stations vertical
- With DO3, CETOP03, Enerpac VP, or porting block for remote valves



### Return Line Filter Kit ▶ 84

- Extends life of pump and other hydraulic components, reduces damage created by oil borne contaminants
- Internal pressure by-pass
- Provides 25 micron nominal filtration
- Maintenance indicator included
- Can be easily mounted to the pump
- Variety of assembly hardware included





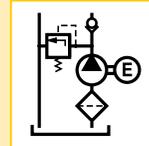
Flow: 120-640 in<sup>3</sup>/min

Pressure: 5000 psi max

Motor: 1.5 hp

Reservoir: 2.5-10 gal

- (E)** Bombas eléctricas
- (F)** Centrale hydraulique
- (D)** Modulare Spannpumpe



**Heat Exchanger Kits** 84 ▶

- Recommended for applications in which the pump is running in high ambient temperature or high duty cycles
- Increases oil life and consequently that of the pump and other hydraulic components
- Available in 24VDC or 115VAC



**Float/Temperature Switch Kit** 86 ▶

- Senses both oil level and temperature
- Float switch shuts down pump before the oil reaches an unsafe level
- Temperature switch shuts down pump when the oil has reached an unsafe operating temperature; protecting the pump and components from overheating



**Pressure Switch Kits** 85 ▶

- Signals when the hydraulic circuit has reached the desired pressure
- Automates the clamp or unclamp cycle
- Monitors system pressure, and can be tied to external controls



**Options**

**Valves**

104 ▶



**GW-2510 Pressure gauge 10,000 psi**



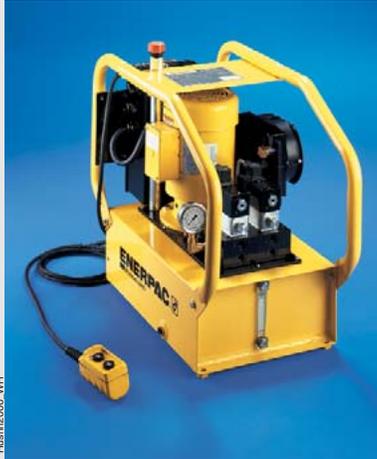
Includes: G2535L 2 1/2" Gauge  
FZ1608 1/4" Hex nipple  
FZ1638 1/4" Elbow

**Important**

Oil should be replaced every 500 working hours to ensure long life. Change filters when changing oil or 4 times a year, whichever comes first.

Output flow rate should be matched to hydraulic components used in the system.

Shown: WEH-4020JHL-WMK21



Swing cylinders  
Work supports

Linear cylinders

Power sources

## WE series

Enerpac single and two-stage electric workholding pumps are designed to be customized for your application.

### Application

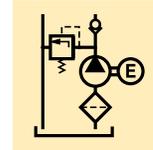
Enerpac electric pumps used in conjunction with swing cylinders, work supports, directional valves, control valves and sequence valves can provide a complete clamping solution. The optional heat exchanger and filter kit provide additional life. The pressure switch allows the unit to be fully automated.

## When reliability is essential

- New innovative modular design for demanding workholding applications
- Easy to customize with standard kits to meet any requirement
- Integrated oil sight gauge
- Electrical junction box includes plug-in connections
- Integrated adjustable relief valve allows user to set the maximum system pressure
- Oversized filtered breather for easy reservoir fills without the need of tools
- System relief included in pump

Flow:	120-640 in <sup>3</sup> /min
Pressure:	5000 psi max
Motor:	1.5 hp
Reservoir:	2.5-10

- (E) Bombas eléctricas
- (F) Centrale hydraulique
- (D) Hydraulische Pumpe



## Options

### VP-series Modular valves

104 ▶



### Manifold kits

83 ▶

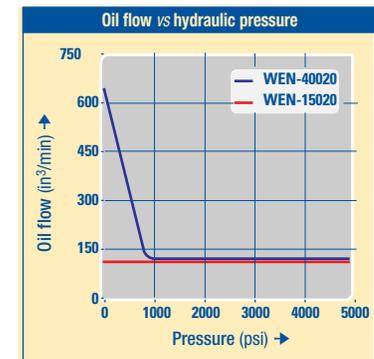
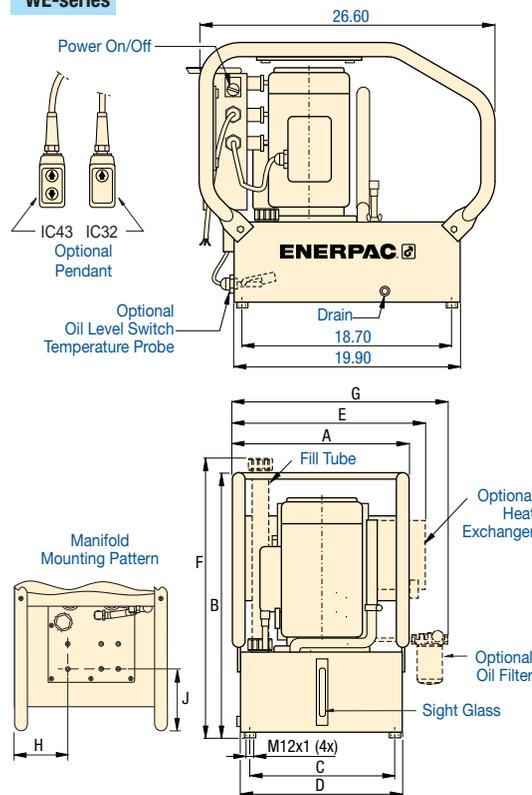


### Accessory kits

84-86 ▶



### WE-series



## Product selection

Output Flow Rate		Pressure Rating		Model number	Motor Size	Relief Valve Adjustment Range	Sound Level
in <sup>3</sup> /min 1 <sup>st</sup> stage	in <sup>3</sup> /min 2 <sup>nd</sup> stage	psi 1 <sup>st</sup> stage	psi 2 <sup>nd</sup> stage				
640	120	800	5,000	<b>WE SERIES</b>	1.5	800-5,000	79

## Product dimensions in inches [ ]

Usable Oil Capacity	Motor Size	Model number**	Pump Dimensions (in)										lbs
			A	B	C	D	E	F	G	H	J		
gal	hp												
2.5	1.5	WE-XXX10X	10.11	21.68	6.50	8.75	14.61	24.43	14.11	2.70	6.09	175*	
5	1.5	WE-XXX20X	15.10	22.68	12.25	13.75	17.10	25.43	19.10	5.20	6.09	199*	
10	1.5	WE-XXX40X	15.10	27.68	12.25	13.75	17.10	30.43	19.10	5.20	6.09	263*	

\* Weight shown is for basic pump unit without accessories.

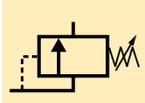
\*\*See page 87 for more information on creating the model number to fit your needs.

Pressure: 5000 psi

Stations: 1-4 valves horizontal

Stations: 1-8 valves vertical

- E** Colectores
- F** Manifolds
- D** Manifolds



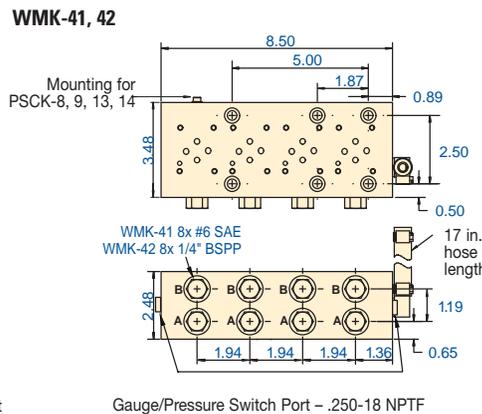
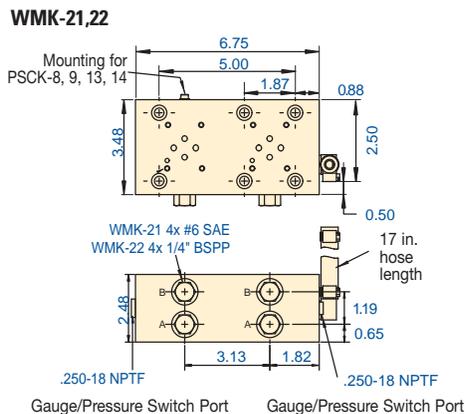
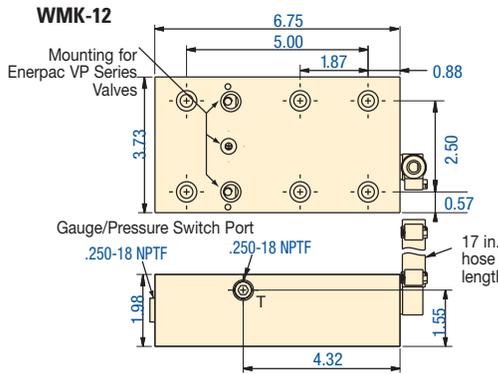
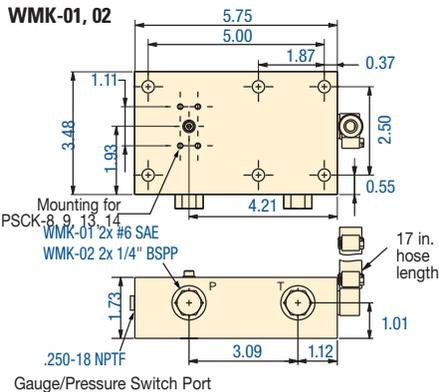
## For quick and easy installation ...integrated workholding system

- Manifolds allow the use of accessories such as heat exchangers, filter kits, pressure switches and gauges
- Multiple valve options
- With DO3 and Enerpac VP series and standard valve mounting patterns
- All installation components included
- Manifold not required when mounting Enerpac VM series manual valves

### Options

VP-series, modular valves

104 ▶



### Product selection

Valve mounting pattern	Model number	Number of Stations	Coverplate * Model nr.	lbs
Remote Valve, SAE porting block	WMK-01	-	-	8.0
Remote Valve, BSPP porting block	WMK-02	-	-	13.0
Enerpac VP Series	WMK-12	1-8	-	14.0
D03 and VSS/VST Series	WMK-21	2	MC-1	14.0
CETOP03 and VSS/VST Series	WMK-22	2	MC-1	14.0
D03 and VSS/VST Series	WMK-41	4	MC-1	22.0
CETOP03 and VSS/VST Series	WMK-42	4	MC-1	22.0

\* Manifold Cover Plate must be ordered separately. Includes gasket and mounting bolts.

Shown: WMK-21, WMK-12, WMK-01



### WMK series

Manifolds are necessary to mount directional control valves. Enerpac WMK manifolds are designed for use in conjunction with WE series workholding pumps, allowing installation of multiple directional control valves.

WMK-01 and -02 allow for plumbing to remote mounted valves.



WMK-12 allows VP Series valves to be mounted directly to the pump.



WMK-21, -22, -41 and -42 allow mounting of D03 or CETOP03 valves directly to the pump.



■ Enerpac WMK-41 manifold used in Enerpac WE-series pump. Unused manifold stations are sealed with cover plates.

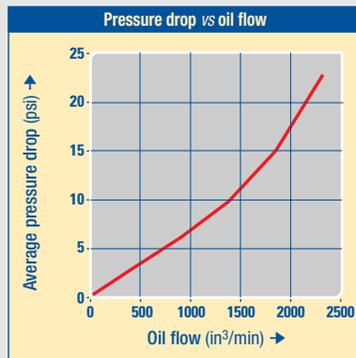


Shown: PFK-25



### PFK-series

The oil filter kit removes contaminants from the return oil flow before allowing it back into the reservoir, reducing component damage.



## Extend life of hydraulic components

...increase system reliability

- 25 micron nominal filter cleans oil to increase system life
- Internal bypass valve to prevent damage if the filter is dirty
- All installation components included
- Kit assembles quickly and easily to Enerpac pump and manifold
- Maintenance indicator included

**Filtration:** 25 micron

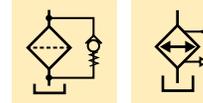
**Pressure:** max. 200 psi

**Max. flow:** 7.0 GPM

**(E)** Filtro

**(F)** Filtre

**(D)** Filter



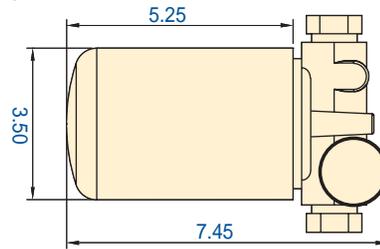
### Options

**PF-25**  
Replacement filter element



For best performance, replace filter element on a regular basis. Change filters when changing oil or 4 times a year whichever comes first.

PFK-25



### Product selection

Nominal filtration	Model number	Maximum pressure	Maximum oil flow	Bypass pressure setting	Filter gauge/ service indicator	
micron		psi	GPM	psi		lbs
25	<b>PFK-25</b>	200	7.0	25	✓	2.4

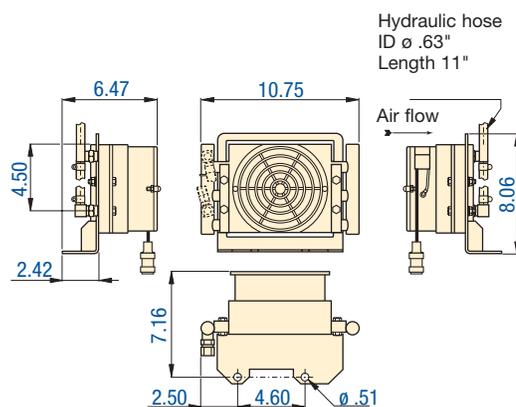
Shown: HE-1



### HE-series

Heat exchanger removes heat from the return oil to provide cooler operation.

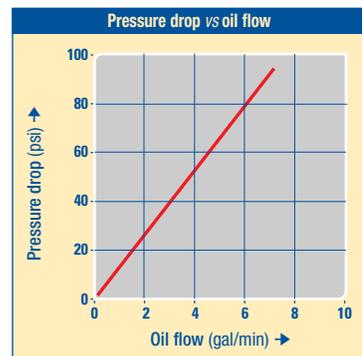
HE-1, 2



**Transfer:** 900 Btu/h

**Pressure:** max. 300 psi

**Voltage:** 115V, 24V



### Product selection

Voltage	Model number	Thermal transfer *	Amperage draw	Maximum pressure	Maximum oil flow	
		Btu/h	kJoule	psi	GPM	lbs
24 VDC	<b>HE-1</b>	900	950	300	7.0	6.3
115 VAC	<b>HE-2**</b>	900	950	300	7.0	6.3

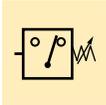
\*At 0.5 G/min and ambient temperature of 70°F.

\*\*HE-2 requires separate 115V power supply.

[www.enerpac.com](http://www.enerpac.com)

- Temp.: 40-165 °F
- Pressure: 290-10,000 psi
- Accuracy: ± 2%
- Voltage: 24/115/230 V

- E** Presostatos
- F** Pressostats
- D** Druckschalter

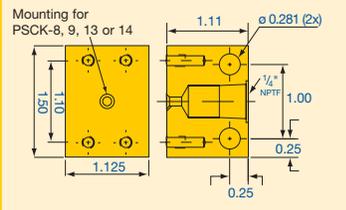


## Options

**GW-2510**  
Pressure gauge,  
10,000 psi



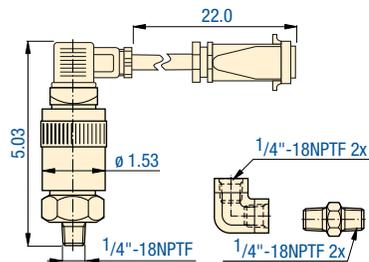
**PB-2**  
Adapter block



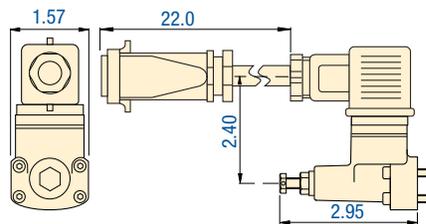
## Control your pump, monitor your system

- Integrated kit mounts easily to your hydraulic system
- All installation components included
- Accuracy of ± 2% of full scale
- High-duty cycle
- IC-7234 Switch included on factory-built pumps with "P" option
- PSCK Series switches only available as separately ordered kits.

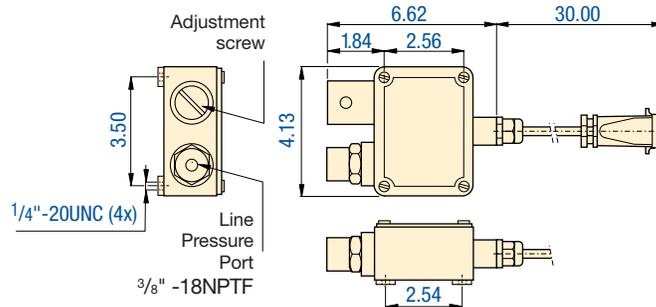
PSCK-11, 12



PSCK-13, 14



IC-7234



## Product selection

Adjustable pressure range	Electrical specification	Model number	Amperage Rating	Dead-band	Switchpoint repeatability	Temperature range	
psi	at 50/60Hz		A	psi	% of range	°F	lbs
<b>▼ Mechanical adjustment</b>							
700-10,000	24 VDC	<b>IC-7234</b>	5.0	115-550	± 2 %	40 - 165	1.0
500-3500	24/115/230 V	<b>PSCK-11</b>	5.0	90-400	± 2 %	40 - 165	1.0
3000-5000	24/115/230 V	<b>PSCK-12</b>	5.0	250-800	± 2 %	40 - 165	1.0
1450-5000	24/115/230 V	<b>PSCK-13</b>	2.0	260-500	± 2 %	40 - 165	1.0
290-3045	24/115/230 V	<b>PSCK-14</b>	2.0	90-220	± 2 %	40 - 165	1.0

Note: Electrical harness included with kit.

Shown: PSCK-14, PSCK-12



## PSCK series

Pressure switches monitor the hydraulic system to determine any change of pressure. The signal can then be used to control the pump, or other peripheral devices.

## Application

These pressure switches are designed for use in high cycle applications, machine tool interface, robotics and flexible machine systems. These switches can be used to automate the clamp and unclamp cycle.

## Important

**Pressure switch and electrical harness are specifically designed to work in conjunction with WE pumps and WMK manifolds.**

For other uses, please reference individual pressure switches.

132 ▶

**All kits will turn off electric motor on WE series electric pumps when system pressure reaches preset level.**

■ Pressure switch kit PSCK-12 installed on the WE-series workholding pump.



# Float/temperature switch kit & control pendant LS, IC series

Shown: LS-1



## LS-series

Oil level indicator for pump reservoir. If the pump is mounted in a remote area that does not provide visual access to the external oil level sight, the float switch will turn off the pump before internal damage can occur due to cavitation.

Built-in thermal switch shuts motor off before pump damage can occur when oil temperature exceeds 175°F.

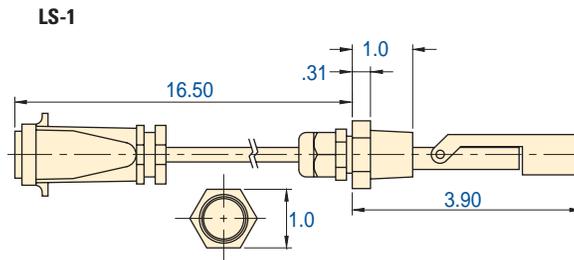
## Electronic float switch for feedback on pump oil level

- Drop-in design allows for easy installation to pump reservoir
- Electrical connector included
- Built-in thermal sensing provides feedback on oil temperature
- Senses low oil level in pump reservoir
- Universal voltage at 50/60 Hz

Temp. Set Point: 175 °F

Voltage: 24 VAC/DC

- (E) Indicador del nivel/temp.
- (F) Interrupteur de niveau/temp.
- (D) Ölstand/Temperaturschalter



## Product selection

Fixed temperature signal	Model number	Voltage	Thermostat rating setting	Maximum pressure	
°F			Amps	psi	lbs
175	LS-1	24 VAC/DC	2.6	150	.75

Shown: IC-32, IC-43



## IC-series

Pendant controls are used on single-circuit systems as a simple and affordable way to control electric valves.

## Control Pendants

- Provides safe and accurate control of solenoid valves
- Enclosure NEMA 4 rated for indoor or outdoor applications
- Molded from high-strength engineered resins
- Industrial strength strain relief protects cord from abuse
- Two button unit controls two solenoid valves
- Single button controls one solenoid valve or dump valve
- UL, CSA and CE approved

Voltage: 24 VDC

Cord Length: 10 ft.

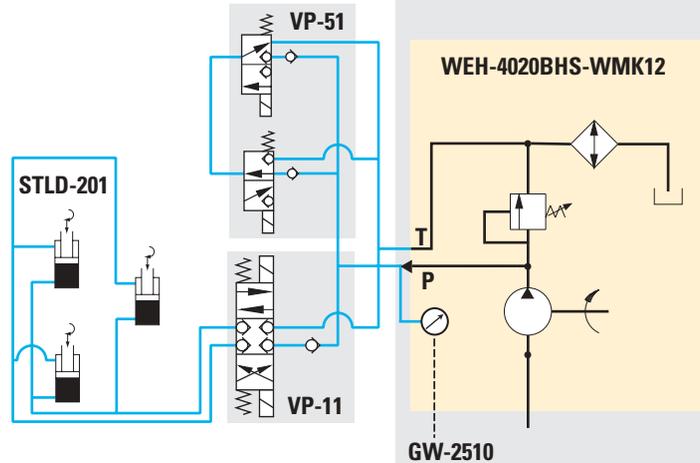
## Product selection

Used with Cylinders	Model number	Number of Switches	
			lbs
1 x Single-acting	IC-32	1	2.5
1 x Double-acting/2 x Single-acting	IC-43	2	2.5

# Hydraulic system circuits

## Single circuit hydraulic system

- WEH-4020BHS-WMK12: Basic pump unit
- VP-11 controls the STLD-201 swing clamps
- VP-51 acts as an unloading valve:
  - Energized: Flow and pressure are sent to the fixture
  - De-energized: Oil is allowed to flow back into the tank to reduce stress and prolong the life of the pump.



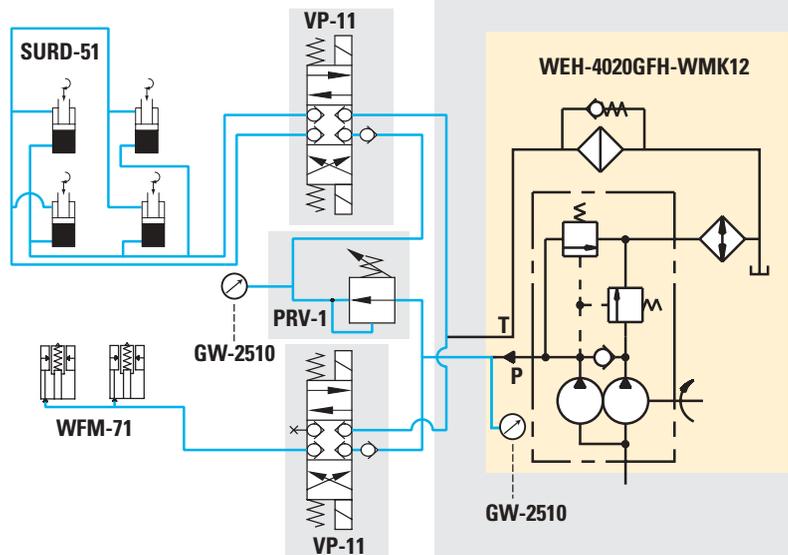
System component	Quantity	Model number	Page number
Pump Unit Single-Stage	1	WEH-4010BS-WMK-12	82
Modular directional valves	1	VP-11	104
Modular directional valves	1	VP-51	104
Tie Rod Kit	1	TRK-2	114
Pressure Gauge	1	GW-2510	81

### ! Important

Use of an unloading valve is required in high cycle applications. Failure to unload the pump when pressure is not needed will cause damage or premature failure of your power unit.

## Double circuit hydraulic system

- WEH-4020GFH-WMK12: Pump unit with filter and heat exchanger to prolong life
- Mounted on WMK-12 manifold:
  - Two VP-11 control valves to allow individual control of the WFM-71 work supports and SURD-51 swing clamps
  - One PRV-1 to allow full pressure to the work support and reduced pressure to the swing clamps



System component	Quantity	Model number	Page number
Pump Unit Two-Stage	1	WEH-4020GFH-WMK12	82
Modular valve	2	VP-11	104
Pressure Reducing Valve	1	PRV-1	119
Tie Rod Kit	1	TRK-3	114
Pressure Gauge	2	GW-2510	81
*Adapter Fitting	1	FZ-2023	138

\*Used to connect GW-2510 to PRV-1.

### ! Important

When using multiple valves to control independent circuits, be sure to incorporate a pressure port check valve on each valve. Without this check valve, your system may not perform as designed. Enerpac VP Series valves have this feature built in for your convenience.



# Customizing your pump

Swing cylinders  
Work supports

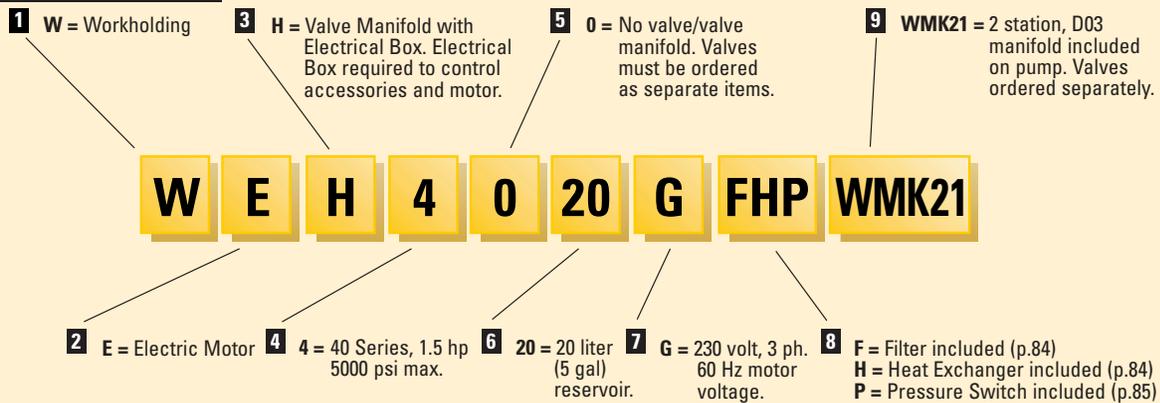
Linear cylinders

Power sources

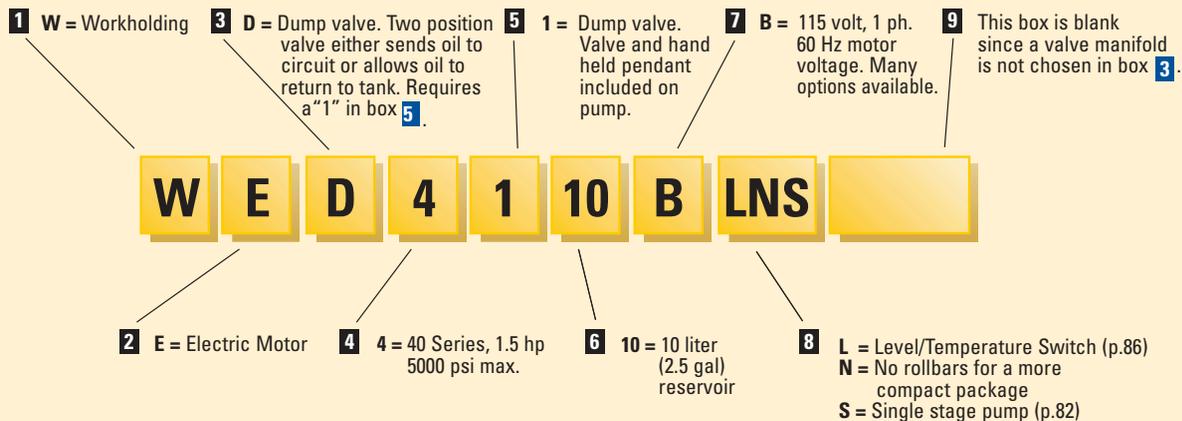
## Building your customized Hushh model number

Enerpac's wide variety of options and accessories allows you to build a custom power unit to your specific needs. Power units can be configured with just the essentials, or fully configured to be used in the most demanding applications. And, you don't need to order all of the options today. If you decide you want to upgrade or change in the future, simply order the accessory kits at that time. Use the sample model numbers below and the chart on page 89 to help you configure your custom Hushh power unit. Be sure to reference back to the specific accessory product pages if you need more information.

### Example 1



### Example 2



Circuit type	Basic Model Number	Suggested Options
Dump pump for single-acting pallet circuits	WED-4110B	Change "B" to "G" for 230 volt 3-phase power supply <b>7</b>
		Add "F" to end of model number for return line filter <b>8</b>
		Add "S" to end of model number for single speed pump <b>8</b>
One double-acting circuit	WEM-4410B	Change "B" to "G" for 230 volt 3-phase power supply <b>7</b>
		Change "10" to "20" for larger 5 gallon reservoir <b>6</b>
		Change "M" to "R" for solenoid valve with remote pendant <b>3</b>
Auto coupler system (p126)	WEQ-4020JFN-WMK21	Change "J" to "G" for 230 volt 3-phase power supply <b>7</b>
		Add "H" to model number for heat exchanger <b>8</b>
Pressure demand (pressure switch)	WEL-4220BP	Change "B" to "G" for 230 volt 3-phase power supply <b>7</b>
		Change "20" to "10" for smaller 2.5 gallon reservoir <b>6</b>
		Add "L" to part number for level/temperature shut-off valve <b>8</b>
Multiple circuits	WEH-4020G-WMK12	Change "G" to "J" for 460 volt 3-phase power supply <b>7</b>
		Change "20" to "10" for smaller 2.5 gallon reservoir <b>6</b>
		Change "WMK12" to a different manifold to fit your needs <b>9</b>
		Multiple valves are ordered separately (see page 104)



## Custom build your Pump

▼ This is how a WE series Model Number is built:

**W E H 4 0 20 B FH WMK21**

1	2	3	4	5	6	7	8	9
Product Type	Motor Type	Pump Type	Pump Series	Valve Type	Res. Capacity	Power Supply	Options	Manifold Options

### 1 Product Type

**W** = Workholding Pump

### 2 Motor Type

**E** = Electric

### 3 Pump Type \*3

**D** = Dump (Valve Type 1 only)

**H** = Valve manifold with electrical box (Valve Type 0 only)

**K** = Valve manifold without electrical box (Valve Type 0 only) \*6

**L** = Manual with electrical box

**M** = Manual without electrical box

**N** = No valve with electrical box (Valve Type 0 only)

**R** = Remote (solenoid)

**V** = Electrical valve without pendant

**W** = No valve without electrical box (Valve Type 0 only) \*6

### 4 Pump Series

**4** = 1.5 HP 5000 psi, 120 in<sup>3</sup>/min

### 5 Valve Type

**0** = No valve/coverplate or manifold

**1** = Dump

**2** = 3-way, 2-position, manual valve

**3** = 3-way, 3-position, manual or electric

**4** = 4-way, 3-position, manual or electric

**6** = 3-way, 3-position, manual valve w/P.O. check

**8** = 4-way, 3-position, manual valve w/P.O. check

### 6 Reservoir Capacity

**10** = 10 Liters (2.5 gal)

**20** = 20 Liters (5 gal)

**40** = 40 Liters (10 gal)

### 7 Power Supply

Single Phase

**A** = 115V, 1 ph, 50 Hz\*5

**B** = 115V, 1 ph, 60 Hz\*5

**Y** = 115V, 1 ph, 60 Hz

(with 20 AMP plug, required for Canada)

**E** = 208-240V, 1 ph, 50 Hz

**I** = 208-240V, 1 ph, 60 Hz

Three Phase

**M** = 190-200V, 3 ph, 50/60 Hz

**G** = 208-240V, 3 ph, 50/60 Hz

**W** = 380-415V, 3 ph, 50/60 Hz

**K** = 440V, 3 ph, 50/60 Hz

**J** = 460-480V, 3 ph, 50/60 Hz

**R** = 575V, 3 ph, 50/60 Hz

### 8 Options \*4 (Leave blank if not required)

**F** = Filter Kit

**H** = Heat exchanger \*1

**L** = Level/Temperature Switch

**N** = No Roll Bars \*2

**P** = Pressure Switch

**S** = Single Stage

### 9 Manifold Options \*5 (Pump types H and K only. Otherwise, leave blank.)

**WMK-01** = SAE porting block for remote valves

**WMK-02** = BSPP porting block for remote valves

**WMK-12** = 1-8 station VP series mounting

**WMK-21** = 2 station D03 mounting

**WMK-22** = 2 station CETOP03 mounting

**WMK-41** = 4 station D03 mounting

**WMK-42** = 4 station CETOP03 mounting

## Example

The **WED-4110BHL** is a 1.5 HP, 5,000 psi, 2-stage pump with a dump valve, a 10 liter reservoir, a 115V, 1-phase, 60 Hz motor, a heat exchanger and a level/temperature switch.

\*1 Requires 115VAC Source for Heat Exchanger on models without electrical box.

\*2 Unless specified, all standard pumps are supplied with Roll Bars.

\*3 Single circuit, intermittent duty, manual and electric valves are available factory installed. Consult Enerpac for options.

\*4 Options should be added to model number in alphabetical order.

\*5 Units with valve manifolds do not include valves. See valve section for available options to be ordered separately.

\*6 Units without electrical box require customer supplied motor starter and electrical controls for pressure switch, heat exchanger and level switch.

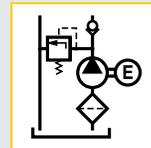
Flow: 120-640 in<sup>3</sup>/min

Pressure: 5000 psi max

Motor: 1.5 hp

Reservoir: 2.5-10 gal

- (E)** Bombas eléctricas
- (F)** Centrale hydraulique
- (D)** Modulare Spannumppe



Power sources

Valves

System components

Yellow pages

## Options

**LK-1**  
Leveling feet  
**CK-1**  
Casters



**SK-1**  
Skid bars



Previous Model #	Current Model #
------------------	-----------------

WEN-15020BR	WEN-4020BS
WEN-15020GR	WEN-4020GS
WEN-40020BR	WEN-4020B
WEN-40020GR	WEN-4020G

Shown: PEM2045



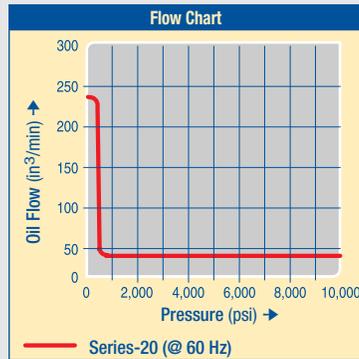
Swing cylinders  
Work supports

Linear cylinders

Power sources

## 20-Series

1 HP electric pumps are ideal for medium to high production manufacturing.



## Increased Productivity and Efficiency

- Two-speed pump
  - First stage gear pump
  - Second stage piston pump
- Two-speed design provides rapid advance and controlled pressure build up
- 1 HP induction motor
- Single phase 115 volt motor standard
- Three phase 230/460 volt motor available
- Reservoir mounting holes for easy mounting to fixed surface
- System safety relief and user-adjustable relief standard
- 3/8" NPT ports on all models

## Select the required operation

### PED series: with Dump Valve

- Ideal for punching and crimping
- For use when load holding is not required
- Control pendant with 10-ft cord controls valve and motor

### PER 20 series: with Solenoid Valve

- Ideal for production applications
- All valves are 3-position for Advance/Hold/Retract
- Control pendant with 10-ft cord for remote valve operation

### PEM series: with Manual Valve

- Ideal choice for most applications
- Manual valve control, for both single-acting or double-acting applications
- Manual motor control

### PER 23 series: with Remote Jog

- Same as PEM version, but with remote motor Jog control
- Manual Valve control for either single-acting or double acting cylinders
- Control pendant with 10-ft cord for remote motor control

### WES 20 series: with Pressure Switch

- Includes manual 2-way valve
- Pressure switch controls motor
- Pump builds to pressure, automatically re-starts if pressure drops
- 5000 psi max pressure

## Product selection

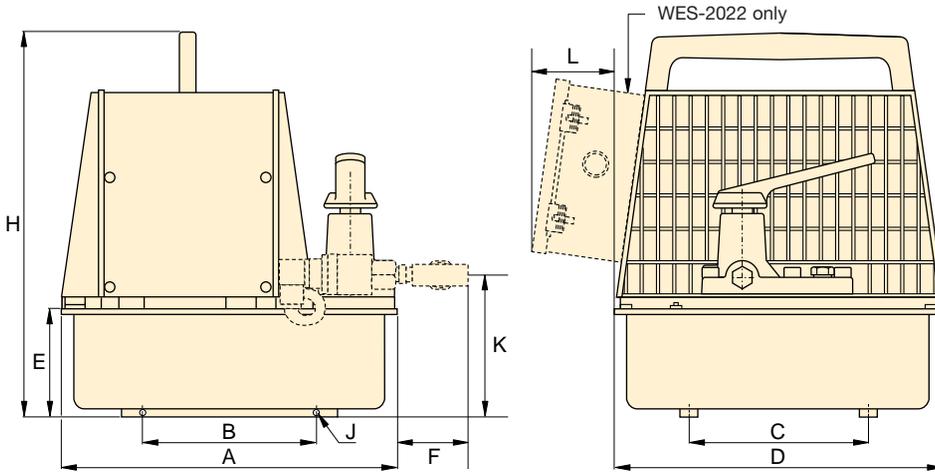
Output Flow Rate		Pressure Rating		Model number	Motor Size	Relief Valve Adjustment Range	Sound Level
1 <sup>st</sup> stage	2 <sup>nd</sup> stage	1 <sup>st</sup> stage	2 <sup>nd</sup> stage**				
240	42	500	10,000	PE, WE	1	1,000–10,000	80

\* Motor current draw is 19.5A at max pressure in each stage.

