

**ENERPAC** 

POWERFUL SOLUTIONS. GLOBAL FORCE.



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**WORKHOLDING**

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## 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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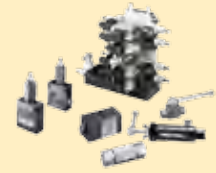
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# The World Class Brand

**A** complete range of quality Workholding products for all production applications, with local availability and after sale service anywhere in the world....this is what makes Enerpac a global leader in hydraulic Workholding.

Across every continent, Enerpac's network of authorized distributors and service centers provide sales and support of products designed to enhance productivity and performance, while making the work place safer.

With over 150 sales specialists and a network of service and engineering support in 17 countries across the globe, Enerpac is a valuable partner for customers involved in production manufacturing using hydraulic clamping components and those who support them with custom tooling.

Always at the leading edge of technology, Enerpac continues to develop its range of time and cost saving products, utilizing modern engineered materials to improve productivity and minimize operator fatigue.

Enerpac's commitment to the continued development of quality hydraulic Workholding products ensures that the products you purchase are the best in the industry. We will continue to lead the way in the development of quality hydraulic Workholding products for industrial production applications.





# Enerpac Workholding Value Proposition

- Expert Design
- Highly Reliable
- Service Excellence
- Worldwide Experience
- Application Support
- Availability
- Quality
- Value
- Innovative Products
- Systems Solutions



## Global Network

Enerpac has an extensive network of authorized distributors and service centers located in more than 90 countries worldwide. You can rely on Enerpac for the products and technical support you need to get your job done, anywhere in the world.

## Logistics Excellence

Enerpac's mission is to maintain service excellence in the ever-changing world of modern distribution. Providing our extensive range of products to our thousands of distributors worldwide demands a logistic expertise only a market leader can provide.



## Total Quality

Our products are tested to the most exacting standards. These high standards guarantee the quality, price and performance requirements of the markets we serve around the globe.

## A Tradition of Innovation

Enerpac has a long history of finding new solutions to better meet the challenges of the industries we serve. We were the first to develop a swing clamp with an internal rotation system. Our Collet-Lok® clamping products have provided our customers with both automation and security by combining hydraulic clamping actuation with an internal lock to mechanically retain the clamping force. The ZW-Class series of electric pumps are designed to run cool, be more energy efficient and easy to configure to your application. Our Auto-coupler connection system provides an automated connection to the fixture, perfect for robotic loaded applications. To support our production machining customers, Enerpac continues to identify new solutions for your most challenging applications.



**ENERPAC**   
POWERFUL SOLUTIONS. GLOBAL FORCE.

# A Guide to Your New Enerpac Workholding Catalogue

**The New Enerpac Workholding catalog;**

**... helps you design more efficient workholding fixtures,**

**... is a global resource of workholding solutions.**

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

**1 Metric hydraulic product data section**

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

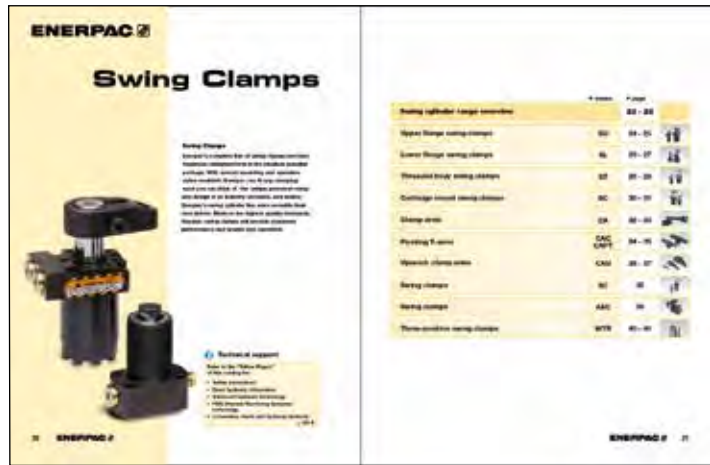
**2 Yellow Pages section**

Your guide to safety, basic hydraulics and application suggestions.

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

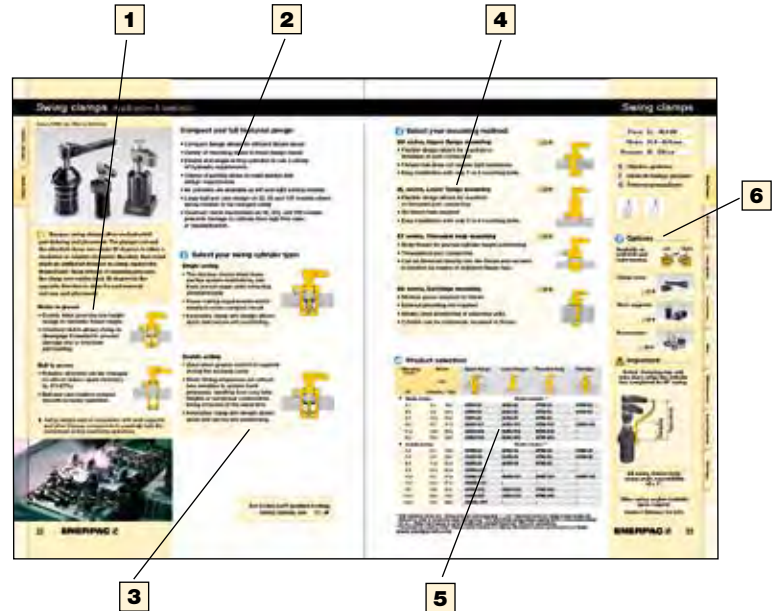
- 1.** Select your main product category from the *main index* on page 3. This index shows page numbers of product offerings in the catalog.
- 2.** From here you go to the selected product *range overview*. For an example see pages 20 and 21 for the swing cylinders and work supports overview. On this page you will find the main groups with regard to functional and mounting style options.
- 3.** Proceed to pages 22 and 23 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, 24 and onwards, of the specific product series of your choice. These pages have *gray* columns on both sides of the spread.

**Range overview**



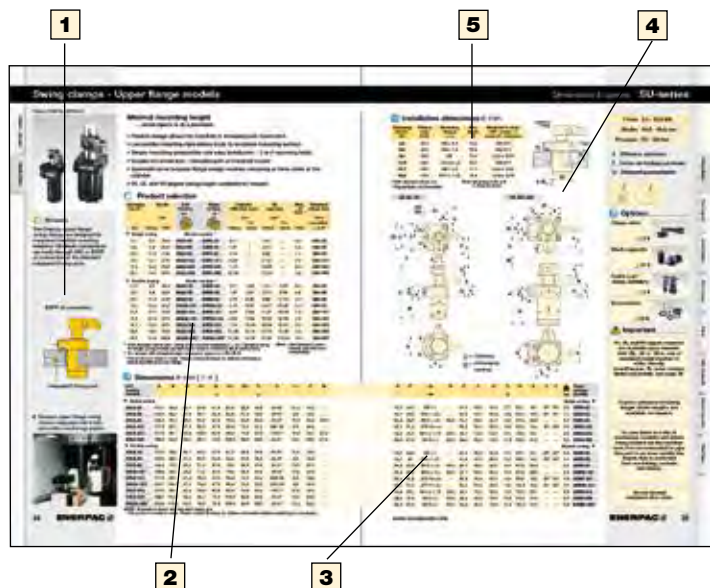
**Application & selection pages**

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



**Product data pages**

- 1 Application schematic including real life application example.
- 2 Product selection.
- 3 Detailed dimensional data.
- 4 Product dimensional drawings.
- 5 Installation specifications.





# Collet-Lok®

Enerpac Collet-Lok® products combine the automation of hydraulic actuation with the security of an internal locking mechanism. After actuation and locking, these products maintain their clamping or supporting capacity without maintaining hydraulic pressure in the circuit. Available in Swing, Push, and Work Supports models, Enerpac Collet-Lok® products are also available in numerous special configurations and modifications.

## 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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### Swing Clamps

Enerpac Collet-Lok® Swing Clamps combine the rotational actuation and clamping force of a hydraulic Swing Clamp with an internal locking mechanism that maintains the applied clamping force without holding hydraulic pressure in the clamp. Ideal for use in large-scale fixtures, they are available in 4,4, 8,9 and 37,8 kN models. Standard models are available in either Threaded Body or Lower Flange configurations. Available modifications include flange top manifold porting, longer strokes, non-rotational versions and special design bodies. Viton seals are standard.



### Work Supports




Enerpac Collet-Lok® Work Supports use internal spring force to lift the support rod into contact with the work piece and then maintain the support with an internal locking system. Cataloged in 8,9, 17,8, and 44,5 kN capacities, these products are available in Threaded Body (8,9 and 17,8 kN only) and Lower Flange models (8,9, 17,8, and 44,5 kN). Available modifications include longer strokes, flange top manifold porting, and special design bodies. Viton seals are standard.



### Push Cylinders

Enerpac Collet-Lok® Push Cylinders are designed for either clamping or supporting applications. The clamping or supporting force is maintained once the internal lock is engaged. Available in either 11,1 or 22,2 kN capacities, these cylinders are available in both Threaded Body or Lower Flange models. Available modifications include flange top manifold porting, longer strokes, and special design bodies. Viton seals are standard.

# Products

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Collet-Lok® Work supports	MPFS, MPTS	16-17	
Collet-Lok® Push cylinders	MPFC, MPTC	18-19	



Shown: MPTC-110, MPFL-50V, MPFC-210, MPTS-100, MPFS-100



▶ Enerpac Collet-Lok® cylinders are designed to mechanically hold the workpiece after hydraulic pressure is removed. Clamping capacities range from 4,4 to 37,8 kN.

■ MPTL-100 and MPTR-100 Collet-Lok® Swing Clamps are used to securely clamp these exhaust manifolds.



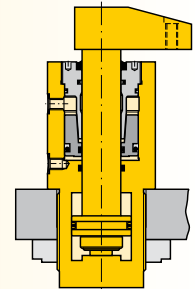
## Hydraulic actuation with mechanical lock

- Collet-Lok® technology combines hydraulic actuation for clamping or supporting with an internal locking collet
- Clamp bodies are available in either threaded mount or flange mount
- Flange mount units feature both tubing ports and bottom manifold ports
- Flange top manifold ports available as a special
- VITON seals are standard.

## Collet-Lok® Designs:

### Collet-Lok® Swing Clamps

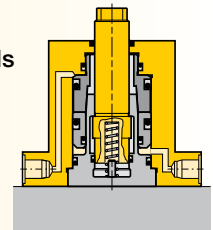
- Available in 4,4, 8,9 and 37,8 kN models
- Available in Right Hand or Left Hand Swing and Straight (guided) models.



▣ 12-15 ▶

### Collet-Lok® Work Supports

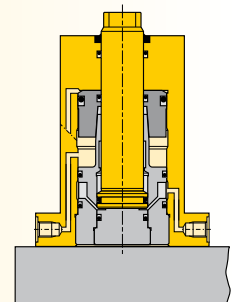
- Available in 4,4, 17,8 and 44,5 kN models
- Spring advance design to maintain contact with the work piece.



▣ 16-17 ▶

### Collet-Lok® Push Cylinders

- Available in 11,1 and 22,2 kN models
- Designed for Push only
- Can be used as a heavy-duty Work Support.



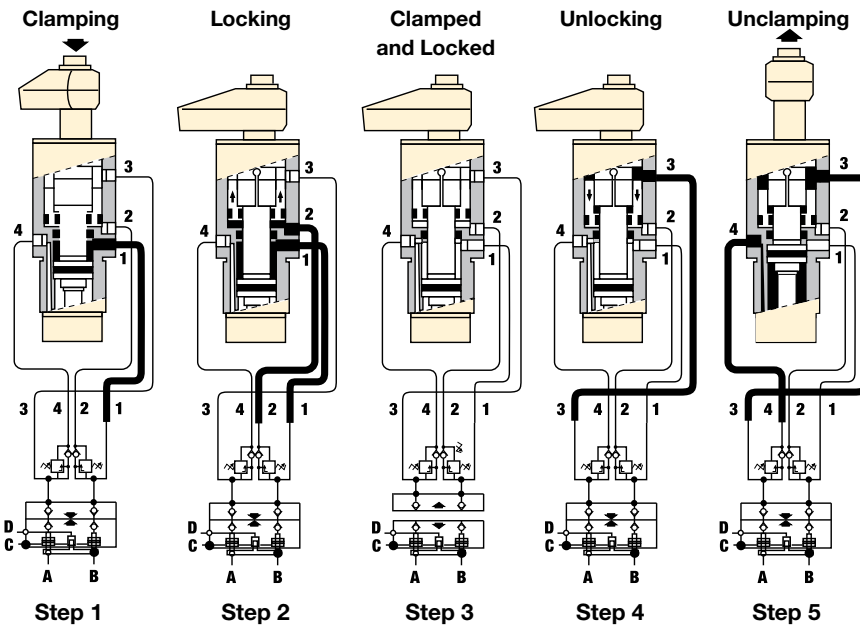
▣ 18-19 ▶



## Why use Collet-Lok®?

Collet-Lok® technology from Enerpac combines hydraulic actuation with mechanical locking to provide the automation and control of hydraulics and the long term security of a mechanical lock. Available in Swing Clamps, Push Cylinders and Work Supports, Collet-Lok® is a unique solution that is well suited to today's demanding manufacturing environment.

## Collet-Lok® Clamping and Unclamping Cycle



**MPTR-100** Collet-Lok® swing cylinder

- 1 = 90° Rotation + Clamp
- 2 = Lock
- 3 = Unlock
- 4 = Unclamp + 90° Rotation

**MCA-62, MPA-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

## How Does Collet-Lok® Work?

The ports on Collet products are conveniently labeled in the order that they are used during a clamping or unclamping cycle.

The typical Collet-Lok® circuit pairs the Clamp circuits with the Lock circuits by using a sequence valve to delay the Lock function until the clamping pressure is almost reached. When unclamping, the Unlock and Unclamp circuits are also paired with a sequence valve so the Lock is released before the clamp extends to Unclamp. An alternate approach to controlling these circuits is to use a PLC to operate individual valves for the Clamp/Unclamp and Lock/Unlock functions.

Because Collet-Lok® provides a mechanical lock to hold the clamping force onto the work piece, support components used in standard hydraulic clamping circuits such as pilot operated check valves and accumulators are not needed. In typical applications, the hydraulic circuit in a fixture with Collet-Lok® clamps is de-pressurized after the clamping cycle is completed. This allows for complete security during the machining cycle, or if the work pieces are pre-clamped and staged in a pallet pool for extended periods of time.

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

Force: 4,4 - 37,8 kN

Stroke: 24,0 - 42,0 mm

Pressure: 100 - 350 bar

## Collet-Lok® Sequence:

### Step 1

2-passage Auto coupler connects external power source with pallet receiver 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 work piece on the pallet is now securely clamped, without being connected to a power source.

### Step 4

After being in 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.

## Options

Collet-Lok® swing clamps

12 ▶



Collet-Lok® work supports

16 ▶



Collet-Lok® push cylinders

18 ▶



# Swing cylinders - Collet-Lok® design

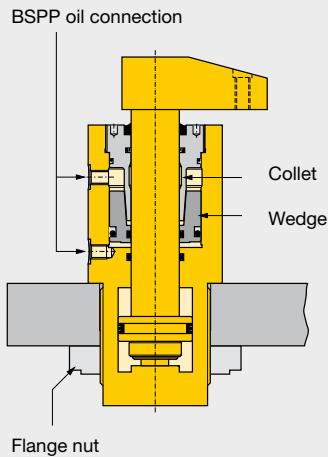
Shown: MPTR-100V, MPFR-100V



Collet-Lok® products

## MP series

Enerpac Collet-Lok® cylinders are designed to mechanically hold the workpiece after hydraulic pressure is removed. Clamping capacities range from 4,4 to 37,8 kN.



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

- Double acting Collet-Lok® action allows fully automated operation
- Additional level of safety since live hydraulics are not required to maintain clamping force
- Collet-Lok® swing cylinders can be mounted by the flange or threaded into the fixture. Flanged models have manifold ports and tubing ports.
- Viton seals are standard.

## Selection chart

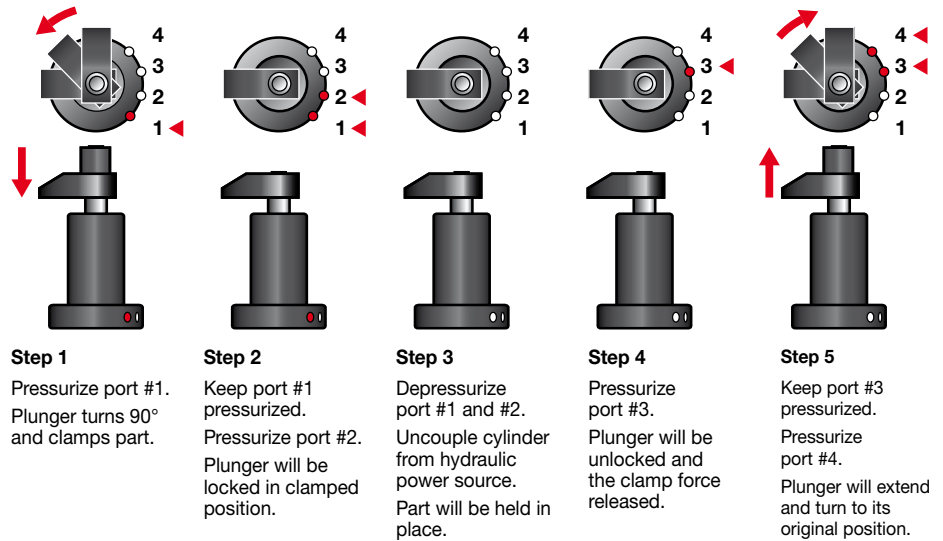
Clamping force <sup>1)</sup> kN	Stroke mm		Left turning 	Right turning 90° 	Cylinder effective area cm <sup>2</sup>		Oil capacity cm <sup>3</sup>		Max. oil flow <sup>1)</sup> l/min	Standard clamp arm Sold separately
	Clamp	Total			Clamp	Un-clamp	Clamp	Un-clamp		
<b>▼ Lower flange</b>										
			Model number							
4,4	8	24,2	MPFL-50V	MPFR-50V	1,6	4,5	3,9	10,9	0,5	MA-540
8,9	12	28,2	MPFL-100V	MPFR-100V	3,2	7,1	9,0	19,9	1,0	MA-1050
37,8	10	42	MPFL-300V*	MPFR-300V*	13,2	22,2	55,7	93,4	4,0	MA-3070
<b>▼ Threaded body</b>										
			Model number							
8,9	12	28,2	MPTL-100V	MPTR-100V	3,2	7,1	9,0	19,9	0,5	MA-1050
37,8	10	42	MPTL-300V*	MPTR-300V*	13,2	22,2	55,7	93,4	4,0	MA-3070

<sup>1)</sup> Using standard clamp arm. Clamp arms are sold separately (∅ 14).

**Note:** - Call Enerpac for models with UNF thread and SAE port connections.  
- Minimum working pressure for Collet-Lok® system is 100 bar.

\* This product is made to order. Please contact Enerpac for delivery information before specifying in your design.

## Collet-Lok® sequence



## Product dimensions in mm [ ]

Left turning models *	A	B	C	C1	D ∅	D1 ∅	F ∅	H1	H2	H3
<b>▼ Lower flange</b>										
MPFL-50V	201,2	177	171,2	25	58	85	19	10	12,5	-
MPFL-100V	222,9	194,7	192,9	25	68	100	22,3	10	12,5	-
MPFL-300V	322	280	275	25	89,8	130	34,9	11	12,5	-
<b>▼ Threaded body</b>										
MPTL-100V	213,2	185	121,3	90,5	M48 x 1,5	64	22,3	31,5	67	75,5
MPTL-300V	310,5	268,5	163	115	M80 x 2,0	89	34,9	38	92	100,5

**Note:** Dimensions shown with standard clamp arm.

\* For nonrotational model replace "L" with "N". Example: MPFN-100V.

## Installation dimensions in mm

Clamping force <sup>1)</sup> kN	Fixture hole Ø D3	Mounting thread J mm	Minimum depth J2
------------------------------------	----------------------	-------------------------	---------------------

### ▼ Lower flange

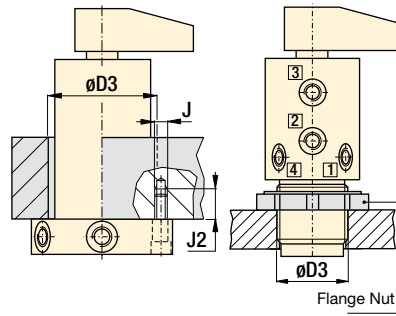
4,4	58,4 ±0,3	M6 x 1	18
8,9	68,6 ±0,3	M8 x 1,25	19
37,8	90,5 ±0,3	M10 x 1,5	19

Clamping force <sup>1)</sup> kN	Fixture hole Ø D3	Mounting flange Sold separately □ 87 ▶	Mounting nut Sold separately □ 86 ▶
------------------------------------	----------------------	--	---

### ▼ Threaded body

8,9	M48 x 1,5	MF-482	FN-482
37,8	M80 x 2	MF-802	FN-802

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

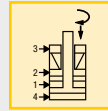


## Oil port functions

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

Force: 4,4 - 37,8 kN
Stroke: 24,0 - 42,0 mm
Pressure: 100 - 350 bar

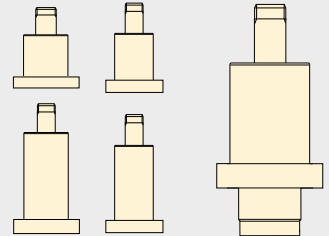
- E Cilindros giratorios
- F Vérins de bridage pivotants
- D Schwenkspannzylinder



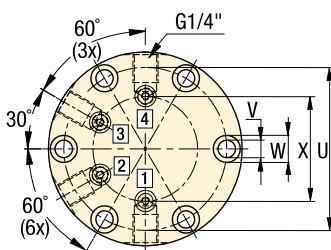
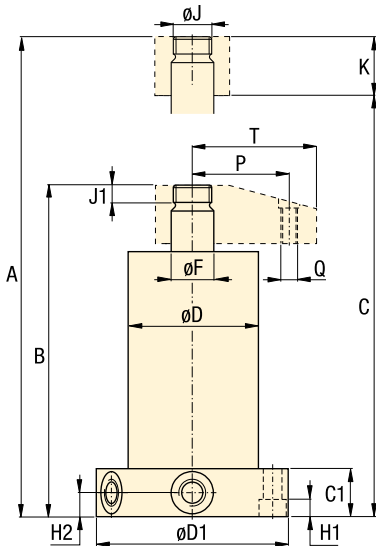
## Custom Options Available

Intermediate capacities

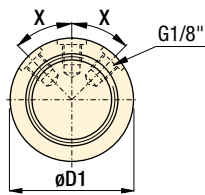
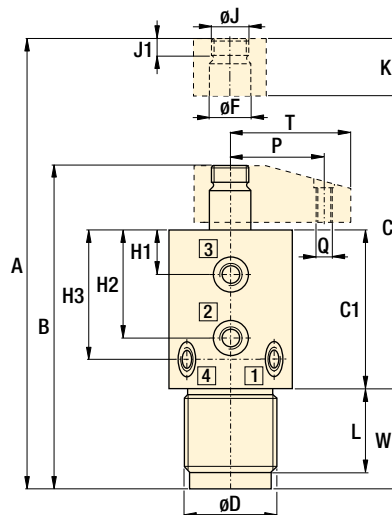
Different flange locations



## MPF models



## MPT models



X = 45° MPT-100 models

X = 30° MPT-300 models

	J	J1	K	L	P	Q	T	U	V	W	X	Right turning models	
								Ø	Ø	Ø	kg		
<b>Lower flange ▼</b>													
	M16 x 1,5	8	30	-	40	M8 x 1,25	54	70,1	9	Ø 14	48,0	2,3	MPFR-50V*
	M20 x 1,5	9	30	-	50	M10 x 1,5	64	84,1	9	Ø 14	54,1	3,5	MPFR-100V*
	M33 x 2,0	10	47	-	70	M16 x 2	93	112,1	11	Ø 17	96,1	12,0	MPFR-300V*
<b>Threaded body ▼</b>													
	M20 x 1,5	9	30	41,5	50	M10 x 1,5	64	-	-	61,9	-	3,0	MPTR-100V*
	M33 x 2,0	10	47	85	70	M16 x 2	93	-	-	99,5	-	11,0	MPTR-300V*

**FS** Flexible Machining Systems  
See Yellow Pages (□ 224)

## Options

Clamp arms □ 14 ▶	
Collet-Lok® work supports □ 16 ▶	
Sequence valves □ 152 ▶	
Accessories □ 86 ▶	

## ⚠ Important

Minimum unlock pressure must be at least 105 bar above lock pressure.



# Swing cylinders, MA-series *Dimensions & options*

Force: 4,4 - 37,8 kN

Pressure: 100 - 350 bar

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

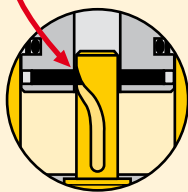
## Important

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 center 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%.

Index mechanism



## Options

### Gauges

□190 ▶



### Flow control valves

□155 ▶



### Sequence valves

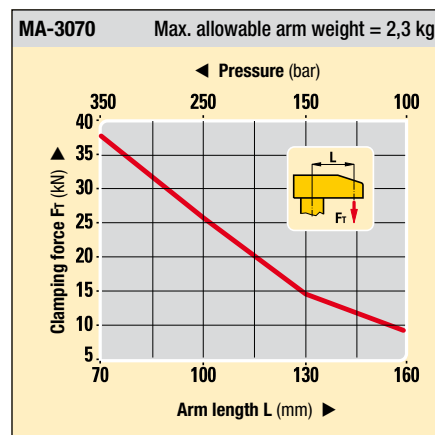
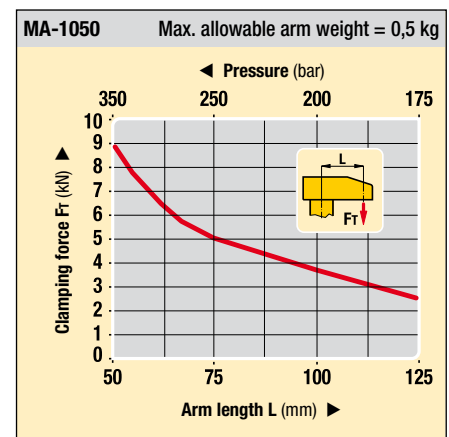
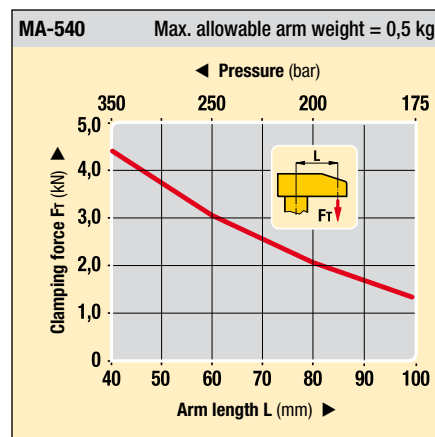
□152 ▶



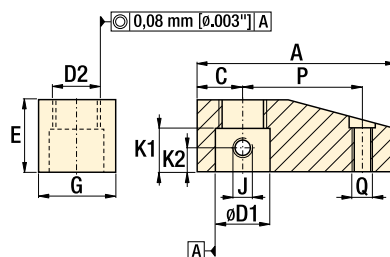
## **i** Determine the right size of your Collet-Lok® swing cylinder

The maximum operating pressure, clamping force and length of the clamp arm will determine your size of swing cylinder. The real operating pressure is a function of both the clamp arm length and clamping force.

In the diagrams below you select the required clamp arm length and clamping force. The use of different length clamp arms requires reduction in applied pressure and resulting clamp force. The diagrams below show this relation.



### MA models Standard clamp arms for Collet-Lok® swing clamps



## **A** Product dimensions in mm [ ]

Clamp. force kN	Model number	A	C	D1 ø	D2	E	G	J	K1	K2	P	Q	kg
-----------------	--------------	---	---	---------	----	---	---	---	----	----	---	---	----

### ▼ Standard clamp arms for Collet-Lok® swing clamps

4,4	<b>MA-540</b>	74,7	18,0	19,02-19,05	M16 x 2	30	32	M8 x 1,25	19	10	40	M8 x 1,25	0,5
8,9	<b>MA-1050</b>	83,0	19,0	22,30-22,33	M20 x 1,5	30	35	M8 x 1,25	18	10	50	M10 x 1,5	0,5
37,8	<b>MA-3070</b>	128,0	35,0	34,97-35,00	M33 x 2	47	59	M8 x 1,25	32	17	70	M16 x 2	2,3

**i** Special configurations are available

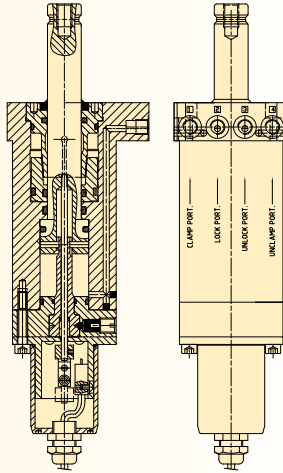
**Model: MPFL100PE001-S**

**Body style:** Upper flange

**Clamp capacity:** 9 kN (2000 lbs)

**Clamping stroke:** 18 mm (.71 in.)

**Special feature:** Position sensing



**Special features for Swing Cylinders \***

Enerpac can design Collet-Lok® cylinders with special features to meet the needs of your production fixtures:

- Special mounting
- Special manifold port location
- Longer stroke
- Special rotation
- Internal clutch to protect rotation mechanism
- Viton seals
- Special rod end
- Position sensing

\* Special features also available for Collet-Lok® Push Cylinders and Work Supports.

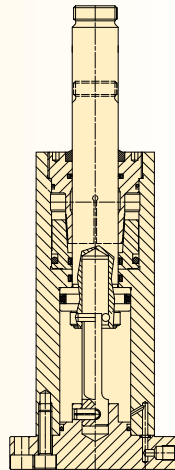
**Model: MPFN300VE002**

**Body style:** Lower flange

**Clamp capacity:** 39 kN (8800 lbs)

**Clamping stroke (straight):**  
57,4 mm (2.25 in.)

**Special feature:** Viton seals  
Long stroke



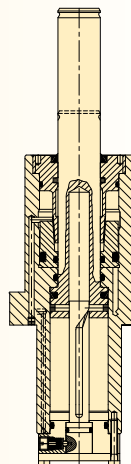
**Model: MPFL200VE100**

**Body style:** Mid-body flange

**Clamp capacity:** 20 kN (3900 lbs)

**Clamping stroke (left hand):**  
63,5 mm (2.50 inch)

**Special feature:** Viton seals  
Long stroke  
Mid-flange body



# Work supports - Collet-Lok® design

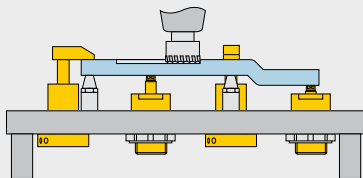
Shown: MPFS-100, MPTS-100



Collet-Lok® products

## MP 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.



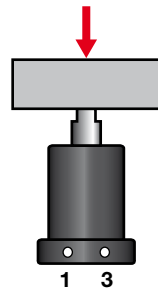
While pallet No. 1 is in the machine, a new work piece is loaded on to pallet No. 2.



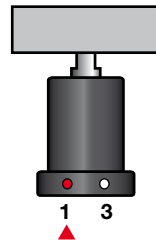
## Hydraulically locked, mechanically maintained work support

- *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
- Capacities up to 44,5 kN available.

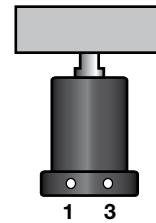
## Collet-Lok® sequence



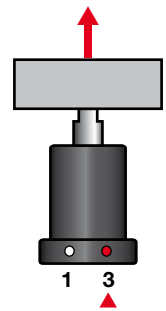
**Step 1**  
Install the workpiece on the support cylinder. The plunger position will adjust to the contour of the workpiece.



**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.

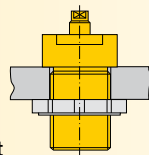


**Step 4**  
Pressurize oil port #3. The plunger will be unlocked. When the workpiece is removed, plunger will extend into its original position.

## Mounting style

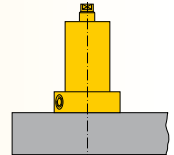
### MPT series, Threaded mount

Threaded body can be used with a threaded hole in fixture plate or a jam nut with a bored hole. Ports are located in top collar block.



### MPF series, Flange models

Mounts directly to fixture plate. Offers the flexibility of side ports or manifold ports on the underside of the flange.



## Product selection

Max. support force	Support plunger stroke	Flange models	Threaded models	Operating pressure		Locking system displacement		Plunger contact spring force	Max. oil flow
				min.	max.	lock	unlock		
8,9	10	MPFS-100V	-	100	350	3,93	3,93	20,0	0,5
17,8	10	MPFS-200V	-	100	350	6,06	6,06	35,2	1,0
44,5	19,6	MPFS-450V	-	100	350	18,03	18,03	300,4	4,0
8,9	10	-	MPTS-100V	100	350	3,93	3,93	15,0	0,5
17,8	10	-	MPTS-200V	100	350	6,06	6,06	30,0	1,0

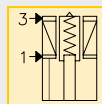


Force: 8,9 - 44,5 kN

Stroke: 10 - 19,6 mm

Pressure: 100 - 350 bar

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



**Options**

Collet-Lok® swing cylinders

12



Auto couplers

174



Positive clamping cylinders

80



Sequence valves

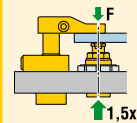
152



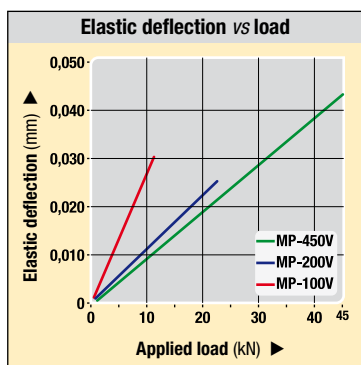
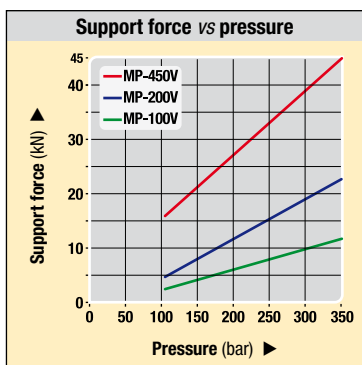
**Important**

**WARNING!**

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

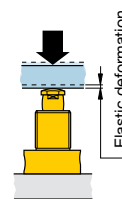


For proper application, clamp force, pressures and timing, consult Enerpac for support.



**Deflection chart:**

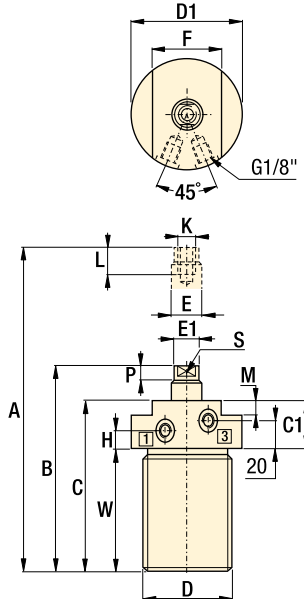
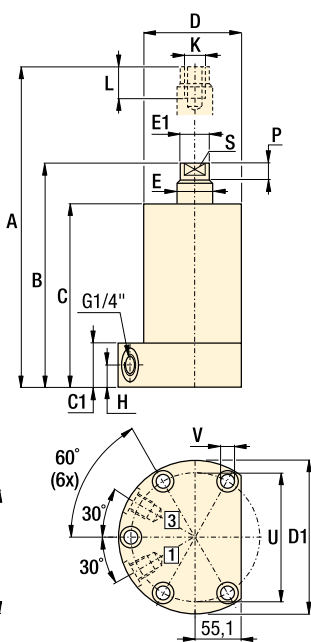
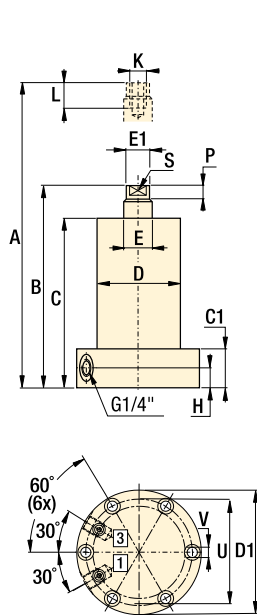
Elastic deformation of the work support resulting from the application of load.



**MPFS-100V, -200V**

**MPFS-450V**

**MPTS-100V, -200V**



**Product dimensions** in mm [  $\pm$  ]

Model number	A	B	C	C1	D	D1	E	E1	F	H	K	L	M	P	S*	U	V	W	X	kg
						Ø	Ø	Ø								Ø	Ø		Ø	
<b>▼ Flange models</b>																				
<b>MPFS-100V</b>	126	116	106	25	Ø 76	110	15,9	14	-	12,5	M8 x 1,25	15	-	7	2,8	94,1	9	-	81,5	4,0
<b>MPFS-200V</b>	130	120	106	25	Ø 92	130	25	24	-	12,5	M12 x 1,75	20	-	9	2,8	112,1	9	-	97,1	6,0
<b>MPFS-450V</b>	193,4	173,8	161	25	Ø 130	165	50	48	-	12,5	M20 x 2	30	-	10	30 **	147	11	-	125	16,0
<b>▼ Threaded models</b>																				
<b>MPTS-100V</b>	125	115	105	38	M60 x 2	69	15,9	14	55	15,5	M8 x 1,25	15	20	7	2,8	-	-	67	-	3,0
<b>MPTS-200V</b>	129	119	105	38	M80 x 2	89	25	24	70	15,5	M12 x 1,75	20	20	9	2,8	-	-	67	-	4,0

\* 2x spanner holes Ø 2,8 mm for MPFS-100 and 200 models.

\*\* Wrench Flats for MPFS-450.

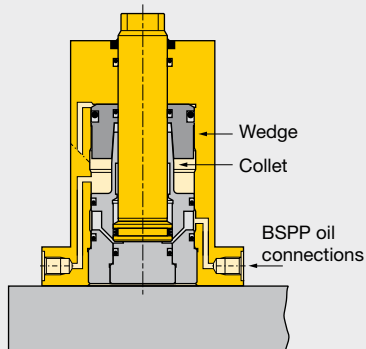
# Push cylinders - Collet-Lok® design

Shown: MPTC-110, MPFC-210



## MP series

Collet-Lok® positive locking push cylinders are designed to mechanically hold the workpiece after hydraulic pressure is removed. Push capacities range from 11,1 kN to 22,2 kN.



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.

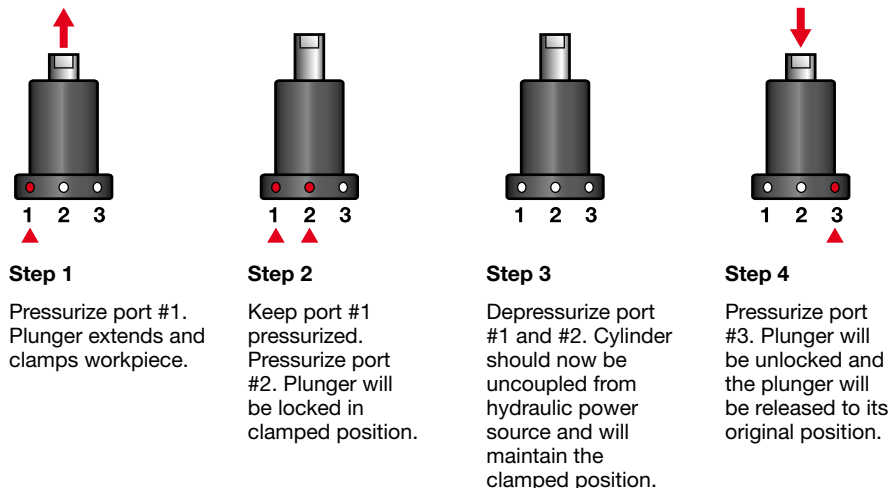


Ideal when live hydraulics are not available

...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
- Capacities up to 39,9 kN available on request.

## Collet-Lok® sequence



## Product selection

Max. push force	Hydr. plunger stroke	Lower flange	Threaded body	Operating pressure		Hydraulic effective area		Oil capacity		Max. oil flow
				bar min.	bar max.	cm <sup>2</sup> adv.	cm <sup>2</sup> adv.	cm <sup>3</sup> unlock	cm <sup>3</sup> retr.	
11,1	15,3	MPFC-110V	MPTC-110V	50	350	3,23	4,92	6,06	3,93	2,0
22,2	15,2	MPFC-210V	MPTC-210V	50	350	6,39	10,00	10,00	6,06	4,0

Maximum cycle rate: 8 cycles/min.

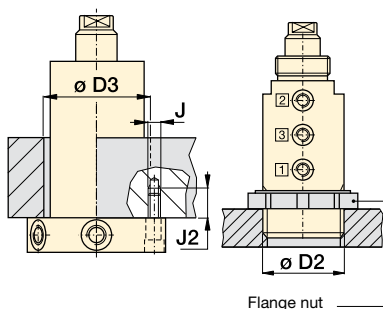
Note: Call Enerpac to order models with UNF thread and SAE port connections. Capacities up to 39,9 kN available on request.

## Dimensions in mm [ $\varnothing$ ]

Model number	A	B	C	C1	D	D1	D2	E	E1	F
						$\varnothing$		$\varnothing$	$\varnothing$	$\varnothing$
▼ Lower flange										
MPFC-110V	155,8	140,5	131	-	$\varnothing$ 70,0	100	-	15,8	15	-
MPFC-210V	176,7	161,5	149	-	$\varnothing$ 78,0	110	-	22,2	20	-
▼ Threaded body										
MPTC-110V	154,8	139,5	130	18,5	M60 x 2	60	M36 x 1,5	15,8	15	46
MPTC-210V	175,7	160,5	148	18	M70 x 2	70	M48 x 1,5	22,2	20	55

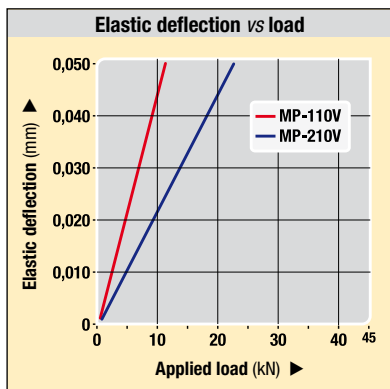
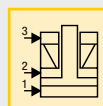
**A** Installation dimensions in mm

Push force kN	Fixture hole ø D3	Mounting thread J	Minimum depth J2
<b>▼ Lower flange</b>			
11,1	71	M6 x 1,0	17
22,2	79	M8 x 1,0	18
<b>▼ Threaded body</b>			
11,1	M60 x 2	-	-
22,2	M70 x 2	-	-



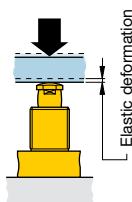
<b>Force: 11,1 - 22,2 kN</b>
<b>Stroke: 15,0 mm</b>
<b>Pressure: 50 - 350 bar</b>

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



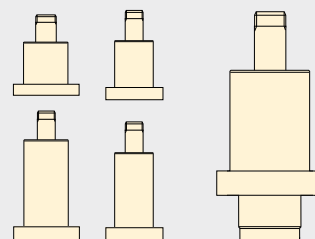
**Deflection chart:**

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

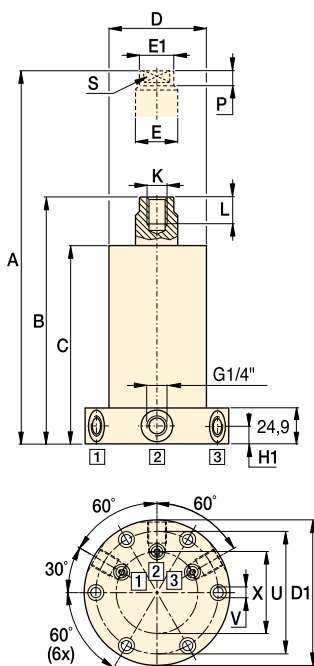


**Custom Options Available**

- Intermediate capacities
- Different flange locations



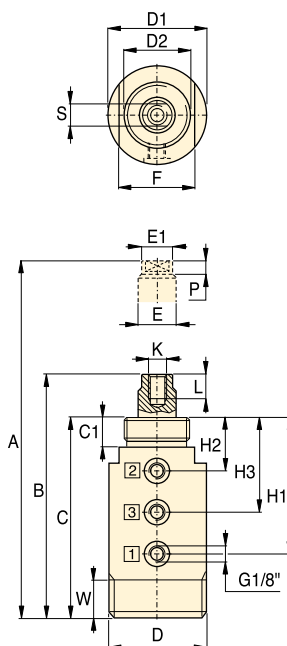
**MPFC**



**Oil port functions**

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

**MPTC**



H1	H2	H3	K	L	P	S*	U	V	W	X	kg	Model number
<b>Lower flange ▼</b>												
12,5	-	-	M8 x 1,25	15	7,0	12,0	84,1	7	-	56,1	4,0	<b>MPFC-110V</b>
12,5	-	-	M10 x 1,5	20	8,7	16,0	94,0	9	-	70,0	5,0	<b>MPFC-210V</b>
<b>Threaded body ▼</b>												
96,0	33,0	64,5	M8 x 1,25	15	7,0	12,0	-	-	19	-	3,0	<b>MPTC-110V</b>
111,0	32,5	72,0	M10 x 1,5	20	8,7	16,0	-	-	20	-	3,4	<b>MPTC-210V</b>

\* Spanner holes (x 2)

**Options**

- Auto couplers** 174 ▶
- Sequence valves** 152 ▶
- Accessories** 86 ▶
- Collet-Lok® swing cylinders** 12 ▶

**Important**

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

# Swing Clamps

## Swing Clamps

Enerpac's complete line of swing clamps provides 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 clamps will provide maximum performance and trouble free operation.



## 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

 197 ▶



▼ series

▼ page

<b>Swing cylinder range overview</b>		<b>22 - 23</b>	
Upper flange swing clamps	SU	24 - 25	
Lower flange swing clamps	SL	26 - 27	
Threaded body swing clamps	ST	28 - 29	
Cartridge model swing clamps	SC	30 - 31	
Clamp arms	CAS CAL	32 - 33	
Pivoting T-arms	CAC CAPT	34 - 35	
Upreach clamp arms	CAU	36 - 37	
Swing clamps	SC	38	
Swing clamps	ASC	39	
Three-position swing clamps	WTR	40 - 41	

# Swing clamps *Application & selection*

Collet-Lok® products

Swing clamps

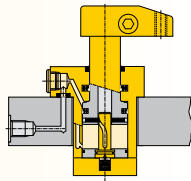
Shown: SCRD-122, STLD-22, SLRS-202



► Enerpac swing clamps 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.

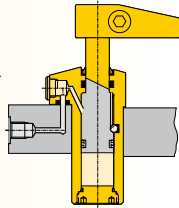
### Roller in groove

- Double index provides low height design to minimize fixture height
- Overload clutch allows clamp to disengage if needed to prevent damage due to improper part loading



### Ball in groove

- Rotation direction can be changed on-site to reduce spare inventory by 2/3 (67%)
- Ball and cam rotation ensures smooth accurate operation



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

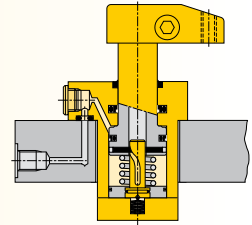
## Compact and full featured design

- 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 22, 52 and 121 models allows swing rotation to be changed easily
- Overload clutch mechanism on 92, 202, and 352 models prevents damage to cylinder from high flow rates or misapplication.

## i Select your swing cylinder type:

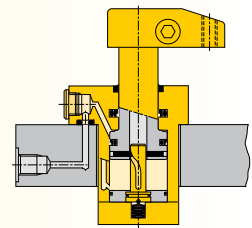
### Single acting

- 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.



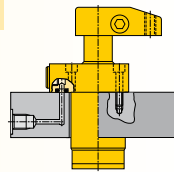
For Collet-Lok® positive locking swing clamps, see 12 ▶

## 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.

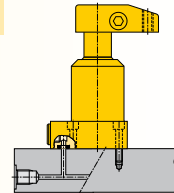
 24 ▶



### 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.

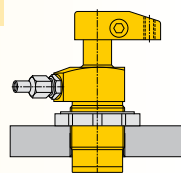
 26 ▶



### 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.

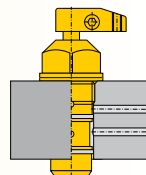
 28 ▶



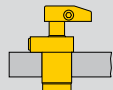



### SC series, Cartridge mounting


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

 30 ▶



## Product selection

Clamping force <sup>1)</sup>	Stroke		Upper flange	Lower flange	Threaded body	Cartridge
	kN	mm				
	clamping	total				
<b>▼ Single acting</b>						
	Model number <sup>2)</sup>					
2,1	8,1	16,4	<b>SURS-22</b>	<b>SLRS-22</b>	<b>STRS-22</b>	<b>SCRS-22</b>
4,9	9,9	22,6	<b>SURS-52</b>	<b>SLRS-52</b>	<b>STRS-52</b>	<b>SCRS-52</b>
8,0	11,9	23,0	<b>SURS-92</b>	<b>SLRS-92</b>	<b>STRS-92</b>	-
10,7	12,7	27,9	<b>SURS-121</b>	<b>SLRS-121</b>	<b>STRS-121</b>	<b>SCRS-122</b>
17,4	14,0	29,5	<b>SURS-202</b>	<b>SLRS-202</b>	<b>STRS-202</b>	-
33,1	16,0	32,6	<b>SURS-352</b>	<b>SLRS-352</b>	<b>STRS-352</b>	-
<b>▼ Double acting</b>						
	Model number <sup>2)</sup>					
2,2	8,1	16,4	<b>SURD-22</b>	<b>SLRD-22</b>	<b>STRD-22</b>	<b>SCRD-22</b>
5,6	9,9	22,6	<b>SURD-52</b>	<b>SLRD-52</b>	<b>STRD-52</b>	<b>SCRD-52</b>
9,0	11,9	23,0	<b>SURD-92</b>	<b>SLRD-92</b>	<b>STRD-92</b>	-
9,0	32,0	43,0	<b>SURDL-92*</b>	-	-	-
11,6	12,7	27,9	<b>SURD-121</b>	<b>SLRD-121</b>	<b>STRD-121</b>	<b>SCRD-122</b>
11,6	31,8	47,0	<b>SURDL-121</b>	-	-	-
18,7	14,0	29,5	<b>SURD-202</b>	<b>SLRD-202</b>	<b>STRD-202</b>	-
33,8	16,0	32,6	<b>SURD-352</b>	<b>SLRD-352</b>	<b>STRD-352</b>	-
33,8	31,8	48,4	<b>SURDL-352*</b>	-	-	-




<sup>1)</sup> With standard clamp arm. Clamp arms are sold separately ( 32). Clamping forces for single-acting models are reduced in order to overcome return spring force. <sup>2)</sup> For left turning swing clamps replace the R in the model number for an L. **Note:** Call Enerpac to order models with imperial thread and SAE port connections.

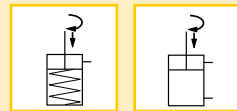
\* This product is made to order. Please contact Enerpac for delivery information before specifying in your design.  
[www.enerpacwh.com](http://www.enerpacwh.com)

Force: 2,1 - 33,8 kN

Stroke: 16,4 - 48,4 mm


Pressure: 35 - 350 bar

-  Cilindros giratorios
-  Vérins de bridage pivotants
-  Schwenkspannzylinder



## Options

Available as both left and right turning

Left  90°  Right

### Clamp arms

 32 ▶



### Work supports

 43 ▶



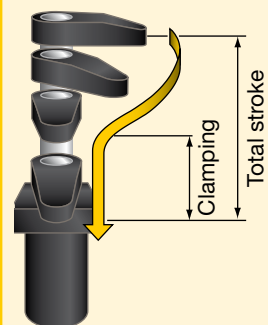
### Accessories

 86 ▶



## Important

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



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

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

# Swing clamps - Upper flange models

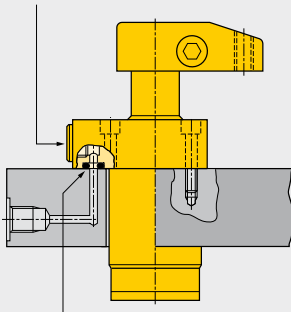
Shown: SURS-52, SURS-202



## SU series

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

BSP 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	
	kN	mm				cm <sup>2</sup>	cm <sup>3</sup>			
	Clamp	Total			Clamp	Un-clamp	Clamp	Un-clamp	l/min	
<b>▼ Single acting</b>										
Model number <sup>2)</sup>										
2,1	8,1	16,4	<b>SULS-22</b>	<b>SURS-22</b>	0,77	–	1,31	–	0,2	<b>CAS-22</b>
4,9	9,9	22,6	<b>SULS-52</b>	<b>SURS-52</b>	1,81	–	4,10	–	0,4	<b>CAS-52</b>
8,0	11,9	23,0	<b>SULS-92</b>	<b>SURS-92</b>	3,16	–	6,88	–	1,0	<b>CAS-92</b>
10,7	12,7	27,9	<b>SULS-121</b>	<b>SURS-121</b>	4,06	–	11,47	–	1,6	<b>CAS-121</b>
17,4	14,0	29,5	<b>SULS-202</b>	<b>SURS-202</b>	7,10	–	19,99	–	2,3	<b>CAS-202</b>
33,1	16,0	32,6	<b>SULS-352</b>	<b>SURS-352</b>	12,39	–	37,20	–	3,9	<b>CAS-352</b>
<b>▼ Double acting</b>										
Model number <sup>2)</sup>										
2,2	8,1	16,4	<b>SULD-22</b>	<b>SURD-22</b>	0,77	1,55	1,31	2,62	0,2	<b>CAS-22</b>
5,6	9,9	22,6	<b>SULD-52</b>	<b>SURD-52</b>	1,81	3,81	4,10	8,69	0,4	<b>CAS-52</b>
9,0	11,9	23,0	<b>SULD-92</b>	<b>SURD-92</b>	3,16	8,06	6,88	17,70	1,0	<b>CAS-92</b>
9,0	32,0	43,0	<b>SULD-92*</b>	<b>SURDL-92*</b>	3,16	8,06	13,27	30,48	1,0	<b>CAS-92</b>
11,6	12,7	27,9	<b>SULD-121</b>	<b>SURD-121</b>	4,06	7,94	11,47	22,94	1,6	<b>CAS-121</b>
11,6	31,8	47,0	<b>SULD-121</b>	<b>SURDL-121</b>	4,06	7,94	15,90	37,69	1,6	<b>CAS-121</b>
18,7	14,0	29,5	<b>SULD-202</b>	<b>SURD-202</b>	7,10	15,16	19,99	42,61	2,3	<b>CAS-202</b>
33,8	16,0	32,6	<b>SULD-352</b>	<b>SURD-352</b>	12,39	23,74	37,20	71,28	3,9	<b>CAS-352</b>
33,8	31,8	48,4	<b>SULD-352*</b>	<b>SURDL-352*</b>	12,39	23,74	57,85	110,94	3,9	<b>CAS-352</b>

<sup>1)</sup> With standard clamp arm. Clamp arms are sold separately (□ 32). 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.

\* This product is made to order. Please contact Enerpac for delivery information before specifying in your design.

**Note:** Call Enerpac to order models with SAE port connections.

## Dimensions in mm [ ]

Left turning models	A	B	C	C1	D	D1	D2	F	G	H	K	M
						∅		∅				
<b>▼ Single acting</b>												
<b>SULS-22</b>	112,1	59,0	26,7	43,0	27,9	47,2	45,0	10,0	G1/8"	11,2	16,0	-
<b>SULS-52</b>	135,3	69,3	27,4	50,1	34,8	54,0	57,2	16,0	G1/8"	9,9	19,2	-
<b>SULS-92</b>	144,2	76,3	28,2	51,2	47,9	70,0	54,0	25,0	G1/4"	13,0	25,0	15,0
<b>SULS-121</b>	171,5	85,7	27,4	55,3	47,5	66,4	73,2	22,2	SAE #4	9,9	30,4	-
<b>SULS-202</b>	167,0	88,1	28,4	58,0	62,6	85,0	70,0	32,0	G1/4"	13,0	30,1	23,2
<b>SULS-352</b>	189,3	100,7	28,2	60,7	76,8	100,0	89,0	38,0	G1/4"	13,0	40,0	27,4
<b>▼ Double acting</b>												
<b>SULD-22</b>	112,1	59,0	26,7	43,0	27,9	47,2	45,0	10,0	G1/8"	11,2	16,0	-
<b>SULD-52</b>	135,3	69,3	27,4	50,1	34,8	54,0	57,2	16,0	G1/8"	9,9	19,2	-
<b>SULD-92</b>	144,2	76,3	28,2	51,2	47,9	70,0	54,0	25,0	G1/4"	13,0	25,0	-
<b>SULD-92*</b>	184,2	96,3	28,2	71,2	47,9	70,0	54,0	25,0	G1/4"	13,0	25,0	-
<b>SULD-121</b>	171,5	85,7	27,4	55,3	47,5	66,4	73,2	22,2	SAE #4	9,9	30,4	-
<b>SULD-121</b>	228,7	104,7	27,4	74,4	47,5	66,4	73,2	22,2	SAE #4	9,9	30,4	-
<b>SULD-202</b>	167,0	88,1	28,4	58,0	62,6	85,0	70,0	32,0	G1/4"	13,0	30,1	-
<b>SULD-352</b>	189,3	100,7	28,2	60,7	76,8	100,0	89,0	38,0	G1/4"	13,0	40,0	-
<b>SULD-352*</b>	220,9	116,5	28,2	76,5	76,8	100,0	89,0	38,0	G1/4"	13,0	40,0	-

**NOTE:** dimensions shown with standard clamp arm.

\* This product is made to order. Please contact Enerpac for delivery information before specifying in your design.

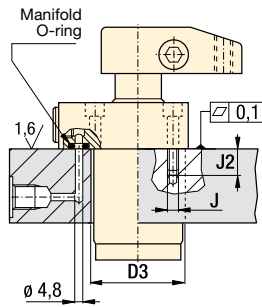


**Installation dimensions** in mm

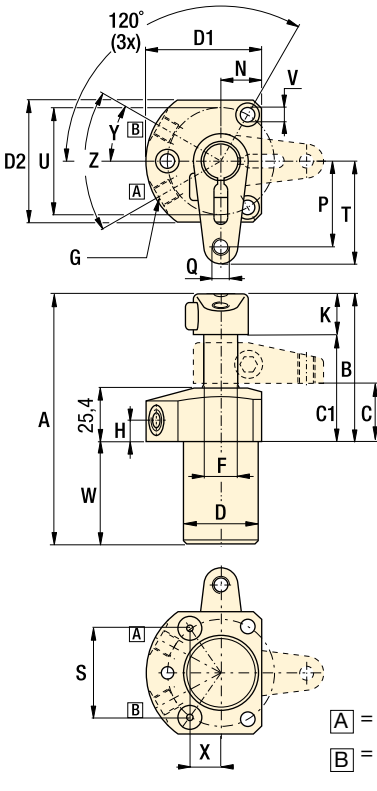
Clamping force <sup>1)</sup> kN	Fixture hole Ø D3	Mounting thread J	Min. depth J2	Manifold O-ring <sup>2)</sup> ARP number or inside Ø x thickness
2,2	28,5	M5 x 0,8	16,5	568-010
5,6	35,5	M6 x 1,0	16,5	568-011
9,0	49,0	M6	15,0	4,32 x 3,53
11,6	49,0	.312-24 UNF	20,3	568-011
18,7	63,5	M8 x 1,0	17,0	4,32 x 3,53
33,8	78,0	M10 x 1,25	18,8	4,32 x 3,53

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

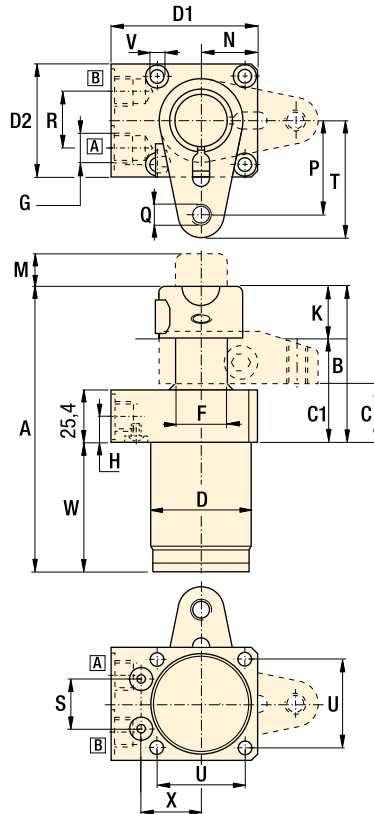
**Note:** Mounting bolts and O-rings included.



**-92, 52, 121**



**-92, 202, 352**



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

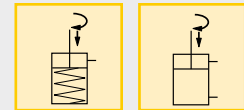
N	P	Q	R	S	T	U	V	W	X	Y	Z	kg	Right turning models
													<b>Single acting ▼</b>
15,5	24,6	M6 x 1	-	21,0	30,9	41,9	5,7	53,1	18,1	30°	60°	0,5	<b>SURS-22</b>
19,1	40,0	M8 x 1,25	-	41,0	47,9	50,0	6,8	66,0	14,4	30°	60°	1,1	<b>SURS-52</b>
26,4	45,9	M10 x 1,5	26,0	23,7	56,0	42,0	6,5	67,9	28,6	-	-	2,0	<b>SURS-92</b>
25,1	51,4	.375-16 UNC	-	52,0	61,8	63,5	8,8	85,9	18,2	30°	60°	1,6	<b>SURS-121</b>
34,4	55,2	M12 x 1,75	26,0	29,1	70,2	55,0	8,5	78,9	35,1	-	-	3,5	<b>SURS-202</b>
43,4	67,9	M16 x 2	26,0	34,4	82,9	70,0	10,8	88,6	41,6	-	-	5,5	<b>SURS-352</b>
													<b>Double acting ▼</b>
15,5	24,6	M6 x 1	-	21,0	30,9	41,9	5,7	53,1	18,1	30°	60°	0,5	<b>SURD-22</b>
19,1	40	M8 x 1,25	-	41,0	47,9	50,0	6,8	66,0	14,4	30°	60°	1,1	<b>SURD-52</b>
26,4	45,9	M10 x 1,5	26,0	23,7	56,0	42,0	6,5	67,9	28,6	-	-	2,0	<b>SURD-92</b>
26,4	45,9	M10 x 1,5	26,0	23,7	56,0	42,0	6,5	87,9	28,6	-	-	2,6	<b>SURDL-92*</b>
25,1	51,4	.375-16 UNC	-	52,0	61,8	63,5	8,8	85,9	18,2	30°	60°	1,6	<b>SURD-121</b>
25,1	51,4	.375-16 UNC	-	52,0	61,8	63,5	8,8	124,0	18,2	30°	60°	1,8	<b>SURDL-121</b>
34,4	55,2	M12 x 1,75	26,0	29,1	70,2	55,0	8,5	78,9	35,1	-	-	3,5	<b>SURD-202</b>
43,4	67,9	M16 x 2	26,0	34,4	82,9	70,0	10,8	88,6	41,6	-	-	5,5	<b>SURD-352</b>
43,4	67,9	M16 x 2	26,0	34,4	82,9	70,0	10,8	104,3	41,6	-	-	6,9	<b>SURDL-352*</b>

**Force: 2,1 - 33,8 kN**

**Stroke: 16,4 - 48,4 mm**

**Pressure: 35 - 350 bar**

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



**Options**

**Clamp arms**

32 ▶

**Work supports**

43 ▶

**Collet-Lok® swing cylinders**

12 ▶

**Accessories**

86 ▶

**Important**

30, 45, and 60 degree rotations are available upon request. Add -30, -45 or -60 to end of standard model number to order directly from Enerpac. To order rotation limiter separately, see page 58.

Custom cylinders including longer stroke lengths are available on request.

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.

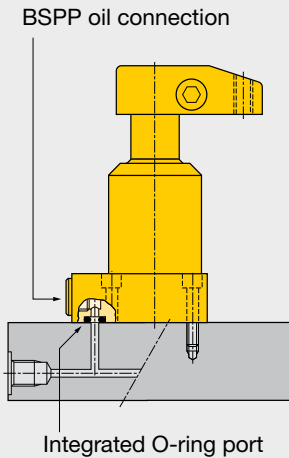
# Swing clamps - Lower flange models

Shown: SLRD-52, SLRS-202



## SL series

Enerpac lower flange series swing clamps 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.



Lower flange swing clamps 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> kN	Stroke mm		Left turning 90° 	Right turning 90° 	Cylinder effective area cm <sup>2</sup>		Oil capacity cm <sup>3</sup>		Max. oil flow <sup>1)</sup> l/min	Standard clamp arm Sold separately  32 ▶
	Clamp	Total			Un-clamp	Clamp	Un-clamp	Clamp		
<b>▼ Single acting</b>										
Model number <sup>2)</sup>										
2,1	8	16,5	<b>SLLS-22</b>	<b>SLRS-22</b>	0,77	–	1,31	–	0,2	<b>CAS-22</b>
4,9	10	22,6	<b>SLLS-52</b>	<b>SLRS-52</b>	1,81	–	4,10	–	0,4	<b>CAS-52</b>
8,0	12	23,0	<b>SLLS-92</b>	<b>SLRS-92</b>	3,16	–	6,88	–	1,0	<b>CAS-92</b>
10,7	13	27,9	<b>SLLS-121</b>	<b>SLRS-121</b>	4,06	–	11,47	–	1,6	<b>CAS-121</b>
17,4	14	29,5	<b>SLLS-202</b>	<b>SLRS-202</b>	7,10	–	19,99	–	2,3	<b>CAS-202</b>
33,1	16	32,6	<b>SLLS-352</b>	<b>SLRS-352</b>	12,39	–	37,20	–	3,9	<b>CAS-352</b>

<b>▼ Double acting</b>										
Model number <sup>2)</sup>										
2,2	8	16,5	<b>SLLD-22</b>	<b>SLRD-22</b>	0,77	1,55	1,31	2,62	0,2	<b>CAS-22</b>
5,6	10	22,6	<b>SLLD-52</b>	<b>SLRD-52</b>	1,81	3,81	4,10	8,69	0,4	<b>CAS-52</b>
9,0	12	23,0	<b>SLLD-92</b>	<b>SLRD-92</b>	3,26	8,06	6,88	17,70	1,0	<b>CAS-92</b>
11,6	13	27,9	<b>SLLD-121</b>	<b>SLRD-121</b>	4,06	7,94	11,47	22,94	1,6	<b>CAS-121</b>
18,7	14	29,5	<b>SLLD-202</b>	<b>SLRD-202</b>	7,10	15,26	19,99	42,61	2,3	<b>CAS-202</b>
33,8	16	32,6	<b>SLLD-352</b>	<b>SLRD-352</b>	12,39	23,74	37,20	71,38	3,9	<b>CAS-352</b>

<sup>1)</sup> With standard clamp arm. Clamp arms are sold separately (page 32). 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 SAE port connections.

## Dimensions in mm [ ]

Left turning models	A	C	C1	D	D1	D2	F	G	H	K	M
				∅			∅				
<b>▼ Single acting</b>											
<b>SLLS-22</b>	112,1	79,5	96,1	27,9	47,2	45,0	10,0	G1/8"	13,5	16,0	–
<b>SLLS-52</b>	135,3	93,5	116,1	34,8	54,0	57,2	16,0	G1/8"	14,0	19,3	–
<b>SLLS-92</b>	152,2	104,1	127,1	47,9	70,0	54,0	25,0	G1/4"	12,5	25,0	15,0
<b>SLLS-121</b>	171,5	113,3	141,2	47,5	66,4	73,2	22,2	SAE#4	15,4	30,4	–
<b>SLLS-202</b>	175,0	115,3	144,9	63,8	85,0	70,0	32,0	G1/4"	12,5	30,2	23,2
<b>SLLS-352</b>	197,3	124,7	157,3	79,7	100,0	89,0	38,0	G1/4"	12,5	40,0	27,4
<b>▼ Double acting</b>											
<b>SLLD-22</b>	112,1	79,5	96,1	27,9	47,2	45,0	10,0	G1/8"	13,5	16,0	–
<b>SLLD-52</b>	135,3	93,5	116,1	34,8	54,0	57,2	16,0	G1/8"	14,0	19,3	–
<b>SLLD-92</b>	152,2	104,1	127,1	47,9	70,0	54,0	25,0	G1/4"	12,5	25,0	–
<b>SLLD-121</b>	171,5	113,3	141,2	47,5	66,4	73,2	22,2	SAE#4	15,4	30,4	–
<b>SLLD-202</b>	175,0	115,3	144,9	63,8	85,0	70,0	32,0	G1/4"	12,5	30,2	–
<b>SLLD-352</b>	197,3	124,7	157,3	79,7	100,0	89,0	38,0	G1/4"	12,5	40,0	–

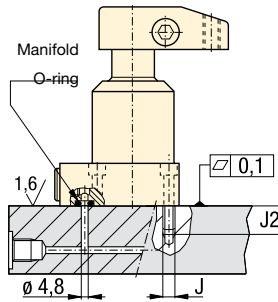
**NOTE:** dimensions shown with standard clamp arm.