\*\* WES-2022 is 5000 psi max



20 series



Flow:	42-240 in <sup>3</sup> /min
Pressure:	10,000 psi max
Motor:	1.0 hp
Reservoir:	1.0-5 gal

Options

**G-series Pressure gauges**  [134](#)

**FL-series High pressure filters**  [137](#)

**FZ-series Fittings**  [138](#)

**HF-series Hydraulic oil**  [137](#)

**Important**

Oil should be replaced every 500 working hours to ensure long life. Change filters when changing oil or 4 times a year whichever comes first.

Output flow rate should be matched to hydraulic components used in the system.

**Product dimensions** in inches 

Model Number	Valve Type	Circuit Type	Reservoir Size (gallons)	A	B	C	D	E	F	H	J	K	L	lbs
PED-2001	dump	single acting	1.0	12.62	6.38	7.50	12.12	3.88	-	17.25	0.26	-	-	78
PEM-2021	manual 2-way	single acting	1.0	12.62	6.38	7.50	12.12	3.88	-	17.25	0.26	-	-	75
PEM-2022	manual 2-way	single acting	2.0	12.62	6.38	7.50	12.12	6.50	-	20.69	0.26	-	-	87
PEM-2025	manual 2-way	single acting	5.0	17.00	12.75	9.25	13.50	9.38	-	24.88	0.26	-	-	140
PEM-2031	manual 3-way	single acting	1.0	12.62	6.38	7.50	12.12	3.88	-	17.25	0.26	-	-	77
PEM-2032	manual 3-way	single acting	2.0	12.62	6.38	7.50	12.12	6.50	-	20.69	0.26	-	-	88
PEM-2035	manual 3-way	single acting	5.0	17.00	12.75	9.25	13.50	9.38	-	24.88	0.26	-	-	140
PEM-2041	manual 4-way	double acting	1.0	12.62	6.38	7.50	12.12	3.88	-	17.25	0.26	-	-	77
PEM-2042	manual 4-way	double acting	2.0	12.62	6.38	7.50	12.12	6.50	-	20.69	0.26	-	-	88
PEM-2045	manual 4-way	double acting	5.0	17.00	12.75	9.25	13.50	9.38	-	24.88	0.26	-	-	140
PER-2031	solenoid 3-way	single acting	1.0	12.62	6.38	7.50	12.12	3.88	-	17.25	0.26	-	-	93
PER-2032	solenoid 3-way	single acting	2.0	12.62	6.38	7.50	12.12	6.50	-	20.69	0.26	-	-	116
PER-2035	solenoid 3-way	single acting	5.0	17.00	12.75	9.25	13.50	9.38	-	24.88	0.26	-	-	154
PER-2041	solenoid 4-way	double acting	1.0	12.62	6.38	7.50	12.12	3.88	-	17.25	0.26	-	-	98
PER-2042	solenoid 4-way	double acting	2.0	12.62	6.38	7.50	12.12	6.50	-	20.69	0.26	-	-	109
PER-2045	solenoid 4-way	double acting	5.0	17.00	12.75	9.25	13.50	9.38	-	24.88	0.26	-	-	160
PER-2321	remote jog, 2-way	single acting	1.0	12.62	6.38	7.50	12.12	3.88	-	17.25	0.26	-	-	80
PER-2341	remote jog, 4-way	double acting	1.0	12.62	6.38	7.50	12.12	3.88	-	17.25	0.26	-	-	80
PER-2342	remote jog, 4-way	double acting	2.0	12.62	6.38	7.50	12.12	6.50	-	20.69	0.26	-	-	91
WES-2022	manual, 2-way	pressure demand	2.0	12.62	6.38	7.50	12.12	6.50	2.24	20.69	0.26	7.55	4.38	103

Shown: WEM-1401B



Swing cylinders  
Work supports

Linear cylinders

Power sources

## WE series

Enerpac two stage electric submerged pumps are a quiet, economical workholding power source. Submerged in oil the motor stays cooler when used on an intermittent basis.

## Best performance for mid-range cylinders

- Reduce cycle times for improved productivity
- Two-speed pump unit provides rapid cylinder advance
- Submerged dual voltage induction motor, runs cooler and quieter
- Available with heat exchanger for higher duty cycle applications
- Externally adjustable relief valve – no need to open pump when reducing pressure
- Reservoir mounting holes for easy mounting to fixed surface
- Full length side tube for easy monitoring of oil level
- Auxiliary return port, eliminates the need for a separate adapter

## Product selection

Motor voltage	Motor capacity	Amperage draw	Maximum oil flow at 60Hz in <sup>3</sup> /min		Pressure rating psi		Usable oil capacity gal	Adjustable relief valve psi	Adjustable relief valve lbs
			1 <sup>st</sup> stage	2 <sup>nd</sup> stage	1 <sup>st</sup> stage	2 <sup>nd</sup> stage			
50/60 Hz 1 ph	hp	A							
115V-1ph	.50	13.5	150	40	1000	5000	1.5	1000 - 5000	63 <sup>1)</sup>
230V-1ph	.50	6.75	150	40	1000	5000	1.5	1000 - 5000	63 <sup>1)</sup>

<sup>1)</sup> Weight for WES models is 83 lbs.

## Select your pump type



### WED series with dump valve

- For use when load holding is not required
- Ideal for palletized workholding
- Motor is on only during work cycle



### WEJ series with remote jog

- Manual valve control
- Motor can be turned on and off by remote pendant for jogging capability



### WEM series with manual valve

- Manual valve control
- Manual motor control
- Simple and economical solution to your workholding power source needs



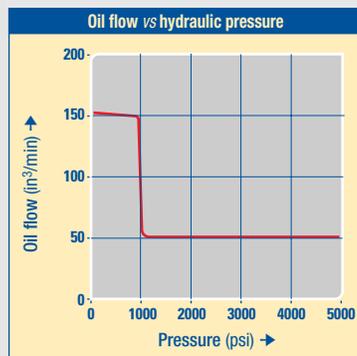
### WER series with remote actuated solenoid

- Solenoid directional with shear seal design
- Remote valve operation



### WES series with pressure switch

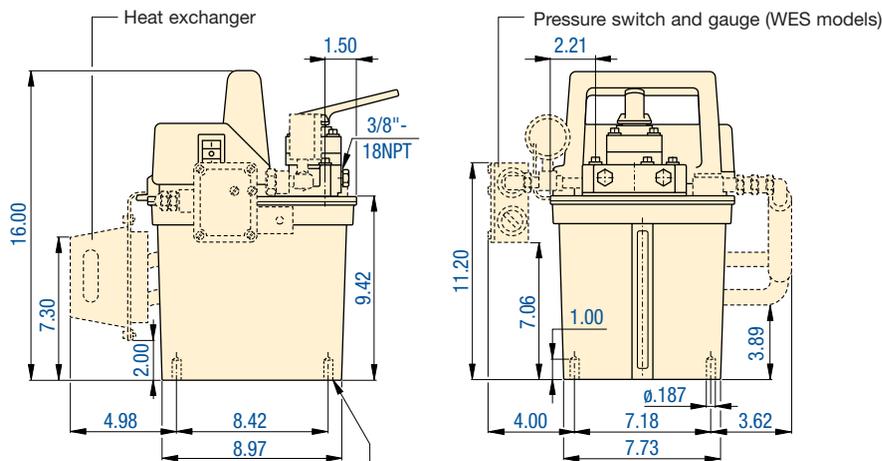
- Pressure switch turns motor on and off
- Used when pressure must be maintained over a period of time
- With pressure gauge



Pressure switch specifications: - Classification NEMA 1  
- Pressure range: 3000 - 5000 psi  
- Maximum differential: 350 - 510 psi



## WE-series Submerged



Use (4x) 1/4-20 or M6 (coarse) bolts.  
Mounting holes not tapped.

**Flow:** 40 in<sup>3</sup>/min

**Pressure:** 5000 psi

**Motor:** .5 hp

**Reservoir:** 1.5 gal

- E** Bombas eléctricas
- F** Centrale hydraulique
- D** Tauchpumpe



## Options

**G-series**  
Pressure gauges

134 ▶



**FL-series**  
High pressure filters

137 ▶



**FZ-series**  
Fittings

138 ▶



**HF-series**  
Hydraulic oil

137 ▶



## ! Important

Oil should be replaced every 500 working hours to ensure long life. Change filters when changing oil or 4 times a year whichever comes first.

Heat exchanger cools oil in pumps used in higher duty cycle applications.

Output flow rate should be matched to hydraulic components used in the system.

	Used with cylinder	Valve function	Valve type	Model number	Motor voltage 50/60 Hz	Heat exchanger
	Single-Acting	Advance / Retract	Dump	<b>WED-1001B</b>	115V	
	Single-Acting	Advance / Retract	Dump	<b>WED-1001E</b>	230V	
	Single-Acting	Advance / Retract	Jog	<b>WEJ-1201B</b>	115V	
	Single-Acting	Adv. / Hold / Retr.	Jog	<b>WEJ-1301B</b>	115V	
	Double-Acting	Adv. / Hold / Retr.	Jog	<b>WEJ-1401B</b>	115V	
	Single-Acting	Advance / Retract	Manual 3/2	<b>WEM-1201B</b>	115V	
	Single-Acting	Advance / Retract	Manual 3/2	<b>WEM-1201D</b>	115V	●
	Single-Acting	Advance / Retract	Manual 3/2	<b>WEM-1201E</b>	230V	
	Single-Acting	Advance / Retract	Manual 3/2	<b>WEM-1201F</b>	230V	●
	Single-Acting	Adv. / Hold / Retr.	Manual 3/3	<b>WEM-1301B</b>	115V	
	Single-Acting	Adv. / Hold / Retr.	Manual 3/3	<b>WEM-1301F</b>	230V	●
	Double-Acting	Adv. / Hold / Retr.	Manual 4/3	<b>WEM-1401D</b>	115V	●
	Double-Acting	Adv. / Hold / Retr.	Manual 4/3	<b>WEM-1401E</b>	230V	
	Single-Acting	Adv. / Hold / Retr.	Solenoid	<b>WER-1301B</b>	115V	
	Single-Acting	Adv. / Hold / Retr.	Solenoid	<b>WER-1301D</b>	115V	●
	Single-Acting	Adv. / Hold / Retr.	Solenoid	<b>WER-1301E</b>	230V	
	Double-Acting	Adv. / Hold / Retr.	Solenoid	<b>WER-1401B</b>	115V	
	Double-Acting	Adv. / Hold / Retr.	Solenoid	<b>WER-1401D</b>	115V	●
	Double-Acting	Adv. / Hold / Retr.	Solenoid	<b>WER-1401F</b>	230V	●
	Single-Acting	Advance / Retract	Manual 3/2	<b>WES-1201B</b>	115V	
	Single-Acting	Advance / Retract	Manual 3/2	<b>WES-1201E</b>	230V	
	Single-Acting	Adv. / Hold / Retr.	Manual 3/3	<b>WES-1301B</b>	115V	
	Single-Acting	Adv. / Hold / Retr.	Manual 3/3	<b>WES-1301E</b>	230V	
	Double-Acting	Adv. / Hold / Retr.	Manual 4/3	<b>WES-1401B</b>	115V	
	Double-Acting	Adv. / Hold / Retr.	Manual 4/3	<b>WES-1401E</b>	230V	

Shown: WEM-1401B



Swing cylinders  
Work supports

Linear cylinders

Power sources

## WER series

Enerpac submerged motor pumps are available in a wide range of configurations to fit any requirement.

## Important

**WER series pumps use the VE-series valves shown on page 109. WER-13 series uses VEF-series valve. WER-14 series uses VEC-series valve.**

### CUSTOM BUILD YOUR SUBMERGED PUMP

If the Submerged Pump that would best fit your application cannot be found in the chart on page 92-93, you can easily build your custom submerged pump here.

▼ This is how a Submerged Pump Model Number is built up:



#### 1 Product Type

**W** = Workholding

#### 2 Motor Type

**E** = Electric Motor

#### 3 Pump Type

**D** = Dump  
**J** = Jog  
**M** = Manual  
**R** = Remote (Solenoid)  
**S** = Pressure Switch

#### 4 Pump Series

**1** = .5 hp, 10,000 psi

#### 5 Valve Type

**0** = Dump  
**2** = 3-way, 2-position, normally open  
**3** = 3-way, 3-position, tandem center  
**4** = 4-way, 3-position, tandem center  
**5** = Custom VE-series valve (WER only)  
See Example 2 below.

#### 6 Reservoir Size

**01** = 1.5 gallon

#### 7 Motor Voltage and Heat Exchanger

**B** = 115 V, 1 Ph, 50/60 Hz  
**D** = 115 V, 1 Ph, 50/60 Hz with Heat Exchanger  
**E** = 230 V, 1 Ph, 50/60 Hz  
**F** = 230 V, 1 Ph, 50/60 Hz with Heat Exchanger  
**I** = 230 V, 1 Ph, 60 Hz

\* To order WER models, for 60 Hz applications, replace the "E" suffix for "I".

#### Ordering Example 1

##### Model Number: WER-1301B

The WER-1301B is a .5 hp, 5,000 psi, submerged electric pump, with 1.5 gallon usable oil capacity, a 3-way, 3-position modular, remote solenoid valve (VEF-series) and a 115 V, 1 Phase, 50/60 Hz motor.

#### Ordering Example 2

##### Model Number: WER-1501B- VED15000D

The WER-1501B is a .5 hp, 5,000 psi, submerged electric pump, with 1.5 gallon usable oil capacity. The valve, model VED15000D is a 115 V, 60 Hz solenoid valve. (For details and options for all VE-series valves see page 109.)

Flow: .055-.250 in<sup>3</sup>/stroke

Pressure: 3000-10,000 psi

Reservoir: 6.2-55 in<sup>3</sup>

- E** Bombas manuales
- F** Pompes à main
- D** Handpumpen



## Options

### Fittings

138 ▶



### Hoses

136 ▶



### Hydraulic oil

137 ▶



## Important

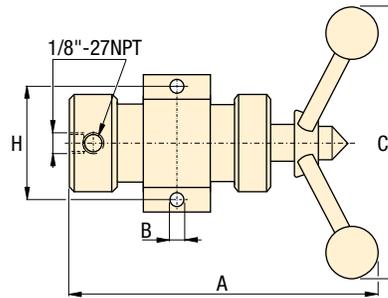
P-141, P-142 and P-202 are designed for a maximum operating pressure of 10,000 psi.

## Exclusively from Enerpac

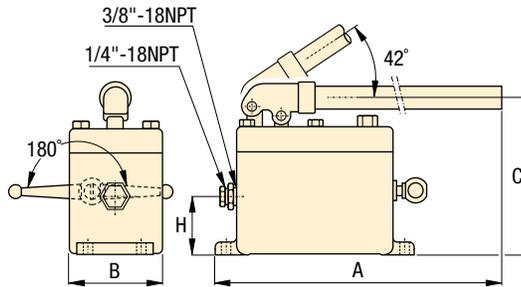
...to power single-acting cylinders

- Internal pressure relief valve (except SP-621) prevents over-pressurization
- Two speed operation reduces handle strokes by as much as 78% over single speed pumps
- Low handle effort minimizes operator fatigue
- Compact size – enables easy conversion of manual fixtures to hydraulic power

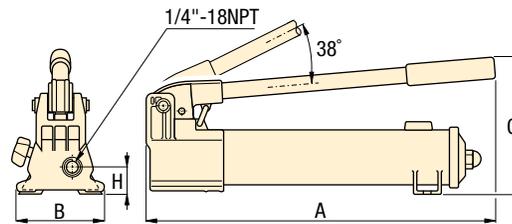
SP-621



P-51



P-141, -142, -202



Shown: SP-621, P-51, P-142



## P series

Single and two-speed hand operated pumps for operation of single-acting cylinders.

### SP-621 Screw pump

Single speed non-vented, internally sealed screw pump to operate single-acting cylinders. Can be mounted in any position and used to operate a single fixture. The piston is screwed into the pump, forcing the oil in the hydraulic system.

## Product selection

Maximum hydraulic pressure	Usable oil capacity	Model number	Pressure rating		Oil volume per stroke		Piston stroke	Max. handle effort	Dimensions in inches				
			psi	psi	in <sup>3</sup>	in <sup>3</sup>			A	B	C	H	lbs
<b>▼ Single speed</b>													
3000	6.2	SP-621	–	3000	–	<sup>1)</sup>	<sup>1)</sup>	60 <sup>2)</sup>	10.10	.41	12.40	2.81	7.0
3000	50	P-51	–	3000	–	.25	1.00	61	26.00	3.63	6.31	2.25	12.0
10,000	20	P-141	–	10,000	–	.055	.50	72	13.25	3.75	5.63	1.13	4.5
<b>▼ Two speed</b>													
10,000	20	P-142	200	10,000	.221	.055	.50	78	13.25	3.75	5.63	1.13	4.5
10,000	55	P-202	200	10,000	.221	.055	.50	63	20.06	3.75	5.69	1.13	7.5

<sup>1)</sup> Handle travel of SP-621 is 2.50 inches; 40 handle rotations displace 6.2 in<sup>3</sup> of oil.

<sup>2)</sup> Handle effort on SP-621 is 60 ft.lbs at 3000 psi.

# Air hydraulic boosters *Application & selection*

Shown: AHB-46, B-5003, B-3006



Swing cylinders  
Work supports

Linear cylinders

Power sources

## ▶ AHB and B series boosters

Large effective area of air piston allows compressed air to generate high output hydraulic pressure.

## For high production applications

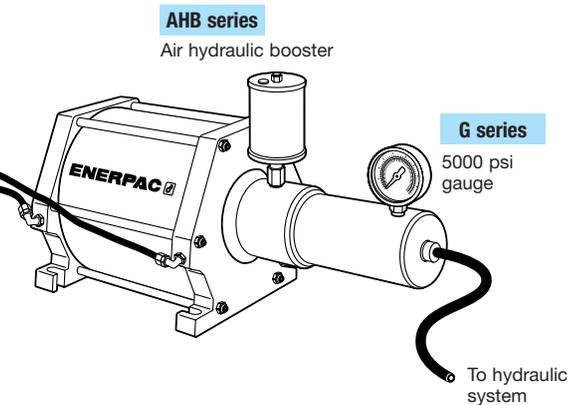
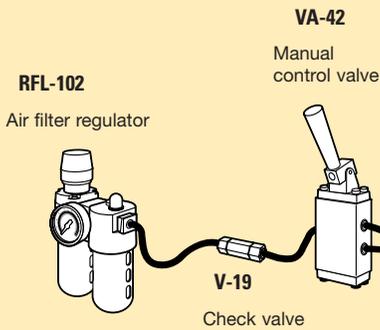
- High speed operation
- Extended service life
- Constant hydraulic output
- Large oil delivery per stroke allows quick filling of cylinders for clamping or punching

### AHB series Boosters

- Fiberglass wound air chamber eliminates possibility of rust due to moisture in air system
- Designed for fully automated production applications
- Double-acting, high speed operation of air piston

### B series Boosters

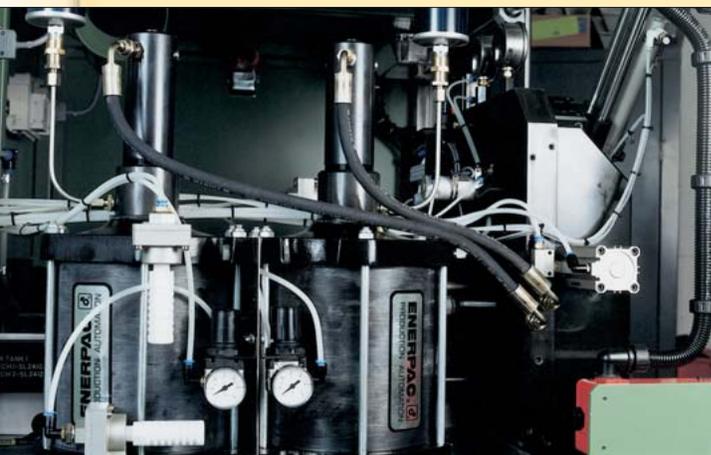
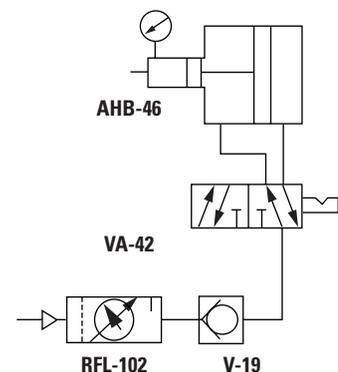
- One-shot spring return
- Aluminum construction
- Built-in stroke sensor for automatic cycle operation  
30 VDC switch closes 1" before end of full air piston stroke
- Internal self-bleeding  
Automatically purges air from system when booster piston is at highest point in circuit



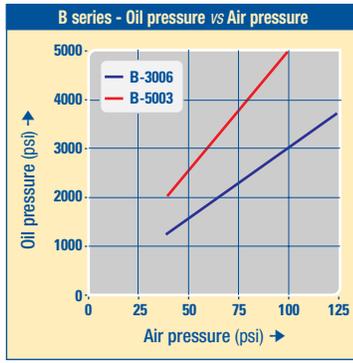
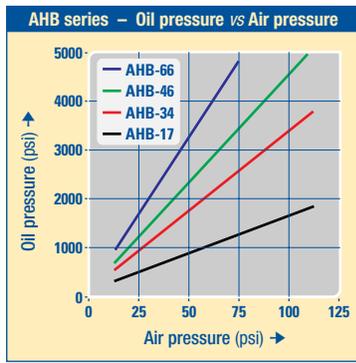
■ In an automated clamping set-up with both hydraulic and pneumatic components, AHB series boosters are used as a power source for the hydraulic system.

## **i** Hydraulic system schematics

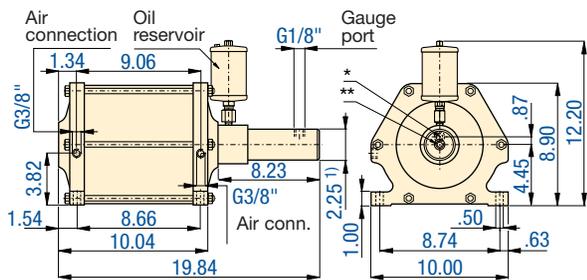
Complete power systems eliminates guesswork of selecting valves and other system components. Plug in your 15 to 115 psi shop air line and connect your hydraulic components for a total system.



98-010

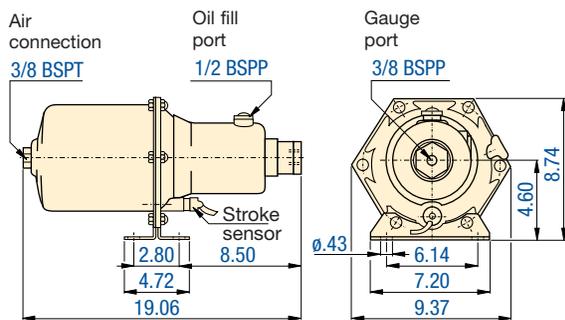


**AHB series**



- <sup>1)</sup> Ø 2.83" for model AHB-17
- \* Oil connection (G1/4") for model AHB-17
- \*\* Oil connection (G1/4") for model AHB-34, -46, -66
- \*\*\* Adapter to 3/8" NPT air connection is included.
- NOTE: FZ-2060 Adapter available for gauge port.

**B series**



**Product selection**

Oil pressure psi	Oil volume per stroke in <sup>3</sup>	Air to oil pressure ratio	Model number	Air	Air	Hydraulic piston diameter in	Hydraulic stroke in	Air operating pressure psi	🔧 lbs	
				consumption per cycle <sup>1)</sup> ft <sup>3</sup> at 85 psi air	piston diameter in					
<b>▼ AHB series</b>										
at 75 psi air pressure	at 100 psi air pressure									
1200	1600	18.0	1:16	AHB-17	2.2	8.00	2.00	5.71	15-115	41.4
2550	3400	8.5	1:34	AHB-34	2.2	8.00	1.38	5.71	15-115	37.2
3450	4600	6.1	1:46	AHB-46	2.2	8.00	1.18	5.71	15-115	36.1
4800	-	4.5	1:64	AHB-66	2.2	8.00	1.00	5.71	15-75	35.4
<b>▼ B series</b>										
2250	3000	6.2	1:30	B-3006	.95	7.10	1.22	5.20	40-125	31.0
3750	5000	3.7	1:50	B-5003	.95	7.10	.94	5.20	40-125	31.0

<sup>1)</sup> One cycle = advance + retract stroke.  
Note: Seal material: Buna-N, Polyurethane.

- Ratio: 1:16-1:64
- Pressure: 1600-5000 psi
- Oil flow: 3.7-18.0 in<sup>3</sup>/stroke
- Air: .95-2.2 scfm/cycle

- E** Multiplicadores
- F** Multiplicateurs
- D** Druckübersetzer



**Options**

**Air valves** [122](#)

**Regulator-filter-lubricator** [122](#)

**Fittings** [138](#)

**Important**

Boosters can provide high oil flow rates based on the volume of in-coming air. Do not exceed the flow rate requirements of the components being used.

For vertical mounting of booster, an elbow fitting is recommended for the oil reservoir.

Power sources

Valves

System components

Yellow pages

# Activator wand & booster

Shown: RA-1061, B81



Swing cylinders  
Work supports

Linear cylinders

Power sources

## B and RA series

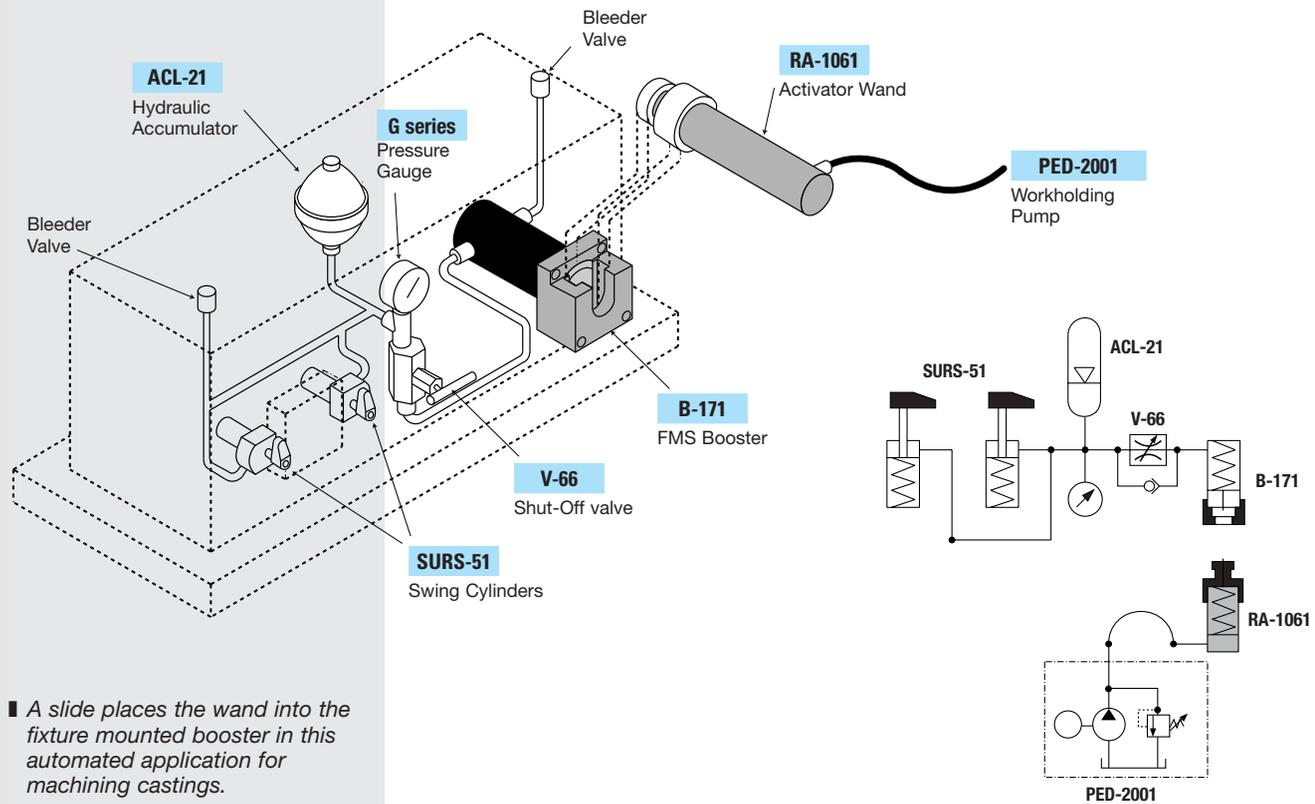
Mechanical energy transfer system uses external cylinder to operate receiver booster.

## Contamination resistant closed hydraulic system

- No-leak palletized system, eliminates oil loss at connection point
- Closed design prevents machining chips and coolant from entering the hydraulic circuit
- Booster can be mounted in either horizontal or vertical position for flexible fixture design

## Hydraulic system schematics

The Activator Wand RA-1061 is placed into the receiver booster B-81 or B-171. The mechanical transfer of force from the activator wand plunger to the booster piston provides oil flow to the system.

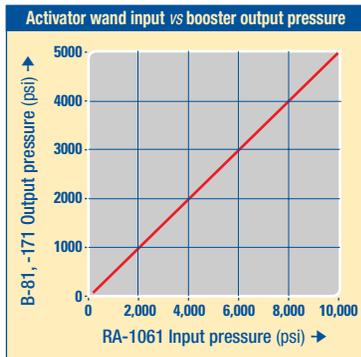


■ A slide places the wand into the fixture mounted booster in this automated application for machining castings.

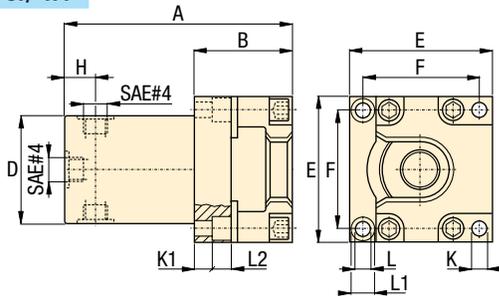


## Product selection

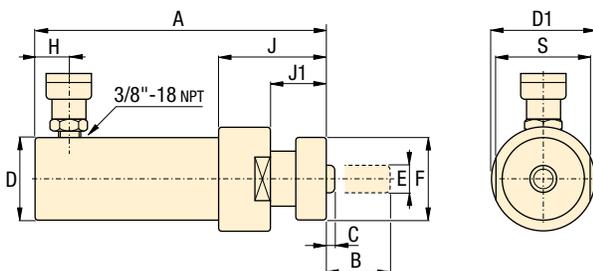
Pressure ratio	Oil flow ratio	Oil volume per stroke in <sup>3</sup>	Stroke in	Model number	Effective area in <sup>2</sup>	Operating pressure psi	lbs
<b>▼ Receiver booster</b>							
2:1	1.75:1	8.10	2.04	<b>B-81</b>	3.98	400-5000	12.7
2:1	1.75:1	17.10	4.30	<b>B-171</b>	3.98	400-5000	15.7
<b>▼ Activator wand</b>							
-	-	9.90	4.44	<b>RA-1061</b>	2.23	800-10,000	11.3



**B-81, -171**



**RA-1061**



**Product dimensions** in inches [ ]

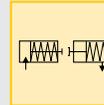
Model number	A	B	C	D	D1	E	F	H	J	J1	K	K1	L	L1	L2	S
▼ Receiving booster																
<b>B-81</b>	6.86	2.74	1.74	3.00	—	4.00	3.25	1.12	—	—	.41	2.26	.41	.62	.42	—
<b>B-171</b>	9.12	2.74	1.74	3.00	—	4.00	3.25	1.12	—	—	.41	2.26	.41	.62	.42	—
▼ Activator wand																
<b>RA-1061</b>	11.62	4.63	.19	2.25	3.00	.75	2.32	.75	3.02	1.53	—	—	—	—	—	2.75

Ratio: 2 : 1

Stroke: 2.04-4.44 in

Pressure: 400-5000 psi

- E** Multiplicadores
- F** Multiplicateur
- D** Betätigungszyylinder und Druckverstärker



**Options**

**Fittings**

138 ▶



**Hoses**

136 ▶



For 10,000 psi pumps, refer to the Enerpac Industrial Tools Catalog E324.



Existing fixtures with manual-connect single-acting circuits can be easily upgraded into the wand and booster.

**Important**

The activator wand has a 2 to 1 ratio of input pressure versus output pressure.

The booster output flow is 1.75 times the wand input flow.

# Oil/oil intensifiers

Shown: PID-401



Swing cylinders  
Work supports

Linear cylinders

Power sources

## ► PID series

When hydraulic pressure from an existing power source is limited, Enerpac oil-to-oil intensifiers serve to increase output pressure to satisfy the required application.

■ PID-Series intensifier utilizes low pressure machine hydraulics to power clamping cylinders.



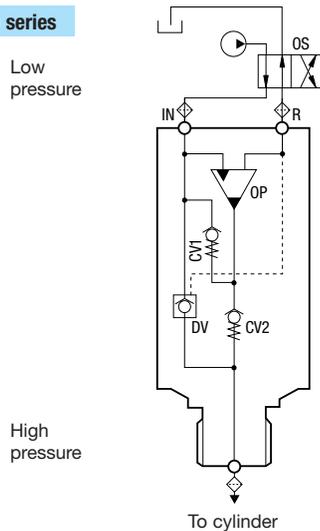
## High flow units intensify low inlet oil pressure to high outlet pressure

- Internal bypass valving enables high output flow rates
- Wide range of intensification ratios allows for adapting to various operating pressure requirements
- Compact and self-contained design allows for ease of installation
- Include dump valve eliminating the need for an external pilot check valve
- Select fit of all internal components provides long operating life

## 📘 Intensifier principle

- When oil is supplied to the inlet (IN) port it flows freely past the check valves (CV) and the dump valve to the cylinder and advances it.
- As the inlet pressure increases the oscillating pump (OP) automatically increases the outlet pressure by the chosen intensification.
- Once the maximum pressure is reached, the pump frequency lowers and balances at the maximum pressure.
- Free flow from the cylinder to tank occurs when the directional control valve is switched to supply the R-port.
- 10 micron filtration is required in the circuit to ensure trouble free operation (see options).

### PID series



## 🌐 Product selection

Max Pressure	Pressure intensification ratio	Maximum input flow	Maximum output flow	Model number	Inlet pressure range	
psi		in <sup>3</sup> /min	in <sup>3</sup> /min	with dump valve	psi	lbs
10,000	1 : 3.2	610	150	<b>PID-321</b>	300 - 1560	2.6
10,000	1 : 4.0	580	120	<b>PID-401</b>	300 - 1250	2.6
10,000	1 : 5.0	550	95	<b>PID-501</b>	300 - 1000	2.6
10,000	1 : 6.6	530	75	<b>PID-661</b>	300 - 750	2.6

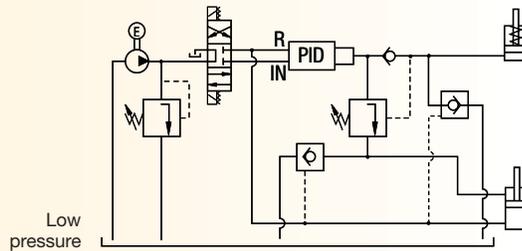
\* Operating pressures above 5000 psi require high pressure fittings or intensifier models with BSPP ports. Contact Enerpac for details.



**i System set-up information**

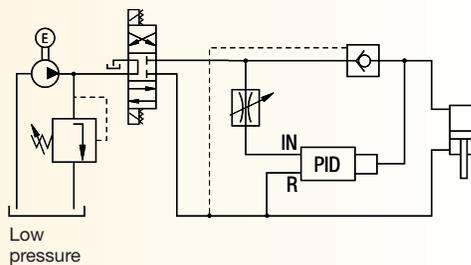
**With dump valve (PID models)**

The intensifier with the dump valve is used to achieve high pressure on the advance side of a double-acting cylinder.



**With external dump valve**

In a circulating system where the pump's oil flow is higher than the maximum inlet oil flow of the intensifier, an external check valve and flow control valve reduces the pump's oil flow.



This application can be set up when machines are equipped with low pressure hydraulics but the pressure to clamp the workpiece must be higher.

Ratio: 1:3.2-1:6.6

Flow: 75-150 in<sup>3</sup>/min

Pressure: 960-10,000 psi

- E** Multiplicadores
- F** Multiplicateurs
- D** Öl-Öl Druckübersetzer



**Options**

FL-series, High pressure filters



Directional valves



FZ-series Fittings



PID models with dump valve provide an economical means of relieving pressure from the system.

Can be panel mounted into machine (M24x1,5 thread).

**! Important**

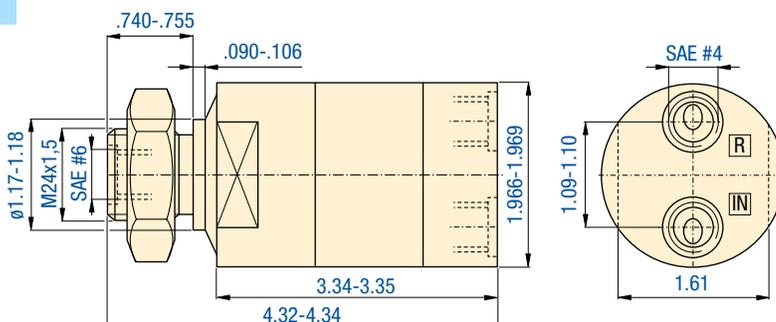
Do not exceed maximum allowable inlet pressure.

10 micron inlet filtration is essential to ensure trouble-free operation.

Applications above 5000 psi require high pressure fittings or intensifier models with BSPP ports. Contact Enerpac for details.

**A Product dimensions in inches [ ]**

PID series



# Valves

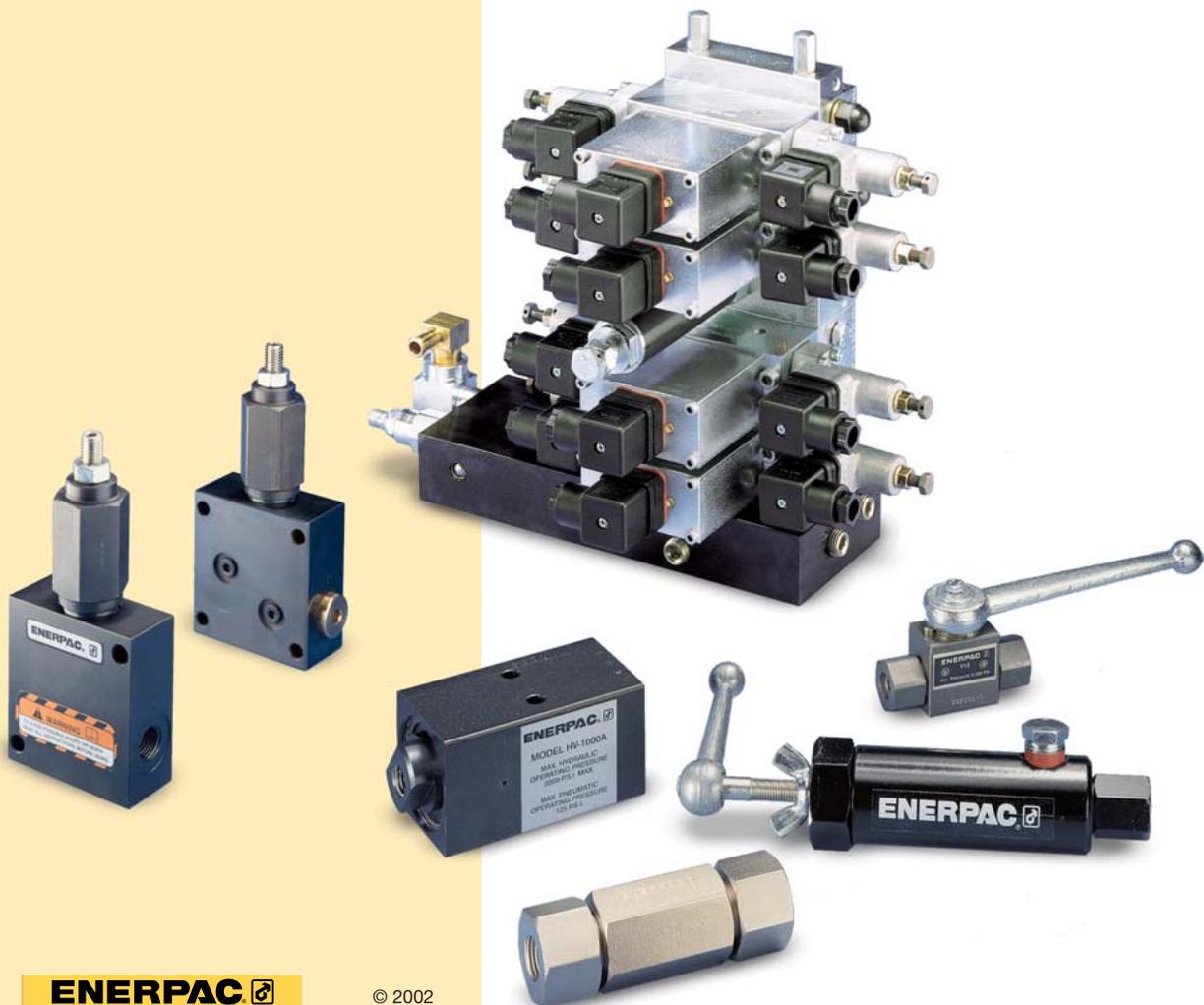
## Technical support

Refer to the “Yellow Pages” of this catalog for:

- Safety instructions
- Basic hydraulic information
- Advanced hydraulic technology
- FMS (Flexible Machining Systems) technology
- Conversion charts and hydraulic symbols

 141 ▶

Controlling the operation of your clamping system requires the use of many specialized directional, pressure and flow control valves. Enerpac has the complete line of valving components to complement any hydraulic system. Choose from either manual or electric directional valves, and a wide variety of pressure control, flow control and specialty valves to provide the control and automation that your application needs.



	▼ series	▼ page	
<b>Modular directional valves</b>	<b>VP</b>	<b>104</b>	
<b>Pressure switches, Flow control valve</b>	<b>PSCK VFC</b>	<b>105</b>	
<b>Solenoid valves, Inline check valve</b>	<b>VSS VST, PA</b>	<b>106</b>	
<b>4-Way manual control valves</b>	<b>VMM VMT</b>	<b>107</b>	
<b>Solenoid modular valves</b>	<b>VE</b>	<b>108 - 109</b>	
<b>3-Way directional manual control valves</b>	<b>V</b>	<b>110 - 111</b>	
<b>4-Way directional manual control valves</b>	<b>V</b>	<b>112 - 113</b>	
<b>Tie rod kits, Remote/porting manifolds</b>	<b>TRK WM/PB</b>	<b>114</b>	
<b>Valve manifolds</b>	<b>MB</b>	<b>115</b>	
<b>Sequence valves</b>	<b>MVP WVP, V</b>	<b>116</b>	
<b>Pilot operated check valves</b>	<b>MV, V</b>	<b>117</b>	
<b>Flow control valves</b>	<b>VFC</b>	<b>118</b>	
<b>Pressure reducing valves</b>	<b>PRV</b>	<b>119</b>	
<b>Accessory valves</b>	<b>MH, HV PLV, V</b>	<b>120 - 121</b>	
<b>Air valves and accessories</b>	<b>VA, VR RFL</b>	<b>122 - 123</b>	

Shown: VP-12

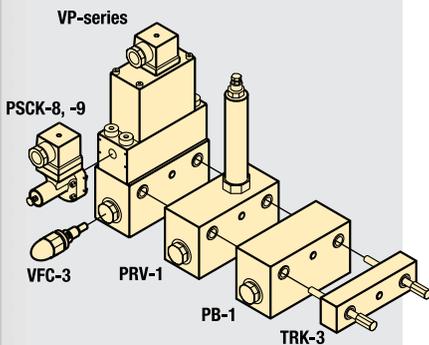


## VP-series

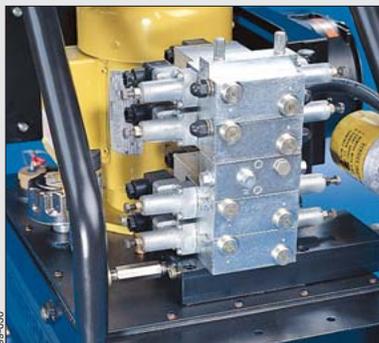
Solenoid directional valves control the direction of the oil flow to each cylinder port.

### Application

With the use of WMK-12 manifold these valves allow quick and easy assembly of hydraulic control valves on your Enerpac WE-series pump. For remote mounting of these valves use WM-10 manifold.



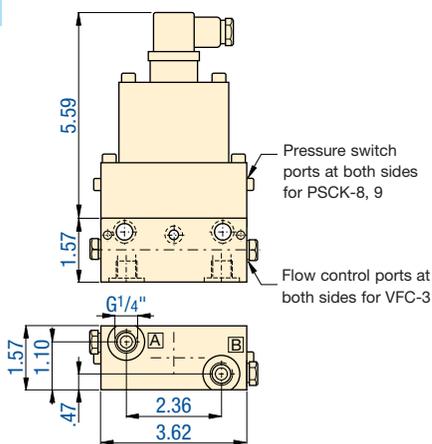
■ Enerpac VP-series valves stackbuilt on WMK-12 manifold, mounted on a WE-series workholding pump.



## Solenoid directional valves

- Dual poppet valve design for zero internal leakage
- Inlet check-valve standard
- High cycle switching
- Stackable to 8 valve stations high
- 250-5000 psi operational pressure
- Oil flow capacity 427 in<sup>3</sup>/min @ 5000 psi
- Oil flow capacity 915 in<sup>3</sup>/min @ 0 psi
- G<sup>1</sup>/<sub>4</sub>" oil connections and integrated filtration
- Multiple voltage options

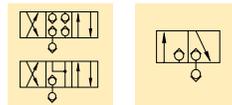
### VP series



Pressure: 5000 psi

Max. Flow: 915 in<sup>3</sup>/min

- (E) Válvulas de control
- (F) Electro distributeurs
- (D) Wegesitzventile



### Options

#### WMK-series Manifolds

115 ▶

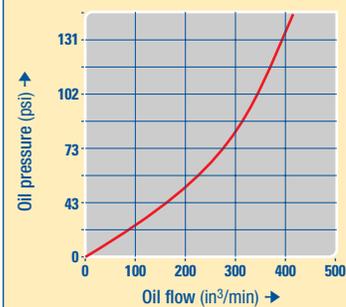


#### Tie Rod Kits

138 ▶



#### Oil flow vs pressure drop



## Product selection

Voltage @ current	Model number	Flow path	Used with cylinder(s)
at 50/60 Hz			
<b>▼ 4/3 Closed center</b>			
24 VDC @ 1.13 A	VP-11		1x Dbl-act. / 2x Sgl-act.
110 VAC @ 500 mA	VP-12		1x Dbl-act. / 2x Sgl-act.
230 VAC @ 250 mA	VP-13		1x Dbl-act. / 2x Sgl-act.
<b>▼ 4/3 Float center</b>			
24 VDC @ 1.13 A	VP-21		1x Dbl-act. / 2x Sgl-act.
110 VAC @ 500 mA	VP-22		1x Dbl-act. / 2x Sgl-act.
230 VAC @ 250 mA	VP-23		1x Dbl-act. / 2x Sgl-act.
<b>▼ 3/2 Normally closed</b>			
24 VDC @ 1.13 A	VP-31		1x Dbl-act. / 2x Sgl-act.
110 VAC @ 500 mA	VP-32		1x Dbl-act. / 2x Sgl-act.
230 VAC @ 250 mA	VP-33		1x Dbl-act. / 2x Sgl-act.
<b>▼ 3/2 Normally open</b>			
24 VDC @ 1.13 A	VP-41		1x Dbl-act. / 2x Sgl-act.
110 VAC @ 500 mA	VP-42		1x Dbl-act. / 2x Sgl-act.
230 VAC @ 250 mA	VP-43		1x Dbl-act. / 2x Sgl-act.
<b>▼ 3/2 1 port normally closed, 1 port normally open</b>			
24 VDC @ 1.13 A	VP-51		1x Dbl-act. / 2x Sgl-act.
110 VAC @ 500 mA	VP-52		1x Dbl-act. / 2x Sgl-act.
230 VAC @ 250 mA	VP-53		1x Dbl-act. / 2x Sgl-act.

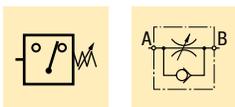
Note: DIN 43650 electrical connector included. Valve weight 6.5 lbs (3,0 kg.).

Pressure: 5000 psi

Flow: 427 in<sup>3</sup>/min @ 5000 psi

Voltage: 115/230 VAC, 24 VDC

- E** Presostatos
- F** Pressostats
- D** Druckschalter

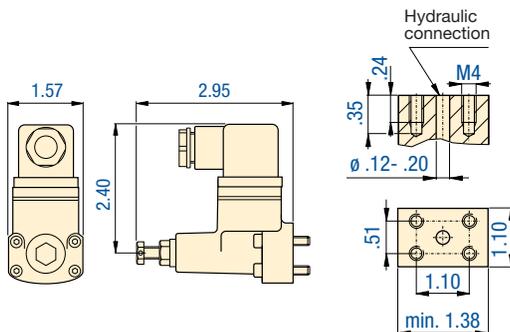


## To control your hydraulic system

- Mounts directly into VP-series modular valves
- In-line installation
- Cartridge type flow control valve and pressure switches can be manifold mounted for remote use
- Lockable adjustment screw on PSCK models

PSCK-8, 9

mounting dim.



Shown: PSCK-8, VFC-3



## Options

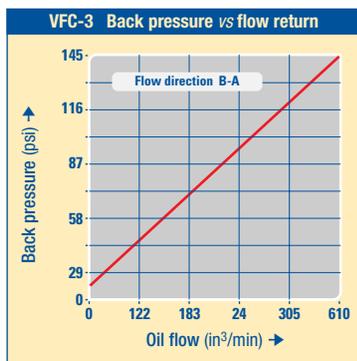
**PB-1 Auxiliary block**

114 ▶



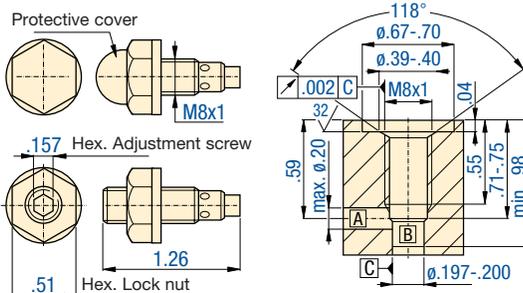
**Pressure reducing valves**

119 ▶



VFC-3

VFC-3 mounting dimensions



## PSCK-8, 9

Adjustable pressure switches will open or close electrical contacts when the desired pressure value is reached.

## Application

To open or close an electric circuit when a preset pressure value is reached. The electrical circuit is used to control further working cycles, such as actuating control valves or to terminate a working cycle. Directly mounted into Enerpac VP-series valves.

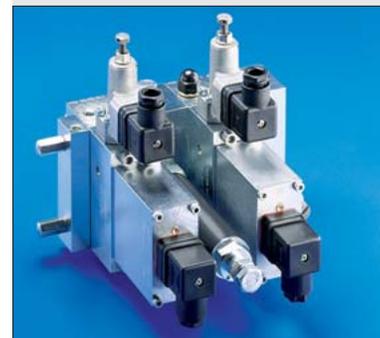
## VFC-3

Screw-in throttle type valve to control the amount of oil flow to the hydraulic cylinder.

## Application

Used to control cylinder speed in hydraulic circuits. Directly mounted into Enerpac VP-series valves or custom made manifolds for remote applications.

■ PSCK-8 and VFC-3 directly mounted on VP-valves.



## Product selection

Solenoid voltage @ current	Model number	Hydraulic scheme	Pressure range	Deadband	Maximum oil flow
at 50/60 Hz			psi	psi	in <sup>3</sup> /min
▼ Pressure switch					
24 VDC @ 2 A	PSCK-8		1450 - 5000	261 - 501	427
115 VAC @ 2 A					
230 VAC @ 2 A					
▼ Pressure switch					
24 VDC @ 2 A	PSCK-9		290 - 3045	87 - 218	427
115 VAC @ 2 A					
230 VAC @ 2 A					
▼ Flow control valve					
screw-in throttle valve	VFC-3		0-5000	-	427

Shown: VST-1401D, VSS-2210D



## VSS, VST-series

Solenoid directional control valves. Poppet design for zero leakage promote system efficiency. Increases the life of your workholding pump by decreasing internal valve leakage.

### Application

Advance and retract for single- and double-acting cylinders. The valves require check valves for positive load holding and can be installed for the same independent operation with single-acting cylinders by blocking the B port.

VSS-2210D mounted directly on Turbo II air pump for use on positive clamping fixture.



## Zero leakage poppet valves increase efficiency

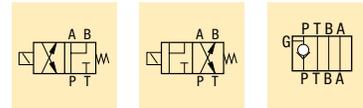
- Poppet valve design for zero leakage
- 4-way, 2-position float offset or normally open
- DO3 mounting pattern
- DIN-standard rectifier plugs for easy connection to power source
- Including O-rings and mounting bolts
- SAE manifold ports simplify plumbing
- Inline check valve provides positive load holding

Pressure: 0-5000 psi

Flow: 690 in<sup>3</sup>/min max.

Voltage: 115 VAC, 24 VDC

- (E) Electroválvulas
- (F) Electro distributeurs
- (D) Elektromagnetische Ventile



## Options

DO3 Manifolds MB-series

109 ▶



Fittings

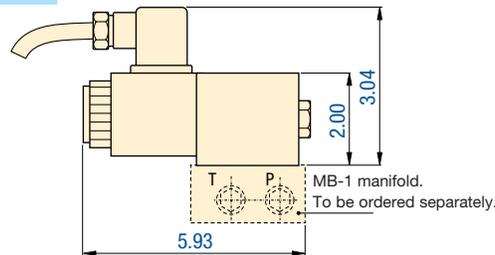
132 ▶



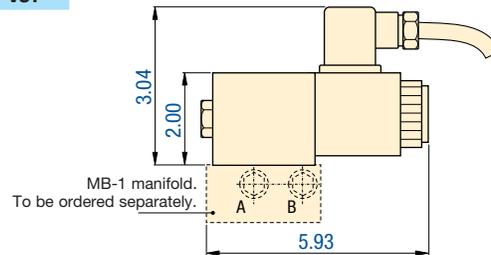
## Important

For multiple circuit applications, where some valves are de-energized while others stay energized, the VD1P inline check valve is recommended to prevent pressure drop on the holding circuit.

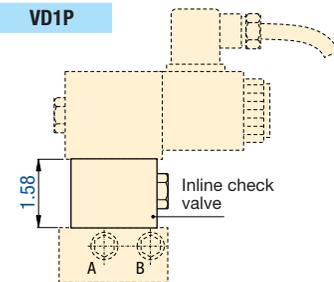
### VSS



### VST



### VD1P



## Product selection

Valve flow path	Solenoid voltage @ current	Model number	Hydr. symbol	Pressure range	Pressure drop <sup>1)</sup>	Max. oil flow
	at 50/60 Hz			psi	psi	in <sup>3</sup> /min
<b>▼ Solenoid poppet valves – Normally open</b>						
4-way, 2 position	24VDC @ .60 A	VSS-1410D		0-5000	180	690
4-way, 2 position	115VAC @ .40 A	VSS-2210D		0-5000	180	690
<b>▼ Solenoid poppet valves – Normally closed</b>						
4-way, 2 position	24VDC @ .60 A	VST-1410D		0-5000	180	690
4-way, 2 position	115VAC @ .40 A	VST-2210D		0-5000	180	690
<b>▼ Inline check valve</b>						
-	-	VD1P		0-5000	0	690

<sup>1)</sup> Pressure drop from P-A or P-B at maximum oil flow of 690 in<sup>3</sup>/min.

Pressure: 0-5000 psi

Flow: 1040 in<sup>3</sup>/min

- E** Válvulas de control de 4 vias
- F** Distributeurs à 4 voies
- D** 4-Wege-Ventile



## Manual control of single and double-acting cylinders

- Near zero leakage pressure seal design
- 4-way, 3-position float center
- Detented handle positions
- Low handle effort 12 lbs, even at full pressure
- Handle can be repositioned for side by side valve mounting
- Compact size for directly mounting on fixture for individual circuit control

## Options

VD1P, Inline check valve

106

DO3 Manifolds

115

Hoses and couplers

136

Fittings

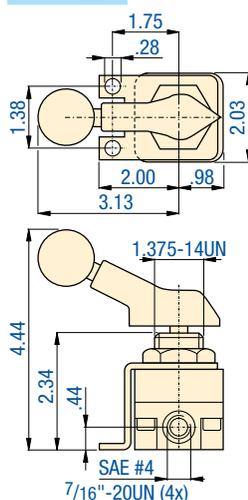
138

## Important

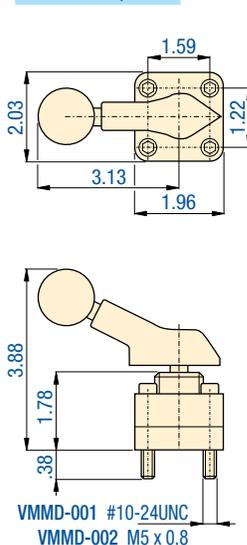
For multiple circuit applications, where some valves are de-energized while others stay energized, the VD1P inline check valve is recommended to prevent pressure drop on the holding circuit.

Pressure on return side (tank) should not exceed 250 psi.

VMTD-001



VMMD-001, -002



## Product selection

Valve mounting pattern	Mounting bolts included	Oil ports	Model number	Hydr. symbol	Pressure range	Pressure drop <sup>1)</sup>	Max. oil flow
					psi	psi	in <sup>3</sup> /min
<b>▼ 4-way, 3-position control valves – Float Center</b>							
Panel mtg.	-	SAE #4	VMTD-001		0-5000	70	1040
DO3	#10-24un	-	VMMD-001		0-5000	70	1040
Cetop 03	M5 x 0,8	-	VMMD-002		0-5000	70	1040

<sup>1)</sup> Pressure drop from P-A or P-B at maximum oil flow of 1040 in<sup>3</sup>/min.

Seal material: Buna-N, Polyurethane.

www.enerpac.com

Shown: VMMD-001, VMTD-001



## VMM and VMT-series

Manual directional control valves for single- and double-acting cylinder control. Lapped pressure seal surface provide near zero leakage.

The VMTD-001 has threaded port connections and removable holding bracket for panel mounting.

## Application

Panel mounting on fixtures for control of individual circuits. The blocked pressure port in the center position allows demand style pumps to stall out, saving energy. The A and B ports drain to tank to allow downstream hoses to be disconnected from palletized fixtures.

The valves require check valves for positive load holding

Several VMTD-001 valves mounted on fixture waiting to be transferred to machine.



# Solenoid modular valves *Application & selection*

Shown: VEC-15600D, VEC-15000B, VEK-15000B



## VE-series

Solenoid modular valves are especially well suited for workholding and production applications. With 11 possible flowpaths and 2 manifolds, for either Enerpac's Submerged pump or a remote NPT mount, you can "custom build" a valve for almost any application.

### Application

Ideal when mounted on remote manifold for applications where independent control of multiple cylinders is required.

## Unmatched combination of possibilities

- Shear seal design minimizes internal leakage
- Relief valve and pilot-operated check accessory valves are stackable eliminating external plumbing
- Remote and pump mounting
- Mounting bolts included with each modular valve

## Select the required valve flow path

Valve flow path	For cylinder	Valve code	Hydraulic symbol
<b>▼ 2-way, 2-position (2/2)</b>			
Normally closed	Unloading *	<b>VEH</b>	
Normally open	Unloading *	<b>VEK</b>	
<b>▼ 3-way, 2-position (3/2)</b>			
Normally open	Single-acting	<b>VEP</b>	
<b>▼ 3-way, 3-position (3/3)</b>			
Tandem center	Single-acting	<b>VEF</b>	
Closed center	Single-acting	<b>VEG</b>	
<b>▼ 4-way, 2-position (4/2)</b>			
Crossover offset	Double-acting	<b>VEE</b>	
Float offset	Double-acting	<b>VEM</b>	
<b>▼ 4-way, 3-position (4/3)</b>			
Open center	Double-acting	<b>VEA</b>	
Closed center	Double-acting	<b>VEB</b>	
Tandem center	Double-acting	<b>VEC</b>	
Float center	Double-acting	<b>VED</b>	

\* VEH and VEK valve models require the use of tank port for dump or unloading.

## Product specifications

Pressure range	Maximum oil flow	Voltage @ Hz	Amperage draw	
			Amps	
psi	in <sup>3</sup> /min		inrush	holding
0-10,000	920	24 VDC @ 50/60 Hz	-	2.5
0-10,000	920	115 VAC @ 60 Hz	3.6	1.0
0-10,000	920	220/240 VAC @ 50 Hz	1.3/1.4	.45/.53
0-10,000	920	230 VAC @ 60 Hz	1.8	.50 A

Note: Seal material: Buna-N, Polyurethane.  
DIN43650 Valve plug included on remote mounted valves.

**Custom build your modular valves**

▼ This is how a Solenoid Modular Valve Model Number is built up:



**1 Modular valve code**

- A = 4/3 Open center
- B = 4/3 Closed center
- C = 4/3 Tandem center
- D = 4/3 Float center
- E = 4/2 Crossover offset
- F = 3/3 Tandem center
- G = 3/3 Closed center
- H = 2/2 Normally closed
- K = 2/2 Normally open
- M = 4/2 Float offset
- P = 3/2 Normally open

**2 Oil flow capacity**

- 1 = 920 in<sup>3</sup> per minute

**3 Solenoid voltage**

- 1 = 24 VDC, 50 / 60 Hz
- 2 = 230 V, 1 ph, 50 Hz
- 5 = 115 V, 1 ph, 60 Hz
- 6 = 230 V, 1 ph, 60 Hz

**4 Accessory valves**

- 000 = No accessory valves
- 100 = VS-11 Relief valve only
- 150 = VS-11 Relief valve and VS-51 3-way pilot operated check valve VEF/VEG only
- 160 = VS-11 Relief valve and VS-61 4-way pilot operated check valve VEA/VEB/VEC/VED only
- 500 = VS-51 3-way pilot operated check valve VEF/VEG only
- 600 = VS-61 4-way pilot operated check valve VEA/VEB/VEC/VED only

**5 Manifold**

- A = No manifold
- B = Remote mounted manifold
- D = Pump mounted manifold VEA/VEC/VEF only

**Example**

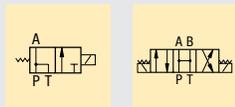
The **VEA-15600-D** is a modular valve with a 4-way, 3-position open center flowpath, 115 VAC, and an integrated pilot-operated check valve, for mounting on an Enerpac pump. Bolt Kit **BK-2** is included.

Pressure: 0-10,000 psi

Flow max.: 920 in<sup>3</sup>/min

Voltage: 24, 115, 230 V

- E Válvulas de control
- F Electro distributeurs
- D Wegesitzventile



**Options**

**Gauges and accessories**  [134](#)

**Fittings**  [138](#)

**Accessory Valves and Bolt Kits**

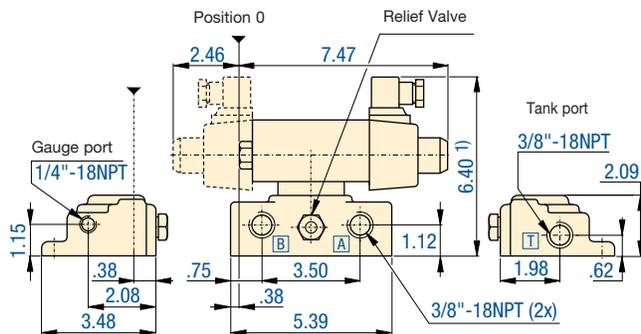
Use **VS-11** relief valve to add system pressure control to VE-series valves.

Use **VS-51** 3-way pilot operated check valve to convert 3-way VE-valve into load-holding valve.

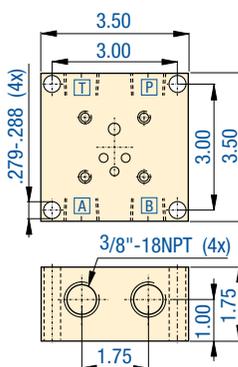
Use **VS-61** 4-way pilot operated check valve to convert 4-way VE-valve into load-holding valve.

To install accessory valves to stack build modular valves use bolt kits: **BK-2** for 1 VS valve; **BK-3** for 2 VS valves.

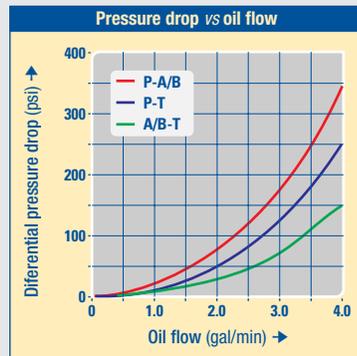
**VE series Modular Valve Pump Mounted**



**Modular Valve Remote Mounted**



<sup>1)</sup> add 1.85 inch for each Accessory Valve.  
Note: BK-1 Bolt Kit is included with each modular valve.



# 3-way directional manual control valves *Application & selection*

Shown: VM-2, VM-3



## V-series

Manual operated 3-way, 2-position and 3-way, 3-position directional control valves for operation of single-acting cylinders. Remote mount valves include return line kit for connecting the valves to pump reservoir.

### Application

Pump mounted valves provide centralized control of pump output for cylinder cycling. Remote mounted at any convenient point along the system where control of cylinders is needed.

Four VC-15 Enerpac manual valves mounted on fixture to give independent control of several hydraulic circuits.



## Reliable control of single-acting cylinders

- Directional control valves provide advance/hold/retract operation for use with single-acting cylinders
- Remote or pump mounting on most Enerpac pumps
- Return line kit included with remote valves
- Available "locking" option on VC and VM-series valves for load-holding applications

## Select the required center position

### Non-locking

- Use in simple clamping circuits. Has interflow between ports when shifted.

### Closed center

- For multiple valve and cylinder operation. All ports blocked in the center position.

### Locking center

- For positive load holding without loss of pressure. Cylinder travel can only resume by shifting valve from hold position.

### Tandem center

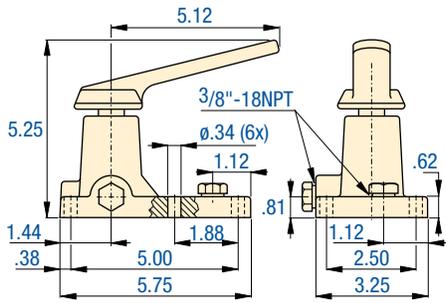
- For one or multiple cylinder operation. Pump flow is directed back to tank in the center position.

## Product selection

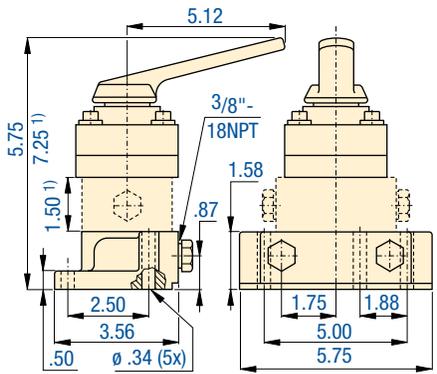
Valve type	Valve mounting location	Model number	Hydraulic symbol
<b>▼ Manual 3-way, 2-position (3/2)</b>			
-	Pump	VM-2	
<b>▼ Manual 3-way, 3-position (3/3)</b>			
Tandem center	Pump	VM-3	
Tandem center	Remote	VC-3	
<b>▼ Manual 3-way, 3-position (3/3)</b>			
Tandem center, locking	Pump	VM-3L	
Tandem center, locking	Remote	VC-3L	
Closed center	Remote	VC-15	
Closed center, locking	Remote	VC-15L	



**VM-2**

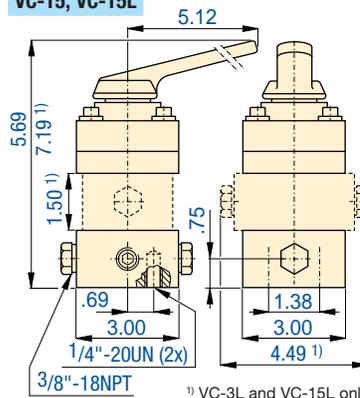


**VM-3, VM-3L**



<sup>1)</sup> VM-3L only

**VC-3, VC-3L  
VC-15, VC-15L**



<sup>1)</sup> VC-3L and VC-15L only

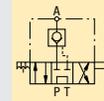
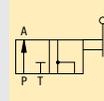
**Product specifications**

Model number	Pressure range	Used for cylinder	Schematic flowpath			lbs
			Advance	Hold	Retract	
<b>▼ Manual 3-way, 2-position (3/2)</b>						
VM-2	0-10,000	Single-acting		-		4.8
<b>▼ Manual 3-way, 3-position (3/3)</b>						
VM-3	0-10,000	Single-acting				4.6
VC-3	0-10,000	Single-acting				6.4
<b>▼ Manual 3-way, 3-position (3/3)</b>						
VM-3L	0-10,000	Single-acting				8.6
VC-3L	0-10,000	Single-acting				10.3
VC-15	0-10,000	Single-acting				6.4
VC-15L	0-10,000	Single-acting				10.3

Pressure: 0-10,000 psi

Flow max.: 1040 in<sup>3</sup>/min

- E** Válvulas de control
- F** Distributeurs à 3 voies
- D** 3-Wege-Ventile



**Options**

Gauges and accessories



134 ▶

Hoses and couplers



136 ▶

Fittings



138 ▶

**Important**

**Locking Valves**

For applications that require positive load holding, most VM and VC valves are available with pilot operated check valve. This option provides hydraulic locking of the load until valve is shifted into retract position. To order this feature, place an "L" at the end of the model number.

**Valving help**

See Basic System Set-up and Valve information in our "Yellow Pages".

164 ▶

# 4-way directional manual control valves *Application & selection*

Shown: VC-20, VM-4



Swing cylinders  
Work supports

Linear cylinders

Power sources

Valves

## V-series

Manual operated 4-way, 3-position directional control valves for operation of double-acting or two single-acting cylinders. Remote mount valves include return line kit for connecting the valves to pump reservoir.

### Application

Pump mounted valves provide centralized control of pump output for cylinder cycling. Remote mounted at any convenient point along the system where control of cylinders is needed.

## Reliable control of double-acting cylinders

- Directional control valves provide advance/hold/retract operation for use with double-acting or two single-acting cylinders
- Remote or pump mounting on most Enerpac pumps
- Return line kit included with remote valves
- Available "locking" option on VC and VM-series valves for load-holding applications

## Select the required center position

### Non-locking

- Use in simple clamping circuits. Has interflow between ports when shifted.

### Closed center

- For multiple valve and cylinder operation. All ports blocked in the center position.

### Locking center

- For positive load holding without loss of pressure. Cylinder travel can only resume by shifting valve from hold position.

### Tandem center

- For one or multiple cylinder operation. Pump flow is directed back to tank in the center position.

■ Enerpac VC-4 manual valves mounted to control hydraulic circuit on pallet fixture.