**Installation dimensions** in mm

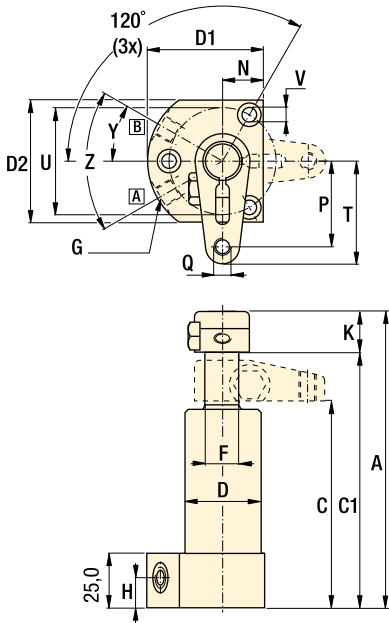
Clamping force <sup>1)</sup> kN	Mounting thread J	Minimum thread depth J2	Manifold O-ring <sup>2)</sup> ARP number or inside Ø x thickness
2,2	M5 x 0,8	16,5	568-010
5,6	M6 x 1,0	16,5	568-011
9,0	M6 x 1,0	15,0	4,32 x 3,53
11,6	312-24 UNF	20,3	568-011
18,7	M8 x 1,0	17,0	4,32 x 3,53
33,8	M10 x 1,25	18,8	4,32 x 3,53

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

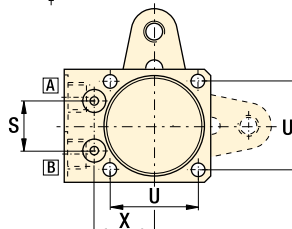
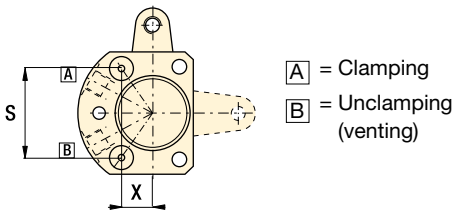
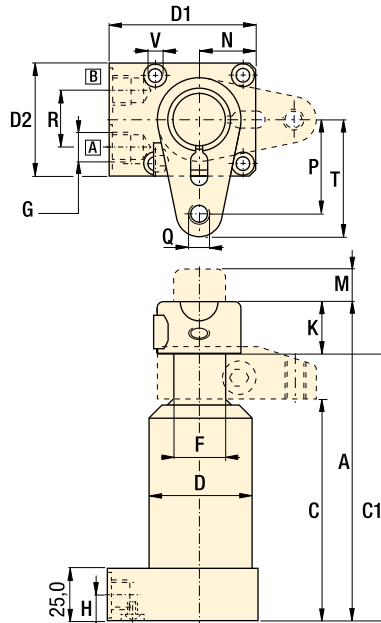
**Note:** Mounting bolts and O-rings included.



**-22, 52, 121**

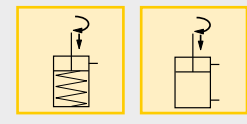


**-92, 202, 352**



- Force: 2,1 - 33,8 kN**
- Stroke: 16,5 - 32,6 mm**
- Pressure: 35 - 350 bar**

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



**Options**

- Clamp arms** 32
- Work supports** 43
- Collet-Lok® swing cylinders** 12
- Accessories** 86

**Important**  
30, 45, and 60 degree rotations are available upon request. Add -30, -45 or -60 to end of standard model number to order directly from Enerpac. To order rotation limiter separately, see page 32.

Custom cylinders including longer stroke lengths are available on request.

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.

N	P	Q	R	S	T	U	V	X	Y	Z	Right turning models
											kg
											<b>Single acting ▼</b>
15,5	24,5	M6 x 1	-	21,0	31,0	40,1	5,8	18,1	30°	60°	0,5 <b>SLRS-22</b>
19,1	40,0	M8 x 1,25	-	41,0	48,0	50,0	6,9	14,4	30°	60°	1,1 <b>SLRS-52</b>
26,4	45,1	M10 x 1,5	25,9	23,7	56,1	41,9	6,6	28,7	-	-	2,0 <b>SLRS-92</b>
25,1	51,4	0,375-16 UNC	-	52,0	62,0	63,5	8,9	18,2	30°	60°	1,6 <b>SLRS-121</b>
34,4	55,2	M12 x 1,75	25,9	29,1	70,4	55,1	8,4	35,1	-	-	3,5 <b>SLRS-202</b>
43,4	67,9	M16 x 2	26,0	34,4	82,9	70,0	10,8	41,6	-	-	5,5 <b>SLRS-352</b>
											<b>Double acting ▼</b>
15,5	24,5	M6 x 1	-	21,0	30,9	41,9	5,7	18,1	30°	60°	0,5 <b>SLRD-22</b>
19,1	40,0	M8 x 1,25	-	41,0	47,9	50,0	6,8	14,4	30°	60°	1,1 <b>SLRD-52</b>
26,4	45,1	M10 x 1,5	26,0	23,7	56,0	42,0	6,5	28,6	-	-	2,0 <b>SLRD-92</b>
25,1	51,4	0,375-16 UNC	-	52,0	61,8	63,5	8,8	18,2	30°	60°	1,6 <b>SLRD-121</b>
34,4	55,2	M12 x 1,75	26,0	29,1	70,2	55,0	8,5	35,1	-	-	3,5 <b>SLRD-202</b>
43,4	67,9	M16 x 2	26,0	34,4	82,9	70,0	10,8	41,6	-	-	5,5 <b>SLRD-352</b>

Swing Clamps  
Work Supports  
Linear Cylinders  
Power Sources  
Valves  
Pallet Components  
System Components  
Yellow Pages

# Swing clamps - Threaded body models

Shown: STRD-52, STRD-202

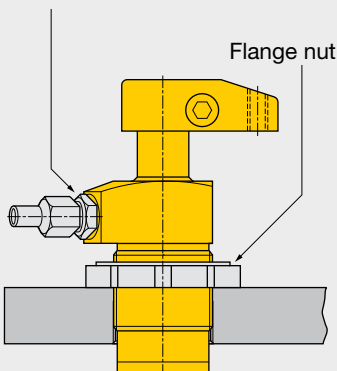


## ST series

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

The cylinder height is adjusted to the appropriate height, and then locked in place using a jam nut (□86).

BSPB oil connection



Threaded body swing clamps 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
	kN	Clamp			Total	mm	cm <sup>2</sup>	cm <sup>3</sup>		
<b>▼ Single acting</b>										
			<b>Model number<sup>2)</sup></b>							
2,1	8	16,5	<b>STLS-22</b>	<b>STRS-22</b>	0,77	–	1,31	–	0,2	<b>CAS-22</b>
4,9	10	22,6	<b>STLS-52</b>	<b>STRS-52</b>	1,81	–	4,10	–	0,4	<b>CAS-52</b>
8,0	12	23,0	<b>STLS-92</b>	<b>STRS-92</b>	3,16	–	6,88	–	1,0	<b>CAS-92</b>
10,7	13	27,7	<b>STLS-121</b>	<b>STRS-121</b>	4,06	–	11,47	–	1,6	<b>CAS-121</b>
17,4	14	29,5	<b>STLS-202</b>	<b>STRS-202</b>	7,10	–	19,99	–	2,3	<b>CAS-202</b>
33,1	16	32,6	<b>STLS-352</b>	<b>STRS-352</b>	12,39	–	37,20	–	3,9	<b>CAS-352</b>
<b>▼ Double acting</b>										
			<b>Model number<sup>2)</sup></b>							
2,2	8	16,5	<b>STLD-22</b>	<b>STRD-22</b>	0,77	1,55	1,31	2,46	0,2	<b>CAS-22</b>
5,6	10	22,6	<b>STLD-52</b>	<b>STRD-52</b>	1,81	3,81	4,10	8,52	0,4	<b>CAS-52</b>
9,0	12	23,0	<b>STLD-92</b>	<b>STRD-92</b>	3,16	8,06	6,88	17,70	1,0	<b>CAS-92</b>
11,6	13	27,7	<b>STLD-121</b>	<b>STRD-121</b>	4,06	7,94	11,47	22,94	1,6	<b>CAS-121</b>
18,7	14	29,5	<b>STLD-202</b>	<b>STRD-202</b>	7,10	15,16	19,99	42,61	2,3	<b>CAS-202</b>
33,8	16	32,6	<b>STLD-352</b>	<b>STRD-352</b>	12,39	23,74	37,20	71,28	3,9	<b>CAS-352</b>

<sup>1)</sup> With standard clamp arm. Clamp arms are sold separately (□32). 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 SAE port connections.



## Dimensions in mm [ □32 ]

Left turning models	A	B	C	C1	C2	D	D1	D2	F	G	H	J1
						∅			∅			
<b>▼ Single acting</b>												
<b>STLS-22</b>	112	59	26,4	43,0	24,9	M28 x 1,5	39,4	33	10	G1/8"	10	–
<b>STLS-52</b>	135	69	27,4	50,1	24,9	M35 x 1,5	47,5	38	16	G1/8"	10	–
<b>STLS-92</b>	143	80	33,5	56,4	30,2	M48 x 1,5	62,5	48	25	G1/4"	13	43
<b>STLS-121</b>	171	86	27,7	55,3	25,4	1.875-16 UNF	60,5	51	22	SAE#4	10	–
<b>STLS-202</b>	165	93	35,6	65,0	32,0	M65 x 1,5	75,9	65	32	G1/4"	13	55
<b>STLS-352</b>	186	105	35,1	67,5	32,0	M80 x 2	88,4	80	38	G1/4"	13	65
<b>▼ Double acting</b>												
<b>STLD-22</b>	112	59	26,4	43,0	24,9	M28 x 1,5	39,4	33	10	G1/8"	10	53
<b>STLD-52</b>	135	69	27,4	50,1	24,9	M35 x 1,5	47,5	38	16	G1/8"	10	66
<b>STLD-92</b>	143	80	33,5	56,4	30,2	M48 x 1,5	62,5	48	25	G1/4"	13	43
<b>STLD-121</b>	171	86	27,7	55,3	25,4	1.875-16 UNF	60,5	51	22	SAE#4	10	86
<b>STLD-202</b>	165	93	35,6	65,0	32,0	M65 x 1,5	75,9	65	32	G1/4"	13	55
<b>STLD-352</b>	186	105	35,1	67,5	32,0	M80 x 2	88,4	80	38	G1/4"	13	65

**NOTE:** dimensions shown with standard clamp arm.



**Accessory Chart**

Model Nos.		Mounting flange	Flange nut
Left turning	Right turning		
			
90°			
		Sold Separately ☐ 87 ▶	Sold Separately ☐ 86 ▶

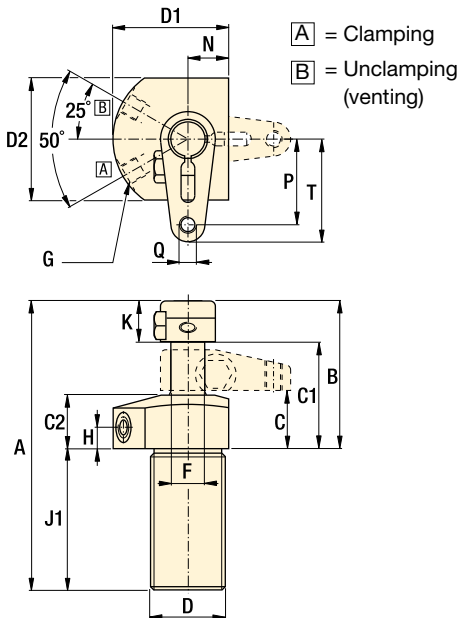
▼ Single acting

STLS-22	STRS-22	MF-282	FN-282
STLS-52	STRS-52	MF-352	FN-352
STLS-92	STRS-92	MF-482	FN-482
STLS-121	STRS-121	MF-481	FN-481
STLS-202	STRS-202	MF-652	FN-652
STLS-352	STRS-352	MF-802	FN-802

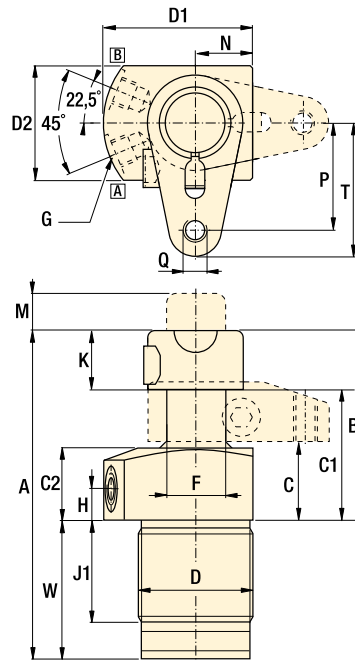
▼ Double acting


STLD-22	STRD-22	MF-282	FN-282
STLD-52	STRD-52	MF-352	FN-352
STLD-92	STRD-92	MF-482	FN-482
STLD-121	STRD-121	MF-481	FN-481
STLD-202	STRD-202	MF-652	FN-652
STLD-352	STRD-352	MF-802	FN-802

-22, 52, 121



-92, 202, 352



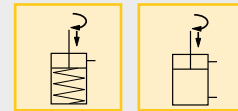
K	M	N	P	Q	T	W	Y	Z		Right turning models
Single acting ▼										
16	-	15,5	24	M6 x 1	31	-	25°	50°	0,5	<b>STRS-22</b>
19	-	19,1	40	M8 x 1,25	48	-	25°	50°	1,1	<b>STRS-52</b>
25	15,5	23,9	45	M10 x 1,5	56	63,0	22,5°	45°	2,0	<b>STRS-92</b>
30	-	25,4	51	0.375-16 UNC	62	-	25°	50°	1,6	<b>STRS-121</b>
30	23,6	32,5	55	M12 x 1,75	70	71,9	22,5°	45°	3,2	<b>STRS-202</b>
40	27,9	39,9	68	M16 x 2	83	81,5	22,5°	45°	5,5	<b>STRS-352</b>
Double acting ▼										
16	-	15,5	24	M6 x 1	31	-	25°	50°	0,5	<b>STRD-22</b>
19	-	19,1	40	M8 x 1,25	48	-	25°	50°	1,1	<b>STRD-52</b>
25	-	23,9	45	M10 x 1,5	56	63,0	22,5°	45°	2,0	<b>STRD-92</b>
30	-	25,4	51	0.375-16 UNC	62	-	25°	50°	1,6	<b>STRD-121</b>
30	-	32,5	55	M12 x 1,75	70	71,9	22,5°	45°	3,5	<b>STRD-202</b>
40	-	39,9	68	M16 x 2	83	81,5	22,5°	45°	5,5	<b>STRD-352</b>

Force: 2,1 - 33,8 kN

Stroke: 16,5 - 32,6 mm

Pressure: 35 - 350 bar

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



**Options**

**Clamp arms**  
☐ 32 ▶ 

**Work supports**  
☐ 43 ▶ 

**Collet-Lok® swing cylinders**  
☐ 12 ▶ 

**Accessories**  
☐ 86 ▶ 

**Important**

30, 45, and 60 degree rotations are available upon request. Add -30, -45 or -60 to end of standard model number to order directly from Enerpac. To order rotation limiter separately, see page 32.

Custom cylinders including longer stroke lengths are available on request.

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 clamps - Cartridge models

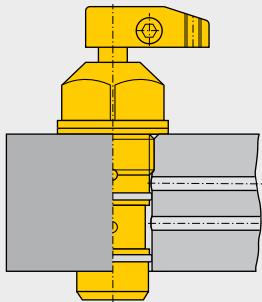
Shown: SCRD-122, SCRD-52



## SC series

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

Cartridge swing clamps simplify mounting and optimize clamping effectiveness.



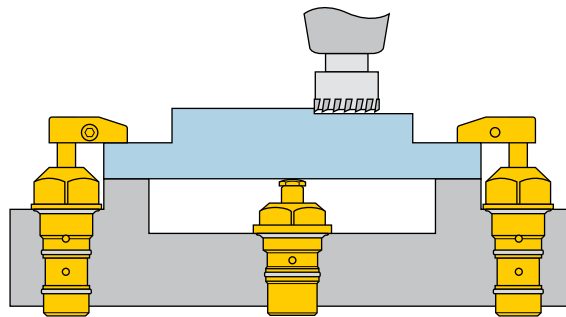
Hydraulic fixture with components on two faces for more efficient production.



## Eliminates the need for tubing and fittings

- 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 clamps 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
	kN	mm			cm <sup>2</sup>	cm <sup>3</sup>				
	Clamp	Total		90°	Clamp	Un-clamp	Clamp	Un-clamp	l/min	Sold separately □ 32 ▶
<b>▼ Single acting</b>										
Model number <sup>2)</sup>										
2,1	8,1	16,8	<b>SCLS-22</b>	<b>SCRS-22</b>	0,77	-	1,31	-	0,2	<b>CAS-22</b>
4,9	9,9	22,6	<b>SCLS-52</b>	<b>SCRS-52</b>	1,81	-	4,09	-	0,4	<b>CAS-52</b>
10,7	12,7	27,7	<b>SCLS-122</b>	<b>SCRS-122</b>	4,06	-	11,47	-	1,6	<b>CAS-121</b>
<b>▼ Double acting</b>										
Model number <sup>2)</sup>										
2,2	8,1	16,8	<b>SCLD-22</b>	<b>SCRD-22</b>	0,77	1,55	1,31	2,49	0,2	<b>CAS-22</b>
5,6	9,9	22,6	<b>SCLD-52</b>	<b>SCRD-52</b>	1,81	3,81	4,09	8,52	0,4	<b>CAS-52</b>
11,6	12,7	27,7	<b>SCLD-122</b>	<b>SCRD-122</b>	4,06	7,94	11,47	22,94	1,6	<b>CAS-121</b>

<sup>1)</sup> With standard clamp arm. Clamp arms are sold separately (□32). 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.

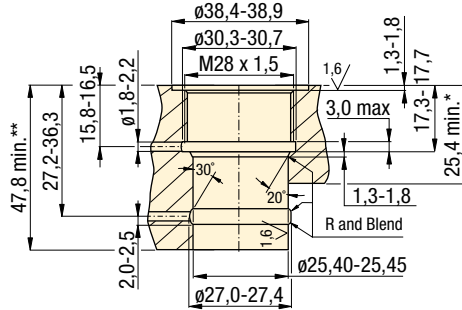
## Dimensions in mm [ □ 32 ]

Left turning models	A	B	C	C1	C2	D1	D2	E	F
						∅	∅	hexagon	
<b>▼ Single acting</b>									
<b>SCLS-22</b>	112,0	57,4	24,9	41,4	23,9	38,4	25,4	34,8	9,9
<b>SCLS-52</b>	135,4	79,8	37,8	60,7	35,3	56,6	34,8	50,5	16,0
<b>SCLS-122</b>	171,5	96,5	38,6	66,3	36,3	75,9	57,2	69,6	22,1
<b>▼ Double acting</b>									
<b>SCLD-22</b>	112,0	57,4	24,9	41,4	23,9	38,4	25,4	34,8	9,9
<b>SCLD-52</b>	135,4	79,8	37,8	60,7	35,3	56,6	34,8	50,5	16,0
<b>SCLD-122</b>	171,5	96,5	38,6	66,3	36,3	75,9	57,2	69,6	22,1

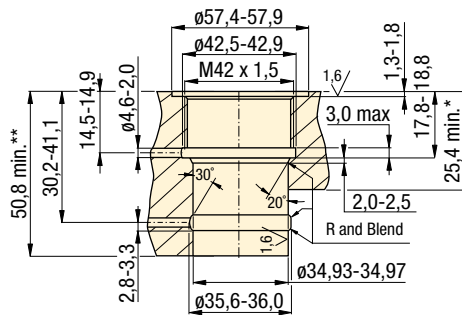
NOTE: dimensions shown with standard clamp arm.

**Installation dimensions in mm**

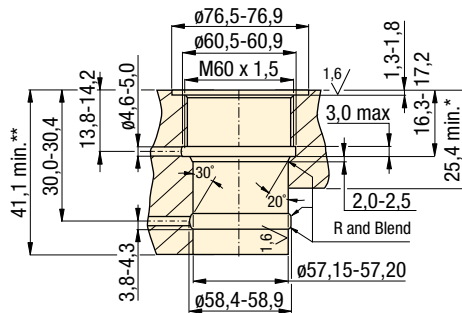
**-22 models**



**-52 models**



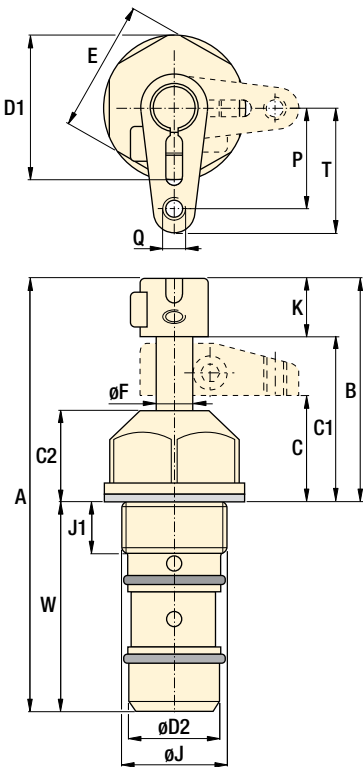
**-122 models**



\* Minimum plate height for single-acting models.

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

**-22, 52, 122 models**

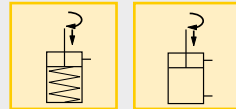


**Force: 2,1 - 11,6 kN**

**Stroke: 16,8 - 27,7 mm**

**Pressure: 35 - 350 bar**

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



**Options**

**Clamp arms**

☐ 32 ▶

**Work supports**

☐ 43 ▶

**Collet-Lok® swing cylinders**

☐ 12 ▶

**Accessories**

☐ 86 ▼

**Sequence valves**

☐ 152 ▶

**⚠ Important**

30, 45, and 60 degree rotations are available upon request. Add -30, -45 or -60 to end of standard model number to order directly from Enerpac. To order rotation limiter separately, see page 32.

Custom cylinders including longer stroke lengths are available on request.

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.

	J	J1	K	P	Q	T	W		Right turning models
	Ø							kg	
	M28 x 1,5	12,7	16,0	24,6	M6 x 1	31,0	54,6	0,5	<b>Single acting ▼</b>
	M42 x 1,5	13,7	19,3	40,1	M8 x 1,25	48,0	55,6	0,9	<b>SCRS-52</b>
	M60 x 1,5	13,2	30,5	51,6	.375-16 UNC	62,0	74,9	2,5	<b>SCRS-122</b>
									<b>Double acting ▼</b>
	M28 x 1,5	12,7	16,0	24,6	M6 x 1	31,0	54,6	0,5	<b>SCRD-22</b>
	M42 x 1,5	13,7	19,3	40,1	M8 x 1,25	48,0	55,6	0,9	<b>SCRD-52</b>
	M60 x 1,5	13,2	30,5	51,6	.375-16 UNC	62,0	74,9	2,5	<b>SCRD-122</b>

# Clamp arms for swing clamps

Shown: CAS-122, CAL-122



Collet-Lok® products

Swing clamps

## Clamp Arms

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.

Ordering rotation limiting spacers

### BUILD YOUR PART NUMBER:

SP	186
Clamp force	Angle
02 = 2,2 kN	30
05 = 5,6 kN	45
09 = 9,0 kN	60
12 = 11,6 kN	
20 = 18,7 kN	
35 = 33,8 kN	

### Example:

SP-12 45-186 converts a 11,6 kN swing cylinder to 45 degree rotation.

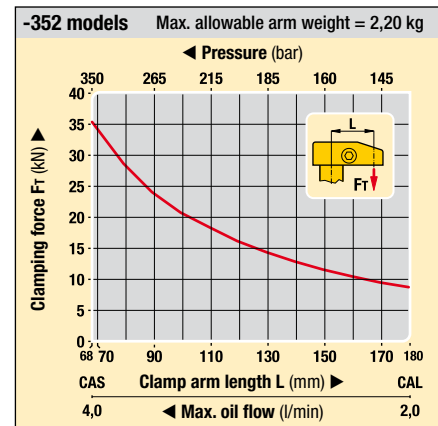
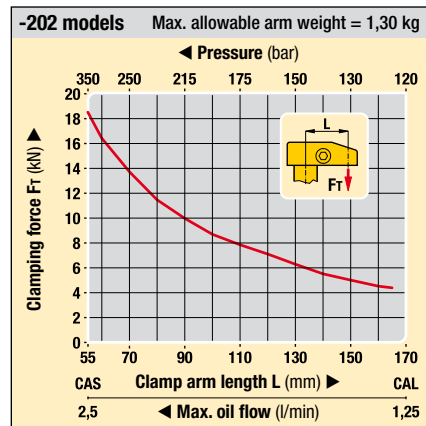
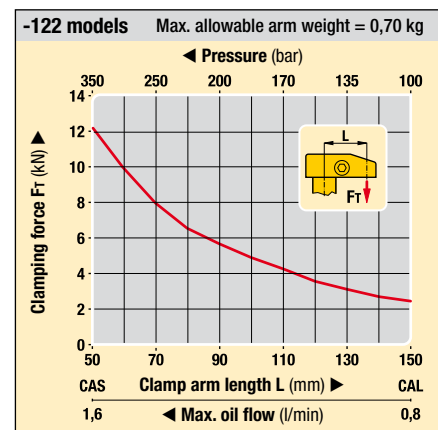
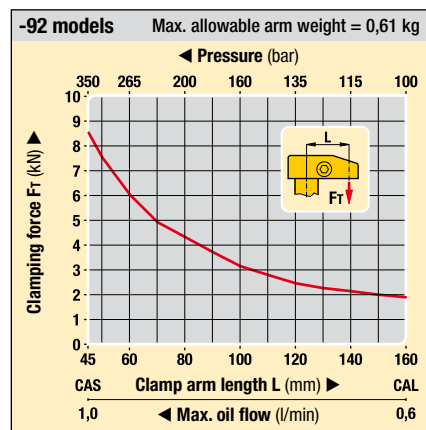
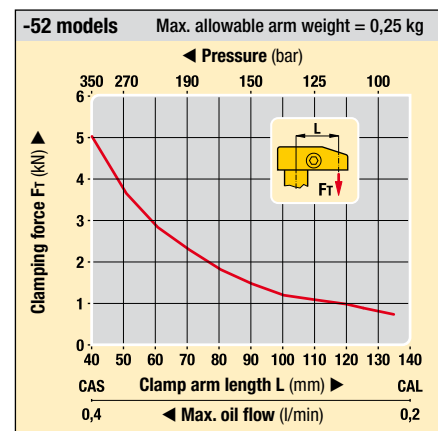
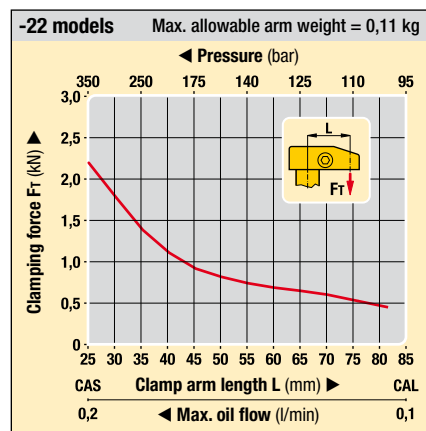
The addition of this spacer requires minor disassembly of the clamp. If you are uncomfortable doing this, please contact an authorized Enerpac Service Center.

## Patented Design

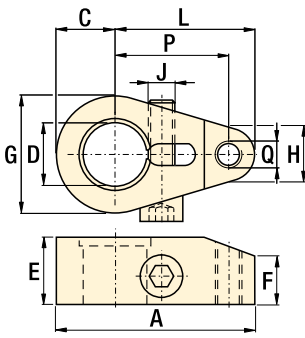
- Easy and precise location of the clamp arm in any position
- Arm can be easily installed and fastened while the cylinder is mounted in the fixture to allow exact arm positioning
- Vise not required for fastening arms.

## Pressure vs clamping force

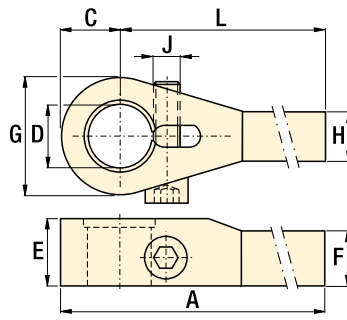
The use of different length clamp arms requires reduction in applied pressure and resulting clamp force. The charts below show this relationship.



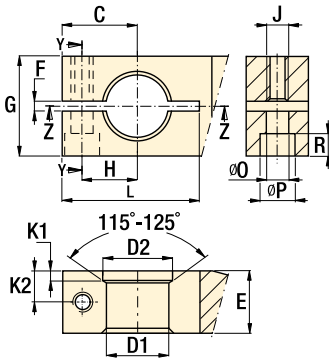
CAS models Standard clamp arms



CAL models Long clamp arms



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



Dimensions in mm [  $\pm$  ]

Clamp force kN	Model number	A	C	D	E	F	G	H	J	L	P	Q	kg
				ø			ø						
2,2	CAS-22	41	9,7	9,98-10,03	16	10	19	13	M6 x 1	31	25	M6 x 1	0,1
5,6	CAS-52	61	12,7	16,00-16,03	19	11	25	16	M8 x 1	48	40	M8 x 1,25	0,4
9,0	CAS-92	76	20,1	25,02-25,04	25	16	40	22	M10 x 1,25	56	45	M10 x 1,5	0,3
11,6	CAS-121	80	17,8	22,25-22,28	30	16	36	21	.375-24 UNF	62	51	.375-16 UN	0,5
18,7	CAS-202	94	24,1	32,00-32,05	30	21	48	30	M12 x 1,25	70	55	M12 x 1,75	0,5
33,8	CAS-352	118	35,1	38,02-38,05	40	30	70	30	M16 x 1,5	83	68	M16 x 2	1,4
2,2	CAL-22	92	9,7	9,98-10,03	16	11	19	11	M6 x 1	83	-	-	0,1
5,6	CAL-52	148	12,7	16,00-16,03	19	11	25	14	M8 x 1	135	-	-	0,5
9,0	CAL-92	180	20,1	25,02-25,04	25	16	40	18	M10 x 1,25	160	-	-	0,6
11,6	CAL-122	179	17,8	22,25-22,28	30	16	36	19	M10 x 1,5	162	-	-	0,7
18,7	CAL-202	202	24,1	32,00-32,05	30	21	48	25	M12 x 1,25	178	-	-	0,7
33,8	CAL-352	215	35,1	38,02-38,05	40	34	70	30	M16 x 1,5	180	-	-	1,9

Clamp force kN	C	D1 <sup>1)</sup>	D2	E	F	G	H	J	K1	K2	L	O	P	R
		ø	ø									ø	ø	
2,2	15,5	10,00-10,02	12,58-12,62	16	1,5-3,0	20	9,4	M6 x 1	3,1-3,5	8	25-28	7	11	6
5,6	20,1	16,00-16,03	18,47-18,51	19	1,5-3,0	30	13,5	M8 x 1	4,1-4,5	10	35-40	9	14	7
9,0	30,0	25,00-25,03	27,85-27,95	25	1,5-3,0	40	22,1	M10 x 1,25	3,9-4,2	12	55-60	11	17	9
11,6	28,4	22,24-22,27	25,46-25,55	30	1,5-3,0	35	17,8	M10 x 1,5	6,9-7,3	13	52-57	11	17	8
18,7	35,1	32,00-32,04	35,50-35,60	30	1,5-3,0	60	24,9	M12 x 1,25	5,1-5,5	15	62-67	13	19	11
33,8	39,9	38,00-38,04	41,50-41,60	40	1,5-3,0	70	30,0	M16 x 1,5	4,9-5,3	20	80-85	17	25	11

<sup>1)</sup> Surface roughness for D1 should be I,6 micro meters.  
<sup>2)</sup> Not for use with Collet-Lok swing clamps.


Force: 2,2 - 33,8 kN

Pressure: 35 - 350 bar

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

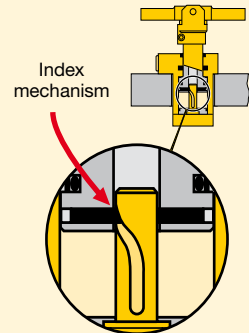
Options

Gauges and accessories  190 ▶

Flow control valves  155 ▶

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 center 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 clamps*

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

Collet-Lok® products

Swing clamps



▶ **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 recommends using the pivoting T-arms with double-acting swing clamps of the SU, SL, ST and SC-series.**

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



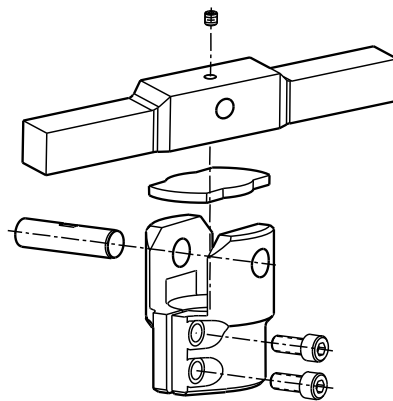
## Clamping two workpieces with one cylinder

...quick and precise clamp arm positioning

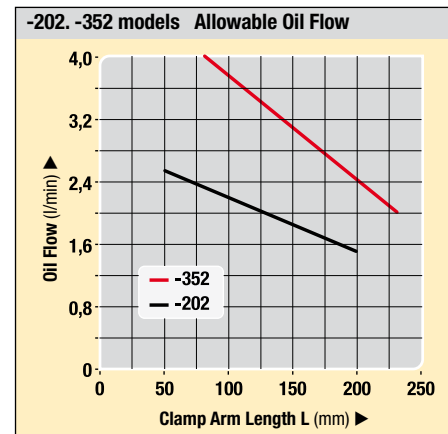
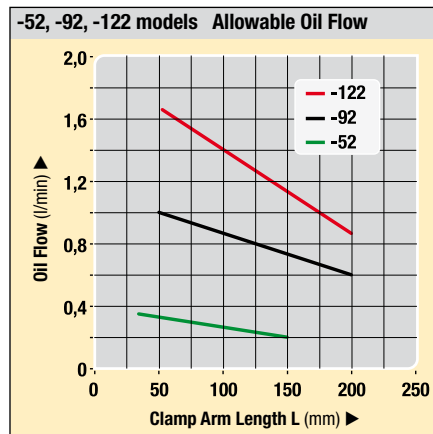
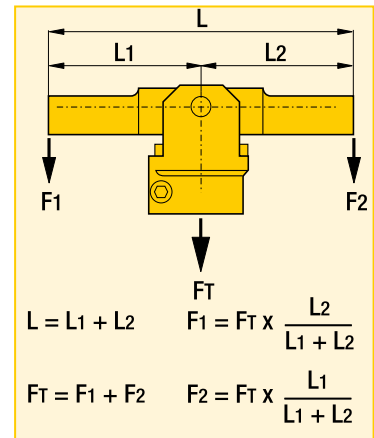
- Easy and precise location of the clamp arm in any position
- Arm can be easily installed and fastened while the cylinder is mounted in the fixture to allow exact arm positioning
- Vise not required for fastening arms or threaded into the fixture
- CAC-92, -202 and -352 are only to be used on double-acting cylinders.

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

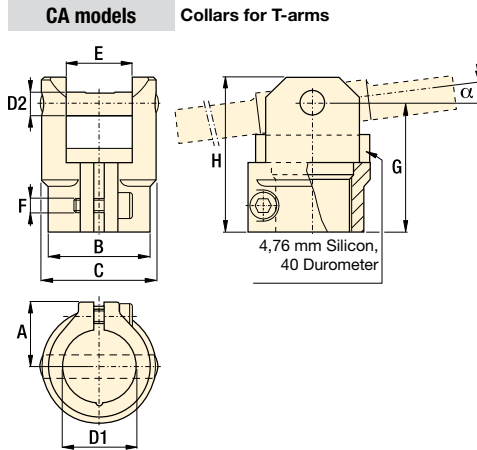
The distribution of the clamp arm force is based upon the length of the T-arm as measured from the pivoting point.



### **!** Important



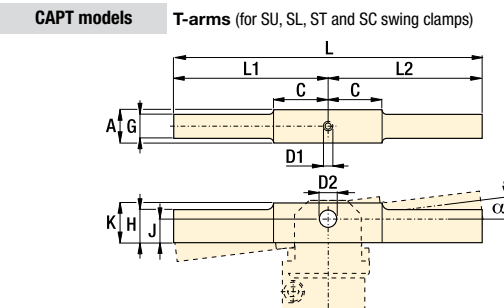
Shown: CAC-202



**Collars - Dimensions** in mm [ ]

Clamp. force kN	Model number	Max. tilt angle $\alpha$	A	B	C	D1	D2	E	F	G	H	kg
5,6	<b>CAC-52</b>	20°	16,5	24,2	28,0	16,0	6,0	6,0	M4 x 0,7	32,0	40,0	0,1
9,0	<b>CAC-92</b>	14°	22,0	34,6	39,0	25,0	8,0	8,0	M5 x 0,8	43,4	52,6	0,2
11,6	<b>CAC-122</b>	14°	22,0	34,6	39,0	22,3	8,0	8,0	M5 x 0,8	43,4	52,6	0,2
18,7	<b>CAC-202</b>	10°	27,2	46,6	54,5	32,0	10,0	10,7	M6 x 1	51,2	63,0	0,4
33,8	<b>CAC-352</b>	10°	34,0	54,6	63,0	38,0	14,0	14,0	M8 x 1,25	63,4	79,0	0,8

Shown: CAPT-202



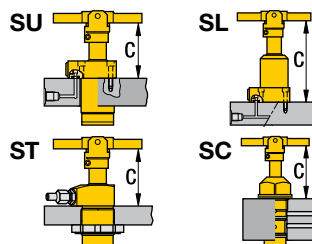
**T-arms - Dimensions** in mm [ ]

Clamp. force kN	Model number	A	C	D1*	D2	G	H	J	K	L	L1	L2	kg
5,6	<b>CAPT-52</b>	15,5	25,4	M3 x 0,5	6,00-6,10	12,7	12,7	9,9	19,1	152,4	76,2	76,2	0,3
9,0	<b>CAPT-92</b>	22,1	38,1	M4 x 0,7	8,00-8,10	18,3	18,3	15	22,1	203,2	101,6	101,6	0,7
11,6	<b>CAPT-122</b>	22,1	38,1	M4 x 0,7	8,00-8,10	18,3	18,3	15	22,1	203,2	101,6	101,6	0,7
18,7	<b>CAPT-202</b>	28,4	31,8	M6 x 1	10,00-10,10	22,1	22,1	16,3	28,7	203,2	101,6	101,6	1,0
33,8	<b>CAPT-352</b>	34,8	25,1	M6 x 1	14,00-14,10	30,0	30,0	18,5	34,8	228,6	114,3	114,3	1,8

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

**Installation dimensions** in mm [ ]

Clamping force kN	T-arm model	SU-series C	SU-L-series C	SL-series C	ST-series C	SC-series C
<b>T-arm installation dimensions - Fully unclamped position</b>						
5,6	-52	73,7	-	139,7	73,7	81,0
9,0	-92	79,5	99,3	155,7	84,3	-
11,6	-122	90,2	108,7	176,0	90,2	98,3
18,7	-202	90,7	-	177,5	90,7	-
33,8	-352	102,6	119,1	199,1	100,8	-



**Force: 5,6 - 33,8 kN**

**Pressure: 35 - 350 bar**

- Brazos de amarre
- Bras de bridage
- Spannarme

**Options**

**Gauges and accessories**

190

**Flow control valves**

155

**Download CAD files from enerpacwh.com**

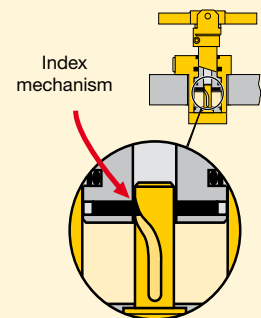
**30, 45, and 60 degree rotations are available upon request.**

**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 center 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%.*

# Upreach clamp arms for swing clamps

Shown: CAU-352, CAU-122, CAU-22

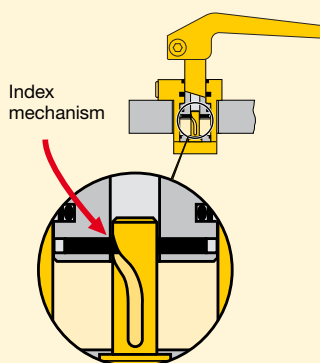


⚡ Enerpac's patented upreach clamp arm design attaches to the hydraulic swing cylinder, allowing parts to be clamped at various distances from the hydraulic cylinder. Clamp arms are available in an extended length which can be machined to fit your unique requirements.

## ⚠ 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 center of gravity of the clamp arm.

### Example:

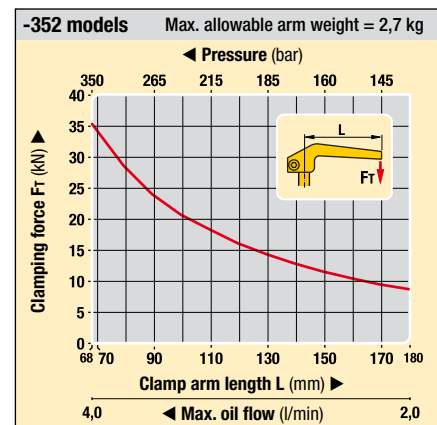
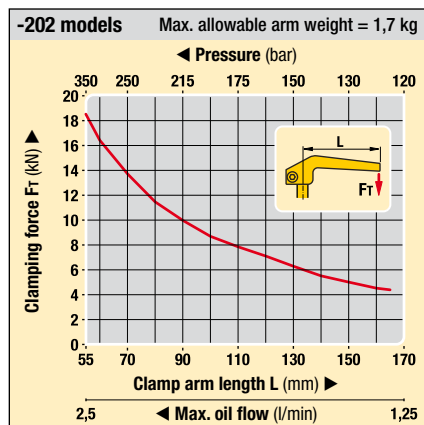
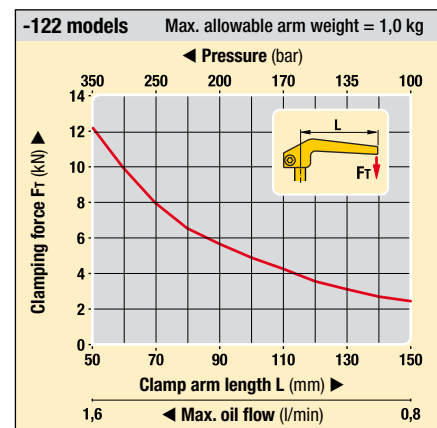
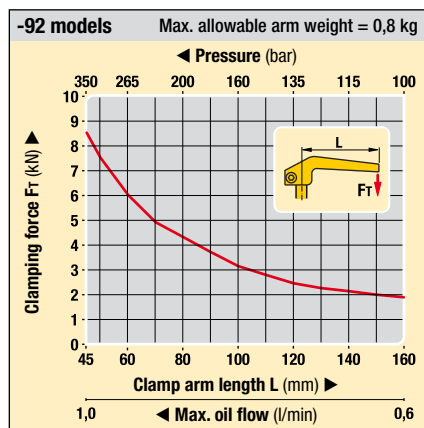
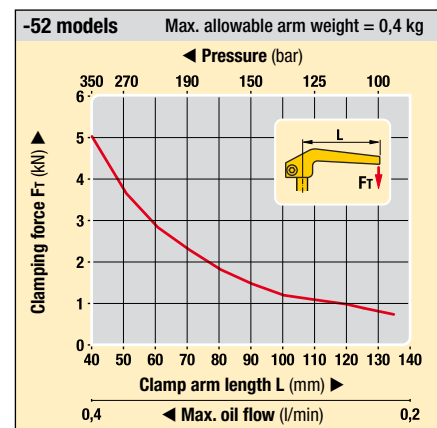
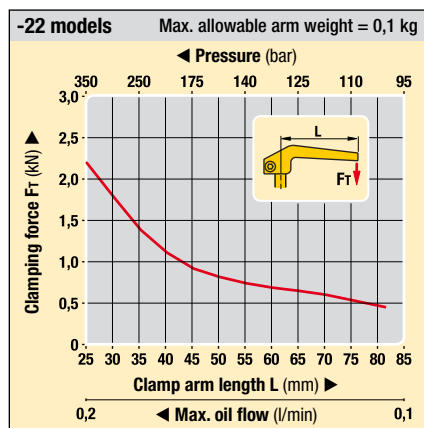
If the mass of the arm is twice that of the long arm, flow rates must be reduced by 50%.

## Patented Design

- Upreach design allows more flexible part clamping
- 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
- Arm length can be cut to desired size
- Angled arm with minimal deflection achieves maximum workpiece contact.

## 🌐 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.

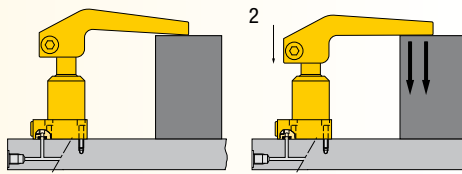


**Angled arms use deflection to improve clamping**

**Angled arms**

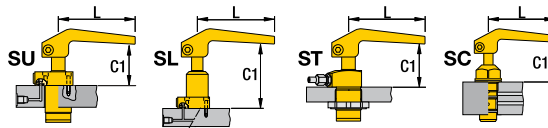
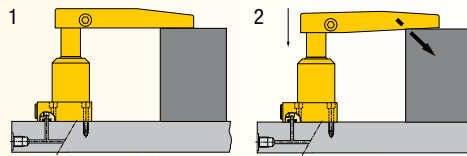
Tip engages part first and contact increases as clamping force is applied.

Eliminates “push” effect caused by straight arms deflecting under load.



**Straight Arms**

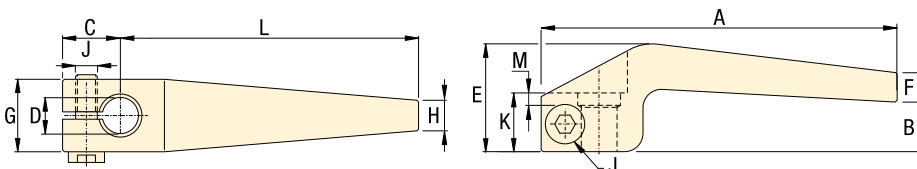
Great for most applications, but standard deflection can cause part movement and lower the true clamping force.



**Installation dimensions in mm [  $\pm 0.1$  ]**

Model number	Clamp force	L	SU-Series C1	SL-Series C1	ST-Series C1	SC-Series C1
<b>▼ Stock length dimensions</b>						
CAU-22	0,44	82,5	56,6	109,7	56,6	53,1
CAU-52	0,89	134,8	71,6	137,7	71,6	78,7
CAU-92	2,00	160,0	73,6	149,6	78,7	-
CAU-122	2,22	161,1	83,5	169,4	83,6	91,7
CAU-202	4,45	177,5	88,1	175,3	95,3	-
CAU-352	8,45	180,0	99,0	192,0	106,2	-
<b>▼ Minimum length dimensions</b>						
CAU-22	2,22	25,0	59,7	112,8	59,7	56,1
CAU-52	5,56	40,0	76,7	142,7	76,7	83,8
CAU-92	9,01	45,0	79,9	155,7	84,8	-
CAU-122	11,57	50,8	89,4	175,3	89,4	97,5
CAU-202	18,68	55,0	94,5	181,6	101,6	-
CAU-352	33,81	68,0	106,9	199,9	114,1	-

**CAU models Upreach clamp arms**



**Dimensions in mm [  $\pm 0.1$  ]**

Model number	A	B	B	C	D	E	F	F	G	H	H	J	K	L	L	M	kg
		Std.	Min.				Std.	Min.		Std.	Min.			Std.	Min.		
CAU-22	98,5	13,7	16,8	16,0	9,98-10,01	29,7	8,1	13,7	20,0	8,4	20,8	M6 x 1	16,3	82,5	25,0	1,0	0,1
CAU-52	155,0	21,6	26,7	20,0	16,00-16,03	41,9	6,6	14,5	30,0	11,9	31,8	M6 x 1	19,1	135,0	40,0	1,3	0,4
CAU-92	190,0	23,6	29,7	30,0	25,02-25,04	48,0	10,9	19,3	40,0	14,5	40,9	M8 x 1,25	24,9	160,0	45,0	2,3	0,8
CAU-122	190,0	28,2	34,0	28,5	22,25-22,28	57,2	12,7	29,2	38,1	16,5	39,6	M10 x 1,5	30,0	161,5	50,8	3,8	1,0
CAU-202	212,5	32,3	38,6	35,0	32,00-32,03	61,2	13,2	24,4	60,0	17,3	54,4	M10 x 1,5	30,0	177,5	55,0	2,8	1,7
CAU-352	220,0	41,1	49,0	40,0	38,02-38,05	79,8	18,8	34,3	66,0	15,7	54,1	M10 x 1,5	40,1	180,0	68,0	1,8	2,7


Refer to clamping force charts on page 36.  
Never cut shorter than indicated minimum length.


Force: 0,4 - 33,8 kN


Pressure: 35 - 350 bar

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

**Options**

Sequence valves  [152](#)

Flow control valves  [155](#)

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

Shown: SC-3, SC-1



## SC series

These swing clamps 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 include a retract spring for single-acting operation. Both cylinders can be operated as double-acting cylinders by connecting a retract line to the vent port.

## Changeable swing function

...with 360° fully adjustable clamp arm

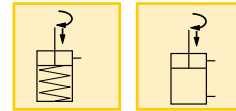
- Changeable swing function: clamp arm movement can be adjusted to left or right swing, or straight pull function
- 88-92° clamp arm swing arc
- Easy installation: built-in mountings and brackets
- Compact design for use in limited space applications
- Easy and precise locating of arm for clamp positioning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

Force: 2,2 - 9,6 kN

Stroke: 19,1 - 38,1 mm

Pressure: 138 - 207 bar

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



Arm length mm	Max. pressure bar	Clamping force kN
<b>▼ SC-1</b>		
-	207	11,7
51 <sup>2)</sup>	207	9,6
76	207	8,7
102	207	7,7
127	166	5,3
152	138	3,7
<b>▼ SC-3</b>		
-	207	3,1
25 <sup>2)</sup>	207	2,2
51	138	1,1

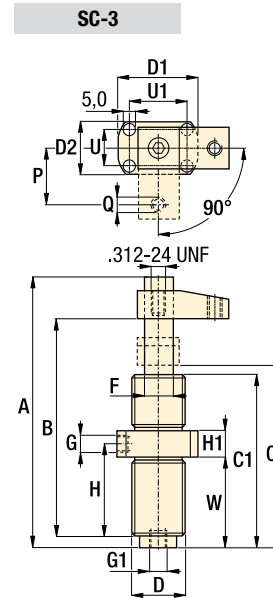
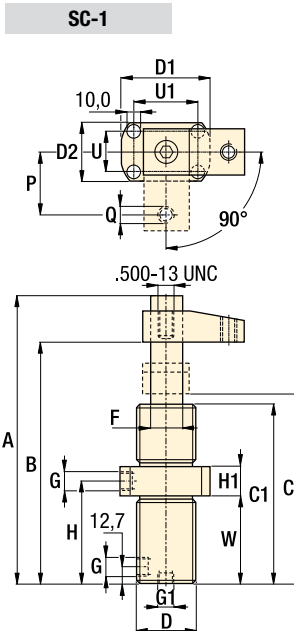
## Selection chart

Clamping force <sup>1)</sup>	Stroke		Model number	Cylinder effective area		Oil capacity	
	mm	mm		cm <sup>2</sup>	cm <sup>3</sup>		
kN	Clamp	Total		Pull	Push	Pull	Push
9,6	12,7	38,1	<b>SC-1</b>	6,3	11,4	24,1	43,4
2,2	6,4	19,1	<b>SC-3</b>	1,6	2,9	3,0	5,4

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

**Note:** - Long clamp arms can be fabricated by the user.  
- For long clamp arms, use VFC series flow control valves.

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



## Product dimensions in mm [ ⊕ ⊖ ]

Model number	A	B	C	C1	D	D1	D2	F	G	G1	H	H1	P	Q	U	U1	W	⚖
								Ø	NPT	NPT				UNC				kg
<b>SC-1</b>	226	187	149	146	1.875-16UN	74	48	25	.250-18	.125-27	84,1	22,4	51	.375-16	32,5	52,3	73	2,7
<b>SC-3</b>	134	108	94	88	1.00-12UNF	51	29	13	.125-27	.125-27	54,6	16,0	25	.250-20	19,1	38,1	52	0,9

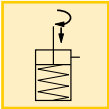


Force: 6,1 - 19,5 kN

Stroke: 6,4 - 10,9 mm

Pressure: 80 - 170 bar

- E** Cilindros giratorios
- F** Vérins 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.

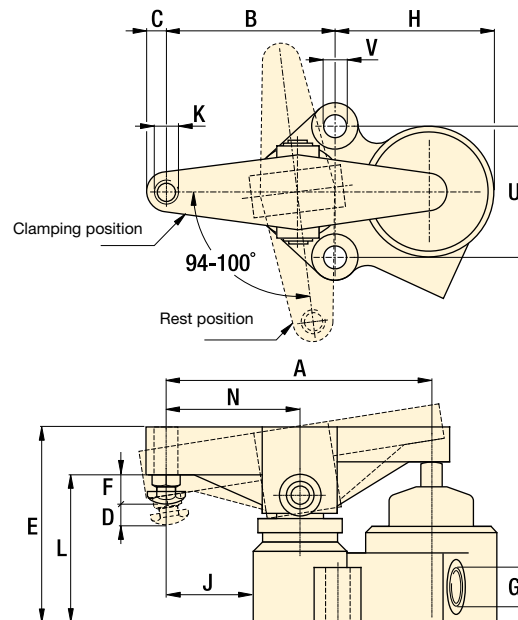
Shown: ASC-30



### 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.

ASC-30, -100



### Important

For high cycle applications use double-acting cylinders.

## Selection chart

Clamping force	Stroke	Model number	Operating pressure	Cylinder effective area	Oil capacity	Max. oil flow	
kN	mm		bar	cm <sup>2</sup>	cm <sup>3</sup>	l/min	kg
6,1	6,4	<b>ASC-30</b>	80 - 170	3,5	4,9	1,9	2,7
19,5	10,9	<b>ASC-100</b>	80 - 170	11,4	20,0	1,9	8,2

## Product dimensions in mm [ ]

Model number	A	B	C	D	E	F	G	H	J	K	L	N	U	V
							NPT			UN				ø
<b>ASC-30</b>	127,0	85,9	12,7	6,4	88,9	19,1	.125-27	69,9	41,4	.500-13	69,9	63,5	63,5	10,4
<b>ASC-100</b>	177,8	114,3	13,5	10,9	133,4	18,5	.125-27	108	57,2	.500-13	101,6	88,9	88,9	16,0

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



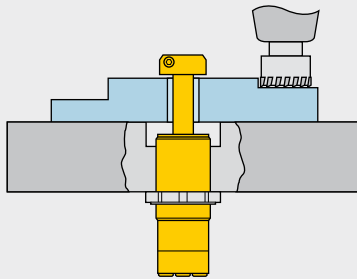
# Three-position swing cylinder *Application & selection*

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.

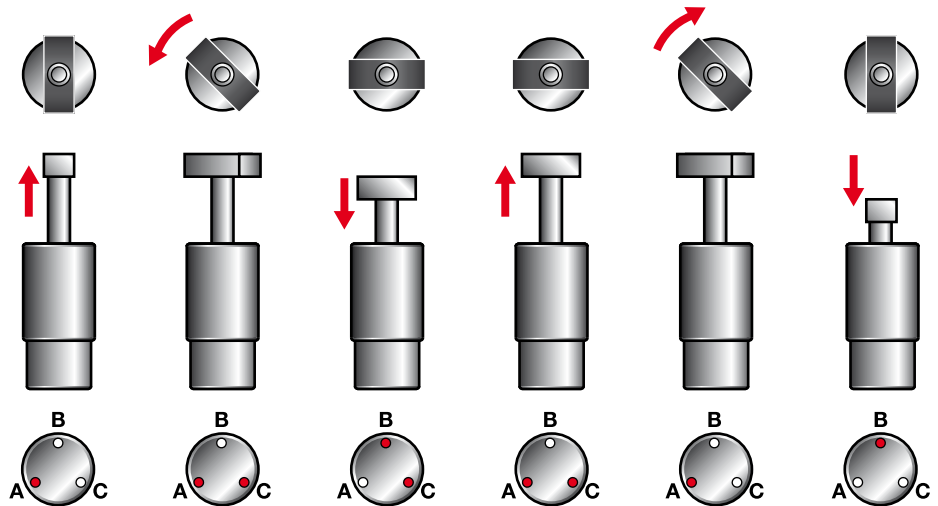


## Unobstructed part loading

- 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 A.  
Plunger extends through workpiece.

### Step 2

Keep port A pressurized.  
Pressurize port C.  
Plunger makes 90° flat rotation.

### Step 3

Keep port C pressurized.  
Pressurize port B.  
Plunger retracts: clamp force is applied.

### Step 4

Keep port C pressurized.  
Pressurize port A.  
Plunger extends: clamp force is released.

### Step 5

Keep port A pressurized.  
Depressurize port C.  
Plunger makes 90° rotation.

### Step 6

Pressurize port B.  
Plunger retracts through workpiece.

## Selection chart

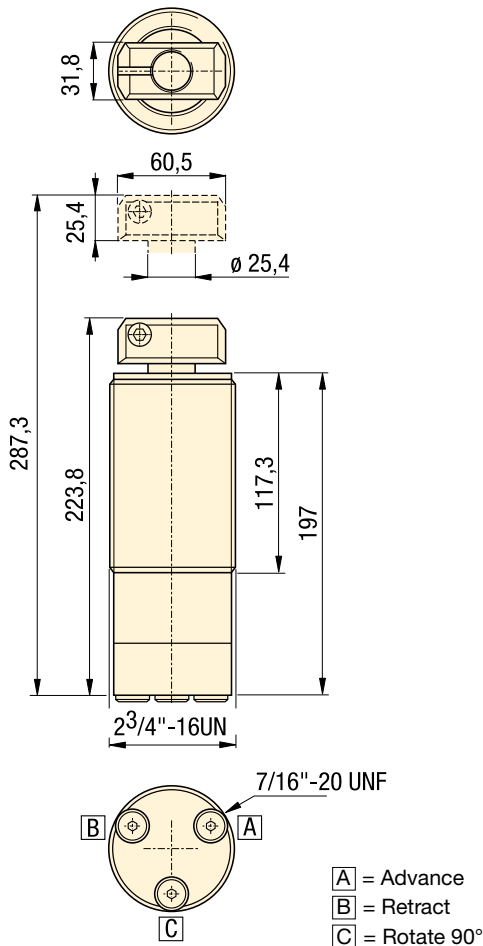
Clamping force <sup>1)</sup>	Stroke	Model number <sup>2)</sup>	Cylinder effective area		Oil capacity		Max. oil flow	Maximum cycle rate
			cm <sup>2</sup> Clamp.	cm <sup>2</sup> Unclamp.	cm <sup>3</sup> Clamp.	cm <sup>3</sup> Unclamp.		
kN	mm						l/min	cycles /min
22,2	63,5	<b>WTR-24</b>	6,3	11,4	41,0	72,1	1,9	4

<sup>1)</sup> When using optional CA-28 clamp arm, max. operating pressure is 138 bar.

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

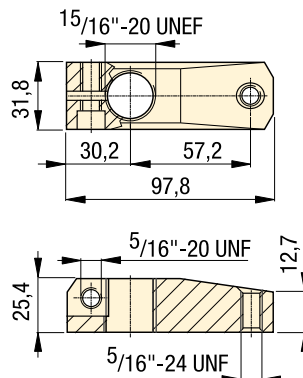
\* This product is made to order. Please contact Enerpac for delivery information before specifying in your design.

**WTR-24**



**Optional CA-28 clamp arm**

The WTR-24 has a two-sided standard clamp arm 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 140 bar maximum.

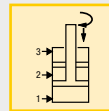


Force: 8,7 - 22,2 kN

Stroke: 63,5 mm

Pressure: 140 - 350 bar

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



**Options**

High pressure filters

193 ▶



Fittings

194 ▶



Valves

136 ▶



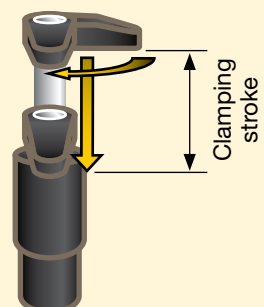
**Important**

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 page 42.

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



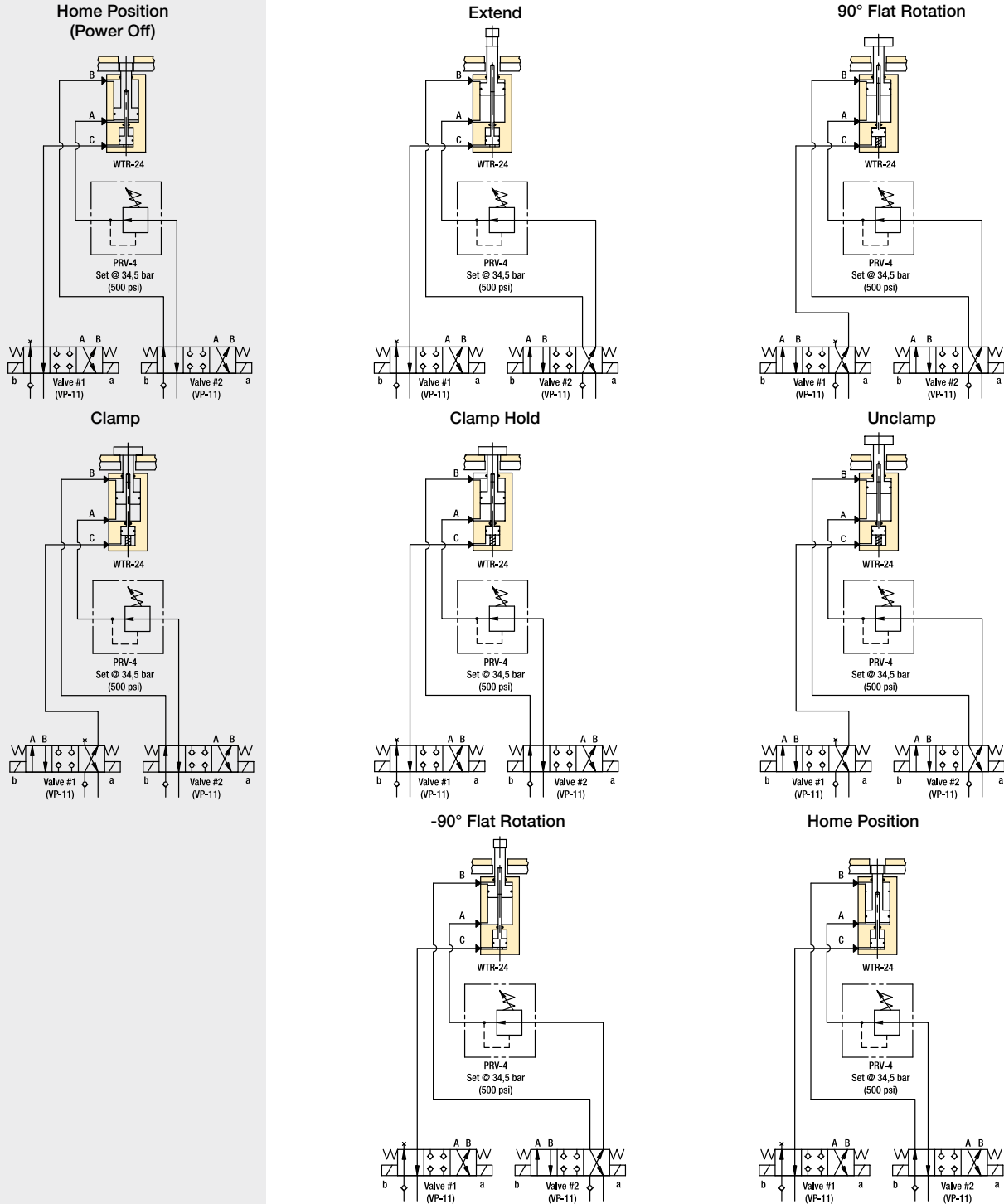
# WTR-series schematics

**⚠ Important**

Circuit must include a Pressure Reducing Valve (PRV-4) in the "A" port circuit to reduce the pressure in Unclamp to prevent damage to the cylinder.



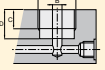
## Recommended valving system for WTR-24

- 4-way 3-position closed center valves are recommended
- Valves can be manual or solenoid operated
- Valves must be cycled as shown for proper actuation of the WTR-24.





# Work supports

	▼ series	▼ page	
<b>Work support range overview</b>		<b>44 - 45</b>	
Hydraulic advance work supports	<b>WF</b>	46 - 47	
Spring advance work supports	<b>WS</b>	48 - 49	
Work support mounting dimensions	<b>WF, WS</b>	50 - 51	

## 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

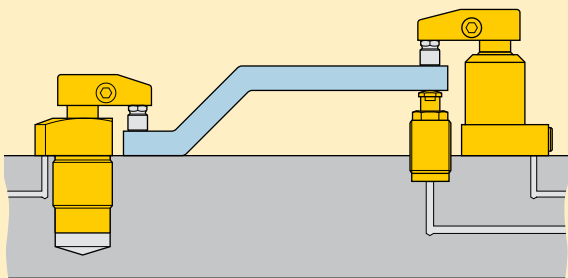
197 ▶

Shown: WFL-112, WFC-72, WFL-442



▶ 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.

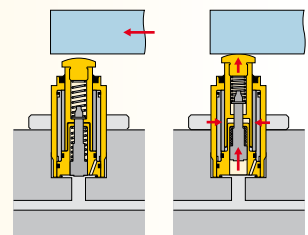
## Wide range of sizes and types to efficiently support workpiece

- Low pressure lock-up capability enables the use of machine tool hydraulic systems
- High rated support capacities allow 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 allow design flexibility

## i Select your work support method:

### WF series, Hydraulic advance

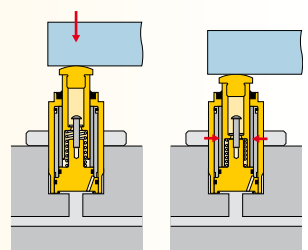
- Retracted plunger allows unobstructed workpiece loading.
- Internal hydraulic plunger advances allowing external plunger to advance under spring load. Bronze sleeve squeezes and holds plunger in fixed position.



▶ 46 ▶

### 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.



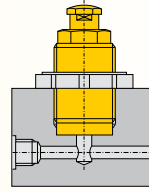
▶ 48 ▶



## Select your mounting method:

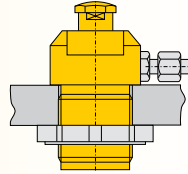
### Manifold mount

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



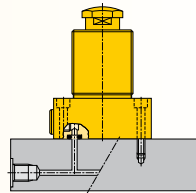
### Threaded body

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



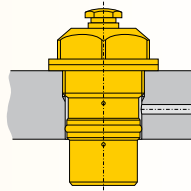
### Lower flange

- 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

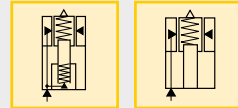


Force: 7,3 - 44,5 kN

Stroke: 9,1 - 16,8 mm

Pressure: 48 - 3 50 bar

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



## Options

Swing cylinders

22 ▶



Accessories

86 ▶



In-line filters

193 ▶



Sequence valves

152 ▶



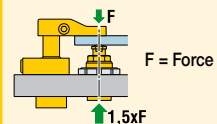
## Product selection

Maximum support force	Stroke	Manifold mount	Threaded body	Lower flange	Cartridge style
kN	mm				
▼ Hydraulic advance		Model number			
7,3	9,9	<b>WFM-72</b>	-	-	-
7,3	10,1	-	<b>WFT-72</b>	-	-
11,1	10,1	-	-	<b>WFL-112</b>	-
22,2	10,4	-	-	<b>WFL-222</b>	-
33,4	13,5	-	-	<b>WFL-332</b>	-
44,5	16,5	-	-	<b>WFL-442</b>	-
7,3	9,9	-	-	-	<b>WFC-72</b>
11,1	9,1	-	-	-	<b>WFC-112</b>
22,2	10,4	-	-	-	<b>WFC-222</b>
▼ Spring advance		Model number			
7,3	9,7	<b>WSM-72</b>	-	-	-
7,3	9,7	-	<b>WST-72</b>	-	-
11,1	9,7	-	-	<b>WSL-112</b>	-
22,2	9,7	-	-	<b>WSL-222</b>	-
33,4	13,7	-	-	<b>WSL-332</b>	-
44,5	16,8	-	-	<b>WSL-442</b>	-
7,3	9,7	-	-	-	<b>WSC-72</b>
11,1	9,7	-	-	-	<b>WSC-112</b>
22,2	11,9	-	-	-	<b>WSC-222</b>

## Important

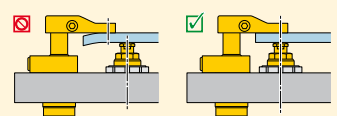
### WARNING!

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.



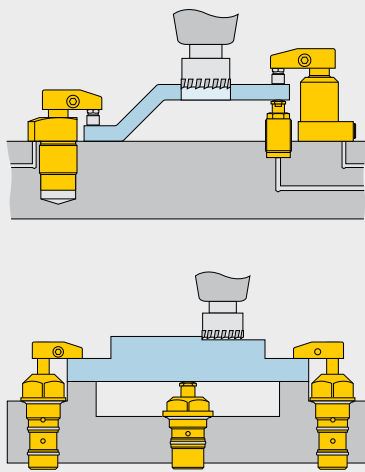
# Work supports - Hydraulic advance

Shown: WFM-72, WFL-112



## 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.



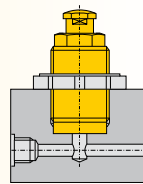
## For unobstructed part loading

- 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 allow 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

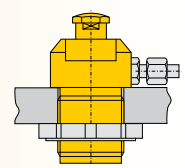
### WFM series, Manifold models

Eliminates the need for fittings and tubing on the fixture.



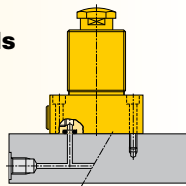
### WFT series, Threaded models

Offers the flexibility of side or bottom porting.



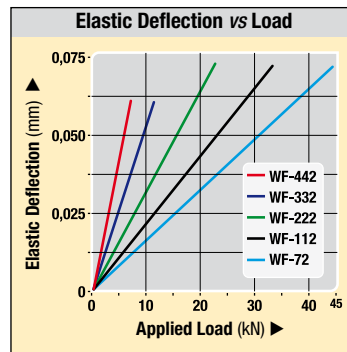
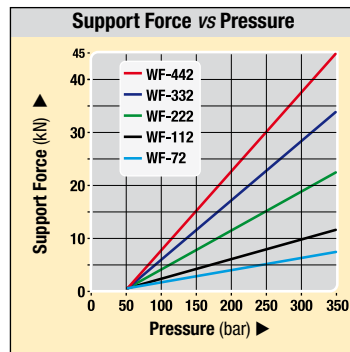
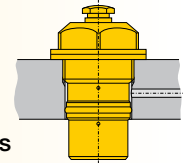
### WFL series, Lower flange models

Plumbed directly – no fixture hole required.



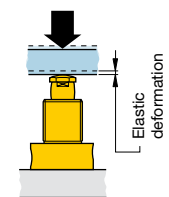
### WFC series, Cartridge models

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



## Deflection chart:

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

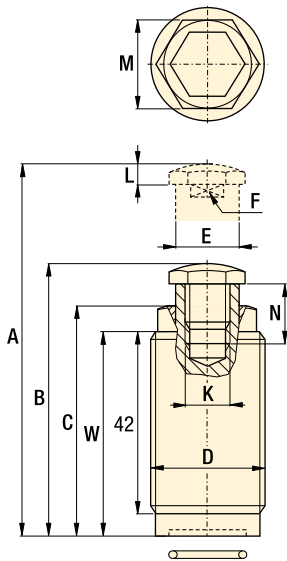


## Product selection

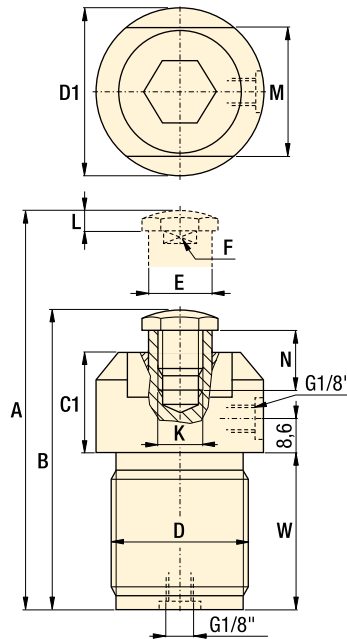
Max. support force	Support plunger stroke	Manifold mount	Threaded body	Lower flange	Cartridge style	Operating pressure		Plunger contact spring force		Oil capacity	Max. oil flow
						min. bar	max. bar	ext. N	retr. N		
7,3	9,9	WFM-72	-	-	-	48	350	8,9	25,8	0,66	0,7
7,3	10,2	-	WFT-72	-	-	48	350	8,9	25,8	0,66	0,7
11,1	10,2	-	-	WFL-112	-	48	350	15,1	23,1	0,98	1,0
22,2	10,4	-	-	WFL-222	-	48	350	9,3	86,8	3,11	3,1
33,4	13,5	-	-	WFL-332	-	48	350	17,8	77,9	3,93	3,9
44,5	16,5	-	-	WFL-442*	-	48	350	14,7	97,9	4,92	4,9
7,3	9,9	-	-	-	WFC-72	48	350	8,9	25,8	0,66	0,7
11,1	9,1	-	-	-	WFC-112	48	350	15,1	23,1	0,98	1,0
22,2	10,4	-	-	-	WFC-222	48	350	9,3	86,8	3,11	3,1

\* This product is made to order. Please contact Enerpac for delivery information before specifying in your design.

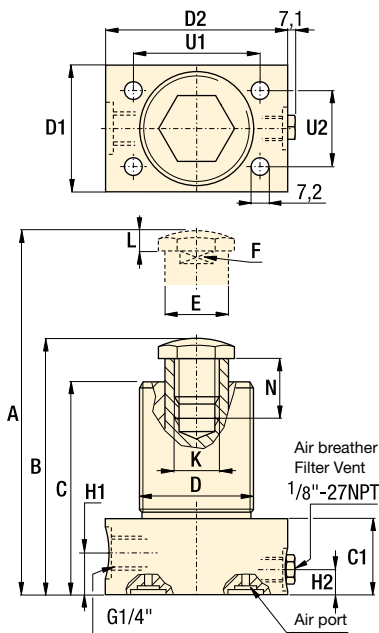
**WFM series**



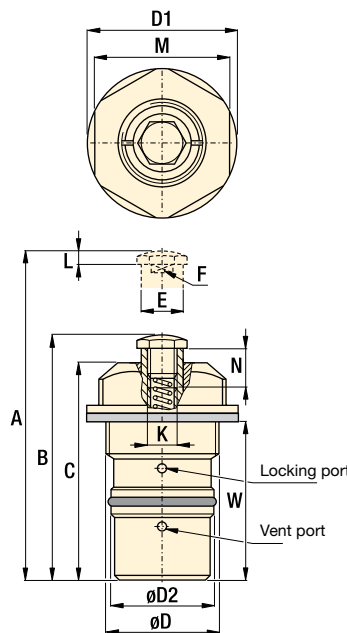
**WFT series**



**WFL series**



**WFC series**

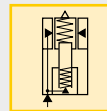


Force: 7,3 - 44,5 kN

Stroke: 9,1 - 16,5 mm

Pressure: 50 - 350 bar

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



**Options**

**Accessories**

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**In-line filters**

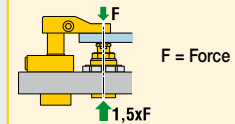
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**Important**

**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.

Custom cylinders including longer stroke lengths are available on request.

**Product dimensions** in mm [ ]

Model number	Capacity kN	A	B	C	C1	D	D1	D2	E	F	H1	H2	K	L	M	N**	U1	U2	W		
		Ø																			kg
<b>WFM-72</b>	7,3	76,7	66,8	55,9	-	M30x1,5	-	-	15,01	13,0	-	-	M10x1,5	4,6	24,1	13,0	-	-	50,8	0,2	
<b>WFT-72</b>	7,3	89,7	79,5	-	26,2	M35x1,5	43,7	-	15,01	13,0	-	-	M10x1,5	4,6	34,0	13,0	-	-	41,9	0,2	
<b>WFL-112</b>	11,1	99,8	89,9	78,7	27,4	M35x1,5	38,1	ø60,4	15,98	12,4	14,2	17,8	M10x1,5	4,6	-	18,5	41,1	23,9	-	0,6	
<b>WFL-222</b>	22,2	104,9	94,5	78,0	26,4	M68x1,5	69,9	82,6	38,00	25,4	14,0	13,2	M20x2,5	6,1	-	23,4	55,6	55,6	-	2,2	
<b>WFL-332</b>	33,4	112,3	98,8	87,9	27,2	ø 73,2	76,2	88,9	44,98	30,0	13,5	10,9	M20x2,5	6,1	-	23,6	62,0	62,0	-	2,9	
<b>WFL-442*</b>	44,5	129,3	112,8	103,1	30,2	ø 85,9	88,9	101,6	54,99	36,6	13,5	10,9	M20x2,5	6,1	-	31,5	74,7	74,7	-	4,3	
<b>WFC-72</b>	7,3	81,8	71,9	62,5	-	M33x1,5	42,2	30,0	15,01	13,0	-	-	M10x1,5	4,6	38,1	13,0	-	-	50,3	0,4	
<b>WFC-112</b>	11,1	102,4	93,2	82,0	-	M42x1,5	57,2	38,1	15,98	12,4	-	-	M10x1,5	4,6	50,8	18,5	-	-	60,2	0,9	
<b>WFC-222</b>	22,2	115,8	105,4	91,4	-	M60x1,5	76,2	57,2	38,00	25,4	-	-	M20x2,5	6,1	69,9	23,4	-	-	69,0	1,8	

\* This product is made to order. Please contact Enerpac for delivery information before specifying in your design.  
 \*\* Note: Dimension N is factory set. May change on types 222, 332 and 442 due to adjusted contact spring force.  
 Note: For manifold mounting dimensions ( ).



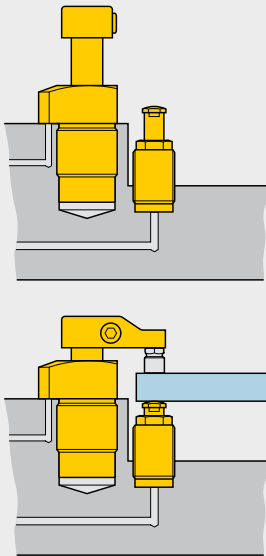
# Work supports - Spring advance

Shown: WSL-112, WSM-72



## 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.



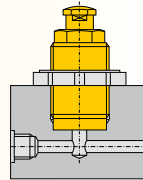
## Spring advance work support contacts workpiece as it is loaded into fixture

- Low pressure lock-up capability enables the use of machine tool hydraulic systems
- High rated support capacities allow 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 allow design flexibility
- Can be operated as air advance by removing the spring and applying air pressure on the vent port

## Mounting style

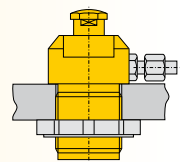
### WSM series, Manifold mount

Eliminates the need for fittings and tubing on the fixture.



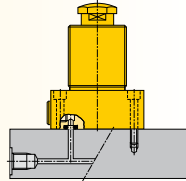
### WST series, Threaded body

Offers the flexibility of side or bottom porting.



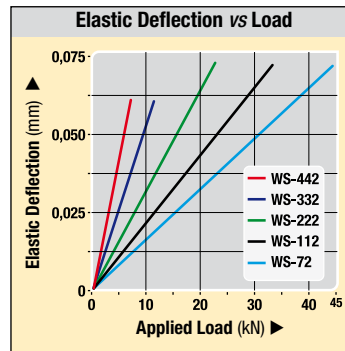
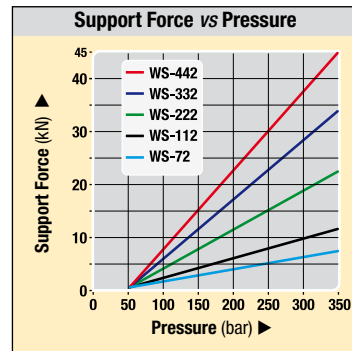
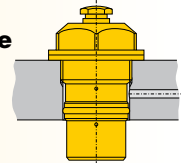
### WSL series, Lower flange

Plumbed directly – no fixture hole required.



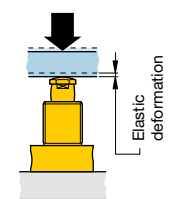
### WSC series, Cartridge mount style

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



### Deflection chart:

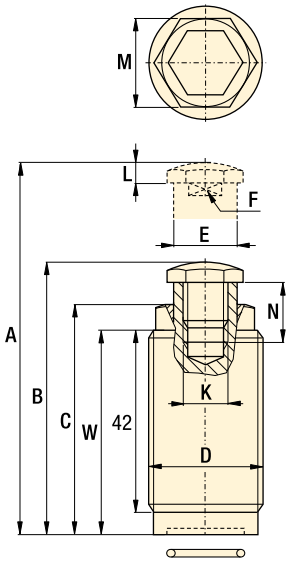
Elastic deformation of the work support resulting from the application of load.



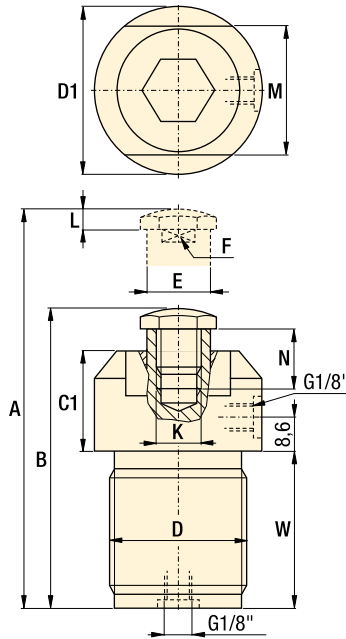
## Product selection

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
						min. bar	max. bar	ext. N	retr. N		
7,3	9,7	WSM-72	-	-	-	48	350	8,9	25,8	0,66	0,7
7,3	9,7	-	WST-72	-	-	48	350	8,9	25,8	0,66	0,7
11,1	9,7	-	-	WSL-112	-	48	350	15,1	23,1	0,98	1,0
22,2	9,7	-	-	WSL-222	-	48	350	9,3	86,8	3,11	3,1
33,4	13,7	-	-	WSL-332	-	48	350	17,8	77,9	3,93	3,9
44,5	16,8	-	-	WSL-442*	-	48	350	14,7	97,9	4,92	4,9
7,3	9,7	-	-	-	WSC-72	48	350	8,9	25,8	0,66	0,7
11,1	9,7	-	-	-	WSC-112	48	350	15,1	23,1	0,98	1,0
22,2	11,9	-	-	-	WSC-222	48	350	9,3	86,8	3,11	3,1

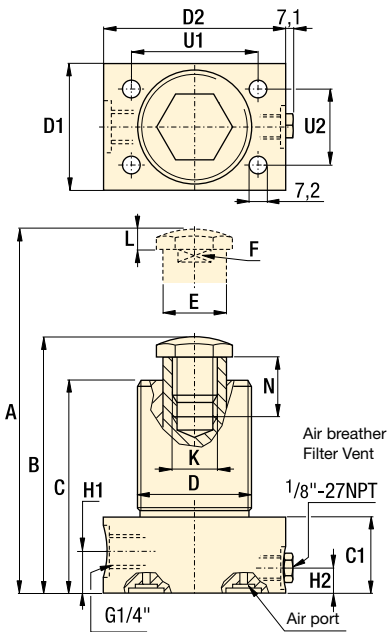
**WSM series**



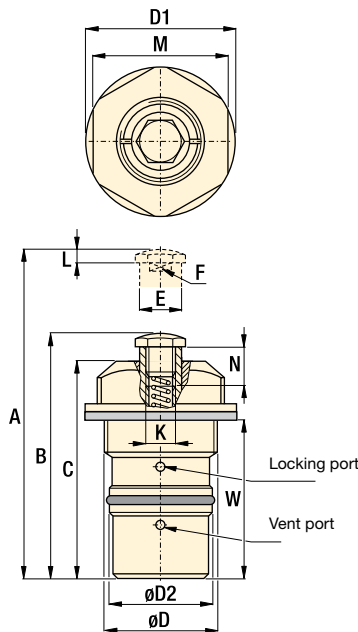
**WST series**



**WSL series**



**WSC series**

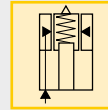


Force: 7,3 - 44,5 kN

Stroke: 9,7 - 16,8 mm

Pressure: 50 - 350 bar

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



**Options**

**Accessories**

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**In-line filters**

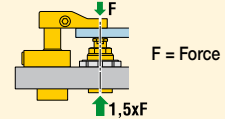
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**Important**

**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.

Custom cylinders including longer stroke lengths are available on request.

Mounting dimensions ▶ 50 ▶

**Product dimensions in mm** [ ]

Model number	Capacity kN	A	B	C	C1	D	D1	D2	E0	F	H1	H2	K	L	M	N**	U1	U2	W	kg
<b>WSM-72</b>	7,3	76,2	66,5	55,9	-	M30x1,5	-	-	15,0	13,0	-	-	M10x1,5	4,6	24,1	13,0	-	-	50,8	0,2
<b>WST-72</b>	7,3	89,2	79,5	-	26,2	M35x1,5	43,6 ø	-	15,0	13,0	-	-	M10x1,5	4,6	34,0	13,0	-	-	41,9	0,2
<b>WSL-112</b>	11,1	85,3	75,7	64,5	24,1	M35x1,5	38,1	60,5	16,0	12,4	11,2	9,9	M10x1,5	4,6	-	18,5	41,1	23,9	-	0,6
<b>WSL-222</b>	22,2	99,3	89,7	74,9	24,9	M68x1,5	69,9	82,6	38,0	25,4	12,2	10,2	M20x2,5	6,1	-	23,4	55,6	55,6	-	2,2
<b>WSL-332</b>	33,4	109,0	95,3	85,6	27,2	73,2	76,2	88,9	45,0	30,0	13,0	9,4	M20x2,5	6,1	-	23,6	62,0	62,0	-	2,9
<b>WSL-442*</b>	44,5	126,7	110,0	102,6	30,2	85,6	86,4	101,6	55,0	36,6	13,5	10,9	M20x2,5	6,1	-	31,5	74,7	74,7	-	4,3
<b>WSC-72</b>	7,3	81,3	71,6	62,5	-	M33x1,5	42,4 ø	30,0	15,0	13,0	-	-	M10x1,5	4,6	38,1	13,0	-	-	50,3	0,4
<b>WSC-112</b>	11,1	85,9	76,2	65,0	-	M42x1,5	57,1 ø	38,1	16,0	12,4	-	-	M10x1,5	4,6	50,8	18,5	-	-	43,1	0,9
<b>WSC-222</b>	22,2	101,0	89,2	76,2	-	M60x1,5	76,2 ø	57,2	38,0	25,4	-	-	M20x2,5	6,1	69,9	23,4	-	-	53,9	1,8

\* This product is made to order. Please contact Enerpac for delivery information before specifying in your design.  
 \*\* Note: Dimension N is factory set. May change on types 222, 332 and 442 due to adjusted contact spring force.  
 Note: For manifold mounting dimensions (▶ 50).  
[www.enerpacwh.com](http://www.enerpacwh.com)

# Mounting dimensions *for work supports*

Shown: WFL-112 holding a casting in place.



## Mounting work supports

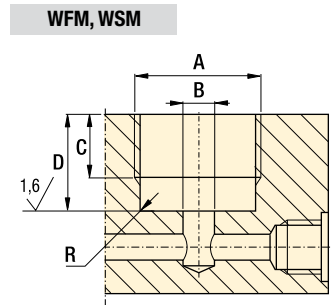
Enerpac work supports are offered in a wide variety of mounting styles. Dimensions for fixture holes and cavity preparation are specified for each mounting style separately.

■ 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.



## Product dimensions in mm [ $\text{mm}$ ]

Model number	A	B	C	D	R	Manifold O-ring <sup>1)</sup>	Flange nut
	$\varnothing$						
<b>▼ For manifold mount work supports</b>							
<b>WFM-72</b>	M30 x 1,5	9,4-9,9	13,2-13,7	18,8-19,3	0,4	ARP-017	FN-302
<b>WSM-72</b>	M30 x 1,5	9,4-9,9	13,2-13,7	18,8-19,3	0,4	ARP-017	FN-302

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

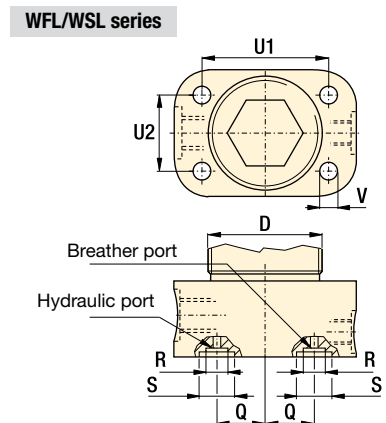
## Threaded work support mounting dimensions

Threaded body work supports can be mounted directly into a fixture. The thread size (D) can be found in the dimension charts on  $\square 47$  (WFT) and  $\square 49$  (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.



## Product dimensions in mm [ $\text{mm}$ ]

Model numbers	D	Q	R	S	U1	U2	V	Manifold O-ring <sup>1)</sup>	Flange nut
			$\varnothing$	$\varnothing$					
<b>▼ For lower flange work supports</b>									
<b>WFL-112</b>	M30 x 1,5	14,5	5,8	9,4	41,1	23,9	7,2	ARP-010	FN-302
<b>WFL-222</b>	M68 x 1,5	27,4	8,6	14,2	55,4	55,4	7,2	ARP-110	—
<b>WFL-332</b>	73,2	30,5	8,6	14,2	62,0	62,0	7,2	ARP-110	—
<b>WFL-442</b>	85,9	36,6	8,6	14,2	74,7	74,7	7,2	ARP-110	—
<b>WSL-112</b>	M35 x 1,5	14,5	5,8	9,4	41,1	23,9	7,2	ARP-010	FN-352
<b>WSL-222</b>	M68 x 1,5	27,4	8,6	14,2	55,4	55,4	7,2	ARP-110	—
<b>WSL-332</b>	73,2	30,5	8,6	14,2	62,0	62,0	7,2	ARP-110	—
<b>WSL-442</b>	85,9	36,6	8,6	14,2	74,7	74,7	7,2	ARP-110	—

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

Force: 7,3 - 44,5 kN

Stroke: 9,7 - 16,8 mm

Pressure: 48 - 350 bar

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

**Options**

Accessories

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In-line filters

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Fittings

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Swing cylinders

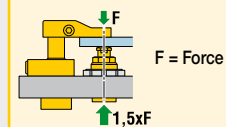
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**Important**

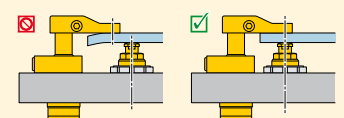
**WARNING!**

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.

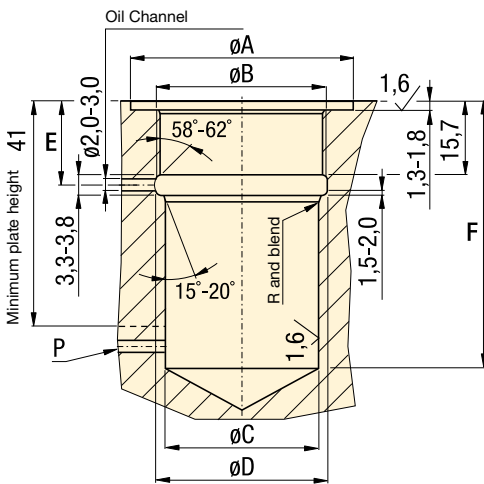
Always center load over work support.



**Cartridge work support mounting dimensions**

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

WFC, WSC



**Dimensions** in mm [ ]

Model numbers	A	B	C	D	E	F	Ventilation below force required
<b>▼ Hydraulic advance</b>							
WFC-72	42,7-43,2	M33 x 1,5	30,02-30,07	33,3-33,8	15,7-17,3	52,8	No
WFC-112	57,4-57,9	M42 x 1,5	38,07-38,13	42,4-42,9	17,5-19,0	62,5	Yes
WFC-222	76,5-77,0	M60 x 1,5	57,12-57,18	60,5-70,0	17,5-18,3	71,1	Yes
<b>▼ Spring advance</b>							
WSC-72	42,7-43,2	M33 x 1,5	30,02-30,07	33,3-33,8	15,7-17,3	52,8	No
WSC-112	57,4-57,9	M42 x 1,5	38,07-38,13	42,4-42,9	17,5-19,0	45,7	Yes
WSC-222	76,5-77,0	M60 x 1,5	57,12-57,18	60,5-70,0	17,5-18,3	55,9	Yes

Note: Ventilation required on WFC-112, 222 below 41 mm when mounted in blind cavity.

# 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.

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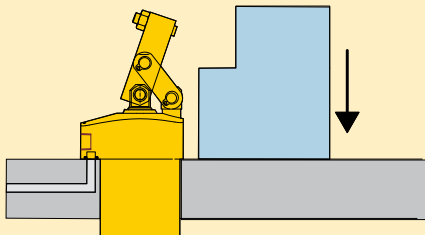
	▼ series	▼ page	
Link clamps / Link clamp arms	LU LCA	54 - 55 56 - 57	
<b>Pull cylinder range overview</b>		<b>58 - 59</b>	
Upper flange pull cylinders	PU	60 - 61	
Lower flange pull cylinders	PL	62 - 63	
Threaded body pull cylinders	PT	64 - 65	
<b>Linear cylinders</b>		<b>66 - 93</b>	
Threaded cylinders	CST, CDT	66 - 67	
Additional threaded cylinders	CYDA, WMT, WRT	68 - 69	
Manifold cylinders	CSM	70 - 71	
Block cylinders	BD, BMD BMS, BS	72 - 75	
Pull down clamps	ECH, ECM	76 - 77	
Hollow plunger cylinders	CY, HCS, QDH, RWH	78 - 79	
Positive clamping cylinders	MRS	80 - 81	
Single-acting universal cylinders	RW, MRW, REB, REP	82 - 83	
Double-acting universal cylinders	BRD, BAD	84 - 85	
Cylinder accessories	AW, BS, FN, MF	86 - 87	
Tie rod cylinder	TR	88 - 92	
Tie rod accessories	TRA, TRR	93	

Shown: LUCS-32

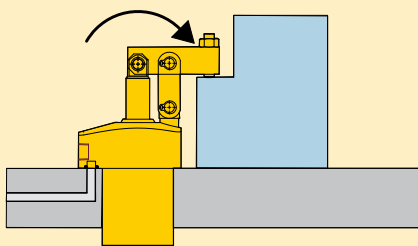


**▶ Link clamp allows unobstructed part loading and high clamping forces. The hydraulic cylinders extend to provide clamping force, and retract to allow part removal.**

Arm completely retracts to allow part loading.

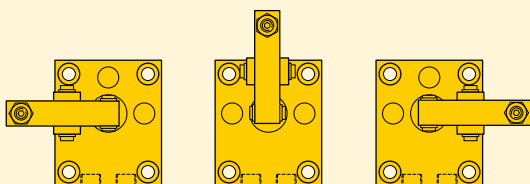


As cylinder extends, arm pivots to clamp part in place.



Arm location is changed easily without the use of tools.

Left      Center      Right



## Quick and accurate clamping action

- Hydraulic cylinder pushes linkage, pivoting clamp arm into position
- Design ensures repeatable clamping location
- Linkage can be re-positioned to clamp at 90, 180, or 270 degrees from ports
- Clamps can be mounted using supplied bolts or held in place with flange nut
- Standard arm or long arm ordered separately.

## Product selection

Clamping force <sup>1)</sup>	Stroke	Model number	Cylinder effective area	Oil capacity	Standard clamp arm (Sold separately)	Long clamp arm (Sold separately)
kN	mm		cm <sup>2</sup>	cm <sup>3</sup>		

### ▼ Single acting

2,9	18,5	<b>LUCS-32</b>	1,23	2,27	<b>LCAS-32</b>	<b>LCAL-32</b>
7,8	23,4	<b>LUCS-82</b>	3,10	7,28	<b>LCAS-82</b>	<b>LCAL-82</b>
11,8	29,7	<b>LUCS-122</b>	4,13	12,59	<b>LCAS-122</b>	<b>LCAL-122</b>
18,7	34,5	<b>LUCS-192</b>	6,39	22,67	<b>LCAS-192</b>	<b>LCAL-192</b>
27,2	44,7	<b>LUCS-282*</b>	9,61	45,18	<b>LCAS-282</b>	<b>LCAL-282</b>

### ▼ Double acting

3	18,5	<b>LUCD-32</b>	1,23	2,27	<b>LCAS-32</b>	<b>LCAL-32</b>
8	23,5	<b>LUCD-82</b>	3,10	7,28	<b>LCAS-82</b>	<b>LCAL-82</b>
12	29,7	<b>LUCD-122</b>	4,13	12,59	<b>LCAS-122</b>	<b>LCAL-122</b>
19	34,5	<b>LUCD-192</b>	6,39	22,67	<b>LCAS-192</b>	<b>LCAL-192</b>
28	44,7	<b>LUCD-282*</b>	9,61	45,18	<b>LCAS-282</b>	<b>LCAL-282</b>

Contact Enerpac for models with imperial threads and SAE ports.

\* This product is made to order. Please contact Enerpac for delivery information before specifying in your design.

## Dimensions in mm [ ]

Model number	Port Size	C1	C2	C3	D	D1	D2	E
--------------	-----------	----	----	----	---	----	----	---

### ▼ Single acting

<b>LUCS-32</b>	1/8" BSPP	27,9	36,6	55,1	M48 x 1,5	62,0	55,9	27,9°
<b>LUCS-82</b>	1/8" BSPP	30,0	41,4	65,0	M65 x 1,5	82,0	70,1	31,1°
<b>LUCS-122</b>	1/4" BSPP	37,1	49,5	79,2	M80 x 2	102,1	87,9	28,5°
<b>LUCS-192</b>	1/4" BSPP	39,9	58,4	93,0	M90 x 2	119,1	102,1	28,3°
<b>LUCS-282*</b>	1/4" BSPP	50,0	66,0	110,7	M105 x 2	134,9	119,9	24,8°

### ▼ Double acting

<b>LUCD-32</b>	1/8" BSPP	27,9	36,6	55,1	M48 x 1,5	62,0	55,9	27,9°
<b>LUCD-82</b>	1/8" BSPP	30,0	41,4	65,0	M65 x 1,5	82,0	70,1	31,1°
<b>LUCD-122</b>	1/4" BSPP	37,1	49,5	79,2	M80 x 2	102,1	87,9	28,5°
<b>LUCD-192</b>	1/4" BSPP	39,9	58,4	93,0	M90 x 2	119,1	102,1	28,3°
<b>LUCD-282*</b>	1/4" BSPP	50,0	66,0	110,7	M105 x 2	134,9	119,9	24,8°

Contact Enerpac for models with imperial threads and SAE ports.

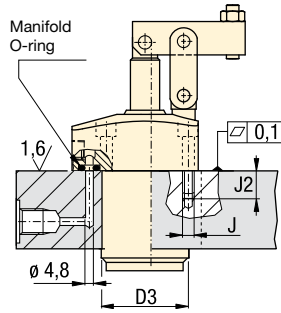
\* This product is made to order. Please contact Enerpac for delivery information before specifying in your design.

**Installation dimensions** in mm

Clamp <sup>1)</sup> force kN	Fixture hole Ø D3	Mounting thread J	Min. depth J2	Manifold O-ring <sup>2)</sup> ARP No. or Inside Ø x thickness
3	48,3	M6 x 1,0	16,5	-010
8	65,3	M8 x 1,0	19,0	-010
12	80,3	M8 x 1,0	19,0	-010
19	90,5	M10 x 1,25	22,5	-010
28	105,5	M12 x 1,25	24,0	-010

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

Note: Mounting bolts and O-rings included.

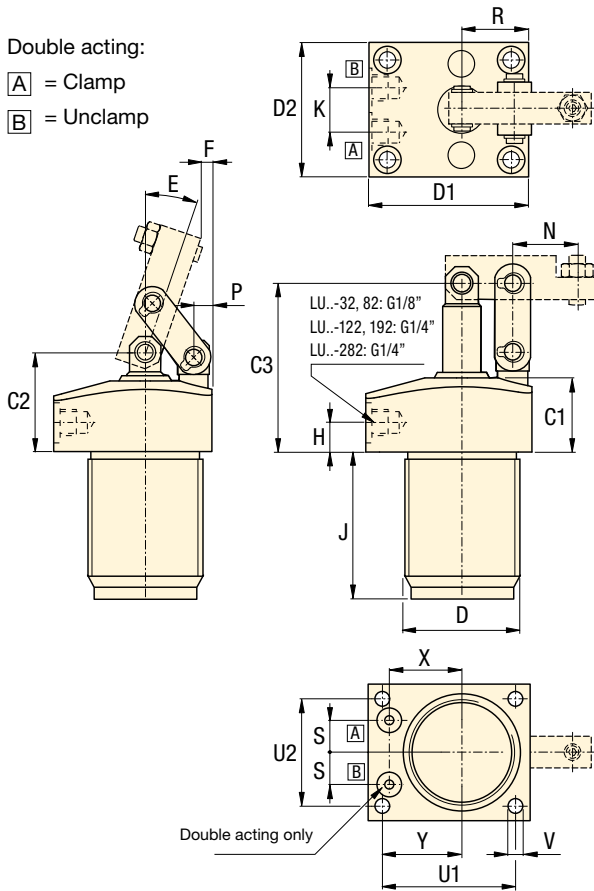


**all models**

Dimensions shown with standard clamp arm.

Double acting:

- A** = Clamp
- B** = Unclamp



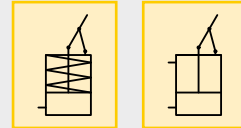
	F	H	J	K	N	P	R	S	U1	U2	V Ø	X	Y	kg
<b>Single acting ▼</b>														
1,0	10,9	47,0	-	23,6	8,4	27,9	10,4	52,1	46,0	6,6	28,7	29,0	1,2	
5,1	10,9	63,0	-	31,8	8,9	35,1	14,0	68,1	55,9	8,1	38,5	39,9	2,5	
0,8	11,9	71,1	-	37,6	11,9	43,9	16,1	87,9	73,9	8,1	44,2	51,1	4,5	
0,8	15,0	87,9	-	41,4	15,0	51,1	18,1	101,1	82,0	10,4	49,8	58,9	6,9	
2,0	20,1	99,1	-	51,1	16,0	59,9	20,9	115,1	100,1	13,0	57,3	65,0	11,7	
<b>Double acting ▼</b>														
1,0	10,9	47,0	20,1	23,6	8,4	27,9	21,6	52,1	46,0	6,6	20,5	29,0	1,2	
5,1	10,9	63,0	23,9	31,8	8,9	35,1	25,4	68,1	55,9	8,1	30,3	39,9	2,5	
0,8	11,9	71,1	30,0	37,6	11,9	43,9	26,4	87,9	73,9	8,1	37,7	51,1	5,0	
0,8	15,0	87,9	-	41,4	15,0	51,1	28,2	101,1	82,0	10,4	48,9	58,9	6,9	
2,0	20,1	99,1	38,1	51,1	16,0	59,9	30,0	115,1	100,1	13,0	52,0	65,0	11,7	

Clamp force: 2,9 - 28 kN

Stroke: 18,5 - 44,7 mm


Pressure: 35 - 350 bar

- E** Cilindros Amarre de enlace
- F** Bride basculante
- D** Gelenkspanner



**Options**

Clamp arms  [57](#)

Work supports  [43](#)

**Important**

Single-acting cylinders use a regenerative circuit; oil is sent to both sides of the piston at the same time. This eliminates the breather port, reducing damage from coolant and contamination.

Clamp arm should be parallel to cylinder mounting surface within 3° to avoid damage to cylinder and linkage. Use the included set screw to adjust clamp arm alignment.

# Clamp arms for link clamps

Shown: LCAS-32

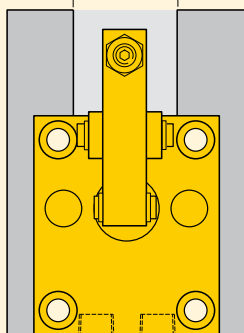


Standard arms are readily available from Enerpac to meet most applications. In applications that require a custom designed arm, the machining information is supplied on page 57.

## Important

Clamp point must be within the boundaries of the anchor links on the clamp. Clamping outside of this area will cause damage to the linkage, leading to premature failure.

Allowable clamping area

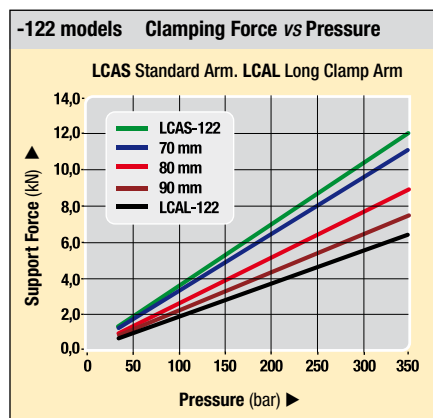
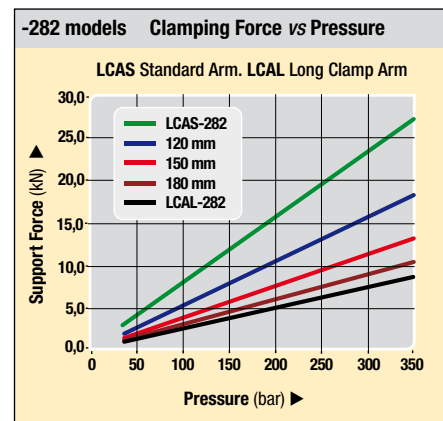
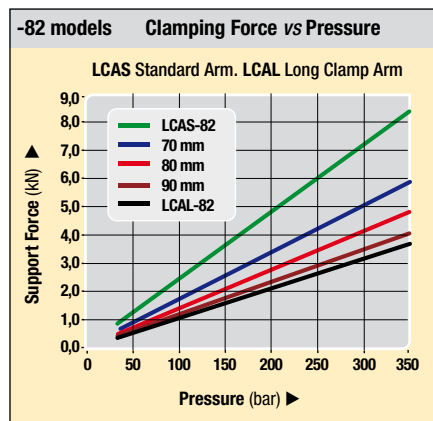
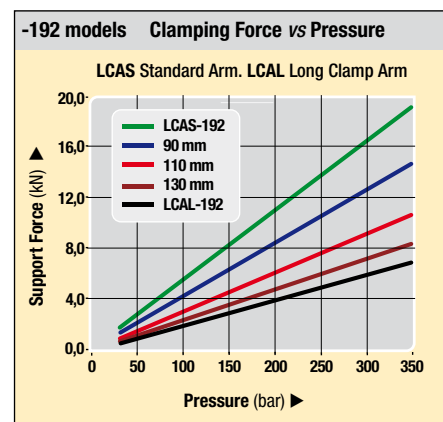
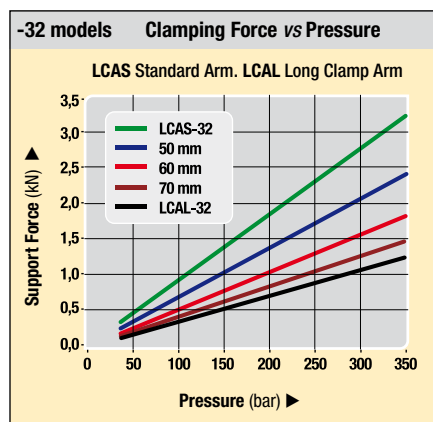


## Standard or custom built

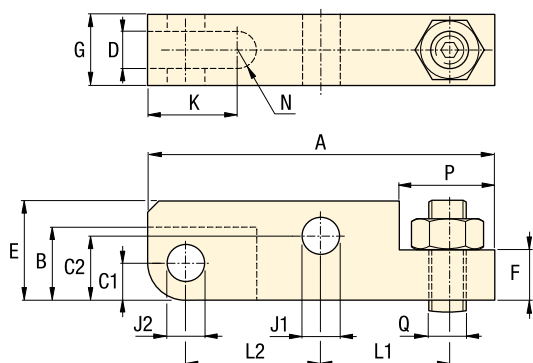
- Available from Enerpac in standard or extended length
- Standard arm includes set screw and lock nut
- Long arm is machinable
- Make your own custom arm to suit specific applications.

## Pressure vs clamping force

Different length clamp arms will determine the amount of clamping force transferred to the workpiece. As the length increases, the clamping force decreases.



**LCAS models** Standard Arm

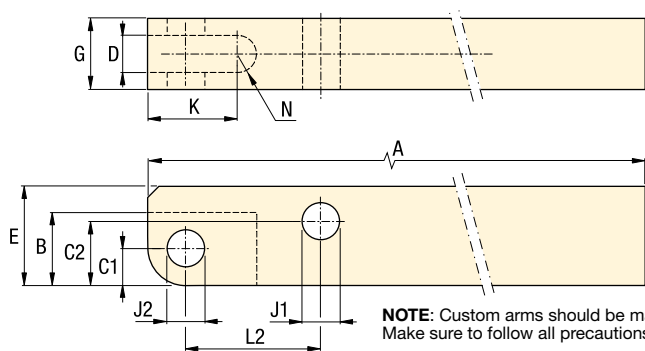


**Dimensions** in mm [ ]

Clamp capacity kN	Model number	A	B	C1	C2	D	E	F	G
▼ Standard clamp arms									
3	<b>LCAS-32</b>	54,0	13,0	6	9,5	6	16	8	11,85
8	<b>LCAS-82</b>	74,5	17,5	8	15,5	10	25	13	18,85
12	<b>LCAS-122</b>	87,5	22,0	10	19,5	11	32	16	21,85
19	<b>LCAS-192</b>	102,5	26,0	11	24,0	13	38	22	24,85
28	<b>LCAS-282</b>	125,0	30,5	13	29,0	16	45	27	31,85

Clamp. capacity kN	Model number	J1	J2	K	L1	L2	N	P	Q
▼ Standard clamp arms									
3	<b>LCAS-32</b>	6,02-6,07	6,02-6,07	13	23,5	18,5	3	13	M6 x 1,0
8	<b>LCAS-82</b>	10,05-10,10	8,05-8,10	16	32,0	24,5	5	22	M10 x 1,5
12	<b>LCAS-122</b>	12,05-12,10	10,05-10,10	20	37,5	30,0	5,5	25	M12 x 1,75
19	<b>LCAS-192</b>	15,05-15,10	12,05-12,10	24	41,5	36,0	6,5	31	M16 x 2,0
28	<b>LCAS-282</b>	18,05-18,10	15,05-15,10	28	51,0	44,0	8	38	M20 x 2,5

**LCAL models** Long Arm



**NOTE:** Custom arms should be manufactured using this print. Make sure to follow all precautions listed.

**Dimensions** in mm [ ]

Clamp. capacity kN	Model number	A	B	C1	C2	D	E	G	J1	J2	K	L2	N
▼ Long clamp arms													
3	<b>LCAL-32</b>	85	13,0	6	9,50	6	16	11,85	6,02-6,07	6,02-6,07	13	18,5	3,0
8	<b>LCAL-82</b>	105	17,5	8	15,50	10	25	18,85	10,05-10,10	8,05-8,10	16	24,5	5,0
12	<b>LCAL-122</b>	110	22,0	10	19,50	11	32	21,85	12,05-12,10	10,05-10,10	20	30,0	5,5
19	<b>LCAL-192</b>	160	26,0	11	24,00	13	38	24,85	15,05-15,10	12,05-12,10	24	36,0	6,5
28	<b>LCAL-282</b>	220	30,5	13	29,00	16	45	31,85	18,05-18,10	15,05-15,10	28	44,0	8,0

**Force: 3 - 28 kN**

**Pressure: 35 - 350 bar**

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

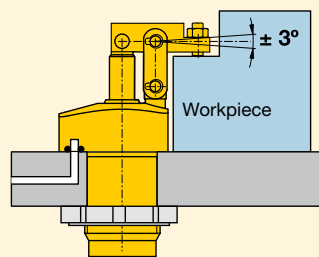
**Options**

**Work supports** [43 ▶](#)

**Accessories** [86 ▶](#)

**Important**

Clamp arm should be parallel to cylinder mounting surface within 3° to avoid damage to cylinder and linkage. Use the included set screw to adjust clamp arm alignment.





# Pull cylinders *Application & selection*

Shown: PLSS-121, PUSD-121

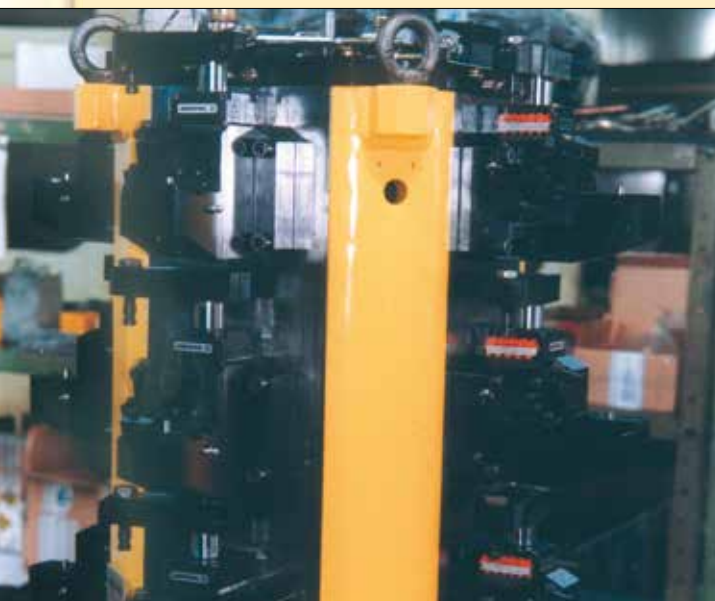


## Pull cylinders

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 5,6 to 43,5 kN for pulling and 13,3 to 81,9 kN 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.*



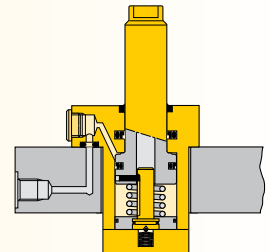
## Compact and full featured design

- 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:

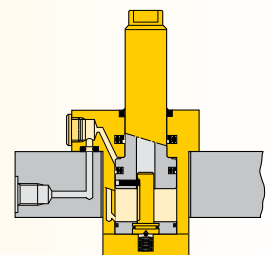
### Single acting

- The obvious choice when there are few system restrictions, and there are not many units retracting simultaneously
- Valving and plumbing is less complex.



### Double acting

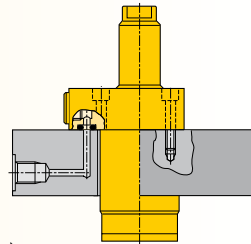
- When greater control is required during the unclamp cycle
- When heavy attachments are being used
- When timing sequences are critical: less sensitive to system back pressures resulting from long tube lengths or numerous components being retracted at the same time.



## Select your mounting method:

### PU series, Upper flange mounting

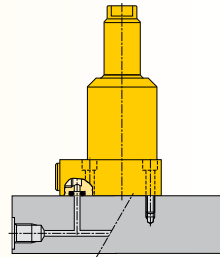
- Flexible design allows for manifold or threaded oil port connection
- Fixture hole does not require tight tolerances
- Easy installation with only 3 or 4 mounting bolts.



 60 ▶

### PL series, Lower flange mounting

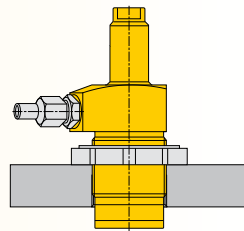
- Flexible design allows for manifold or threaded port connection
- No fixture hole required
- Easy installation with only 3 or 4 mounting bolts.



 62 ▶

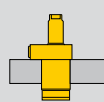
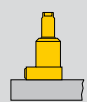
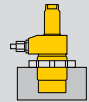
### PT series, Threaded body mounting

- 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.



 64 ▶

## Product selection

Cylinder capacity		Stroke	Upper flange	Lower flange	Threaded body
kN		mm			
Pull	Push				
<b>▼ Single acting</b>					
Model number					
5,6	–	22,6	<b>PUSS-52</b>	<b>PLSS-52</b>	<b>PTSS-52</b>
13,3	–	27,9	<b>PUSS-121</b>	<b>PLSS-121</b>	<b>PTSS-121</b>
<b>▼ Double acting</b>					
Model number					
6,3	13,3	22,6	<b>PUSD-52</b>	<b>PLSD-52</b>	<b>PTSD-52</b>
11,2	28,0	22,1	<b>PUSD-92</b>	<b>PLSD-92</b>	<b>PTSD-92</b>
14,3	27,4	27,9	<b>PUSD-121</b>	<b>PLSD-121</b>	<b>PTSD-121</b>
43,5	81,9	30,5	<b>PUSD-352</b>	<b>PLSD-352</b>	<b>PTSD-352</b>

**Note:** - Call Enerpac to order models with imperial thread and SAE port connections.  
- Pull forces for single-acting cylinders reduced due to spring force.

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

**Pull force: 5,6 - 43,5 kN**

**Push force: 13,3 - 81,9 kN**

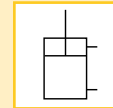
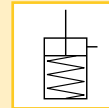
**Stroke: 22,1 - 30,5 mm**

**Pressure: 35 - 350 bar**

**E** Cilindros de tracción

**F** Verins traction

**D** Zugzylinder



## Options

### Accessories

 86 ▶



### Collet-Lok® push cylinders

 18 ▶



### Work supports

 43 ▶



### Swing cylinders

 22 ▶



### Sequence valves

 152 ▶



# Pull cylinders - Upper flange models

Shown: PUSS-52, PUSD-121

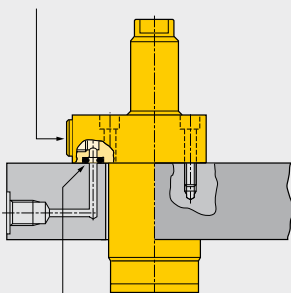


## PU series

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.

Oil connection



Integrated O-ring port

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



## 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 mm	Model number	Cylinder effective area		Oil capacity	
Pull kN	Push kN			Pull cm <sup>2</sup>	Push cm <sup>2</sup>	Pull cm <sup>3</sup>	Push cm <sup>3</sup>
<b>▼ Single acting</b>							
5,6	–	22,6	<b>PUSS-52</b>	1,81	–	4,10	–
13,3	–	27,9	<b>PUSS-121</b>	4,06	–	11,47	–
<b>▼ Double acting</b>							
6,3	13,3	22,6	<b>PUSD-52</b>	1,81	3,81	4,10	8,69
11,2	28,0	22,1	<b>PUSD-92</b>	3,16	8,06	6,88	17,70
14,3	27,4	27,9	<b>PUSD-121</b>	4,06	7,94	11,47	22,94
43,5	81,9	30,5	<b>PUSD-352</b>	12,39	23,74	37,20	71,28

**Note:** - Call Energac to order models with SAE oil connections.  
- Pull forces for single-acting cylinders reduced due to spring force.

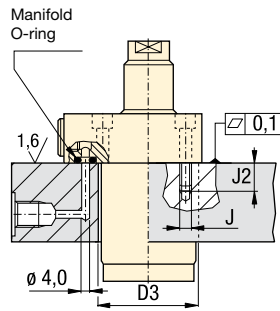
## Dimensions in mm [ ]

Model number	A	B	C1	D	D1	D2	E	E1	F	H
				∅			∅	∅		
<b>▼ Single acting</b>										
<b>PUSS-52</b>	128,8	106,2	24,9	34,8	54,1	57,2	16,0	15,0	13,0	14,0
<b>PUSS-121</b>	160,3	132,3	25,4	47,5	66,5	73,2	22,1	20,8	17,3	15,5
<b>▼ Double acting</b>										
<b>PUSD-52</b>	128,8	106,2	24,9	34,8	54,1	57,2	16,0	15,0	13,0	14,0
<b>PUSD-92</b>	137,9	116,1	24,9	47,8	70,1	54,1	24,9	23,6	17,8	12,4
<b>PUSD-121</b>	160,3	132,3	25,4	47,5	66,5	73,2	22,1	20,8	17,3	15,5
<b>PUSD-352</b>	204,2	173,5	24,9	79,8	100,1	88,9	38,1	36,1	28,7	12,4

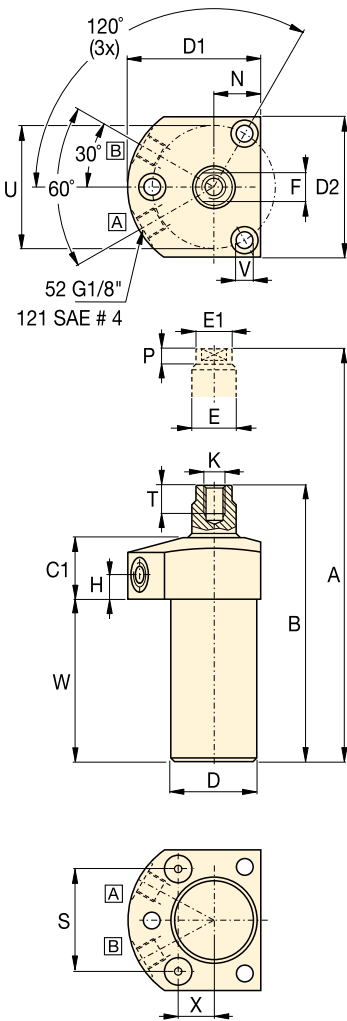
**Installation dimensions** in mm

Pull force kN	Fixture hole Ø D3	Mounting thread J	Min. depth J2	Manifold O-ring <sup>1)</sup> ARP numbers or Inside Ø x thickness
6,3	35,3	M6 x 1	16,5	568-011
11,2	49,0	M6 x 1	15,0	4,32 x 3,53
14,3	48,0	.312-24 UNF	20,3	568-011
43,5	78,0	M10 x 1,25	18,8	4,32 x 3,53

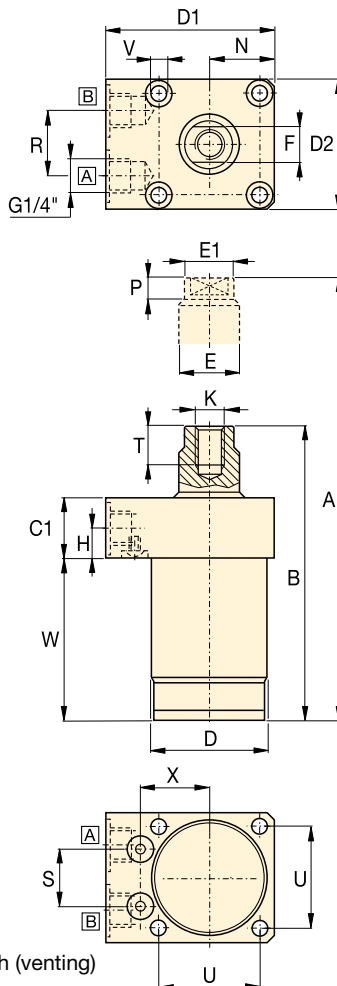
<sup>1)</sup> O-ring material: polyurethane, 92 Durometer



**-52, 121**



**-92, -352**



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

**Pull force: 5,6 - 43,5 kN**

**Push force: 13,3 - 81,9 kN**

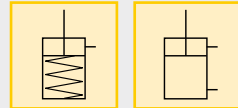
**Stroke: 22,1 - 30,5 mm**

**Pressure: 35 - 350 bar**

**E** Cilindros de tracción

**F** Verins traction

**D** Zugzylinder



**Options**

**Accessories** 86

**Collet-Lok® push cylinders** 18

**Swing cylinders** 22

**Sequence valves** 152

**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.

	K	N	P	R	S	T	U	V	W	X	Model number
											kg
<b>Single acting ▼</b>											
M8 x 1,25	19,1	5,8	-	41,0	15,7	50,0	6,9	66,0	14,4	1,1	<b>PUSS-52</b>
.500-20 UNF	25,1	9,4	-	52,0	19,1	63,5	8,8	85,9	18,2	1,6	<b>PUSS-121</b>
<b>Double acting ▼</b>											
M8 x 1,25	19,1	5,8	-	41,0	15,7	50,0	6,9	66,0	14,4	1,1	<b>PUSD-52</b>
M10 x 1,5	26,4	10,4	25,9	23,7	16,0	41,9	6,6	75,9	28,7	2,0	<b>PUSD-92</b>
.500-20 UNF	25,1	9,4	-	52,0	19,1	63,5	8,9	85,9	18,2	1,6	<b>PUSD-121</b>
M16 x 2	43,4	13,0	25,9	34,8	31,0	70,1	10,9	96,5	41,6	5,6	<b>PUSD-352</b>

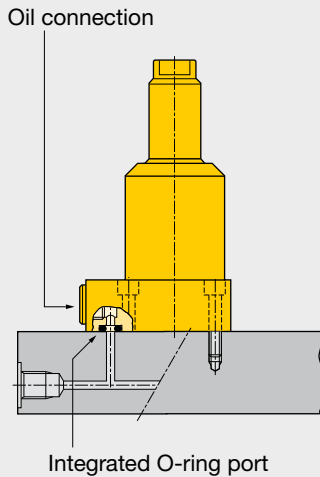
# Pull cylinders - Lower flange models

Shown: PLSS-52, PLSS-121



## 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.



## 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	
	kN	mm		cm <sup>2</sup>	cm <sup>3</sup>		
Pull	Push		Pull	Push	Pull	Push	
<b>▼ Single acting</b>							
5,6	–	22,6	<b>PLSS-52</b>	1,81	–	4,10	–
13,3	–	27,9	<b>PLSS-121</b>	4,06	–	11,47	–
<b>▼ Double acting</b>							
6,3	13,3	22,6	<b>PLSD-52</b>	1,81	3,81	4,10	8,69
11,2	28,0	22,1	<b>PLSD-92</b>	3,16	8,06	6,88	17,70
14,3	27,4	27,9	<b>PLSD-121</b>	4,06	7,94	11,47	22,94
43,5	81,9	30,5	<b>PLSD-352</b>	12,39	23,74	37,20	71,28

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

## Dimensions in mm [ ]

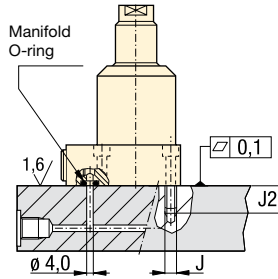
Model number	A	B	C1	D	D1	D2	E	E1	F	H
					∅		∅	∅		
<b>▼ Single acting</b>										
<b>PLSS-52</b>	128,8	106,2	24,9	34,8	54,1	57,2	16,0	15,0	13,0	14,0
<b>PLSS-121</b>	160,3	132,3	25,4	47,5	66,5	73,2	22,1	20,8	17,3	15,5
<b>▼ Double acting</b>										
<b>PLSD-52</b>	128,8	106,2	24,9	34,8	54,1	57,2	16,0	15,0	13,0	14,0
<b>PLSD-92</b>	137,9	116,1	24,9	47,8	70,1	54,1	24,9	23,6	17,8	12,4
<b>PLSD-121</b>	160,3	132,3	25,4	47,5	66,5	73,2	22,1	20,8	17,3	15,5
<b>PLSD-352</b>	204,2	173,5	24,9	79,8	100,1	88,9	38,1	36,1	28,7	12,4



**Installation dimensions** in mm

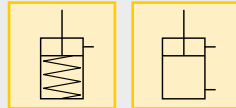
Pull force kN	Mounting thread J	Minimum depth J2	Manifold O-ring <sup>1)</sup> ARP numbers or inside Ø x thickness
6,3	M6 x 1	16,5	568-011
11,2	M6 x 1	15,0	4,32 x 3,53
14,3	M8 x 1	20,3	568-011
14,5	M10 x 1,25	18,8	4,32 x 3,53

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

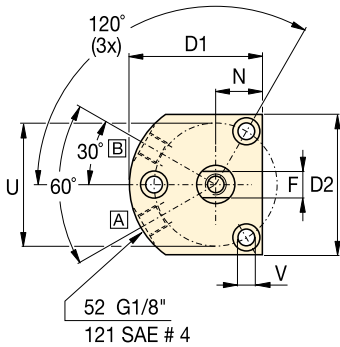


- Pull force: 5,6 - 43,5 kN**
- Push force: 13,3 - 81,9 kN**
- Stroke: 22,1 - 30,5 mm**
- Pressure: 35 - 350 bar**

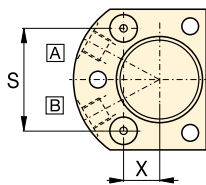
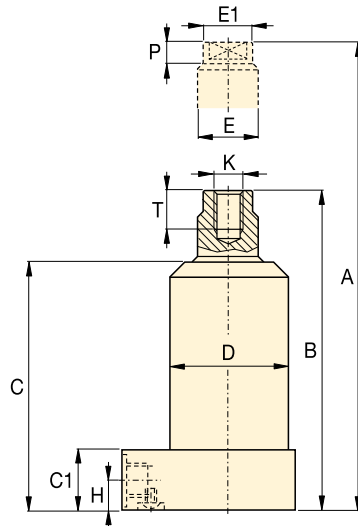
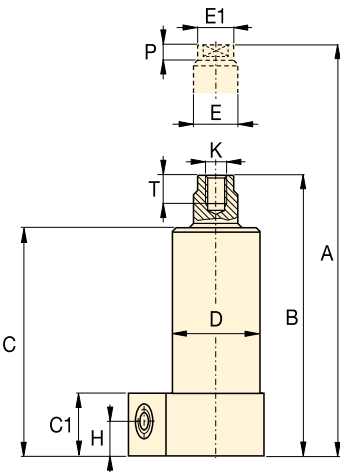
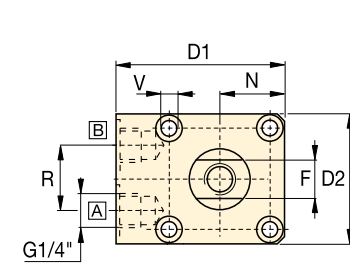
- E** Cilindros de tracción
- F** Verins traction
- D** Zugzylinder



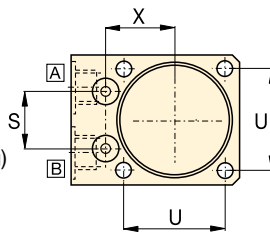
**-52, -121**



**-352, -92**



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



**Options**

- Accessories** 86 ▶
- Collet-Lok® push cylinders** 18 ▶
- Swing cylinders** 22 ▶
- Sequence valves** 152 ▶

**Important**

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

The lower flange pull 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.

	K	N	P	R	S	T	U	V	W	X	kg	Model number
												<b>Single acting ▼</b>
	M8 x 1,25	19,1	5,8	-	41,0	15,7	50,0	6,9	66,0	14,4	1,1	<b>PLSS-52</b>
	.500-20 UNF	25,1	9,4	-	52,0	19,1	63,5	8,8	85,9	18,2	1,6	<b>PLSS-121</b>
												<b>Double acting ▼</b>
	M8 x 1,25	19,1	5,8	-	41,0	15,7	50,0	6,9	66,0	14,4	1,1	<b>PLSD-52</b>
	M10 x 1,5	26,4	10,4	25,9	23,7	16,0	41,9	6,6	75,9	28,7	1,6	<b>PLSD-92</b>
	.500-20 UNF	25,1	9,4	-	52,0	19,1	63,5	8,9	85,8	18,2	2,0	<b>PLSD-121</b>
	M16 X 2	43,4	12,9	25,9	34,4	31,0	70,1	10,9	96,5	41,6	5,6	<b>PLSD-352</b>

# Pull cylinders - Threaded body models

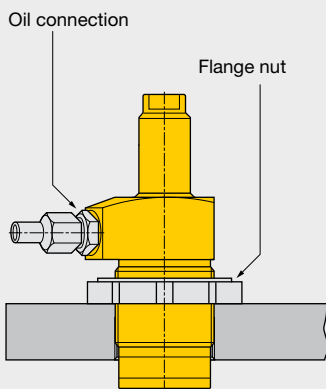
Shown: PTSS-52, PTSD-121



## 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 (□86).



■ 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	
kN		mm		cm <sup>2</sup>		cm <sup>3</sup>	
Pull	Push		Pull	Push	Pull	Push	
<b>▼ Single acting</b>							
5,6	-	22,6	<b>PTSS-52</b>	1,81	-	4,10	-
13,3	-	27,9	<b>PTSS-121</b>	4,06	-	11,47	-
<b>▼ Double acting</b>							
6,3	13,3	22,6	<b>PTSD-52</b>	1,81	3,81	4,10	8,69
11,2	28,0	22,1	<b>PTSD-92</b>	3,16	8,06	6,88	17,70
14,3	27,4	27,9	<b>PTSD-121</b>	4,06	7,94	11,47	22,94
43,5	81,9	30,5	<b>PTSD-352</b>	12,39	23,74	37,20	71,28

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

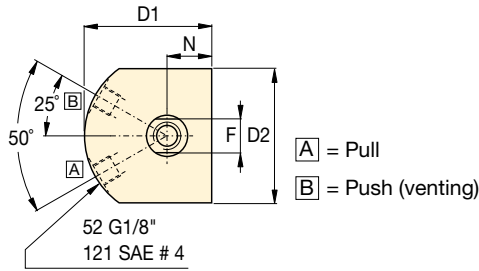
## Dimensions in mm [ ]

Model number	A	B	C1	D	D1	D2	E
							Ø
<b>▼ Single acting</b>							
<b>PTSS-52</b>	128,8	106,2	24,9	M35 x 1,5	47,8	37,8	16,0
<b>PTSS-121</b>	160,3	132,6	25,4	1.875-16 UN	60,5	50,8	22,1
<b>▼ Double acting</b>							
<b>PTSD-52</b>	128,8	106,2	24,9	M35 x 1,5	47,8	37,8	16,0
<b>PTSD-92</b>	130,0	108,0	30,2	M48 x 1,5	62,7	48,3	24,9
<b>PTSD-121</b>	160,3	132,6	25,4	1.875-16 UN	60,5	50,8	22,1
<b>PTSD-352</b>	196,1	165,6	32,0	M80 x 2	88,4	80,0	38,1

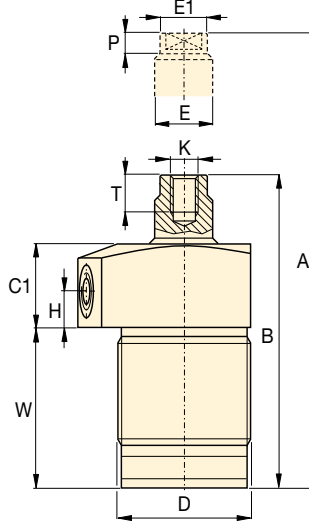
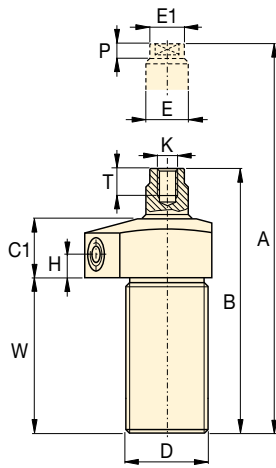
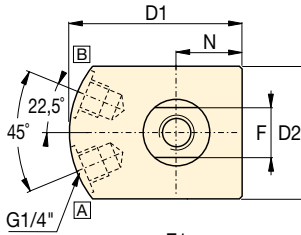
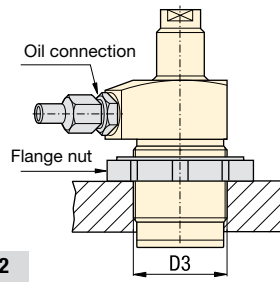
**Installation dimensions** in mm

Pull force kN	Fixture hole thread size D3
6,3	M35 x 1,5
11,2	M48 x 1,5
14,3	1.875-16 UNF
43,5	M80 x 2

-52, 121



-92, -352



**Accessory chart**

Model number	Mounting flange Sold separately ☐87 ▶	Flange nut Sold separately ☐86 ▶
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▼ Single acting

PTSS-52	MF-352	FN-352
PTSS-121	MF-481	FN-811

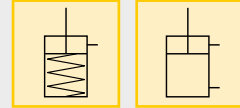
▼ Double acting

PTSD-52	MF-352	FN-352
PTSD-92	MF-482	FN-482
PTSD-121	MF-481	FN-481
PTSD-352	MF-802	FN-802

E1	F	H	K	N	P	T	W	kg	Model number
∅									
Single acting ▼									
15,0	13,0	9,7	M8 x 1,25	19,1	5,8	15,7	66,0	1,1	PTSS-52
20,8	17,3	9,7	.500-20 UNF	25,4	9,7	19,1	85,9	1,6	PTSS-121
Double acting ▼									
15,0	13,0	9,7	M8 x 1,25	19,1	5,8	15,7	66,0	1,1	PTSD-52
23,6	17,8	13,0	M10 x 1,5	24,1	10,4	16,0	62,7	2,0	PTSD-92
20,8	17,3	9,7	.500-20 UNF	25,4	9,7	19,1	85,9	1,6	PTSD-121
36,1	28,7	13,0	M16 x 2,00	39,9	13,0	31,0	81,8	4,7	PTSD-352

<b>Pull force:</b> 5,6 - 43,5 kN
<b>Push force:</b> 13,3 - 81,9 kN
<b>Stroke:</b> 22,1 - 30,5 mm
<b>Pressure:</b> 35 - 350 bar

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



**Options**

<b>Accessories</b>	
	☐86 ▶
<b>Collet-Lok® swing cylinders</b>	
	☐18 ▶
<b>Swing cylinders</b>	
	☐22 ▶
<b>Sequence valves</b>	
	☐152 ▶

**Important**

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

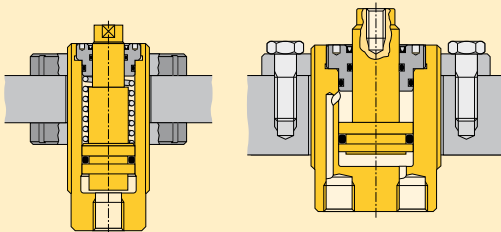
In case there is a risk of machining coolants and debris being inhaled via the breather vent, it is recommended to pipe this port to an area outside the fixture that is protected from machining coolants and debris.