## Product selection

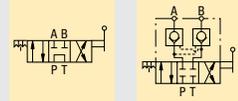
Valve type	Valve mounting location	Model number	Hydraulic symbol
<b>▼ Manual 4-way, 3-position (4/3)</b>			
Tandem center	Pump	<b>VM-4</b>	
Tandem center	Remote	<b>VC-4</b>	
Tandem center, locking	Pump	<b>VM-4L</b>	
Tandem center, locking	Remote	<b>VC-4L</b>	
Closed center	Remote	<b>VC-20</b>	
Closed center, locking	Remote	<b>VC-20L</b>	



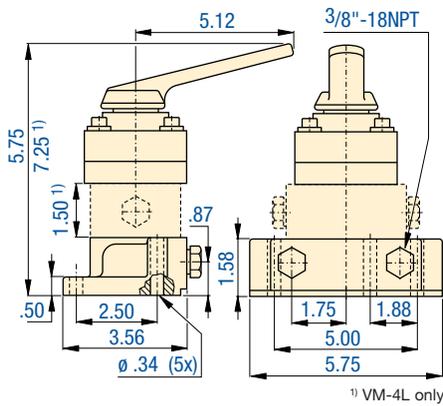
Pressure: 0-10,000 psi

Flow max.: 1040 in<sup>3</sup>/min

- E** Válvulas de control
- F** Distributeurs à 4 voies
- D** 4-Wege-Ventile

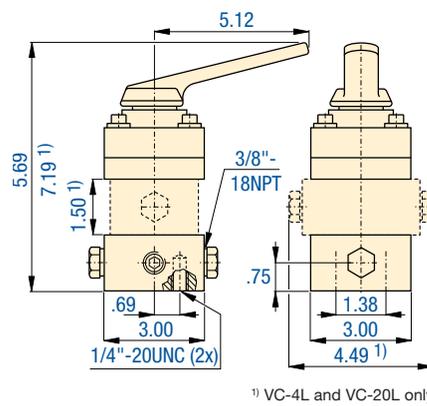


VM-4, VM-4L



<sup>1)</sup> VM-4L only

VC-4, VC-4L  
VC-20, VC-20L



<sup>1)</sup> VC-4L and VC-20L only

**Product specifications**

Model number	Pressure range	Used for cylinder	Schematic flowpath			lbs
			Advance	Hold	Retract	
	psi					
<b>▼ Manual 4-way, 3-position (4/3)</b>						
VM-4	0-10,000	Double-acting				4.6
VC-4	0-10,000	Double-acting				6.4
VM-4L	0-10,000	Double-acting				8.6
VC-4L	0-10,000	Double-acting				10.3
VC-20	0-10,000	Double-acting				6.4
VC-20L	0-10,000	Double-acting				10.3

**Options**

**Gauges and accessories**  [134 ▶](#)

**Hoses and couplers**  [136 ▶](#)

**Fittings**  [138 ▶](#)

**Important**

**Locking Valves**  
For applications that require positive load holding, most VM and VC valves are available with pilot operated check valve. This option provides hydraulic locking of the load until valve is shifted into retract position. To order this feature, place an "L" at the end of the model number.

**Valving help**  
See Basic System Set-up and Valve information in our "Yellow Pages". [164 ▶](#)

Shown: WM-10, TRK-4, PB-1



### TRK-series

Tie Rod Kits mount Enerpac VP-series modular valves to the WMK-12 or WM-10 manifold and can accommodate one to eight VP-valve stations.

### WM-10

Remote manifold allows mounting of VP-series modular valves to a remote location from the pumping unit. This manifold has a built-in adjustable relief valve.

### PB-1

Porting manifold provides three pressure ports for auxiliary lines or accessories, such as a pressure gauge. Mounts between VP-series modular valve stations using TRK-series tie rod kits.

Tie rods mount VP-series valves and accessories to manifold, providing leak-free sealing.



## Simplifies valve and accessory mounting

### TRK-series Tie Rods

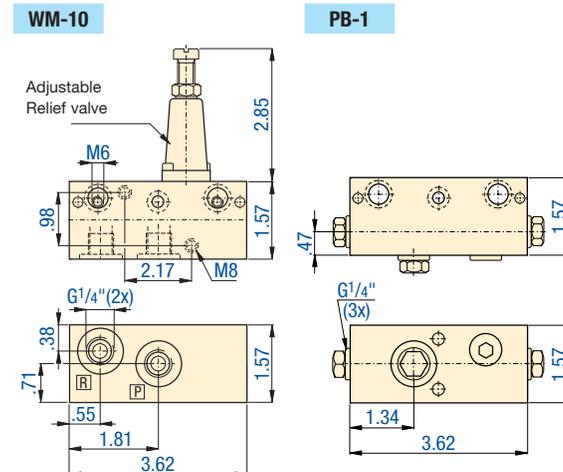
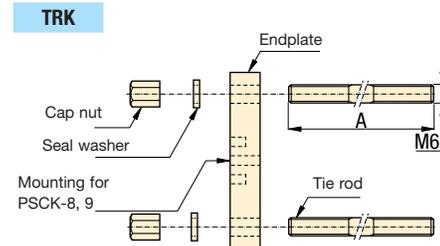
- Connects 1 to 8 VP-series valves station high
- Provide leak-free sealing valves
- G1/4" oil connection

### WM-10 Remote manifold

- Allows remote VP-series valve mounting
- Adjustable relief valve incorporated
- G1/4" oil connection

### PB-1 Porting Manifold

- Provide 3 auxiliary pressure lines
- G1/4" oil connection

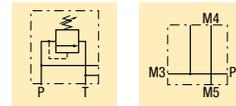


Mounting: 1-8 VP valve stations

Pressure: 5000 psi max.

Flow: 915 in<sup>3</sup>/min

- (E) Pernos de montaje de válv.
- (F) Vis de montaje de distrib.
- (D) Zugstangen



## Options

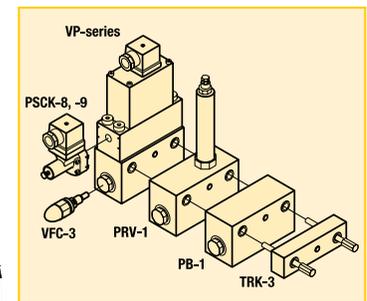
### WMK-12 Manifold

83 ▶



### VP-series directional valves

104 ▶



## Product selection

Quantity of stackable VP-series directional valves	Model number	Tie rod length	Mounting thread
		A	
		inch	mm
▼ Tie rod kits			
1	TRK-1	3.45	M6
2	TRK-2	4.92	M6
3	TRK-3	6.50	M6
4	TRK-4	8.07	M6
5	TRK-5	9.65	M6
6	TRK-6	11.22	M6
7	TRK-7	12.80	M6
8	TRK-8	14.37	M6

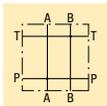
## Product selection

Oil ports	Model number	Hydr. scheme	Maximum pressure
BSPP			psi
▼ Remote manifold with pressure relief			
2x G1/4"	WM-10		5000
▼ Porting manifold (P port connection)			
3x G1/4"	PB-1		5000

Mounting: 1-6 DO3 type valves

Pressure: 5000 psi max.

- E** Colectores
- F** Manifolds
- D** Verkettungsblöcke



## When independent control of multiple cylinders is required

- Multi-station manifolds with SAE porting – minimizes plumbing
- Mounting pattern for DO3 valves and Enerpac VSS and VST Positive Seal Control Valves
- Manifolds allow use of accessories, such as pressure switches and gauges

Shown: MB-4, MB-1



## Options

VSS, VST-series valves

106 ▶



Pressure switches

132 ▶



Gauges

134 ▶



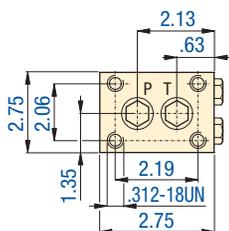
Fittings

138 ▶

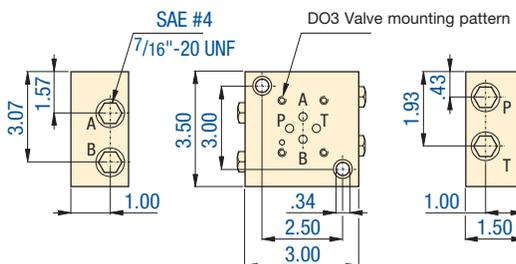


## Important

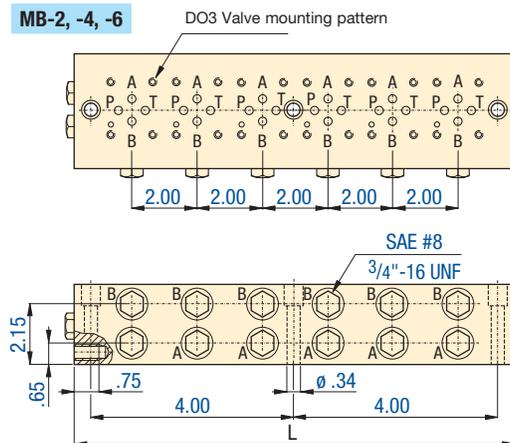
Use MC-1 cover plates to seal non-used manifold stations.



MB-1



MB-2, -4, -6



## MB-series

Single or multiple station manifolds allow installation of VSS and VST-series positive seal control valves or other DO3 valves. Ideal in applications where independent control of multiple cylinders is required.

Each non-used valve station on manifolds must be sealed with MC-1 cover plate.

## Product selection

Valve mounting pattern	Amount of valve stations	Model number	Oil ports cover plate	Optional length model number *	Manifold	
					L	
					inch	lbs
<b>▼ Single station manifold</b>						
DO3, Enerpac VSS, VST valves	1	<b>MB-1</b>	SAE #4	-	-	1.0
<b>▼ Multiple station manifolds</b>						
DO3, Enerpac VSS, VST valves	2	<b>MB-2</b>	SAE #8	MC-1	4.75	3.3
DO3, Enerpac VSS, VST valves	4	<b>MB-4</b>	SAE #8	MC-1	8.75	6.1
DO3, Enerpac VSS, VST valves	6	<b>MB-6</b>	SAE #8	MC-1	12.75	9.5

\* Note: MC-1 manifold cover plate must be ordered separately. Includes gasket and mounting bolts.



Shown: WVP-5, MVPM-5



## Sequence valves

Sequence valves block the oil to a secondary hydraulic circuit until pressure in the primary circuit reaches a preset level. The sequence valves have a built-in check system to allow the oil to flow back without external piping.

Pressure settings for the V-2000 can be adjusted by screwing the slotted pin in or out. The pressure settings for the other models is adjusted by loosening the jam nut and turn the set screw to reach your setting.

## Application

The sequence valves can be mounted in-line or fixture mounted using mounting bolts.

A typical application for the sequence valve would be to build pressure within work supports before the swing cylinders are applied to the supported part, to prevent deflection in the part.

■ Two WVP-5 sequence valves used in conjunction with Enerpac WCA-series Auto Coupler to provide system automation.



Swing cylinders  
Work supports

Linear cylinders

Power sources

Valves

## Pressure dependent sequence control

### MVPM-5, WVP-5

- Direct accurate pressure setting
- Pressure setting between 500-5000 psi for secondary circuit is secured with lock nut
- Mounting holes on WVP-5, manifold mounting ports on MVPM-5

### V-2000

- Direct accurate pressure setting
- Pressure setting between 200-2000 psi for secondary circuit
- Flag indicator appears everytime the valve is operated

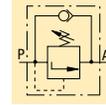
Pressure: 5000 psi max.

Flow: 250 - 366 in<sup>3</sup>/min max.

Ⓔ Válvulas de secuencia

Ⓕ Valve de séquence

Ⓓ Folgeventil



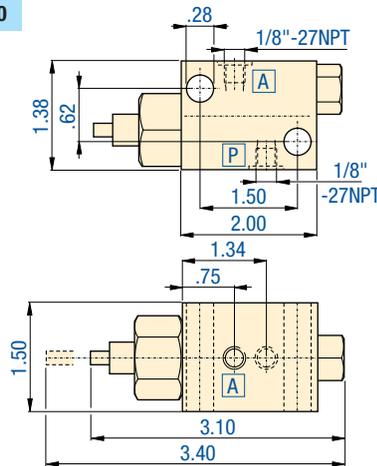
## Options

### Gauges

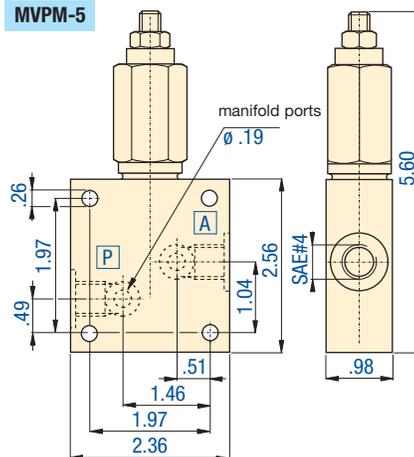
134 ▶



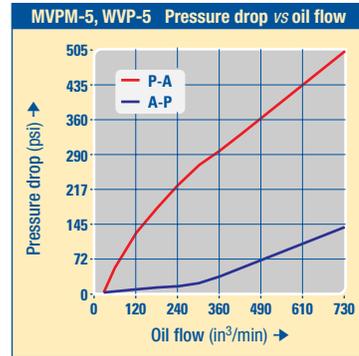
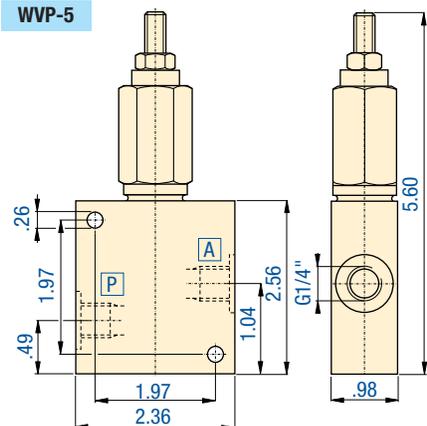
### V-2000



### MVPM-5



### WVP-5



## Product selection

Pressure adjustment range	Maximum pressure	Maximum oil flow	Model number	Oil ports	Opening pressure check valve
psi	psi	in <sup>3</sup> /min			psi lbs
200-2000	5000	250	V-2000	1/8"-27npt	- 2.0
500-5000	5000	366	MVPM-5	G 1/4"	20 2.9
500-5000	5000	366	WVP-5	SAE #4	20 1.8

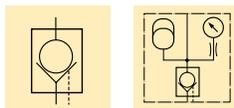
Seal material: Buna-N.

Manifold O-rings included with MVPM-5. For manifold mounting installation information consult Enerpac for surface preparation.

**Pilot ratio: 7:1**

**Flow: 10 GPM max.**

- E** Válvulas antiretorno pilotada
- F** Clapets antiretour piloté
- D** Rückschlagventile



## To hold cylinder load and ensure remote unlocking

- Fast check-off response
- Hardened seats ensure long life and positive pressure holding
- Built-in accumulator to maintain system pressure
- Mounting holes
- Manifold mount body MVM-72

## Options

### Fittings

138 ▶

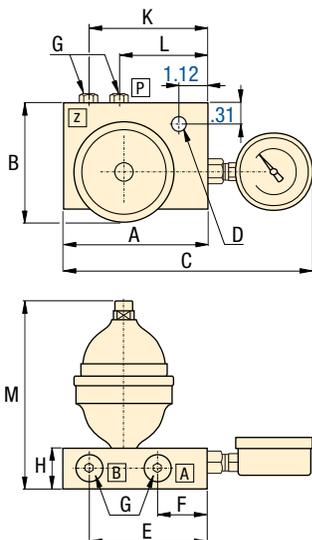


## Product selection

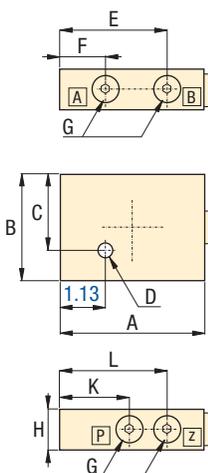
Pilot ratio	Accumulator included	Maximum oil flow	Maximum pressure	Model number	Oil ports	Optional charging tool for ACL	
		GPM	psi				lbs
7 : 1	-	10	5000	<b>V-72</b>	SAE #4	-	4.0
7 : 1	ACL-22	10	5000	<b>MV-722A</b>	G 1/4"	WAT-2	6.0
7 : 1	ACL-202	10	5000	<b>MV-7202A</b>	G 1/4"	WAT-2	7.5
7 : 1	-	10	5000	<b>MVM-72</b>	G 1/4"	-	3.0

For more information on ACL-series Accumulators see page 130.

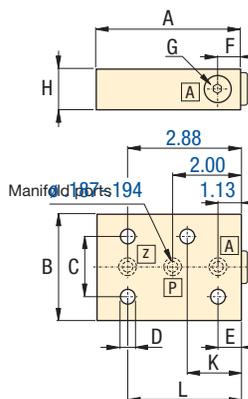
### MV-722A, -7202A



### V-72



### MVM-72



## Product dimensions in inches [±0.004]

Model number	A	B	C	D	E	F	G	H	K	L	M
<b>V-72</b>	3.50	2.50	2.19	.28	2.88	1.13	SAE #4	1.25	2.00	2.88	-
<b>MV-722A</b>	3.50	2.80	7.25	.28	2.88	1.12	G1/4"	1.25	2.88	2.00	5.16
<b>MV-7202A</b>	3.50	3.64	7.13	.28	2.88	1.12	G1/4"	1.25	2.88	2.00	6.73
<b>MVM-72</b>	3.50	2.50	1.50	.28	1.13	1.12	G1/4"	1.25	1.75	2.00	-

Seal material: Buna-N.  
Manifold O-rings included with MVM-72. For manifold mounting installation information consult Enerpac for surface preparation.

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## MV and V-series

Pilot operated check valves check the oil flow with a built-in pilot circuit providing fast, automatic check-off for your workholding applications. The pilot operated check valves with built-in accumulator help to maintain system pressure due to minor oil loss.

## Application

Added capability to open with pilot pressure to allow cylinders to retract. By using a pilot operated check valve, cylinder retraction can be accomplished automatically without operator activity.

Shown: VFC-1, VFC-2



## VFC-series

Provide repeatable oil flow control. The internal check valve allows metered flow in one direction and free flow in the opposite direction. Precise control is achieved with a micro-meter style adjustment knob, which can be locked with the set screw.

## Application

Use VFC-series flow control valves in-line with the Enerpac WE-series workholding pump to protect your components from damage due to high flow rates.

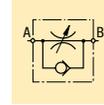
## Regulate the flow of oil

- Color coded flow indicator
- Free flow return
- Fine metering capability
- Lockable
- Standard Viton seals

Max. Flow: 10 GPM

Pressure: 0-5000 psi

- (E) Válv. reguladoras de caudal
- (F) Valves de control débit
- (D) Stromregelventile



## Options

### Fittings

138 ▶



### High pressure filter

137 ▶



Swing cylinders  
Work supports

Linear cylinders

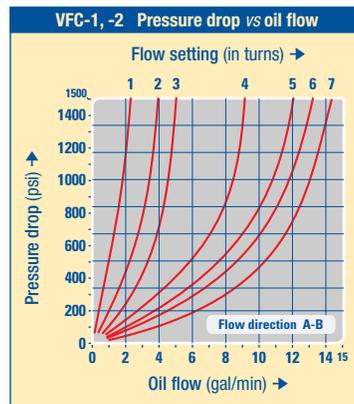
Power sources

Valves

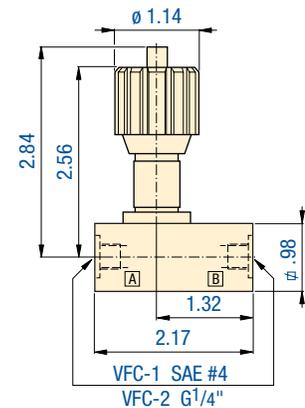
99-025

99-011

## In-line installation of a VFC-1 flow control valve.



VFC-1, -2



## Product selection

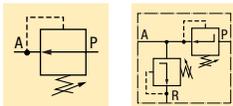
Maximum oil flow	Pressure range	Oil ports	Model number	Flow path	Maximum pressure drop	
GPM	psi				psi	lbs
<b>▼ Flow control valves</b>						
10	0-5000	SAE #4	VFC-1		1500	1.8
10	0-5000	G 1/4"	VFC-2		1500	1.8

Seal material: Viton.

**Pressure:** 5000 psi

**Flow:** 417 in<sup>3</sup>/min

- E** Válv. reguladora de presión
- F** Valve de pression réglable
- D** Druckreduzierventil



## Precise control of hydraulic pressure

- Stackbuilding with VP series modular valves
- Stackable for multiple pressures on one valve stack assembly
- Tool adjustable knob can be locked
- Precise control of pressure
- G1/4" oil connection
- Remote mount PRV-2 and PRV-3
- Built-in pressure relief valve on PRV-2

## Options

**VP-Modular valves**

104 ▶



**Pressure switches**

132 ▶

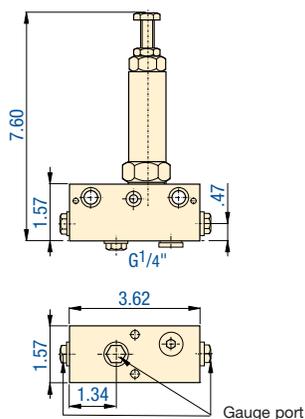


**Tie rod kits**

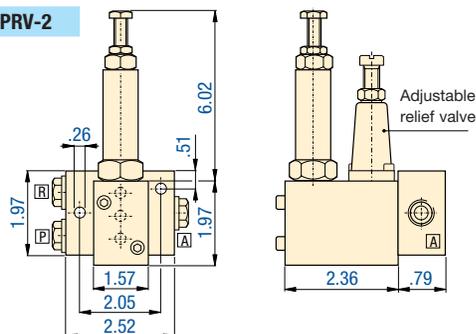
114 ▶



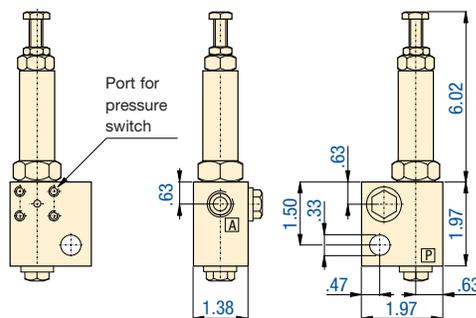
### PRV-1



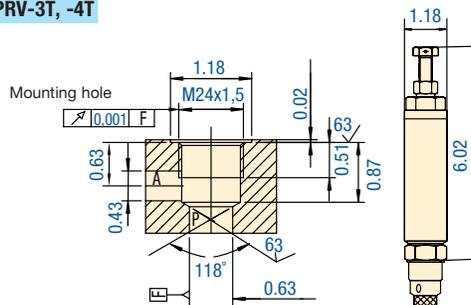
### PRV-2



### PRV-3, -4



### PRV-3T, -4T



Shown: PRV-1



## PRV series

These valves regulate system pressure for all subsequent valves, according to the adjusted pressure. Maintains a constant pressure in a secondary circuit. Includes a check valve that prevents pressure drop on secondary side.

## Application

Used when a hydraulic supply with a higher pressure (primary side) must also be used for another circuit with a lower pressure (secondary circuit).

PRV-1 can be stack built between VP-series valves. PRV-2, 3 and 4 are for remote mounting. Built-in pressure relief valve on PRV-2 protects your system against pressure spikes or shocks. The cartridge from PRV-3 and 4 can be removed from manifold for direct integration into gundrilled fixture. Order PRV-3T or 4T

■ PRV-1 connected with remote manifold WM-10.



## Product selection

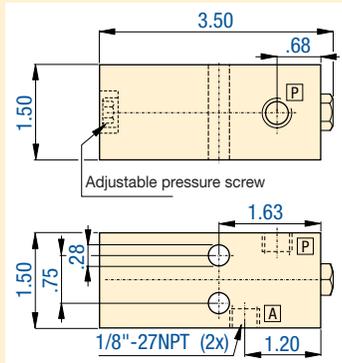
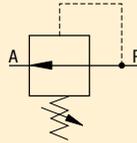
Mounting style	Adjustable pressure range	Maximum pressure	Built-in adjustable pressure relief valve	Model number	Oil ports	Maximum oil flow	
	psi	psi	psi		BSPP	in <sup>3</sup> /min	lbs
VP-series	435 - 4350	5000	-	<b>PRV-1</b>	G1/4"	427	3.5
Remote	435 - 4350	5000	0-5000	<b>PRV-2</b>	G1/4"	427	4.5
Remote	435 - 4350	5000	-	<b>PRV-3</b>	G1/4"	427	2.9
Cartridge	435 - 4350	5000	-	<b>PRV-3T</b>	-	427	1.5
Remote	75 - 2000	5000	-	<b>PRV-4</b>	G1/4"	427	2.9
Cartridge	75 - 2000	5000	-	<b>PRV-4T</b>	-	427	1.5





**PLV-40013B  
Pressure limiting valve**

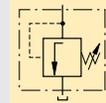
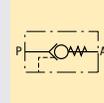
- Allows precise control of pressures reaching specific clamps
- When pressure build-up reaches a preset level, the valve closes, stabilizing pressure to that section of the fixture
- Pressure adjustment between 200 to 1500 psi
- Max. oil flow 305 in<sup>3</sup>/min



Pressure: 0-10,000 psi

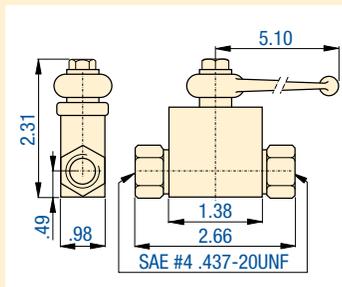
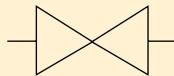
Flow max.: 305-1830 in<sup>3</sup>/min

- E** Válvulas de control
- F** Valves de contrôle
- D** Regelventile



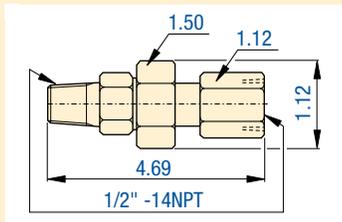
**V-12  
Manual shut-off valve**

- Ball type valve can be used for the master system shut-off or for isolating separate circuits on a fixture
- Viton seals standard
- Straight through design for easy system plumbing and installation
- Fully open allows high flow return of oil
- Max. oil flow 732 in<sup>3</sup>/min



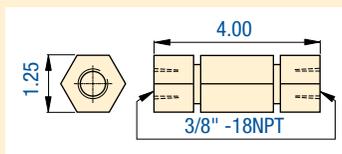
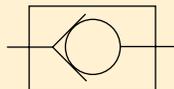
**V-10 Auto-damper valve**

- To protect gauge during high cycle applications
- Creates a flow resistance when load is released suddenly. No adjustments are necessary
- Fits directly into GA-series gauge adaptor



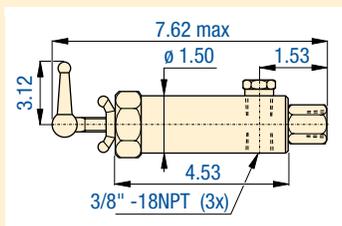
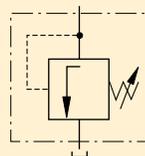
**V-17 Safety check valve**

- Ruggedly built to resist shock and operate with low pressure drop
- Closes smoothly without pounding
- Max. oil flow 1830 in<sup>3</sup>/min



**V-152 Pressure relief valve**

- Limits pressure developed by the pump in hydraulic circuit, thus limiting the force imposed on other components
- 800-10,000 psi adjustment range; ± 3% repeatability
- Valve opens whenever preset pressure is reached. To increase pressure setting, turn handle clockwise
- Max. oil flow 1830 in<sup>3</sup>/min
- Includes 3 ft return line hose kit



**Options**

**VA-42  
Air valve**

122 ▶



**Gauges  
and adaptors**

134 ▶



**Hoses  
and couplers**

136 ▶



**Fittings**

138 ▶



**Important**

**Valving help**  
See Basic System Set-up and Valve information in our "Yellow Pages".

164 ▶

Shown: VA-42, VAS-42



## Air valves

Enerpac's line of directional air valves and accessories complete your workholding system. Used to control air operated hydraulic units, they increase your productivity and efficiency.

### Application

VA-series directional air valves provide either manual or electric control to air operated hydraulic units. Accessories such as rapid exhaust, check valves, silencers and regulators complete the air control system.

## To control and regulate air supply

- Accessory valves provide greater safety and more efficient clamping cycles
- Recommended for use with all air powered units
- Directional valves to control booster and pump air supply
- Remote air valve permits either hand or foot operation

Swing cylinders  
Work supports

Linear cylinders

Power sources

Valves

## Product selection

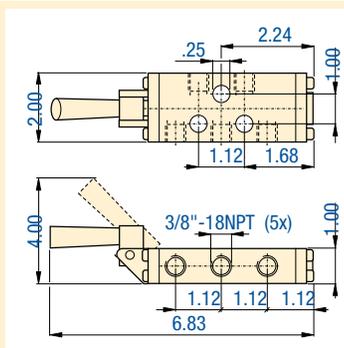
Valve type	Maximum pressure	Model number	Air ports	
	psi		NPT	lbs
<b>▼ Air valves</b>				
5-way, 2-pos., manual	30-150	<b>VA-42</b>	3/8"	2.0
5-way, 2-pos., solenoid	30-150	<b>VAS-42</b>	3/8"	2.5
Rapid exhaust valve	0-100	<b>VR-3</b>	3/8"	1.0
Air check valve	0-100	<b>V-19</b>	3/8"	.80
<b>▼ Accessories</b>				
Regulator-Filter-Lubricator	0-125	<b>RFL-102</b>	3/8"	5.0



**Product specification**

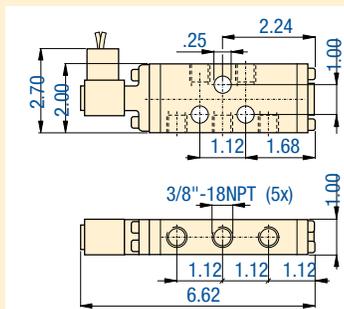
**VA-42**  
Manual operated  
air valve 5-way,  
2-position

- For control of boosters
- Viton seals standard



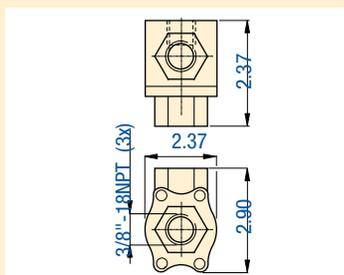
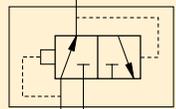
**VAS-42**  
Solenoid operated  
air valve 5-way,  
2-position

- For control of pump and boosters air supply
- Viton seals standard
- Solenoid: 120 VAC, 50/60Hz  
Amperage: inrush .11 Amps, holding .07 Amps
- Maximum cycle rate: 600 cycles per minute



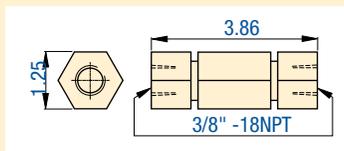
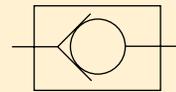
**VR-3**  
Rapid exhaust valve

- Enables booster to advance and retract faster
- Instantly exhaust air supply from booster to atmosphere



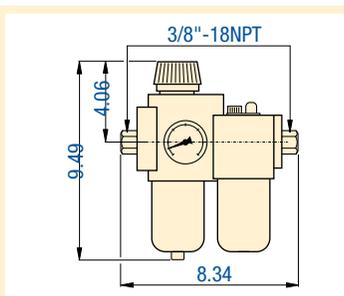
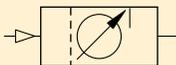
**V-19**  
Air check valve

- Prevent rapid drop of air pressure to the booster in the event of sudden loss of input air



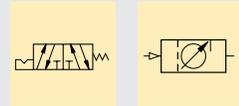
**RFL-102**  
Regulator-Filter-Lubricator

- Regulates air pressure
- Filter air input
- Lubricates air motors with a fine oil vapor mist
- Maximum air flow 48 scfm



**Air Pressure: 0-150 psi**

- E** Válvulas de aire
- F** Valves à air
- D** Luftventile



**Options**

**Gauges and adaptors**

134 ▶



**Hoses and couplers**

136 ▶



**Fittings**

138 ▶



**Important**

Valving help  
See Basic System Set-up  
and Valve information  
in our "Yellow Pages".

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# System

## System components

From the simplest to the most complex hydraulic system, Enerpac's system components help you complete your design. Gauges, pressure switches, couplers and hoses are simple but necessary items for any hydraulic system, and Enerpac can provide the full range. And more specialized components such as accumulators and automatic coupler systems ensure that whatever your need, Enerpac can help.



## Technical support

Refer to the "Yellow Pages" of this catalog for:

- Safety instructions
- Basic hydraulic information
- Advanced hydraulic technology
- FMS (Flexible Machining Systems) technology
- Conversion charts and hydraulic symbols

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# components

	▼ series	▼ page	
Auto-coupler systems	WCA, WPA ACCB	126 - 127	
Rotary couplers	CR CRV	128 - 129	
Accumulators	AC WA	130 - 131	
Pressure switches	IC PSCK	132	
Digital pressure gauges	DG	133	
Pressure gauges	G	134	
Gauge accessories	GA, GS V, NV	135	
Manifolds, Couplers, Hoses, Tubing	A, AH/R HLS, T	136	
High pressure filters, Hydraulic oil	FL, HF	137	
High pressure fittings	BFZ, FZ	138 - 140	

Shown: WCA-62, WPA-62



▶ The automatic coupler system allows connection and disconnection of palletized hydraulic circuits. This system eliminates the direct intervention of an operator, allowing hands free, safe functioning of the process. Typical systems include one base station located at the load/unload station operating one or more pallet receivers.

■ A 4-way auto coupler is being connected to the receiver, mounted on the side of a palletized fixture.

## For automated coupling of hydraulic circuits on palletized systems

- Sensing feedback of coupler position allows for fully automated applications
- Horizontal or vertical mounting for flexible installation on machine tools
- Available as 2 or 4 port model to provide a solution to various hydraulic circuit needs
- Adjustment stroke allows clearance for pallet indexing
- Coupler elements supplied with air blow-off nozzles to prevent damage from contamination
- Automatic coupler control box provides pre-programmed safety features to insure proper sequencing of automatic coupler and fixture operations

### ACCB-1, Automatic coupler control box ▶ 127



99-143

- Provides automatic or manual control of your 2 or 4 port auto coupler station.
- Indicator lights inform when auto coupler is retracted or advanced and whether fixture is unclamped or clamped.
- Includes 2 pressure switches, 3 proximity switches.
- Pressure switches monitor clamping and unclamping system pressure.
- Proximity switches inform PLC when auto coupler is advanced or retracted and when pallet is in position for the auto coupling.
- Integrates with WEQ-4020JFN-WMK21 ▶ 88

## Product selection

Station position	Model No. <sup>1)</sup>	Adjustable stroke	Oil capacity		Maximum oil flow <sup>2)</sup>
			in <sup>3</sup> advance	in <sup>3</sup> retract	
<b>▼ 2 port auto coupler</b>					
Base	WCA-62	.20 - .59	.66	.66	60
Base	WCA-82	4.10 - 4.48	.66	.66	60
Pallet	WPA-62	-	-	-	-
<b>▼ 4 port auto coupler</b>					
Base	WCA-64	.20 - .59	.66	.66	60
Pallet	WPA-64	-	-	-	-

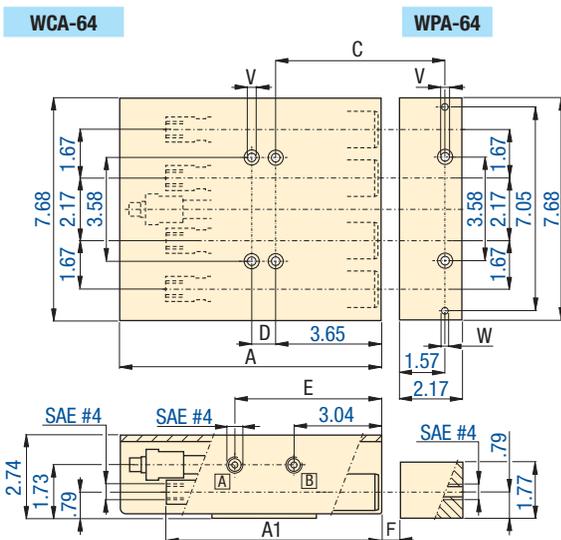
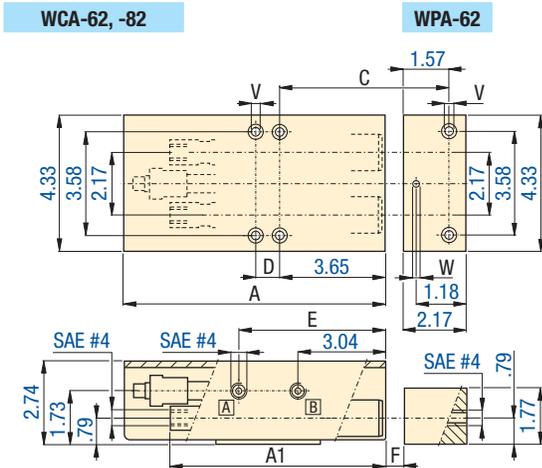
<sup>1)</sup> For additional pallet clearance, WCA-82 long stroke model are available.

<sup>2)</sup> Maximum oil flow of coupler elements is 4.3 GPM.



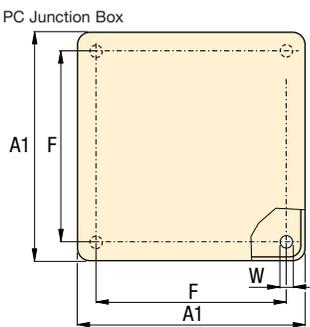
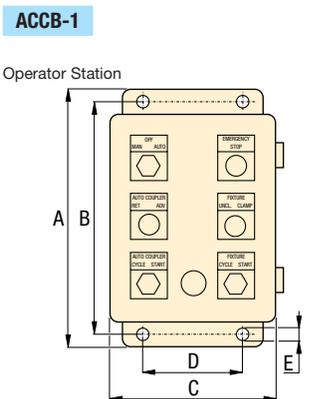
**Product specifications**

Model number	Required radial alignment accuracy in	Operating pressure psi	Hydraulic nozzle model no. (included)	Air blow-off fitting model No. (included)	Recommended alignment tool
<b>▼ 2 port auto coupler</b>					
WCA-62	± .02	580 - 5000	CDF-6	FZ-2050	AT-1
WCA-82	± .02	580 - 5000	CDF-6	FZ-2050	AT-2
WPA-62	± .02	580 - 5000	CDM-6	FZ-2050	AT-1
<b>▼ 4 port auto coupler</b>					
WCA-64	± .02	580 - 5000	CDF-6	FZ-2050	AT-1
WPA-64	± .02	580 - 5000	CDM-6	FZ-2050	AT-1



Model No.	Voltage / Current
<b>▼ Automatic Coupler Control Box</b>	
ACCB-1	115 VAC / 10 A

Note: Enclosure rating NEMA 12.



**Product dimensions in inches** [⊕]

Model No.	A	A1	B	C	D	E	F max.	V <sup>1)</sup> for mounting bolts thread x length	W <sup>2)</sup> lbs
<b>▼ 2 port auto couplers</b>									
WCA-62	8.86	7.48	-	5.42	.83	5.09	.394-.413	.312-18un x 2.75	16.8
WCA-82	15.67	14.03	-	9.36	3.94	8.20	3.70	.312-18un x 2.00	28.8
WPA-62	-	-	-	-	-	-	-	.375-16un x 2.00	4.0
<b>▼ 4 port auto couplers</b>									
WCA-64	8.86	7.48	-	5.42	.83	5.09	.394-.413	.312-18un x 2.75	29.1
WPA-64	-	-	-	-	-	-	-	.375-16un x 2.00	6.6
<b>▼ Automatic Coupler Control Box<sup>3)</sup></b>									
ACCB-1	11.50	24.00	10.75	8.25	6.00	.31	22.50	-	95.0

<sup>1)</sup> Mounting bolts are not included. <sup>2)</sup> Drill dowel pin holes after installing WPA. <sup>3)</sup> Junction Box is 8.0 inch deep. Operator station is 4.0 inch deep.

Connection: 2-4 ports

Stroke: .20-4.48 inch

Pressure: 580-5000 psi

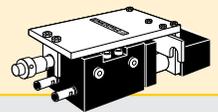
- E** Acopladores automáticos
- F** Coupleurs automatiques
- D** Automatische Kupplungen

**Options**

**High pressure filters**

137 ▶

**AT series alignment tool**  
Use the AT series alignment tool to adjust the position of the pallet station in relation to the base station.



**Hoses**

136 ▶

**Important**

Use high pressure filters on pallet station outlet ports, to avoid contamination of pallet mounted valves and cylinders.

To guarantee leakage free connections, accurate positioning of the pallet and base stations is crucial. Carefully read the instruction manual included with the product.

Do not couple or uncouple with the hydraulic nozzles under pressure. This could damage the internal coupler seals.

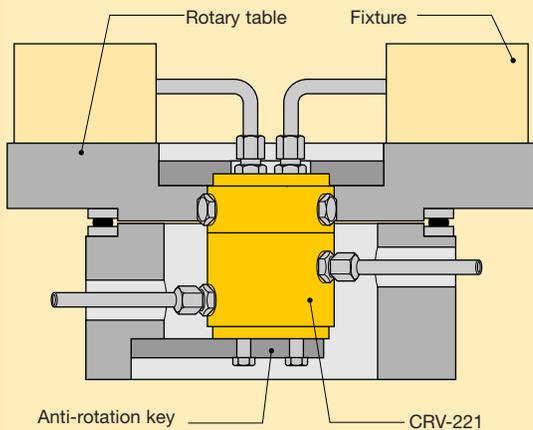
Do not exceed maximum flow and pressure.

# Rotary couplers *Application & selection*

Shown: CRV-221, CR-111



▶ Rotary couplers are specially designed unions to transfer pressurized fluid from a stationary supply line to a rotating device. Used for workholding or clamping device such as fixtures installed on rotating index tables.



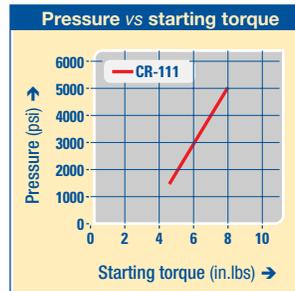
■ In this application eight CRV-221 rotary couplers are installed to power the individual presses of an eight station rotary press table.



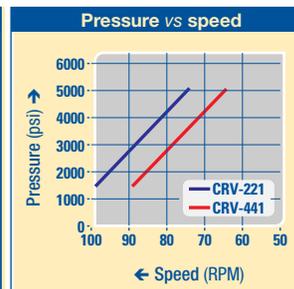
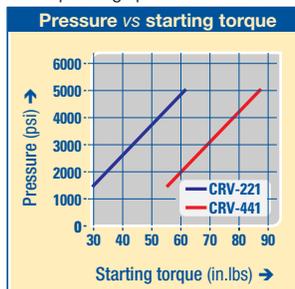
## Permanent hydraulic connection on indexing and rotating work stations

- High rotation per minute
- Low starting torque
- Internal oil bearings for increased lifetime
- Manifold mounting adaptors available to reduce fixture plumbing

### Starting torque and speed diagrams



Max. operating speed = 30 RPM.



Oil loss CRV-221 = 1.22 in<sup>3</sup>/h, CRV-441 = 2.44 in<sup>3</sup>/h

### Product selection

No. of radial passages	Model No. <sup>1)</sup>	Operating pressure range	Maximum speed		Starting torque	
			RPM		in.lbs	
			psi	1500 psi	5000 psi	1500 psi
1	<b>CR-111</b>	1500-5000	30	30	4.5	8
2	<b>CRV-221</b>	1500-5000	100	75	27	60
4	<b>CRV-441</b>	1500-5000	90	65	53	182

<sup>1)</sup> Before selecting, note the starting torque and speed diagrams above.

### Manifold Mounting Adaptor



#### Mounting Adaptor AMP-2, AMP-4

Mounts onto end of two and four passage rotary unions. Allows O-ring mounting directly to fixture.

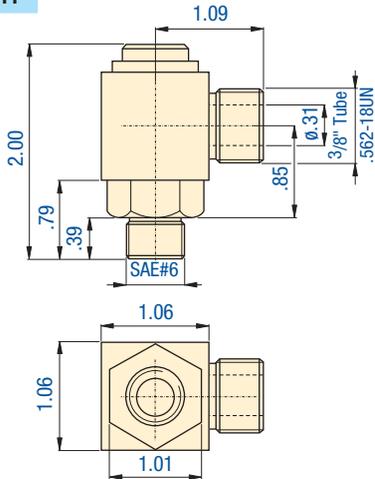
### Product selection

Number of radial passages	Model No. <sup>1)</sup>	Operating pressure range	Used with
		psi	
2	<b>AMP-2</b>	1500-5000	CRV-221
4	<b>AMP-4</b>	1500-5000	CRV-441

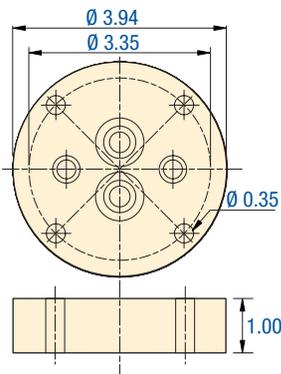


**A** Product dimensions in inches [ ]

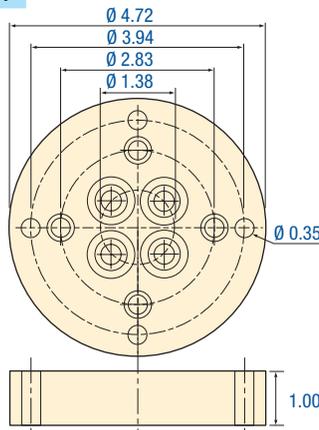
**CR-111**



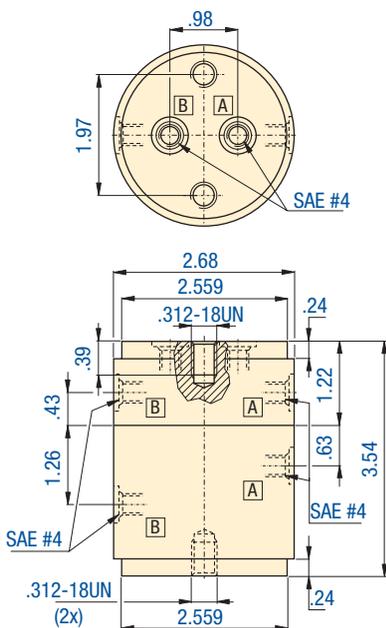
**AMP-2**



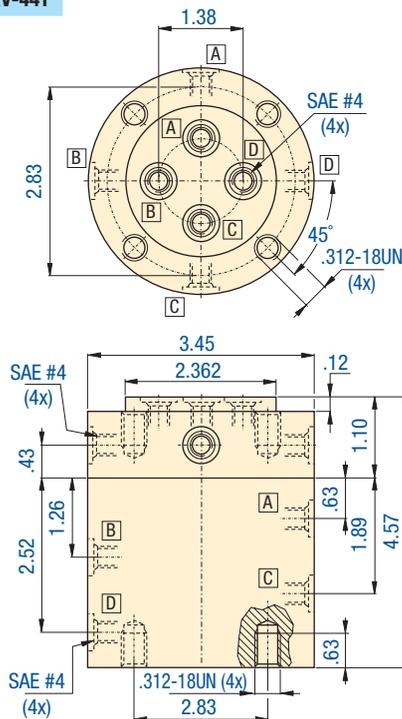
**AMP-4**



**CRV-221**



**CRV-441**



Passages: 1-4 lines

Speed: 30-100 RPM max

Pressure: 1500-5000 psi

- E** Acoplamiento giratorio
- F** Joints tournants
- D** Drehdurchführungen



**B** Options

Fittings [138](#)

Couplers [136](#)

Hoses and couplers [136](#)

**!** Important

Before selecting, note the pressure versus starting torque diagrams.

Rotary couplers must be mounted in the center of rotation of the installation.

Anti-rotation keys should be utilized.

For proper application, clamp force, pressures and timing, consult Enerpac for support.

# Accumulators *Application & selection*

Shown: ACM-1, ACBS-22, ACL-201



► Enerpac accumulators supply auxiliary pressure to dampen shock loads or to compensate pressure drop in applications where system pressure needs to be maintained.

Accumulator packages will help maintain system pressure to your fixture when separated from the hydraulic source. The gauge will display system pressure after the circuit is disconnected.

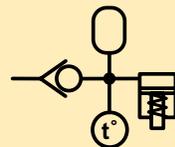
## Accumulator applications:

- Energy storage
- Circuit pulsation dampening
- Thermal expansion compensation

Pulse dampening



Thermal expansion



■ ACBS-202 Accumulator package used to maintain pressure on a machine tool fixture.



## Accumulators

...maintain circuit pressure

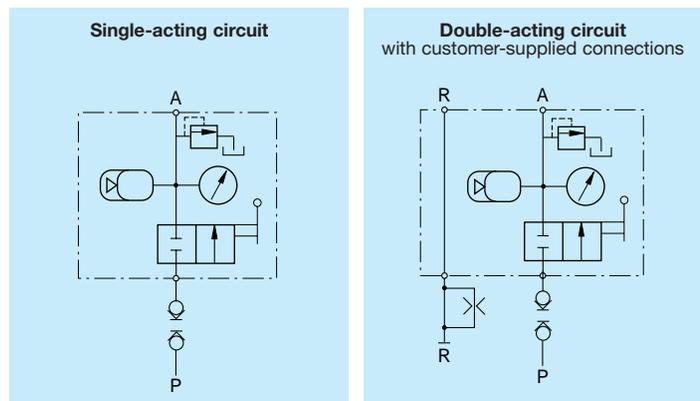
- Ideal for high frequency and rapid discharge applications
- ACL series are pre-charged to 1450 psi
- Corrosion resistant bodies on ACL series
- Spring actuated accumulator for ACM-1
- High energy storage capacity in a compact package

## Accumulator coupler packages

...compact design for easy use of accumulators

- Single design accommodates both single-acting or double-acting circuit
- Relief valve fitted and ball check shut-off
- Glycerin-filled gauge included
- Supplied standard with one male coupler (AH-652)
- Optional manifold mounting. O-ring seals located on bottom of block only for single-acting circuit

## i Accumulator coupler package circuits



## Product selection

Operating pressure psi	Model No.	Max. rated oil volume in <sup>3</sup>	Gas volume in <sup>3</sup>	Pre-charged nitrogen pressure psi	Usable oil capacity in <sup>3</sup> at 5000 psi
<b>▼ Pre-charged accumulators</b>					
0-3000	<b>ACM-1</b>	.10	-	-	-
1500-5000	<b>ACL-21</b>	.90	1.22	1450	.53
1500-5000	<b>ACL-201</b>	7.70	10.37	1450	4.51
1500-5000	<b>ACL-502</b>	20.60	27.46	1450	12.0
<b>▼ Pre-charged accumulator coupler packages</b>					
1500-5000	<b>ACBS-22</b>	1.00	1.22	1450	.53
1500-5000	<b>ACBS-202</b>	10.00	10.37	1450	4.51
<b>▼ Accumulators</b>					
0-5000 1)	<b>WA-502</b>	2.50	2.50	2)	2.50
0-5000 1)	<b>WA-505</b>	5.50	5.50	2)	4.00
0-5000 1)	<b>WA-5010</b>	10.00	10.00	2)	7.50
0-5000 1)	<b>WA-5030</b>	30.00	30.00	2)	18.50

<sup>1)</sup> See pre-charge chart on the next page for hydraulic operating pressures.

<sup>2)</sup> WA-series accumulators are shipped uncharged. They must be charged using the WAT-1 charging tool.



Shown: PSCK-5, PSCK-6



ⓘ Enerpac remote mounted pressure switches monitor the hydraulic system to determine any change of pressure. The signal can then be used to control the pump, or other peripheral devices.

### IC-series

The IC-series electrical pressure switches provide pressure readings for monitoring and/or control of hydraulic system pressure in workholding systems.

### PSCK-series

The PSCK-series digital pressure switches are designed for use in high cycle applications, machine tool interface, robotics and flexible machine systems (FMS). These can be used to automate the clamp and unclamp cycle.

■ *Integrated in your hydraulic system, the pressure switch can be used to automate your clamping cycles.*



Swing cylinders  
Work supports

Linear cylinders

Power sources

Valves

System components

## Reliable electrical control of hydraulic power

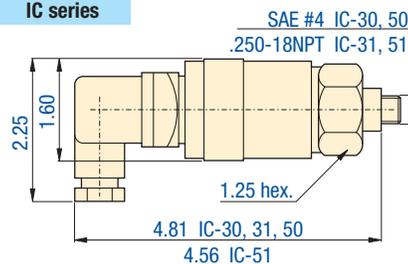
### Electrical IC series

- Compact design minimizes space requirements on fixture
- Switch is easily adjustable to meet system requirements

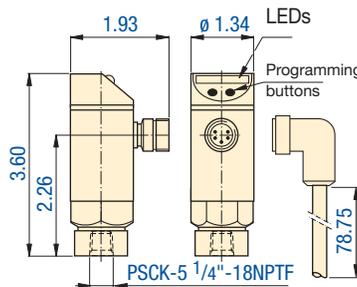
### Digital PSCK series

- Accuracy of  $\pm .25\%$  of full scale
- Solid state
- Adjustable in increments of 50 psi
- Adjustable deadband
- Dynamic bar graph set point and pressure display
- High duty cycle

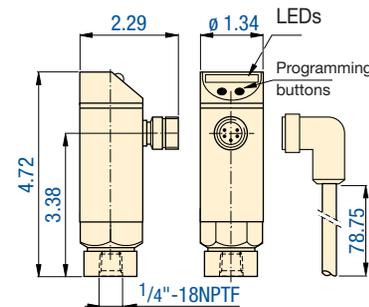
#### IC series



#### PSCK-5



#### PSCK-6



Pressure: 500-7500 psi

Accuracy: .25-1.50%

- Ⓔ Presostatos
- Ⓕ Pressostats
- Ⓖ Druckschalter



### Options

#### Fittings

138 ▶



#### Gauges

134 ▶



### ⚠ Important

Do not exceed the maximum pressure.

### Product selection

Adjustable pressure range	Electrical specifications	Model number	Deadband	Switch point repeatability	Oil port	
psi	at 50/60 Hz		psi	% of range	lbs	
<b>▼ Electrical pressure switches</b>						
500-3500	125 VAC @ 5 A	IC-30	100 - 500	+ 1.50	SAE #4	1.0
500-3500	125 VAC @ 5 A	IC-31	100 - 500	+ 1.50	.250-18 NPT	1.0
3000-7500	125 VAC @ 5 A	IC-50	250 - 800	+ 1.50	SAE #4	1.0
3000-7500	125 VAC @ 5 A	IC-51	250 - 800	+ 1.50	.250-18 NPT	1.0
<b>▼ Digital pressure switches<sup>1)</sup></b>						
500-5000	24 VDC @ 250 mA	PSCK-5	60	$\pm .25$	1/4" NPT	1.0
500-5000	115 VAC @ 2.5 A	PSCK-6	60	$\pm .25$	1/4" NPT	1.3

<sup>1)</sup> Electrical harness included with kit.

Pressure: 0-10,000 / 0-15,000

Accuracy: 0.2-0.5%

Voltage: 115 VAC / 3 VDC

- E** Manómetros digitales
- F** Manomètres digitaux
- D** Digitale Manometer

## Options

### Fittings

138 ▶



### Gauge adaptors

135 ▶



## Important

Do not exceed the maximum pressure.

Gauges can be easily plugged into the hydraulic system using GA-3 gauge adaptor.

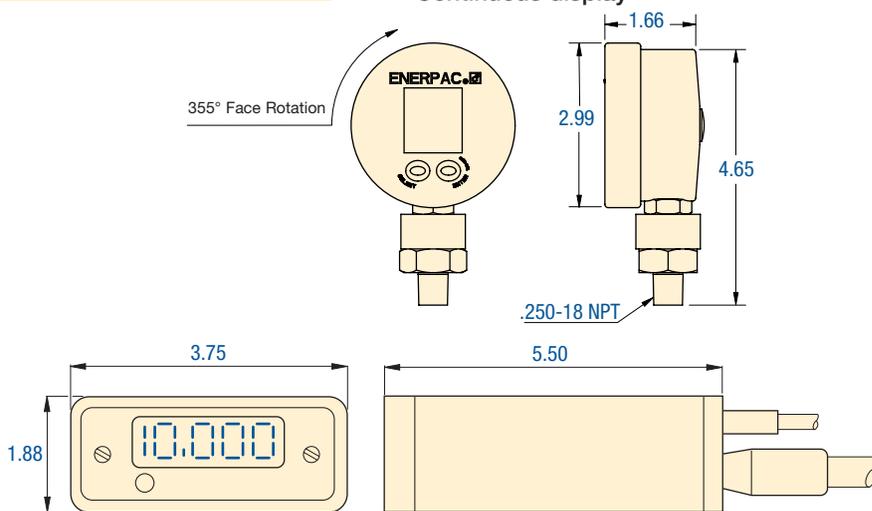
## Easy and precise pressure monitoring

### DGB, DGL, DGP

- Rated for system pressure up to 10,000 psi
- Solid state design – can be used continuously to full pressure without gauge damage or accuracy loss
- Auto zero – ensures that gauge reads actual system pressure
- Dampens out pressure pulsations for stable readings despite pump generated pulsations (a pulsation must last 0.35 seconds to affect readings)
- DGP-1 includes angle bracket simplifying installation onto fixture or bench

### DGR-1

- Rated for system pressure up to 15,000 psi
- Displays in psi, bar, MPa, kPa, mbar/hPa
- Zero reset – ensures that gauge reads actual system pressure
- Protective cover can be ordered separately DGR-1PC
- 3 VDC battery included - DGR-1B
  - 1400 hours continuous operation in standard mode
  - IP65 protection
- Two modes
  - Automatic shut off (15 min)
  - Continuous display



Shown: DGP-1



Enerpac digital pressure gauges offer greater accuracy and are easier to read than conventional dial gauges, greatly enhancing your ability to monitor and control hydraulic system pressure.

### DGB-1 Basic

Tracks hydraulic pressure through 10,000 psi range in increments of 10 psi.

### DGL-1 Dual limit

Preset an upper and lower hydraulic pressure limit. The gauge can activate an alarm or light if system pressure registers beyond or below the preset limit.

### DGP-1 Peak indicator

Captures peak hydraulic pressure readings.

### DGR-1 Remote Operation

Battery operated for additional flexibility. Includes max. and min. pressure capture.

Enerpac digital gauges provide clear and accurate pressure readings.

## Product selection

Pressure range	Operating voltage <sup>1)</sup>	Accuracy	Model No.	Operating temperature range	Scale reading increments	
psi		% of full scale		°F	psi	lbs
0-10,000	115 VAC <sup>1)</sup>	0.50	DGB-1	30 - 130	10	4.0
0-10,000	115 VAC <sup>1)</sup>	0.50	DGL-1	30 - 130	10	4.0
0-10,000	115 VAC <sup>1)</sup>	0.50	DGP-1	30 - 130	10	4.0
0-15,000	3 VDC	0.20	DGR-1	30 - 120	10	0.5

<sup>1)</sup> Includes 115V line transformer using 9-12 VDC adapter and transducer.



# Pressure gauges and accessories *Application & selection*

Shown: GS-2, G-2512L, GS-3



► Enerpac digital pressure gauges offer greater accuracy and are easier to read than conventional dial gauges, greatly enhancing your ability to monitor and control hydraulic system pressure.

G series, glycerine filled pressure gauges allow the operator a visual representation of what is happening in the hydraulic circuit.

Enerpac gauges provide a safe and inexpensive monitoring system for your hydraulic circuit. These gauges deliver years of accurate service while withstanding vibration, corrosive media and atmospheric conditions.

■ Enerpac gauges used to monitor system pressure and maintain process accuracy.

Swing cylinders  
Work supports

Linear cylinders

Power sources

Valves

System components

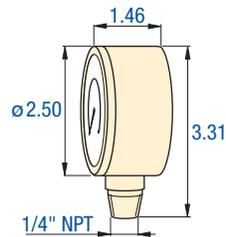
## Highly reliable and accurate pressure sensing

- $\pm 1.5\%$  accuracy of full scale
- All pressure sensing parts sealed and dampened by glycerine for long life
- Includes safety blow-out disk and pressure equalizing membrane to prevent overpressurization
- Copper alloy, coiled safety Bourdon tube for 1000 psi and higher
- Dual psi and bar scale readings, 2.5 inch gauge face

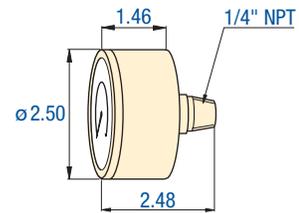
## Gauge accessories for easy installation

- Needle valves providing positive shut-off
- 303 stainless steel stem (NV-25)
- Snubber valves to control pressure surges between gauge and hydraulic system
- Gauge adaptors – male end screws into pump or cylinder, female port accepts hose or coupler, the third port is for gauge connection
- FM-25NG for panel mounting of 2.50 inch diameter gauges

lower mount models

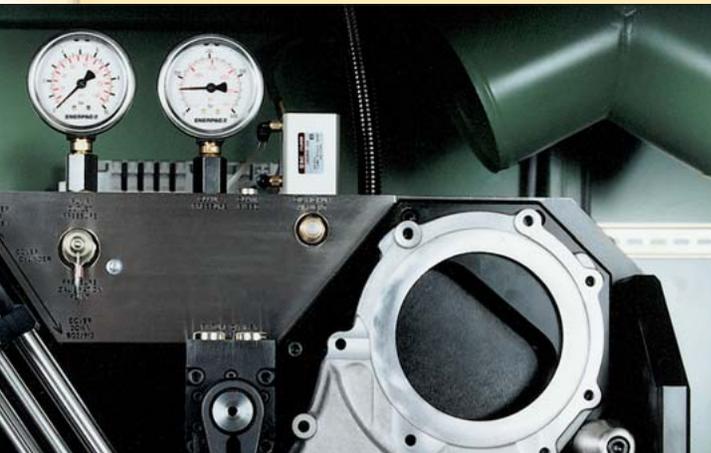


rear mount models



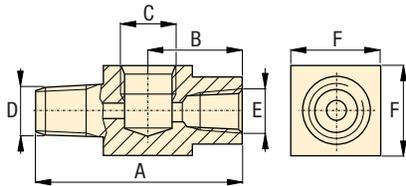
## Product selection

Pressure range	Model No.	PSI graduation		Bar graduation	
		Major	Minor	Major	Minor
Hg    psi    bar		psi	psi	bar	bar
<b>▼ Vacuum gauge – Lower mount</b>					
0-30"	G-2501L	-	-	5Hg	.50Hg
<b>▼ Compound gauge – Lower mount</b>					
0-30"	G-2502L	10	1	10Hg	2Hg
<b>▼ Pressure gauge – Lower mount</b>					
-	G-2509L	10	2	1	.01
-	G-2510L	10	2	1	.02
-	G-2511L	50	5	1	.02
-	G-2512L	50	5	5	.05
-	G-2513L	100	10	10	1
-	G-2514L	100	20	10	1
-	G-2515L	500	50	10	2
-	G-2516L	500	50	50	5
-	G-2517L	1000	100	100	10
-	G-2535L	2000	200	100	10
<b>▼ Pressure gauge – Rear mount</b>					
-	G-2531R	100	20	10	1
-	G-2534R	1000	100	100	10
-	G-2537R	2000	200	100	10

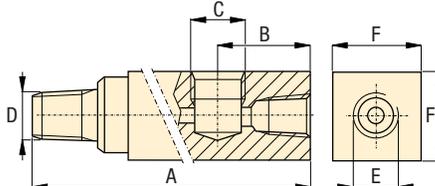




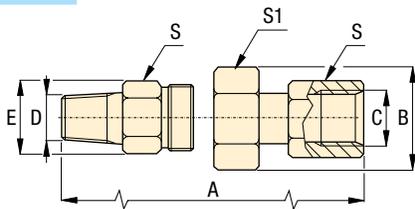
**GA-1**



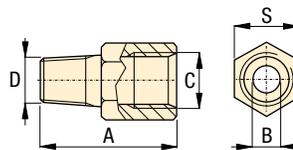
**GA-2, -3, -4**



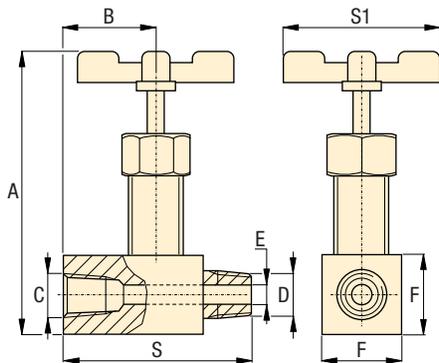
**GA-918**



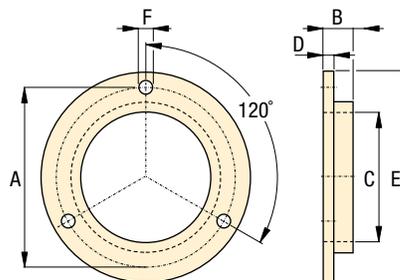
**GS-2, -3**



**NV-25, V-9**



**FM-25NG**



**Product dimensions** in inches [Ⓜ]

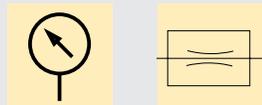
Gauge port NPT	Max. pressure psi	Model No. A	Dimensions							
			B	C	D	E	F	S	S1	
<b>▼ Gauge adaptors</b>										
1/2"	10,000	GA-1	2.81	1.24	1/2"NPT	3/8"NPT	3/8"NPT	1.25	-	-
1/2"	10,000	GA-2	6.10	1.38	1/2"NPT	3/8"NPT	3/8"NPT	1.25	-	-
1/4"	10,000	GA-3	5.25	1.38	1/4"NPT	3/8"NPT	3/8"NPT	1.25	-	-
1/2"	10,000	GA-4	4.38	1.38	1/2"NPT	1/4"NPT	3/8"NPT	1.25	-	-
<b>▼ Swivel gauge adaptor</b>										
1/2"	10,000	GA-918	2.25	1.72	1/2"NPT	1/2"NPT	1.30	-	1.13	1.50
<b>▼ Gauge shut-off valves</b>										
1/4"	10,000	NV-25	3.50	1.06	1/4"NPT	1/4"NPT	2.50	.88	2.13	2.50
1/2"	10,000	V-9	3.63	1.25	1/2"NPT	1/2"NPT	2.50	1.00	2.13	2.50
<b>▼ Gauge snubber valves</b>										
1/4"	5000	GS-2	1.63	.018	1/4"NPT	SAE #4	-	-	.75	-
1/4"	5000	GS-3	1.63	.018	1/4"NPT	G1/4"	-	-	.75	-
<b>▼ Flange mounting for panel mounting of G series gauges</b>										
-	-	FM-25NG	2.95	.17	2.51	.07	3.35	.14	-	-

Pressure: 0-10,000 psi

Accuracy: 1.5% /full scale

Gauge face: ø 2.5 inch

- E** Manómetros
- F** Manomètres
- D** Manometer



**Options**

**Hoses and couplers**  [136](#)

**Digital gauges**  [133](#)

**Pressure switches**  [132](#)

**V-10 Auto Damper® Valve**  [120](#)

**Important**

Do not exceed maximum pressure.

Gauge snubbers or needle valves are recommended for high cycle applications.

Do not keep gauges under permanent pressure. The use of shut-off valves is recommended.

For basic system set-up information, refer to our "Yellow Pages" section. [141](#)

# Manifolds, couplers, hoses, tubing

Shown: HLS, HF, AH, AR, FL, T, A-series



**Use genuine Enerpac manifolds, couplers, hoses and tubings to connect your workholding cylinders or fixtures to the hydraulic power source.**

## A series, Manifolds

For multiple hydraulic line connections at one central location directing oil to or from a pressure source.

## AH/AR series, Couplers

Quick disconnect low leakage couplers for easy connection of hydraulic circuits.

## HLS series, Hoses

High pressure hydraulic hoses, featuring a heavy-duty protective plastic coating.

## T series, Tubing

High pressure steel tubing, available in 5 ft lengths.

## Options

### Fittings

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## Manifolds

- Easy to connect
- Mounting holes on all models

## Couplers

- Spee-D-Coupler® design allows cylinder to be connected and disconnected in seconds
- For more safety: couplers cannot be connected or disconnected while under hydraulic pressure

## Hydraulic hoses and tubings

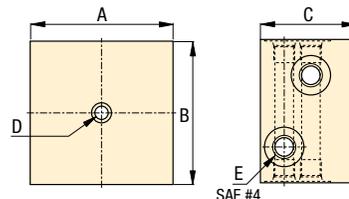
- Heavy duty coating for abrasion resistance
- Resistant against mineral based hydraulic oil as well as water glycols
- High pressure steel tubing for permanent installations

## Important

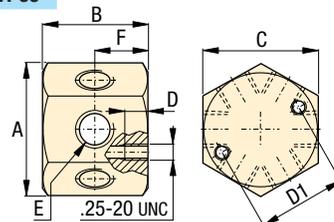
Do not exceed the maximum pressure.

Inspect hoses and tubing frequently and replace as required.

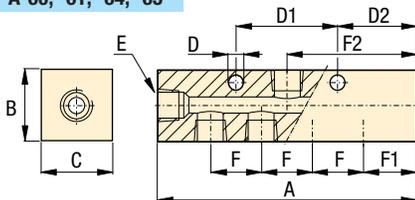
A-63



A-66



A-60, -61, -64, -65



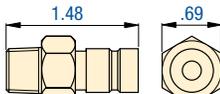
## Manifolds dimensions in inches

Number of ports	Model No.	A	B	C	D	D1	D2	E	F	F1	F2	Weight lbs
2 x 4	A-63	3.00	3.00	2.00	.25	-	-	SAE #4	-	-	-	2.0
5	A-60	3.50	1.25	1.25	.28	1.50	1.00	SAE #4	1.50	1.00	1.75	1.0
7	A-61	6.50	1.25	1.25	.28	1.50	1.25	SAE #4	1.00	1.25	3.25	1.4
7	A-64	7.00	1.25	1.25	.25	3.00	1.25	.375-18 NPT	1.50	1.25	3.50	3.3
7	A-65	14.5	1.25	1.25	.25	8.00	1.25	.375-18 NPT	4.00	1.25	7.25	6.1
6	A-66	2.30	1.63	2.00	.52	1.50	-	.375-18 NPT	-	-	-	1.8

## Couplers

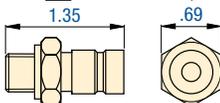
AH-650

Male coupler half  
.250-18 NPT



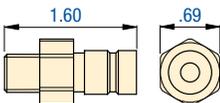
AH-652

Male coupler half  
G1/4" BSPP



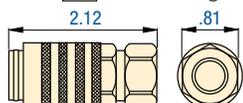
AH-654

Male coupler half  
SAE #4 .437-20 UNF



AR-650

Female coupler half  
.250-18 NPT



## Hoses

Length ft	Model No.	Internal diameter in	Maximum pressure psi
▼ 1/4", 37° flare			
1	HLS-512	.19	5000
2	HLS-524	.19	5000
3	HLS-536	.19	5000
4	HLS-548	.19	5000
5	HLS-560	.19	5000
▼ 3/8" NPT			
3	H-9203	.25	10,000
6	H-9206	.25	10,000
10	H-9210	.25	10,000

## Tubing

Length ft	Model No.	Internal diameter in	Maximum pressure psi
5	T-2560	.25	5000



## High pressure filters

- Keep your hydraulic system clean
- Pleated stainless steel wire mesh screen construction provides large filter area in a compact size
- Rated for full system pressure up to 5000 psi
- Bi-directional design allows filtration of oil in either flow direction
- Two piece body construction for easy replacement of filter elements
- High flow rates are obtainable with a minimum pressure drop
- Threaded port connections on each end simplify installation

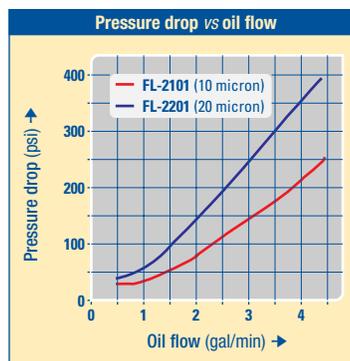
## Hydraulic oil

- Ensures effective lubricity
- Protects essential parts

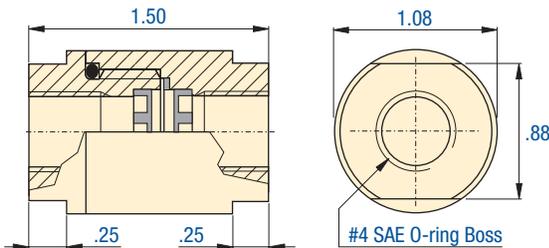
## Filtration

**20 micron filter** provides the longest service life before element replacement

**10 micron filter** recommended for more sensitive hydraulic components



### FL series



## High in line pressure filters

Model No.	Filtration		Filter element set	lbs
	micron			
	Nominal	Absolute		
FL-2101	10	25	FL-2101K	.4
FL-2201	20	40	FL-2201K	.4

## Hydraulic oil

Contents	Model No.	Specifications genuine Enerpac hydraulic oil			
Gal					
.25	HF-100	0°F	<12,000 S.U.S	Flash, C.O.C.	400 °F
1	HF-101	100°F	150/165 S.U.S	Pour point	-25 °F
5	HF-102	210°F	42/45 S.U.S	Aniline point	210/220 °F
55	HF-104				

Note: Viscosity index: 100 min

**E** Mangueras, Filtros Acoplamientos, Aceite

**F** Flexibles, Filtres Raccords, Huile

**D** Schläuche, Filter Kupplungen, Öl

## High pressure filters

Compact in line high pressure filters prevent chips and debris that have entered the hydraulic fluid system from damaging hydraulic system components.