# Threaded cylinders *Application & selection*




Shown: CST-10382, CST-572, CST18252, CDT-18132, CDT-40252



**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.**



## Accessory chart

Body thread D	Mounting flange Sold Separately  87 ▶	Flange nut Sold Separately  86 ▶	Plunger thread K	Contact bolt Sold Separately  86 ▶
M12 x 1,5	MF-122	FN-122	M4 x 0,7	BS-42
M20 x 1,5	MF-202	FN-202	M6 x 1	BS-62
M28 x 1,5	MF-282	FN-282	M8 x 1,25	BS-82
M30 x 1,5	-	FN-302	M10 x 1,5	BS-102
M35 x 1,5	MF-352	FN-352	M16 x 2	BS-162
M42 x 1,5	MF-422	FN-422	M20 x 2,5	BS-202
M48 x 1,5	MF-482	FN-482		
M55 x 1,5	MF-552	FN-552		
M65 x 1,5	MF-652	FN-652		
M80 x 2	MF-802	FN-802		

■ *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

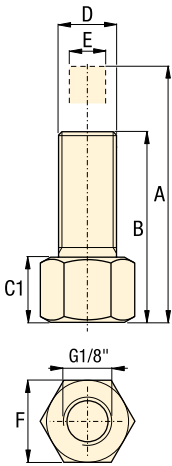
- Minimum cylinder diameter combined with maximized clamping forces
- Threaded body allows fine positioning and easy installation
- Internal plunger wipers allow maintenance-free, high-cycle performance
- Center-tapped plungers will hold workpiece contact buttons
- Single-acting models with spring return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

## Product selection

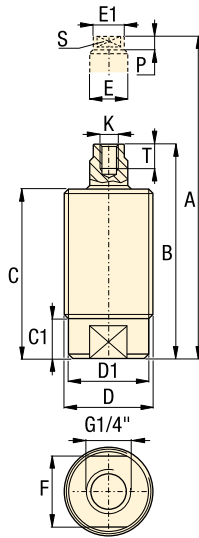
Cylinder capacity at 350 bar kN	Stroke mm	Model number	Effective area cm <sup>2</sup>		Oil capacity cm <sup>3</sup>		
			push	pull	push	pull	
<b>▼ Single acting</b>							
1,7	-	7,3	CST-272	0,52	-	0,36	-
1,7	-	10,3	CST-2102	0,52	-	0,52	-
1,7	-	12,0	CST-2132	0,52	-	0,67	-
4,4	-	7,0	CST-572	1,29	-	0,82	-
4,4	-	13,0	CST-5132	1,29	-	1,64	-
4,4	-	18,8	CST-5192	1,29	-	2,46	-
4,4	-	25,0	CST-5252	1,29	-	3,11	-
4,4	-	37,4	CST-5382	1,29	-	4,75	-
11,3	-	8,6	CST-1072	3,32	-	2,32	-
11,3	-	13,0	CST-10132	3,32	-	4,31	-
11,3	-	19,0	CST-10192	3,32	-	6,30	-
11,3	-	26,8	CST-10252	3,32	-	8,29	-
11,3	-	38,0	CST-10382	3,32	-	12,60	-
17,2	-	13,0	CST-18132	5,10	-	6,63	-
17,2	-	25,0	CST-18252	5,10	-	12,74	-
17,2	-	38,0	CST-18382	5,10	-	19,37	-
17,2	-	50,0	CST-18502	5,10	-	25,48	-
26,9	-	15,0	CST-27152	7,88	-	11,82	-
26,9	-	25,0	CST-27252	7,88	-	19,70	-
26,9	-	50,0	CST-27502	7,88	-	39,40	-
39,2	-	14,6	CST-40132	11,36	-	14,76	-
39,2	-	26,6	CST-40252	11,36	-	28,39	-
39,2	-	39,6	CST-40382	11,36	-	43,15	-
39,2	-	51,6	CST-40502	11,36	-	56,78	-
<b>▼ Double acting</b>							
17,2	10,4	13,0	CDT-18132	5,10	3,03	6,63	3,94
17,2	10,4	25,0	CDT-18252	5,10	3,03	12,74	7,58
17,2	10,4	38,0	CDT-18382	5,10	3,03	19,37	11,52
17,2	10,4	50,0	CDT-18502	5,10	3,03	38,61	23,11
26,9	18,2	14,7	CDT-27152	7,87	5,29	11,81	7,94
26,9	18,2	24,7	CDT-27252	7,87	5,29	19,68	13,23
26,9	18,2	49,7	CDT-27502	7,87	5,29	39,35	26,45
39,2	26,1	13,0	CDT-40132	11,35	7,55	14,76	9,81
39,2	26,1	25,0	CDT-40252	11,35	7,55	28,39	18,87
39,2	26,1	38,0	CDT-40382	11,35	7,55	43,15	28,68
39,2	26,1	50,0	CDT-40502	11,35	7,55	56,77	37,74

Note: - Seal material: Buna-N, Polyurethane.  
- Minimum operating pressure for single-acting models (to overcome return spring force) is 40 bar.

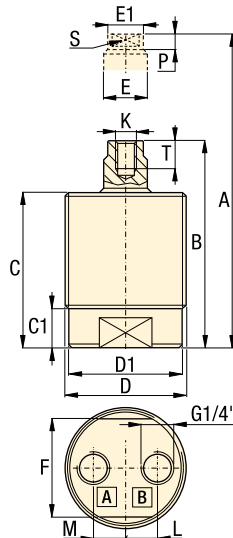
CST-2...., CST-5....



Other CST models



CDT models

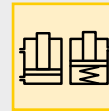


Force: 1,7 - 39,2 kN

Stroke: 7,3 - 51,6 mm

Pressure: 40 - 350 bar

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



**Options**

Accessories

86 ▶



**Product dimensions in mm** [ ]

Model number	A Ext. height	B Retr. height	C	C1	D	D1	E	E1	F	K	L	M	P	S	T	 kg
<b>▼ Single acting</b>																
CST-272	49,3	42,0	42,0	13,5	M12 x 1,5	-	4,8	-	16,0	-	-	-	-	-	-	0,1
CST-2102	52,8	42,8	42,8	14,3	M12 x 1,5	-	4,8	-	16,0	-	-	-	-	-	-	0,1
CST-2132	63,2	51,2	50,2	14,2	M12 x 1,5	-	4,8	-	16,0	-	-	-	-	-	-	0,1
CST-572	58,1	51,1	47,0	7,5	M20 x 1,5	17,7	7,9	7,0	15,9	M4 x 0,7	-	-	4,0	5,9	7,0	0,1
CST-5132	72,6	59,6	55,5	7,5	M20 x 1,5	17,7	7,9	7,0	15,9	M4 x 0,7	-	-	4,0	5,9	7,0	0,1
CST-5192	83,1	64,3	60,0	7,5	M20 x 1,5	17,7	7,9	7,0	15,9	M4 x 0,7	-	-	4,0	5,9	7,0	0,2
CST-5252	98,3	73,3	70,2	7,5	M20 x 1,5	17,7	7,9	7,0	15,9	M4 x 0,7	-	-	4,0	5,9	7,0	0,3
CST-5382	131,1	93,7	89,0	7,5	M20 x 1,5	17,7	7,9	7,0	15,9	M4 x 0,7	-	-	4,0	5,9	7,0	0,4
CST-1072	67,0	58,4	52,0	10,5	M28 x 1,5	26,0	11,9	11,0	24,0	M6 x 1	-	-	5,5	9,0	8,0	0,2
CST-10132	64,4	64,4	58,0	10,5	M28 x 1,5	26,0	11,9	11,0	24,0	M6 x 1	-	-	5,5	9,0	8,0	0,3
CST-10192	98,9	79,9	73,5	10,5	M28 x 1,5	26,0	11,9	11,0	24,0	M6 x 1	-	-	5,5	9,0	8,0	0,3
CST-10252	115,8	89,0	84,3	10,5	M28 x 1,5	26,0	11,9	11,0	24,0	M6 x 1	-	-	5,5	9,0	8,0	0,4
CST-10382	142,9	104,9	98,5	10,5	M28 x 1,5	26,0	11,9	11,0	24,0	M6 x 1	-	-	5,5	9,0	8,0	0,4
CST-18132	82,9	69,9	63,5	12,5	M35 x 1,5	32,5	16,0	15,0	30,0	M8 x 1,25	-	-	6,5	12,0	12,0	0,5
CST-18252	114,9	89,9	83,5	12,5	M35 x 1,5	32,5	16,0	15,0	30,0	M8 x 1,25	-	-	6,5	12,0	12,0	0,5
CST-18382	146,4	108,4	102,0	12,5	M35 x 1,5	32,5	16,0	15,0	30,0	M8 x 1,25	-	-	6,5	12,0	12,0	0,6
CST-18502	174,4	124,4	118,0	12,5	M35 x 1,5	32,5	16,0	15,0	30,0	M8 x 1,25	-	-	6,5	12,0	12,0	0,7
CST-27152	87,9	72,9	66,5	13,5	M42 x 1,5	39,8	18,0	17,0	36,0	M8 x 1,25	-	-	6,5	15,0	12,0	0,6
CST-27252	118,4	93,4	87,0	13,5	M42 x 1,5	39,8	18,0	17,0	36,0	M8 x 1,25	-	-	6,5	15,0	12,0	0,9
CST-27502	195,9	145,9	139,5	13,5	M42 x 1,5	39,8	18,0	17,0	36,0	M8 x 1,25	-	-	6,5	15,0	12,0	1,3
CST-40132	89,4	74,8	68,5	11,0	M48 x 1,5	45,4	19,9	19,0	41,4	M10 x 1,5	-	-	8,0	16,9	12,0	1,0
CST-40252	120,9	94,3	88,0	11,0	M48 x 1,5	45,4	19,9	19,0	41,4	M10 x 1,5	-	-	8,0	16,9	12,0	1,1
CST-40382	164,9	125,3	119,0	11,0	M48 x 1,5	45,4	19,9	19,0	41,4	M10 x 1,5	-	-	8,0	16,9	12,0	1,5
CST-40502	188,6	137,0	130,7	11,0	M48 x 1,5	45,4	20,0	19,0	41,4	M10 x 1,5	-	-	8,0	16,9	12,0	1,7
<b>▼ Double acting</b>																
CDT-18132	81,0	68,0	61,5	16,0	M48 x 1,5	45,7	15,8	15,0	41,0	M8 x 1,25	12,8	12,8	6,5	12,7	12,0	1,0
CDT-18252	107,0	82,0	75,5	16,0	M48 x 1,5	45,7	15,8	15,0	41,0	M8 x 1,25	12,8	12,8	6,5	12,7	12,0	1,3
CDT-18382	131,5	93,5	87,0	16,0	M48 x 1,5	45,7	15,8	15,0	41,0	M8 x 1,25	12,8	12,8	6,5	12,7	12,0	1,5
CDT-18502	155,5	105,5	99,0	16,0	M48 x 1,5	45,7	15,8	15,0	41,0	M8 x 1,25	12,8	12,8	6,5	12,7	12,0	1,7
CDT-27152	85,7	71,0	64,5	17,0	M55 x 1,5	52,7	17,9	17,0	46,0	M8 x 1,25	16,0	10,0	6,5	15,8	12,0	1,1
CDT-27252	106,7	82,0	75,5	17,0	M55 x 1,5	52,7	17,9	17,0	46,0	M8 x 1,25	16,0	10,0	6,5	15,8	12,0	1,4
CDT-27502	156,7	107,0	100,5	17,0	M55 x 1,5	52,7	17,9	17,0	46,0	M8 x 1,25	16,0	10,0	6,5	15,8	12,0	1,8
CDT-40132	91,5	78,5	70,5	17,5	M65 X 1,5	60,5	21,9	21	54,9	M10 x 1,5	19,5	10,5	8,0	16,9	15,0	1,8
CDT-40252	115,5	90,5	82,5	17,5	M65 x 1,5	60,5	21,9	21,0	54,9	M10 x 1,5	19,5	10,5	8,0	16,9	15,0	2,0
CDT-40382	141,5	103,5	95,5	17,5	M65 x 1,5	60,5	21,9	21,0	54,9	M10 x 1,5	19,5	10,5	8,0	16,9	15,0	2,5
CDT-40502	175,0	125,0	117,0	17,5	M65 x 1,5	60,5	21,9	21,0	54,9	M10 x 1,5	19,5	10,5	8,0	16,9	15,0	3,0



# Threaded cylinders *Application & selection*

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



▶ 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.

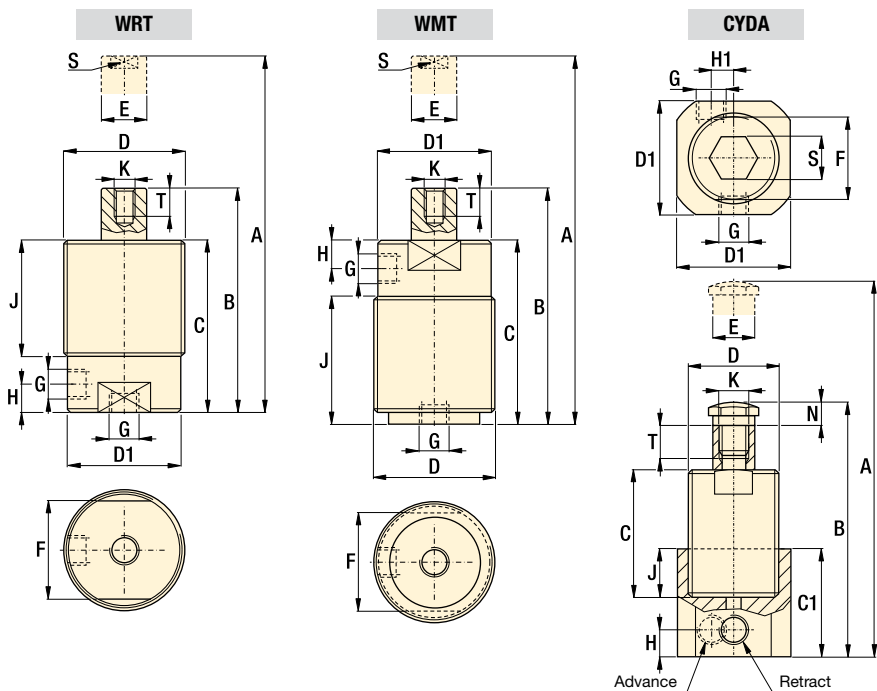
### Double acting

- 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.

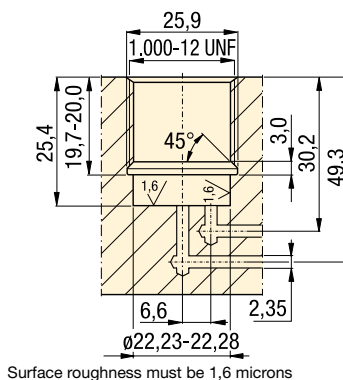
## **globe** Product selection

Cylinder capacity at maximum pressure		Stroke mm	Model number	Effective area		Oil capacity		Operating pressure bar
kN push	kN pull			cm <sup>2</sup> push	cm <sup>2</sup> pull	cm <sup>3</sup> push	cm <sup>3</sup> pull	
<b>▼ Single acting</b>								
17,4	–	12,7	<b>WRT-21</b>	5,10	–	0,33	–	40-350
17,4	–	25,4	<b>WRT-22</b>	5,10	–	0,66	–	40-350
<b>▼ Double acting</b>								
5,3	2,7	39,6	<b>CYDA-15</b>	2,65	1,29	10,16	5,08	10-210
17,4	12,0	11,9	<b>WMT-39</b>	5,10	3,48	6,39	4,42	10-350
17,4	12,0	24,9	<b>WMT-40</b>	5,10	3,48	12,95	8,85	10-350

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



Manifold dimensions using CYDA-15 without base

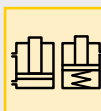


Force: 5,3 - 17,4 kN

Stroke: 11,9 - 39,6 mm

Pressure: 10 - 350 bar

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



### Accessory chart

Body Thread	Mounting Flange	Flange Nut	Plunger Thread	Contact Bolt
<b>D</b>	Sold separately	Sold separately	<b>K</b>	Sold separately
1.000-12 UN	MF-251	FN-251	0.250-28 UN	BS-61
1.375-18 UN	MF-351	FN-351	0.313-24 UN	BS-81

### Options

Cylinder accessories



### Important

Apply Loctite 222 or equivalent to threads and torque CYDA-15 in cavity to 8-11 Nm. Cavity must be designed to withstand hydraulic forces.

### Product dimensions in mm [ $\varnothing$ ]

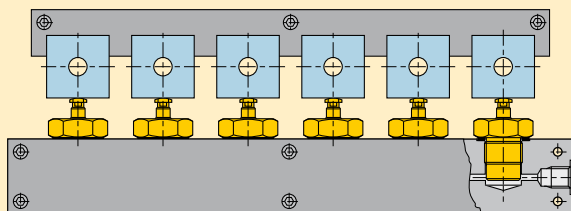
Model number	A	B	C	C1	D	D1	E	F	G	H	H1	J	K	N	S	T	kg
							$\varnothing$	$\varnothing$					UNF				
<b>▼ Single acting</b>																	
WRT-21	95,3	82,6	74,9	-	1.375-18 UNEF	31,2	19,1	26,9	SAE #2	15,7	-	50,8	.250-28	-	12,7	8,1	0,5
WRT-22	120,7	95,3	87,6	-	1.375-18 UNEF	31,2	19,1	26,9	SAE #2	15,7	-	63,5	.250-28	-	12,7	8,1	0,6
<b>▼ Double acting</b>																	
CYDA-15	151,9	112,3	80,1	44,5	1.000-12 UNF	31,8	12,7	22,1	1/8" NPTF	9,7	5,1	25,4	.313-24	7,9	12,7	10,4	0,5
WMT-39	95,0	83,1	76,0	-	1.375-18 UNEF	33,0	14,2	26,9	1/8" NPTF	18,5	-	52,1	.250-28	-	11,9	9,9	0,5
WMT-40	120,9	96,0	88,9	-	1.375-18 UNEF	33,0	14,2	26,9	1/8" NPTF	18,5	-	65,0	.250-28	-	11,9	9,9	0,5

# Manifold cylinders *Application & selection*

Shown: CSM-10132, CSM-572, CSM-18252



▶ 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.

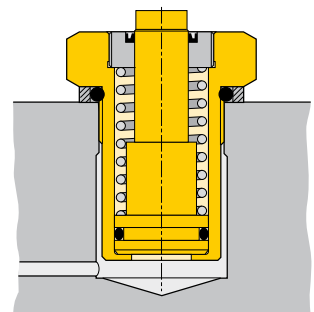


## Compact, fixture-integrated positioning and holding

- 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
- High-strength bodies and internal plunger wipers allow maintenance-free, high cycle performance
- Center-tapped plungers will hold workpiece contact buttons.

## Manifold mount

Manifold cylinders are designed to be screwed directly into a manifold or fixture. Enerpac's manifold cylinders include a steel washer and O-ring providing an effective seal between the cylinder and manifold.



## Product selection

Cylinder capacity at 350 bar	Stroke	Model number	Effective area	Oil capacity
kN	mm		cm <sup>2</sup>	cm <sup>3</sup>
1,7	7	<b>CSM-272</b>	0,5	0,4
1,7	13	<b>CSM-2132</b>	0,5	0,7
5,3	7	<b>CSM-572</b>	1,6	1,1
5,3	13	<b>CSM-5132</b>	1,6	2,0
11,3	7	<b>CSM-1072</b>	3,3	2,3
11,3	13	<b>CSM-10132</b>	3,3	4,3
11,3	19	<b>CSM-10192</b>	3,3	6,3
17,2	13	<b>CSM-18132</b>	5,1	6,6
17,2	25	<b>CSM-18252</b>	5,1	12,7
26,9	15	<b>CSM-27152</b>	7,9	11,8
26,9	25	<b>CSM-27252</b>	7,9	19,7

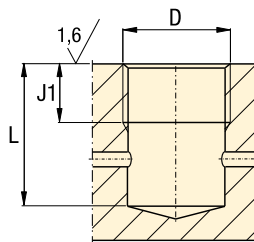
Note: - Seal material: Buna-N, Polyurethane.

**A** Installation dimensions in mm [  ]

Model number	D Thread	D2 min. $\phi$	L min.
CSM-272	M12 x 1,5	11	22
CSM-2132	M12 x 1,5	11	33
CSM-572	M20 x 1,5	13	28
CSM-5132	M20 x 1,5	13	37
CSM-1072	M28 x 1,5	16	28
CSM-10132	M28 x 1,5	16	35
CSM-10192	M28 x 1,5	16	44
CSM-18132	M36 x 1,5	19	39
CSM-18252	M36 x 1,5	19	58
CSM-27152	M42 x 1,5	19	40
CSM-27252	M42 x 1,5	19	58

Note: - O-rings included.

**Installation dimensions**



Force: 1,7 - 26,9 kN

Stroke: 7 - 25 mm

Pressure: 40 - 350 bar

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



**B** Accessory chart

Plunger Thread K	Contact Bolt
M4 x 0,7	BS-42
M6 x 1	BS-62
M8 x 1,25	BS-82

**B** Options

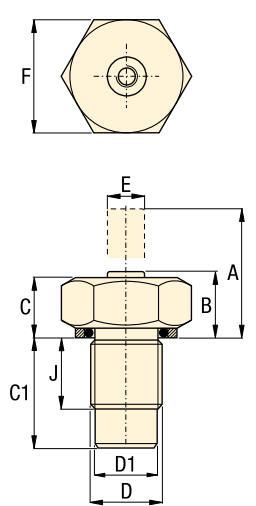
Contact bolts  86 

**!** Important

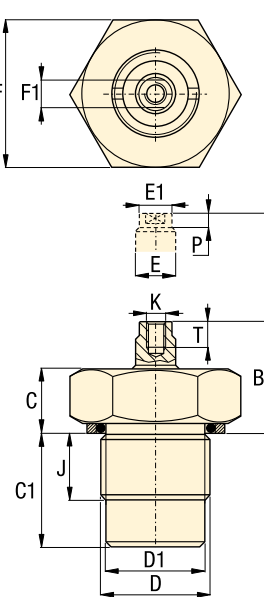
**Tighten manifold cylinders according to specifications in the instruction sheet.**

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

**CSM-272, 2132**



**other models**



**A** Product dimensions in mm [  ]

Model number	A Ext. height	B Retr. height	C	C1	D	D1	E	E1	F	F1	J	K	P	T	 kg
CSM-272	20,5	13,5	13,3	21,7	M12 x 1,5	10,1	4,8	-	19	-	11,4	-	-	-	0,1
CSM-2132	24,4	11,4	11,2	32,2	M12 x 1,5	10,1	4,8	-	19	-	11,4	-	-	-	0,1
CSM-572	23,5	16,5	12,5	27,5	M20 x 1,5	17,5	7,9	7	27	5,9	12,5	M4 x 0,7	4,0	7	0,2
CSM-5132	29,5	16,5	12,5	36,0	M20 x 1,5	17,5	7,9	7	27	5,9	12,5	M4 x 0,7	4,0	7	0,3
CSM-1072	27,3	20,3	14,8	27,1	M28 x 1,5	25,6	11,9	11	36	9,0	14,1	M6 x 1	5,5	8	0,5
CSM-10132	33,3	20,3	14,8	33,1	M28 x 1,5	25,6	11,9	11	36	9,0	14,1	M6 x 1	5,5	8	0,6
CSM-10192	39,3	20,3	14,8	48,6	M28 x 1,5	25,6	11,9	11	36	9,0	14,1	M6 x 1	5,5	8	0,7
CSM-18132	36,2	23,2	16,8	36,6	M36 x 1,5	34,2	15,9	15	46	12,0	18,1	M8 x 1,25	6,5	12	0,5
CSM-18252	48,2	23,2	16,8	56,1	M36 x 1,5	34,2	15,9	15	46	12,0	18,1	M8 x 1,25	6,5	12	0,6
CSM-27152	42,2	27,2	20,8	37,5	M42 x 1,5	39,7	17,9	17	55	15,0	16,9	M8 x 1,25	6,5	12	0,7
CSM-27252	52,8	27,8	21,3	56,0	M42 x 1,5	39,7	17,9	17	55	15,0	16,9	M8 x 1,25	6,5	12	0,9

# Block cylinders *Application & selection*

Shown: BD-18202, BMD-70502, BD-40252



## BD, BMD, BMS, BS-series

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.



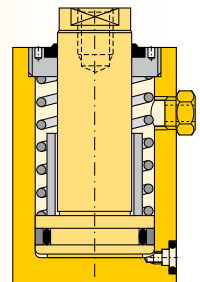
## Versatile, all purpose cylinder

- Six clamping capacities 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
- Two oil connection possibilities:
  - with BSPP threaded oil ports
  - with manifold O-ring ports
- Compact cylinder design does not require large amounts of space on your fixture
- Integral wiper ring, keeps contaminants out of cylinder to extend life
- Designed according ISO-standards.

## Select your block cylinder type:

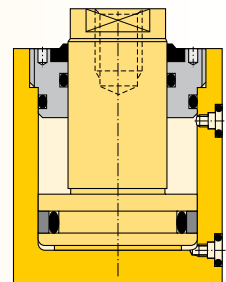
### **BMS, BS series, single-acting**

- BS series with BSPP oil port
- BMS series with manifold O-ring ports
- Internal threaded plunger
- Nickel-plated plunger
- Strong return spring
- Black oxide base
- Filtered vent plug.



### **BMD, BD series, double-acting**

- BD series with BSPP oil port
- BMS series with manifold O-ring ports
- Internal threaded plunger
- Nickel-plated plunger
- Black oxide base.



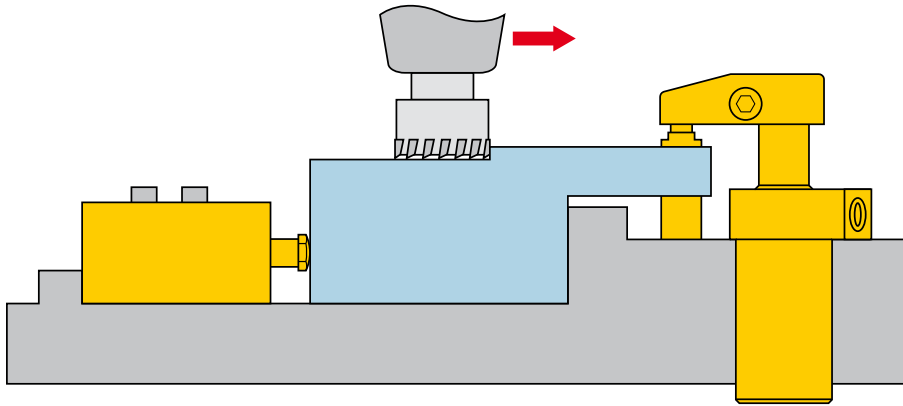


### Application example

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

#### Spherical 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.



**Force: 10,9 - 274,8 kN**

**Stroke: 8 - 56 mm**

**Pressure: 40 - 350 bar**

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



### Options

#### Contact bolts

 86 ▶




#### Fittings

 194 ▶




#### Valves

 156 ▶



### Product selection

Piston Ø	Rod Ø	Clamping force		Stroke mm	Model Nr. Manifold O-ring oil port	Model Nr. BSPB threaded oil port	Cylinder effective area		Cylinder oil capacity		Minimum spring return force N	 kg
		push kN	pull kN				push cm <sup>2</sup>	pull cm <sup>2</sup>	push cm <sup>3</sup>	pull cm <sup>3</sup>		
<b>▼ Single acting</b>												
20	12	10,9	-	8	<b>BMS-1082</b>	<b>BS-1082</b>	3,1	-	2,5	-	93	0,9
20	12	10,9	-	18	<b>BMS-10182</b>	<b>BS-10182</b>	3,1	-	5,7	-	108	1,2
25	16	17,0	-	10	<b>BMS-18102</b>	<b>BS-18102</b>	4,9	-	4,9	-	168	1,3
25	16	17,0	-	25	<b>BMS-18252</b>	<b>BS-18252</b>	4,9	-	12,3	-	157	1,8
40	25	43,6	-	12	<b>BMS-40122</b>	<b>BS-40122</b>	12,6	-	15,1	-	378	2,0
40	25	43,6	-	25	<b>BMS-40252</b>	<b>BS-40252</b>	12,6	-	31,4	-	381	2,7
50	32	68,2	-	12	<b>BMS-70122</b>	<b>BS-70122</b>	19,6	-	23,6	-	471	3,3
50	32	68,2	-	25	<b>BMS-70252</b>	<b>BS-70252</b>	19,6	-	49,1	-	425	4,4
80	50	174,9	-	20	<b>BMS-180202</b>	<b>BS-180202</b>	50,2	-	100,5	-	917	12,0
100	63	273,4	-	25	<b>BMS-280252</b>	<b>BS-280252</b>	78,5	-	196,3	-	1419	19,0
<b>▼ Double acting</b>												
20	12	11,0	7,0	16	<b>BMD-10162</b>	<b>BD-10162</b>	3,1	2,0	5,0	3,2	-	0,9
20	12	11,0	7,0	36	<b>BMD-10362</b>	<b>BD-10362</b>	3,1	2,0	11,3	7,2	-	1,2
25	16	17,2	10,1	20	<b>BMD-18202</b>	<b>BD-18202</b>	4,9	2,9	9,8	5,8	-	1,3
25	16	17,2	10,1	50	<b>BMD-18502</b>	<b>BD-18502</b>	4,9	2,9	24,5	14,8	-	1,8
40	25	44,0	26,8	25	<b>BMD-40252</b>	<b>BD-40252</b>	12,6	6,3	31,4	15,8	-	1,9
40	25	44,0	26,8	50	<b>BMD-40502</b>	<b>BD-40502</b>	12,6	6,3	62,8	31,6	-	2,6
50	32	68,7	40,6	25	<b>BMD-70252</b>	<b>BD-70252</b>	19,6	11,6	49,1	29,0	-	3,2
50	32	68,7	40,6	50	<b>BMD-70502</b>	<b>BD-70502</b>	19,6	11,6	98,2	58,0	-	4,3
80	50	175,8	107,2	25	<b>BMD-180252</b>	<b>BD-180252</b>	50,2	30,6	125,6	76,6	-	9,3
80	50	175,8	107,2	50	<b>BMD-180502</b>	<b>BD-180502</b>	50,2	30,6	251,2	153,1	-	11,5
100	63	274,8	165,7	28	<b>BMD-280282</b>	<b>BD-280282</b>	78,5	47,3	219,8	132,6	-	14,7
100	63	274,8	165,7	56	<b>BMD-280562</b>	<b>BD-280562</b>	78,5	47,3	439,6	265,1	-	18,2

# Block cylinders *Dimensions & options*

Shown: BD-18202, BMD-70502, BD-40252



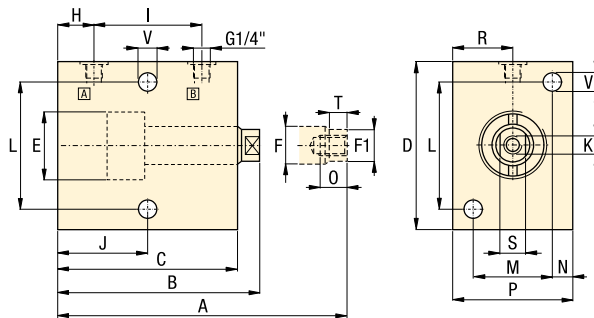
## **BD, BMD, BMS, BS-series**

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

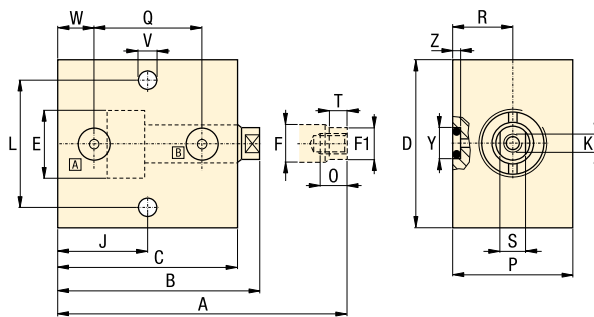
They can be used for positioning, clamping, pushing, pressing or punching operations.

The plunger has an internal thread to accommodate accessories such as contact bolts.

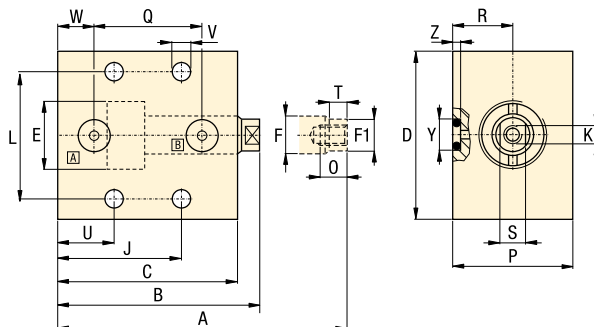
### All BS and BD models



- BMS-1082**    **BMD-10162**
- BMS-18102**   **BMD-18202**
- BMS-40122**   **BMD-40252**
- BMS-70122**   **BMD-70252**
- BMD-280282**



- BMS-10182**   **BMD-10362**
- BMS-18252**   **BMD-18502**
- BMS-40252**   **BMD-40502**
- BMS-70252**   **BMD-70502**
- BMS-180252**   **BMD-180502**
- BMS-280252**   **BMD-280562**



### **Dimensions in mm [ $\text{mm}$ ]**

Model Nr. Manifold O-ring port	Model Nr. BSPP port	A	B	C	D	E	F	F1	H	I	J
						ø	ø	ø			
<b>▼ Single acting</b>											
<b>BMS-1082</b>	<b>BS-1082</b>	70	62	54,5	60	20	12	11	12,0	25	24,5
<b>BMS-10182</b>	<b>BS-10182</b>	100	82	74,5	60	20	12	11	12,0	45	44,5
<b>BMS-18102</b>	<b>BS-18102</b>	80	70	62,0	65	25	16	15	12,0	30	27,0
<b>BMS-18252</b>	<b>BS-18252</b>	125	100	92,0	65	25	16	15	12,0	60	57,0
<b>BMS-40122</b>	<b>BS-40122</b>	92	80	68,0	80	40	25	24	12,0	35	32,0
<b>BMS-40252</b>	<b>BS-40252</b>	130	105	93,0	80	40	25	24	12,0	60	57,0
<b>BMS-70122</b>	<b>BS-70122</b>	102	90	76,0	100	50	32	31	14,0	40	36,0
<b>BMS-70252</b>	<b>BS-70252</b>	140	115	101,0	100	50	32	31	14,0	65	61,0
<b>BMS-180202</b>	<b>BS-180202</b>	151	131	114,0	140	80	50	49	15,5	70	66,5
<b>BMS-280252</b>	<b>BS-280252</b>	177	152	132,5	170	100	63	62	18,0	80	77,5
<b>▼ Double acting</b>											
<b>BMD-10162</b>	<b>BD-10162</b>	78	62	54,5	60	20	12	11	12,0	25	24,5
<b>BMD-10362</b>	<b>BD-10362</b>	118	82	74,5	60	20	12	11	12,0	45	44,5
<b>BMD-18202</b>	<b>BD-18202</b>	90	70	62,0	65	25	16	15	12,0	30	27,0
<b>BMD-18502</b>	<b>BD-18502</b>	150	100	92,0	65	25	16	15	12,0	60	57,0
<b>BMD-40252</b>	<b>BD-40252</b>	105	80	68,0	80	40	25	24	12,0	35	32,0
<b>BMD-40502</b>	<b>BD-40502</b>	155	105	93,0	80	40	25	24	12,0	60	57,0
<b>BMD-70252</b>	<b>BD-70252</b>	115	90	76,0	100	50	32	31	14,0	40	36,0
<b>BMD-70502</b>	<b>BD-70502</b>	165	115	101,0	100	50	32	31	14,0	65	61,0
<b>BMD-180252</b>	<b>BD-180252</b>	131	106	89,0	140	80	50	49	15,5	45	41,5
<b>BMD-180502</b>	<b>BD-180502</b>	181	131	114,0	140	80	50	49	15,5	70	66,5
<b>BMD-280282</b>	<b>BD-280282</b>	152	124	104,5	170	100	63	62	18,0	52	49,5
<b>BMD-280562</b>	<b>BD-280562</b>	208	152	132,5	170	100	63	62	18,0	80	77,5

■ *Block cylinder used for punching applications.*

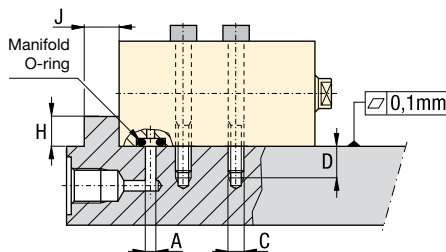


## i Installation instructions

When operating above 140 bar 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 1,6 microns



### 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 mm [ ]

Clamping force at 350 bar	Oil channel diameter	Mounting thread	Minimum thread length	Torque (bolt type 12.9 DIN 912)	Minimum support dimensions		Manifold O-ring	
kN	A	C	D	Nm	H	J	Di x W	Partnumber
11	ø 4	M6	11	17	5	7	4,34 x 3,53	CZ392.041
17	ø 4	M8	13	40	5	8	4,34 x 3,53	CZ392.041
44	ø 4	M10	16	85	5	10	4,34 x 3,53	CZ392.041
68	ø 4	M12	19	145	5	13	4,34 x 3,53	CZ392.041
175	ø 6	M16	24	353	10	16	7,52 x 3,53	CZ935.041
275	ø 6	M20	30	675	10	21	7,52 x 3,53	CZ935.041

<sup>1)</sup> Manifold O-rings included

**Force: 10,9 - 274,8 kN**

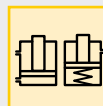
**Stroke: 16 - 56 mm**

**Pressure: 40 - 350 bar**

**E Cilindros tipo bloque**

**F Vérins cube**

**D Blockzylinder**



**⚠ Important**

**Linear cylinder support is required at operating pressures above 140 bar. Follow the instructions on this page.**

## B Accessory chart

Plunger Thread K	Contact Bolt 86 ▶
M6 x 1	<b>BS-62</b>
M8 x 1,25	<b>BS-82</b>
M16 x 2	<b>BS-16</b>
M20 x 2,5	<b>BS-20</b>
M30 x 3,5	<b>BS-30</b>
M36 x 4	<b>BS-36</b>

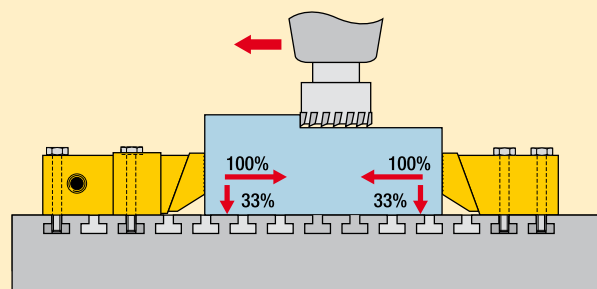
	K	L	M	N	O	P	Q	R	S	T	U	V	W	Y	Z	Model Nr. Manifold O-ring	Model Nr. BSPP port	
																ø	ø	
<b>Single acting ▼</b>																		
M6	45	25	7,5	10	40	25,0	20,0	9	5,5	-	7,0	12,0	11,0 - 11,1	2,8 - 2,9	<b>BMS-1082</b>	<b>BS-1082</b>		
M6	45	25	7,5	10	40	45,0	20,0	9	5,5	24,5	7,0	12,0	11,0 - 11,1	2,8 - 2,9	<b>BMS-10182</b>	<b>BS-10182</b>		
M8	50	30	7,5	12	45	30,0	22,5	13	6,0	-	9,0	12,0	11,0 - 11,1	2,8 - 2,9	<b>BMS-18102</b>	<b>BS-18102</b>		
M8	50	30	7,5	12	45	60,0	22,5	13	6,0	27,0	9,0	12,0	11,0 - 11,1	2,8 - 2,9	<b>BMS-18252</b>	<b>BS-18252</b>		
M16	60	35	10,0	25	55	37,5	27,5	22	9,5	-	11,0	9,5	11,0 - 11,1	2,8 - 2,9	<b>BMS-40122</b>	<b>BS-40122</b>		
M16	60	35	10,0	25	55	62,5	27,5	22	9,5	27,0	11,0	9,5	11,0 - 11,1	2,8 - 2,9	<b>BMS-40252</b>	<b>BS-40252</b>		
M20	80	45	10,0	30	65	40,0	32,5	27	11,0	-	12,5	12,5	11,0 - 11,1	2,8 - 2,9	<b>BMS-70122</b>	<b>BS-70122</b>		
M20	80	45	10,0	30	65	65,0	32,5	27	11,0	26,0	12,5	12,5	11,0 - 11,1	2,8 - 2,9	<b>BMS-70252</b>	<b>BS-70252</b>		
M30	110	80	15,0	45	110	70,0	55,0	41	14,5	26,5	17,0	15,5	14,1 - 14,2	2,8 - 2,9	<b>BMS-180202</b>	<b>BS-180202</b>		
M36	135	90	17,5	50	125	80,0	62,5	50	17,0	37,5	21,0	18,0	14,1 - 14,2	2,8 - 2,9	<b>BMS-280252</b>	<b>BS-280252</b>		
<b>Double acting ▼</b>																		
M6	45	25	7,5	10	40	25,0	20,0	9	5,5	-	7,0	12,0	11,0 - 11,1	2,8 - 2,9	<b>BMD-10162</b>	<b>BD-10162</b>		
M6	45	25	7,5	10	40	45,0	20,0	9	5,5	24,5	7,0	12,0	11,0 - 11,1	2,8 - 2,9	<b>BMD-10362</b>	<b>BD-10362</b>		
M8	50	30	7,5	12	45	30,0	22,5	13	6,0	-	9,0	12,0	11,0 - 11,1	2,8 - 2,9	<b>BMD-18202</b>	<b>BD-18202</b>		
M8	50	30	7,5	12	45	60,0	22,5	13	6,0	27,0	9,0	12,0	11,0 - 11,1	2,8 - 2,9	<b>BMD-18502</b>	<b>BD-18502</b>		
M16	60	35	10,0	25	55	37,5	27,5	22	9,5	-	11,0	9,5	11,0 - 11,1	2,8 - 2,9	<b>BMD-40252</b>	<b>BD-40252</b>		
M16	60	35	10,0	25	55	62,5	27,5	22	9,5	27,0	11,0	9,5	11,0 - 11,1	2,8 - 2,9	<b>BMD-40502</b>	<b>BD-40502</b>		
M20	80	45	10,0	30	65	40,0	32,5	27	11,0	-	12,5	12,5	11,0 - 11,1	2,8 - 2,9	<b>BMD-70252</b>	<b>BD-70252</b>		
M20	80	45	10,0	30	65	65,0	32,5	27	11,0	26,0	12,5	12,5	11,0 - 11,1	2,8 - 2,9	<b>BMD-70502</b>	<b>BD-70502</b>		
M30	110	80	15,0	45	110	45,0	55,0	41	14,5	-	17,0	15,5	14,1 - 14,2	2,8 - 2,9	<b>BMD-18052</b>	<b>BD-18052</b>		
M30	110	80	15,0	45	110	70,0	55,0	41	14,5	26,5	17,0	15,5	14,1 - 14,2	2,8 - 2,9	<b>BMD-180502</b>	<b>BD-180502</b>		
M36	135	90	17,5	50	125	52,0	62,5	50	17,0	-	21,0	18,0	14,1 - 14,2	2,8 - 2,9	<b>BMD-280282</b>	<b>BD-280282</b>		
M36	135	90	17,5	50	125	80,0	62,5	50	17,0	37,5	21,0	18,0	14,1 - 14,2	2,8 - 2,9	<b>BMD-280562</b>	<b>BD-280562</b>		

# Pull down clamps *Application & selection*

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



► 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.

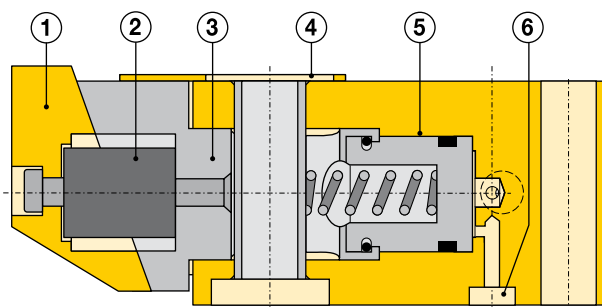


## Low profile clamp

..... 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.

## Product selection

Lateral clamping force at 350 bar	Pull down force at 350 bar	Stroke	Model number	Effective area	Oil capacity	Mounting bolts <sup>1)</sup> (included)
kN	kN	mm		cm <sup>2</sup>	cm <sup>3</sup>	

### ▼ Hydraulic pull down clamps

3,9	1,3	5,1	<b>ECH-52</b>	1,16	0,13	M8 x 45
17,4	5,8	7,9	<b>ECH-202</b>	5,03	1,07	M12 x 80

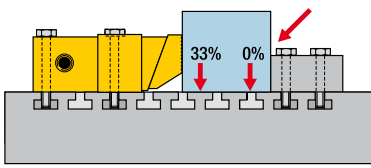
Holding force	For pull down clamp model number	Model number	Mounting bolts included <sup>1)</sup> number	Replaceable ribbed jaws model
kN				

### ▼ Mechanical counter holds

3,9	ECH-52	<b>ECM-5</b>	M8 x 35	ECJR-5
17,4	ECH-202	<b>ECM-20</b>	M12 x 65	ECJR-20

<sup>1)</sup> Torque M8 with 24,4 Nm, M12 with 85,4 Nm.  
The use of T-nuts requires longer bolts.

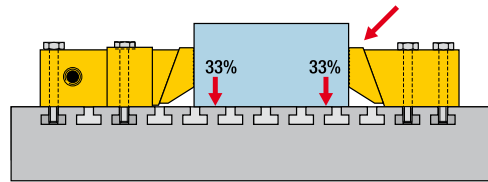
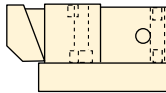
**i Pull down force**



**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.

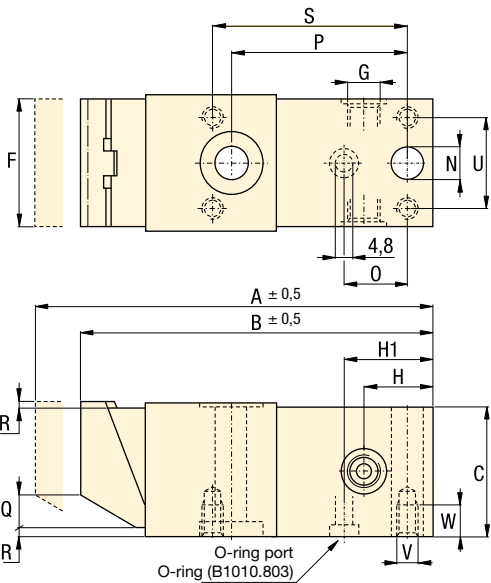
The mounting surface must extend out under the jaw.



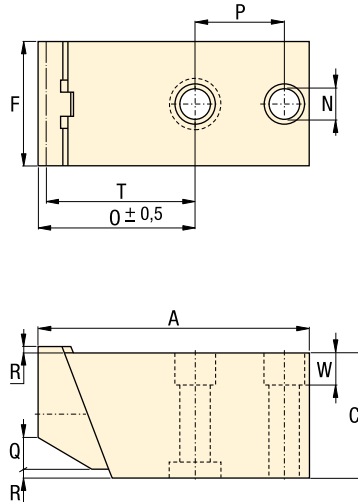
**Counter hold set-up**

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

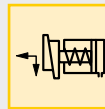


Force: 3,9 - 17,4 kN

Stroke: 5,1 - 7,9 mm

Pressure: 15 - 350 bar

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



**Options**

**Fittings**

194



**Threaded cylinders**

66



**Positive clamping cylinders**

80



**! Important**

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

**Product dimensions in mm [  $\pm$  ]**

Model number	A	B	C	F	G	H	H1	N	O	P	Q	R	S	T	U	V	W	kg
<b>▼ Hydraulic pull down clamps</b>																		
ECH-52	105,2	100,1	30,0	30,0	G1/8"	19,1	18,8	8,4	11,7	53,1	3,0	2,0	58,9	-	22,1	M5 x 0,8	6,1	0,7
ECH-202	142,7	134,9	50,0	50,0	G1/4"	24,9	23,6	12,4	13,7	67,1	14,0	3,0	73,9	-	36,1	M8 x 1,25	11,9	2,5
<b>▼ Mechanical counter holds</b>																		
ECM-5	79,0	-	30,0	30,0	-	-	-	8,4	41,9	25,9	3,0	2,0	-	40,9	-	-	7,9	0,6
ECM-20	102,1	-	50,0	50,0	-	-	-	12,4	59,9	30,0	14,0	3,0	-	58,9	-	-	13,0	1,9

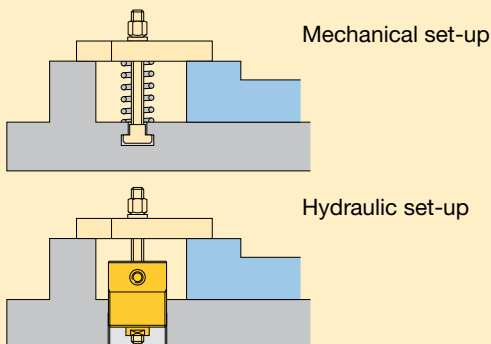


# Hollow plunger cylinders *Application & selection*

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

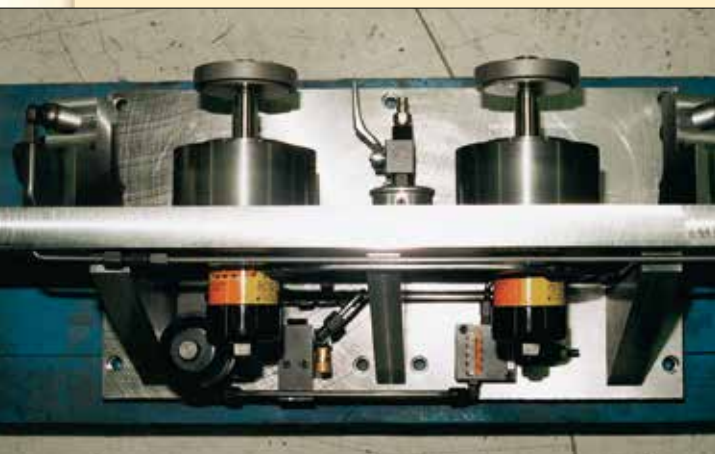


▶ These cylinders are regularly used for upgrading mechanical clamping to faster and easier hydraulic clamping. Other typical applications include production pressing, punching and crimping operations.



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.



## For high force push and 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

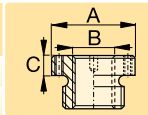
Cylinder capacity <sup>1)</sup>	Stroke	Center hole diameter	Model number	Effective area	Oil capacity	Operating pressure
kN	mm	mm		cm <sup>2</sup>	cm <sup>3</sup>	bar
11,6	6,4	9,9	<b>CY1254-25</b>	5,61	3,61	210
17,8	8,4	13,5	<b>MRH-20</b>	8,58	6,72	210
17,8	8,4	13,5	<b>RWH-20</b>	8,58	6,72	210
17,8	8,4	13,5	<b>RWH-20T</b>	8,58	6,72	210
21,5	10,2	10,7	<b>HCS-20*</b>	6,19	6,23	350
33,0	7,9	19,6	<b>CY2129-25</b>	15,94	12,62	210
33,0	16,0	19,6	<b>CY2129-5</b>	15,94	25,56	210
56,3	12,1	13,0	<b>HCS-50*</b>	16,26	19,50	350
59,3	16,0	22,6	<b>CY2754-5</b>	28,65	45,88	210
61,4	8,1	19,6	<b>MRH-120</b>	17,81	14,09	350
61,4	8,1	19,6	<b>QDH-120</b>	17,81	14,09	350
61,4	8,1	19,6	<b>RWH-120</b>	17,81	14,09	350
61,4	25,9	19,6	<b>RWH-121</b>	17,81	45,23	350
83,7	14,2	17,0	<b>HCS-80*</b>	23,42	32,61	350
104,6	13,2	26,9	<b>RWH-200</b>	30,58	38,84	350
104,6	51,3	26,9	<b>RWH-202</b>	30,58	155,35	350
113,4	16,0	21,0	<b>HCS-110*</b>	32,65	52,27	350
160,2	12,7	33,3	<b>RWH-300</b>	46,58	58,99	350
160,2	25,4	33,3	<b>RWH-301</b>	46,58	118,31	350
160,2	63,2	33,3	<b>RWH-302</b>	46,58	294,97	350

<sup>1)</sup> At maximum operating pressure. **Note:** Seal material Buna-N, Polyurethane, Teflon.

\* This product is made to order. Please contact Enerpac for delivery information before specifying in your design.

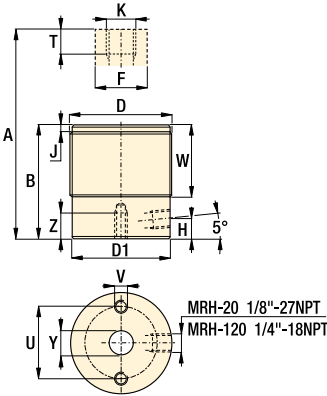
**Optional Heat Treated Hollow Saddles**

Saddle type	Cylinder model number	Saddle model No.	Saddle Dimensions (mm)		
			A	B	C
Threaded hollow	RWH-200, 202	HP-2015	53,6	1"-8	9,7
	RWH-300, 301, 302	HP-3015	63,3	1¼"-7	9,7

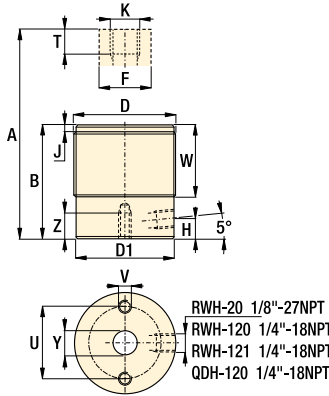


Smooth hollow saddles are standard on all RWH-20 and 30-models (RWH-12 models are not equipped with saddles).

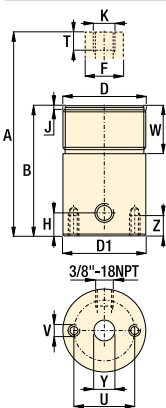
**MRH-20, 120**



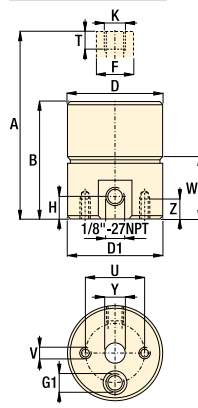
**RWH-20, 120, 121, QDH-20**



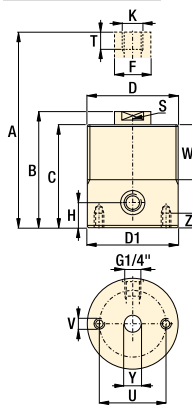
**other RWH model**



**CY models**

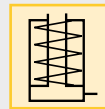


**HCS models**



- Force: 11,6 - 160,2 kN**
- Stroke: 6,4 - 63,2 mm**
- Pressure: 55 - 350 bar**

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



**Options**

**Flange nuts**

86 ▶

**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 700 bar maximum working pressure (except RWH-20 and RWH120).**

**Product dimensions in mm [  $\text{mm}$  ]**

Model nr.	A	B	C	D	D1	F	H	J	K	S	T	U	V	W	Y	Z	
				ø	ø							ø					kg
<b>CY1254-25</b>	57,2	50,8	-	ø 44,5	44,5	14,2	7,4	-	.375-16 UNC	-	15,7	31,8	.250-20 UNC	24,6	ø 9,9	9,7	0,5
<b>MRH-20</b>	60,8	52,3	-	M48 x 1,5	45,0	25,3	7,1	3,0	ø 13,5	-	22,4	35,1	M6 x 1	38,1	ø 12,7	6,4	0,6
<b>RWH-20</b>	60,7	52,3	-	1.875-16 UN	45,5	25,4	7,1	3,0	ø 13,5	-	22,1	35,1	.250-20 UNC	38,1	.500-20 UNF	6,35	1,4
<b>RWH-20T</b>	60,7	52,3	-	1.875-16 UN	45,5	25,4	7,1	3,0	.500-20 UNF	-	12,4	35,1	.250-20 UNC	38,1	ø 13,5	6,4	1,4
<b>HCS-20*</b>	84,3	74,4	66,0	M58 x 1,5	58,0	18,0	11,0	-	M10 x 1,5	14,0	25,8	40,0	M6 x 1	40,0	ø 10,7	10,0	1,1
<b>CY2129-25<sup>1)</sup></b>	58,7	50,8	-	ø 66,8	63,5	28,7	7,9	-	.750-10 UNC	-	28,7	44,5	.375-16 UNC	20,3	ø 19,6	8,6	1,1
<b>CY2129-5<sup>1)</sup></b>	85,3	69,3	-	ø 66,8	63,5	28,7	7,9	-	.750-10 UNC	-	28,7	44,5	.375-16 UNC	39,1	ø 19,6	11,2	1,4
<b>HCS-50*</b>	96,5	84,4	75,0	M65 x 1,5	65,0	28,0	14,0	-	M12 x 1,75	22,0	24,2	45,0	M8 x 1,25	45,0	ø 13,0	12,0	1,5
<b>CY2754-5<sup>1)</sup></b>	92,2	76,2	-	ø 88,9	79,5	31,8	11,2	-	.875-9 UNC	-	31,8	53,8	.375-16 UNC	40,9	ø 22,6	11,2	2,7
<b>MRH-120</b>	64,5	56,0	-	M70 x 1,5	70,0	35,0	10,0	4,8	M18 x 1,5	-	15,2	50,0	M8 x 1,25	30,2	ø 17,3	6,1	1,4
<b>QDH-120</b>	64,5	56,4	-	2.750-16 UN	69,9	35,1	9,9	4,8	.750-10 UNC	-	15,7	50,8	.312-18 UNC	30,2	ø 17,3	6,4	1,4
<b>RWH-120</b>	64,5	56,4	-	2.750-16 UN	69,9	35,1	9,9	4,8	.750-16 UNF	-	15,5	50,8	.312-18 UNC	30,2	ø 17,3	6,4	1,4
<b>RWH-121</b>	107,7	81,8	-	2.750-16 UN	69,9	35,1	13,5	4,8	.750-16 UNF	-	18,5	50,8	.312-18 UNC	30,2	ø 17,3	6,4	2,2
<b>HCS-80*</b>	109,4	95,2	85,0	M75 x 1,5	75,0	32,0	17,0	-	M16 x 2	24,0	32,2	55,0	M8 x 1,25	50,0	ø 17,0	12,0	2,3
<b>RWH-200</b>	136,9	124,0	-	3.875-12 UN	98,6	53,8	19,1	4,8	1.562-16 UN	-	22,4	82,6	.375-16 UNC	38,1	ø 26,9	9,7	6,2
<b>RWH-202</b>	213,1	161,8	-	3.875-12 UN	98,6	53,8	19,1	4,8	1.562-16 UN	-	22,4	82,6	.375-16 UNC	38,1	ø 26,9	9,7	7,7
<b>HCS-110*</b>	120,4	104,4	93,0	M90 x 2	90,0	40,0	19,0	-	M20 x 2,5	32,0	36,7	65,0	M10 x 1,5	60,0	ø 21,0	15,0	3,6
<b>RWH-300</b>	140,2	127,5	-	4.500-12 UN	114,0	64,5	21,6	4,8	1.812-16 UN	-	22,4	91,9	.375-16 UNC	42,2	ø 33,3	15,7	8,6
<b>RWH-301</b>	165,6	140,2	-	4.500-12 UN	114,0	64,5	21,6	4,8	1.812-16 UN	-	22,4	91,9	.375-16 UNC	42,2	ø 33,3	15,7	9,8
<b>RWH-302</b>	241,8	178,6	-	4.500-12 UN	114,0	64,5	21,6	4,8	1.812-16 UN	-	22,4	91,9	.375-16 UNC	42,2	ø 33,3	15,7	10,9

<sup>1)</sup> For these models G1 = manifold and 1/8-27 NPTF

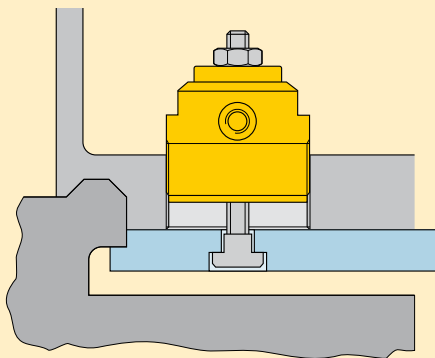
# Positive clamping cylinder *Application & selection*

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



▶ 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.

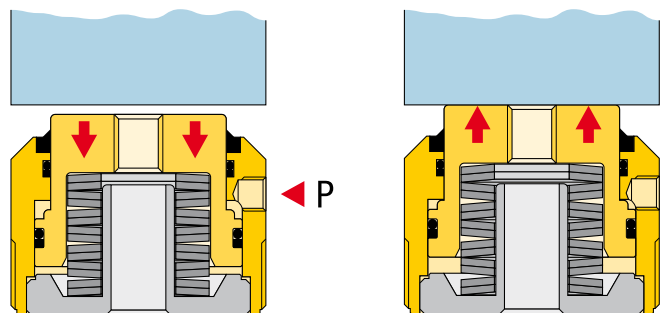
## Ideal for palletized applications

- 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.

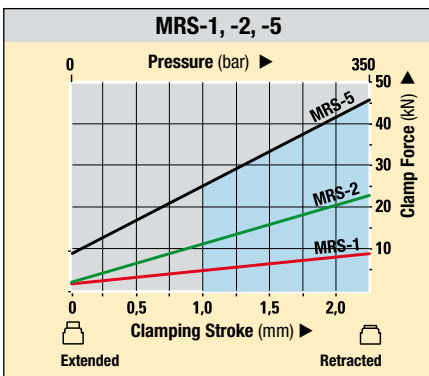
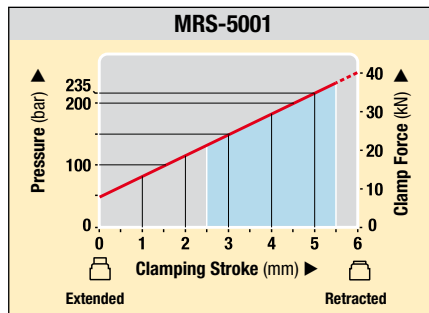
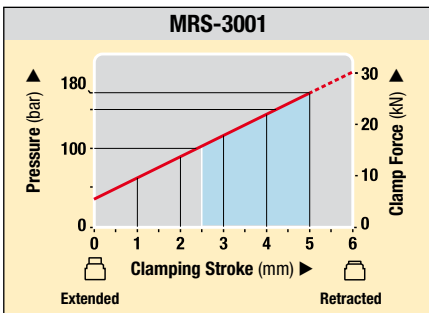
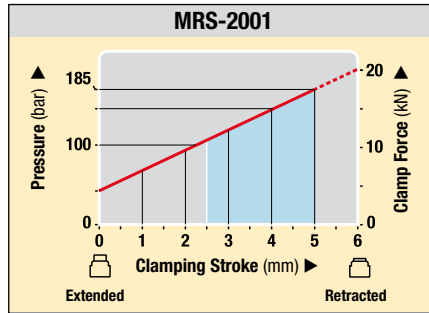
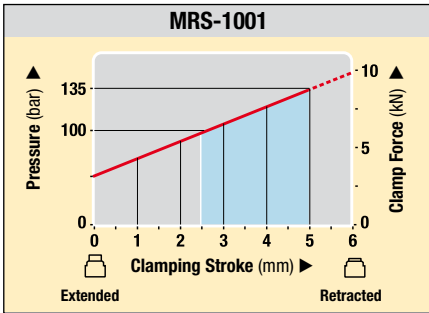
## Product selection

Cylinder capacity at 350 bar	Effective clamping stroke	Model number	Required operating pressure <sup>1)</sup>	Max. tensioning stroke	Oil capacity
kN	mm		bar	mm	cm <sup>3</sup>
12,0	2,3	<b>MRS-1</b>	350	2,3	8,36
26,7	2,3	<b>MRS-2</b>	350	2,3	4,26
51,2	2,3	<b>MRS-5</b>	350	2,3	8,19
8,5	2,5	<b>MRS-1001</b>	140	5,1	8,85
16,5	2,5	<b>MRS-2001</b>	185	5,1	11,96
25,8	2,5	<b>MRS-3001</b>	180	5,1	19,99
37,8	3,0	<b>MRS-5001</b>	235	5,6	22,12

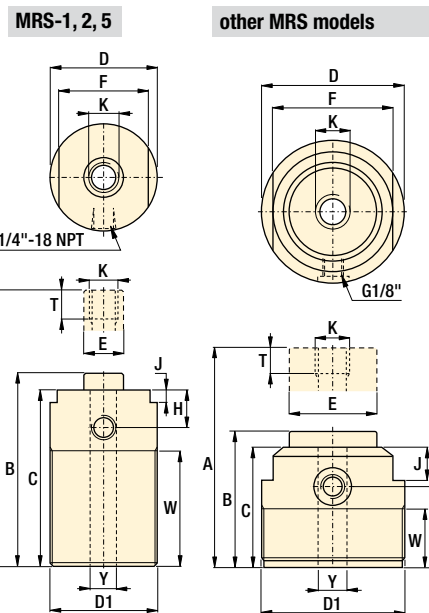
<sup>1)</sup> Minimum operating pressure to fully retract the plunger.

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

**1** Pressure/Stroke/Force diagrams



= Suggested Clamping Range



- Force:** 8,5 - 51,2 kN
- Stroke:** 2,3 - 5,6 mm
- Pressure:** 140 - 350 bar

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



**Options**

**Contact bolts** [86](#)

**Flange nuts** [86](#)

**Collet-Lok® work supports** [16](#)

**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.

**Product dimensions** in mm [ ]

Model number	A	B	C	D	D1	E	F	H	J	K	T	W	Y	kg
MRS-1	85,1	82,8	79,0	36,1	M36 x 1,5	12,7	30,0	18,0	6,1	M8 x 1,25	36,1	50,0	8,9	0,5
MRS-2	89,9	87,9	84,1	48,0	M48 x 1,5	17,3	39,9	20,1	7,1	M10 x 1,5	38,1	50,0	10,9	0,9
MRS-5	125,0	122,7	119,1	59,9	M60 x 2	22,1	50,0	21,1	7,1	M16 x 2	39,9	85,1	17,0	1,8
MRS-1001	62,0	56,9	53,1	65,0	M65 x 1,5	39,9	55,1	35,1	15,0	M12 x 1,75	20,1	24,9	13,0	1,2
MRS-2001	65,0	59,9	56,9	80,0	M80 x 2	54,9	65,0	38,1	15,0	M 16 x 2	20,1	29,0	17,0	2,1
MRS-3001	73,9	69,1	66,0	95,0	M95 x 2	59,9	80,0	46,0	17,0	M20 x 2,5	20,1	37,1	21,1	3,0
MRS-5001	96,0	65,0	67,6	95,0	M95 x 2	59,9	80,0	46,0	17,0	M20 x 2,5	20,1	37,1	21,1	3,5



# Universal cylinders - Single acting *Application & selection*

Shown: RW-50, BRW-104

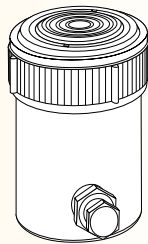


► Used when high cylinder forces or long strokes are required in a confined area. Can handle a wide range of production tooling applications.