## Hydraulic oil

Use only genuine Enerpac hydraulic oil to guarantee optimal performance and long life of your hydraulic equipment.

## Options

### Fittings

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## Important

**Do not exceed the maximum pressure.**

■ Hydraulic power is distributed by manifolds and transported by hoses and tubing.



# High pressure fittings *Selection & dimensions*

Shown: FZ-2023, -2054, -2052



**Fittings are used to connect all cylinders, components, power sources, tubes, gauges and hoses in a hydraulic system. Enerpac fittings provide flexible, safe and leak-free connections.**

**Multiple hydraulic line connections are easily installed with Enerpac fittings and manifolds.**

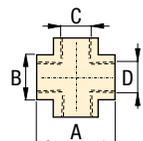
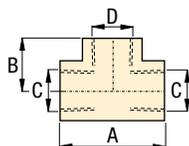
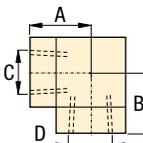
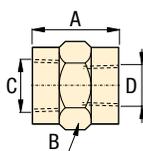
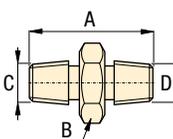
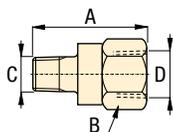


## Proper connection for hydraulic components

- Male and female BSPP, UNF, NPT threaded fittings in common sizes allow easy connection of all components
- BFZ and FZ-1000 models are 10,000 psi maximum pressure
- FZ-2000 models are 5000 psi maximum pressure

## Product selection

From	To	Max. pressure psi	Model No.	Dimensions in inch			
				A	B	C	D
<b>▼ Adaptors</b>							
1/4"NPT	1/8"NPT	10,000	FZ-1642	1.18	.75	1/8"NPT	1/4"NPT
G1/4"	1/4"NPT	10,000	BFZ-16411	1.38	.75	1/4"NPT	G1/4"
3/8"NPT	1/4"NPT	10,000	FZ-1055	1.75	.94	1/4"NPT	3/8"NPT
SAE #4	1/4"NPT	5000	FZ-2007	1.14	.75	7/16"UN	1/4"NPT
SAE #4	1/8"NPT	5000	FZ-2008	.97	.56	7/16"UN	1/8"NPT
SAE #4	SAE #2	5000	FZ-2022	1.13	.68	5/16"UN	7/16"UN
1/2"NPT	1/4"NPT	10,000	FZ-1633	1.69	1.13	1/4"NPT	1/2"NPT
1/2"NPT	3/8"NPT	10,000	FZ-1634	1.69	1.13	3/8"NPT	1/2"NPT
<b>▼ Nipples</b>							
1/4"NPT	1/4"NPT	10,000	FZ-1608	1.50	.63	1/4"NPT	1/4"NPT
3/8"NPT	G1/4"	10,000	BFZ-305	1.42	.75	3/8"NPT	G1/4"
3/8"NPT	3/8"NPT	10,000	FZ-1617	1.50	.75	3/8"NPT	3/8"NPT
3/8"NPT	3/8"NPT	10,000	FZ-1619	2.00	.75	3/8"NPT	3/8"NPT
<b>▼ Connectors</b>							
1/4"NPT	1/4"NPT	10,000	FZ-1605	1.10	.75	1/4"NPT	1/4"NPT
3/8"NPT	1/4"NPT	10,000	FZ-1615	1.13	1.00	3/8"NPT	1/4"NPT
3/8"NPT	3/8"NPT	10,000	FZ-1614	1.44	.94	3/8"NPT	3/8"NPT
1/2"NPT	3/8"NPT	10,000	FZ-1625	1.88	1.14	1/2"NPT	3/8"NPT
<b>▼ Elbows</b>							
1/4"NPT	1/4"NPT	10,000	FZ-1638	1.42	.94	1/4"NPT	1/4"NPT
3/8"NPT	3/8"NPT	10,000	FZ-1610	1.31	.81	3/8"NPT	3/8"NPT
<b>▼ Tee</b>							
1/4"NPT	1/4"NPT	10,000	FZ-1637	1.77	.94	1/4"NPT	1/4"NPT
3/8"NPT	3/8"NPT	10,000	FZ-1612	1.77	1.00	3/8"NPT	3/8"NPT
<b>▼ Cross</b>							
3/8"NPT	3/8"NPT	10,000	FZ-1613	1.77	1.00	3/8"NPT	3/8"NPT





**Product selection**

From	To	Max. pressure	Model number	Dimensions in inch			
				A	B	C	D

▼ Reducers

3/8"NPT	1/4"NPT	10,000	FZ-1630	.75	.56	1/4"NPT	3/8"NPT
---------	---------	--------	---------	-----	-----	---------	---------

▼ Adaptors SAE to 37° Flared Tube

SAE #4	ø .25	5000	FZ-2019	1.22	.56	7/16"UN	ø .25
SAE #8	ø .25	5000	FZ-2039	1.37	.88	3/4"UN	ø .25

▼ Adaptor SAE to 37° Flared End

SAE #2	ø .25	5000	FZ-2025	1.24	.56	5/16"UN	ø .25
SAE #6	ø .25	5000	FZ-2059	1.30	.69	9/16"UN	ø .25

▼ Swivel banjo BSPP to tube

G1/4"	ø 8 mm	10,000	BFZ-307	1.10	1.18	G1/4"	ø 8 mm
-------	--------	--------	---------	------	------	-------	--------

▼ Swivel T-banjo BSPP to tube

G1/4"	ø 8 mm	10,000	BFZ-309	1.10	1.18	G1/4"	ø 8 mm
-------	--------	--------	---------	------	------	-------	--------

▼ Straight union

SAE #4	SAE #4	5000	FZ-2005	1.22	.56	7/16"UN	7/16"UN
SAE #8	SAE #8	5000	FZ-2040	1.17	.88	3/4"UN	3/4"UN

▼ SAE plug

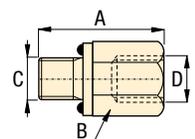
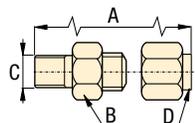
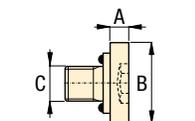
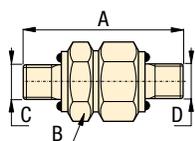
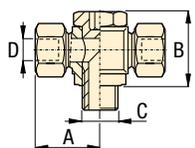
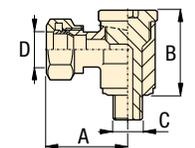
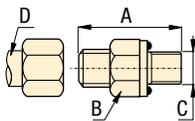
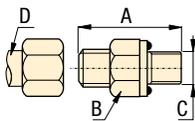
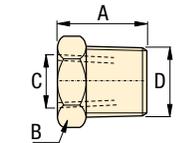
SAE #4	-	5000	FZ-2006	.10	.56	7/16"UN	-
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▼ Adaptor NPT to 37° Flared End Tube

1/4"NPT	ø .25	5000	FZ-2020	1.41	.56	1/4"NPT	ø .25
1/8"NPT	ø .25	5000	R-1054	1.28	.50	1/8"NPT	ø .25
3/8"NPT	ø .25	5000	FZ-2061	1.44	.75	3/8"NPT	ø .25

▼ Adaptors

G1/8"	1/8"NPT	5000	FZ-2055	.95	.75	G1/8"	1/8"NPT
G1/4"	1/4"NPT	5000	FZ-2023	1.26	.88	G1/4"	1/4"NPT
1/4"NPT	SAE #4	5000	FZ-2042	1.31	.69	1/4"NPT	7/16"UN
SAE #6	1/4"NPT	5000	FZ-2056	1.16	.75	9/16"UN	1/4"NPT
G1/8"	1/4"NPT	5000	FZ-2060	1.21	.75	G1/8"	1/4"NPT



Pressure: 0-10,000 psi

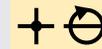
Threads: NPT, UNF, BSPP

For tubing: .25 inch / 8 mm

**E** Acoplamientos

**F** Raccords

**D** Verschraubungen



**Options**

Gauges



134 ▶

Manifolds, couplers, hoses, tubing



136 ▶

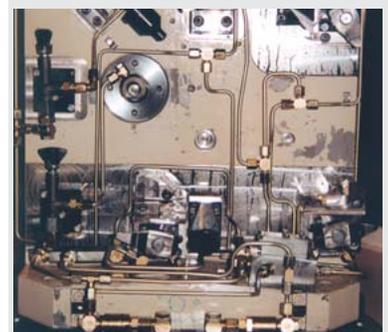
**Important**

Do not exceed maximum pressure.

Use fittings and tubing in high cycle applications and areas having excessive heat or weld splatter.

To seal NPT threads use anaerobic thread sealers or Teflon paste. Apply Teflon tape one thread from the end of the fitting, to prevent it from winding up in the hydraulic system.

High pressure hydraulic fittings allow connection of many components with minimum effort.



Pressure: 0-5000 psi

Threads: NPT, UNF, BSPP

For tubing: .25 inch / 8 mm

- E** Acoplamiento
- F** Raccords
- D** Verschraubungen



## Options

Manifolds, couplers, hoses, tubing

136 ▶



## Important

Do not exceed maximum pressure.

Use fittings and tubing in high cycle applications and areas having excessive heat or weld splatter.

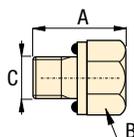
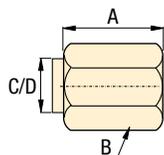
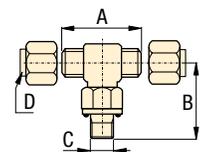
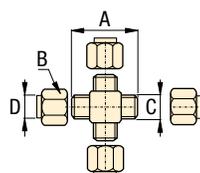
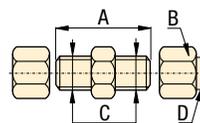
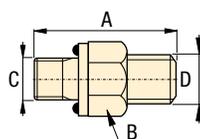
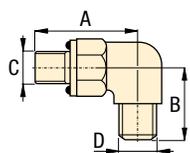
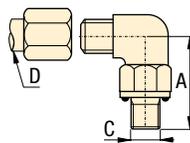
High pressure fittings enable the design of hydraulic systems to meet a variety of applications.



99-000

## Product selection

From	To	Max. pressure psi	Model No.	Dimensions in inch			
				A	B	C	D
<b>▼ Elbow SAE to 37° Flared End</b>							
SAE #2	ø .25	5000	FZ-2024	1.03	.75	5/16"UN	ø .25
SAE #4	ø .25	5000	FZ-2035	1.03	.75	7/16"UN	ø .25
<b>▼ Elbow BSPP to 37° Flared End</b>							
G1/8"	SAE #4	5000	FZ-2051	1.02	.89	G1/8"	7/16"UN
G1/4"	SAE #4	5000	FZ-2052	1.26	1.06	G1/4"	7/16"UN
<b>▼ Straight union BSPP to 37° Flared End</b>							
G1/8"	SAE #4	5000	FZ-2053	1.13	.89	G1/8"	7/16"UN
G1/4"	SAE #4	5000	FZ-2054	1.26	1.06	G1/4"	7/16"UN
<b>▼ Straight union 37° Flared Tube Ends</b>							
1/4"	ø .25	5000	FZ-2033	1.37	.50	1/4"	ø .25
<b>▼ Cross Flared 37° Tube Ends</b>							
1/4"	ø .25	5000	FZ-2034	1.78	.50	1/4"	ø .25
<b>▼ Tee SAE to Flared Tube</b>							
SAE #4	ø .25	5000	FZ-2036	1.78	1.03	7/16"UN	ø .25
<b>▼ 37° Flared nut and sleeve for 1/4" tubing</b>							
1/4"	ø .25	5000	FZ-2037	.61	.56	37°	ø .25
<b>▼ 37° Flared cap for 1/4" tubing</b>							
1/4"	ø .25	5000	FZ-2038	.61	.56	37°	ø .25
<b>▼ SAE Plug</b>							
SAE #8	-	5000	FZ-2041	.73	.69	3/4"UN	-





## Enerpac "Yellow Pages"

*stand for*

### Hydraulic Information!

If selecting hydraulic equipment is not your daily routine, then you will appreciate these pages. The "Yellow Pages" are designed to help you work with hydraulics. They will help you to better understand the basics of hydraulics of system set-ups and the most commonly used hydraulic techniques. The better your choice of equipment, the better you will appreciate hydraulics.

Take the time to go through these "Yellow Pages" and you will benefit even more from Enerpac hydraulic workholding.

#### GLOBAL LIFETIME WARRANTY STATEMENT



**www.enerpac.com**  
Visit our web site for the complete Global Lifetime Warranty or call your Authorized Service Center.

Enerpac products are warranted to be free of defects in materials and workmanship. Any product that does not conform to specification will be repaired or replaced at Enerpac's expense, anywhere in the world; simple as that!

This warranty does not cover ordinary wear and tear, abuse, misuse, alterations, or the use of improper fluids. Determination of the authenticity of a warranty claim will be made only by Enerpac or its Authorized Service Centers.

**Enerpac is certified for several quality standards. These standards require compliance with standards for management, administration, product development and manufacturing.**



Enerpac worked hard to earn the quality rating ISO 9001, in its ongoing pursuit of excellence.

#### UL approved

All electrical components used on Enerpac products carry the UL rating when possible.

#### Index

▼ page

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Conversion factors and hydraulic symbols	157 - 163
Valving technology	164 - 167
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Converting from mechanical clamping to hydraulic clamping	170 - 172



#### Canadian Standards Association



Where specified, Enerpac electric pump assemblies meet the design, assembly and test requirements of the Canadian Standards Association.

#### Product Design Criteria

All hydraulic components are designed and tested to be safe for use at maximum 350 bar/5,000 psi pressure unless otherwise specifically noted.

#### EMC Directive 89/336/EEC

Where specified, Enerpac electric power pumps meet the requirements for Electromagnetic Compatibility per EMC Directive 89/336/EEC.

#### World Standard Guarantee



All Enerpac products are guaranteed against defects in workmanship and materials for as long as you own them. Replace worn or damaged parts with genuine Enerpac parts. These are designed to fit properly and withstand rated loads.

#### CE Marking & Conformity



Enerpac provides a Declaration of Conformity and CE marking for products that conform with the European Community Directives.



Hydraulic clamping can increase your machine shop's efficiency by reducing setup time. Power clamping can also maximize output in another way—by reducing employee lost time due to the injuries that can occur with manual clamping.

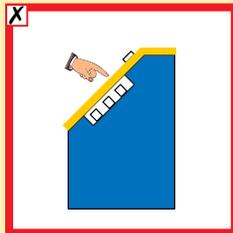
Although hydraulic operation moves the control of the clamping fixture to an area of greater safety, operators must still be alert to several common sense practices. And to that end we offer some DOs and DON'Ts, simple common sense points which apply to all Enerpac hydraulic products.

The line drawings and application photos of Enerpac products throughout this catalog are used to portray how some of our customers have used hydraulics in industry. In designing similar systems, care must be taken to select the proper components that provide safe operation and fit your needs.

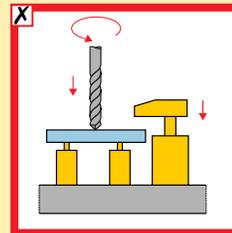
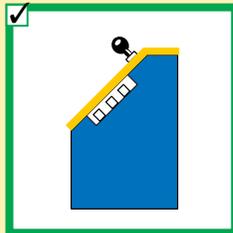
Check to see if all safety measures have been taken to avoid the risk of injury and property damage from your application or system.

Enerpac can not be held responsible for damage or injury, caused by unsafe use, maintenance or application of its products. Please contact the Enerpac office or a representative for guidance when you are in doubt as to the proper safety precautions to be taken in designing and setting up your particular system.

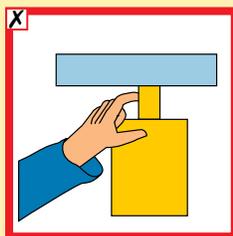
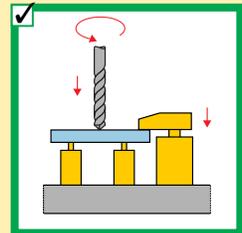
In addition to these tips, every Enerpac product comes with instructions spelling out specific safety information. Please read them carefully.



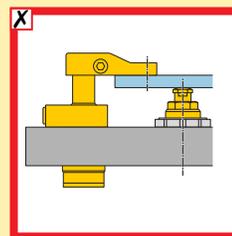
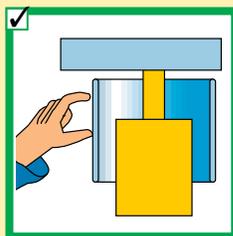
Prevent inadvertent activation of the control units of power operated clamping systems.



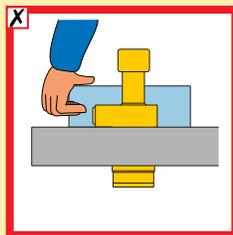
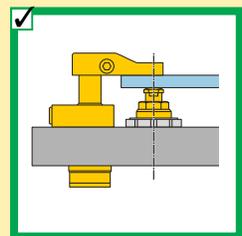
Clamping devices must be activated before main spindle can be started.



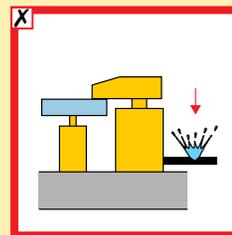
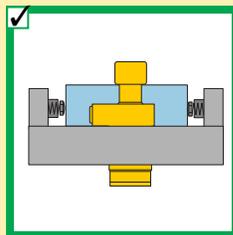
Obey the safe distance between clamping elements and workpiece to avoid personal injury.



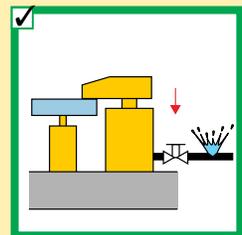
Do not apply off-center load. Clamping force must be directly over the support point.

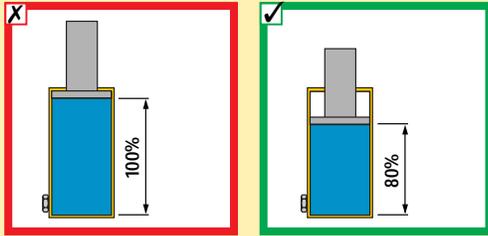


Use mechanical devices and not fingers to hold part until the hydraulics are activated.

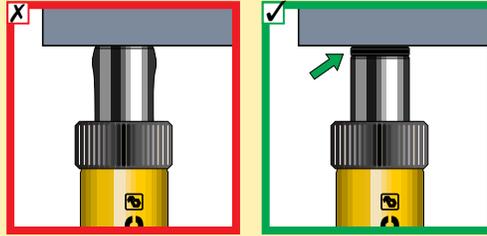


Use check-valves to maintain hydraulic pressure to clamping devices in the event of a hydraulic line failure.

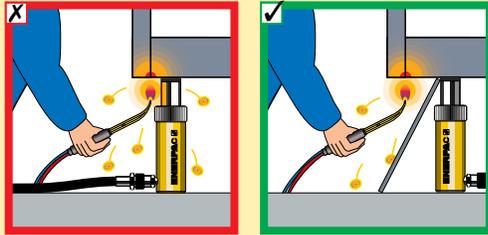




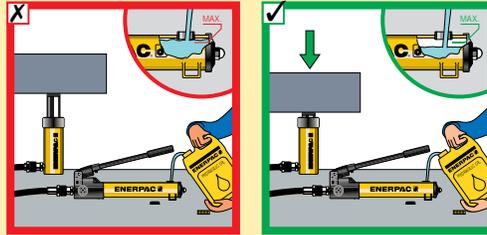
Do not operate cylinders beyond limits of rated stroke or pressure. Use only 80% of usable stroke.



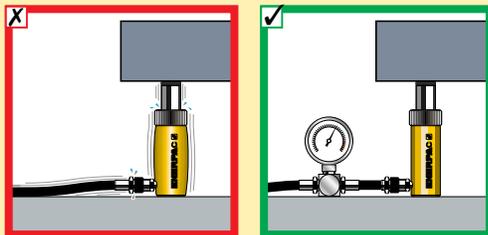
Use saddles or buttons to prevent mushrooming of plungers. Saddles distribute load evenly on the plunger.



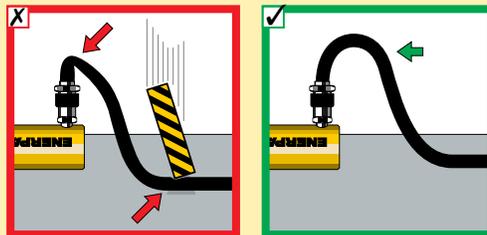
Keep hydraulic equipment away from open fire and temperatures above 150 °F / 65 °C.



Fill pump only to recommended level. Fill only when connected cylinders are fully retracted.



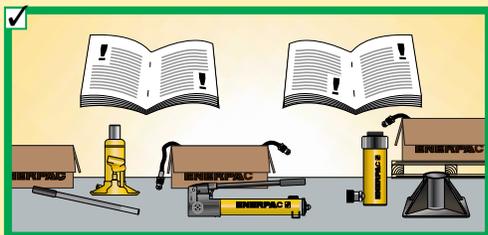
Do not override the factory setting of pressure relief valves. Always use a gauge to check system pressure.



Do not kink hoses. Bending radius must be at least 4.5 inch (115 mm). Do not drive over or drop heavy objects on hoses. Use high pressure tubing in high cycle applications.



Use genuine Enerpac hydraulic oil. Wrong fluid destroys seals and pump, will render your warranty null and void your guarantee.



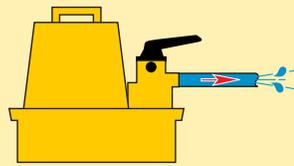
Always read instructions and safety warnings that come with your Enerpac hydraulic equipment.



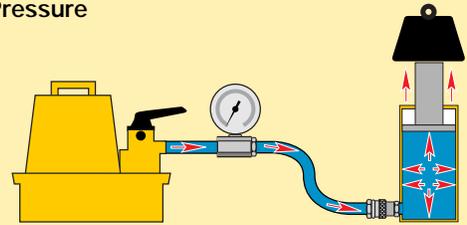
## Oil Flow

A hydraulic pump produces flow. Flow is the amount of fluid coming out of the pump.

Oil Flow



Pressure



## Pressure

Pressure occurs when there is resistance to flow.

## Pascal's Law

Pressure applied at any point upon a confined liquid is transmitted undiminished in all directions (Fig.1). This means that when more than one hydraulic cylinder is being used, each cylinder will pull or push at its own rate, depending on the force required to move the load at that point (Fig. 2).

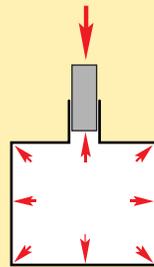


Figure 1

Cylinders with the lightest load will move first and cylinders with the heaviest load will move last (Load A), if the cylinders have the same capacity.

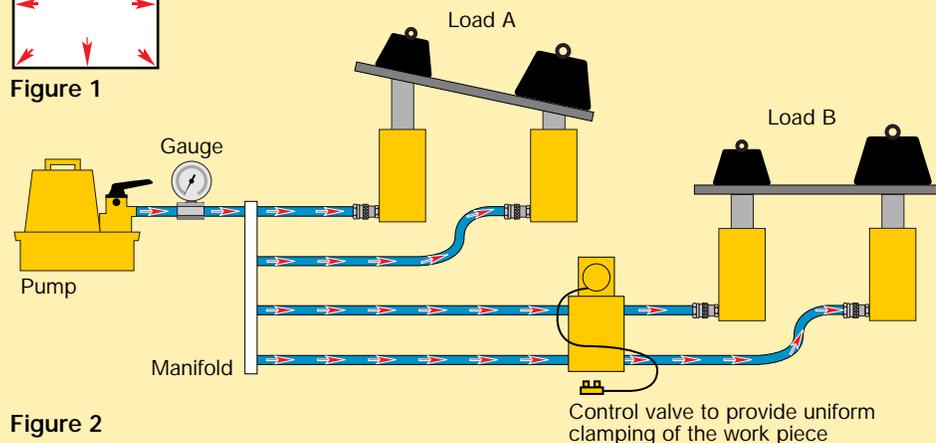


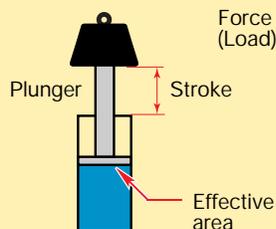
Figure 2

To have all cylinders operate uniformly so that the load is being pulled or pushed at the same rate at each point, control valves (see Valve section) must be added to the system (Load B).

## Force

The amount of force a hydraulic cylinder can generate is equal to the hydraulic pressure times the "effective area" of the cylinder (see cylinder selection charts).

Use the formula  $F = P \times A$  to determine either force, pressure or effective area if two of the variables are known.



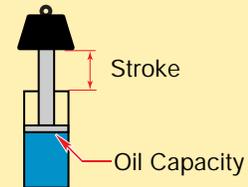
Force	=	Hydraulic Working Pressure	x	Cylinder Effective Area
F	=	P	x	A



### Cylinder Oil Capacity

The volume of oil required for a cylinder (cylinder oil capacity) is equal to the effective area of the cylinder times the stroke.

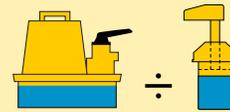
$$\begin{array}{|c|} \hline \text{Cylinder Oil Capacity} \\ \hline \text{in}^3 \\ \text{(cm}^3\text{)} \\ \hline \end{array} = \begin{array}{|c|} \hline \text{Cylinder Effective Area} \\ \hline \text{in}^2 \\ \text{(cm}^2\text{)} \\ \hline \end{array} \times \begin{array}{|c|} \hline \text{Cylinder Stroke} \\ \hline \text{in} \\ \text{(cm)} \\ \hline \end{array}$$



### Usable Oil Capacity

The amount of hydraulic oil in the pump's reservoir which can be used to activate one or more cylinders.

$$\begin{array}{|c|} \hline \text{Pump Usable Oil Capacity} \\ \hline \text{in}^3 \\ \text{(cm}^3\text{)} \\ \hline \end{array} \div \begin{array}{|c|} \hline \text{Cylinder Oil Capacity} \\ \hline \text{in}^3 \\ \text{(cm}^3\text{)} \\ \hline \end{array} = \begin{array}{|c|} \hline \text{Total Number of Cylinders} \\ \hline \end{array}$$



### Cylinder Speed

Cylinder speed is determined by dividing the pump flow rate by the cylinder effective area.

$$\begin{array}{|c|} \hline \text{Cylinder Clamp Speed} \\ \hline \text{(mm/sec)} \\ \hline \end{array} = \frac{\text{Pump Flow Rate (cm}^3\text{/min)}}{\text{Cylinder Effective Area (cm}^2\text{)}} \times \frac{10}{60}$$

## Seals

Various seal types are used in our hydraulic equipment: O-rings, U-cups, Quad-rings and T-rings for static and dynamic applications such as rod-seal, piston-seal and wipers. Buna-N (nitrile rubber) and Polyurethane basic compounds are most frequently used - they offer the best performance and durability for most applications.

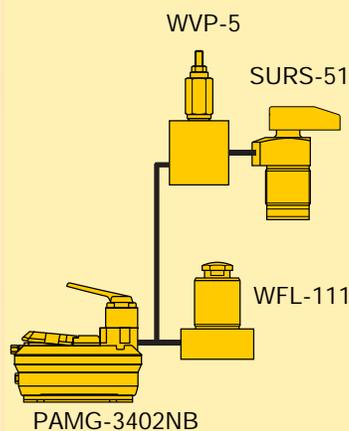
Heat is a crucial factor in seal life. Maximum temperature for good seal life is 150°F (65°C). This is also the maximum temperature of Enerpac hydraulic oil. Above 150°F, the use of Viton and high temperature oil is necessary. Viton has a maximum temperature which is much higher than nitrile or polyurethane. Viton is however an extremely quick wearing material. In many cases Viton seals will have a short working life due to abrasive wear.

Not all machine tool coolants are compatible with standard Enerpac seals. While most are, there are coolants that can harden or soften seals, which may result in free entry of contamination into the hydraulic cylinder. Using a high water based coolant may cause severe corrosive damage. This will often occur on fixtures where coolant has been allowed to pool for an extended period of time and evaporation has allowed it to concentrate. Drain and clean fixtures after use.

Often Viton seals are an immediate cure for coolant attack on standard Enerpac seals. When using Viton seals in cylinders, seals in the power source must also be replaced by Viton because inevitably some coolant will enter the hydraulic system. Consult the coolant manufacturer to verify compatibility with any seal material. Cutting fluid suppliers will provide an application book on the compatibility of their fluids. If problems arise after previous successful use, or if problems persist, contact Enerpac.



Building the right workholding system for a specific production tooling requirement is best achieved by observing the following basic steps – three steps deal with equipment selection, one with system connection.



## Step 1

Selecting the type of cylinders, determined by shape and size of workpiece and the machining process involved, is the critical factor in any workholding system. For that reason, Enerpac offers an exceptionally broad range of production tooling cylinders – in terms of type, stroke and force rating.

**Positioning and push cylinders** are designed to position the workpiece and to push-clamp it securely in that position.

**Down-holding cylinders** are designed to clamp the positioned workpiece firmly to the fixture or worktable. The range of Enerpac swing cylinders and edge-clamps meet virtually any down-holding requirement.

**Pull cylinders** are used where the workpiece shape or fixture dictates clamping by pull forces, this type of cylinder with hydraulic or spring return can be selected to match particular needs.

**Work support cylinders** are designed to maintain the workpiece accurately on the prescribed plane throughout the machining operation. These support cylinders preclude both vibration and distortion problems.

## Step 2

Select cylinder force and stroke, and choose single or double-acting operation. The choice of force and stroke is largely dependent on size and shape of the workpiece and machining operation involved. Another factor to be considered is working space or clearance around the job, fixture or worktable.

Where a machining operation requires positive hydraulic return action, double-acting cylinders should be specified. Where spring-return action is sufficient, single-acting cylinders or a combination of the two can be used.

## Step 3

Select the power source. The power source for an automatic workholding system can accurately be matched to the requirements. Enerpac pumps span a wide range of sizes and capacities – in compressed air or electric-driven configurations.

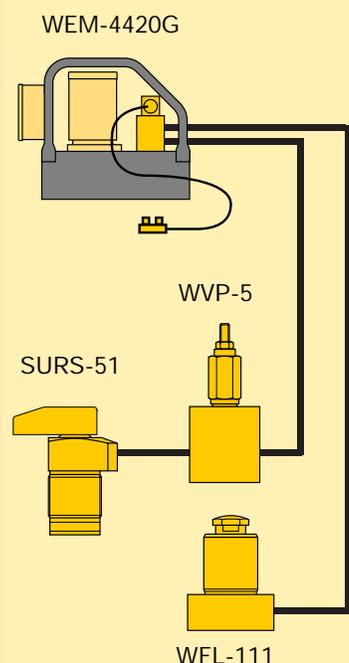
## Step 4

Connect the system. Getting your workholding system together for operation means connecting the pump to the various control valves and cylinders through a circuit of hoses and/or piping, fittings, gauges and other accessories.

For example, two swing cylinders and work support cylinders working in sequence, powered by an electric-drive hydraulic pump unit would require the following components:

1. WE Workholding pump
2. GA Gauge Adaptor
3. G Pressure gauge
4. H Hoses
5. FZ Fittings
6. SU Swing cylinders
7. WFL Work Support cylinders
8. WVP-5 Sequence valve

Select all these components from their respective catalog sections.





## Swing Cylinders and Worksupports

The combined use of clamping cylinders and work supports in fixturing has become indispensable.

**Swing cylinders** have become important clamping components for fixturing applications where unrestricted loading and unloading of the workpiece is required. Enerpac offers the most complete, comprehensively featured and compact swing cylinder line.

**Work supports** are widely used to support critical workpiece areas to prevent them from bending and/or vibrating during the machining process. This minimizes the deflection of the workpiece, improving its quality and assuring a high degree of repeatability.

The combination of swing cylinders and work supports provides substantial time savings and quality improvements in the machine tool industry.

### Support forces

When designing a fixture, several products features of swing cylinders and work supports have to be considered. The determination of the necessary support force and the size of the work support is very critical. In principle the work support has to overcome two forces:

- clamping forces
- machining forces (including forces that may be generated by vibrations)

### Clamping forces

In practice, as a rule of thumb, the clamping force applied to the work support should not exceed 50% of its capacity at a given operating pressure. For many applications this is sufficient to absorb additional forces like machining forces. This 2 to 1 safety factor may need to be increased to 4 to 1 if extreme vibration or an interrupted cut is used.

The pressure/force diagrams, provided in the product selection pages of this catalog, allow for quick selection of the right combination of swing cylinder and work support.

The recommended ratio between clamping force and support force can be achieved by selecting the right sizes of the clamping components and/or by operating the swing cylinder and the work support with different operating pressures, e.g. the work support will be operated at maximum pressure while the swing cylinder operates at a reduced pressure.

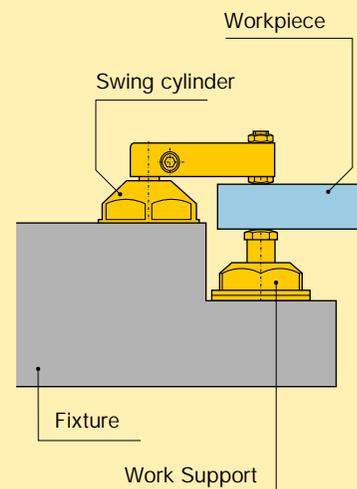


Figure 1  
The combined use of clamping cylinders and work supports.



[www.enerpac.com](http://www.enerpac.com)

Download the **Swing Clamp Selection Tool**.

The size of the swing cylinder that can be used depends on the required force and length of the clamping arm.

With this tool you can determine, based on above mentioned input and type of clamp, which size of clamp can be used.



## Point of contact

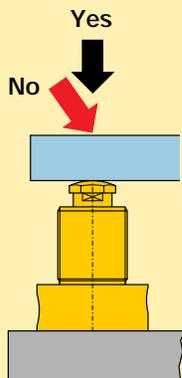


Figure 2

The direction of the clamping force must be axial at the centerline of the work support's plunger for best results in clamping and repeatability of quality. Side loading of the work support must be avoided in order to ensure reliable and safe function (Figure 2).

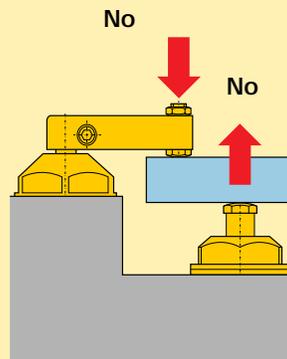


Figure 3

An off-set load will cause bending of the workpiece and uncontrolled deflection (Figure 3).

## Hydraulic requirements

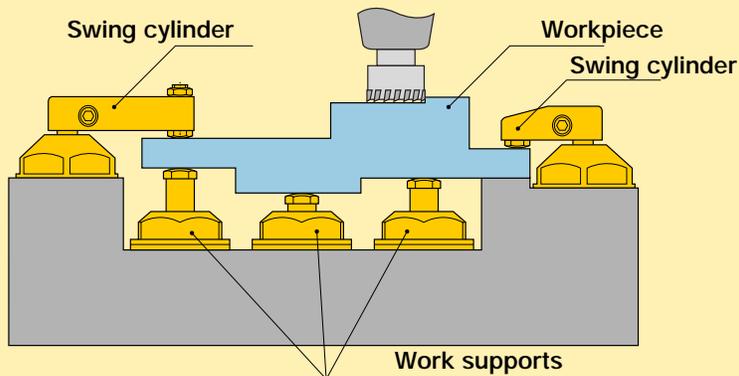


Figure 4

Swing cylinders and hydraulically advancing work supports are very sensitive regarding the oil flow rate applied.

To ensure safe and reliable function of these elements the maximum oil flow rate indicated in the catalog pages and in the instruction literature must not be exceeded. If there is the risk of high oil flow rates it is recommended to use flow control valves to adjust the flow rate.

During the clamping sequence it must be ensured that work supports will be operated only after the workpiece is firmly positioned and held against locators and datums. However, if the cylinder is clamping directly over the work support, the work support should be brought to full pressure before the cylinders clamp. This can be done by using a sequence valve.