## **i** Block and cylindrical models

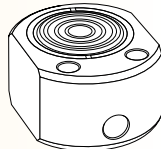
### Cylindrical models

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



### Block models

- Easily mounted
- Compact design



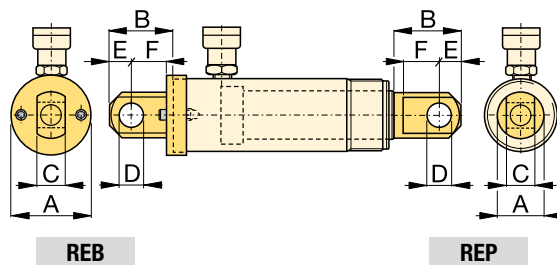
■ Enerpac RW-101 cylinders used in a high pressure toggle style clamping set-up.



## 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.



Type	Model number	Clevis eye dimensions (mm)						Pin to pin* mm
		A	B	C	D	E	F	
Base <sup>1)</sup>	REB-5	44,5	47,8	14,2	16,0	16,0	25,4	60,2
	REB-10	63,5	66,8	25,4	22,3	25,4	35,1	78,0
Plunger	REP-5	28,7	41,2	14,2	16,0	16,0	19,1	—
	REP-10	42,9	50,8	25,4	22,3	25,4	28,7	—

\* Pin to Pin- REB and REP Clevises fitted. Add cylinder stroke length.

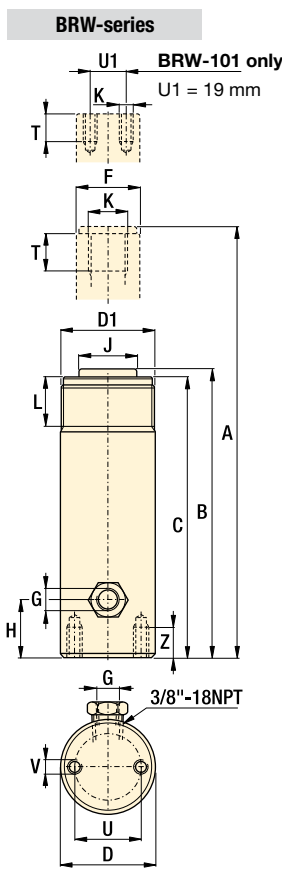
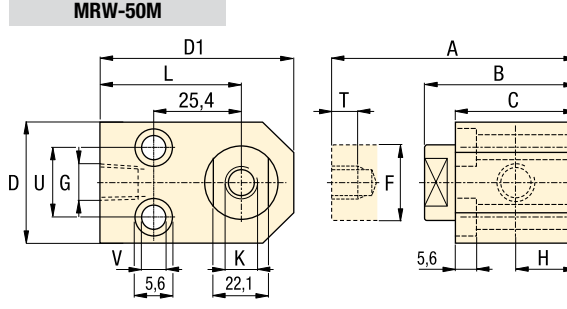
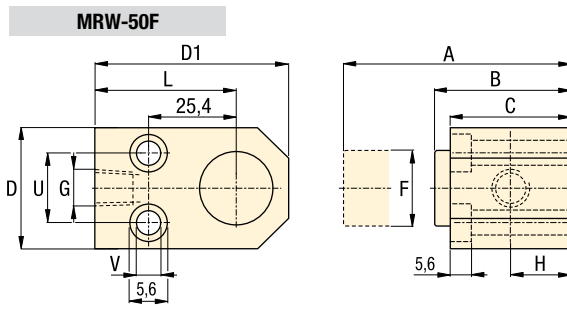
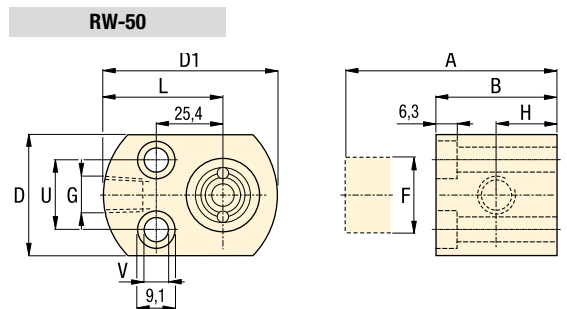
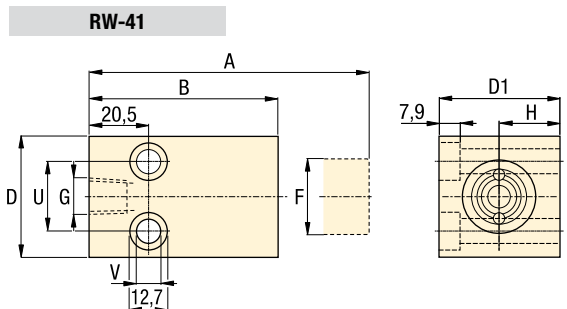
<sup>1)</sup> Mounting screws are included.

## **globe** Product selection

Cylinder capacity at 350 bar	Stroke	Model number	Effective area	Oil capacity	Operating pressure
kN	mm		cm <sup>2</sup>	cm <sup>3</sup>	bar
<b>▼ Block models</b>					
22,1	15,7	<b>RW-41</b>	6,39	10,16	6-550
22,1	15,7	<b>RW-50</b>	6,39	10,16	40-700
22,1	15,0	<b>MRW-50F</b>	6,39	10,16	6-550
22,1	15,0	<b>MRW-50M</b>	6,39	10,16	6-550
<b>▼ Cylindrical models</b>					
22,1	25,7	<b>BRW-51</b>	6,39	16,22	40-700
22,1	80,5	<b>BRW-53</b>	6,39	48,67	40-700
22,1	131,3	<b>BRW-55</b>	6,39	81,12	40-700
50,6	25,1	<b>BRW-101</b>	14,39	36,54	40-700
50,6	55,4	<b>BRW-102</b>	14,39	77,84	40-700
50,6	106,2	<b>BRW-104</b>	14,39	150,92	40-700
50,6	155,2	<b>BRW-106</b>	14,39	224,01	40-700
50,6	257,3	<b>BRW-1010</b>	14,39	370,18	40-700

Note: Seal material Buna-N, Polyurethan.





Force: 22,1 - 50,6 kN

Stroke: 15,0 - 257,3 mm

Pressure: 40 - 350 bar

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



**Options**

Cylinder accessories 86 ▶

**Important**

These cylinders are intended for medium cycle applications. The return spring is intended for retracting the plunger for 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 mm [ ]

Model number	A	B	C	D	D1	F	G	H	J	K	L	T	U	V	Z	kg	
							NPTF										
<b>▼ Block models</b>																	
<b>RW-41</b>	80,8	65,0	-	41,1	41,1	25,4	1/4 -18	20,6	-	-	-	-	25,4	8,9	-	0,8	
<b>RW-50</b>	56,9	41,4	-	41,1	58,9	25,4	3/8 -18	19,1	-	-	38,1	-	28,4	5,6	-	0,8	
<b>MRW-50F</b>	55,9	40,9	40,9	41,1	65,0	25,4	3/8 -18	20,6	-	-	44,5	-	28,4	5,6	-	0,8	
<b>MRW-50M</b>	66,0	51,1	40,9	41,1	65,0	25,4	3/8 -18	20,6	-	M8 x 1,25	44,5	6,1	28,4	5,6	-	0,8	
<b>▼ Cylindrical models</b>																	
<b>BRW-51</b>	137,7	112,0	103,9	38,1	M38 x 1,5	25,4	1/4 -18	19,1	25,4	M18 x 2,5	30,0	15,5	25,4	M6 x 1	14,0	1,0	
<b>BRW-53</b>	247,1	166,6	158,8	38,1	M38 x 1,5	25,4	1/4 -18	19,1	25,4	M18 x 2,5	30,0	15,5	25,4	M6 x 1	14,0	1,4	
<b>BRW-55</b>	349,0	217,7	209,6	38,1	M38 x 1,5	25,4	1/4 -18	19,1	25,4	M18 x 2,5	30,0	15,5	25,4	M6 x 1	14,0	1,8	
<b>BRW-101</b>	115,1	89,9	86,6	57,2	M56 x 2	38,1	1/4 -18	19,1	-	M5 x 0,8	29,2	6,1	39,6	M8 x 1,25	12,4	1,7	
<b>BRW-102</b>	177,0	121,7	115,1	57,2	M56 x 2	38,1	1/4 -18	19,1	35,1	M22 x 1,5	29,2	17,3	39,6	M8 x 1,25	12,4	2,2	
<b>BRW-104</b>	278,6	172,5	165,9	57,2	M56 x 2	38,1	1/4 -18	19,1	35,1	M22 x 1,5	29,2	17,3	39,6	M8 x 1,25	12,4	3,2	
<b>BRW-106</b>	401,8	246,6	241,3	57,2	M56 x 2	38,1	1/4 -18	19,1	35,1	M22 x 1,5	29,2	17,3	39,6	M8 x 1,25	12,4	4,4	
<b>BRW-1010</b>	606,6	349,3	342,9	57,2	M56 x 2	38,1	1/4 -18	19,1	35,1	M22 x 1,5	28,7	19,1	39,6	M8 x 1,25	12,7	6,3	

# Universal cylinders - Double acting *Application & selection*

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



▶ 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 BRD 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

## **i** 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. Mounting screws not included.



### Flange mounting

Mounts onto cylinder collar thread. Retainer nut included. Mounting screws not included.



### Retainer nut

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

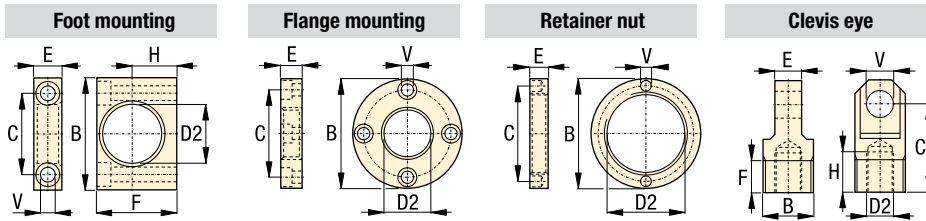


### Clevis eye

Threads onto plunger or base.

## **globe** Product selection

Cylinder capacity at 350 bar		Stroke mm	Model number	Effective area		Oil capacity	
push kN	pull kN			push cm <sup>2</sup>	pull cm <sup>2</sup>	push cm <sup>3</sup>	pull cm <sup>3</sup>
17,4	7,7	28,2	<b>BRD-41</b>	5,10	2,19	14,58	6,55
17,4	7,7	78,9	<b>BRD-43</b>	5,10	2,19	40,48	18,03
17,4	7,7	155,2	<b>BRD-46</b>	5,10	2,19	79,31	34,41
40,0	21,8	31,6	<b>BRD-93</b>	11,42	6,32	32,77	18,03
40,0	21,8	82,3	<b>BRD-93</b>	11,42	6,32	90,78	49,16
40,0	21,8	158,0	<b>BRD-96</b>	11,42	6,32	178,29	98,32
40,0	21,8	260,2	<b>BRD-910</b>	11,42	6,32	293,98	162,23
69,0	36,9	157,2	<b>BRD-166</b>	20,32	10,71	322,33	170,42
69,0	36,9	258,8	<b>BRD-1610</b>	20,32	10,71	528,64	278,58
109,0	47,8	159,7	<b>BRD-256</b>	31,74	13,87	503,57	219,59
109,0	47,8	261,1	<b>BRD-2510</b>	31,74	13,87	825,90	360,51



- Force: 17,4 - 109 kN
- Stroke: 28,2 - 261,1 mm
- Pressure: 35 - 700 bar

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



**Cylinder attachments** in mm [ ]

Cylinder capacity at 350 bar kN	Cylinder capacity at 700 bar kN	D2	Model number	B	C	E	F	H	V		kg
17,4	34,8	42,1	<b>BAD-141</b>	80,0	58,0	20,0	57,0	31,8	10,5	0,4	
40,0	80,0	56,1	<b>BAD-171</b>	105,0	78,0	25,0	82,5	44,5	13,5	1,2	
69,0	138,0	70,1	<b>BAD-181</b>	127,0	95,2	35,0	100,0	52,4	20,0	2,9	
109,0	218,0	85,1	<b>BAD-191</b>	159,0	117,5	45,0	125,0	63,5	26,5	4,5	
<b>▼ Flange mounting with retainer nut</b>											
17,4	34,8	42,1	<b>BAD-142</b>	98,4	78,6	19,0	-	-	11,0	1,0	
40,0	80,0	56,1	<b>BAD-172</b>	120,5	98,4	25,4	-	-	11,0	2,1	
69,0	138,0	70,1	<b>BAD-182</b>	143,0	115,9	35,0	-	-	14,0	3,8	
109,0	218,0	85,1	<b>BAD-192</b>	165,0	135,7	44,5	-	-	17,0	6,0	
<b>▼ Retainer nut</b>											
17,4	34,8	M42 x 1,5	<b>BAD-143</b>	57,0	49,5	9,5	-	-	6,3	0,1	
40,0	80,0	M56 x 2	<b>BAD-173</b>	75,0	63,5	12,7	-	-	6,7	0,3	
69,0	138,0	M70 x 2	<b>BAD-183</b>	92,0	79,4	19,0	-	-	6,7	0,6	
109,0	218,0	M85 x 2	<b>BAD-193</b>	108,0	95,2	25,4	-	-	6,7	0,8	
<b>▼ Clevis eye</b>											
17,4	34,8	M16 x 1,5	<b>BAD-150</b>	M30 x 1,5	52,4	15,9	19,1	23,8	16,0	0,2	
40,0	80,0	M22 x 1,5	<b>BAD-151</b>	M42 x 1,5	57,1	25,4	25,4	23,8	20,0	0,6	
69,0	138,0	M30 x 1,5	<b>BAD-152</b>	M56 x 2	77,8	31,9	25,4	26,9	25,0	1,3	
109,0	218,0	M42 x 1,5	<b>BAD-153</b>	M70 x 2	77,8	38,2	25,4	30,2	32,0	2,1	

**Options**

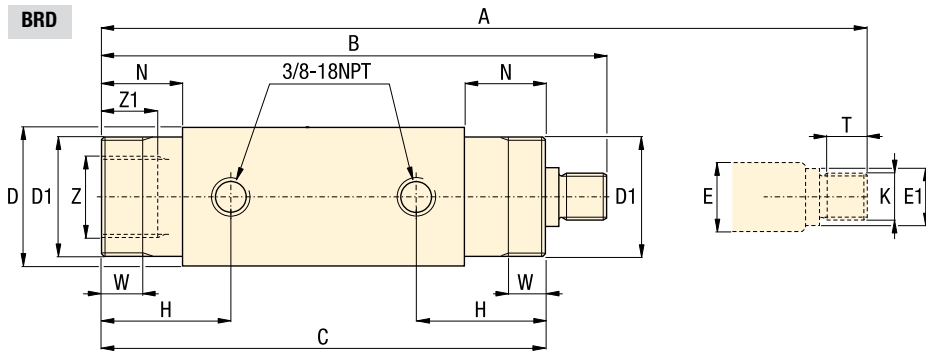
**Cylinder accessories** 86 ▶

**Important**

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

BRD series cylinders are designed for a maximum operating pressure of 700 bar.

When applying 700 bar cylinder capacities double as well.



**Product dimensions** in mm [ ]

Model number	A	B	C	D	D1	E	E1	H	K	N	T	W	Z	Z1		kg
<b>BRD-41</b>	213,7	185,5	162,3	50,8	M42 x 1,5	19,0	17,5	47,0	M16 x 1,5	29,0	19,3	11,0	M30 x 1,5	12,0	2,2	
<b>BRD-43</b>	315,3	236,4	213,0	50,8	M42 x 1,5	19,0	17,5	47,0	M16 x 1,5	29,0	19,3	11,0	M30 x 1,5	12,0	2,9	
<b>BRD-46</b>	467,7	312,5	289,3	50,8	M42 x 1,5	19,0	17,5	47,0	M16 x 1,5	29,0	19,3	11,0	M30 x 1,5	12,0	4,1	
<b>BRD-91</b>	253,4	221,8	198,4	63,5	M56 x 2	25,4	23,9	57,7	M22 x 1,5	38,1	19,4	14,2	M42 x 1,5	14,8	4,1	
<b>BRD-93</b>	355,0	272,7	249,2	63,5	M56 x 2	25,4	23,9	57,7	M22 x 1,5	38,1	19,4	14,2	M42 x 1,5	14,8	5,0	
<b>BRD-96</b>	506,9	348,9	325,4	63,5	M56 x 2	25,4	23,9	57,7	M22 x 1,5	38,1	19,4	14,2	M42 x 1,5	14,8	6,3	
<b>BRD-910</b>	710,6	450,4	427,0	63,5	M56 x 2	25,4	23,9	57,7	M22 x 1,5	38,1	19,4	14,2	M42 x 1,5	14,8	8,6	
<b>BRD-166</b>	547,2	390,0	358,8	76,2	M70 x 2	34,9	32,0	73,7	M30 x 1,5	53,8	25,4	22,4	M56 x 2	26,2	10,0	
<b>BRD-1610</b>	750,4	491,6	358,8	76,2	M70 x 2	34,9	32,0	73,7	M30 x 1,5	53,8	25,4	22,4	M56 x 2	26,2	13,2	
<b>BRD-256</b>	583,7	424,0	397,0	95,0	M85 x 2	47,6	45,0	89,0	M42 x 1,5	70,0	22,3	28,5	M70 x 2	25,2	16,3	
<b>BRD-2510</b>	786,2	525,1	397,0	95,0	M85 x 2	47,6	45,0	89,0	M42 x 1,5	70,0	22,3	28,5	M70 x 2	25,2	20,9	

Shown: Cylinder accessories



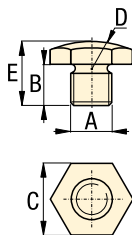
These accessories are provided so that you can effectively position, mount and actuate Enerpac hydraulic cylinders according to your specific fixturing or production applications.

## For optimum mounting and fixture flexibility

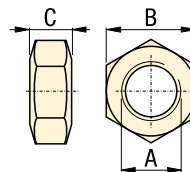
...to match specific applications

- **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.

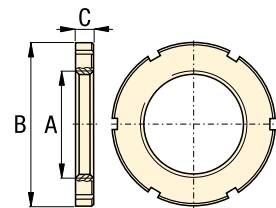
All BS Models



FN-121, 201, 251



All other FN models



## Product dimensions in inches [ $\text{mm}$ ]

A thread	Model number	B	C	D	E
<b>▼ Spherical contact bolts</b>					
#6-32 UNC	<b>BS-21</b>	5,1	6,4	6,0	8,9
#8-32 UNC	<b>BS-41</b>	7,1	7,9	7,9	10,9
M4 x 0,7	<b>BS-42</b>	7,1	7,9	7,9	10,9
.250-28 UNF	<b>BS-61</b>	7,9	11,1	11,1	14,0
M6 x 1	<b>BS-62</b>	7,9	11,1	11,1	14,0
.313-24 UNF	<b>BS-81</b>	9,9	14,2	14,0	17,0
M8 x 1,25	<b>BS-82</b>	9,9	14,0	14,0	17,0
.375-16 UNC	<b>BS-91</b>	9,9	16,0	16,2	17,0
.500-13 UNC	<b>BS-101</b>	9,9	17,5	17,0	18,0
M10 x 1,5	<b>BS-102</b>	6,6	17,0	23,1	10,9
M16 x 2	<b>BS-162</b>	11,9	22,0	22,0	23,9
M20 x 2,5	<b>BS-202</b>	11,9	23,9	22,0	23,9

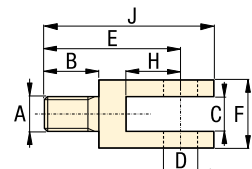
A thread	Model number	B	C
<b>▼ Jam nuts</b>			
.500-20 UNF	<b>FN-121</b>	19,0	7,9
M12 x 1,5	<b>FN-122</b>	27,9	6,1
.750-16 UNF	<b>FN-201</b>	28,7	10,7
M20 x 1,5	<b>FN-202</b>	36,1	7,9
1.000-12 UNF	<b>FN-251</b>	38,1	14,0
1.125-16 UN	<b>FN-281</b>	44,4	9,9
M28 x 1,5	<b>FN-282</b>	50,0	9,9
1.25-16 UN	<b>FN-301</b>	47,7	9,9
M30 x 1,5	<b>FN-302</b>	50,0	9,9
1.313-16 UN	<b>FN-331</b>	47,7	6,4
1.375-18 UNEF	<b>FN-351</b>	47,7	6,4
M35 x 1,5	<b>FN-352</b>	55,1	10,9
1.625-16	<b>FN-421</b>	57,1	7,9
M42 x 1,5	<b>FN-422</b>	63,5	11,9
1.875-16	<b>FN-481</b>	63,5	13,0
M48 x 1,5	<b>FN-482</b>	74,9	13,0
2.125-16 UN	<b>FN-551</b>	79,5	9,7
M55 x 1,5	<b>FN-552</b>	80,0	13,0
2.500-16 UN	<b>FN-651</b>	82,5	9,9
M65 x 1,5	<b>FN-652</b>	95,0	14,0
3.125-16 UN	<b>FN-801</b>	104,9	13,0
M80 x 2	<b>FN-802</b>	115,1	16,0

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

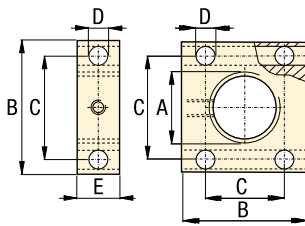


## Product dimensions in mm [ $\text{mm}$ ]

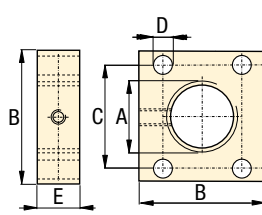
A thread	Model number	B	C	D	E	F	H	J
<b>▼ Yoke</b>								
.312-24 UN	<b>Y-3121</b>	12,7	7,9	7,9	31,8	16	12,7	39,6



MF and AW-51 models



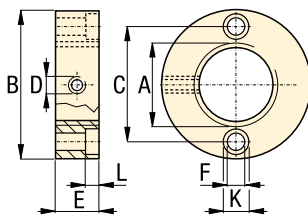
other AW models



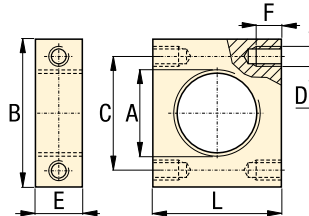
**Product dimensions** in mm [ ]

A thread	Model number	B	C	D ø	E
<b>▼ Mounting flanges – Rectangular</b>					
1.375-18 UNEF	<b>AW-5</b>	44,5	34,0	6,9	12,7
1.500-16 UN	<b>AW-51</b>	57,1 x 69,8	41,1 x 53,8	10,4	25,4
1.875-16 UN	<b>AW-89</b>	57,2	45,0	8,4	25,4
2.500-16 UN	<b>AW-19</b>	82,6	55,1	8,9	24,9
3.125-16 UN	<b>AW-90</b>	95,3 x 120,7	60,4 x 88,9	16,3	31,8
.500-20 UNF	<b>MF-121</b>	38,1	25,4	6,9	25,4
M12 x 1,5	<b>MF-122</b>	39,9	24,9	6,4	24,9
1.000-12 UNF	<b>MF-201</b>	57,2	38,1	10,2	38,1
M20 x 1,5	<b>MF-202</b>	65,0	45,0	10,2	39,9
1.000-12 UNF	<b>MF-251</b>	63,5	44,5	10,2	38,1
1.125-16 UN	<b>MF-281</b>	69,8	50,8	10,2	38,1
M28 x 1,5	<b>MF-282</b>	74,9	50,0	10,2	39,9
1.313-16 UN	<b>MF-331</b>	76,2	57,2	10,2	38,1
1.375-18 UNF	<b>MF-351</b>	76,2	57,2	10,2	38,1
M35 x 1,5	<b>MF-352</b>	80,0	56,9	10,2	39,9
1.625-16 UN	<b>MF-421</b>	82,6	63,5	10,2	38,1
M42 x 1,5	<b>MF-422</b>	90,0	63,0	10,2	39,9
1.875-16 UN	<b>MF-481</b>	89,0	70,0	10,2	38,1
M48 x 1,5	<b>MF-482</b>	95,0	70,1	10,2	39,9
2.125-16 UN	<b>MF-551</b>	101,6	76,2	11,7	44,5
M55 x 1,5	<b>MF-552</b>	110,0	82,0	11,9	45,0
2.500-16 UN	<b>MF-651</b>	114,3	88,9	11,7	44,5
M65 x 1,5	<b>MF-652</b>	115,1	88,9	11,9	45,0
3.125-16 UN	<b>MF-801</b>	127,0	101,6	11,7	44,5
M80 x 2	<b>MF-802</b>	134,9	108,0	11,9	45,0

AW-53, -121



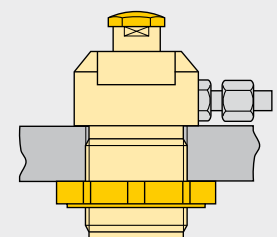
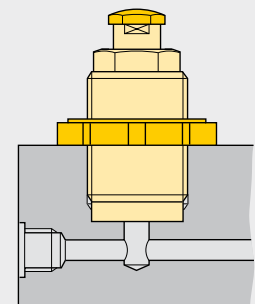
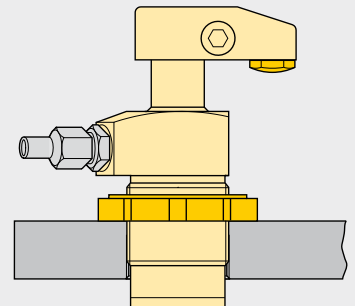
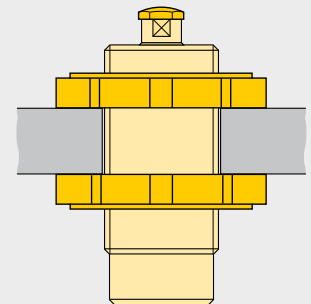
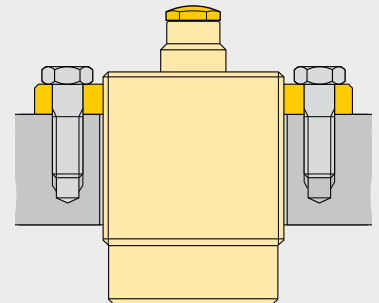
AW-102



**Product dimensions** in mm [ ]

A thread	Model number	B ø	C	D thread	E	F ø	K ø	L
<b>▼ Mounting flanges – Cylindrical</b>								
1.500-16 UN	<b>AW-53</b>	73,2	57,2	.250-20 UNC	19,1	7,1	10,4	7,9
2.750-16 UN	<b>AW-121</b>	114,3	92,2	.250-20 UNC	19,1	8,6	12,7	9,7
<b>▼ Mounting flanges – Rectangular</b>								
2.250-14 UNS	<b>AW-102</b>	101,6	76,2	.438-20 UNF	31,8	15,7	-	82,6

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



Linear Cylinders

Power Sources

Valves

Pallet Components

System Components

Yellow Pages



# 350 bar Tie Rod Cylinders *Application & selection*

Shown: TRFM-1506, TRFL-3210 and TRCM-3206



**Enerpac 350 bar Tie Rod cylinders provide a variety of mounting options for pushing and positioning workpieces and fixtures on a machine.**

Enerpac tie rod cylinders are designed to the highest industry standards to provide long life and worry-free performance in the most demanding applications.

## Standard bore sizes

Bore diameter mm	Rod diameter mm	Capacity at 350 bar		Effective area	
		Push kN	Pull kN	Push cm <sup>2</sup>	Pull cm <sup>2</sup>
38,1	25,4	39	22	11,4	6,3
50,8	35,0	70	37	20,3	10,7
63,5	44,4	109	56	31,7	16,1
82,5	50,8	185	115	53,5	33,3
101,6	63,5	280	170	81,1	49,4

## Additional bore sizes

Bore diameter mm	Rod diameter mm	Capacity at 350 bar	
		Push kN	Pull kN
127,0	88,9	437	223
152,4	101,6	629	349
177,8	127,0	856	419
203,2	139,7	1118	590

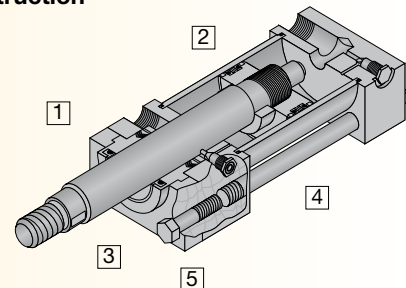
Contact Enerpac for ordering information on additional bore sizes.

## Flexibility of motion

- Rod seal (1) uses spring loaded multiple lip vee rings, a supporting bronze bearing ring bushing and a double lip wiper
- Piston seal (2) combines two bi-directional sealing cast iron piston rings with two block vee seals with back-up rings
- Hardened chrome plated piston rod (3) resists scoring and corrosion, assuring maximum life
- Steel tubing barrel (4), honed to a fine finish assures superior sealing, minimum friction and maximum seal life
- Rod bushing and seals can be serviced by merely removing the retainer plate (5) on most models.

### Tie Rod cylinder construction

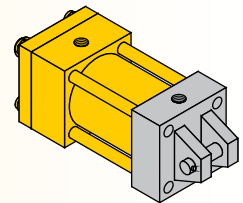
- 1 Rod Seal
- 2 Piston Seal
- 3 Piston Rod
- 4 Barrel
- 5 Retainer Plate



## Tie Rod cylinder mounting styles

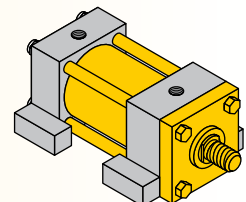
### Clevis Mount – TRCM Series

- NFPA style MP1
- Allows cylinder to pivot
- Requires provision for pivoting on rod end.



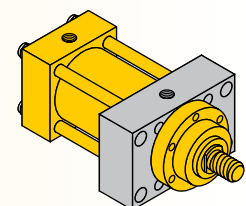
### Foot mount – TRFM series

- NFPA style MS2
- Allows easy mounting with only four bolts
- Backup key included in design to ensure long life.



### Flange mount – TRFL series

- NFPA style ME5
- Allows cylinder length to be buried in machine
- Strongest, most rigid mount.



## Product selection

Piston diameter	Rod diameter	Stroke	Clevis mount	Foot mount	Flange mount
mm	mm	mm			
38,1	25,4	50,8	TRCM-1502	TRFM-1502	TRFL-1502
38,1	25,4	101,6	TRCM-1504	TRFM-1504	TRFL-1504
38,1	25,4	152,4	TRCM-1506	TRFM-1506	TRFL-1506
38,1	25,4	254,0	TRCM-1510*	TRFM-1510	TRFL-1510
38,1	25,4	304,8	TRCM-1512*	TRFM-1512	TRFL-1512
50,8	35,0	50,8	TRCM-2002	TRFM-2002	TRFL-2002
50,8	35,0	101,6	TRCM-2004	TRFM-2004	TRFL-2004
50,8	35,0	152,4	TRCM-2006	TRFM-2006	TRFL-2006
50,8	35,0	254,0	TRCM-2010	TRFM-2010	TRFL-2010
50,8	35,0	304,8	TRCM-2012	TRFM-2012	TRFL-2012
63,5	44,4	50,8	TRCM-2502	TRFM-2502	TRFL-2502
63,5	44,4	101,6	TRCM-2504	TRFM-2504	TRFL-2504
63,5	44,4	152,4	TRCM-2506	TRFM-2506	TRFL-2506
63,5	44,4	254,0	TRCM-2510	TRFM-2510	TRFL-2510
63,5	44,4	304,8	TRCM-2512	TRFM-2512	TRFL-2512
82,5	50,8	50,8	TRCM-3202	TRFM-3202	TRFL-3202
82,5	50,8	101,6	TRCM-3204	TRFM-3204	TRFL-3204
82,5	50,8	152,4	TRCM-3206	TRFM-3206	TRFL-3206
82,5	50,8	254,0	TRCM-3210	TRFM-3210	TRFL-3210
82,5	50,8	304,8	TRCM-3212	TRFM-3212	TRFL-3212
101,6	63,5	50,8	TRCM-4002	TRFM-4002	TRFL-4002
101,6	63,5	101,6	TRCM-4004	TRFM-4004	TRFL-4004
101,6	63,5	152,4	TRCM-4006	TRFM-4006	TRFL-4006
101,6	63,5	254,0	TRCM-4010	TRFM-4010	TRFL-4010
101,6	63,5	304,8	TRCM-4012	TRFM-4012	TRFL-4012

Cushions are available for all cylinder models. Cushions slow down heavy loads prior to end of stroke, preventing damage to the cylinder of the machine. To add cushions to your Enerpac Tie Rod cylinder, simply add the letter "C" to the end of any model number. Note: the addition of cushions does not affect the outside dimensions of the cylinder.

\* These models are only rated to 276 bar due to constraints on the mechanical properties of the rod.

## Custom build your Tie Rod cylinder

TR	CM	15	12	C
1	2	3	4	5
<b>1 Product Type</b> TR = Tie Rod		<b>3 Bore Diameter (mm)</b> 15 = 38,1 mm 20 = 50,8 25 = 63,5 32 = 82,5 40 = 101,6	<b>4 Stroke (mm)</b> 02 = 50,8 04 = 101,6 06 = 152,4 10 = 254,0 12 = 304,8	<b>5 Cushions</b> Blank = None C = Cushions both ends
<b>2 Mounting</b> CM = Clevis Mount FM = Foot Mount FL = Flange Mount				

## Seal and repair kits

Seal kits include piston, rod and barrel seals. Repair kits include seal kit plus rod bushing and rear bearing ring.

## Product dimensions in mm

Bore diameter mm	Rod diameter mm	Seal kit	Repair kit
38,1	25,4	TR15SK	TR15RK
50,8	35,0	TR20SK	TR20RK
63,5	44,4	TR25SK	TR25RK
82,5	50,8	TR32SK	TR32RK
101,6	63,5	TR40SK	TR40RK

Force: 39 - 280 kN

Stroke: 50,8 - 304,8 mm

Pressure: 35 - 350 bar

**E** Cilindros Atirantados

**F** Vérins à tirants

**D** Zugankerzylinder

## Options

### Accessories

93 ▶



### ZW Series Pumps

114 ▶



### VP Series Valves

136 ▶



### Fittings

194 ▶



## Important

Consult individual product selection pages for application and installation criteria specific to each mounting style. If you are unsure of an application, contact Enerpac directly.

Enerpac can provide many other tie rod cylinders in a wide variety of mounting styles, bore and stroke sizes. Contact Enerpac directly and talk to our Custom Products group for a quotation.

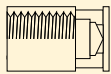
Shown: TRCM-3204



### TR series clevis mount

Enerpac clevis mount 350 bar Tie Rod cylinders provide for motion in two axis, increasing the range of motion on your machine with only one cylinder.

### Special rod ends

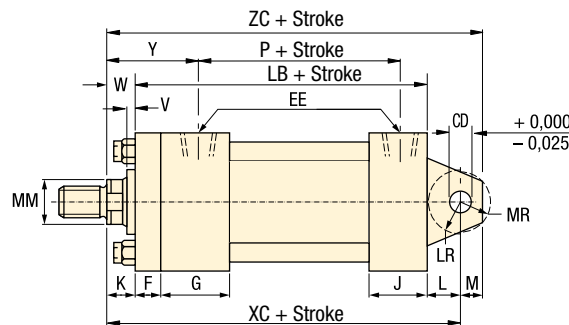
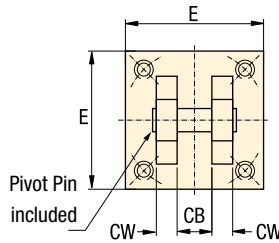


- Either internal or external threads available
- Custom designs to match your tooling requirements

### Flexibility of motion

- Clevis mount cylinders include pivot pin for mounting in your machine
- Standard rod eyes and rod clevises available for each bore size.
- NFPA style MP1
- Designed to carry shear loads
- Pivot pins should be carried by rigidly held bearings and closely fit for the entire length of the pin

TRCM models Clevis mount



Force: 39 - 280 kN

Stroke: 50,8 - 304,8 mm

Pressure: 35 - 350 bar

**E** Cilindros Atirantados

**F** Vérins à tirants

**D** Zugankerzylinder

### Options

#### Accessories

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#### ZW Series Pumps

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#### VP Series Valves

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#### Fittings

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### Dimensions in mm [ $\text{mm}$ ]

Bore diameter	Rod diameter	Model number	A	B	C	CB	CD	CW	D*	E	EE	F	G	J	K
38,1	25,4	TRCM-15xx**	28,7	38,1	12,7	19,0	12,7	12,7	22,3	63,5	SAE #10	9,6	44,4	38,1	12,7
50,8	35,0	TRCM-20xx	41,4	50,8	16,0	31,7	19,0	16,0	28,7	76,2	SAE #10	16,0	44,4	38,1	16,0
63,5	44,4	TRCM-25xx	50,8	60,4	19,0	31,7	19,0	16,0	38,1	88,9	SAE #10	16,0	44,4	38,1	16,0
82,5	50,8	TRCM-32xx	57,1	66,8	22,3	38,1	25,4	19,0	42,9	114,3	SAE #12	19,0	50,8	44,4	19,0
101,6	63,5	TRCM-40xx	76,2	79,5	25,4	50,8	35,0	25,4	52,3	127,0	SAE #12	22,3	50,8	44,4	19,0

\* D = Distance across plunger wrench flats.

\*\* 254 and 305 mm models are rated at only 276 bar.

Bore diameter	Rod diameter	Model number	KK2	L	LB	LR	M	MM	MR	NA	P	V	W	XC	Y	ZC	kg
38,1	25,4	TRCM-15xx	3/4"-16	19,0	127,0	16,0	12,7	25,4	16,7	24,6	54,1	12,7	25,4	171,4	60,4	184,1	***
50,8	35,0	TRCM-20xx	1"-14	31,7	133,3	28,7	19,0	35,0	23,8	34,0	73,1	9,6	25,4	190,5	66,8	209,5	***
63,5	44,4	TRCM-25xx	1-1/4"-12	31,7	136,6	28,7	19,0	44,4	23,8	43,1	76,2	12,7	31,7	200,1	73,1	219,2	***
82,5	50,8	TRCM-32xx	1-1/2"-12	38,1	158,7	31,7	25,4	50,8	30,2	49,5	91,1	9,6	31,7	228,6	78,4	254,0	***
101,6	63,5	TRCM-40xx	1-7/8"-12	54,1	168,4	47,7	35,0	63,5	35,0	62,2	98,5	9,6	35,0	257,3	84,0	292,1	***

\*\*\* For product weights, please reference the price list or contact Enerpac customer service for more information.

Force: 39 - 280 kN

Stroke: 50,8 - 304,8 mm

Pressure: 35 - 350 bar

**E** Cilindros Atirantados

**F** Vérins à tirants

**D** Zugankerzylinder

## Options

### Accessories

93 ▶



### ZW Series Pumps

114 ▶



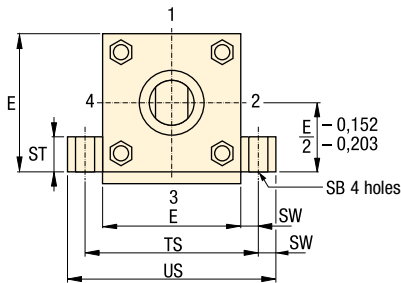
### VP Series Valves

136 ▶



### Fittings

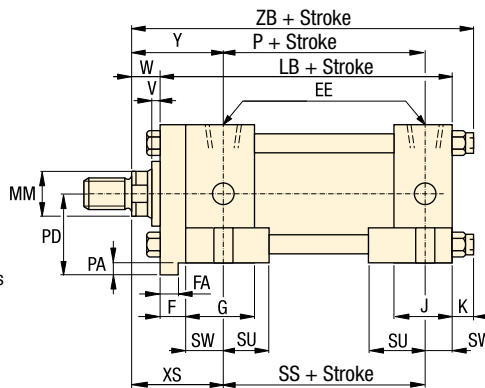
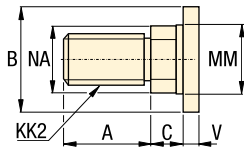
194 ▶



## Ease of installation

- Foot mount cylinders provide simplest mounting option with just four bolt holes required
- Standard key mount is included ensuring proper mounting and adding rigidity
- NFPA style MS2
- Compact mounting fits in tight spaces where other cylinders cannot

### TRFM models Foot Mount



Shown: TRFM-1506



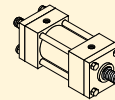
### TR series foot mount

Enerpac foot mount 350 bar Tie Rod cylinders provide a high quality positioning solution using a minimal amount of space.

### Important

Some custom options may require reduction of working pressure or special installation considerations. Contact Enerpac Technical Service to discuss your application.

### Special rod ends



#### Double rod ends

- Available on all models except clevis mounts
- The two rod ends can be different on the same cylinder

## Dimensions in mm [ ]

Bore diameter	Rod diameter	Model number	A	B	C	D*	E	EE	F	FA	G	J	K	KK2	LB	MM
38,10	25,40	TRFM-15xx	28,70	38,10	12,70	22,35	63,5	SAE #10	9,65	7,87-7,92	44,45	38,10	12,70	3/4"-16	127,00	25,4
50,80	35,05	TRFM-20xx	41,40	50,80	16,00	28,70	76,20	SAE #10	16,00	14,22-14,27	44,45	38,10	16,00	1"-14	133,35	35,05
63,50	44,45	TRFM-25xx	50,80	60,45	19,05	38,10	88,90	SAE #10	16,00	14,22-14,27	44,45	38,10	16,00	1-1/4"-12	136,65	44,45
82,55	50,80	TRFM-32xx	57,15	66,80	22,35	42,93	114,3	SAE #12	19,05	17,37-17,45	50,80	44,45	19,05	1-1/2"-12	158,75	50,80
101,60	63,50	TRFM-40xx	76,20	79,50	25,40	52,32	127,00	SAE #12	22,35	20,55-20,62	50,80	44,45	19,05	1-7/8"-12	168,40	63,50

\* D = Distance across plunger wrench flats.

Bore diameter	Rod diameter	Model number	NA	P	PA	PD	SB	SS	ST	SU	SW	TS	US	V	W	XS	Y	ZB	kg
38,10	25,40	TRFM-15xx	24,64	73,15	4,82	36,58	11,18	98,55	12,7	23,88	9,65	82,55	101,60	12,70	25,40	44,45	60,45	165,10	***
50,80	35,05	TRFM-20xx	34,04	73,15	7,87	45,97	14,22	92,20	19,05	31,75	12,7	101,60	127,00	9,65	25,40	54,10	66,80	174,75	***
63,50	44,45	TRFM-25xx	43,18	76,2	7,87	52,32	20,57	85,85	25,40	39,62	17,53	123,95	158,75	12,70	31,75	65,02	73,15	184,15	***
82,55	50,80	TRFM-32xx	49,53	91,19	9,65	66,80	20,57	104,90	25,40	39,62	17,53	149,35	184,15	9,65	31,75	68,33	78,49	209,55	***
101,60	63,50	TRFM-40xx	62,23	98,55	11,18	74,68	26,93	101,60	31,75	50,80	22,35	171,45	215,90	9,65	35,05	79,50	84,07	222,25	***

\*\*\* For product weights, please reference the price list or contact Enerpac customer service for more information.

Shown: TRFL-3206



### TR series flange mount

Enerpac flange mount 350 bar Tie Rod cylinders provide the most rigid mounting ensuring long life and high accuracy on your machine.

### Extra strong

- Flange mount is part of the cylinder end cap, providing maximum strength and rigidity
- Allows length of cylinder to be mounted inside the machine
- NFPA style ME5
- Simple four bolt mounting pattern makes installation easy
- Mounting is best suited for tension applications

**Force: 39 - 280 kN**

**Stroke: 50,8 - 304,8 mm**

**Pressure: 35 - 350 bar**

**E Cilindros Atirantados**

**F Vérins à tirants**

**D Zugankerzylinder**

### Options

**Accessories**

▣ 86 ▶

**ZW Series Pumps**

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**VP Series Valves**

▣ 136 ▶

**Fittings**

▣ 194 ▶

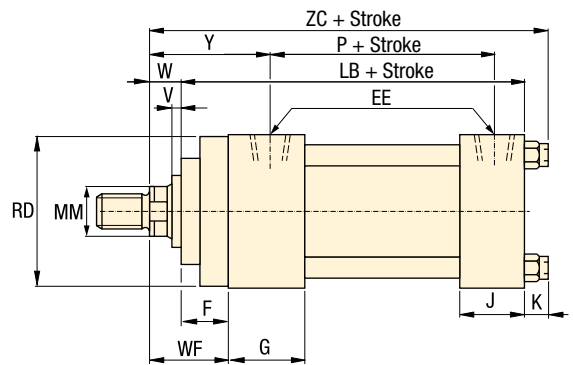
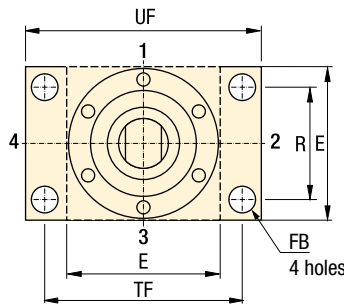
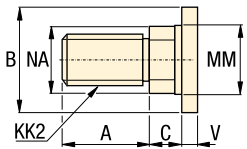
Collet-Lok® products

Swing clamps

Work Supports

Linear Cylinders

TRFL models Flange Mount



### Special rod ends

**Rod boots**

- Rod boots are made from neoprene coated fabric
- Impervious to oil grease and water
- Rated for temperatures from 7,8 °C to 93,3 °C

**Metallic wipers**

- Recommended in applications where contaminants tend to cling to the rod surface
- Available on all rod diameters

### Dimensions in mm [ ]

Bore diameter	Rod diameter	Model number	A	B	C	D*	E	EE	F	FB	G	J	K	KK2
38,10	25,40	TRFL-15xx	28,70	38,10	12,70	22,35	63,50	SAE #10	9,6	11,1	44,45	38,10	12,70	3/4"-16
50,80	35,05	TRFL-20xx	41,40	50,80	16,00	28,70	76,20	SAE #10	16,0	14,2	44,45	38,10	16,0	1"-14
63,50	44,45	TRFL-25xx	50,80	60,45	19,05	38,10	88,90	SAE #10	16,0	14,2	44,45	38,10	16,0	1-1/4"-12
82,55	50,80	TRFL-32xx	57,15	66,80	22,35	42,9	114,30	SAE #12	19,05	17,5	50,80	44,45	19,0	1-1/2"-12
101,60	63,50	TRFL-40xx	76,20	79,5	25,40	52,3	127	SAE #12	22,35	17,5	50,80	44,45	19,0	1-7/8"-12

\* D = Distance across plunger wrench flats.

Bore diameter	Rod diameter	Model number	LB	MM	NA	P	R	RD	TF	UF	V	W	WF	Y	ZB	
38,10	25,40	TRFL-15xx	127,0	25,4	24,6	73,15	41,40	-	87,38	107,95	12,70	25,40	35,05	60,45	165,10	***
50,80	35,05	TRFL-20xx	133,3	35,0	34,0	73,15	52,07	-	104,90	130,30	9,65	25,40	41,40	66,80	174,75	***
63,50	44,45	TRFL-25xx	136,6	44,4	43,18	76,20	64,77	-	117,60	143,00	12,70	31,75	47,75	73,15	184,15	***
82,55	50,80	TRFL-32xx	158,7	50,8	49,53	91,19	82,55	101,60	149,35	181,10	9,65	31,75	50,80	78,49	209,55	***
101,60	63,50	TRFL-40xx	168,4	63,5	62,23	98,55	97,03	114,30	162,05	193,80	9,65	35,05	57,15	84,07	222,25	***

\*\*\* For product weights, please reference the price list or contact Enerpac customer service for more information.

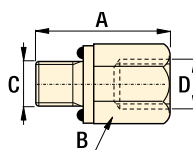


## For high production applications

- Fit any style of Enerpac tie-rod cylinder
- Rod eyes and rod clevises
  - Required for proper mounting of TRCM series cylinders
  - Pivot pins supplied separately
- Pivot pins for rod eyes and clevises
  - Provided with cotter pins
  - Must be ordered separately
- Linear alignment coupler
  - Prevents binding caused by misalignment
  - Reduces rod seal and bearing wear

## Fittings dimensions in mm [ $\text{mm}$ ]

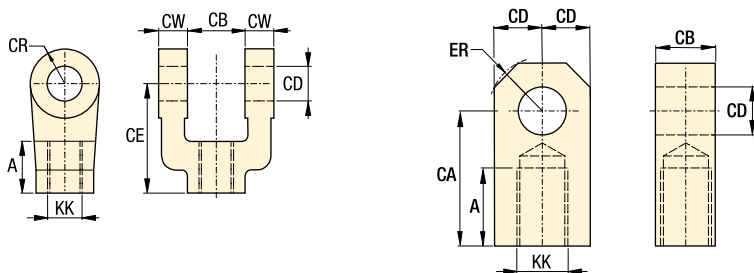
From	To	Model number	A	B	C	D
SAE #10	3/8" NPT	<b>FZ2077</b>	33,2	25,4	SAE #10	3/8" NPT
SAE #12	3/8" NPT	<b>FZ2078</b>	25,4	31,7	SAE #12	3/8" NPT
SAE #10	SAE #6	<b>FZ2079</b>	32,0	25,4	SAE #10	SAE #6
SAE #12	SAE #6	<b>FZ2080</b>	24,4	31,7	SAE #12	SAE #6



TRRE-15, TRCC-15, TRPP-15, TRAC-15

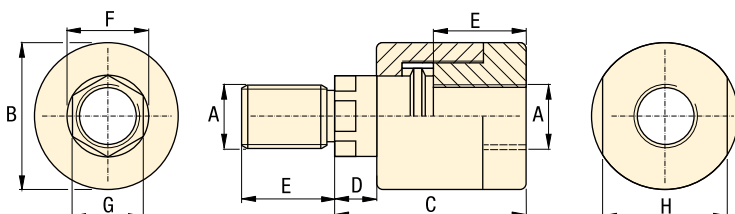


Enerpac 350 bar Tie-Rod cylinder accessories allow you to complete your design making installation on your machine a simple project.



## Rod Clevis and Rod Eye dimensions in mm [ $\text{mm}$ ]

Rod clevis model number	Rod eye model number	Maximum tension load kN	KK	A	CA	CB	CD	CE	CR	CW	ER	Clevis Pin
<b>TRRC-15</b>	<b>TRRE-15</b>	55	3/4"-16	28,7	52,3	31,7	19,0	60,4	19,0	16,0	23,8	<b>TRPP-15</b>
<b>TRRC-20</b>	<b>TRRE-20</b>	90,9	1"-14	41,4	71,3	38,1	25,4	79,5	25,4	19,0	28,7	<b>TRPP-20</b>
<b>TRRC-25</b>	<b>TRRE-25</b>	135,6	1-1/4"-12	50,8	87,3	50,8	35,0	104,9	35,0	25,4	39,6	<b>TRPP-25</b>
<b>TRRC-32</b>	<b>TRRE-32</b>	220	1-1/2"-12	57,1	101,6	63,5	44,4	114,3	41,4	31,7	47,7	<b>TRPP-32</b>
<b>TRRC-40</b>	<b>TRRE-40</b>	311,8	1-7/8"-12	76,2	127,0	63,5	50,8	139,7	50,8	31,75	50,8	<b>TRPP-40</b>



## Linear Alignment Coupler in mm [ $\text{mm}$ ]

Model number	Maximum tension load kN	A	B	C	D	E	F	G	H
<b>TRAC-15</b>	37,8	3/4"-16	44,4	58,6	12,7	28,7	24,6	22,3	38,1
<b>TRAC-20</b>	71,1	1"-14	63,5	74,6	12,7	41,4	35,0	29,4	57,1
<b>TRAC-25</b>	86,7	1-1/4"-12	63,5	74,6	12,7	41,4	35,0	29,4	57,1
<b>TRAC-32</b>	149	1-1/2"-12	82,5	111,2	20,5	57,1	44,45	38,1	76,2
<b>TRAC-40</b>	266,9	1-7/8"-12	95,2	138,1	22,3	76,2	50,8	47,7	88,9

# 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	
<b>Choosing a Pump</b>		96 - 97	
<b>Turbo II air-hydraulic pumps</b>	PA	98 - 101	
<b>Air-hydraulic pumps</b>	ZAJ	102	
<b>Air-hydraulic pumps</b>	PA	103	
<b>Air-hydraulic boosters</b>	AHB, B	104 - 105	
<b>Air valves and accessories</b>	VA, VR RFL	106 - 107	
<b>Economy electric pumps</b>	WU	108 - 109	
<b>Electric submerged pumps</b>	WE	110 - 113	
<b>Z-Class Electric pumps</b>	ZW	114 - 117	
<b>Return line filter kit and heat exchanger kits</b>	ZPF, ZHE	118 - 119	
<b>Level/temperature switch and pressure transducer</b>	ZLS ZPT, ZPS	120	
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<b>Continuous connection pumps</b>	ZW	124 - 125	
<b>Single station D03 pumps</b>	ZW	126 - 127	
<b>Electric driven workholding pump</b>	ZW5	128 - 131	
<b>Hand pumps</b>	P, SP	132	
<b>Enerpac system solutions</b>		133	

# Choosing a pump

Flow rate: 0,08 - 8,7 l/min

Pressure: 65 - 700 bar

Reservoir: Up to 40 liters

## Options

### Manual valves



☞ 143, 148-151 ▶

### Electric valves



☞ 136-142 ▶

### Air operated valves



☞ 140 ▶

## Important

1 in<sup>3</sup> = 16,387 cm<sup>3</sup>

1 cm<sup>3</sup> = 0,061 in<sup>3</sup>

1 dm<sup>3</sup> = 1 litre = 61,02 in<sup>3</sup>

1 US gal = 3,785 litres

## Select your pump type

### Air operated pump

Best choice for medium circuits with intermittent or medium duty applications. Air operated pumps have lower flow rates than electric pumps, but are more economical.

☞ 98-103 ▶



### Air hydraulic booster

Best choice for small circuits with intermittent or medium-duty applications. Air hydraulic boosters provide a single shot of oil to your circuit at high pressure.

☞ 104-105 ▶



### Economy electric operated pump

The Economy pump is best suited to power small to medium size fixtures. Its lightweight and compact design makes it ideal for applications which require easy transport of the pump. The universal motor works well on long extension cords.

☞ 108-109 ▶



### Electric submerged pump

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.

☞ 110-113 ▶



### Electric operated pump

Best choice for large circuits with medium or high-duty applications. Electric operated pumps have the highest flow rates available and can be configured with many different accessories.

☞ 114-131 ▶



## Select your pump options

### Reservoir size

Choose a reservoir size that holds enough oil to fill all of your lines, manifolds and cylinders, with enough reserve for future needs. Each Enerpac cylinder has an oil capacity listed on its product page, and each power unit has a reservoir capacity listed.

### Valve type

Directional valves allow you control over what portion of the circuit receives oil. Valves can be operated manually, by electric solenoid or by air pilot pressure. Multiple valves can be used with one power unit to control multiple circuits.

### Accessories

For increased automation, electric pumps can be outfitted with additional accessories, including pressure switches, level switches, and control pendants. These options can either be factory installed or added to an existing power unit in the future.

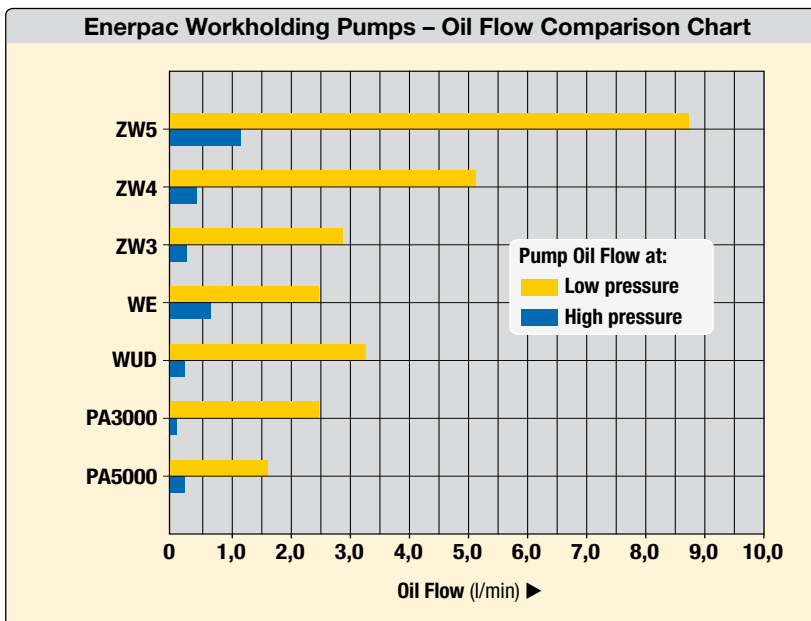
## Factors to consider when choosing a pump

- ? Is an air or electric pump preferred
- ? How frequently will the pump cycle
- ? Are there size constraints where the pump would be mounted
- ? What is the oil volume of the clamps actuated together in each group
- ? Is there an accumulator? What is the oil volume
- ? Are there sequence valves? What is the setting of the first one
- ? Are the control valves to be controlled by the machine controller

- Flow rate: 0,08 - 8,7 l/min
- Pressure: 65 - 700 bar
- Reservoir: up to 40 liters

## Enerpac Workholding Pump Comparison Chart

### What oil flow is right for you?



Type of pump	Oil flow at low pressure (l/min)	Oil flow at high pressure (l/min)
ZW5-Series	8,74	1,64
ZW4-Series	5,19	0,82
ZW3-Series	2,80	0,54
WE-Series Submerged	2,45	0,65
WUD-Series Economy	3,28	0,33
Turbo Air PA3000-Series	2,46	0,08
Turbo Air PA5000-Series	1,64	0,33



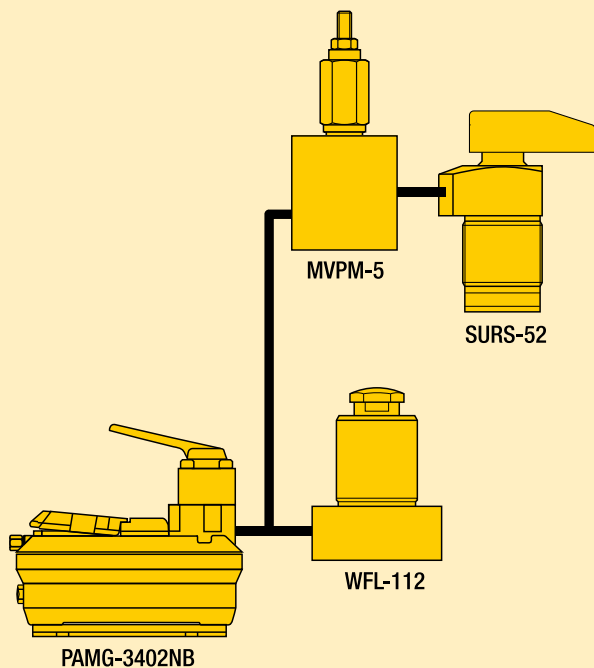
# Turbo II air-hydraulic pumps *Application & selection*

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, the Turbo II series helps to keep noise level to a minimum.



## 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: 4-8,5 bar – 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
- Fully serviceable air motor assembly.

## Select the required output

### 3000 series

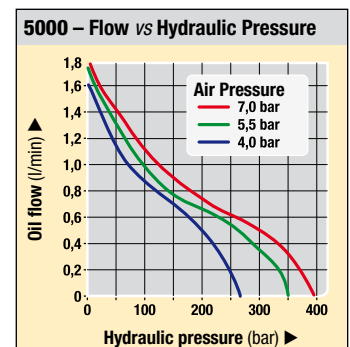
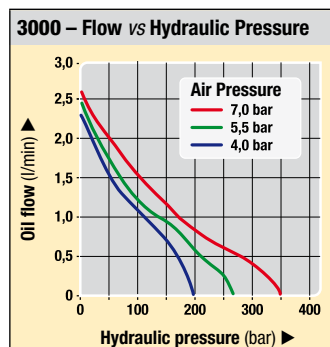
- Hydraulic to air ratio: 45:1

### 5000 series

- Hydraulic to air ratio: 60:1

\*\* NOTE: From 4-8,5 bar air inlet pressure. Performance is significantly diminished below 4 bar. 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.

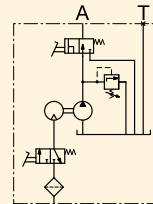
## Output oil flow vs pressure



 **Select the required output:**

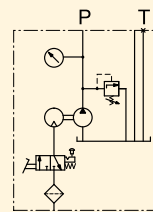
**PATG series**

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



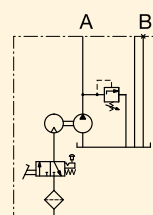
**PACG series**

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



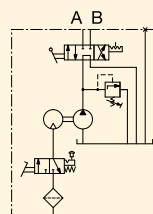
**PASG series**

- Momentary or continuous air inlet treadle
- Suitable for mounting any single- or double-acting valve with a D03 mounting configuration
- Available with multiple valve manifold (7,5 litre only).



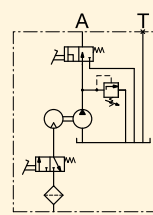
**PAMG series**

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



**PARG series**

- Includes 5 m air pendant for remote control of single-acting cylinders
- Provides advance, hold and retract functions.



**Oil Flow: 0,08 - 2,46 l/min**

**Pressure: 350 bar**

**Air: 340 l/min**

**Reservoir: 1,1 - 5,0 litres**

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


 **Options**

**Gauges and accessories**

 190 ▶



**Regulator-filter-lubricator**

 106,158 ▶



 **Important**

**For high cycle applications electric pumps are recommended.**



# PA-series *Dimensions & options*

Shown: PACG30S8S-WM10



## ▶ 1,9 litre Turbo Air Pump

The 1,9 litres Turbo pump models feature a drawn steel reservoir with an oil level sight glass. Choose from models with a P & T manifold for use with remote mount valves, a single station D03 manifold, the standard treadle or manual 4 way valve models. The PARG series uses an air operated pendant to control the pump functions. Or build a system pump with multiple Enerpac VP valve series, VP03 series or VSS/VST series D03 mount valves. The VMMD series D03 Manual valves can also be used.

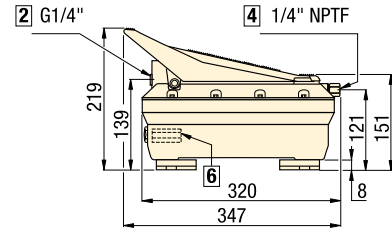
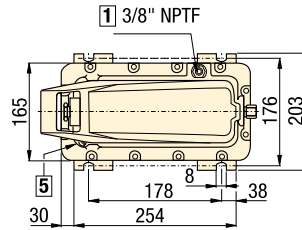
- 1 Auxiliary vent/tank fill port
- 2 Hydraulic output
- 3 Gauge mounting port
- 4 Swivel air input with filter
- 5 Filtered permanent tank vent
- 6 Adjustable pressure relief valve
- 7 Air pendant air input

## 🌐 Product selection

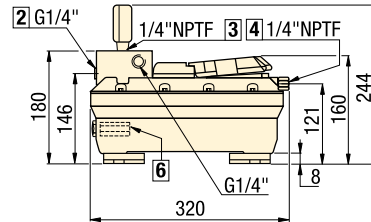
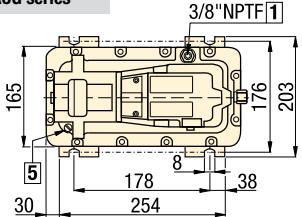
Description	Model numbers 3000 series	Model numbers 5000 series	Usable oil capacity <sup>2)</sup>		Air pressure range	Air consumption	kg
			horizontal mount litres	vertical mount			
	2,46 l/min <sup>1)</sup>	1,64 l/min <sup>1)</sup>			bar	l/min	
<b>▼ Factory supplied valves</b>							
Hand/foot 3-way	PATG-3102NB	PATG-5102NB	2,1	1,1	1,7 - 8,6	340	8,6
Hand 4-way	PAMG-3402NB	PAMG-5402NB	2,1	1,1	1,7 - 8,6	340	11,3
Remote 3-way pendant	PARG-3102NB	PARG-5102NB	2,1	1,1	1,7 - 8,6	340	10,4
<b>▼ User supplied valves</b>							
Remote mount	PACG-3002SB	PACG-5002SB	2,1	1,1	1,7 - 8,6	340	8,6
Pump mount, single D03 Valve	PASG-3002SB	PASG-5002SB	2,1	1,1	1,7 - 8,6	340	8,6

## 🌐 1,9 litres reservoir (dimensions in mm)

### PATG series

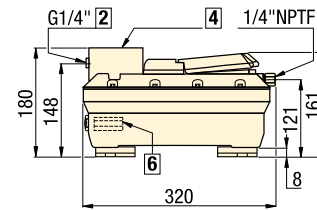
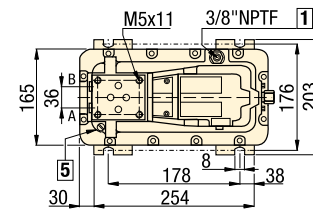


### PACG series

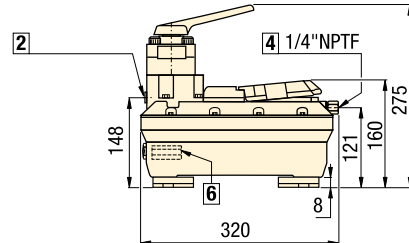
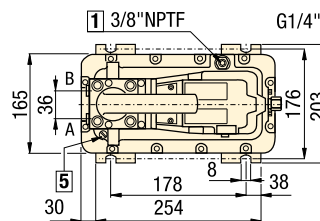


PACG series include pressure gauge G-2517L.

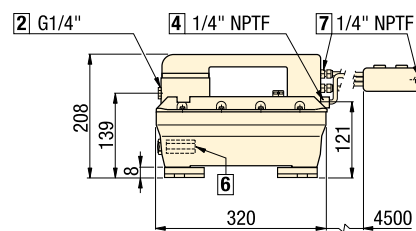
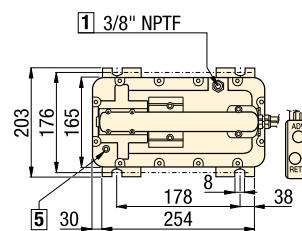
### PASG series



### PAMG series



### PARG series

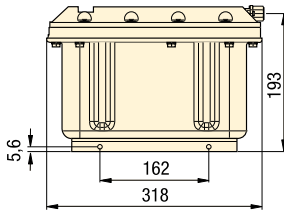


<sup>1)</sup> At 0 bar hydraulic and 7 bar air pressure.

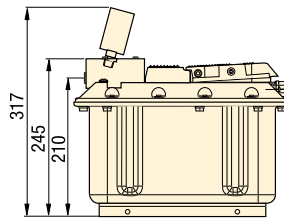
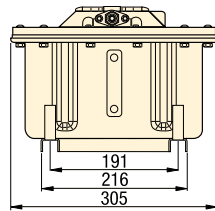
<sup>2)</sup> Turbo air-hydraulic pumps are also available with 5,0 litres reservoir. To order replace 2 in model number with 5. Sound level: 75 dBA.

**7,5 litres reservoir** (dimensions in mm)

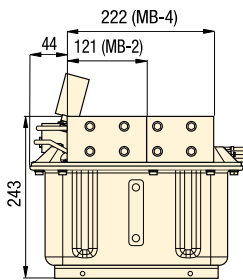
All models



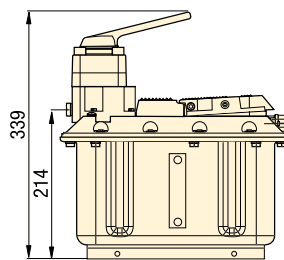
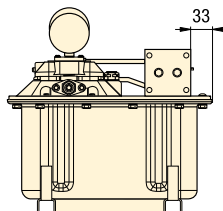
PACG series



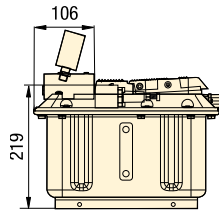
PACG with MB2 or MB4



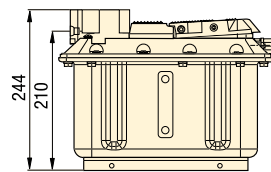
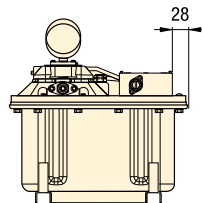
PAMG series



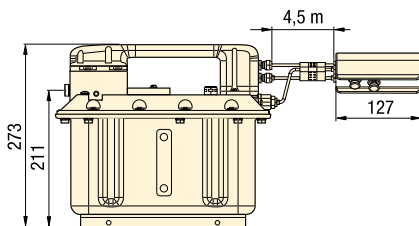
PACG with WM10



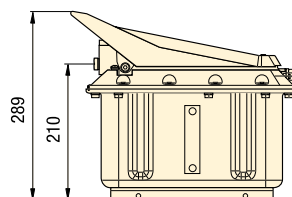
PASG series



PARG series



PATG series



Oil Flow: 0,08 - 2,46 l/min

Pressure: 350 bar

Air: 340 l/min

Reservoir: 1,9 - 7,5 litres

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

**Options**

Gauges and accessories

190 ▶




Regulator-filter-lubricator

106,158 ▶



**Product selection**

Description	Model numbers 3000 series	Model numbers 5000 series	Usable oil capacity	Air pressure range	Air consumption	
	2,46 l/min <sup>1)</sup>	1,64 l/min <sup>1)</sup>	litres	bar	l/min	kg
<b>▼ Factory supplied valves</b>						
Hand/foot 3-way	PATG-31S8N	PATG-51S8N	7,5	1,7 - 8,6	340	24,5
Hand 4-way	PAMG-34S8N	PAMG-54S8N	7,5	1,7 - 8,6	340	27,2
Remote 3-way pendant	PARG-31S8N	PARG-51S8N	7,5	1,7 - 8,6	340	26,3
<b>▼ User supplied valves</b>						
Remote mount	PACG-30S8S	PACG-50S8S	7,5	1,7 - 8,6	340	24,5
Pump mount, Single D03 Valve	PASG-30S8S	PASG-50S8S	7,5	1,7 - 8,6	340	24,5
Pump mount, Two D03 Valves	PACG-30S8S-MB2	PACG-50S8S-MB2	7,5	1,7 - 8,6	340	26,3
Pump mount, Four D03 Valves	PACG-30S8S-MB4	PACG-50S8S-MB4	7,5	1,7 - 8,6	340	27,6
Pump mount, (1-8) VP Valves	PACG-30S8S-WM10	PACG-50S8S-WM10	7,5	1,7 - 8,6	340	25,4

<sup>1)</sup> At 0 bar hydraulic and 7 bar air pressure. Sound level: 75 dBA.

Shown: ZAJ-06505S2C



## ZAJ-series

These heavy-duty air driven pumps are well suited for use in production applications.

Available with a P & T manifold for use with remote mounted VP, VP03, VSS or VST zero leakage class valves, or with either single or dual pump mounted 2-position/3-way normally Closed valves 24 VDC solenoid valves.

## Heavy-duty Air Powered Pump

- Suited for use in production applications
- 3,8 litre steel reservoir with sight glass, mounting flange.

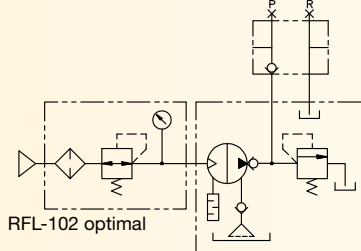
Flow: 2,0 l/min @ 0 bar  
1,0 l/min @ 140 bar

Pressure: 350 bar max.

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

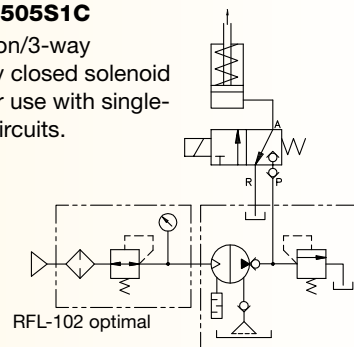
### ZAJ-06505M1

Pressure and tank manifold for use with remote mounted valves.



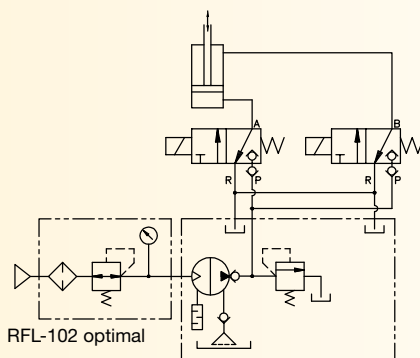
### ZAJ-06505S1C

2-position/3-way normally closed solenoid valve for use with single-acting circuits.



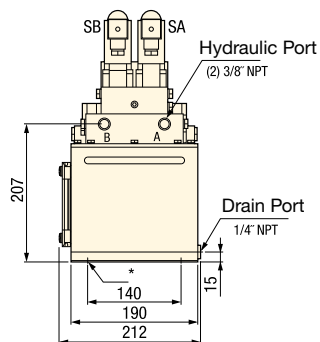
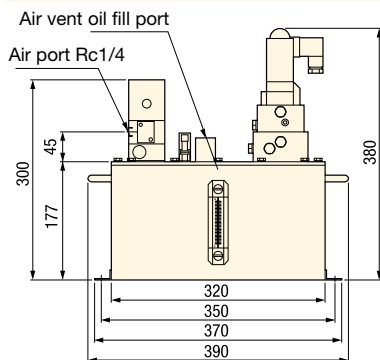
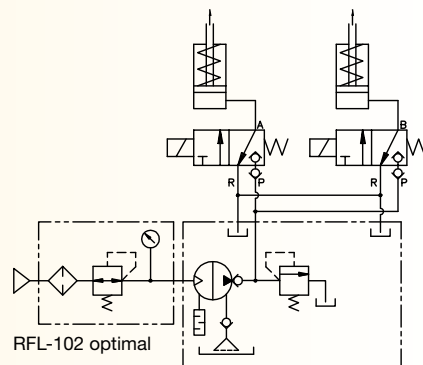
### ZAJ-06505S2C

Dual 2 position/3 way normally closed solenoid valves for use with double-acting circuits.



### ZAJ-06505S2C

Dual 2 position/3 way normally closed solenoid valves for use with two independent single-acting circuits.



\* 4 x 11 mm mounting holes

Supplied valving	Valve solenoid voltage	Model number	Air pressure range bar	Oil ports NPTF	Air consumption l/min	kg
Pressure and tank manifold	-	<b>ZAJ-06505M1</b>	1,0 - 6,9	3/8"	510	22,2
Single 2 pos./3 way solenoid valve	24 VDC	<b>ZAJ-06505S1C</b>	1,0 - 6,9	3/8"	510	22,2
Dual 2 pos./3 way solenoid valve	24 VDC	<b>ZAJ-06505S2C</b>	1,0 - 6,9	3/8"	510	22,2



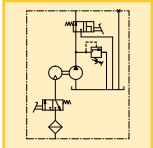
Max. flow: 0,98 - 1,97 l/min

Pressure: 210 - 350 bar

Air: 255 l/min

Reservoir: 0,6 litres

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



## 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.

Shown: PA-135, -136



### ▶ PA-series

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

## Options

Regulator-filter-lubricator

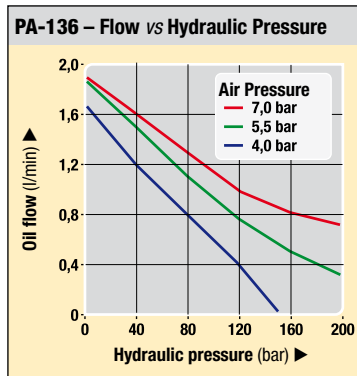
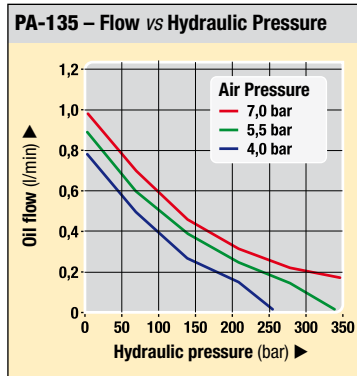
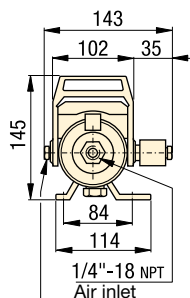
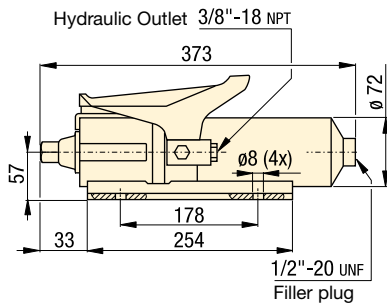


106,158 ▶

Fittings



194 ▶



■ 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	kg
					bar	l/min	
litres	l/min	bar			bar	l/min	
0,6	0,98	350	PA-135	Advance/Retract	4,1 - 6,9	255	6,5
0,6	1,97	210	PA-136	Advance/Retract	4,1 - 6,9	255	6,5

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

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

# Air hydraulic boosters *Application & selection*

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



## AHB and B-series boosters

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

## For high production applications

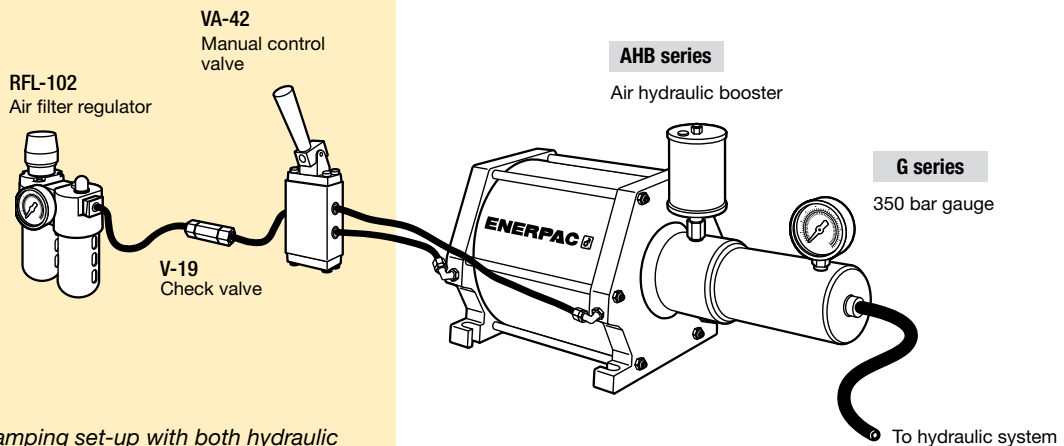
- High speed operation
- Extended service life
- Constant hydraulic output
- Large oil delivery per stroke allows quick filling of cylinders for clamping or punching

### 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, one-shot, high speed operation of air piston

### B series boosters

- One-shot spring return
- Steel and cast iron construction
- Built-in stroke sensor for automatic cycle operation  
30 VDC switch closes 25 mm before end of full air piston stroke
- Internal self-bleeding  
Automatically purges air from system when booster piston is at highest point in circuit

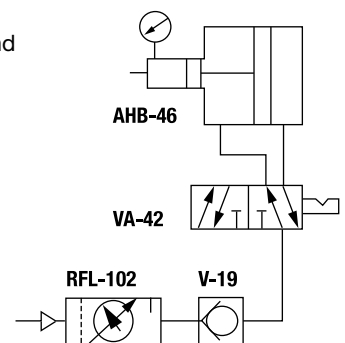


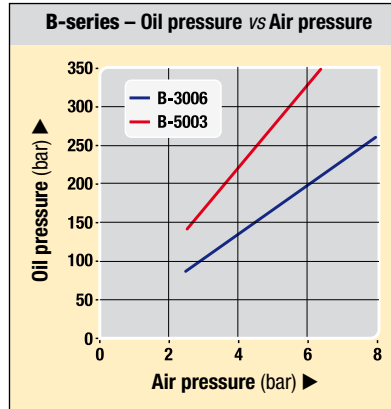
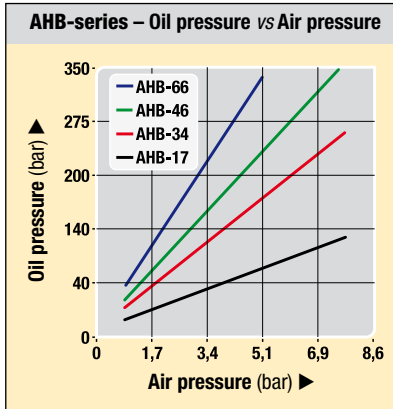
■ In an automated clamping set-up with both hydraulic and pneumatic components, AHB series boosters are used as a power source for the hydraulic system.



## Hydraulic system schematics

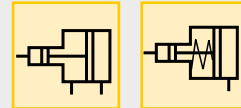
Complete power systems eliminate the guesswork of selecting valves and other system components. Plug in your 1 to 8 bar shop air line and connect your hydraulic components for a total system.





- Ratio: 1:16 - 1:64
- Pressure: 100 - 350 bar
- Oil flow: 60-295 cm<sup>3</sup>/stroke
- Air: 27 - 64 dm<sup>3</sup>/cycle

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



**Options**

**Air valves**

☐ 106,158 ▶

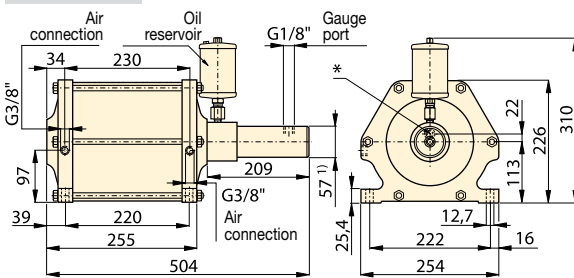
**Regulator-filter-lubricator**

☐ 106,158 ▶

**Fittings**

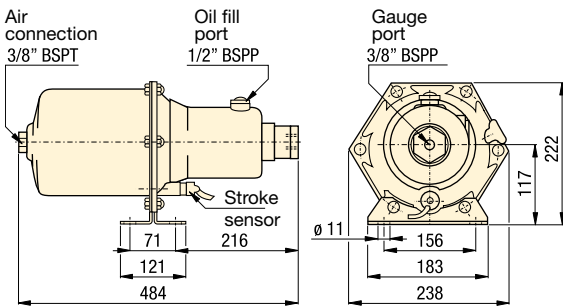
☐ 194 ▶

**AHB series**



<sup>1)</sup> Ø 72 mm for model **AHB-17**  
 \* Oil connection (G1/4")  
 \*\*\* Adapter to 3/8" NPT air connection is included.  
 NOTE: FZ-2060 Adaptor available for gauge port.

**B series**



**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.**

**Selection chart**

Oil pressure bar	Oil volume per stroke cm <sup>3</sup>	Air to oil pressure ratio	Model number	Air consumption per cycle <sup>1)</sup> dm <sup>3</sup> at 6 bar air	Air piston diameter mm	Hydraulic piston diameter mm	Hydraulic stroke mm	Air operating pressure bar		
										at 5 bar air pressure
<b>▼ AHB series</b>										
83	110	295,0	1:16	<b>AHB-17</b>	62,6	203	51	145	1-8	18,8
175	235	139,3	1:34	<b>AHB-34</b>	63,6	203	35	145	1-8	16,8
240	315	100,0	1:46	<b>AHB-46</b>	63,9	203	30	145	1-8	16,4
330	-	73,7	1:64	<b>AHB-66</b>	64,1	203	25	145	1-5	16,0
<b>▼ B series</b>										
155	210	101,6	1:30	<b>B-3006</b>	27	180	31	132	3-9	14,0
260	350	60,6	1:50	<b>B-5003</b>	27	180	24	132	3-9	14,0

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

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.

- 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.

## Important

**Valving help**  
See Basic System Set-up and Valve information in our "Yellow Pages".

## To control and regulate air supply

### 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 0,11 Amps, holding 0,07 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 1500 l/min

### HV-1000A Air pilot holding valve

- Holds fluid under pressure offering independent control of different branches of the same fixture
- Valve can control the pilot air and the booster in sequence
- Max. oil flow 5 l/min
- Works with the VA-42 four-way air valve and a booster

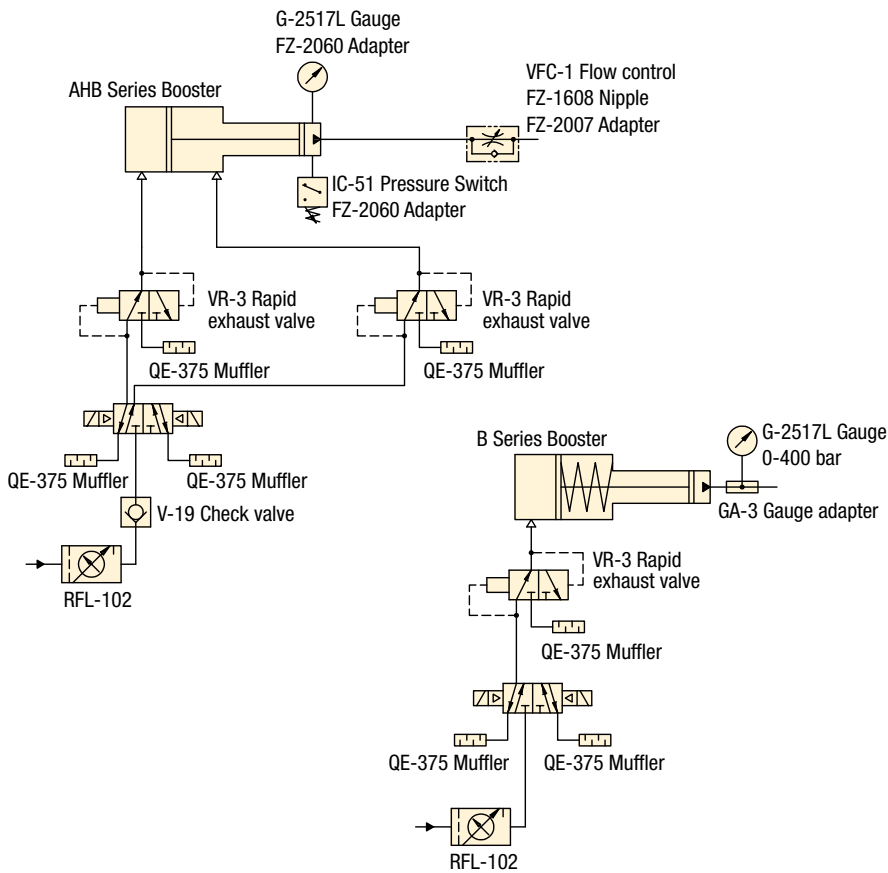
### QE-375 Muffler

- Use with VR-3 or VAS/VA-42
- Reduces noise level of exhaust air from pump.

## Product selection

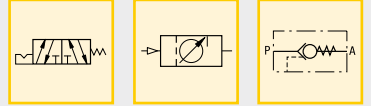
Maximum pressure bar	Model number
<b>▼ Air valves</b>	
2-10	VA-42
2-10	VAS-42
0-7	VR-3
0-7	V-19
<b>▼ Holding Valve</b>	
0-7	HV-1000A*
<b>▼ Accessories</b>	
0-8,6	RFL-102
0-8,6	QE-375

\* Maximum hydraulic pressure: 207 bar.



**Air Pressure: 0 - 10 bar**

- E** Válvulas de aire
- F** Valves à air
- D** Luftventile



## Options

**Gauges and adaptors**

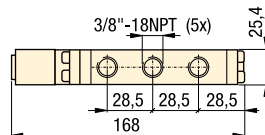
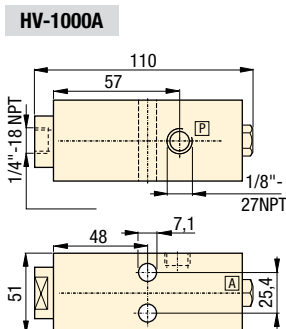
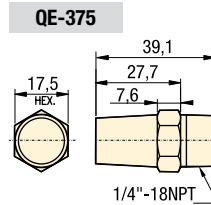
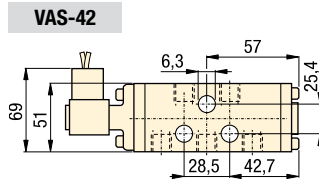
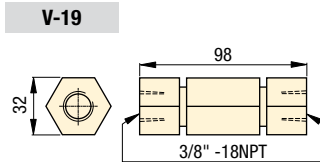
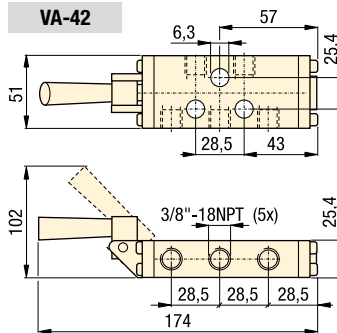
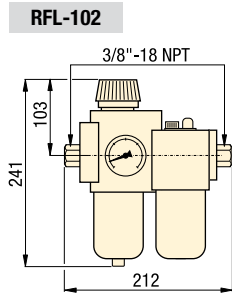
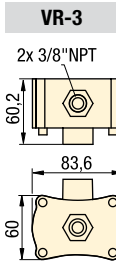
190 ▶

**Hoses**

192 ▶

**Fittings**

194 ▶



## Important

**Valving help**  
See Basic System Set-up and Valve information in our "Yellow Pages".

197 ▶



Shown: WUD-1301E



## WU-series

The Economy pump is best suited to power small to medium size fixtures. Its lightweight and compact design makes it ideal for applications which require easy transport of the pump. The universal motor works well on long extension cords.

## Heavy on performance, light on weight

- Lightweight and compact design, 12 kg
- Large easy-carry handle for maximum portability
- Two-speed operation reduces cycle times for improved productivity
- 115 VAC 50/60- or 220 VAC 50/60-cycle universal motor will operate on voltage as low as 60 volts
- 24 VDC remote motor control, 3 meters for operator safety
- Starts under full load
- High strength molded shroud with integral handle, protects motor from contamination and damage
- Designed for intermittent duty cycle.

### WUD-1100 series

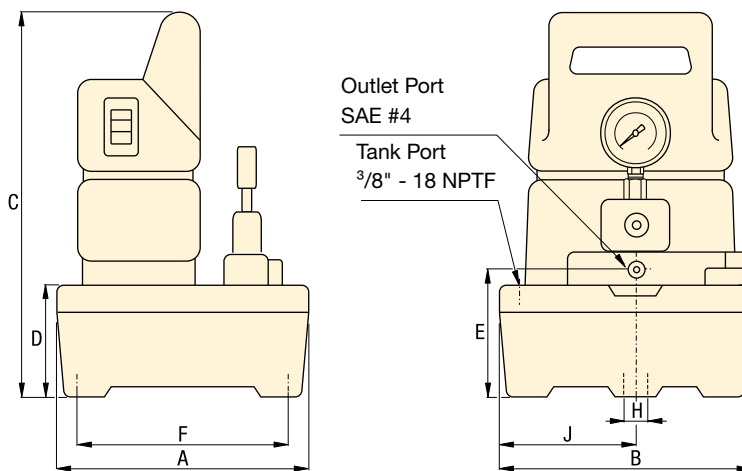
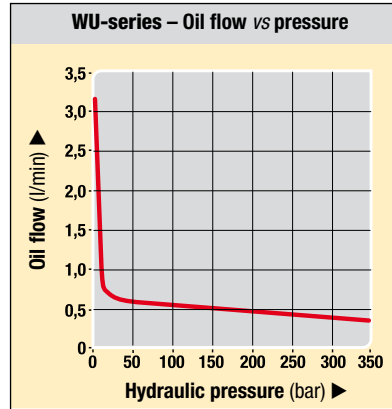
- Provides advance/auto-retract of single-acting cylinders
- 3 meters pendant controls motor and valve operation
- Use with AP-500 accumulator coupler package.

### WUD-1300 series

- Provides advance/hold/retract of single-acting cylinders
- 3 meters pendant controls motor and valve operation
- Ideal for applications requiring remote valve operation
- Use with ACBS-22 or ACBS-202 accumulator coupler packages.

## Product selection

Model number	Used with cylinder	Pressure rating bar	
		1st stage	2nd stage
WUD-1100B	single-acting	14	350
WUD-1101B	single-acting	14	350
WUD-1100E	single-acting	14	350
WUD-1101E	single-acting	14	350
WUD-1300B	single-acting	14	350
WUD-1301B	single-acting	14	350
WUD-1300E	single-acting	14	350
WUD-1301E	single-acting	14	350



**Product dimensions in mm** [ ]

Usable oil capacity	Model number	A	B	C	D	E	F	H	J	
1,9	<b>WUD-1100B</b>	244	244	362	102	120	203	10	133	11,8
3,8	<b>WUD-1100B</b>	368	309	374	105	130	324	10	143	15,9
1,9	<b>WUD-1100E</b>	244	244	362	102	120	203	10	133	11,8
3,8	<b>WUD-1100E</b>	368	309	374	105	130	324	10	143	15,9
1,9	<b>WUD-1300B</b>	244	244	362	102	120	203	10	133	11,8
3,8	<b>WUD-1300B</b>	368	309	374	105	130	324	10	143	15,9
1,9	<b>WUD-1300E</b>	244	244	362	102	120	203	10	133	11,8
3,8	<b>WUD-1300E</b>	368	309	374	105	130	324	10	143	15,9

	Output flow rate		Valve type	Current draw	Motor voltage	Sound level	Model number
	1st stage	2nd stage					
	3,28	0,33	Dump*	9,5	115	85	<b>WUD-1100B</b>
	3,28	0,33	Dump*	9,5	115	85	<b>WUD-1101B</b>
	3,28	0,33	Dump*	3,2	230	85	<b>WUD-1100E</b>
	3,28	0,33	Dump*	3,2	230	85	<b>WUD-1101E</b>
	3,28	0,33	Dump and Hold	9,5	115	85	<b>WUD-1300B</b>
	3,28	0,33	Dump and Hold	9,5	115	85	<b>WUD-1301B</b>
	3,28	0,33	Dump and Hold	3,2	230	85	<b>WUD-1300E</b>
	3,28	0,33	Dump and Hold	3,2	230	85	<b>WUD-1301E</b>

\* Electric dump valve for auto-retract of cylinders.

- Flow: 0,33 l/min**
- Pressure: 350 bar max**
- Motor: 0,37 kW**
- Reservoir: 1,9 - 3,8 litres**

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

**Standard equipment**

**Gauge, filter and pressure switch**

Pumps are supplied with a manifold mounted 400 bar gauge for convenient reading of pump pressure.

A filter at the pressure port helps to protect the pump from contamination.

A manifold mounted adjustable pressure switch provides control of the pump shut-off pressure.

**Options**

- G-series pressure gauges** 190 ▶
- Hoses** 192 ▶
- FZ-series fittings** 194 ▶
- HF-series hydraulic oil** 193 ▶

# Electric submerged pumps

Shown: WEM-1401E



## 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 (60-70 dBA)
- 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.

## Select your pump type

### WED-series with dump valve

- For use when load holding is not required
- Ideal for palletized workholding for single acting circuits
- 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.



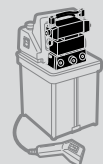
### WEM-series with manual valve

- 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, WET-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: IC-51: 207-517 bar  
IC-31: 35-241 bar.

Flow: 0,65 l/min

Pressure: 350 bar max

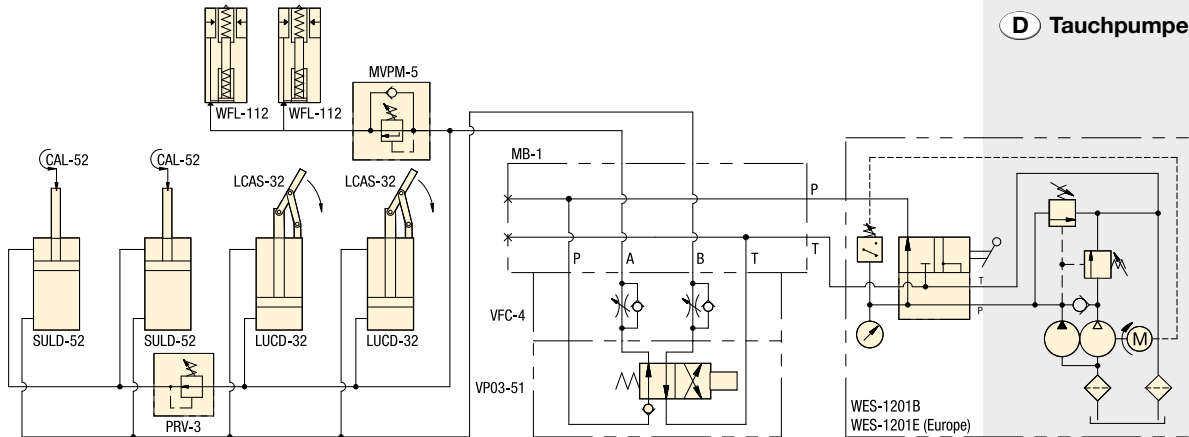
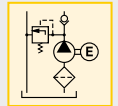
Motor: 0,37 kW

Reservoir: 5,7 litres

**E** Bombas eléctricas

**F** Centrale hydraulique

**D** Tauchpumpe



Used with cylinder	Valve function	Valve type	Model number	Motor voltage 50/60 Hz	Heat exchanger
Single-Acting	Advance / Retract	Dump	<b>WED-1101B</b>	115V	
Single-Acting	Advance / Retract	Dump	<b>WED-1101E</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>WET-1201B</b>	115V	
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	

## Options

**G-series pressure gauges**

190 ▶



**FL-series high-pressure filters**

193 ▶



**FZ-series fittings**

194 ▶



**HF-series hydraulic oil**

193 ▶



## 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.

# WE-series, Submerged Electric Pumps

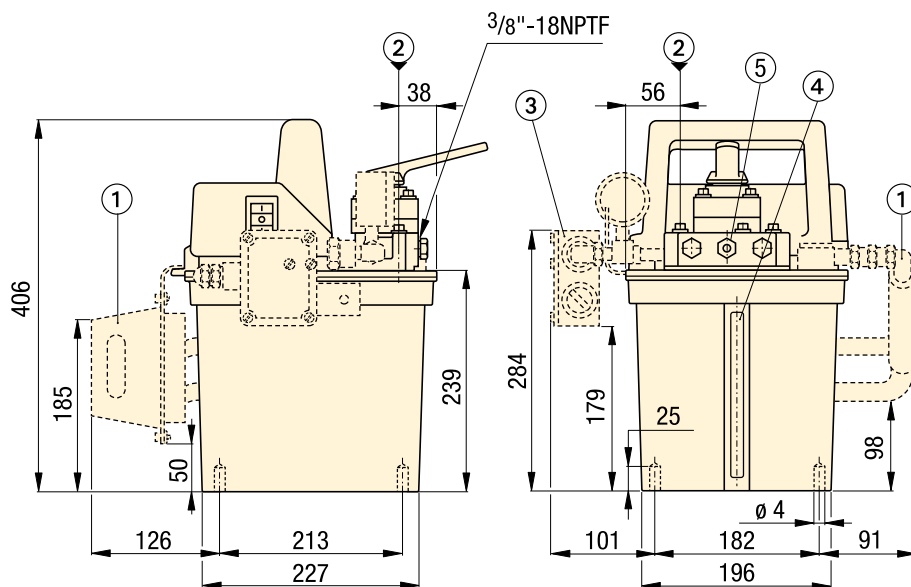
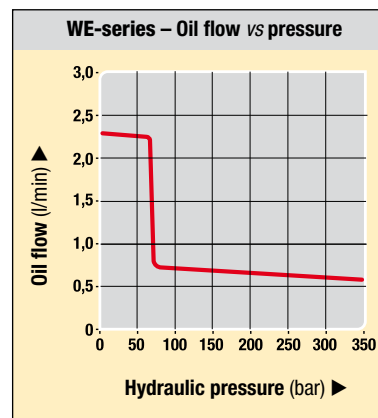
Shown: WEM-1401E



## WER series

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

◀ For full features see page 110.



Dimensions shown in mm.

- ① Heat Exchanger (optional for all models)
- ② Fill Port
- ③ Pressure Switch (WES-Series, optional for other models)
- ④ Oil Level Indicator
- ⑤ Adjustable Relief Valve

## Product selection

Motor voltage	Motor capacity	Amperage draw	Maximum oil flow**		Pressure rating		Usable oil capacity	Adjustable relief valve	Weight
			1st stage	2nd stage	1st stage	2nd stage			
50/60 Hz	kW	Amps	1st stage	2nd stage	1st stage	2nd stage	litres	bar	kg
115V-1ph	0,37	13,5	2,45	0,65	70	350	5,5	70 - 350	29 <sup>1)</sup>
230V-1ph	0,37	6,75	2,45	0,65	70	350	5,5	70 - 350	29 <sup>1)</sup>

<sup>1)</sup> Weight for WES and WET models is 37 kg.

\*\* All flow data at 50 Hz.



## Custom build your submerged pump

### ▼ This is how a submerged pump model number is built up:

If the submerged pump that would best fit your application cannot be found in the chart on page 111, you can easily build your custom submerged pump here.



#### 1 Product Type

W = Workholding Pump

#### 2 Motor Type

E = Electric motor

#### 3 Pump Type

D = Dump

J = Jog

M = Manual

R = Remote (solenoid)

S = Pressure switch (IC-51)

T = Pressure switch (IC-31)

#### 4 Pump Series

1 = 0,37 kW, 350 bar

#### 5 Valve Type

0 = No valve (WER only)

1 = 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 Capacity

01 = 5,5 litres usable oil

#### 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



#### Examples

Model number:  
**WER-1301E**

The **WER-1301E** is a 0,37 kW, 350 bar, submerged electric pump, with 5,5 litres usable oil capacity, a 3-way, 3-position modular, remote solenoid valve (VEF-series) and a 230 V, 1 phase, 50/60 Hz motor.

Model number:  
**WER-1501E- VED11000D**

The **WER-1501E** is a 0,37 kW, 350 bar, submerged electric pump, with 5,5 litres usable oil capacity. The valve, model **VED11000D** is a 24 V, 50 Hz solenoid valve. (For details and options for all VE-series valves see pages 146-147).

Flow: 0,65 l/min

Pressure: 350 bar max

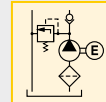
Motor: 0,37 kW

Reservoir: 5,5 litres

**E** Bombas eléctricas

**F** Centrale hydraulique

**D** Tauchpumpe



#### Important

**WER series pumps use the VE-series valves shown on page 146. WER-13 series uses VEF-series valve. WER-14 series uses VEC-series valve.**

**WES series pumps use IC-51 pressure switch, adjustable from 210-525 bar**

**WET series pumps use IC-31 pressure switch, adjustable from 35-245 bar.**

Shown: ZW5020HE-FT22



**Z-Class electric pumps are designed for use in the harshest manufacturing environments. The pumps provide reliable and durable performance in a wide variety of configurations.**

## The standard for workholding applications

- Features Z-Class high-efficiency pump design; higher oil flow and by-pass pressure, cooler running and requires 18% less current than comparable pumps
- Totally enclosed, fan cooled industrial electric motors supply extended life and stand up to harsh industrial environments
- Multiple valve and reservoir configurations provide application specific models to match the most demanding workholding applications
- High-strength, molded electrical enclosure protects electronics, power supplies and LCD readout from coolant and contamination.

Collet-Lok® products

Swing clamps

Work Supports

Linear Cylinders

Power Sources

### Basic configurations

All pumps listed in this chart include LCD electrical box, 20 litres reservoir, return line filter and either 0-420 bar pressure gauge or pressure transducer (solenoid valve models). For additional options, see the complete pump matrix on page 117.

### Pump type

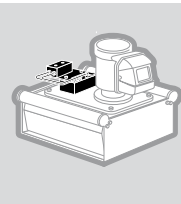
### Valve/manifold type

### Motor voltage

50/60 Hz

### ZW-Series with manifold

- Used when supplying pressure to multiple valve circuits
- Valves must be supplied separately.



Pressure and tank ports

230 VAC, 3 ph

Single station DO3

230 VAC, 3 ph

Enerpac VP-series

230 VAC, 3 ph

Two station DO3

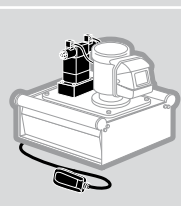
230 VAC, 3 ph

Four station DO3

230 VAC, 3 ph

### ZW-Series with pallet coupling valve

- Provides momentary pressure and flow to fixture
- Ideal for pallet disconnect systems.



4-way, 3-pos. solenoid operated

115 VAC, 1 ph

4-way, 3-pos. solenoid operated

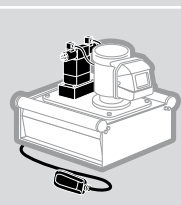
230 VAC, 3 ph

4-way, 3-pos. solenoid operated

460 VAC, 3 ph

### ZW-Series with continuous connection valve

- Provides solenoid control of one single or double-acting circuit
- Control valve supplied with integrated pilot operated check to ensure positive pressure holding.



4-way, 3-pos. solenoid operated

115 VAC, 1 ph

4-way, 3-pos. solenoid operated

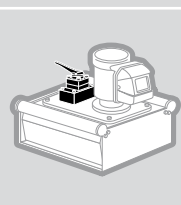
230 VAC, 3 ph

4-way, 3-pos. solenoid operated

460 VAC, 3 ph

### ZW-Series with manual valve

- Provides manual control of one single or double-acting circuit
- Control valve supplied with center holding function to ensure positive position holding.



4-way, 3-pos. manually operated

115 VAC, 1 ph

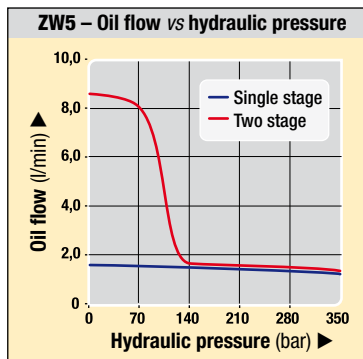
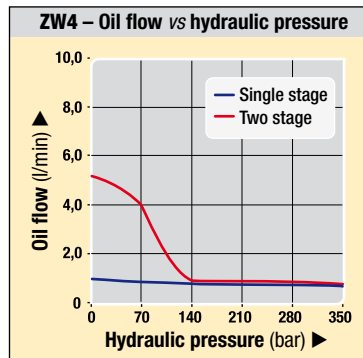
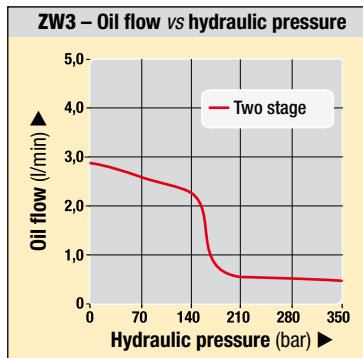
4-way, 3-pos. manually operated

230 VAC, 3 ph

4-way, 3-pos. manually operated

460 VAC, 3 ph

## Output oil flow versus hydraulic pressure



ZW3 Series Output oil flow at 0,54 l/min at 350 bar LCD Electric Model Nr.	ZW4 Series Output oil flow at 0,82 l/min at 350 bar LCD Electric Model Nr.	ZW5 Series Output oil flow at 1,64 l/min at 350 bar LCD Electric Model Nr.
ZW3020HG-FE01	ZW4020HG-FW01	ZW5020HG-FW01
ZW3020HG-FE11	ZW4020HG-FW11	ZW5020HG-FW11
ZW3020HG-FE12	ZW4020HG-FW12	ZW5020HG-FW12
ZW3020HG-FE21	ZW4020HG-FW21	ZW5020HG-FW21
ZW3020HG-FE41	ZW4020HG-FW41	ZW5020HG-FW41
ZW3420DB-FT	ZW4420DB-FT	ZW5420DB-FT
ZW3420DE-FT	ZW4420DE-FT	ZW5420DE-FT
ZW3420DW-FT	ZW4420DW-FT	ZW5420DW-FT
ZW3420FB-FT	ZW4420FB-FT	ZW5420FB-FT
ZW3420FE-FT	ZW4420FE-FT	ZW5420FE-FT
ZW3420FW-FT	ZW4420FW-FT	ZW5420FW-FT
ZW3420LB-FG	ZW4420LB-FG	ZW5420LB-FG
ZW3420LE-FG	ZW4420LE-FG	ZW5420LE-FG
ZW3420LW-FG	ZW4420LW-FG	ZW5420LW-FG

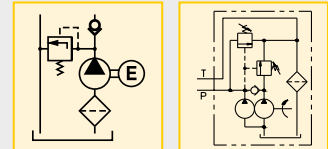
Flow rate: 0,54 - 1,64 l/min

Pressure: 350 bar max

Motor: 0,75 - 1,12 kW

Reservoir: 8 - 40 litres

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



### ! Important

All Z-Class electric pumps are CSA and CE compliant.



LCD electrical package is required for pumps utilizing electric valves, or optional accessories such as the pressure transducer, level switch, pressure switch or heat exchanger.

Single-stage pumps provide constant flow throughout the entire pressure range via a radial piston pump. Two-stage pumps provide high flow via a gear pump until the bypass pressure is reached. At pressures above the bypass setting, the radial piston pump provides flow to the maximum pressure.

# Electric pumps *Dimensions & options*

Shown: ZW5020HE-FT22



## ZW-series

Z-Class electric pumps are designed for use in the harshest manufacturing environments. The pumps provide reliable and durable performance in a wide variety of configurations.

- Efficient design reduces heat generation and reduces power consumption
- Balanced pump section reduces vibration improving durability and sound levels
- Optional back-lit LCD readout provides hour and cycle counts, low voltage warnings and pressure read-out when used with pressure transducer
- Low-voltage pendant on solenoid valve models with sealed switches improves operator safety
- **Z-Class** electric pumps can be supplied with factory installed accessories such as valve manifold, pressure transducer, and return line filter, creating a complete power unit solution.

<b>Flow: 0,54 - 1,64 l/min</b>
<b>Pressure: 350 bar</b>
<b>Motor: 0,75 - 1,12 kW</b>
<b>Reservoir: 8 - 40 litres</b>

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

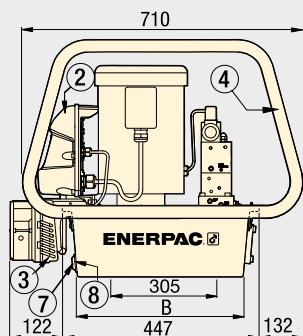
## Options

### User adjustable relief valve

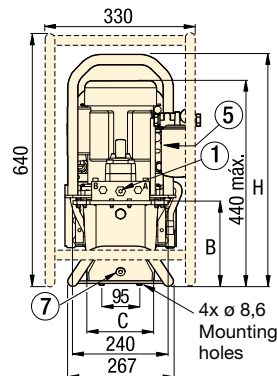
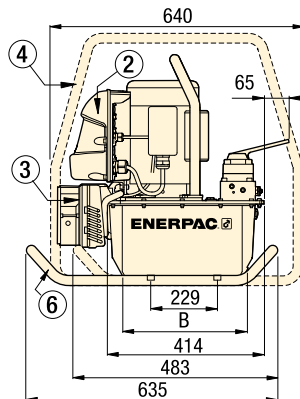
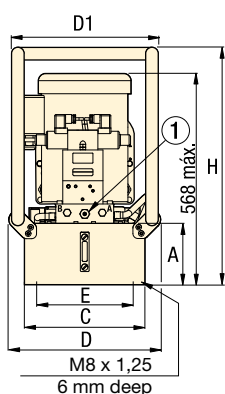


All ZW-Series have a user adjustable relief valve to allow the operator to easily set the optimum working pressure.

10, 20, 40 litres



8 litres



- ① Pump mounted manifold
  - User adjustable relief valve
  - 3/8" NPTF on A and B ports
  - 1/4" NPTF on auxiliary ports
- ② Electric Box (Optional w/manual valve)
- ③ Heat Exchanger (Optional)
- ④ Roll Bar (Optional)
- ⑤ Return Line Filter (Optional)
- ⑥ Skid Bar (Optional)
- ⑦ Oil Drain
- ⑧ Oil Level/Temperature Switch (Optional)

## Product dimensions in mm [ $\text{D} \pm \text{D}$ ]

Usable oil capacity	ZW Series pump dimensions							
	litres	A	B	C	D	D1	E	H
8	206	287	168	-	-	-	-	574
10	155	419	305	384	371	279	599	
20	180	419	422	500	488	396	625	
40	269	399	505	577	572	480	714	

## Product selection

Pump series	Output flow rate at 50 Hz (l/min)				Motor size kW	Relief Valve adjustment range bar	Sound level dBA
	7 bar	50 bar	115 bar	210 bar			
ZW3 *	2,80	2,68	2,32	0,54	0,54	70 - 350	75
ZW4	5,19	4,17	-	0,86	0,82	70 - 350	75
ZW5	8,74	8,23	-	1,68	1,64	70 - 350	75

\* Constant flow rate for single-stage models.

# ZW-series, Electric Pump ordering matrix

## Custom build your pump

▼ This is how a ZW-series Model number is built:

<b>Z</b>	<b>W</b>	<b>4</b>	<b>0</b>	<b>20</b>	<b>H</b>	<b>G</b>	<b>- FG</b>	<b>01</b>
1	2	3	4	5	6	7	8	9
Product Type	Motor Type	Flow Group	Valve Type	Usable Oil Capacity	Valve Operation	Voltage	Options <sup>1</sup>	Manifold Options

### 1 Product type

**Z** = Z-Class Pump

### 2 Motor type

**W** = Workholding Electric

### 3 Flow group

**3** = 0,54 l/min

**4** = 0,82 l/min

**5** = 1,64 l/min

### 4 Valve type

**0** = No valve or valve manifold

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

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

**4** = 4-way, 3-position, manual or solenoid valve

**6** = 3-way, 3-position, tandem center w/P.O. check (manual only)

**8** = 4-way, 3-position, tandem center w/P.O. check (manual only)

### 5 Usable oil capacity

**8** = 8 litres (2 gallon)

**10** = 10 litres (2,5 gallon)

**20** = 20 litres (5 gallon)

**40** = 40 litres (10 gallon)

### 6 Valve operation

**D** = Solenoid valve (pallet coupling) with pendant and LCD (valve type **4**)

**F** = Solenoid valve (continuous connection) with pendant and LCD (valve type **4**)

**G** = Valve manifold without LCD (valve type **0**)

**H** = Valve manifold with LCD (valve type **0**)

**L** = Manual valve with LCD (without pendant, valve type **2, 3, 4, 6** or **8**)

**M** = Manual valve without LCD (valve type **2, 3, 4, 6** or **8**)

**N** = No valve, without LCD (valve type **0**)

**W** = No valve with LCD (valve type **0**)

### 7 Power supply

Single Phase

**B** = 115V, 1 ph, 50-60 Hz<sup>3</sup>

**E** = 208-240V, 1 ph, 50-60 Hz  
European plug

**I** = 208-240V, 1 ph, 50-60 Hz  
USA plug

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<sup>2</sup>

**F** = Return line filter, 25 micron

**G** = 0-420 bar pressure gauge, 63,5 mm<sup>5</sup>

**H** = Heat exchanger<sup>4</sup>

**L** = Level/temperature switch<sup>4</sup>

**N** = No handles (lifting eyes only)<sup>2</sup>

**P** = Pressure switch<sup>4</sup>

**R** = Roll bars

**S** = Single stage

**T** = Pressure transducer<sup>4</sup>

**U** = Foot switch<sup>4</sup>

### 9 Manifold options<sup>5</sup> (Pump types G and H only)

**01** = Pressure & tank porting manifold

**11** = Single station D03

**12** = VP series manifold

**13** = Single station CETOP

**21** = 2 station D03

**22** = 2 station CETOP

**41** = 4 station D03

**42** = 4 station CETOP

<sup>1</sup> Options should be specified in alphabetical order.

<sup>2</sup> Unless specified, all pumps are supplied with reservoir handles.

<sup>3</sup> 115 volt pumps are supplied with CE and CSA approved 15 Amp plug for intermittent use. 20 Amps circuit recommended for frequent full pressure use.

<sup>4</sup> These options require LCD electrical package.

<sup>5</sup> Pressure gauge not available on pump models with pressure transducer. Pressure transducer provides digital pressure readout on LCD display.

<sup>6</sup> Pressure switch option is only used as input to a customer control. It is not used with the LCD electrical package.

## Example

The **ZW5810LG-FT** is a 1,64 l/min, 2-stage pump with a manual 4-way, 3 position tandem center valve, integrated P.O. check, LCD electrical box, 10 litres reservoir, 208-240 volt 3-phase motor, return line filter and pressure transducer.

Flow: 0,54 - 1,64 l/min

Pressure: 350 bar

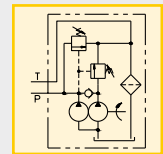
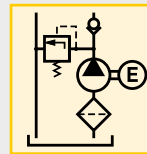
Motor: 0,75 - 1,12 kW

Reservoir: 8 - 40 litres

**E** Bombas eléctricas

**F** Centrale hydraulique

**D** Modulare Spannumppe



## Example

**ZW4020GE-FGS21** is a 0,82 l/min, single-stage pump with a 2 station D03 manifold, standard electric without LCD, 20 litres reservoir, 230 volt, 50/60 Hz motor, return line filter and 0-420 bar pressure gauge.

**ZW4410DW-T** is a 0,82 l/min, 2-stage pump with a pallet de-coupling valve, LCD electrical box, 10 litres reservoir, 380-415 volt 3-phase motor and pressure transducer.

**ZW5040HG-FGL01** is a 1,64 l/min, 2-stage pump with a pressure and tank manifold, LCD electrical box, 40 litres reservoir, 230 Volt 3-phase motor, return line filter, 0-420 bar pressure gauge and level and temperature shutdown switch.



Shown: ZPF



## ZPF 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

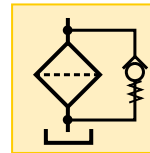
Pressure: max. 13,8 bar

Max. flow: 45,4 l/min

(E) Filtro

(F) Filtre

(D) Filter

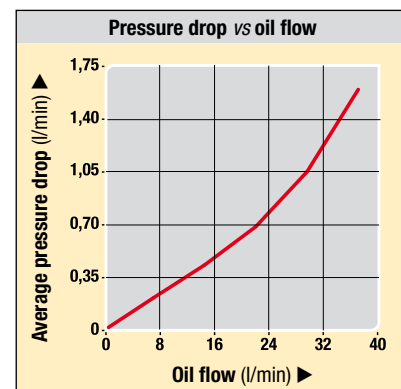


## Options

PF-25 replacement filter element



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



## Product selection

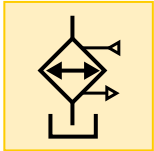
Nominal filtration	Model number	Maximum pressure	Maximum oil flow	Bypass pressure setting	Filter gauge service indicator	kg
micron		bar	l/min	bar		
25	ZPF	13,8	45,4	1,7	●	1,5

Transfer: 900 Btu/h

Pressure: max. 21 bar

Voltage: 24V

- E** Intercambiador de calor
- F** Échangeur de chaleur
- D** Wärmetauscher



## Extends system life

- Electrical connector factory installed
- All installation components included
- Stabilizes oil temperature at a maximum of 54° C at 21° C ambient temperature
- Stabilizes oil viscosity, increasing oil life and reduces wear of pump and other hydraulic components

Shown: ZHE-E10



### ZHE series

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

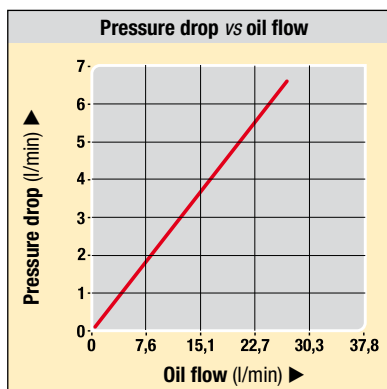
### Important

#### ZHE- Series Heat Exchangers

Heat exchanger stabilizes oil temperature at 54° C at 21° C ambient temperature.

Thermal transfer at 19 l/min and 21° C ambient temperature: 900 Btu/hour.

**Do not exceed maximum oil flow of 26,5 l/min and maximum pressure of 20,7 bar. Not suitable for water-glycol or high water based fluids.**



## Product selection

Voltage	Model number	Thermal transfer*		Amperage draw	Maximum pressure	Maximum oil flow	
		Btu/h	kJoule				
VDC				A	bar	l/min	kg
24	<b>ZHE-E10</b>	900	950	0,95	21	26,5	4,0

\*At 1,9/min and ambient temperature of 21° C.

Shown: ZLS-U4



## ZLS 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 glass, the level/temp switch will turn off the pump before internal damage can occur due to cavitations.

## Electronic level/temperature 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.

Temp. set point: 80° C

Voltage: 24 VDC

- (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	
°C		VDC	Amps	bar	kg
80	<b>ZLS-U4</b>	24	2,6	10	0,05

Shown: ZPT-U4, ZPS-W4



## ZPT-series

ZPT pressure transducer provides constant pressure monitoring for automated pump control.

## ZPS-series

ZPS pressure switch can be used to provide a pressure signal to an external control.

## Control your pump, monitor pressure

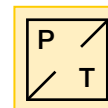
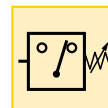
### ZPT pressure transducer

- More durable than analog gauges (against mechanical and hydraulic shock)
- More accurate than analog gauges (0,5% full scale)
- Calibration can be fine tuned for certification
- "Auto-mode" provides automatic pressure make-up
- Display pressure in psi, bar or MPa

Pressure: 3,5 - 700 bar

Voltage: 115 VAC / 24 VDC

- (E) Presión transductor
- (F) Pressostats
- (D) Druckschalter



### ZPS pressure switch

- Includes glycerin filled gauge, G2536L
- Can be used to provide pressure input to customer provided controls
- Not to be used with LCD control
- For pressure based input to the LCD control, use the ZPT-U4 transducer.

## Product Selection

Adjustable pressure range	Electrical specification	Model number	Accuracy (full scale)	Deadband	
bar				bar	kg
3,5 - 700	4-20 mA	<b>ZPT-U4</b>	0,5 %	3,5	0,13
35 - 700	115 VAC /24 VDC N.O.	<b>ZPS-W4</b>	2,0 %	8 - 40	1,22

Note: Electrical harness included with kit. ZPS-W4 includes 0-420 bar pressure gauge.

## Important

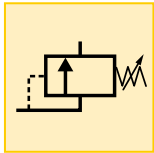
The pressure transducer is factory installed in the "A" port on pumps supplied with valves, and in the "P" port on models with manifolds.

**Pressure: 350 bar**

**Stations: 1-4 valves horizontal**

**Stations: 1-8 valves vertical**

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



## Increased flexibility for complex systems

- Manifolds provide hydraulic connection to remote or pump mounted valves
- Used when multiple valves are required for controlling several independent circuits
- Available for 2 and 4 station D03 as well as Enerpac VP series mounting
- Pressure and tank porting manifold available for use with remote valve sticks
- Manifolds include integrated relief valve for system pressure control.

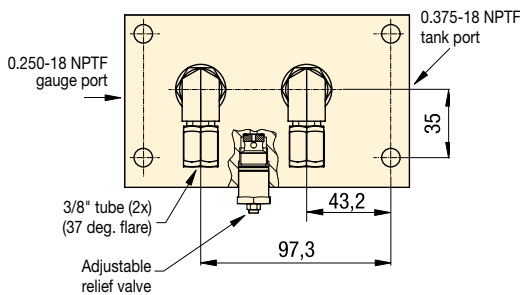
Shown: MB-2, -4



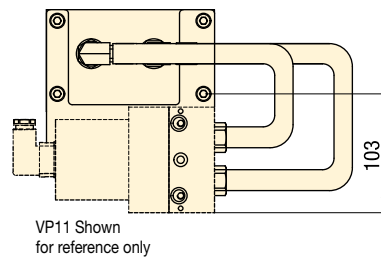
### ▶ MB series

Manifolds allow the use of multiple valves powered by a single hydraulic pump. Manifolds are available factory installed on your Z-Class workholding power unit, or separately for future system upgrades.

#### Option 01



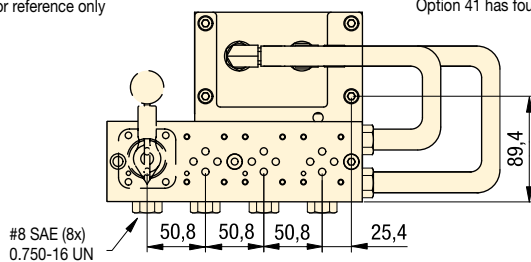
#### Option 12



#### Option 21, 41

VMMD-001 Shown for reference only

Option 21 has two valve stations  
 Option 41 has four valve stations



## Product Selection

Valve mounting pattern	Option code (see page 117)	Number of stations	Coverplate model number
Porting manifold, SAE ports	<b>01</b>	-	-
Enerpac VP Series	<b>12</b>	1-8	-
2 station DO3	<b>21</b>	2	MC-1
4 station DO3	<b>41</b>	4	MC-1
2 station CETOP3	<b>22</b>	2	MC-3
4 station CETOP3	<b>42</b>	4	MC-3

## Options

### Pressure transducer

120 ▶



### Level switch

120 ▶



- *Enerpac porting manifold provides pressure and tank line to remote mounted valve stack on a machining center.*



# Pallet coupling pumps *Application & selection*

Shown: ZW4420FE-FT



▶ The new Enerpac Pallet Coupling Pump provides three modes of operation:

### Manual mode

Pump runs as long as operator holds down pendant button.

### AUTO mode without timer

Pump runs until user-adjustable pressure setting is reached.

### AUTO mode with timer

Pump runs until pressure setting is reached, and adjustable timer runs out.

■ ZW5410FE-FT used to connect and disconnect a palletized fixture.

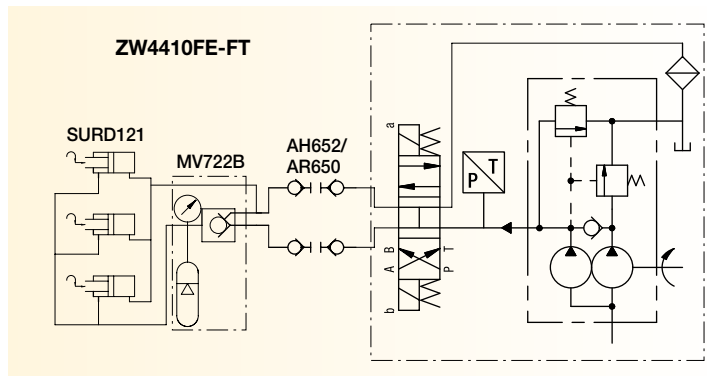


## Automatic pressure control for palletized fixtures

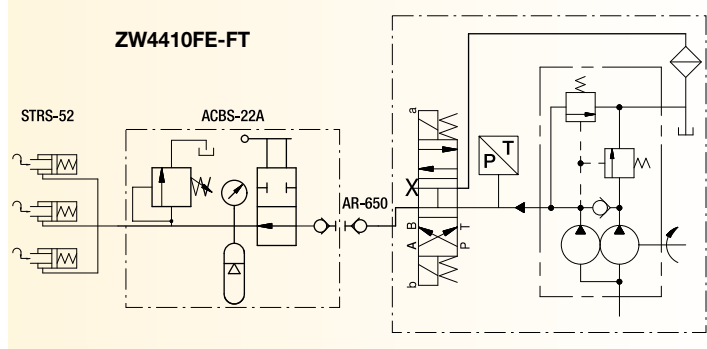
- Programmable clamp and unclamp pressure settings increase automation capability
- Programmable dwell settings ensure desired pressure level is maintained on large circuits or circuits with accumulators
- Remote pendant features sealed switches for improved operator safety
- Backlit LCD provides pump usage information, hour and cycle counts.

## Example Circuits

- Double-acting circuit



- Single-acting circuit



## Product selection

Flow rate @ max. pressure	Motor size	Motor voltage	Model number	Pressure range	Sound level	Usable oil capacity	
l/min	kW	V-ph-Hz		bar	dBA	litres	kg
0,54	0,75	115-1-50	<b>ZW3408DB-FT</b>	70-350	75	8	52
		115-1-50	<b>ZW3410DB-FT</b>			10	61
		230-1-50	<b>ZW3408DE-FT</b>			8	52
		230-1-50	<b>ZW3410DE-FT</b>			10	61
0,82	0,75	115-1-50	<b>ZW4410DB-FT</b>	70-350	75	10	54
		230-1-50	<b>ZW4410DE-FT</b>				
		400-3-50	<b>ZW4410DW-FT</b>				
1,64	1,12	115-1-50	<b>ZW5410DB-FT</b>	70-350	75	10	58
		230-1-50	<b>ZW5410DE-FT</b>				
		400-3-50	<b>ZW5410DW-FT</b>				



## **i** Operation – pallet coupling pump

### Manual mode

Motor and pump operate only when operator presses and holds the up (or down) arrow on the pendant. When button is released, pressure in the hoses is relieved.

### AUTO mode

**With DWELL timer set equal to zero:** operator starts the motor by pressing and holding the up (or down) arrow on the pendant. Pump builds to pressure on the clamp (or unclamp) circuit until it reaches customer programmed setting. The motor immediately turns off and pressure in the hoses is relieved.

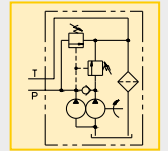
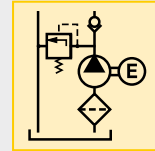
**With DWELL timer set greater than zero:** operator starts the motor by pressing the up (or down) arrow on the pendant. Once the pump reaches the programmed setting, the DWELL timer starts. When the timer runs out, the motor stops and pressure in the hoses is relieved.

Flow: 0,54 - 1,64 l/min

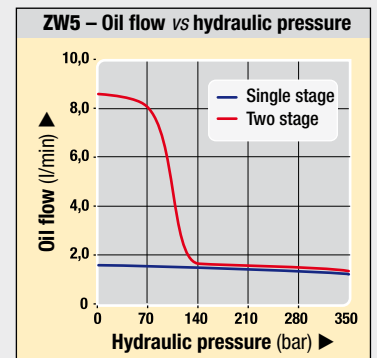
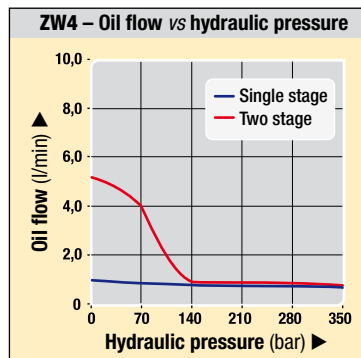
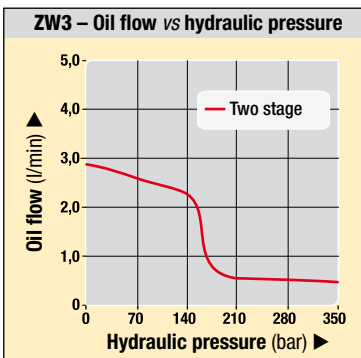
Pressure: 350 bar

Motor: 0,75 - 1,12 kW

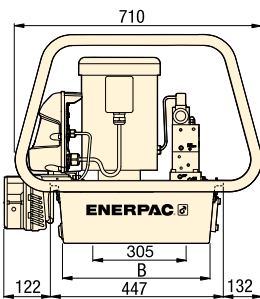
Reservoir: 8,0 - 40,0 litres



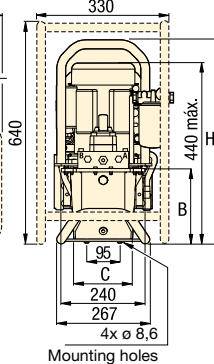
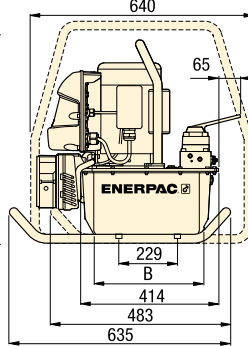
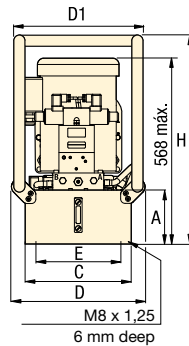
## **g** Output oil flow versus hydraulic pressure



10, 20, 40 litres



8 litres



## **A** Product dimensions in mm [ ]

Usable oil capacity litres	Model number	A	B	C	D	D1	E	H	kg		
									ZW3	ZW4	ZW5
8	ZWxx08xx	206	279	206	—	—	—	574	42	42	47
10	ZWxx10xx	155	412	305	384	371	279	599	49	49	52
20	ZWxx20xx	180	412	422	500	488	396	625	61	61	65
40	ZWxx40xx	269	399	506	577	572	429	714	84	84	87

## **!** Important

Enerpac recommends a pressure differential of no less than 14 bar for most applications. If you believe your application requires a tighter differential, please contact us directly.

For complete ordering matrix of all factory-installed options see page 117.

## **g** Options

Heat exchanger

119 ▶



Level switch

120 ▶



Pressure transducer

120 ▶



Return line filter

118 ▶



# Continuous connection pumps *Application & selection*

Shown: ZW4420FE-FT



▶ The new Enerpac Continuous Connection Pump provides two modes of operation:

### Manual mode

Pump runs continuously, building pressure as long as operator holds down pendant button.

### AUTO mode

Pump runs continuously, maintaining user-set pressure window on clamp circuit as long as necessary.

■ ZW5410FE-FT used to control clamping cycle on a horizontal machining center.



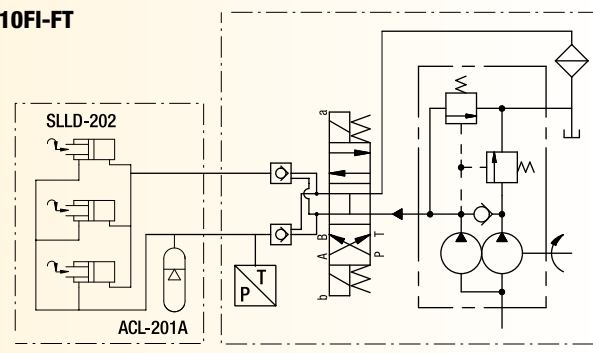
## Automatic pressure control for continuous connection fixtures

- Programmable pressure setting allows pump to maintain system pressure continuously
- Includes pilot operated check valve ensuring pressure is maintained in circuit
- Z-Class high-efficiency pump design; featuring higher oil flow and by-pass pressure than comparable pumps
- High-strength, molded electrical enclosure protects electronics, power supplies and LCD readout from harsh industrial environments.

## Example Circuits

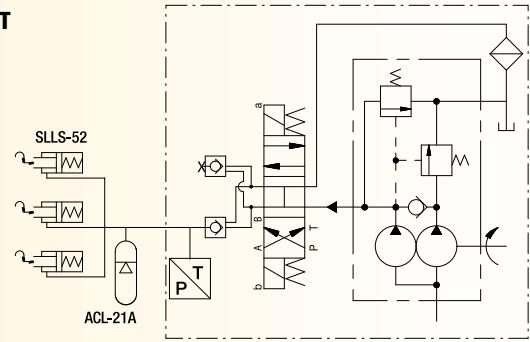
- Double-acting circuit

### ZW4410FI-FT



- Single-acting circuit

### ZW4410FI-FT



## Product selection

Flow rate @ max. pressure	Motor size	Motor voltage	Model number	Pressure range	Sound level	Usable oil capacity	
l/min	kW	V-ph-Hz		bar	dB(A)	litres	kg
0,54	0,75	115-1-50	<b>ZW3408FB-FT</b>	70-350	75	8	52
		115-1-50	<b>ZW3410FB-FT</b>				
		230-1-50	<b>ZW3408FI-FT</b>				
		230-1-50	<b>ZW3410FI-FT</b>				
0,82	0,75	115-1-50	<b>ZW4410FB-FT</b>	70-350	75	10	54
		230-3-50	<b>ZW4410FG-FT</b>				
		460-3-50	<b>ZW4410FJ-FT</b>				
1,64	1,12	115-1-50	<b>ZW5410FB-FT</b>	70-350	75	10	58
		230-3-50	<b>ZW5410FG-FT</b>				
		460-3-50	<b>ZW5410FJ-FT</b>				

### **i** Operation – continuous connection pump

**Manual mode:** The operator turns the pump motor on, and then presses and holds the up arrow on the pendant. When the button is released, the valve shifts to neutral, but pressure is maintained in the clamp circuit by the pilot-operated check valve. When the operator presses and holds the down arrow on the pendant, pressure in the clamp circuit will release, and the fixture will unclamp.

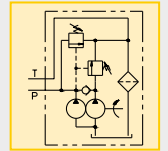
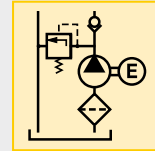
**AUTO mode:** The operator turns the pump motor on, and then presses and holds the up arrow on the pendant. When the customer-programmed HI PRESS setting is reached, the valve shifts to neutral, but pressure is maintained in the clamp circuit by the pilot-operated check valve. If pressure drops below the LO PRESS setting, the valve will re-activate and build pressure in the clamp circuit again. The pump will maintain this cycle until the operator presses and holds the down arrow on the pendant. When the down arrow is pressed, pressure in the clamp circuit will release, and the fixture will unclamp.