**Hydraulic requirements** (continued)

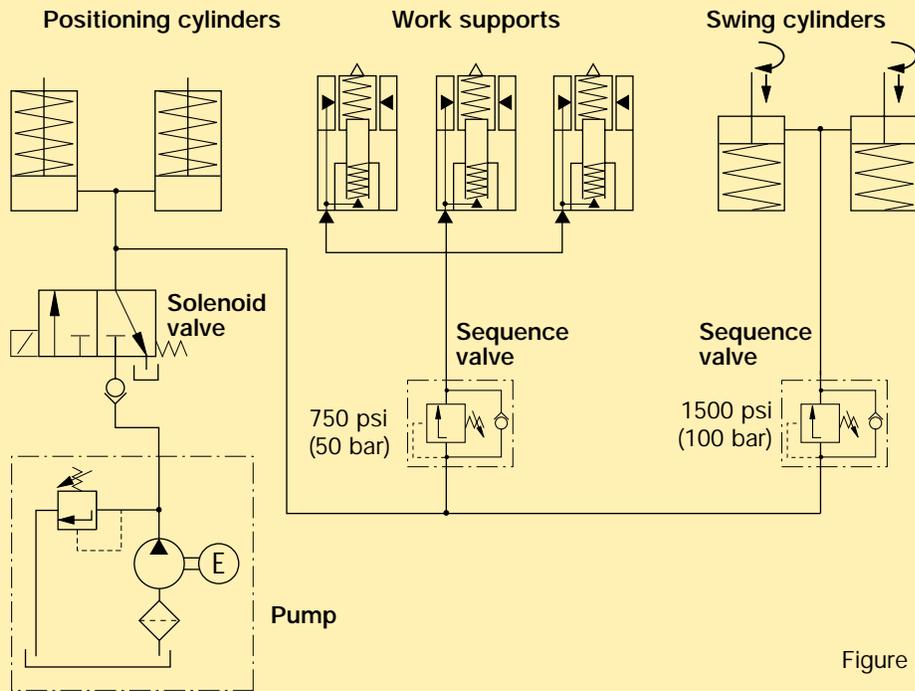


Figure 5

For overhanging areas of the workpiece which have to be supported, the recommended sequence should be as follows (Figure 5):

1. Positioning of the workpiece
2. Actuate work supports
3. Clamp the overhanging area against work support.

The hydraulic sequence can be controlled either by independently controlled hydraulic circuits (Figure 6) or by sequence valves (Figure 7).

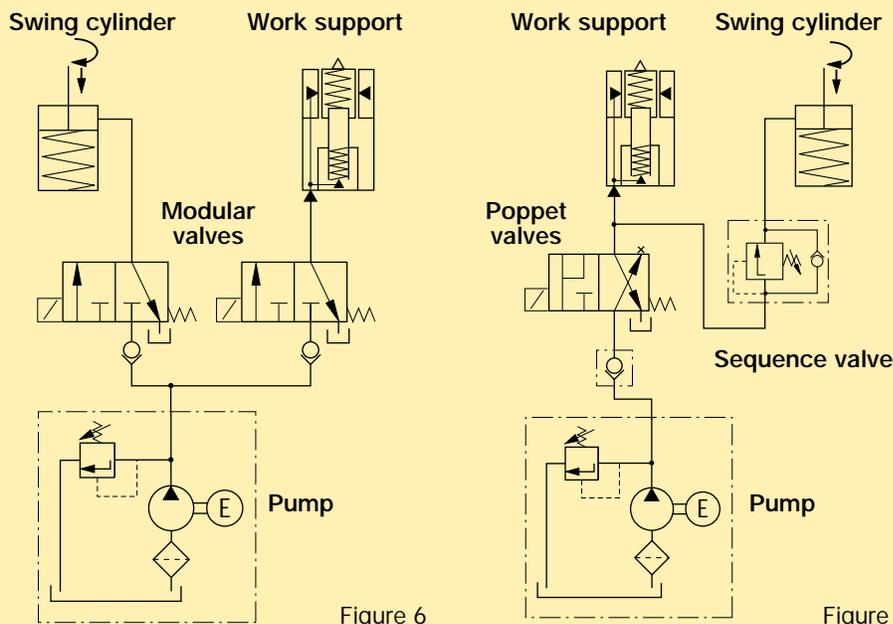


Figure 6

Figure 7

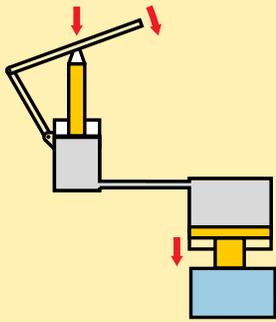


Figure 1: Operating principle of a hydraulic clamping device

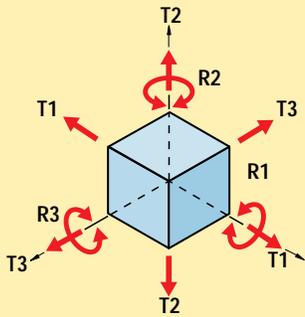


Figure 2: Three-dimensional body

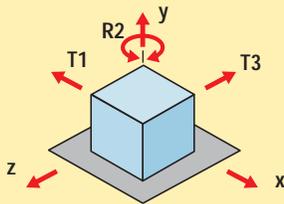


Figure 3a: Three degrees of freedom

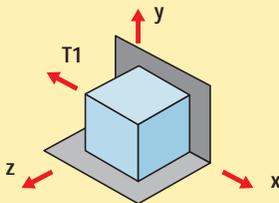


Figure 3b: One degree of freedom.

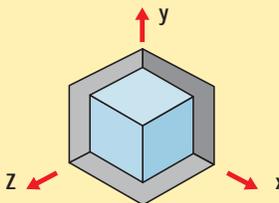


Figure 3c: Zero degree of freedom

## 1 Basic principles

1.1 A simple hydraulic clamping mechanism (Figure 1).

### 1.2 Terms and definitions

1.2.1 Clamping Plunger  
A device that applies clamping force to the workpiece.

1.2.2 Workpiece  
The part or material that is to be held in place.

1.2.3 Pressure Piston  
A device used to apply pressure to a hydraulic medium.

1.2.4 Hydraulic Medium  
A fluid used to transmit the pressure created by applying a force to the pressure piston

### 1.3 Hydraulic clamping process

The hydraulic clamping process consists of properly applying the forces created by a hydraulic clamping system to secure a workpiece. A hydraulic clamping system consists of the components illustrated in Figure 1, which shows the basic arrangement and operating principle of the use of hydraulic media.

Any such process using hydraulic fluids for clamping purposes may be referred to as a hydraulic clamping system. The operating pressure provided by hydraulic fluids in clamping systems can reach a maximum of 5000 psi (350 bar), allowing the application of considerable clamping forces even when using compact clamping cylinders.

When properly designed and controlled, the hydraulic clamping mechanism will prevent the workpiece from moving (sliding, twisting, etc.) when machining or other forces are applied, yet will not cause an unexpected permanent distortion to occur in the workpiece.

## 2 Assembly of hydraulic clamping devices

### 2.1 Locating, clamping, and supporting workpieces

#### 2.1.1 Locating a Body

The term “locating” refers to the process of positioning the workpiece inside the clamping device, and holding it in position for the necessary machining. Only workpieces that are correctly held can be consistently machined within specified tolerances.

#### 2.1.2 Limiting the degrees of freedom

The process of locating and holding a workpiece may be referred to as “limiting the degrees of freedom.” Any motion of a workpiece in any possible direction is considered to represent one degree of freedom.

A three-dimensional workpiece therefore possesses six degrees of freedom, as shown in Figure 2. These six degrees of freedom consist of the translational motions “T” in x, y, and z direction, and the rotational motions “R” turning about the x, y, and z axes.

The degrees of freedom that a given workpiece or body possesses may be reduced by introducing reference planes that pass through any two axes.

For example, the plane in Figure 3a limits movement to travel in x and z directions and rotation about the y-axis. By defining this fixed plane, the workpiece can thus be limited or constrained to three degrees of freedom.

Another two degrees of freedom may be constrained by introducing a second reference plane, as shown in Figure 3b. This reference plane limits movement to translational motion in the x direction.

Constraining the last degree of freedom can be accomplished by defining a third reference plane as shown in Figure 3c.

## 2.1.3 Locating a Workpiece

Since locating a workpiece does not necessarily require the elimination of movement in all six degrees of freedom, the following three locating techniques are used in actual practice.

Figure 4a: Semi-constrained Workpiece. The workpiece is held in one plane only (elimination of three degrees of freedom).

Figure 4b: Constrained Workpiece. The workpiece is held by two planes (elimination of five degrees of freedom)

Figure 4c: Fully-constrained Workpiece. The workpiece is held by three planes (elimination of six degrees of freedom)

## 2.1.4 Avoiding Over-location

- Workpiece with locating planes
- Incorrectly located workpiece
- Correctly located workpiece

Over-location of the workpiece occurs when there is more than one locating plane or point for any given degree of freedom.

To prevent bending the b-c rib while machining the piece, a third reference plane (3) is introduced. Placing a workpiece (6) inside the clamping device (4) causes over-location. Since the distance between the locating planes (1) and (3) is constant in this device, the dimension c differs between individual workpieces. This over-location therefore gives rise to machining error.

Figure 5c shows how to locate a workpiece correctly. To avoid tilting the workpiece, the torque "M" transferred from the workpiece (5) to the body to be machined (6) must be balanced by an appropriate counter-torque. This counter-torque is created by the clamping force "F."

Over-location may also occur if a workpiece (Figure 5) is limited by too many locating points. The introduction of more than three locating points along the bearing surface, or more than two points in the guide plane, or more than one point in the supporting plane may lead to undesirable workpiece motion, and thus adversely affect the precision of the resulting product. Any additional support points must be adjustable.

If the workpiece to be machined must be supported to avoid deflection, then all other bearing points must be defined as variables and must be determined in relationship to the workpiece being machined.

The location process is subject to a number of design guidelines, but exceptions are possible.

- Always arrange the location points according to the pre-machined condition of the workpiece. Previously machined points have priority as desirable locating points.
- The locating points on the locating plane should be as far away from each other as possible.
- Arrange the clamping points such that the defined position is retained during clamping.
- The locating points should be in line with the clamping points to shorten the force vectors inside the workpiece. Three, two, or even one clamping point may be used to clamp a workpiece against the locating plane.
- Precision surfaces should not be held on a continuous surface, so that an "infinite" number of contact points can be avoided.

## 3 Clamping

The term "clamping" refers to the secure fastening of an already positioned workpiece in a clamping device for machining purposes. Locating and clamping may be viewed as a combined operation.

Clamping is invariably associated with force transmission through the device. The force vector should, as far as possible, describe a straight line from the application point of the clamping force through the workpiece to the bearing points.

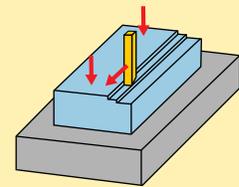


Figure 4a: Semi-constrained Workpiece.

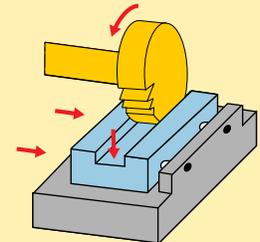


Figure 4b: Constrained Workpiece.

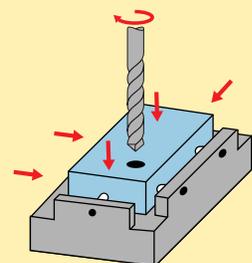


Figure 4c: Fully-constrained Workpiece.

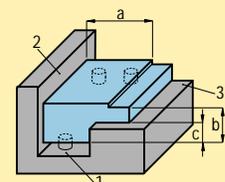


Figure 5a: Workpiece with locating planes.

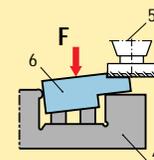


Figure 5b: Incorrectly located workpiece.

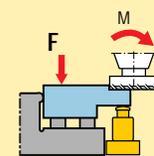


Figure 5c: Correctly located workpiece.

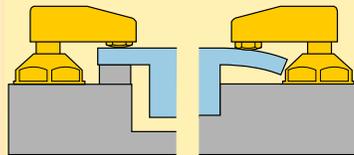


Figure 6: Design guidelines for clamping.

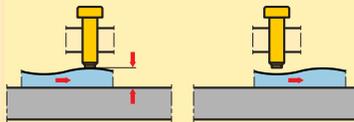


Figure 7: Mechanical clamping.

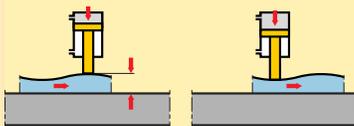


Figure 8: Hydraulic clamping.

As with clamping, locating is subject to a number of design guidelines, although exceptions are possible:

- Keep the clamping force vector away from the critical tolerance zones on the workpiece.
- Workpiece deformation and marking due to clamping forces should be avoided or minimized.
- The clamping points on the workpiece should be selected so that the piece can be machined without reclamping or, if this is not feasible, with a minimum of reclamping.
- The required clamping forces should be approximated by rough estimations.
- The clamping dimensions of the workpiece may change due to thermal expansion and vibration resulting from machining.
- The workpiece should only be exposed to a clamping force if it is appropriately supported by a solid bearing point, as illustrated in Figure 6.

The dimensions of clamped workpieces may change due to vibrations and the effects of thermal expansion. Two types of clamping may compensate for these changes.

- Mechanical Clamping
- Hydraulic Clamping

The illustration in Figure 7 (mechanical clamping) demonstrates that tension is relieved as the dimensions of the workpiece in the clamping area change.

In hydraulic clamping, the clamping elements gripping the workpiece adjust to changes while maintaining a constant clamping force. This is illustrated in Figure 8, where the workpiece is elongated due to temperature increases during machining.

Mechanical clamping is accomplished by using the following mechanical clamping elements:

- Clamping Bars
- Clamping Springs
- Clamping Nuts
- Clamping Bolts (Figure 7)

Hydraulic clamping is achieved by:

- Elastomeric Media
- Clamping with air (pneumatic clamping)
- Clamping with liquids (hydraulic clamping)

Mechanical clamping elements are usually used for simple clamping devices. However, mechanical clamping elements may be converted to hydraulic ones by inserting cylinders between the clamping element and the workpiece. In addition, mechanical elements may also be combined with hydraulic clamping elements.

Clamping may be subject to errors that cause deformation of the clamped workpiece. Since such deformations must not affect the function of the workpiece, all conceivable locating and supporting techniques, as well as the best possible directed transmission of the clamping force through the workpiece, should be considered.

It is recommended that clamping forces be estimated to prevent excessively high clamping forces and possible deformation of the workpiece. Deformation of the workpiece may also be avoided by selecting a suitable shape (for example, a sphere) for the clamping points and the locating points.

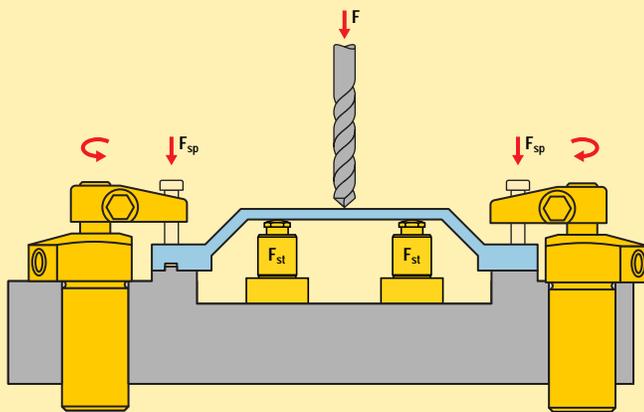


Figure 9: Supported workpieces.

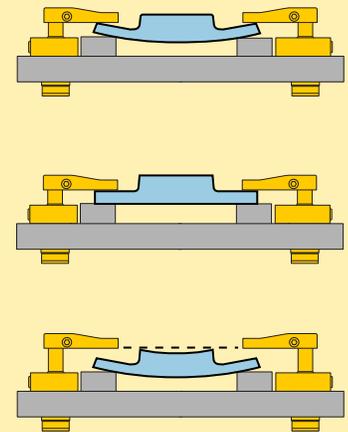


Figure 10a: Deformation caused by conventional clamping.

## 4 Supporting the workpiece

### 4.1 Supported workpiece

The workpiece requires support to ensure functional force transmission between the tool, the workpiece, and the clamping device, and / or to protect the workpiece from deformation (such as deflection at points with a thin cross-section) due to machining forces, gravitational forces, and clamping forces. Workpiece support also acts to eliminate the resulting machining errors (Figure 9).

In addition, surface quality may be improved and the service life of the tool prolonged with the use of an optimum supporting mechanism. The three-dimensional position of a workpiece, however, should not be defined by its support. It is preceded sequentially by the locating process and also has a lower priority.

### 4.2 Supporting Options for Bent Workpieces

- Unclamped workpiece
- Clamped workpiece
- Machined workpiece

A workpiece is considered to be supported even if it must be supported by frequently mobile and variable elements surpassing the theoretical maximum number of locating points. An example of this would be an unstable workpiece that easily vibrates.

When a deformed workpiece must be held and clamped in all three planes without altering its shape, it is possible to use a technique involving self-adjusting spherical surfaces. In this case

the bearing surfaces, the close-tolerance bolts, the limit stops, and the vertically adjustable supporting and clamping elements must be equipped with spherical surfaces.

The illustrations in Figure 10 illustrate two different clamping methods. It shows deformation of a workpiece caused by conventional clamping (Figure 10a). As a result of this deformation, the surface area of the workpiece exhibits a greater degree of deformation when unclamped.

This deformation, which is convex in shape, may be attributed to the fact that the workpiece assumes its original, deformed shape (c), as soon as the clamping pressure is released.

The clamping points illustrated in Figure 10b are spherically shaped, and can therefore largely adapt to the workpiece curvatures (b). The machined surface is therefore flat, and the workpiece is only exposed to possible internal stresses that may be released by machining.

### 4.3 Determination of the Clamping Force

It is important to ensure that a workpiece that is clamped inside a device is not moved from its position by the clamping force and the subsequent action of the cutting force. This risk of movement may be minimized by applying the clamping force to the solid bearing surfaces of the device (Figure 11).

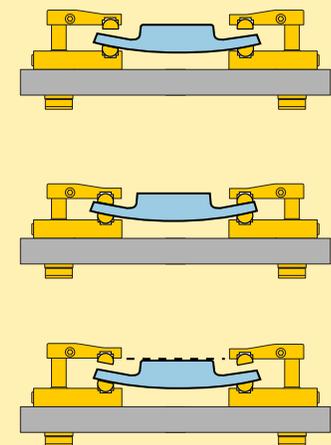


Figure 10b: Eliminate deformation using spherical ball supports.

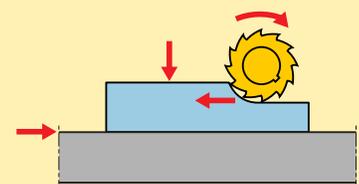
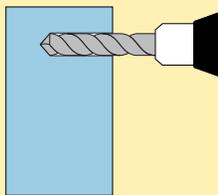
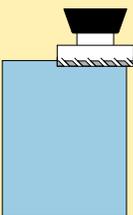


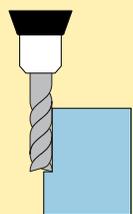
Figure 11: Approximation of the clamping force.



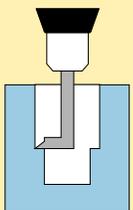
Drilling



Face milling



End mill



Boring

## Introduction

This introduction will help you use information provided by tool manufactures in the application of their tools. Estimating cutting forces being transferred into the workpiece is just one tool to use in a competitive workholding environment.

The information presented here is only to be a guideline and not the final decision. Use this information with a cutting tool brochure you get from your cutting tool supplier as an aid in determining your cutting forces. Much of the calculations presented here are readily available from many sources. Your cutting supplier may even have a little slide chart you can obtain to do equations for you.

The operations described here include boring, drilling, end milling and face milling.

**Drilling** involves using a multi-fluted tool with a helix spiral. The tool is driven in as it is rotated to create a round hole.

**End Milling** uses a multi-fluted rotary tool with or without removable (inserts) teeth to remove material along the edge of the workpiece. The cut is usually very shallow and the depth is many times the thickness of the cut.

**Face Milling** involves a very shallow depth, but a very wide cut. Cutters can range up to 12 inches (300 mm) or more in diameter and can have many replaceable teeth (inserts).

These examples are only a very small sample of operations that can use hydraulic workholding.

## Cutting force determinations

These cutting force examples involve face milling. The largest use of hydraulic workholding is by far for some sort of milling operations.

### 1 Imperial system

Cutting Force (Pounds) = Spindle Horsepower x 26400 (Horsepower to foot pounds per minute at 80% efficiency)/Cutting Speed (In tool surface feet per minute) Spindle Horsepower = Unit Power (Horsepower per cubic inches of material removed per minute) x Material removal rate (Cubic Inches per Minute)

Material removal rate (Cubic inches per minute) = Width of the cut (Inches) x Depth of the Cut (Inches) x Feed per cutter tooth (Inches) x Number of cutter teeth x Spindle RPM

#### Example

An 8-inch diameter cutter with 10 teeth (inserts) is machining low silicon aluminum at 3000 SFM (surface feet per minute).

First, you must convert surface feet/minute into tool RPM/Solving Tool RPM= SFM

$$\text{Diameter (Inch)} \times .2618 = 1432 \text{ Tool RPM}$$

Now you can determine your material removal rate. An independent tool catalog lists a feed per tooth of 0.008" maximum at 3000 SFM at cut depth of 0.1".

This gives 8" (diameter cutter) x 0.100" (cut depth) x 0.008" (feed per tooth) x 10 (number of teeth) x 1432 (spindle RPM)= 91.6 cubic inches per minute material removal rate.

Next, spindle horsepower is found using unit HP from the table Spindle Horsepower = 91.6 x 0.4 (Unit Horsepower for Aluminum with a dull tool)= 36.6 HP.

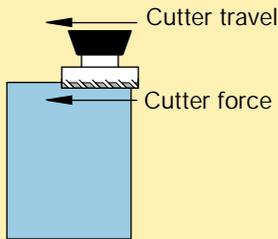
Note this Horsepower is for fixture design and not for machine tool horsepower requirements. For example a true 40 HP machine can remove aluminum well over 200 cubic inches per minute.



Using the original formula:  
 $36.6 \text{ HP} \times 26,400/3000 \text{ SFM} = 322 \text{ lbs.}$   
 3000 SFM of force being transmitted into the work.

Force is transmitted in the same direction as the cutter movement. In other words, if the cutter moves right to left in the diagram below, the cutter force is transmitted from right to left.

Using a safety factor of 2 for rigid clamping gives 644 pounds in line parallel to the line force and 483 pounds using an elastic medium such as hydraulics with a safety factor of 1.5. Note this force does not take into account any sort of friction factors if you plan on relying on friction force between a swing cylinder and the workpiece.



**For example:**  
 The coefficient of friction for lubricated aluminum is .12 (flooded with coolant) this same 483 pounds of force becomes  $483/.12 = 4025$  pounds. This uses clamp force only and does not take into account any direct forces that may be developed by the cylinders that located the workpiece against fixed locators.

$$\text{Cutting Force}^{\text{[1]}} = \frac{\text{Spindle Hp} \times 26406^{\text{[2]}}}{\text{Cutting Speed}^{\text{[3]}}}$$

- [1] Cutting force in Pounds
- [2] Spindle Horsepower to foot-pounds at 80% efficiency
- [3] Cutting tool surface feet per minute

$$\text{MRR}^{\text{[1]}} = \text{W} \times \text{D} \times \text{F} \times \text{N} \times \text{RPM}^{\text{[2]}}$$

- [1] Material Removal Rate (in<sup>3</sup>/min)
- [2] W = Width of cut (in)
- D = Depth of cut (in)
- F = Feed per tooth (in)
- N = Number of cutter teeth
- RPM = Spindle speed

$$\text{Tool RPM} = \frac{\text{SFM}^{\text{[1]}}}{\text{Diameter} \times 0,2618}$$

- [1] SFM = Surface Feet per Minute

## Unit Power for dull tools [imperial system]

Material	Unit Power hp/in <sup>3</sup> /min			
	Hardness	Turning HSS & Carbide Tools	Drilling HSS Drills	Milling HSS & Carbide Tools
<b>STEELS</b>	85-200 Bhn	1.4	1.3	1.4
Plain Carbon	35-40Rc	1.7	1.7	1.9
Alloy Steels	40-50Rc	1.9	2.1	2.2
Tool Steels	50-55Rc	2.5	2.6	2.6
	55-58Rc	4.2	3.2	3.2
<b>CAST IRONS</b>	110-190 Bhn	0.9	1.2	0.8
Gray, Ductile & Malleable	190-320 Bhn	1.7	2.0	1.4
<b>STAINLESS STEELS</b>	135-275 Bhn	1.6	1.4	1.7
	30-45Rc	1.7	1.5	1.9
<b>TITANIUM</b>	250-375 Bhn	1.5	1.4	1.4
<b>NICKEL ALLOYS</b>	80-360 Bhn	2.5	2.2	2.4
<b>ALUMINUM ALLOYS</b>	30-150 Bhn	0.3	0.2	0.4
<b>MAGNESIUM ALLOYS</b>	40-90 Bhn	0.3	0.2	0.2
<b>COPPER ALLOYS</b>	10-80Rb	0.8	0.6	0.8
	80-100Rb	1.2	1.0	1.2



$$\text{Cutting Force} \text{ [1]} = \frac{\text{Spindle kW} \times 48000 \text{ [2]}}{\text{Cutting Speed} \text{ [3]}}$$

- [1] Cutting force (N)
- [2] Spindle power (kW) required at 80% efficiency
- [3] Cutting tool surface speed (m/min)

$$\text{MRR} \text{ [1]} = \frac{W \times D \times F \times N \times \text{RPM} \text{ [2]}}{1000}$$

- [1] Material Removal Rate (cm<sup>3</sup>/min)
- [2] W = Width of cut (mm)  
D = Depth of cut (mm)  
F = Feed per tooth (mm)  
N = Number of teeth  
RPM = Spindle speed

$$\text{Tool RPM} = \frac{\text{MPM} \times 1000 \text{ [1]}}{\pi \times \text{Tool diameter} \text{ [2]}}$$

- [1] MPM = Surface speed m/min
- [2] Tool diameter in millimeters

## Metric System

Cutting Force (Newtons) = Spindle Power (kW) x 48000 (80% efficiency) / Cutting Speed (Meters per minute).  
Spindle Power = Unit Power (kilowatts per cubic centimeters of material remove per minute) x Material removal rate (cubic centimeters per minute)

Material removal rate (Cubic centimeters per minute) = Width of cut (mm) x depth of cut (mm) x feed per tooth (mm) x number of teeth x spindle RPM/1000.

### Example:

A 200 mm cutter with 10 teeth is machining low silicon aluminum at 1000 MPM (meters per minute).

Solving Tool RPM = MPM x 1000 / Diameter (mm) x π (= 1592 Tool RPM)

The same tool catalog lists a feed per tooth of 0.2 mm at 1000 MPM and a cutting depth of 2.5 mm. This gives an 200 mm cutter x 2.5 mm depth x 0.2 mm feed x 10 teeth x 1592 Tool RPM/1000 = 1592 cm<sup>3</sup>/min.

Spindle power = 1592 x 0.018 = 28.7 kW  
This too is power from a fixture design standpoint; the actual operation will use less power than indicated here.

Using the original formula transposed is:  
Cutting Force 1378 (Newtons) = 28.7 (kW) x 48000 (80% efficiency) / 1000 (MPM cutting speed)

Multiply by a safety factor of 2 for rigid clamping and by 1.5 for elastic clamping (hydraulic).

This calculation does not take into account coefficients of friction when using clamp cylinders. For example, if the aluminum has a coefficient of .12 (flooded with coolant), the clamping force becomes 1378/.12 = 11483 Newtons of force. This calculation does not take into account forces being generated by the fixture positioning cylinders.

Use these numbers and set up your hydraulic system to run at about 50 to 75% of its rated pressure. This leaves some reserve for a later date when the process is optimized and you need more holding/ clampforce for higher speeds and feeds. If you design to the maximum now, you have nothing in reserve.

## Unit Power for dull tools [metric system]

Material	Hardness	TURNING P1	DRILLING P	MILLING P d
		HSS AND CARBIDE TOOLS	HSS DRILLS	HSS AND CARBIDE TOOLS
		feed	feed	feed
		.12 - .50 mm/r	.05 - .20 mm/r	.12 - .30 mm/r
<b>STEELS, WROUGHT AND CAST</b>				
Plain Carbon	85-200 Bhn	0.064	0.059	0.064
Alloy Steels	35-40 Rc	.077	.077	.086
Tool Steels	40-50 Rc	.086	.096	.100
	50-55 Rc	.114	.118	.118
	55-58 Rc	.191	.146	.146
<b>CAST IRONS</b>	110-190 Bhn	.41	.055	.036
Gray, Ductile and malleable	190-320 Bhn	.077	.091	.064
<b>STAINLESS STEELS, WROUGHT AND CAST</b>	135-275 Bhn	.073	.064	.077
Ferritic, Austenitic and Martensitic	30-45 Rc	.077	.068	.086
<b>TITANIUM</b>	250-375	.068	.064	.064
<b>NICKEL ALLOYS</b>	80-360 Bhn	.114	.100	.109
<b>ALUMINUM ALLOYS</b>	30-150 Bhn	.014	.009	.018
<b>MAGNESIUM ALLOYS</b>	40-90 Bhn	.009	.009	.009
<b>COPPER ALLOYS</b>	10-80 R <sub>B</sub>	.036	.027	.036
	80-100 R <sub>B</sub>	.055	.046	.055





The following information consists of recommendations, advice and general rules regarding the design of hydraulic workholding systems. These tips apply to just about any system, and are a good starting point if you have questions about what products to use and how to apply them properly.

## General Design

Double acting cylinders should always be used in applications where cycle time is critical. While the cylinders are designed with strong return springs, they may not consistently overcome the effects of long runs of tubing, orifices, and other restrictions. Double acting cylinders help eliminate these effects.

Many hydraulic pumps are rated for substantial flow rates (10 GPM or more) that are far beyond the requirements of a hydraulic workholding system. While these pumps can be used, it is not recommended in general practice. Workholding cylinders are typically very small in comparison to the types of cylinders that these pumps were designed to operate. You will spend a great deal of time and money reducing the flow through the use of valving and still may not have an ideal system. Consider a separate hydraulic pump rated for less flow whenever possible.

Spool valves are very common and inexpensive, but also have their share of issues regarding use in hydraulic workholding systems. Spool valves are designed for use at much higher flow rates than those typically seen in workholding circuits. In fact the acceptable internal leakage in these valves is typically equal to the total amount of flow required for a small workholding circuit. And, the leakage will result in improper function and possible damage to many pumps designed for workholding systems.

Breather vents on cylinders are often overlooked. When you put oil into a single acting cylinder and it begins to advance, the opposite side of the cylinder is filled with air. This air has to go somewhere. The breather vent provides this path. In turn, when the cylinder is retracting, and oil is leaving the cylinder, a vacuum is created and air needs to re-fill that opposite side of the cylinder. If the breather vent is located in an area that is subject to contamination from coolant, and chips, these items will also get pulled into the cylinder. Make sure the breather vent is plumbed to a clean location at all times.

## Swing Cylinders

The swing cylinders turn on a mechanical concept of a ball or a pin riding in a hardened groove. Trying to turn this too fast with a large heavy arm will result in enormous pressure on the ball or the pin, causing damage and eventually failure. A large arm also increases the amount of side load introduced into the cylinder. As the length of the arm increases, the allowable clamp load has to decrease accordingly. Follow the one-second rule: it should take at least one full second for the clamp arm to rotate and engage the part. Anything faster can result in damage.

## Work Supports

Work supports are rated based upon a somewhat constant load. Sharp vibrations from an interrupted cut or a large impact load (such as dropping a part on the fixture) will cause the work support to slip. Because of the design, once the work support has been subjected to a high impact load, it may no longer function. Be aware of this fact and limit impact loading wherever possible.

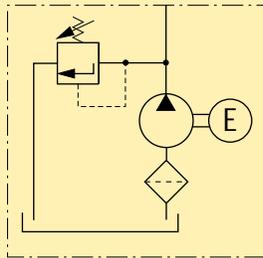
## Manifold Mounting

Manifold mounting of cylinders significantly decreases the amount of space required on a fixture. It also makes installation and service much simpler. Be sure to clean and de-burr all passages in the fixture manifold. Burrs can break loose over time and be ingested into the hydraulic cylinders, causing severe damage. If you have a long line of cylinders all in the same manifold, route the passages from the center out and use large diameters for the main feed line. The use of small passages everywhere in the manifold will cause drastic back-pressures on single acting circuits.

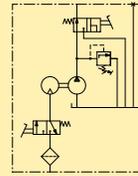
Be sure to include a passage for the breather vents where necessary. This passage should be routed to a large open area, not an enclosed cavity. Eventually, an enclosed cavity may fill up with chips and coolant and begin to work into the cylinders.