Flow: 0,54 - 1,64 l/min

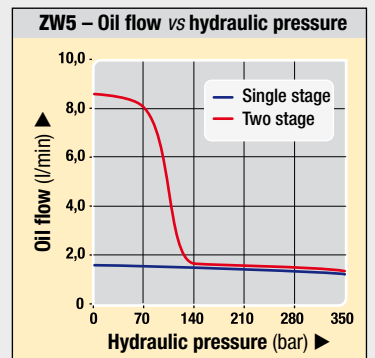
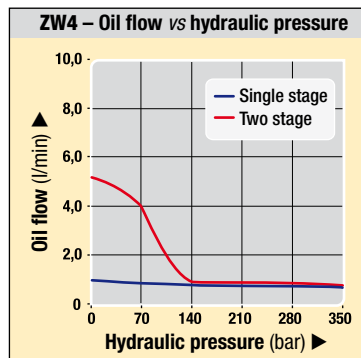
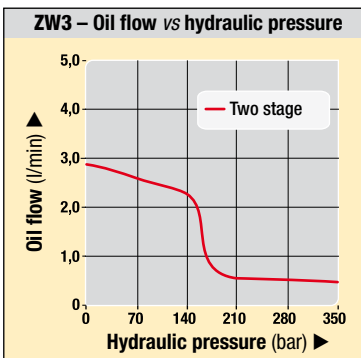
Pressure: 350 bar

Motor: 0,75 - 1,12 kW

Reservoir: 8 - 40 litres

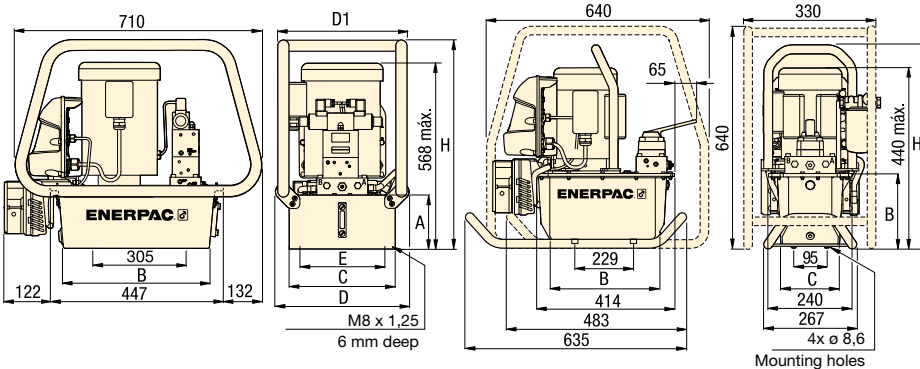


### **globe** Output oil flow versus hydraulic pressure



10, 20, 40 litres

8 litres



### **A** Product dimensions in mm [ ]

Usable oil capacity litres	Model number	A	B	C	D	D1	E	H	kg		
									ZW3	ZW4	ZW5
8	ZWxx08xx	206	279	206	—	—	—	574	42	42	47
10	ZWxx10xx	155	412	305	384	371	279	599	49	49	52
20	ZWxx20xx	180	412	422	500	488	396	625	61	61	65
40	ZWxx40xx	269	399	506	577	572	429	714	84	84	87

### **!** Important

Enerpac recommends a pressure differential of no less than 14 bar for most applications. If you believe your application requires a tighter differential, please contact us directly.

For complete ordering matrix of all factory-installed options see page 117.

### **globe** Options

Heat exchanger  119 ▶

Level switch  120 ▶

Pressure transducer  120 ▶

Return line filter  118 ▶

# Single station D03 pumps *Application & selection*

Shown: ZW4010GE-11



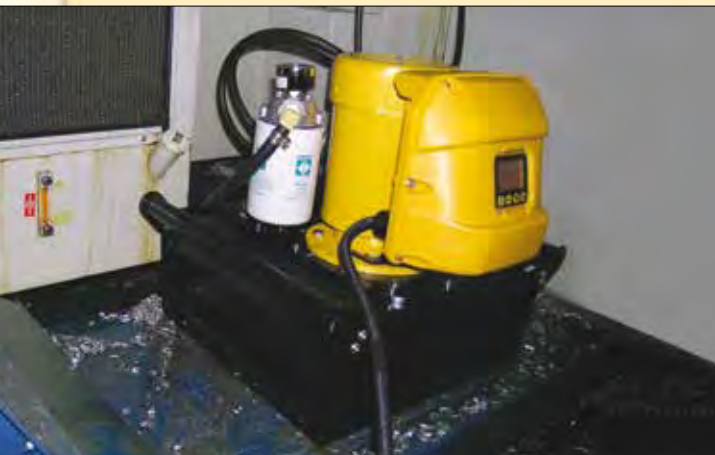
## D03 valve mounting style

Pump accepts any industry standard D03 style directional valve. Also available with 2 station and 4 station manifolds.

## Important

**Be aware of leakage rates of any valve installed on an Enerpac pump. Many standard spool valves have excessive leakage rates at higher pressures that can limit the performance of the electric pump. Be sure to consult Enerpac if you are unsure of your choice of valve.**

■ ZW5020HW-F11 with customer installed valve used to provide pressure to a clamping fixture.



## Industry standard mounting for electric or manual valves

- Highly efficient design provides increased flow rates, reduced heat generation and a decrease in power consumption
- Extensive list of accessories including
  - Heat exchanger
  - Roll-bars
  - Pressure transducer
  - Level and temperature switches
- Replaceable piston check-valves increase service life of major pump components
- Optional backlit LCD provides pump usage information, hour and cycle counts
- Also available with 2 station and 4 station manifolds.

## Product selection

Flow rate @ max. pressure	Motor size	Motor voltage	Model number	Pressure range	Sound level	Usable oil capacity	
l/min	kW	V-ph-Hz		bar	dBA	litres	kg
0,54	0,75	115-1-50	ZW3008GB-11	70-350	75	8	52
		115-1-50	ZW3010GB-11		75	10	61
		230-1-50	ZW3008GI-11		75	8	52
		230-1-50	ZW3010GI-11		75	10	61
0,82	0,75	115-1-50	ZW4010GB-11	70-350	75	10	54
		230-3-50	ZW4010GG-11				
		460-3-50	ZW4010GJ-11				
1,64	1,12	115-1-50	ZW5010GB-11	70-350	75	10	58
		230-3-50	ZW5010GG-11				
		460-3-50	ZW5010GJ-11				

### **i** Operation – single station D03 pumps

The Single Station D03 pumps are supplied without the standard LCD electrical control. This configuration is intended to be used with user supplied controls. Control requirements include: Motor Starter or Contactor, and remote control of the pump mounted valve. Typical applications include: Special Machines and CNC Machines where the control of the pump and valve will be done by PLC or machine control.

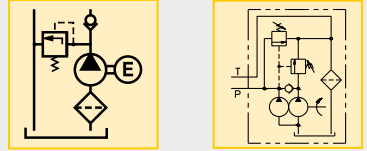
The use of the ZPF Return Line Filter is recommended. If the pump is to be run at pressure at a relief valve setting, the ZHE-E10 Heat Exchanger is also recommended. For monitoring of the oil level and temperature, use the ZLS-U4 Level/Temp Switch. For pump shutdown at pressure, the ZPS-W4 Pressure Switch Kit can provide an input to the customer supplied controls. As these accessories are designed to be used with the standard Enerpac LCD control, the customer assumes responsibility to adapt the standard leads to their controls.

**Flow: 0,54 - 1,64 l/min**

**Pressure: 350 bar**

**Motor: 0,75 - 1,1 kW**

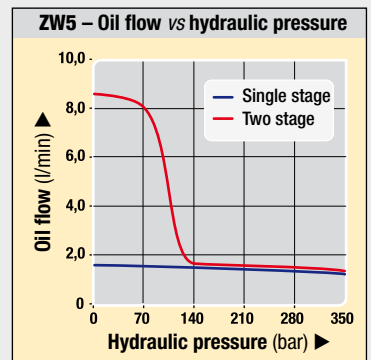
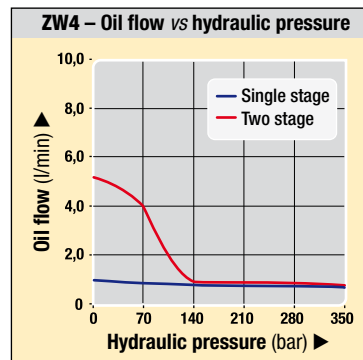
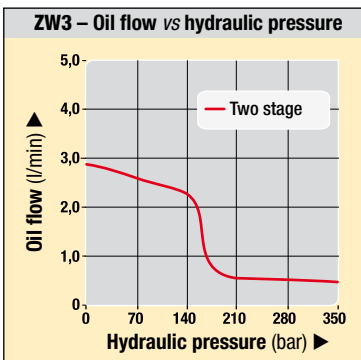
**Reservoir: 8 - 40 litres**



### **!** Important

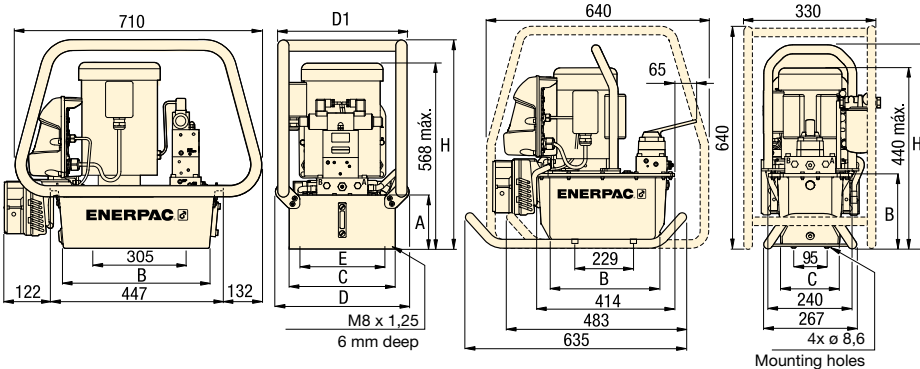
Enerpac recommends a pressure differential of no less than 14 bar for most applications. If you believe your application requires a tighter differential, please contact us directly.

### **g** Output oil flow versus hydraulic pressure



10, 20, 40 litres




8 litres



### **A** Product dimensions in mm [ ]

Usable oil capacity	Model number	A	B	C	D	D1	E	H	kg		
									ZW3	ZW4	ZW5
litres											
8	ZWxx08xx	206	279	206	—	—	—	574	42	42	47
10	ZWxx10xx	155	412	305	384	371	279	599	49	49	52
20	ZWxx20xx	180	412	422	500	488	396	625	61	61	65
40	ZWxx40xx	269	399	506	577	572	429	714	84	84	87

### **!** Options

- Heat exchanger  [119](#)
- Level switch  [120](#)
- Pressure transducer  [120](#)
- Return-line filter  [118](#)
- VP03 solenoid valves  [141](#)
- VMM series manual valves  [143](#)



Shown: ZW5111SWE100



► Enerpac's workholding pump unit features an innovative range of zero leakage, poppet design, directional valves. With the modular valve design, various independent single-acting or double-acting circuits can be realized.

## Application

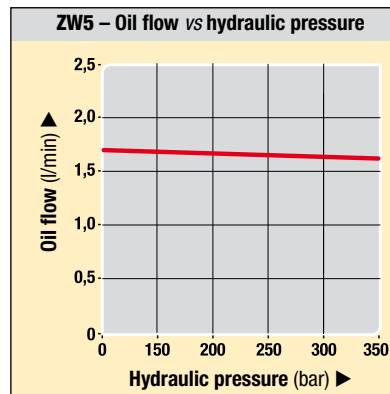
These advanced workholding pumps, operating at maximum 350 bar hydraulic pressure, are highly suitable for production tooling applications – offering the optimum in terms of compact size for required oil flow and pressure rating and customization to your specific needs.

Enerpac electric pump used in conjunction with swing cylinders, work supports, directional valves, control valves and sequence valves can provide a complete clamping solution. The pressure switch allows the unit to be fully automated.

## Customize to your needs

- Various models including electric controls and pressure switch
- Stackable to 8 VP-series valve stations high
- Customer adjustable relief valve
- Glycerine dampened pressure gauge G-2517L on pumps with VP-series valves
- 230/460/3/50/60 Hz 1,1 kW motor.

## Output oil flow



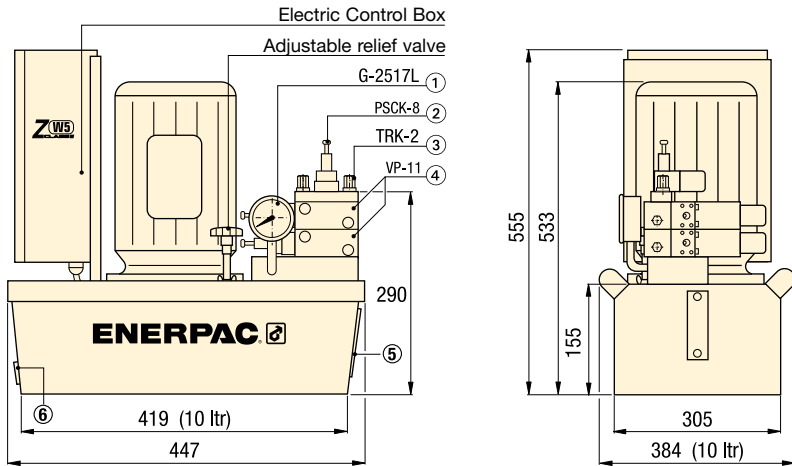
## Product selection

Oil flow rate	Pressure range	Voltage and current	Usable oil capacity <sup>2)</sup>	Valve models included	Model number	kg
l/min	bar	V @ A	litres			
<b>▼ With manifold for VP-series modular valves, no electric controls</b>						
1,64	100-350	230 @ 4,8	10,0	–	<b>ZW5VPSEE100</b>	65
1,64	100-350	400 @ 2,4	10,0	–	<b>ZW5VPSWE100</b>	65
<b>▼ With manifold for CETOP 03 valves, no electric controls</b>						
1,64	100-350	230 @ 4,8	10,0	–	<b>ZW5C03SEE100</b>	65
1,64	100-350	400 @ 2,4	10,0	–	<b>ZW5C03SWE100</b>	65
<b>▼ For 2x single-acting circuits</b>						
1,64	100-350	230 @ 4,8	10,0	1x VP-41	<b>ZW5141SEE100</b>	77
1,64	100-350	400 @ 2,4	10,0	1x VP-41	<b>ZW5141SWE100</b>	77
<b>▼ For 1x double-acting circuits + isolating valve <sup>1)</sup> for A-port</b>						
1,64	100-350	230 @ 4,8	10,0	1x VP-11	<b>ZW5111SEE100</b>	77
1,64	100-350	400 @ 2,4	10,0	1x VP-11	<b>ZW5111SWE100</b>	77
<b>▼ For 2x double-acting circuits + isolating valves <sup>1)</sup> for all A-ports</b>						
1,64	100-350	230 @ 4,8	10,0	2x VP-11	<b>ZW5211SEE100</b>	80
1,64	100-350	400 @ 2,4	10,0	2x VP-11	<b>ZW5211SWE100</b>	80

<sup>1)</sup> Isolating valve is pressure switch PSCK-8.

<sup>2)</sup> ZW5-series pumps comes standard with 8 litres reservoir. (4, 8, 20 or 40 reservoir is optional).

**ZW5-series** Shown: ZW5211SEE100 with standard 10 litres reservoir



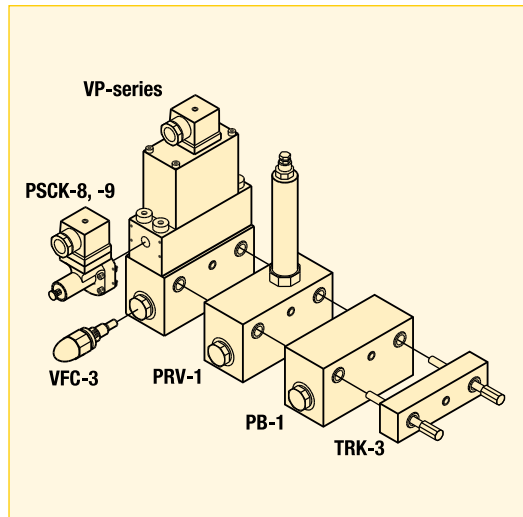
- ① Pressure gauge
- ② Pressure switch
- ③ Tie Rod Kit
- ④ Directional valve
- ⑤ Oil level glass
- ⑥ Oil drain

### Product selection

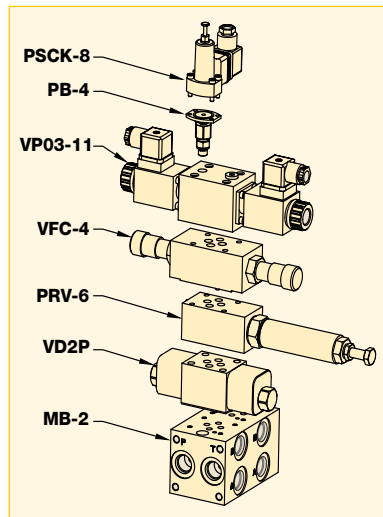
Pump series	Voltage	Phase	Continuous operation at 350 bar	Motor capacity	Motor speed	Motor protection class	Sound Level
	Volt			kW	RPM		dB(A)
<b>ZW5....</b>	230	1	50%	1,1	1390	IP54	75
<b>ZW5.....</b>	400	3	50%	1,1	1390	IP54	75

### Valve options

See page 136 for VP-series valves and available options.

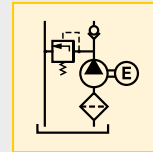


See page 141 for VP03-series valves and available options.




- Flow: 1,64 l/min**
- Pressure: 100 - 350 bar**
- Motor: 1,1 kW**
- Reservoir: 4 - 40 litres**


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



### Options


**VP-series, modular valves**  
[136](#) 

**VFC-3 flow control valve**  
[137](#) 

**Pressure switches**  
[188](#) 

**Hoses and couplers**  
[192](#) 

**High-pressure filters**  
[193](#) 

**Fittings**  
[194](#) 

# Electric Driven Workholding Pumps *Application & selection*

Shown: ZW5111SWE100



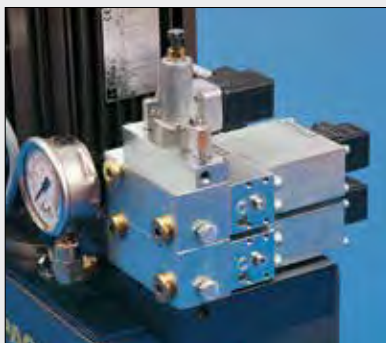
## ZW5 series

These advanced workholding pumps, operating at maximum 350 bar hydraulic pressure, are highly suitable for production tooling applications – offering the optimum in terms of compact size for required oil flow and pressure rating and customization to your specific needs.

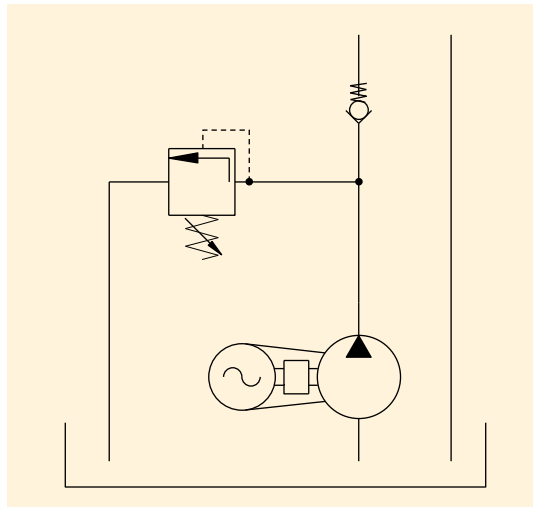
### Application

Enerpac electric pump used in conjunction with swing cylinders, work supports, directional valves, control valves and sequence valves can provide a complete clamping solution. The pressure switch allows the unit to be fully automated.

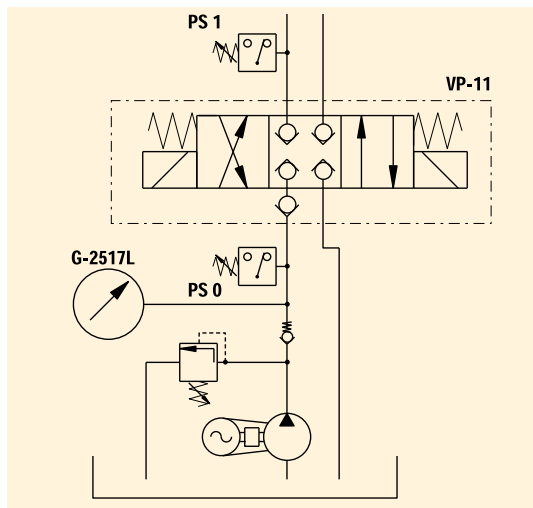
■ Enerpac VP-series valves stackbuilt on ZW5211SWE100. The pressure switch PSCK-8 is mounted directly onto the endplate of Tie Rod Kit TRK-2.



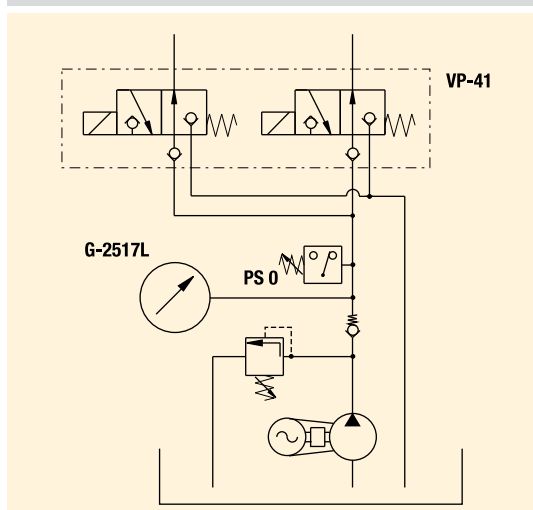
## ZW5VPSEE100 with manifold for VP-series or CETOP 03 valves, without electric controls and gauge



## ZW5111SEE100 For 1x Double-Acting circuit and Isolating Valve for A-port



## ZW5141SEE100 For 2x Single-Acting circuits



### Basic pumps

Customize to your needs with the Enerpac VP-series valves and options or choose your own D03 valve.

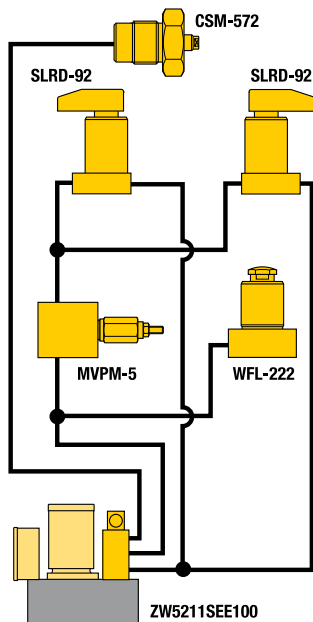
### Isolating valves

For applications where clamping pressure has to be maintained, isolating valves are an economic and safe solution.

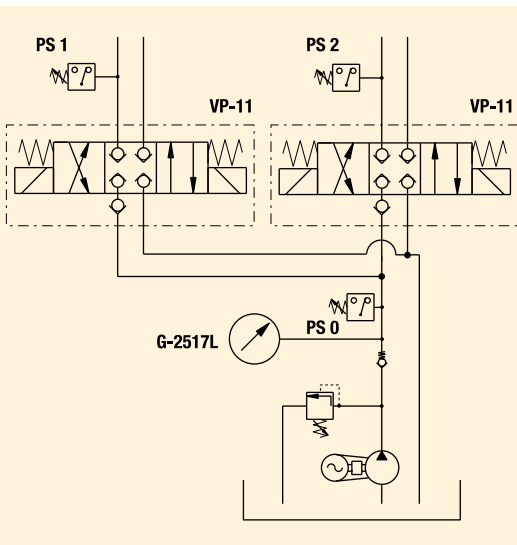
The pressure switch (PS 1) switches in the hydraulic line to the cylinder actuates the valve with a closed center position and isolates the circuit when the preset pressure has been reached. In case of pressure drop the switch opens the valve to compensate.

For some particular applications, i.e., when a workpiece has to be positioned and clamped with different forces, you can set different isolating valve pressures for the independent circuits.

Pressure switch (PS 0) switches the motor off at maximum pressure; in case of pressure drop due to activating circuits, the motor restarts.



**ZW5211SEE100 for 2x Double-Acting circuit and Isolating Valve for all A-ports**



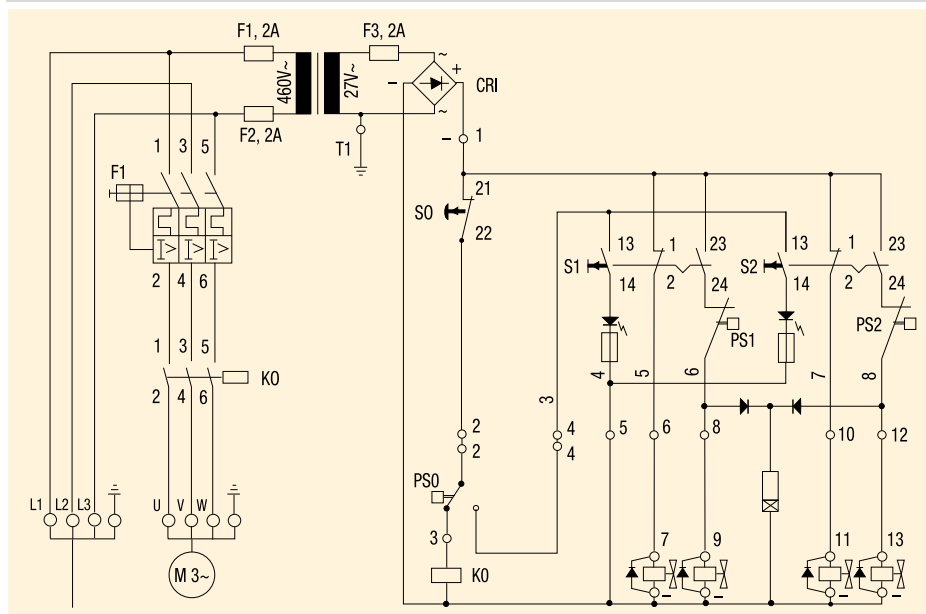
**Application example**

Building the right workholding system for a specific production tooling requirement is best achieved by observing the Basic System Set-up in our “Yellow Pages” (☐202 ▶).

**Electric Scheme**

Shown the electric scheme of the ZW5211SWE100 (400 volt) for two double-acting circuits and isolating valves (pressure switches) in both A-lines.

**ZW5211SWE100**



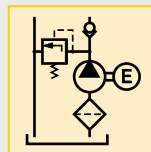
**Flow: 1,64 l/min**

**Pressure: 100 - 350 bar**


**Motor: 1,1 kW**

**Reservoir: 4 - 40 litres**


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



**Options**

**Sequence valves** 

☐152 ▶

**Flow control valves** 

☐155 ▶

**Hoses and couplers** 


☐192 ▶

**High pressure filters** 

☐193 ▶

**Hydraulic oil** 

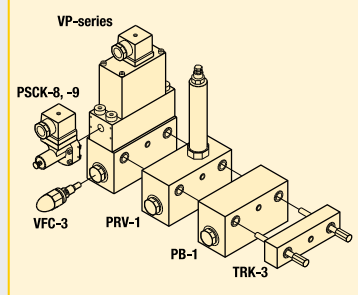
☐193 ▶

**Fittings** 

☐194 ▶

**VP-series valve options** 

☐136 ▶



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.

## 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

Flow: 0,9 - 4,1 cm<sup>3</sup>/stroke

Pressure: 210 - 700 bar

Reservoir: 0,1 - 0,9 litres

**E** Bombas manuales

**F** Pompes à main

**D** Handpumpen



## Options

### Fittings

194 ▶



### Hoses

192 ▶



### Hydraulic oil

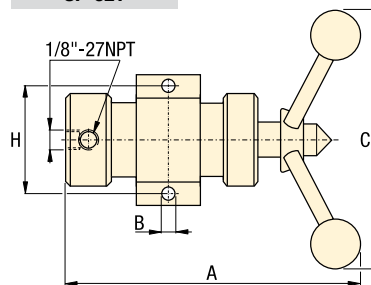
193 ▶



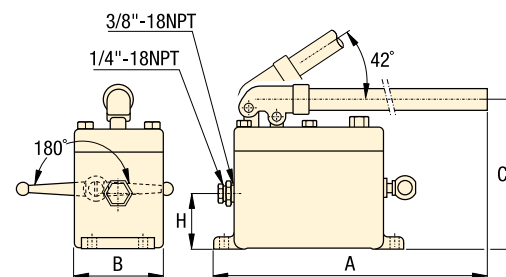
## Important

**P-141, P-142 and P-202** are designed for a maximum operat 700 bar.

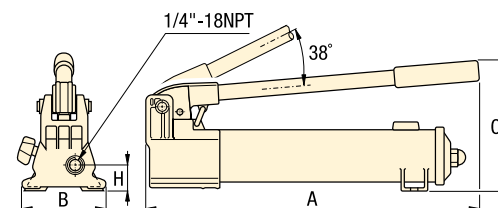
### SP-621



### P-51



### P-141, -142, -202



## Product selection

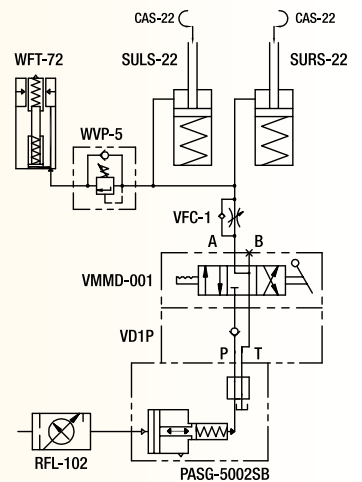
Maximum hydraulic pressure	Usable oil capacity	Model number	Pressure rating		Oil volume per stroke		Piston stroke	Maximum handle effort	Dimensions (mm)				kg
			bar	bar	cm <sup>3</sup>	cm <sup>3</sup>			A	B	C	H	
bar	cm <sup>3</sup>		1st stage	2nd stage	1st stage	2nd stage	mm	kg	A	B	C	H	kg
<b>▼ Single speed</b>													
210	100	<b>SP-621</b>	–	210	–	1)	1)	27 <sup>2)</sup>	256	10	315	72	3,2
210	820	<b>P-51</b>	–	210	–	4,10	25,4	28	660	92	160	57	5,5
700	325	<b>P-141</b>	–	700	–	0,90	12,7	33	336	95	143	29	2,0
<b>▼ Two speed</b>													
350	325	<b>P-142</b>	13,8	700	3,62	0,90	12,7	35	336	95	143	29	2,0
350	325	<b>P-142-5000</b>	13,8	350	3,62	0,90	12,7	35	336	95	143	29	2,0
700	900	<b>P-202</b>	13,8	700	3,62	0,90	12,7	29	509	95	143	29	3,4

1) Handle travel of SP-621 is 63,5 mm; 25 handle rotations displace 102 cm<sup>3</sup> of oil.  
2) Handle effort on SP-621 is 81 Nm at 210 bar



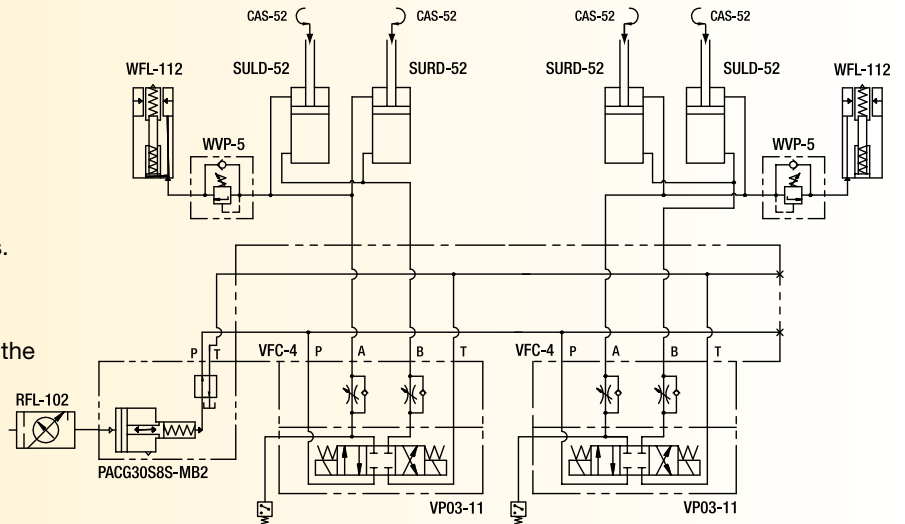
## Air Powered Pump with Manual Valve

This system uses a PASG5002SB Turbo II air powered pump with a VMMD-001 manual valve to control a fixture circuit with single acting swing clamps and work supports. A VDP-1 check module in the valve stack locks the pressure in the system. A WVP-5 sequence valve delays the actuation of the works support until the swing clamp is clamped.



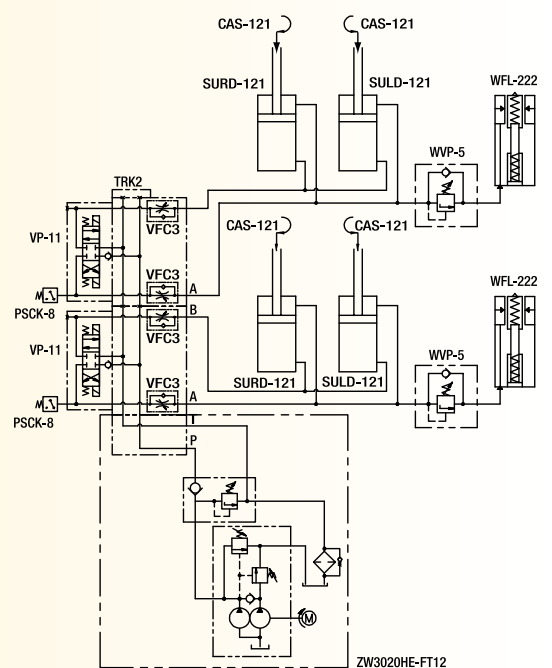
## Air Powered Pump with Dual Solenoid Valves

This system uses a PACG30S8S-MB2 Turbo II air powered pump with two VP03-11 solenoid valves to control two independent fixture circuits with double acting swing clamps and work supports. Flow controls in the valve stack provide control of the cylinder actuation speed. Sequence valves delay the actuation of the work supports until the swing clamps are clamped.



## Electric Pump with Dual Solenoid Valves

This system uses a ZW3020HE-FT12 electric pump and two VP-11 solenoid valves to control two independent fixture circuits with double acting swing clamps and work supports. Flow controls mounted in the valves provide control of the cylinder actuation speed. Pressure switches on the "clamp" circuit can provide confirmation of clamping pressure. Sequence valves delay the actuation of the work supports until the swing clamps are clamped.



# Valves

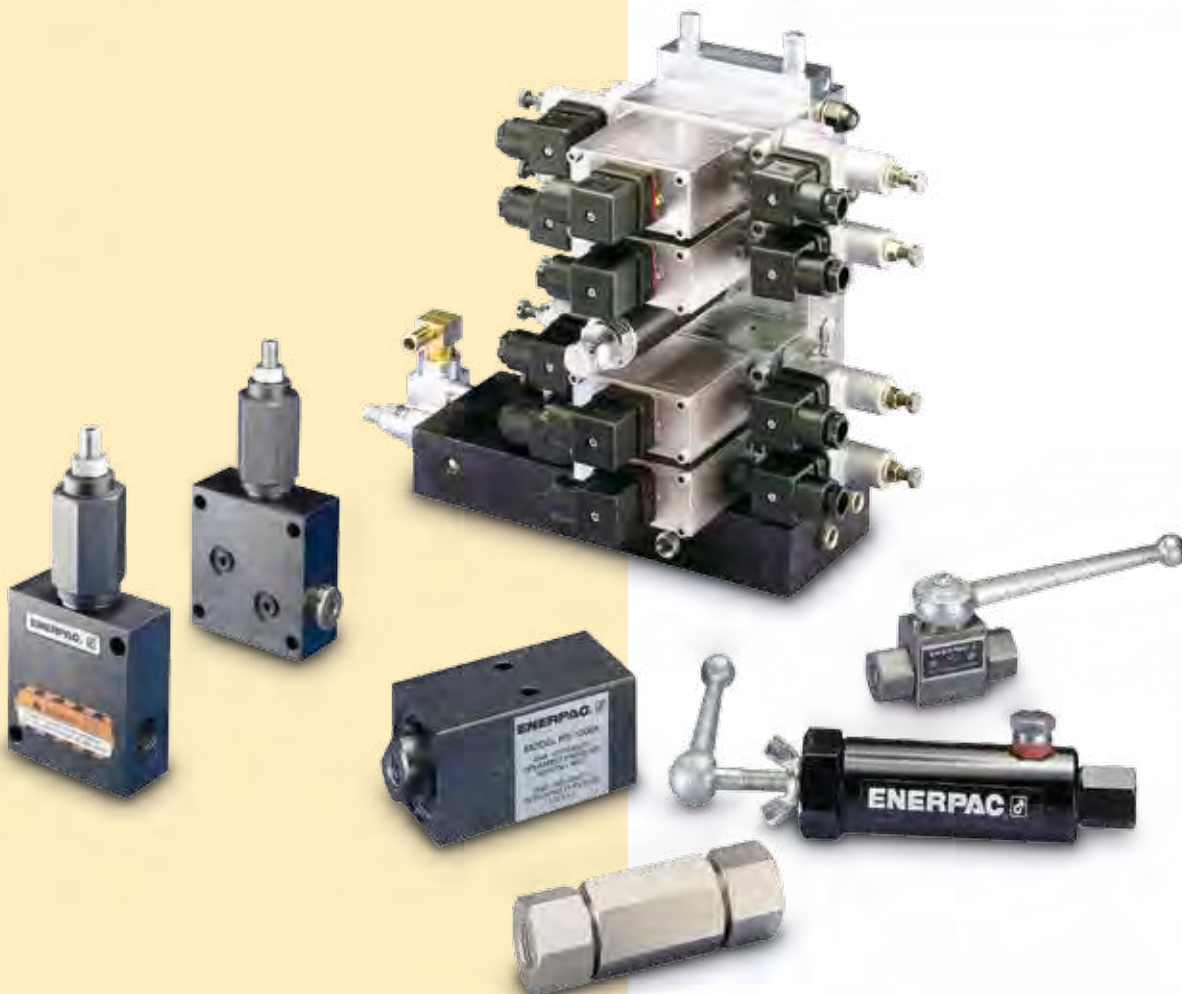
## Technical support

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

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

 197 ▶

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	
Solenoid modular poppet valve	VP	136	
Pressure switches, Flow control valve	PSCK VFC	137	
Pressure reducing valve	PRV	138, 154	
Tie rod kits, Remote/porting manifolds	TRK WM, PB	139	
Solenoid/Air operated 2-position poppet valves	VA, VS, VD	140	
Solenoid poppet valves, D03/CETOP3	VP03	141	
Solenoid D03 spool valves and accessories	VE	142	
Manual, D03/CETOP3 valves	VMM VMT	143	
Valve manifolds	MB	144	
Solenoid modular valves	VE	146 - 147	
3-Way directional manual control valves	V	148 - 149	
4-Way directional manual control valves	V	150 - 151	
Sequence valves	MVP WVP, V	152	
Pilot operated check valves	MV, V	153	
Flow control valves	VFC	155	
Accessory valves	MH, HV PLV, V	156 - 157	
Air valves and accessories	V, VA, VR, RFL, QE	158 - 159	

Shown: VP-12



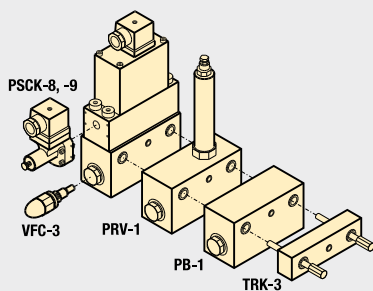
## VP-series

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

### Application

VP-series valves in combination with all its options in the illustration and photo below. With the use of a code 12 manifold (see page 117, 121) these valves allow quick and easy assembly on your Enerpac ZW-series pump. For remote mounting of these valves use a WM-10 manifold.

### VP-series



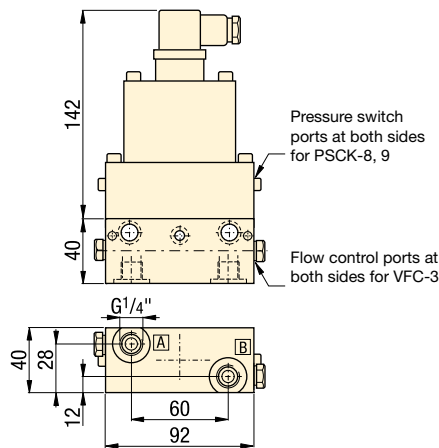
■ Enerpac VP-series valves mounted on -12 manifold, mounted on a ZW-series workholding pump.



## Solenoid directional valves

- Dual poppet valve design for zero internal leakage
- Inlet check-valve standard
- High cycle switching
- Stackable to 8 valve stations high
- 17-350 bar operational pressure
- Oil flow capacity 7 l/min @ 350 bar
- Oil flow capacity 15 l/min @ 0 bar
- G1/4" oil connections and integrated filtration
- 24 VDC and 110 VAC available.

### VP series



## Product selection

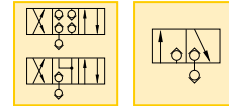
Voltage @ current at 50/60 Hz	Model number	Flow path	Used with cylinder(s)
▼ 4/3 Closed center	24 VDC @ 1,13 A 110 VAC @ 500 mA		1x Double-acting
	VP-11 VP-12		1x Double-acting
▼ 4/3 Float center	24 VDC @ 1,13 A 110 VAC @ 500 mA		1x Double-acting
	VP-21 VP-22		1x Double-acting
▼ 3/2 Normally closed	24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

Note: DIN 43650 electrical connector included. Valve weight 3,0 kg.

Pressure: 350 bar

Max. Flow: 15 l/min

- ⓔ Válvulas de control
- ⓕ Electro distributeurs
- ⓓ Wegesitzventile



## Options

WM-10 remote manifold

☐ 139 ▶

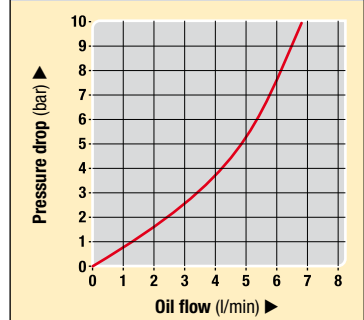


TRK-series Tie rod kits

☐ 139 ▶



### Oil flow vs pressure drop



# PSCK, VFC-series Pressure switches, Flow control valve

Pressure: 350 bar

Flow: 7 l/min @ 350 bar

Voltage: 115 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.

Shown: PSCK-8, VFC-3



## Options

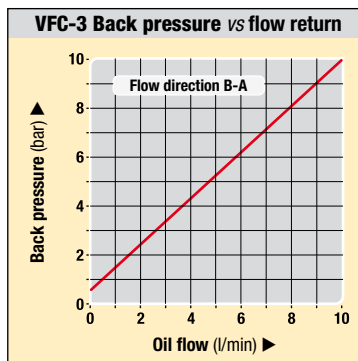
**PB-1 Auxiliary block**

139 ▶

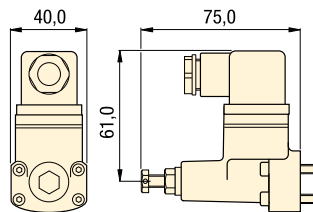


**Pressure reducing valves**

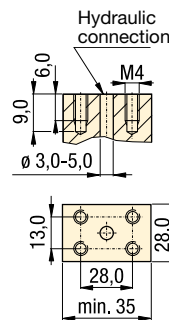
138 ▶



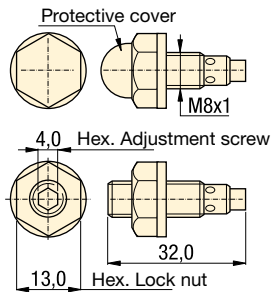
PSCK-8, 9



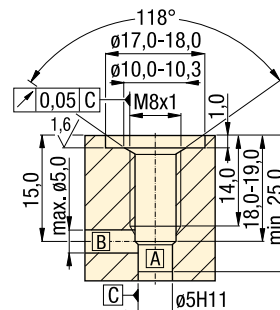
PSCK-8, 9 mounting dimensions



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			bar	bar	l/min
▼ Pressure switch					
24 VDC @ 2 A	PSCK-8		100 - 350	18 - 35	7
115 VAC @ 2 A					
▼ Pressure switch					
24 VDC @ 2 A	PSCK-9		20 - 210	6 - 15	7
115 VAC @ 2 A					
▼ Flow control valve					
screw-in throttle valve	VFC-3		0-350	-	7



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.

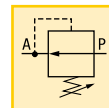
## Precise control of hydraulic pressure

- 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

Pressure: 350 bar

Flow: 7 l/min

- Ⓔ Válv. reguladora de presión
- Ⓕ Valve de pression réglable
- Ⓓ Druckreduzierventil



## Options

VP-series  
Modular  
valves

136 ▶



Pressure  
switches

188 ▶

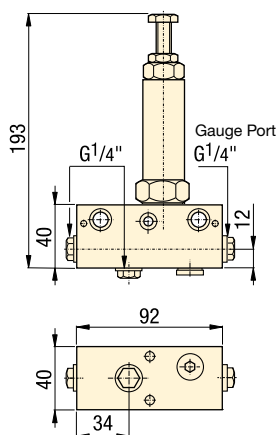


TRK-series  
Tie rod kits

139 ▶



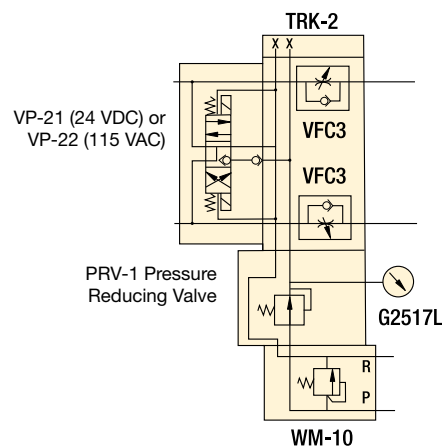
### PRV-1, PRV-5



▼ PRV-1 connected with remote manifold WM-10.



### Valve stacking example



## Product selection

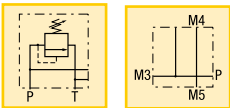
Mounting style	Adjustable pressure range	Maximum pressure	Model number	Oil ports	Maximum oil flow	
	bar	bar		BSP	l/min	kg
VP-series	30 - 300	350	PRV-1	G1/4"	7	1,6
VP-series	75 - 138	350	PRV-5	G1/4"	7	1,6

Mounting: 1-8 VP valve stations

Pressure: 350 bar

Flow: 15 l/min

- E** Pernos de montaje de válv.
- F** Vis de montaje de distrib.
- D** Zugstangen



## 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

Shown: WM-10, TRK-4, PB-1



### ▶ TRK-series

Tie Rod Kits mount Enerpac VP-series modular valves to the 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.

## Options

Pressure switches

188 ▶



VP-series directional valves

130 ▶

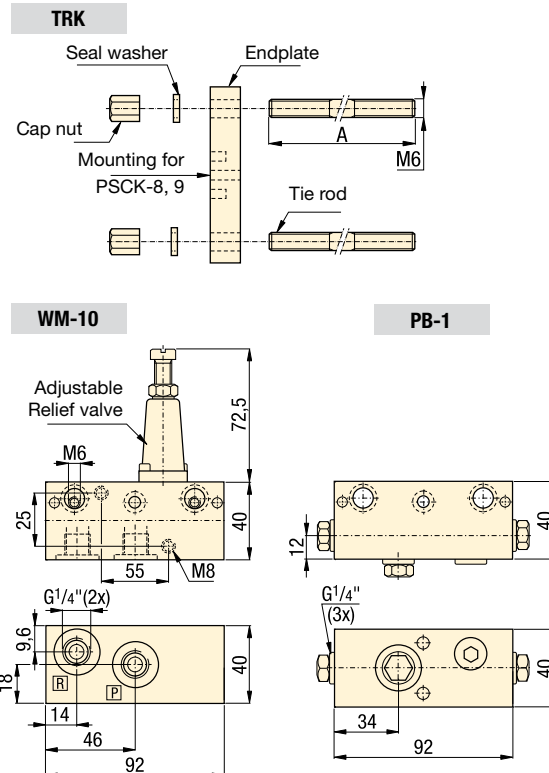
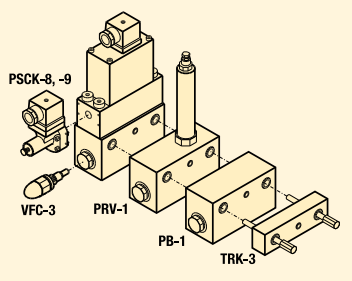


Gauges

189 ▶



VP-series



## Product selection

Quantity of stackable VP-series directional valves	Model number	Tie rod length A	Mounting thread
		mm	mm
<b>▼ Tie rod kits</b>			
1	TRK-1	85	M6
2	TRK-2	125	M6
3	TRK-3	165	M6
4	TRK-4	205	M6
5	TRK-5	245	M6
6	TRK-6	285	M6
7	TRK-7	325	M6
8	TRK-8	365	M6

## Product selection

Oil ports	Model number	Hydraulic schematic	Maximum pressure
BSPP			bar
<b>▼ Remote manifold with pressure relief</b>			
2x G1/4"	WM-10		350
<b>▼ Porting manifold (P port connection)</b>			
3x G1/4"	PB-1		350

■ Tie rods mount VP-series valves and accessories to manifold, providing leak-free sealing.



Shown: VST-1401D, VSS-2210D



## VSS, VST-series

Solenoid and air piloted 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.

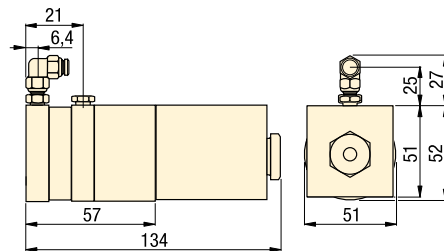
■ VSS-2210D mounted directly on a Turbo II air pump for use on positive clamping fixture.



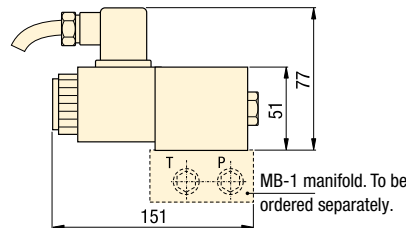
## Zero leakage poppet valves increase efficiency

- Poppet valve design for zero leakage
- 4-way, 2-position float offset or normally open
- D03 or CETOP 3 mounting pattern
- DIN-standard rectifier plugs for easy connection to power source
- Air operated models eliminate need for electricity
- Including O-rings and mounting bolts
- SAE manifold ports simplify plumbing
- Inline check valve provides positive load holding

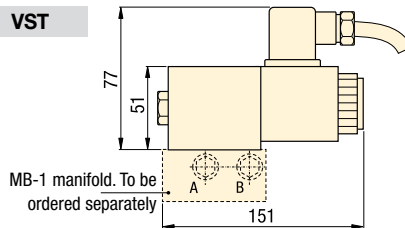
### VAS, VAT



### VSS



### VST

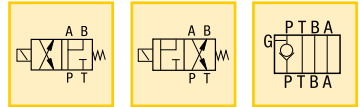


Pressure: 0 - 350 bar

Flow: 11 l/min max.

Voltage: 115 VAC, 24 VDC

- Ⓔ Electroválvulas
- Ⓕ Electro distributeurs
- Ⓖ Elektromagnetische Ventile



## Options

### D03 Manifolds MB-series

144 ▶



### Fittings

194 ▶

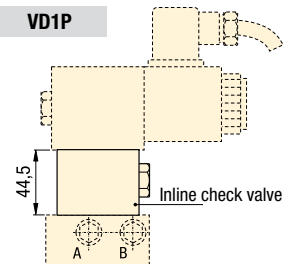


## Important

For multiple circuit applications, the VD1P inline check valve is recommended to prevent pressure drop on the holding circuit.

Order bolt kit BKD-71 to mount VD1P with VAS/VSS/VST valves.

### VD1P



## Product selection

Valve flow path	Solenoid voltage @ current at 50/60 Hz	Model number	Hydr. symbol	Pressure range bar	Pressure drop <sup>1)</sup> bar	Max. oil flow l/min
<b>▼ Solenoid poppet valves – Normally open</b>						
4-way, 2 position	4,1 - 6,8 bar	VAS-0710D		0-350	12	11,3
4-way, 2 position	24VDC @ 1,6 A	VSS-1410D		0-350	12	11,3
4-way, 2 position	115VAC @ 0,4 A	VSS-2210D		0-350	12	11,3
<b>▼ Solenoid poppet valves – Normally closed</b>						
4-way, 2 position	42-70 bar max.	VAT-0710D		0-350	12	11,3
4-way, 2 position	24VDC @ 1,6 A	VST-1410D		0-350	12	11,3
4-way, 2 position	115VAC @ 0,4 A	VST-2210D		0-350	12	11,3
<b>▼ Inline check valve</b>						
-	-	VD1P		0-350	0	11,3

<sup>1)</sup> Pressure drop from P-A or P-B at maximum oil flow of 11 l/min.

Pressure: 0 - 350 bar

Flow: 6 - 57 l/min

Voltage: 24 VDC, 110 VAC

- E** Electroválulas
- F** Electro distributeurs
- D** Elektromagnetische Ventile



## Options

D03 Manifolds  
MB-series

144 ▶

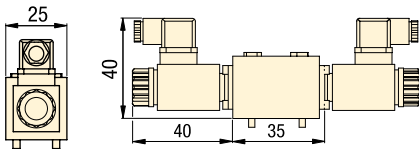


Fittings

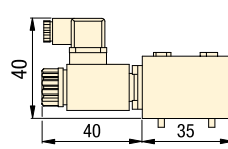
194 ▶



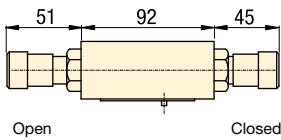
### VP03-11, 12, 21, 22



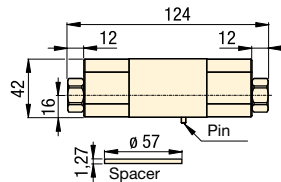
### VP03-51, 52



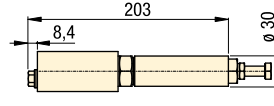
### VFC-4



### VD2P



### PRV-6, PRV-7



## Product selection

Valve flow path	Solenoid voltage 50/60 Hz	Model number	Hydraulic symbol	Pressure range	Maximum oil flow
				bar	l/min
4/3 closed center	24 VDC	VP03-11		0-350	19
4/3 closed center	110 VAC	VP03-12		0-350	19
4/3 float center	24 VDC	VP03-21		0-350	19
4/3 float center	110 VAC	VP03-22		0-350	19
4-way / 2-position	24 VDC	VP03-51		0-250	15
	110 VAC	VP03-52		0-250	15
Dual flow control	-	VFC-4		0-350	38
Dual pilot operated check valve	-	VD2P		0-350	57
Pressure reducing valve	-	PRV-6		30-300	12
	-	PRV-7		5-138	6

Shown: VP03



## VP03-series

VP03 valves are zero leakage, solenoid operated poppet valves.

## Application

Used to control the advance and retract of single acting and double acting cylinders.



## Important

VP03 series valves are zero leakage and can be used with pressure shut down electric pumps and air driven Turbo II pumps.

■ VP03-11 valve on PASG-3002SB Turbo pump.



Shown: VEX-11 valve



## VE-series

Spool style solenoid valves and control modules are used in circuits that do not require zero leakage.

### Application

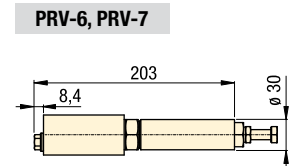
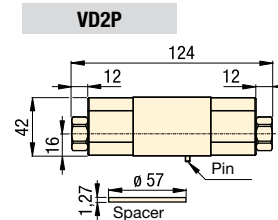
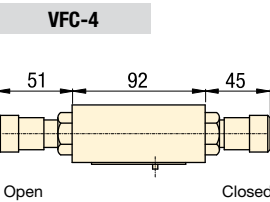
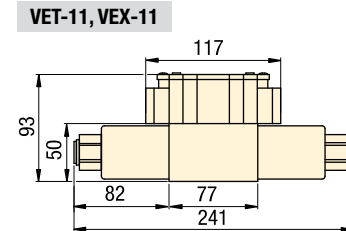
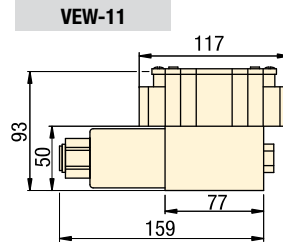
Used to control the advance and retract of single acting and double acting cylinders. The dual check valve can be used to lock pressure in a group of cylinders. The dual flow control offers independent control of cylinder advance and retract speeds. The pressure reducing valve sets a circuit pressure lower than the main pump pressure.

■ VEX-11 valve on ZW5020HG-FT21 pump.



## D03 Direction Valve and accessories

- D03 mounting pattern
- Directional valves
- Pilot operated check valve
- Dual flow control
- Pressure reducing valve



Pressure: 0 - 350 bar

Flow: 0,8 - 4,0 l/min

Voltage: 24 VDC

- E** Electroválulas
- F** Electro distributeurs
- D** Elektromagnetische Ventile

### Options

D03 Manifolds MB-series

144 ▶



Fittings

194 ▶



### Important

To hold the pressure in a clamping circuit, use the VEX11 valve with the VD2P check module. Do not use D03 spool valves with pressure shutdown pumps.

## Product selection

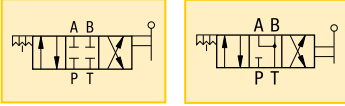
Valve flow path	Solenoid voltage 50/60 Hz	Model number	Hydraulic symbol	Pressure range	Pressure drop	Maximum oil flow
				bar	bar	l/min
4 way, 2 position	24 VDC 1,32 Amps	<b>VEW-11</b>		0-350	9	2,1
4/3 closed center	24 VDC 1,32 Amps	<b>VET-11</b>		0-350	10	2,1
4/3 float center	24 VDC 1,32 Amps	<b>VEX-11</b>		0-350	12	2,1
Dual flow control	-	<b>VFC-4</b>		0-350	-	2,6
Dual pilot operated check valve	-	<b>VD2P</b>		0-350	14	4,0
Pressure reducing valve	-	<b>PRV-6</b>		30-3000	-	0,8
		<b>PRV-7</b>		5-138		



Pressure: 350 bar

Flow: 0,8 - 4,0 l/min

- E** Válvulas de control de 4 vias
- F** Distributeurs à 4 voies
- D** 4-Wege-Ventiler



## Manual control of single and double-acting cylinders

- Near zero leakage pressure seal design
- 4-way, 3-position
- Detented handle positions
- Low handle effort 5 kg, 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
- D03/CETOP 3 mounting pattern

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 series 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 valves require check valves for positive load holding.

■ Several VMTD-001 valves mounted on fixture waiting to be transferred to machine.

## Options

### VD1P, Inline check valve

◀ 140

### D03 Manifolds

144 ▶



### Hoses and couplers

192 ▶



### Fittings

194 ▶



## Important

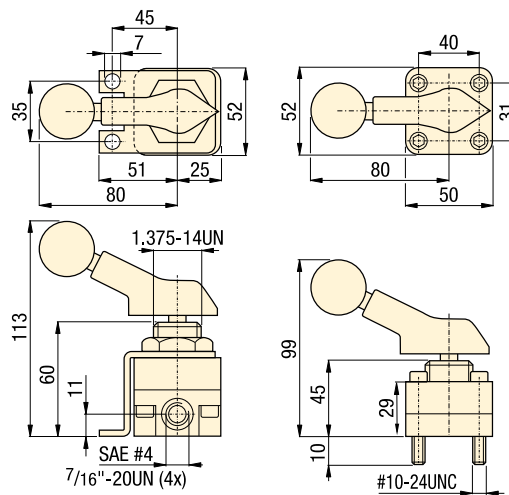
For multiple circuit applications, the VD1P inline check valve is recommended to prevent pressure drop on the holding circuit.

See page 145 for mounting bolt information.

Pressure on return side (tank) should not exceed 17 bar.

VMTD-001, 003

VMMD-001, -003



## Product selection

Valve mounting pattern	Mounting bolts included	Oil ports	Model number	Hydraulic symbol	Pressure range	Pressure drop <sup>1)</sup>	Max. oil flow
					bar	bar	l/min
<b>▼ 4-way, 3-position control valves</b>							
Panel mtg.	-	SAE #4	<b>VMTD-001</b>		0-350	4,8	17
D03/CETOP 3	#10-24UN	-	<b>VMMD-001</b>		0-350	4,8	17
Panel mtg.	-	SAE #4	<b>VMTD-003</b>		0-350	4,8	17
D03/CETOP 3	#10-24UN	-	<b>VMMD-003</b>		0-350	4,8	17

<sup>1)</sup> Pressure drop from P-A or P-B at maximum oil flow of 17 l/min. Seal material: Buna-N, Polyurethane.

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



Shown: MB-4, MB-1



## ▶ MB-series

Single or multiple station manifolds allow installation of VSS and VST-series positive seal control valves or other D03/CETOP 3 valves. Ideal in applications where independent control of multiple cylinders is required.

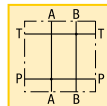
## When independent control of multiple cylinders is required

- Multi-station manifolds with SAE or CETOP 3 porting – minimizes plumbing
- Mounting patterns for:  
VSS and VST Valves (D03 or CETOP 3);  
VE Valves (D03 or CETOP 3);  
VP03 Valves (D03 or CETOP 3);  
VMMD Valves (D03 or CETOP 3)
- Manifolds allow use of accessories, such as pressure switches and gauges.

**Mounting: 1 - 4 valves**

**Pressure: 350 bar**

- Ⓔ Colectores
- Ⓕ Manifolds
- Ⓓ Verkettingsblöcke



## 💡 Options

VSS, VST-series valves

📄 140 ▶



Pressure switches

📄 188 ▶



Gauges and accessories

📄 190 ▶



Fittings

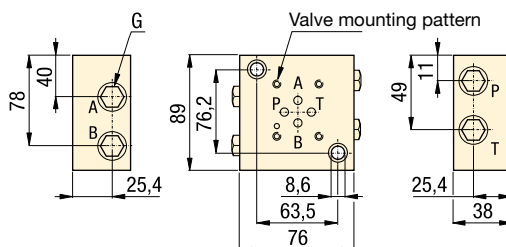
📄 194 ▶



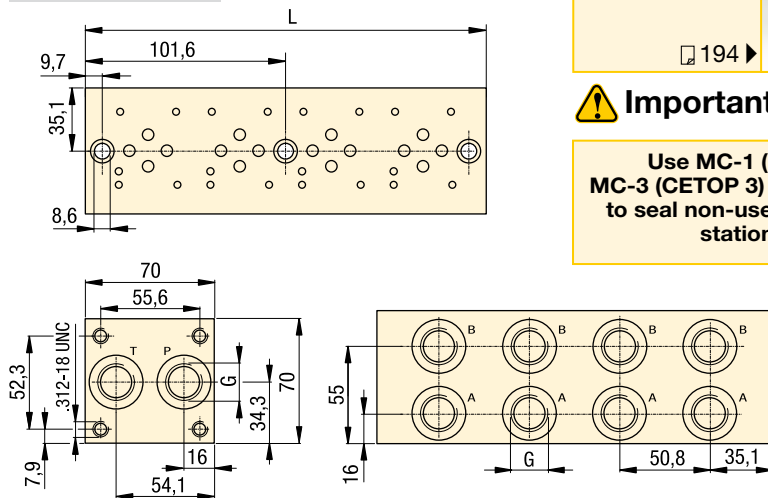
## ⚠ Important

Use MC-1 (D03) or MC-3 (CETOP 3) cover plates to seal non-used manifold stations.

### MB-1, MB-12



### MB-2, -22, MB-4, -42



■ Each non-used valve station on manifolds must be sealed with MC-1 cover plate.



## 🌐 Product selection

Valve mounting pattern	Number of valve stations	Model number	Oil ports cover plate	Coverplate model number *	Manifold	⚖
			G		L	kg
					mm	
<b>▼ Single station manifold</b>						
CETOP 3	1	MB-12	G1/4"	-	-	0,5
D03	1	MB-1	SAE #4	-	-	0,5
<b>▼ Multipler station manifolds</b>						
CETOP 3	2	MB-22	G3/8"	MC-3	121	1,5
D03	2	MB-2	SAE #8	MC-1	121	1,5
CETOP 3	4	MB-42	G3/8"	MC-3	222	2,8
D03	4	MB-4	SAE #8	MC-1	222	2,8

\* Note: - MC-1 manifold cover plate must be ordered separately. Includes gasket and mounting bolts.

- E** Kits de fijación para válvulas
- F** Kits de montage robinet
- D** Zugstangen-Satz

## Options

**VD1P, Inline check valve**



◀ 140

**D03 Manifolds**




◀ 144

**Hoses and couplers**



192 ▶

**Fittings**



194 ▶

## Important

The mounting stud must project into the manifold a minimum of 9,5 mm. After installation, torque the stud nuts to 5 Nm.

To calculate the required stud length, add the stud length for the directional valve and each accessory module used in the valve stack. Add 20 mm to this length. The mounting studs should be cut to this total length.

## Use Stud Bolt Kits to assure the correct bolt length

- Studs are easily cut to length
- Stud nuts make installation easier
- Pre-mount the studs into the manifold to help guide the valve components into place.

Shown: BKD71, BKD72



## BKD-series

Always have the right bolt length required to mount the components in your valve stack by using these stud bolt kits.

Refer to chart to determine the required bolt length.

## Example

Description	Model number	Stud Length	
		mm	in
Directional valve	<b>VP03-11</b>	48	1.87
Dual flow control	<b>VFC-4</b>	40	1.57
Dual P.O. check	<b>VD2P</b>	40	1.57
Stud nut	<b>VD2P</b>	10	0.40
Manifold	<b>V-19</b>	10	0.38
<b>Total length:</b>		<b>147</b>	<b>5.79</b>

## Product selection

Description	Model number	Stud Length	
		mm	in
Imperial stud kit (#10-24) *	<b>BKD71</b>	—	7.00
Metric stud kit (M5) *	<b>BKD72</b>	178	—
<b>▼ Valve mounting bolt lengths using stud kits</b>			
Stud Nut	<b>BKD71, BKD72</b>	10	0.40
Manifold	<b>MB1, MB2, MB3</b>	10	0.38
Solenoid valve	<b>VAS/VSS/VST</b>	41	1.63
Solenoid valve	<b>VEW/VET/VEX</b>	32	1.25
Solenoid valve	<b>VP03</b>	47	1.87
Manual valve	<b>VMMD001/VMMD003</b>	29	1.13
Pressure Reducing Valve	<b>PRV6/PRV7</b>	40	1.57
Check valve, on "P"	<b>VD1P</b>	40	1.57
Dual P.O. check valve	<b>VD2P</b>	40	1.57
Dual flow control	<b>VFC-4</b>	40	1.57

\* Note: Stud kit includes 4 studs and 4 stud nuts

# 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

- 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.

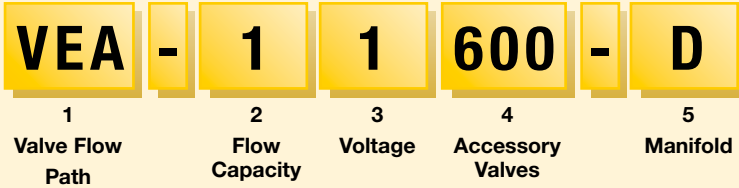
## 🌐 Product specifications

Pressure range	Maximum oil flow	Voltage @ Hz	Amperage draw	
			Amps inrush	Amps holding
0 - 700 bar	15 l/min	24 VDC @ 50/60 Hz	-	2,5 A
0 - 700	15	115 VAC @ 60 Hz	3,6 A	1,0 A
0 - 700	15	220/240 VAC @ 50 Hz	1,3/1,4	0,45/0,53
0 - 700	15	230 VCA @ 60 Hz	1,8 A	0,50 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 = 15 l/min

**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

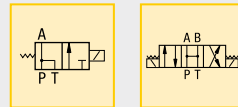
The **VEA-11600-D** is a modular valve with a 4-way, 3-position open center flowpath, 24 VDC, and an integrated pilot-operated check valve, for mounting on an Enerpac pump. Bolt Kit **BK-2** is included.