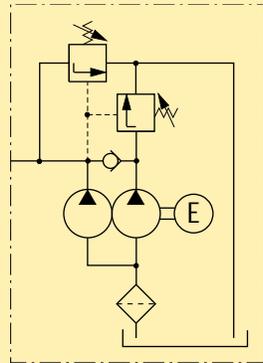
**Power Sources**



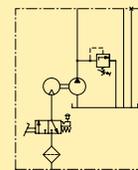
Single-stage electric pump  
Example  
**WED-4110BS**



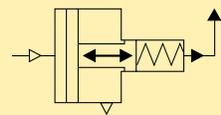
Turbo air pump  
Example  
**PATG-3102NB**



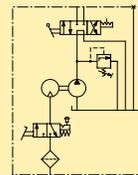
Two-stage electric pump  
Example  
**WEN-4020B**  
**WEM-1401B**



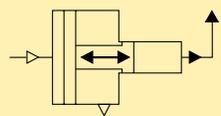
Turbo air pump  
Example  
**PASG-3002SB**



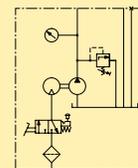
Reciprocating air pump  
Example  
**PA-136**



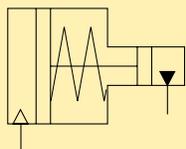
Turbo air pump  
Example  
**PAMG-3402NB**



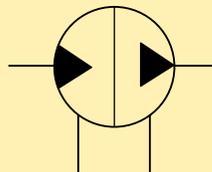
Reciprocating air pump  
Example  
**AHP-40VP**



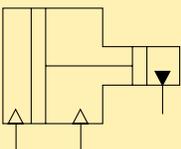
Turbo air pump  
Example  
**PACG-3002NB**



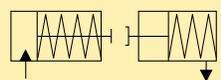
Single-acting booster  
Example  
**B-3006**



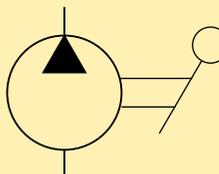
Hydraulic intensifier  
Example  
**PID-321**



Double-acting booster  
Example  
**AHB-34**



Activator wand & Booster  
Example  
**B-171**  
**RA-1061**



Hand pump  
Example  
**P-142**



## Valves

Swing cylinders  
Work supports

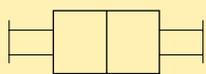
Linear cylinders

Power sources

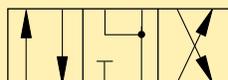
Valves

System components

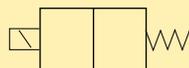
Yellow pages



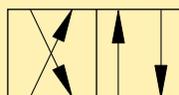
2 position manual



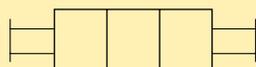
4-way, 3-position, Float center  
Series **VE** Example **VED-15000A**  
**VMM** **VMMD-001**



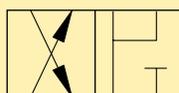
2 position solenoid



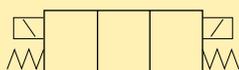
4-way, 2-position, Crossover offset  
Series **VE** Example **VEE-15000A**



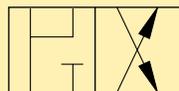
3 position manual



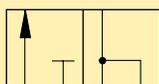
4-way, 2-position, Normally open  
Series **VSS** Example **VSS-1410D**



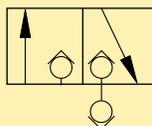
3 position solenoid



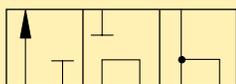
4-way, 2-position, Normally closed  
Series **VST** Example **VST-1410D**



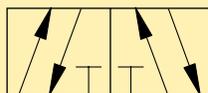
3-way, 2-position, Normally open  
Series **V** Example **VM-2**



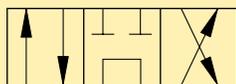
3-way, 2-position, Normally closed  
Series **VP** Example **VP-31**



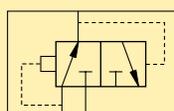
3-way, 3-position, Tandem center  
Series **V** Example **VM-3, VC-3**  
**VE** **VEF-15000D**



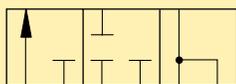
4-way, 2-position, Air valve  
Series **VA** Example **VA-42, VAS-42**



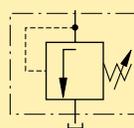
4-way, 3-position, Tandem center  
Series **V** Example **VM-4, VC-4**  
**VE** **VEC-15000D**



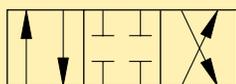
Rapid air exhaust valve  
Series **VR** Example **VR-3**



3-way, 3-position, Closed center  
Series **V** Example **VC-15**  
**VE** **VEG-15000A**



Pressure relief valve  
Series **V** Example **V-152**



4-way, 3-position, Closed center  
Series **V** Example **VC-20**  
**VE** **VEB-15000A**



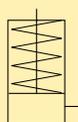
**Valves**

	<p>Sequence valve Series <b>MVP</b> <b>WVP</b> Example <b>MVPM-5</b> <b>WVP-5</b></p>		<p>4-way, 3-position, Closed center Example <b>VP-11,</b> <b>-12, -13</b></p>
	<p>Pressure limiting valve Series <b>PLV</b> Example <b>PLV-40013B</b></p>		<p>4-way, 3-position, Float center Example <b>VP-21,</b> <b>-22, -23</b></p>
	<p>Pressure reducing valve Series <b>PRV</b> Example <b>PRV-3</b></p>		<p>3-way, 2-position, normally closed Example <b>VP-31,</b> <b>-32, -33</b></p>
	<p>Check valve Series <b>V</b> Example <b>V-17</b></p>		<p>3-way, 2-position, normally open Example <b>VP-41,</b> <b>-42, -43</b></p>
	<p>Check valve, pilot operated Series <b>MV</b> <b>V</b> Example <b>MV-72</b> <b>V-72</b></p>		<p>3-way, 2-position, one port normally open and one port normally closed Example <b>VP-51,</b> <b>-52, -53</b></p>
	<p>Flow control valve, free flow check Series <b>VFC</b> Example <b>VFC-1</b></p>		
	<p>Shut-off valve Series <b>V</b> Example <b>V-12</b></p>		
	<p>Auto-damper valve Series <b>GS, V</b> Example <b>GS-2, V-10</b></p>		

Yellow pages

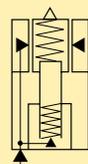


## Cylinders



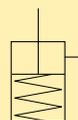
Single-acting cylinder, push

Example  
**CSB-18252**  
**CST-5131**  
**CSM-18131**



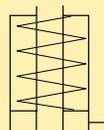
Fluid advance work support

Example  
**WFL-111**



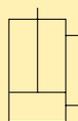
Single-acting cylinder, pull

Example  
**PLSS-51**  
**PTSS-51**  
**PUSS-51**



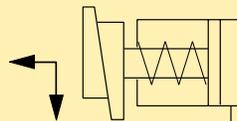
Single-acting hollow plunger cylinder

Example  
**CY-21295**  
**HCS-80**  
**RWH-202**



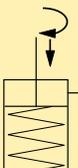
Double-acting cylinder

Example  
**CDB-18252**  
**RD-96**  
**CDT-18131**



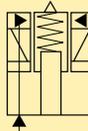
Pull down clamp

Example  
**ECH-202**



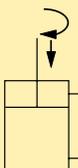
Single-acting swing cylinder

Example  
**SLRS-92**  
**STRS-92**  
**SURS-92**



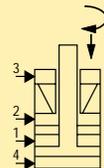
Collet-Lok® work support

Example  
**WPFS-200**  
**WPTS-200**



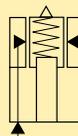
Double-acting swing cylinder

Example  
**SLRD-92**  
**STRD-92**  
**SURD-92**



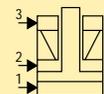
Collet-Lok® swing cylinder

Example  
**WPFR-100**  
**WPTR-100**



Spring advance work support

Example  
**WSL-111**



Collet-Lok® push cylinder

Example  
**WPFS-100**  
**WPTS-100**

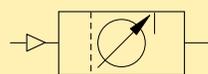


## System Components



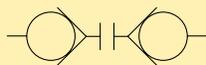
Pressure gauges

Example  
**DGR-1**  
**G-2534R**



Air regulator

Example  
**RFL-102**



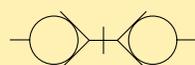
Hydraulic couplers, uncoupled

Example  
**AH-650,**  
**AH-652**  
**AH-654**



Accumulator, gas charged

Example  
**ACL-201**  
**WA-502**



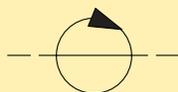
Hydraulic couplers, coupled

Example  
**AH-650**  
**AH-652**  
**AH-654**



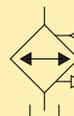
Accumulator, spring loaded

Example  
**ACM-1**



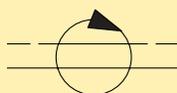
Rotary coupler, single passage

Example  
**CR-111**



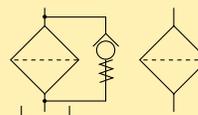
Heat exchanger

Example  
**HE-1**



Rotary coupler, double passage

Example  
**CRV-221**



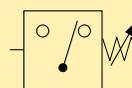
Return Line Filter,  
High Pressure Filter, in line

Example  
**PFK-25**  
**FL-2101**



Rotary coupler, four passage

Example  
**CRV-441**

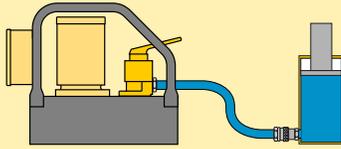


Pressure switch

Example  
**PSCK-5**  
**IC-50**

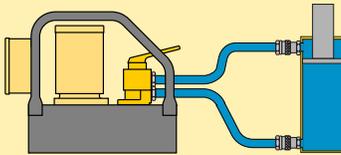


Swing cylinders  
Work supports



3-way valve used with single-acting cylinder

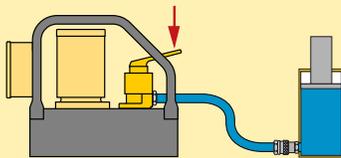
Linear cylinders



4-way valve used with double-acting cylinder

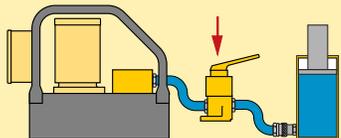
Power sources

Valves



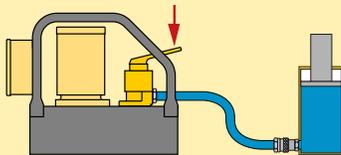
Valves can be pump mounted

System components

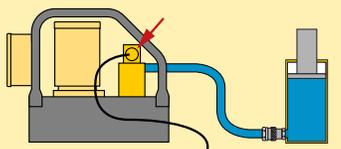


Valves can be remote mounted

Yellow pages



Valves can be manually operated



Valves can be solenoid operated

## Valve types and functions

Hydraulic valves can be divided into 3 groups:

1. Directional Control
2. Pressure Control
3. Flow Control

### 1 Directional Control Valves

Ways – the (oil) ports on a valve.

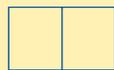
A 3-way valve has 3 ports: pressure (P), tank (T), and cylinder (A).

A 4-way valve has 4 ports: pressure (P), tank (T), advance (A) and retract (B).

Single-acting cylinders require at least a 3-way valve, and can, under certain instances, be operated with a 4-way valve.

Double-acting cylinders require a 4-way valve, providing control of the flow to each cylinder port.

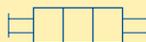
Positions – the number of control points a valve can provide.



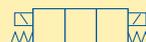
A 2-position valve has the ability to control only the advance or retraction of the cylinder.

To be able to control the cylinder with a hold position, the valve requires a third position.

Operation – the way to shift the valve into position



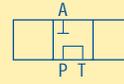
The valve position can be manually operated with the use of the handle.



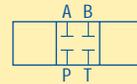
The valve position can be solenoid operated using power supply.

### Center Configuration

The center position of a valve is the position at which there is no movement required of the hydraulic component, whether a tool or cylinder.

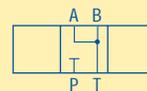


The most common is the **Tandem Center**. This configuration provides for no movement of the cylinder and the unloading of the pump. This provides for minimum heat build-up.



The next most common is the **Closed Center** configuration, which is used mostly for independent control of multi-cylinder applications. This configuration again provides for no movement of the cylinder, but also dead-heads the pump, isolating it from the circuit.

The use of this type of valve requires some means of unloading the pump to prevent heat build-up.



Another commonly used valve configuration is **Float Center**. This type of valve allows the cylinder ports to drain pressure back to tank. Used with a pallet mounted pilot operated check, it allows the hydraulics to be disconnected from the pallet.

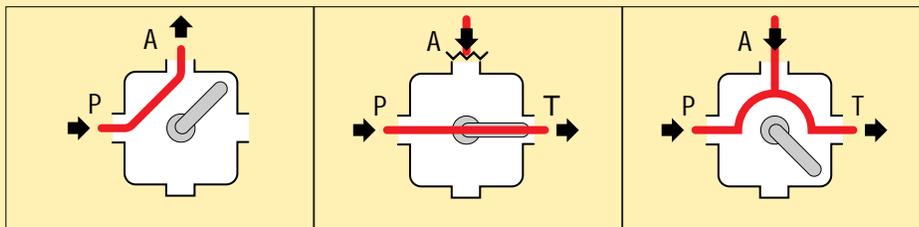


**Advance, Hold and Retract**

The direction of the oil flow can be controlled depending on valve type, valve positions and port functions.

**Single-acting cylinder**

Controlled by a 3-way, 3-position valve.



**Advance**

The oil flows from the pump pressure port P to the cylinder port A: the cylinder plunger will extend.

**Hold (tandem center)**

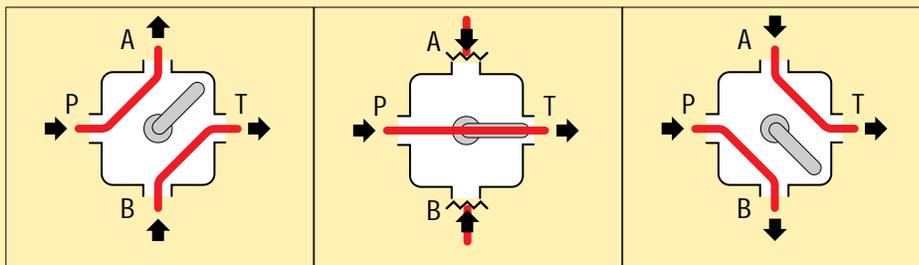
The oil flows from the pump pressure port P to the tank T. The cylinder port A is closed: the cylinder plunger will maintain its position.

**Retract**

The oil flows from the pump and cylinder port A to the tank T: the cylinder plunger will retract.

**Double-acting cylinder**

Controlled by a 4-way, 3-position valve.



**Advance**

The oil flows from the pump pressure port P to the cylinder port A and from cylinder port B to tank T.

**Hold (tandem center)**

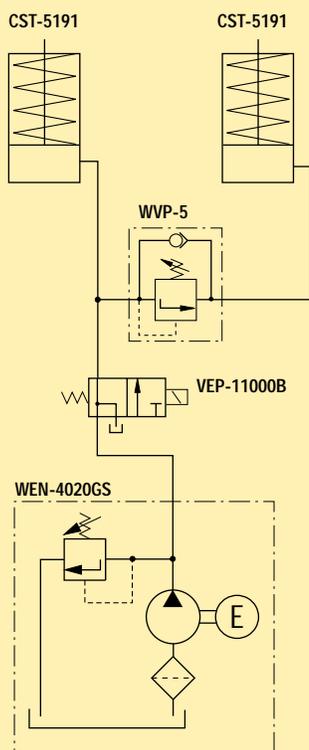
The oil flows from the pump pressure port P to the tank T. The cylinder ports A and B are closed: the cylinder plunger will maintain position.

**Retract**

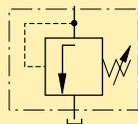
The oil flows from the pump pressure port P to cylinder port B and from cylinder port A to tank T: the cylinder plunger will retract.



## 2 Pressure Control



### Relief Valve

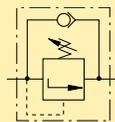


The most common type of pressure control valve is the pressure relief valve. This valve is used to limit the maximum pressure in the hydraulic circuit. This

valve should always be included in any hydraulic system to limit that circuit to a maximum safe pressure. When used in a system, design considerations should be made since the valve does not act instantly. As the pressure approaches the set point the valve will at first only permit a very small amount of oil to pass. It is only when the valve opens farther that the full flow will pass through the valve.

From a practical standpoint, don't set the relief valve with a hand pump and then use it with a power pump and vice versa. The point of operation will vary. Also because of this action, when used in application with a pressure switch, the pressure setting on the pressure switch should be set at least 500 psi (35 bar) lower than the point at which the relief valve opens. This will prevent rapid cycling of the motor on the pump because of the slight pressure loss through the relief valve. If the pressure settings must be closer than that the pressure switch should be monitoring the system pressure and a check valve should be added between the pump and the system. This will permit the pressure to bleed down on the pump through the relief and yet the check holds the pressure in the system, which is monitored by the pressure switch.

### Sequence Valve

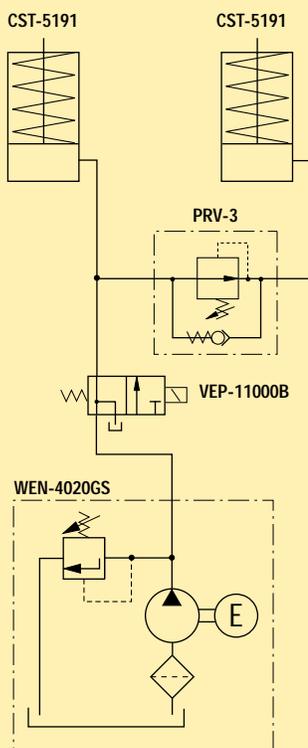


This valve controls the order in which various branches of the hydraulic circuit operate. It sequences the order of the actions. In practice,

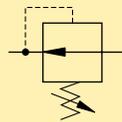
one part of the circuit will reach a preset pressure at which point the sequence valve will open and permit oil to flow to the secondary part of the circuit. When the flow to the secondary part of the circuit begins, the pressure in the first part of the circuit will remain at the set point permitting for example a work support to stay at its rated pressure as the swing cylinder clamps.

Enerpac sequence valves have a free flow return check meaning that there is no sequence action when the circuit is unclamping. There is however a small bias spring that will open at about 30 psi (2 bar). This will ensure a positive seal when the valve must provide sequence action in the forward direction. When multiple sequence valves are used they should be used in parallel and not in series. If used in series, these 30 psi (2 bar) bias springs will restrict the flow in an accumulative effect.

For example, if three valves are used, there would be about  $3 \times 30 \text{ psi} = 90 \text{ psi}$  (6 bar) of backpressure on components after the sequence valve in the system. While on a 5000 psi (350 bar) system this pressure may not seem like much, it is enough to prevent a single-acting swing from unclamping all the way or possibly cause a work support to not fully release and not properly readjust for the next part.



### Pressure Reducing Valve



As the name implies, this valve will reduce the pressure to a lower value for a secondary part of the circuit. This is useful for example when you

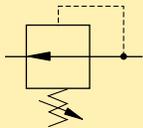
must reduce the capacity of a swing cylinder that might be clamping over a work support. The pressure reducing valve will automatically make-up pressure loss after the valve by permitting a very small amount of oil to the secondary circuit.

This pressure difference from when the valve first closes to the point it re-opens for pressure make-up is referred as the "deadband" of the valve. For example, on the Enerpac pressure reducing valve, this deadband is about 5% of the system pressure. If your system pressure is 3000 psi (210 bar) and the reduced pressure is 2000 psi (140 bar), the pressure in the secondary part of the circuit would need to drop 5% of the system pressure, [ $3000 \times .05 = 150 \text{ psi}$  (10 bar)] before the valve would open.



In this case the secondary part of the circuit would drop to 1850 psi (127.5 bar), before the valve would open and permit oil to flow to the secondary part of the circuit to return the pressure to 2000 psi (140 bar). This valve provides this function in only one direction with free flow in the reverse direction to allow cylinders to unclamp or work supports to unlock.

### Pressure Limiting Valve

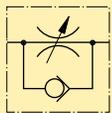


This valve, like the pressure-reducing valve, will limit the pressure in a secondary part of the circuit to a preset lower setting than the system pressure. This valve functions differently in that once the valve closes, the secondary part of the circuit will not receive any make-up oil for any pressure

loss. The system pressure must drop to zero pressure before the valve will open and permit oil to flow to the secondary part of the circuit. There is no pressure make-up capability with a pressure-limiting valve.

## 3 Flow Control

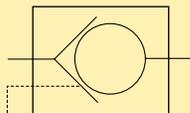
### Flow Control Valves



Flow controls permit the change of speed of a hydraulic component through the use of an adjustable orifice. Unlike a regular flow control that

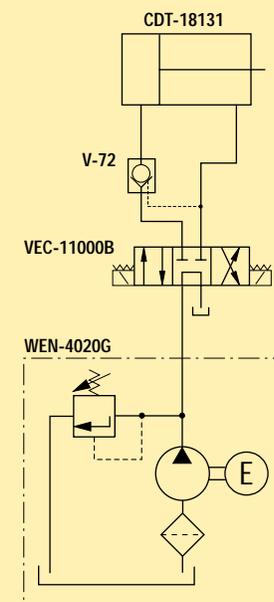
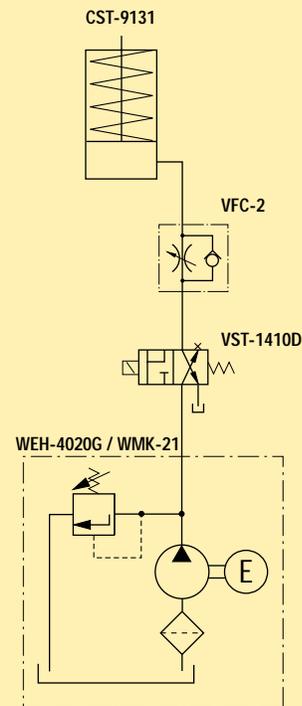
provides the same flow restriction in both directions, these flow controls provide a free flow reverse check. This allows restricted flow in one direction and unrestricted flow in the other. This is a very important feature when using a flow control to regulate the speed of a single-acting swing cylinder or work support. The cylinder requires the clamping speed be regulated to a safe value through the use of a flow control to prevent damage to the cylinder. When unclamping, the spring in the cylinder will develop only a small amount of pressure. To ensure rapid unclamp time, back pressure, or resistance, must be minimized. Free flow reverse checks allow you to minimize this resistance.

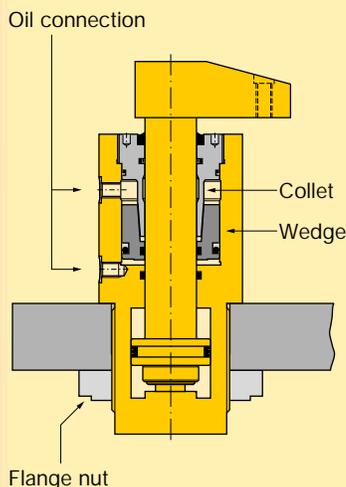
### Pilot Operated Check Valves



A check valve only permits the flow of oil in one direction. The pilot operated check valve works the same as a

regular check valve but also has an additional port for a pressure signal. Pressure to this extra port will mechanically open the check valve to permit the oil to flow in both directions. The pilot operated check is useful in holding pressure over a period of time in a remote part of a circuit, but allowing the pressure to be released using a pressure signal to the extra port on the valve. Usually this pressure is much lower than the system pressure you are holding back. Enerpac pilot operated check valves only require 15% of the system pressure you are clamping with to open the check valve, permitting the oil to return from the fixture and unclamp the part.





One of the most important aspects of machining cycle times is the speed and precision of the workpiece positioning, clamping and release. The speed of these actions is greatly improved through the use of hydraulic workholding components, leading to increased efficiencies and cost savings.

### Use of palletized fixtures

Being able to load many parts onto palletized fixtures also greatly increases the productivity and efficiency of the machining cycle. The use of palletized fixtures poses several problems however. The clamping cylinders must be repeatedly connected and disconnected from the hydraulic power source to make use of the flexibility of the pallets.

With conventional hydraulic cylinders, this also requires the use of load holding valves and accumulators to maintain pressure. With proper maintenance, this system of hydraulic workholding is very effective. This type of clamping is also very susceptible to contamination, and additional care must be taken to maintain the filtration and preventive maintenance schedules required.

### Energac's exclusive Collet-Lok® technology

There is another solution to palletized clamping. Energac's exclusive Collet-Lok® technology eliminates the need for live hydraulics to be maintained on the pallet during the machining cycle. Once the part is hydraulically clamped in position for machining, the cylinders are mechanically locked in place. This mechanical lock replaces the accumulators, load holding valves and other requirements of live hydraulic palletized circuits. Once the machining cycle is complete, the mechanical lock is released, and the cylinders can be retracted to allow for the next piece to be loaded.

Energac offers swing cylinders, work supports and push cylinders with Collet-Lok® technology incorporated. Used in conjunction with an automatic coupler, pressure switches and proximity sensors, this technology can provide a totally automated and accurate clamping cycle.

On the next page is an example of how this technology works. The Collet-Lok® swing cylinder has four ports.

Port #1 is first pressurized to apply the appropriate clamping force. Once this pressure is reached, a sequence valve opens, sending pressure to Port #2, which mechanically locks a wedge into place. This wedge locks the plunger in place, preventing movement, and maintaining the clamping force on the workpiece. The pressure should now be removed and machining can be performed at any time. This lock can be maintained for minutes, hours, even days, without the need for hydraulic pressure.

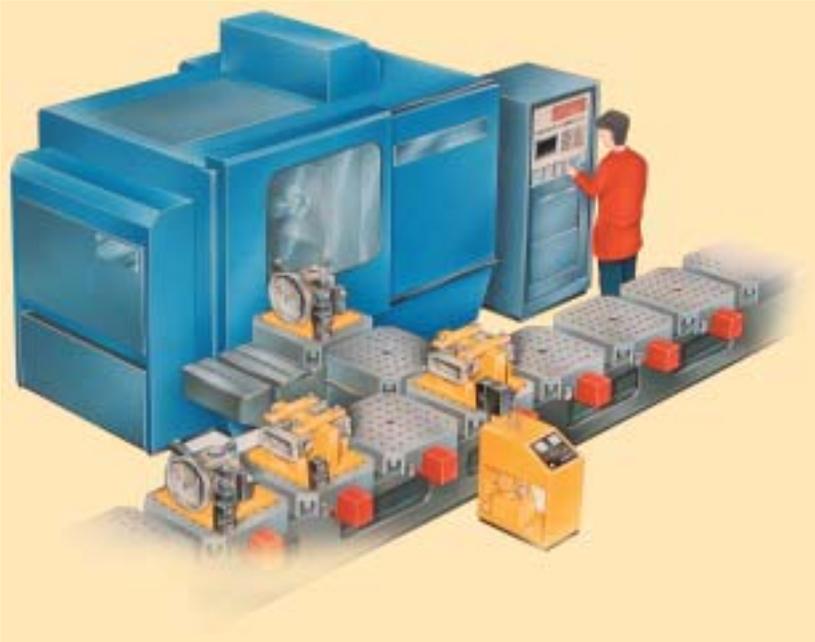
Once the machining cycle is complete, and the workpiece needs to be changed, the lock can be very easily removed. Pressure should be applied to Port #3 to unlock the wedge system. Once the wedge is unlocked, and the plunger is free, pressure can be applied to Port #4 to allow the plunger to retract. With this complete, the machined workpiece can be removed and a new piece can be loaded into the fixture to continue the process.

This system is the ultimate in system automation and positive control in clamping technology. For more information, be sure to consult Energac to receive additional literature and installation instructions.

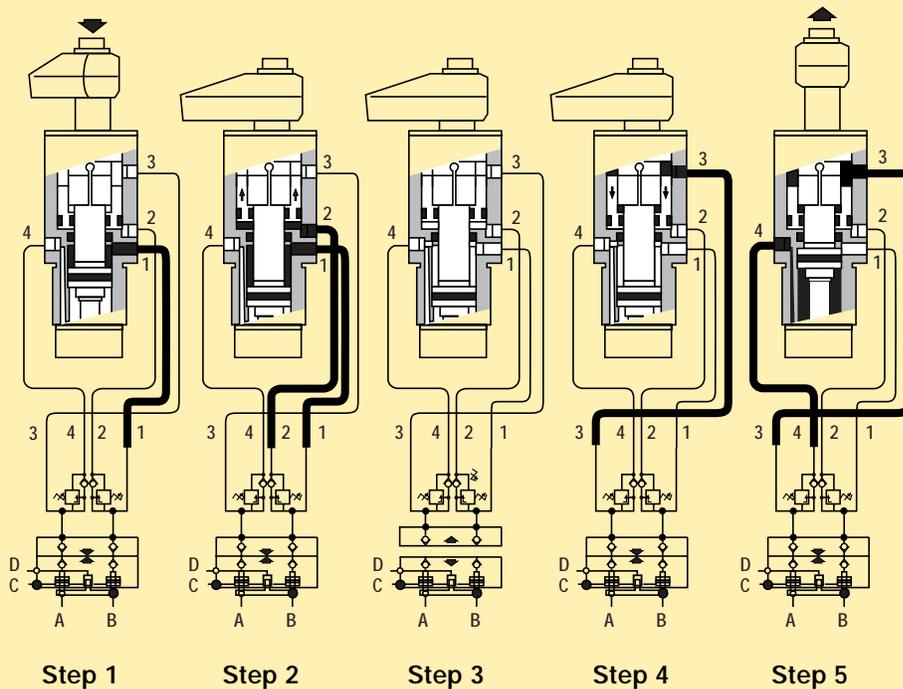
■ Fixture for machining exhaust manifolds.



## Palletized machining



### Hydraulic Clamping and Hydraulic Mechanical Locking



**WPTR-100** Collet-Lok® swing cylinder  
 1 = 90° Rotation + Clamp  
 2 = Lock  
 3 = Unlock  
 4 = Unclamp + 90° Rotation

**WCA-62, WPA-62** Auto coupler  
 A = Pressure line from pump to swing cylinder  
 B = Pressure line from pump to swing cylinder  
 C = Auto coupler advance  
 D = Auto coupler retract

#### Step 1

2-way Auto coupler connects external power source with pallet part and the Collet-Lok® cylinder is activated for hydraulic clamping.

#### Step 2

After reaching maximum clamping pressure the sequence valve is opened and actuates the internal wedge hydraulically.

#### Step 3

The wedge system secures the plunger position mechanically and the hydraulic pressure is taken off, then the auto coupler retracts. The product on the pallet is now securely clamped, without being connected to a power source.

#### Step 4

After being in the center of the machine the pallet returns to the loading and unloading position and the auto coupler is connected again to release the wedge.

#### Step 5

The hydraulic plunger is now retracted and the pallet is free for unloading and loading.

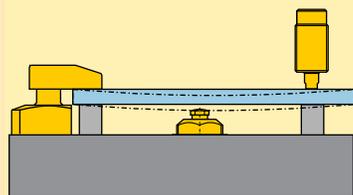


Figure 1: Simple hydraulic fixture with minimal workpiece deflection.

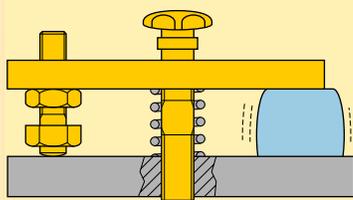


Figure 2: Simple mechanical fixture with larger workpiece deflection.

## Mechanical clamping versus hydraulic clamping

Many factors should be taken into account when deciding whether to use mechanical or hydraulic workholding products for clamping your parts. In general, hydraulic clamping should be used in high volume applications, or when critical tolerances need to be held. Mechanical clamping products can be used in shorter production runs, or on rougher procedures where surface finishes and tight tolerances are optional.

For example, using hydraulic workholding products will allow you to maintain within a 1% accuracy on your clamping force. This is through the use of digital pressure switches, electric powered pumps and hydraulic clamping and support cylinders. This type of accuracy may be necessary when machining a surface requiring tight tolerances, less than .001 inch (0,025 mm). The slightest variation in clamping force could result in part movement or deflection greater than the required overall tolerance (Figure 1). In situations like this, the investment in hydraulic clamping is undeniable.

Mechanical clamping products are sufficient when tight tolerances are not required, or when the part is a large casting for example, and no amount of clamping force will distort the part. A typical operator, for example, can tighten a stud over a clamp to a specific torque value with possibly only 10% accuracy using a manual wrench. This could result in significant differences in part height and position on a fixture (Figure 2). However with a rough casting where the required finish is not critical, this may be acceptable. And, for the cost of mechanical clamping compared to hydraulic clamping, the choice is easy.

There are also situations where hydraulic clamping is not only not necessary for accuracy, but also, potentially dangerous. A perfect example of this is a die casting machine. Heat is an enemy of hydraulic components, and die casting obviously generates an enormous amount of heat. Mechanical clamping is an excellent and safe solution to the problem.

Production quantity runs should also be taken into account along with time savings and cost of materials when choosing between hydraulic and mechanical clamping.

Mechanical clamping is typically less expensive but more time consuming compared to hydraulic clamping. See the examples below for ideal situations in which to use hydraulic or mechanical clamping:

### Example 1

Production quantity:	60,000 pieces
Part material cost:	\$25
Machine time cost:	\$150 p/h
Hydraulic fixture and component cost:	\$30,000
Parts per fixture:	4
Load/unload time:	20 seconds
Run time:	720 seconds

The run time and the load/unload time equate to 185 seconds of machine time per part. The machine costs money no matter whether you are actually cutting chips or waiting to cut chips while you are loading the parts. This is why you must take both the load and the run time into account.

This 185 seconds per part equates to being able to run 155 parts per 8 hour day, at an additional cost of \$7.71 per part due to machine time cost of \$150.00 per hour.

The hydraulic fixture cost of \$30,000 divided over 60,000 parts equates to an additional \$0.50 per part. All together, in this very simple example, you have added only \$8.21 to the cost of the part. The \$8.21 equates to only about a 33% increase in cost. Granted, there are more aspects which could be factored in, but you can see the minimal cost added by hydraulics in this example.

Assume that you were only running 3000 parts on a small run. The machine time is the same, but now, the hydraulic fixture and components adds an additional \$10 to the cost of the part (30,000/3000 parts). This is a total of \$17.71 additional cost, or a 71% increase. Hydraulic clamping is much too expensive for such a short run.



## Example 2

Production quantity:	3000 pieces
Part material cost:	\$25
Machine time cost:	\$150 p/h
Mechanical fixture and component cost:	\$5000
Parts per fixture:	4
Load/unload time:	240 seconds
Run time:	720 seconds

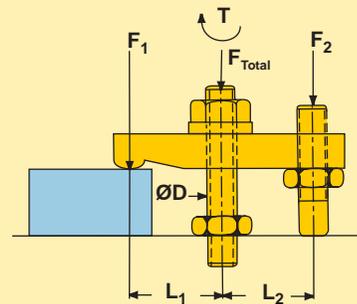
In this example, the production quantity is much lower, and mechanical clamping is being used. The same part is being machined, on the same machine process. The mechanical clamping fixture is much less expensive, only adding \$1.67 to the cost of each part. However, the load/unload time has increased significantly since the operator has to manually clamp each part. The machine is now only able to produce 120 parts per 8 hour day. This adds \$10 to the cost of each part in machine time cost. All together, \$11.67 has been added to the cost of each part, a 47% increase. While this may seem significant, remember that the cost increase using hydraulic clamping was 71%. Mechanical clamping is a much better choice in the lower production runs, even though it may be slower.

Many factors must be taken into account to decide on either mechanical clamping or hydraulic clamping. For example, taking labor into account can significantly add to the cost of mechanical clamping, since it is a much slower process. These examples are very simple and do not include all of the variable details that could affect your decision. Be sure to account for every situation in making your choice.

## Replacing Mechanical Clamping with Hydraulic Clamping

In order to properly replace a mechanical clamping set-up with hydraulic cylinders, the most important thing to understand is the amount of clamping force being applied to the part. Figure 3 is an example of a typical mechanical clamping set-up for either one part or two parts. In this situation, the operator tightens the nut on the clamping stud, which in turn applies a holding force to the work piece. In order to convert this set-up to hydraulic clamping, you will need to know some values from Figure 3.

- T = Torque on the clamping stud (ft-lbs or N-m)
- D = Thread diameter and pitch (for example, 3/8-16 or M8)
- L<sub>1</sub> = Distance from center of clamping stud to contact point on the workpiece
- L<sub>2</sub> = Distance from center of clamping stud to reaction point (or contact point on second workpiece)



You will also need to know whether the clamping stud and nut are lubricated or dry. This makes a difference in how much clamping force is generated.

The first thing to know is how tight that nut is being applied to the clamping stud. This is best measured using a torque wrench. Even though the operator may not use a torque wrench in the everyday use of the fixture, it is critical to be able to provide a torque reading when converting to hydraulic clamping. It may be necessary to use a torque wrench on the part a few times in order to get a good consistent value to be used in calculating the clamping force.

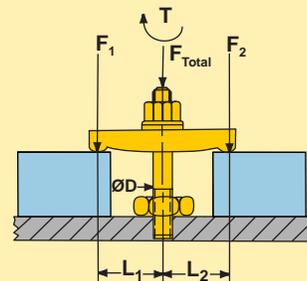


Figure 3: Typical mechanical clamping set-up.

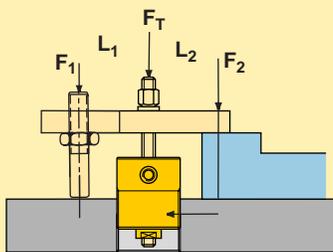


Figure 4: Center-hole cylinder used in hydraulic clamping set-up.

Once you have determined the amount of torque being applied to the clamping stud, and you have measured the diameter of the stud, and the distances  $L_1$  and  $L_2$ , the clamping forces can be calculated. It is important to understand that the amount of clamping force being put into the clamping stud is not the same amount of force being applied to the part. In this setup, much less force gets applied to the part. You can calculate the force applied to the stud using the table. The force applied to the part is based on the formula.

$$F_1 = L_2 / (L_1 + L_2) * F_T$$

$$F_2 = L_1 / (L_1 + L_2) * F_T$$

When  $L_1 = L_2$  (when the clamping stud is exactly halfway between the clamping points),  $F_1 = F_2 = 1/2 F_T$ .

### SAE stud sizes

Dry Threads K = 0.20		
Stud Size	Torque (ft-lbs)	Applied Load (lbs)
	4	1190
1/4"-20	6	1790
	8	2380
	10	2980
	14	3250
5/16"-18	16	3720
	18	4180
	20	4640
	24	4580
3/8"-16	28	5350
	32	6110
	36	6880
	60	8470
1/2"-13	65	9180
	70	9880
	75	10590
	125	13980
5/8"-11	135	15100
	145	16220
	155	17340
	200	18390
3/4"-10	225	20690
	250	22990
	275	25280
	350	27390
7/8"-9	375	29340
	400	31300
	425	33260
	450	30740
1"-8	550	37580
	650	44410
	750	51240

Lubricated Threads K = 0.15		
Stud Size	Torque (ft-lbs)	Applied Load (lbs)
	4	1590
1/4"-20	6	2380
	8	3180
	10	3970
	14	4330
5/16"-18	16	4950
	18	5570
	20	6190
	24	6110
3/8"-16	28	7130
	32	8150
	36	9170
	60	11290
1/2"-13	65	12230
	70	13170
	75	14120
	125	18640
5/8"-11	135	20130
	145	21620
	155	23120
	200	24520
3/4"-10	225	27580
	250	30650
	275	33710
	350	36520
7/8"-9	375	39130
	400	41730
	425	44340
	450	40990
1"-8	550	50100
	650	59210
	750	68320

**Note:** Values in the charts above are based on theoretical values. The chart values are meant to be guidelines in determining equivalent hydraulic cylinders for an application, but are by no means exact. Factors such as lubrication, material, plating and method or torque application can affect the actual clamping force. Please use proper engineering practices when designing a fixture.



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Contact Enerpac to order metric models.

## Yellow Pages

Refer to the "Yellow Pages" of this catalog for:

- Safety instructions
- Basic hydraulic information
- Advanced hydraulic technology
- FMS (Flexible Machining Systems) technology
- Conversion charts and hydraulic symbols