Pressure: 0 - 700 bar

Flow: 15 l/min max.

Voltage: 24, 115, 230 V

- E** Válvulas de control
- F** Electro distributeurs
- D** Wegesitzventile



Options

Gauges and accessories

190 ▶



Fittings

194 ▶



**Accessory Valves and Bolt Kits**

Use **VS-11** relief valve to add system pressure control to VE-series valves.

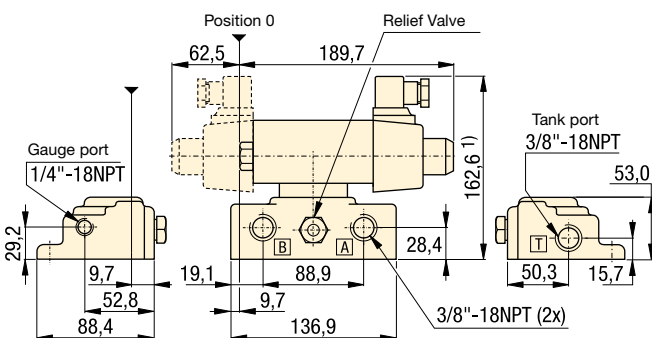
Use **VS-51** 3-way pilot operated check valve to convert 3-way VE-valve into load-holding valve.

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:

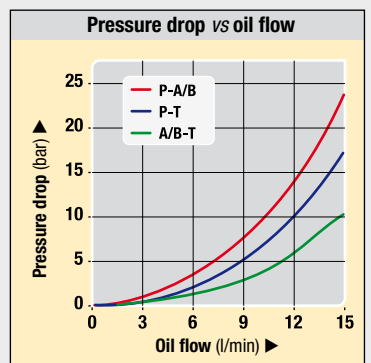
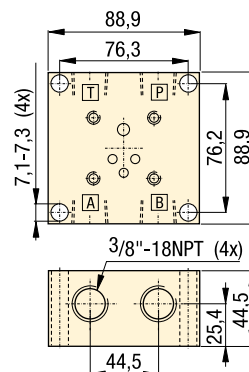
- BK-2** for 1 VS valve;
- BK-3** for 2 VS valves.

VE series Modular Valve Pump Mounted



<sup>1)</sup> add 47 mm for each Accessory Valve.  
Note: BK-1 Bolt Kit is included with each modular valve.

Modular Valve Remote Mounted





# 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.

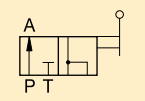
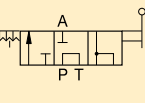
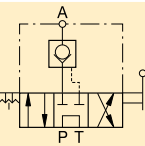
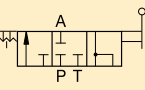
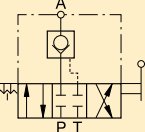
### Locking center

- For positive load holding without loss of pressure. Cylinder travel can only resume by shifting valve from hold position.

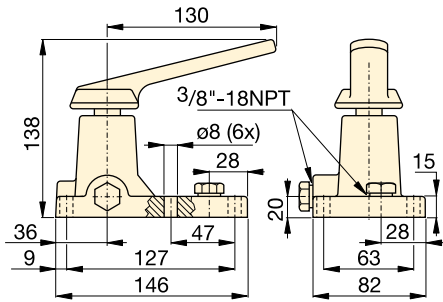
### Tandem center

- For one or multiple cylinder operation. Pump flow is directed back to tank in the center position.

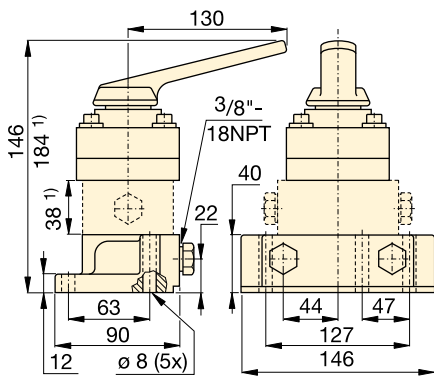
## Product selection

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**

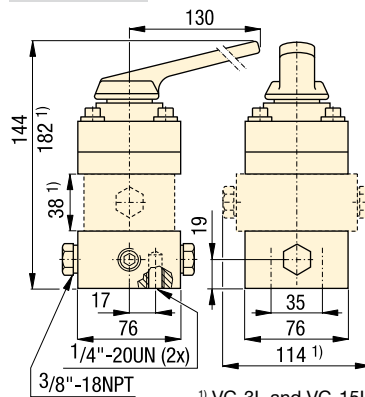


**VM-3, VM-3L**



<sup>1)</sup> VM-3L only

**VC-3, VC-3L  
VC-15, VC-15L**

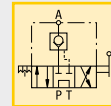
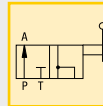


<sup>1)</sup> VC-3L and VC-15L only

Pressure: 0 - 700 bar

Flow: 17 l/min max.

- E** Válvulas de control
- F** Distributeurs à 3 voies
- D** 3-Wege-Ventile



**Options**

Gauges and accessories

190 ▶



Hoses and couplers

192 ▶



Fittings

194 ▶



**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".

197 ▶

**Product specifications**

Model number	Pressure range	Used for cylinder	Schematic flowpath			kg
			Advance	Hold	Retract	
<b>▼ Manual 3-way, 2-position (3/2)</b>						
VM-2	0-700	Single-acting		-		2,2
<b>▼ Manual 3-way, 3-position (3/3)</b>						
VM-3	0-700	Single-acting				2,1
VC-3	0-700	Single-acting				2,9
<b>▼ Manual 3-way, 3-position (3/3)</b>						
VM-3L	0-700	Single-acting				3,9
VC-3L	0-700	Single-acting				4,7
VC-15	0-700	Single-acting				2,9
VC-15L	0-700	Single-acting				4,7

# 4-way directional manual control valves *Application & selection*

Shown: VC-20, VM-4



## 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.

## 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>	

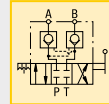
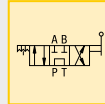
■ Enerpac VC-4 manual valves mounted to control hydraulic circuit on pallet fixture



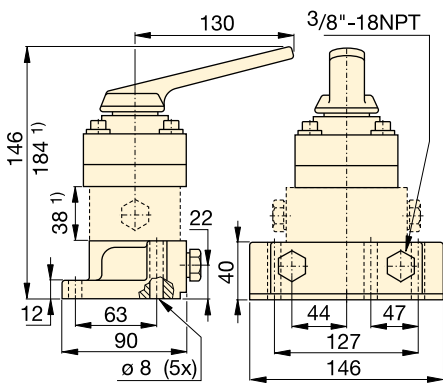
Pressure: 0 - 700 bar

Flow: 17 l/min max.

- E** Válvulas de control
- F** Distributeurs à 4 voies
- D** 4-Wege-Ventile

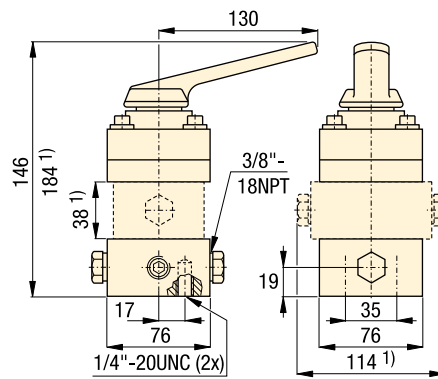


VM-4, VM-4L



<sup>1)</sup> VM-4L only

VC-4, VC-3L  
VC-20, VC-20L



<sup>1)</sup> VC-4L and VC-20L only

**Options**

Gauges and accessories

▣ 190 ▶



Hoses and couplers

▣ 192 ▶



Fittings

▣ 194 ▶



**Product specifications**

Model number	Pressure range bar	Used for cylinder	Schematic flowpath			kg
			Advance	Hold	Retract	
<b>▼ Manual 4-way, 3-position (4/3)</b>						
VM-4	0-700	Double-acting				2,1
VC-4	0-700	Double-acting				2,9
VM-4L	0-700	Double-acting				3,9
VC-4L	0-700	Double-acting				4,7
VC-20	0-700	Double-acting				2,9
VC-20L	0-700	Double-acting				4,7

**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".

▣ 197 ▶



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.

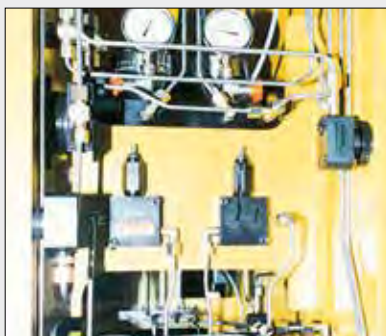
Pressure settings for the V-2000 can be adjusted by screwing the slotted pin in or out. The pressure settings for the other models is adjusted by loosening the jam nut and turn the set screw to reach your setting.

### 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 MCA-series Auto Coupler to provide system automation.



## Pressure dependent sequence control

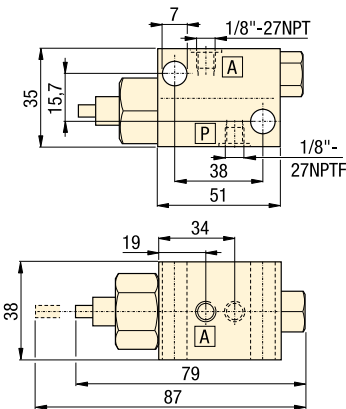
### MVPM-5, WVP-5, MVPC-5

- Direct accurate pressure setting
- Pressure setting between 35-350 bar for secondary circuit is secured with lock nut
- Mounting holes on WVP-5, manifold mounting ports on MVPM-5
- MVPC-5 features cartridge body

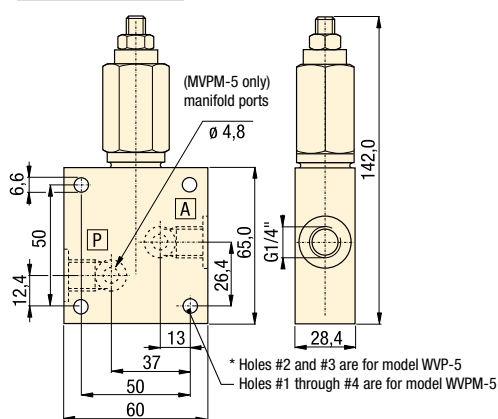
### V-2000

- Direct accurate pressure setting
- Pressure setting between 14-140 bar for secondary circuit
- Flag indicator appears everytime the valve is operated

### V-2000



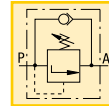
### MVPM-5, WVP-5



Pressure: 350 bar

Flow: 4 - 10 l/min

- E Válvulas de secuencia
- F Valve de séquence
- D Folgeventil



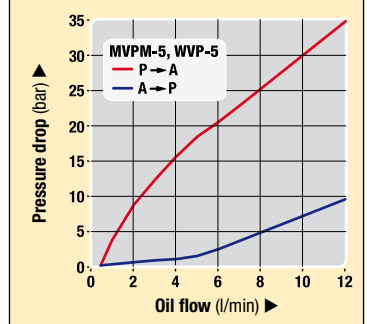
## Options

Gauges and accessories

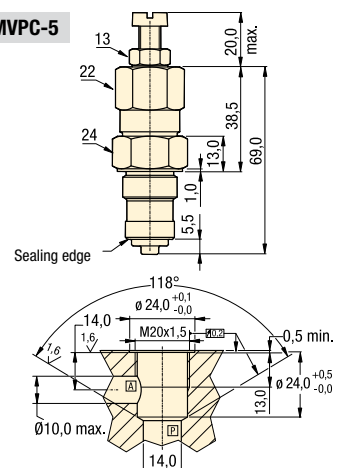
190 ▶



### Pressure drop vs oil flow



### MVPC-5



## Product selection

Pressure adjustment range	Maximum pressure	Maximum oil flow	Model number	Oil ports	Opening pressure check valve	A	kg
bar	bar	l/min			bar	mm	
14 - 140	350	4,0	V-2000	1/8"-27 NPTF	-	-	0,9
35 - 350	350	10,0	MVPC-5	-	0,7	-	0,2
35 - 350	350	6,0	MVPM-5	G 1/4"	1,4	28,5	1,3
35 - 350	350	6,0	WVP-5	SAE #4	1,4	24,9	0,8

Seal material: Buna-N.

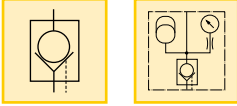
Manifold O-rings included with MVPM-5. For manifold mounting installation information consult Enerpac for surface preparation.



Pilot ratio: 7:1

Flow: 38 l/min max.

- E** Válvulas antiretorno pilotada
- F** Clapets antiretour piloté
- D** Rückschlagventile



## To hold cylinder load and ensure remote unlocking

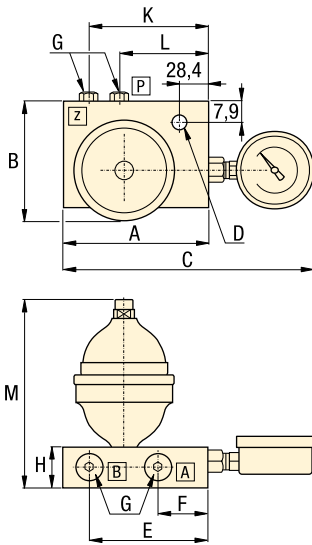
- Fast check-off response
- Hardened seats ensure long life and positive pressure holding
- Built-in accumulator to maintain system pressure
- Mounting holes
- Manifold mount body MVM-72

## Product selection

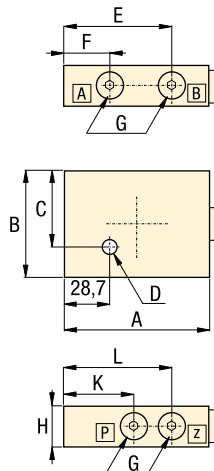
Pilot ratio	Accumulator included	Maximum oil flow l/min	Maximum pressure bar	Model number	Oil ports	Optional charging tool for ACL	kg
7 : 1	-	38	350	<b>MV-72</b>	G 1/4"	-	1,8
7 : 1	ACL-22	38	350	<b>MV-722B</b>	G 1/4"	<b>WAT-2</b>	2,7
7 : 1	ACL-202	38	350	<b>MV-7202B</b>	G 1/4"	<b>WAT-2</b>	3,4
7 : 1	-	38	350	<b>MVM-72</b>	G 1/4"	-	1,4

For more information on ACL-series Accumulators see page 124.

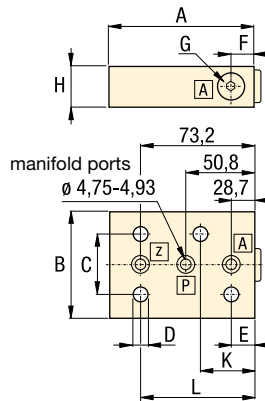
### MV-722B, -7202B



### MV-72



### MVM-72



- A** = Cylinder advance
- B** = Cylinder retract
- P** = Pressure
- Z** = Pilot

## Product dimensions in mm [ ]

Model number	A	B	C	D	E	F	G	H	K	L	M
<b>MV-72</b>	89,0	63,5	55,6	7,1	73,2	28,7	G1/4"	31,8	50,8	73,2	-
<b>MV-722B</b>	89,0	71,1	184,2	7,1	73,2	28,4	G1/4"	31,8	73,2	50,8	145
<b>MV-7202B</b>	89,0	92,4	181,1	7,1	73,2	28,4	G1/4"	31,8	73,2	50,8	185
<b>MVM-72</b>	89,0	63,5	38,1	7,1	28,7	28,4	G1/4"	31,8	44,5	73,2	-

Seal material: Buna-N.

Manifold O-rings included with MVM-72. For manifold mounting installation information consult Enerpac for surface preparation.

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

Shown: MV-72



## MV-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.



## Options

### Fittings

194 ▶



Shown: PRV-3



### 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).

The PRVM-2 manifold can be manifold mounted or plumbed with tubing. The PRV-8 and PRV-9 use this manifold to provide a pre-assembled valve. PRV-3 and 4 are for remote mounting. The cartridge from PRV-3 and 4 can be removed from manifold for direct integration into gundrilled fixture. Order the cartridge separately as PRV-3T or PRV-4T.

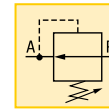
### Precise control of hydraulic pressure

- Tool adjustable knob can be locked
- Precise control of pressure
- G1/4" oil connection
- Remote mount
- PRVM-2 manifold has both 1/4" BSPP and manifold ports
  - Gauge port- 1/8" NPT

Pressure: 350 bar

Flow: 7 l/min

- Ⓔ Válv. reguladora de presión
- Ⓕ Valve de pression réglable
- Ⓖ Druckreduzierventil



### Options

#### Gauges

190 ▶

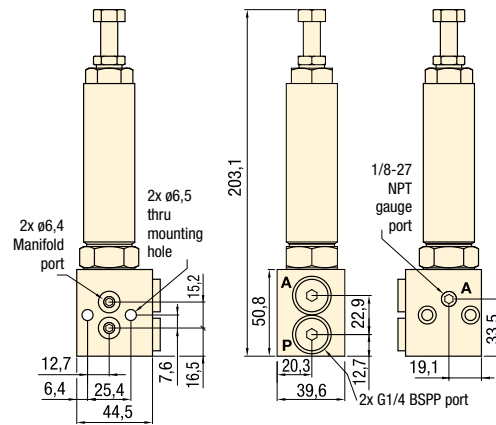


#### Fittings

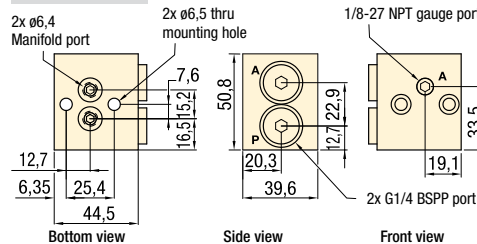
194 ▶



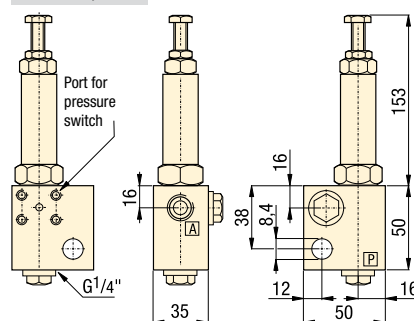
#### PRV-8, 9



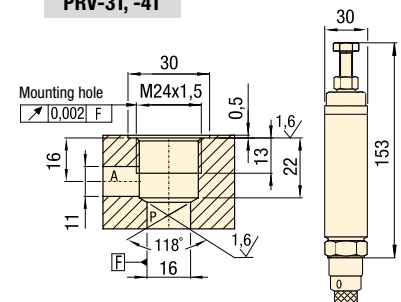
#### PRVM-2



#### PRV-3, -4



#### PRV-3T, -4T



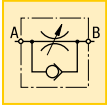
### Product selection

Mounting style	Adjustable pressure range	Maximum pressure	Model number	Oil ports	Maximum oil flow	kg
				BSPP	l/min	
Remote	30 - 300	350	PRV-3	G1/4"	7	1,3
Cartridge	30 - 300	350	PRV-3T	-	7	0,7
Remote	5 - 130	350	PRV-4	G1/4"	7	1,3
Cartridge	5 - 130	350	PRV-4T	-	7	0,7
Remote	30 - 300	350	PRV-8	G1/4"	7	1,1
Remote	5 - 138	350	PRV-9	G1/4"	7	1,1
Remote	-	350	PRVM-2	G1/4"	7	0,6

Max. Flow: 38 l/min

Pressure: 0 - 350 bar

- E** Válv. reguladoras de caudal
- F** Valves de control débit
- D** Stromregelventile



## Regulate the flow of oil

- Poppet valve design for zero leakage
- Color coded flow indicator
- Free flow return
- Fine metering capability
- Lockable
- Standard Viton seals

Shown: VFC-1



## Options

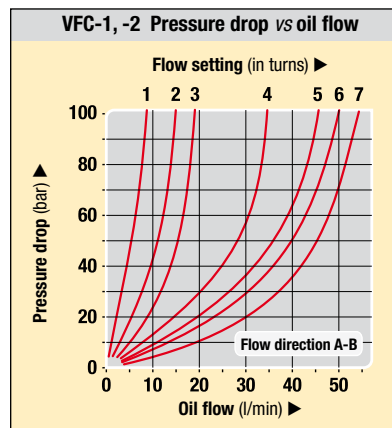
### Fittings

194 ▶



### High pressure filters

193 ▶



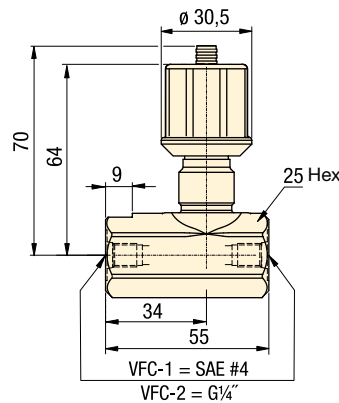
## VFC-series

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.

VFC-1, -2



## Product selection

Maximum oil flow	Pressure range	Oil ports	Model number	Flow path	Maximum pressure drop	
l/min	bar				bar	kg
<b>▼ Flow control valves</b>						
38	0-350	SAE#4	VFC-1		105	0,8
38	0-350	G 1/4"	VFC-2		105	0,8

Seal material: Viton

www.enerpacwh.com

■ In-line installation of a VFC-1 flow control valve.



# Accessory valves *Application & selection*

Shown: HV-1000A, V-17, V-10, V-12, V-152



## Accessory valves

Enerpac accessory valves are available in a wide variety and many configurations to control hydraulic pressure or oil flow. These valves are used in conjunction with other valves and system components to provide full automation and control.

### Application

Accessory valves are used to automate clamp cycles, prevent pressure loss and provide additional operator and component safety.

## Your hydraulic control solution

- Regulate oil flow or system pressure
- All valves feature NPT or SAE porting to insure against leakage at rated pressure
- Can easily be installed in any system
- All valves are painted, coated or plated for corrosion resistance.

## Product selection

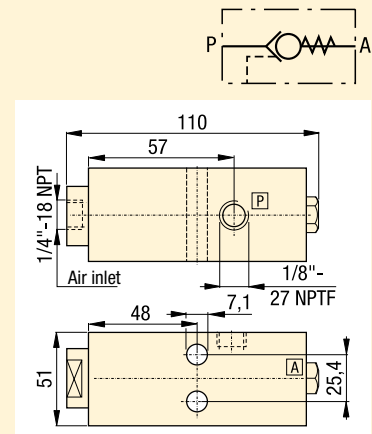
Valve type	Maximum pressure	Model number	Oil ports
	bar		
Holding valve, air pilot	200	<b>HV-1000A</b>	1/8" NPTF
Holding valve, modular	200	<b>MHV-1</b>	1/8" NPTF
Pressure limiting valve	200	<b>PLV-40013B</b>	1/8" NPTF
Manual shut-off valve	350	<b>V-12</b>	SAE #4
Auto-damper valve	700	<b>V-10</b>	1/2" NPTF
Safety check valve	700	<b>V-17</b>	3/8" NPTF
Pressure relief valve	700	<b>V-152</b>	3/8" NPTF

## Product specification

### HV-1000A

#### Air pilot holding valve

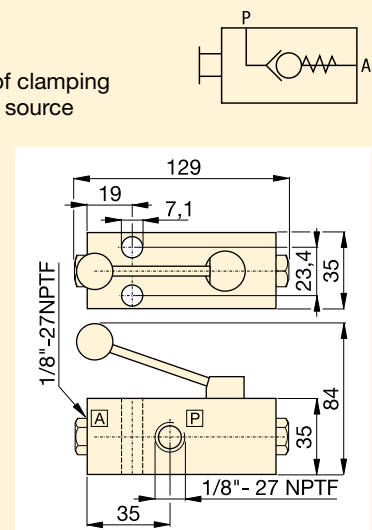
- Holds fluid under pressure offering independent control of different branches of the same fixture
- Valve can control the pilot air and the booster in sequence
- Max. oil flow 5 l/min
- Works with the VA-42 four-way air valve and a booster.



### MHV-1

#### Modular holding valve

- Allows separate operation of clamping fixtures with a single power source
- Ideal for applications when fluid feed lines are impractical. If system pressure is interrupted, the MHV-1 will hold the pressure beyond the valve.
- Max. oil flow 5 l/min
- To release system pressure, rotate valve handle in either direction 90° to release and retract system pressure.



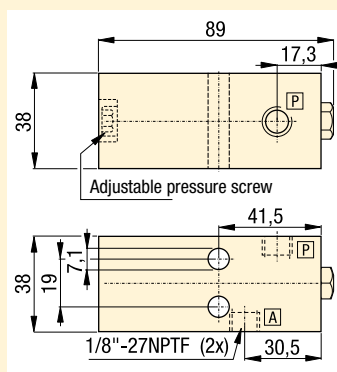
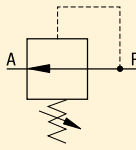
■ V-17 Safety check valve installed on a fixture.



**PLV-40013B**

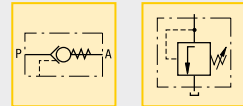
**Pressure limiting valve**

- 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 14-103 bar
- Max. oil flow 5 l/min.



Pressure: 0 - 700 bar  
Flow: 5 - 30 l/min max.

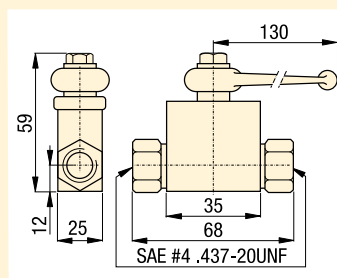
- E** Válvulas de control
- F** Valves de contrôle
- D** Regelventile



**V-12**

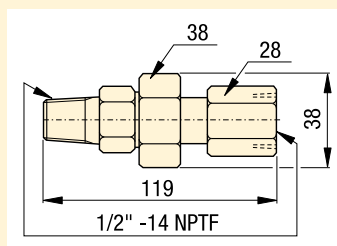
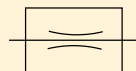
**Manual shut-off valve**

- 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 12 l/min.



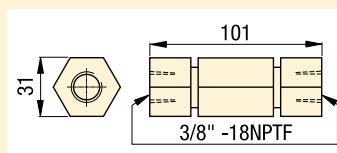
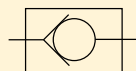
**V-10 Auto-damper valve**

- 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.



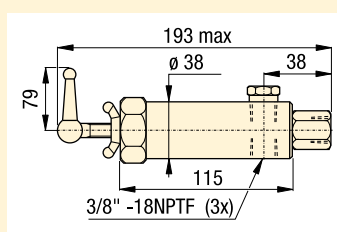
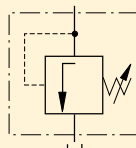
**V-17 Safety check valve**

- Ruggedly built to resist shock and operate with low pressure drop
- Closes smoothly without pounding
- Max. oil flow 30 l/min.




**V-152 Pressure relief valve**

- Limits pressure developed by the pump in hydraulic circuit, thus limiting the force imposed on other components
- 55-700 bar adjustment range; ± 3% repeatability
- Valve opens whenever preset pressure is reached. To increase pressure setting, turn handle clockwise
- Max. oil flow 30 l/min
- Includes 1 meter return line hose kit.



**Options**

**VA-42 Air valve**  [158 ▶](#)

**Gauges and adaptors**  [190 ▶](#)

**Hoses and couplers**  [192 ▶](#)

**Fittings**  [194 ▶](#)

**Important**

**Valving help**  
See Basic System Set-up and Valve information in our "Yellow Pages".  
[197 ▶](#)



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.

- 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

## Important

**Valving help**  
See Basic System Set-up and Valve information in our "Yellow Pages".

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## To control and regulate air supply

### 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 exhausts 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 1360 l/min

### QE-375 Muffler

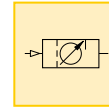
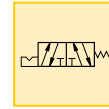
- Use with VR-3 or VAS/VA-42
- Reduces noise level of exhaust air from pump.

Air Pressure: 0 - 10 bar

**E** Válvulas de aire

**F** Valves à air

**D** Luftventile



## Options

### Gauges and adaptors

190 ▶



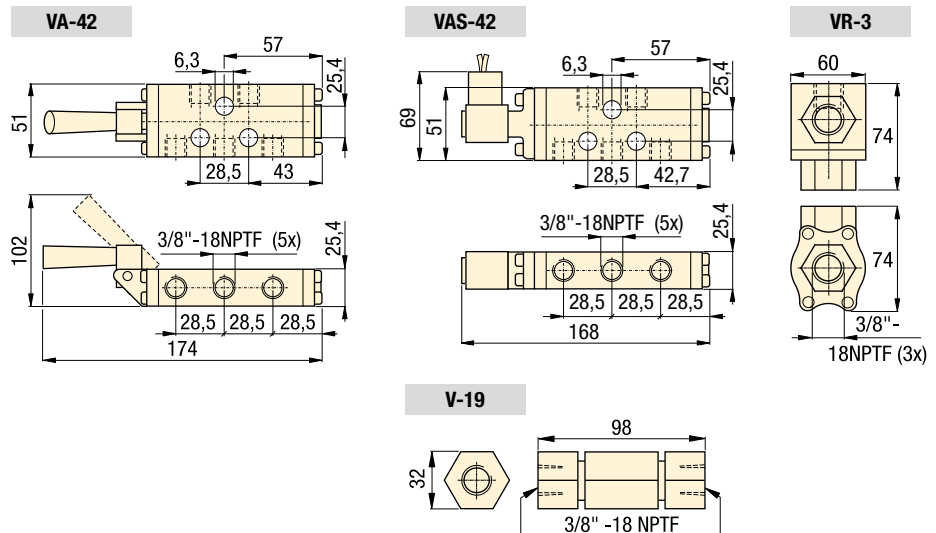
### Hoses and couplers

192 ▶



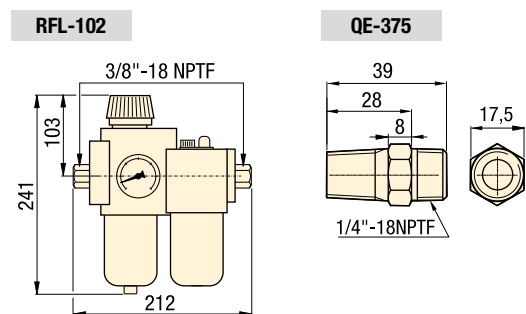
### Fittings

194 ▶



## Product selection

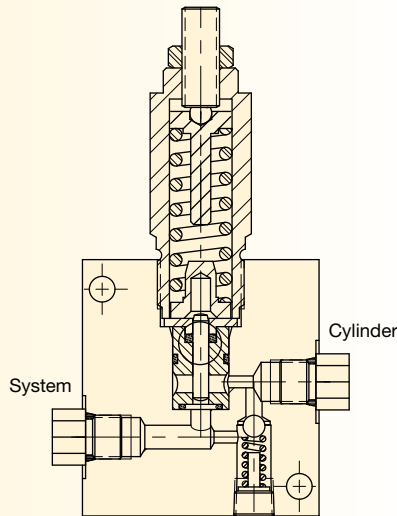
Maximum pressure bar	Model number
▼ Air valves	
2-10	VA-42
2-10	VAS-42
0-7	VR-3
0-7	V-19
▼ Accessories	
0-9	RFL-102
0-9	QE-375



## Valve Cutaways

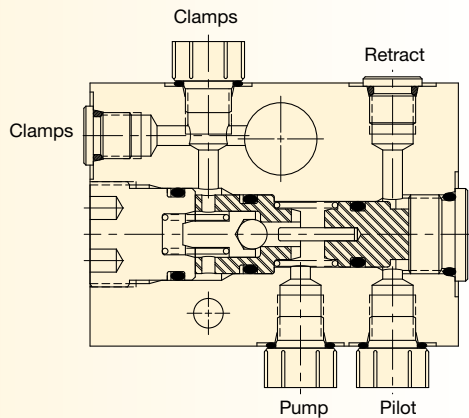
### MVPM-5

The opening point is set by the adjustment spring. Incoming pressure is blocked by the valve spindle in the orifice plate. When opening pressure is reached, the spindle is pushed up until fluid will pass. The system pressure level is maintained as pressure builds in the downstream circuit. Reverse flow is through a reverse check valve.



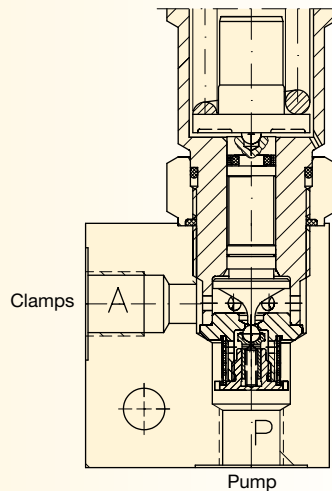
### V-72

System pressure enters through the "Pump" port, flows through the check seat and past the check valve into the cylinder circuit. When system pressure drops, the check ball closes off the seat, blocking flow. To release the cylinder pressure, the "Pilot" port is pressurized, and the pilot piston pushes the check ball off of the seat, allowing reverse flow.



### PRV-3

A check ball is held off of the check seat by a spring loaded spindle. The spring setting determines the closing point of the valve. As pressure builds in the cylinder side of the circuit, the spindle is lifted, and the check seats. Closing off further flow through the valve provides a reduced pressure to the cylinder.



# Palletized fixture

Enerpac provides a variety of solutions for use in palletized fixtures:






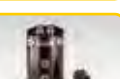


- Manual and Automated Coupler Systems for connecting/disconnecting to the fixture
- Rotary couplers for use with continuous connection systems
- Pressure intensifiers to provide increased pressure for clamping when used with machine hydraulics
- Safe Link for remote wireless monitoring of fixture pressure or clamp position.



## Technical support

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

# components

	▼ series	▼ page	
Accumulators	AC WA	162 - 163	
Coupler Packages	AC, AP MHV	164 - 165	
Manual couplers	MCR, MCH	166 - 171	
Activator wand & boosters	B, RA	172 - 173	
Auto-coupler systems	MCA, MPA WCA, ACC	174 - 175	
Rotary couplers	AMP, CR, CRV	176 - 177	
Pressure intensifiers	PID	178 - 179	
SafeLink Wireless Communication	SLR, SLS SLE, SLD	180 - 185	

Shown: ACL-201A, WA-502, ACL-21A

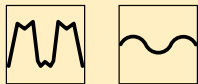


► Enerpac accumulators supply auxiliary pressure to dampen shock loads or to compensate pressure drop in applications where system pressure needs to be maintained.

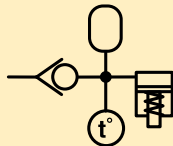
#### Accumulator applications:

- 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 100 bar
- Corrosion resistant bodies on ACL series
- Spring actuated accumulator for ACM-1
- High energy storage capacity in a compact package
- WA accumulators are piston type
- ACL accumulators are diaphragm type
- ACM accumulators use internal spring.

## Product selection

Operating pressure bar	Model number	Max. rated oil volume cm <sup>3</sup>	Gas volume cm <sup>3</sup>	Pre-charged nitrogen pressure bar	Usable oil capacity cm <sup>3</sup> at 350 bar
<b>▼ Pre-charged accumulators</b>					
0-210	<b>ACM-1</b>	1,6	–	–	–
100-350	<b>ACL-22A</b>	14,7	20,0	100	8,7
100-350	<b>ACL-202A</b>	126,2	169,9	100	73,9
100-350	<b>ACL-502A</b>	337,6	450,0	100	196,6
<b>▼ Uncharged accumulators</b>					
0-350 <sup>1)</sup>	<b>WA-502</b>	41,0	41,0	–	41,0
0-350 <sup>1)</sup>	<b>WA-5010</b>	163,9	163,9	–	122,9

<sup>1)</sup> See pre-charge chart on page 163 for hydraulic operating pressures.

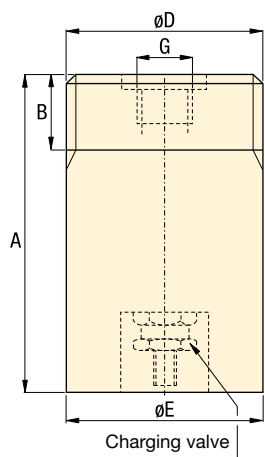


**Recommended pre-charge**

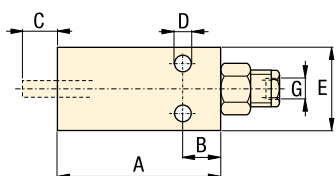
Operating pressure bar	Model number	Nitrogen pressure bar	Usable oil capacity <sup>1)</sup> cm <sup>3</sup>
0 - 70	<b>WA-502</b>	35	24,6
70 - 210	<b>WA-502</b>	70	32,8
210 - 350	<b>WA-502</b>	80	41,0
0 - 70	<b>WA-5010</b>	35	90,1
70 - 210	<b>WA-5010</b>	70	106,5
210 - 350	<b>WA-5010</b>	80	190,5

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

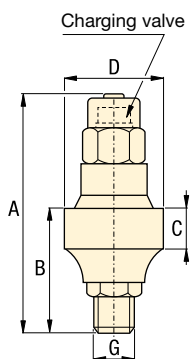
**WA-502, WA-5010**



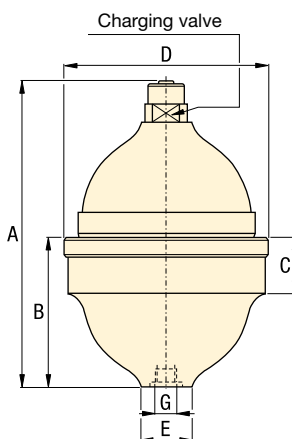
**ACM-1**



**ACL-22A**



**ACL-202A, 502A**



**Product dimensions in mm [ ]**

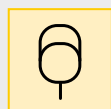
Model number	A	B	C	D	E	F	G	Recommended charging tool	kg
<b>▼ Pre-charged accumulators</b>									
<b>ACM-1</b>	133	19	13	6,7	45	-	1/4"-27 NPTF	-	1,0
<b>ACL-22A</b>	91	37	18	42,9	23	-	G1/4"	WAT-2	0,5
<b>ACL-202A</b>	137	69	29	84,5	29	-	G1/4"	WAT-2	1,2
<b>ACL-502A</b>	171	89	35	114,0	40	-	G3/8"	WAT-2	2,8
<b>▼ Uncharged accumulators</b>									
<b>WA-502</b>	119	30	-	2 3/4" -16 UN	70	-	SAE #8	WAT-1	3,2
<b>WA-5010</b>	181	30	-	2 3/4" -16 UN	70	-	SAE #8	WAT-1	5,2

Pressure: 0 - 350 bar

Oil volume: 1,6 - 337,6 cm<sup>3</sup>

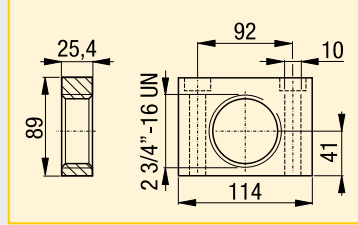
Gas volume: 20 - 450 cm<sup>3</sup>

- E** Acumuladores
- F** Accumulateurs
- D** Druckspeicher



**Options**

**AW-50 Mounting block**  
For WA-series accumulators.



**Hydraulic oil**

193

**Fittings**

194

Shown: AP-500, MHV-1, ACBS-22A



▶ 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.

## Coupler packages

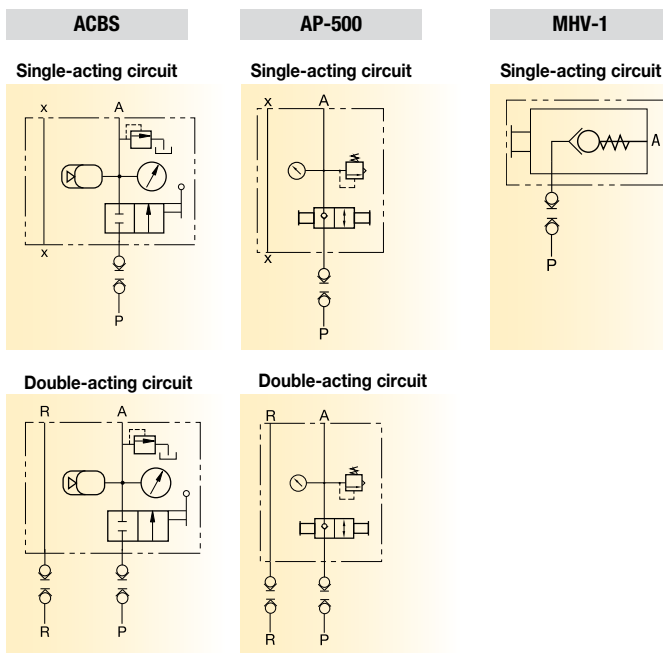
...compact design for easy use of accumulators

- 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.

### MHV-1 Modular holding valve

- Allows separate operation of clamping fixtures with a single power source
- Ideal for applications when fluid feed lines are impractical. If system pressure is interrupted, the MHV-1 will hold the pressure beyond the valve
- Max. oil flow 5 l/min
- To release system pressure, rotate valve handle in either direction 90° to release and retract system pressure.

## **i** Coupler package circuits



■ ACBS-202A Accumulator package used to maintain pressure on a machine tool fixture.



## **i** Product selection

Operating pressure	Model number	Max. rated oil volume	Gas volume	Pre-charged nitrogen pressure	Usable oil capacity
bar		cm <sup>3</sup>	cm <sup>3</sup>	bar	cm <sup>3</sup> at 350 bar

### ▼ Accumulator coupler packages

100 - 350	<b>ACBS-22A</b>	16,4	20,0	100	8,7
100 - 350	<b>ACBS-202A</b>	163,9	169,9	100	73,9
0 - 350	<b>AP-500</b>	<b>AP-500 uses WA-502 or WA-5010 <sup>1)</sup></b>			
0 - 207	<b>MHV-1</b>	-	-	-	-

<sup>1)</sup> See pre-charge chart on page 163 for hydraulic operating pressures.

Pressure: 0 - 350 bar

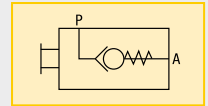
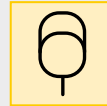
Oil volume: 16,4 - 163,9 cm<sup>3</sup>

Gas volume: 20 - 169,9 cm<sup>3</sup>

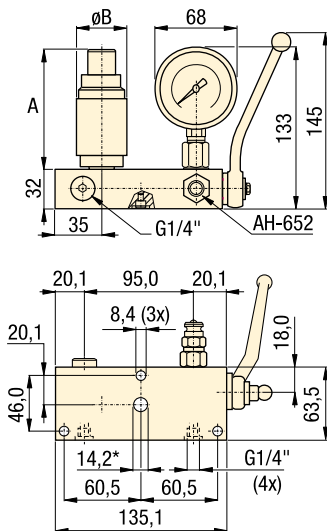
**E** Acopladores manuales

**F** Manuel coupleur

**D** Manuelle kupplung

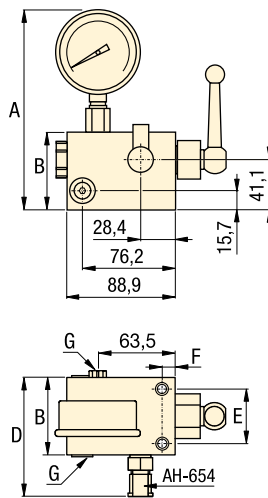


**ACBS**

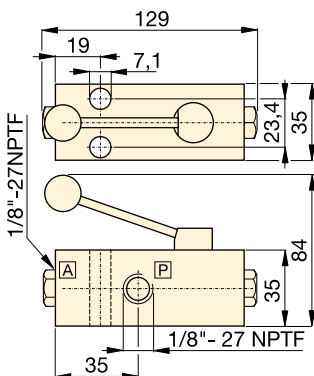


<sup>1)</sup> Manifold hole should not exceed  $\varnothing$  7,6 mm when port is utilized.

**AP-500**



**MHV-1**



**Product dimensions** in mm [ ]

Model number	A	B	C	D	E	F	G	Recommended charging tool	kg
<b>▼ Pre-charged accumulator coupler packages</b>									
<b>ACBS-22A</b>	68	42	-	-	-	-	G1/4"	WAT-2	4,6
<b>ACBS-202A</b>	106	85	-	-	-	-	G1/4"	WAT-2	5,4
<b>AP-500</b>	163,6	63,5	89,0	97,5	44,5	9,7	SAE #4	-	3,9
<b>MHV-1</b>	-	-	-	-	-	-	1/8" NPTF	-	-

**Options**

**Couplers**

192 ▶



**High pressure filters**

193 ▶



**Hydraulic oil**

193 ▶



**Fittings**

194 ▶



**Important**

**Enerpac high pressure in-line filters are required for use with these control units to prevent damage that can be caused by contaminants that have penetrated your hydraulic fluid system.**

**Order an additional male coupler for use in double-acting hydraulic circuits.  
ACBS-Series: AH-652  
AP-500: AH-654**

Shown: MCH-31, MCRA-11, MCRC-21, MCH-21, MCR-21

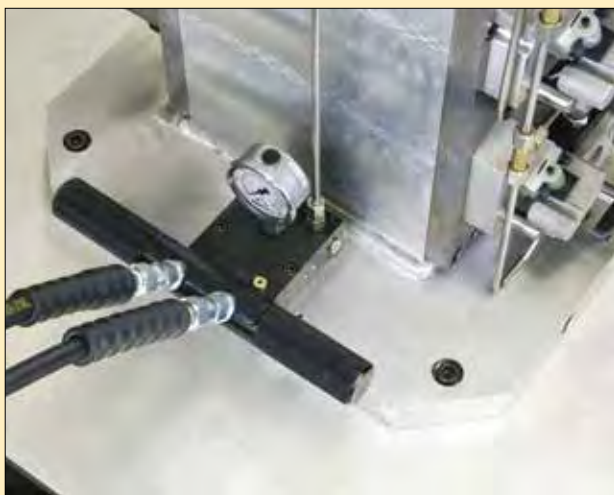


**The Enerpac manual coupler is available as a dual connection model or dual connection with optional air circuit for part present sensing. The fixture side receiver is available with or without an internal pilot operated check valve. Filtration provides protection from contamination.**

### Manual coupler applications:

- **With P.O. check**
  - Use MCRC-21 for a complete, unitized coupler receiver solution.
- **Without P.O. check:**
  - Use MCR-21 when using a remote mounted Pilot Operated Check Valve.

■ *Enerpac manual couplers simplify the process of connecting and disconnecting to a palletized fixture.*

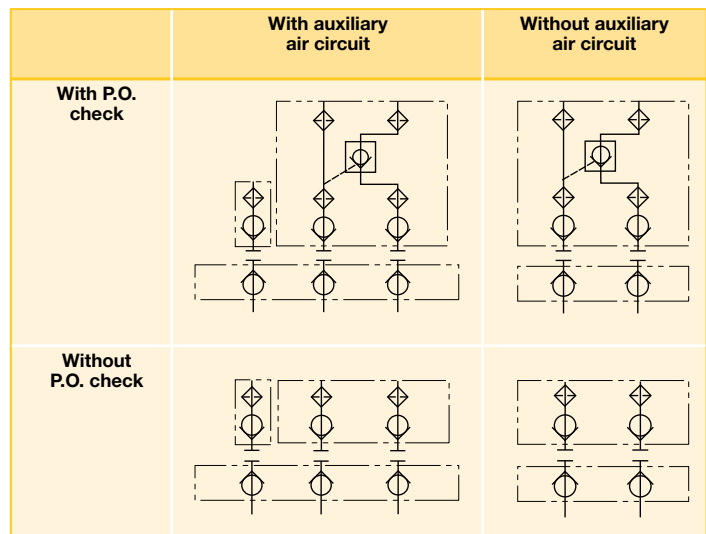


## Manual Couplers

...convenient connection

- Use on palletized fixtures
- Available with or without an internal pilot operated (P.O.) check valve
- Optional coupler block available to add circuit for air part present sensing
- Manifold porting
- Porting for tubing connections
- Filtration to prevent contamination
- Removable front plate provides access to the front filters and check cartridge
- Top port accommodates an accumulator or gauge.

## Manual Coupler Circuits



## Product selection

Model number	Basic configurations	Circuits
<b>MCRC-21</b>	Pallet receiver with P.O. check	Two Hydraulic
<b>MCR-21</b>	Pallet receiver without P.O. check	Two Hydraulic
<b>MCRA-11</b>	Auxiliary air circuit receiver block	One Air
<b>MCH-21</b>	Operator handle	Two Hydraulic
<b>MCH-31</b>	Operator handle	Two Hydraulic, One Air
<b>MCSB-21</b>	Storage block	-
<b>MCPS-21</b>	Proximity switch kit	-

## Select your components

### MCRC-21 Pallet Receiver with P.O. Check

An internal pilot operated check valve and multiple ports to accommodate a gauge or accumulator make the MCRC-21 a great choice of coupler receiver for use in a palletized fixture. Internal filtration protects the check from contamination. Use with the MCH-21 operator handle.



### MCR-21 Pallet Receiver

For applications where the pilot operated check valve is remote mounted in the fixture circuit, use the MCR-1. Internal filtration protects the circuit from outside contamination.



### MCRA-11 Auxiliary air circuit receiver

The MCRA-11 is used to provide an additional connection for use with air part sensing circuits. Use with either the MCRC-21 or the MCR-21. Use with the MCH-31 operator handle.



### MCSB-21 Operator Handle Storage Block

Proper storage of the MCH-21 or MCH-31 handle prevents contamination of the couplers, and makes sure that the handle is disconnected from the fixture. Use the MCPS-21 proximity switch to confirm proper storage as an input to the machine control.



### MCH-21 Two Coupler Operator Handle

Use the MCH-21 with either the MCRC-21 or the MCR-21 pallet receiver.



### MCH-31 Operator Handle

Use the MCH-31 when using the MCRA-11 with either the MCRC-21 or MCR-21 receivers.



Max. Flow: 15 l/min

Pressure: 0 - 350 bar

- E Acopladores manuales
- F Manuel coupleur
- D Manuelle kupplung

## Options

### FZ Series fittings

 194 ▶



### Hoses

 192 ▶



### Pilot operated check valves

 153 ▶



### Accumulators

 162 ▶



## Important

**Do not couple or uncouple with the hydraulic nozzles under pressure. This can damage the couplers.**

**Do not exceed maximum flow and pressure.**

Operating pressure bar	Replacement hydraulic nozzle	Replacement filter kit	Voltage VDC	Model number
7 - 350	AH-654	FL-2201K	-	MCRC-21
7 - 350	AH-654	FL-2201K	-	MCR-21
1 - 7 *	AH-654	FL-2201K	-	MCRA-11
7 - 350	AR-650	-	-	MCH-21
7 - 350	AR-650	-	-	MCH-31
-	AH-654	-	-	MCSB-21
-	-	-	24	MCPS-21

\* Air pressure



# Manual Couplers *Dimensions & options*

Shown: MCH-21, MCR-21



## MCR and MCH-series

The Enerpac MCH-21 two passage operator handle conveniently connects and disconnects to the MCR-21 two passage receiver utilizing a simple push-on, pull-off action.

Collet-Lok® products

Swing clamps

Work Supports

Linear Cylinders

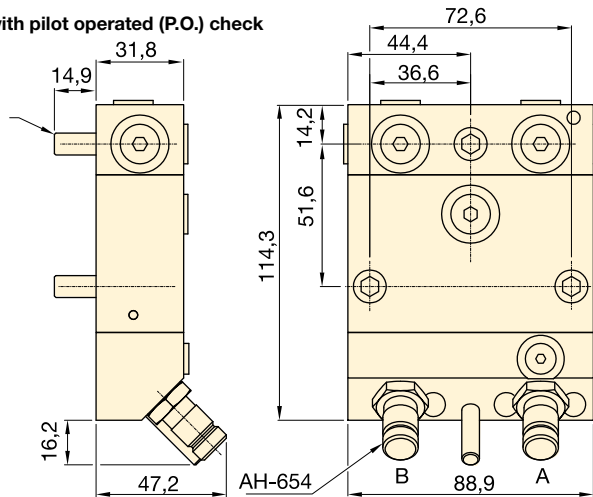
Power Sources

Valves

Pallet Components

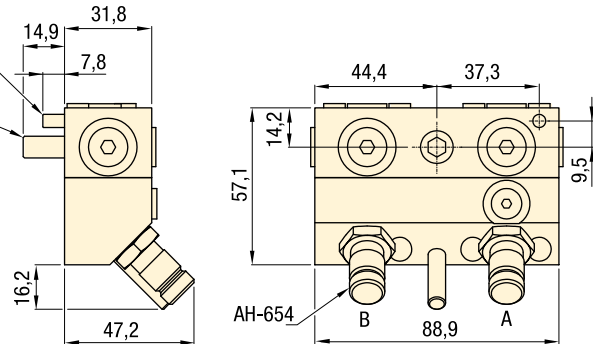
### MCR-21 Receiver with pilot operated (P.O.) check

See page 170 for mounting pattern.



### MCR-21 Receiver without pilot operated check

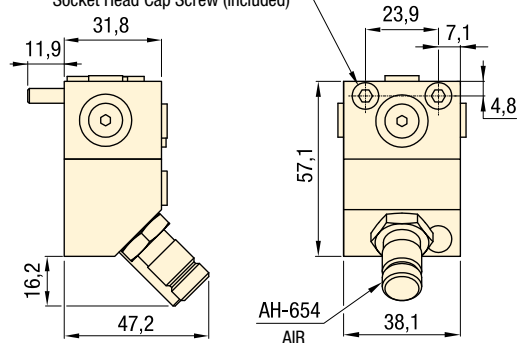
$\varnothing$  4,8 mm  
 15,7 mm length  
 spring roll pin (included)  
 5/16"-18UN  
 38 mm length  
 Socket Head Cap Screw (included)



### MCRA-11 Auxiliary air circuit receiver

See page 170 for mounting pattern.

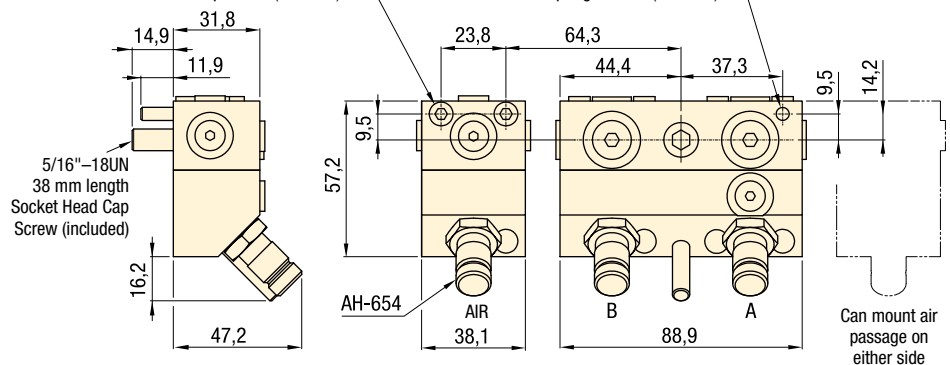
2x #10-24 UN 38 mm length  
 Socket Head Cap Screw (included)



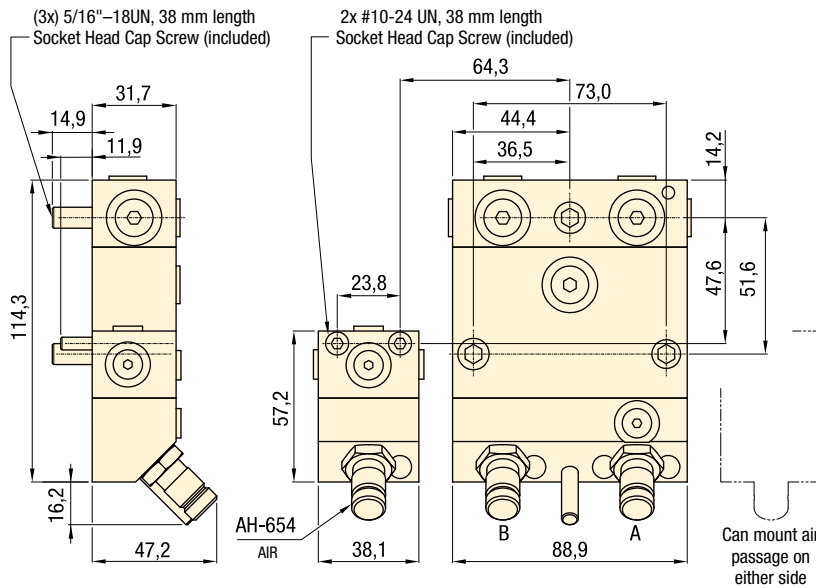
### MCR-21 with MCRA-11 Receiver with air passage and without P.O. check

2x #10-24 UN 38 mm length  
 Socket Head Cap Screw (included)  
 5/16"-18UN  
 38 mm length  
 Socket Head Cap Screw (included)

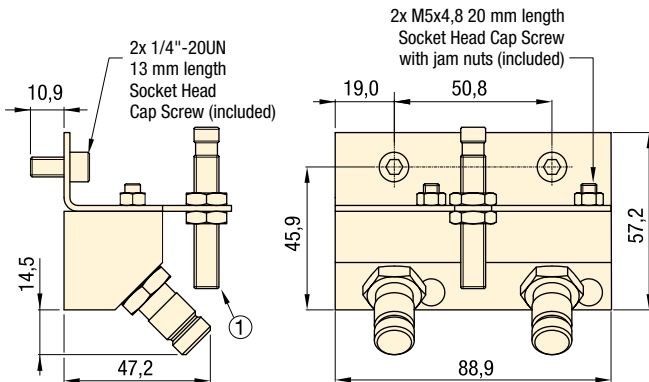
$\varnothing$  4,8 mm, 15,8 mm length  
 Spring Roll Pin (included)



**MCR-21 with MCRA-11** See page 170 for mounting pattern.

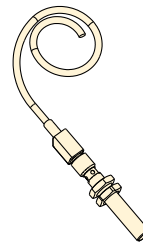


**MCSB-21** Storage block. See page 171 for mounting pattern.

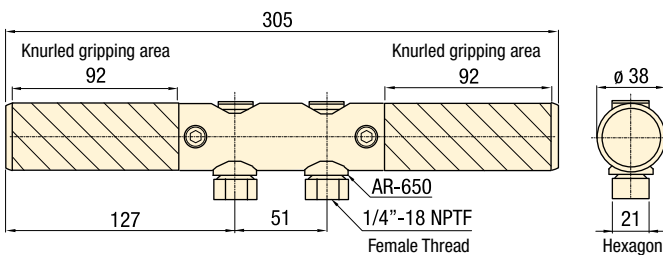


① Optional proximity switch is available. See MCPS-21

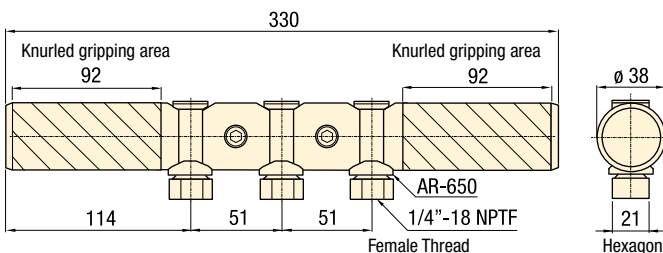
**MCSB-21**  
Optional proximity switch



**MCH-21** Operator handle



**MCH-31** Operator handle



Max. Flow: 15 l/min

Pressure: 0 - 350 bar

- E** Acopladores manuales
- F** Manuel coupler
- D** Manuelle kupplung

**Options**

FZ Series fittings

194 ▶



Hoses and couplers

192 ▶



Pilot operated check valves

153 ▶



Accumulators

162 ▶



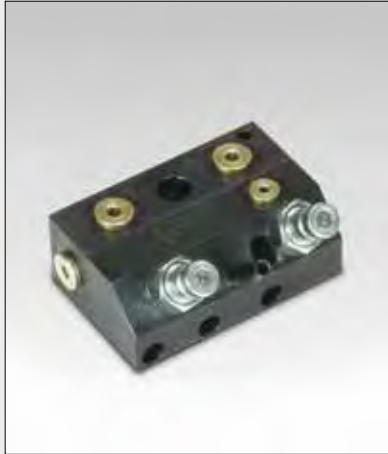
**Important**

Do not couple or uncouple with the hydraulic nozzles under pressure. This can damage the couplers.

Do not exceed maximum flow and pressure.

# Manual Couplers *Mounting patterns*

Shown: MCR-21



## MCR-series

The MCR-21 two passage receiver features multiple SAE #4 ports as well as manifold mount ports for easy plumbing to a fixture. Internal filtration in all receiver models protects the circuit from external contamination.

Collet-Lok® products

Swing clamps

Work Supports

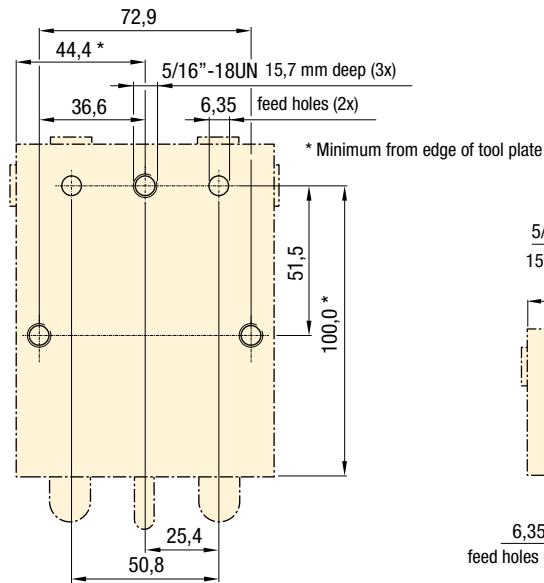
Linear Cylinders

Power Sources

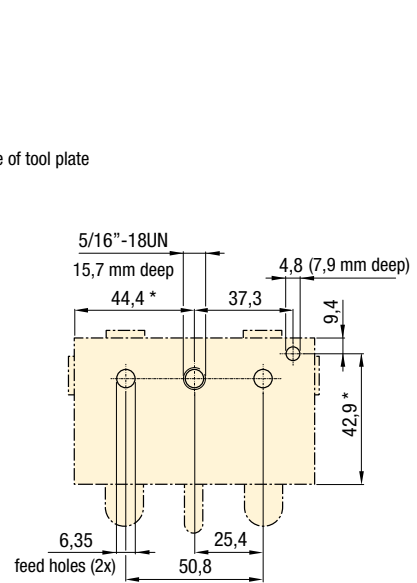
Valves

Pallet Components

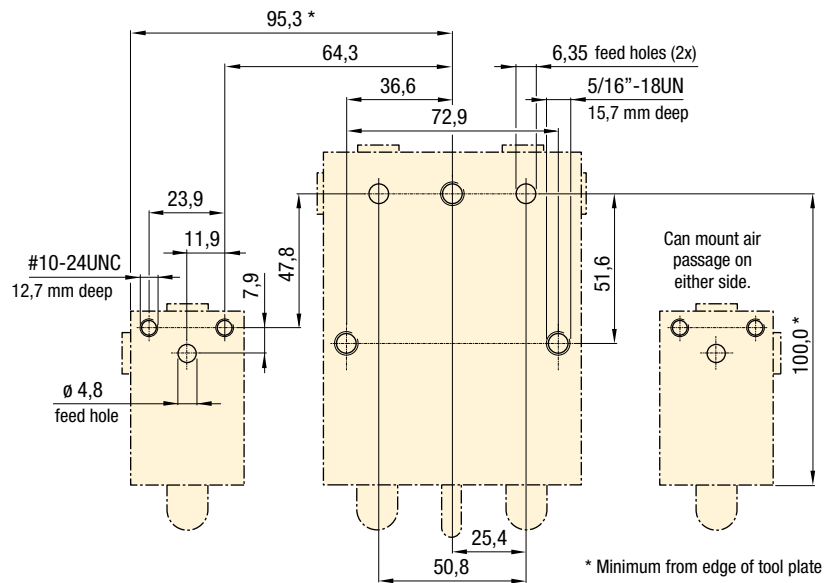
**MCRC-21** Receiver with P.O. check – Mounting hole pattern



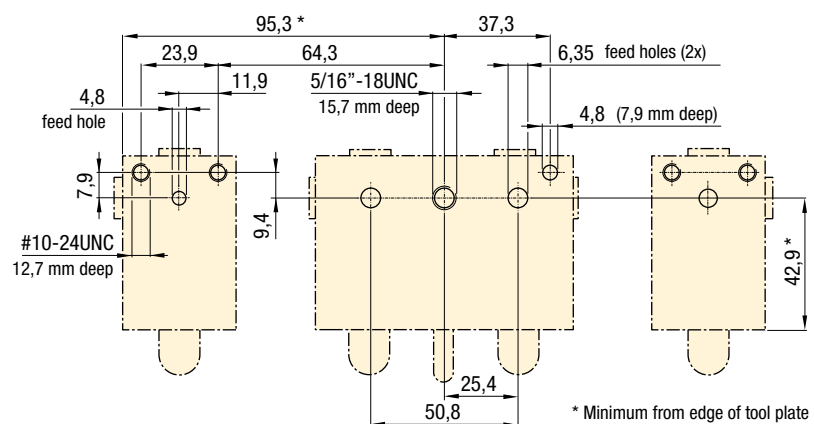
**MCR-21** Receiver without P.O. check – Mounting hole pattern



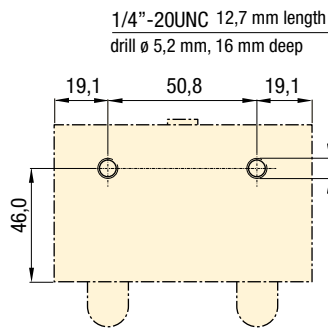
**MCRC-21 with MCRA-11** Receiver with air passage and with P.O. check – Mtg. hole pattern



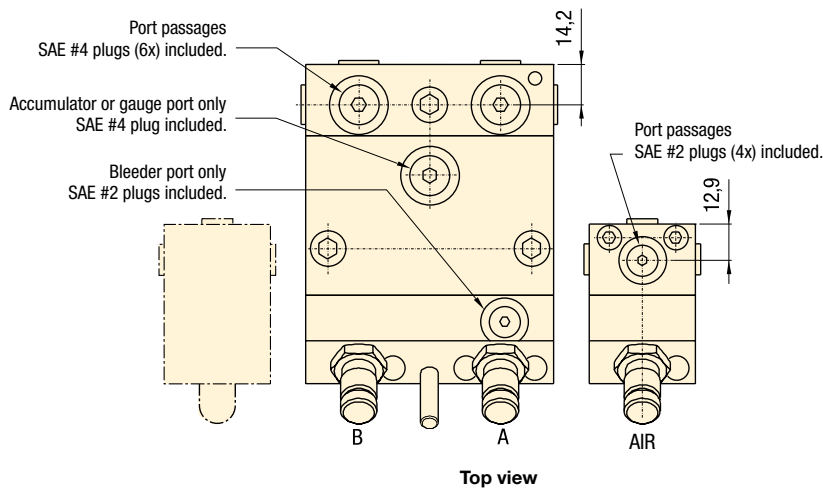
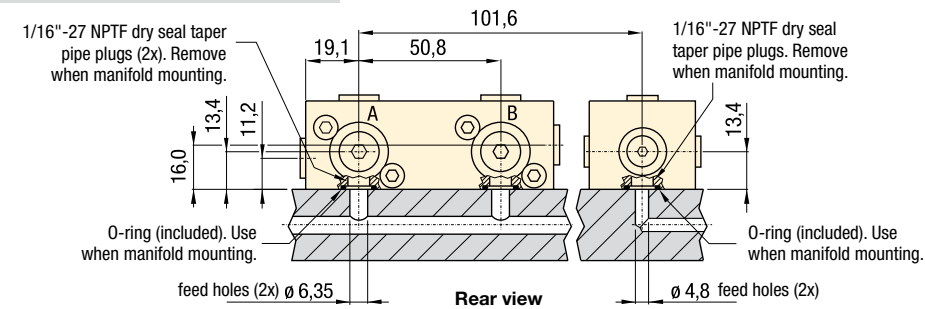
**MCR-21 with MCRA-11** Receiver with air passage and without P.O. check – Mtg. hole pattern



## MCSB-21 Storage Block – Mounting Hole Pattern



## Manifold and Port Dimensions



Flow: 15 l/min max.

Pressure: 0 - 350 bar

- E** Acopladores manuales
- F** Manuel coupleur
- D** Manuelle kupplung

## Options

### FZ Series fittings

194 ▶



### Hoses and couplers

192 ▶



### Pilot operated check valves

153 ▶



### Accumulators

162 ▶



## Important

**Do not couple or uncouple with the hydraulic nozzles under pressure. This can damage the couplers.**

**Do not exceed maximum flow and pressure.**

# Activator wand and booster

Shown: RA-1061, B-81



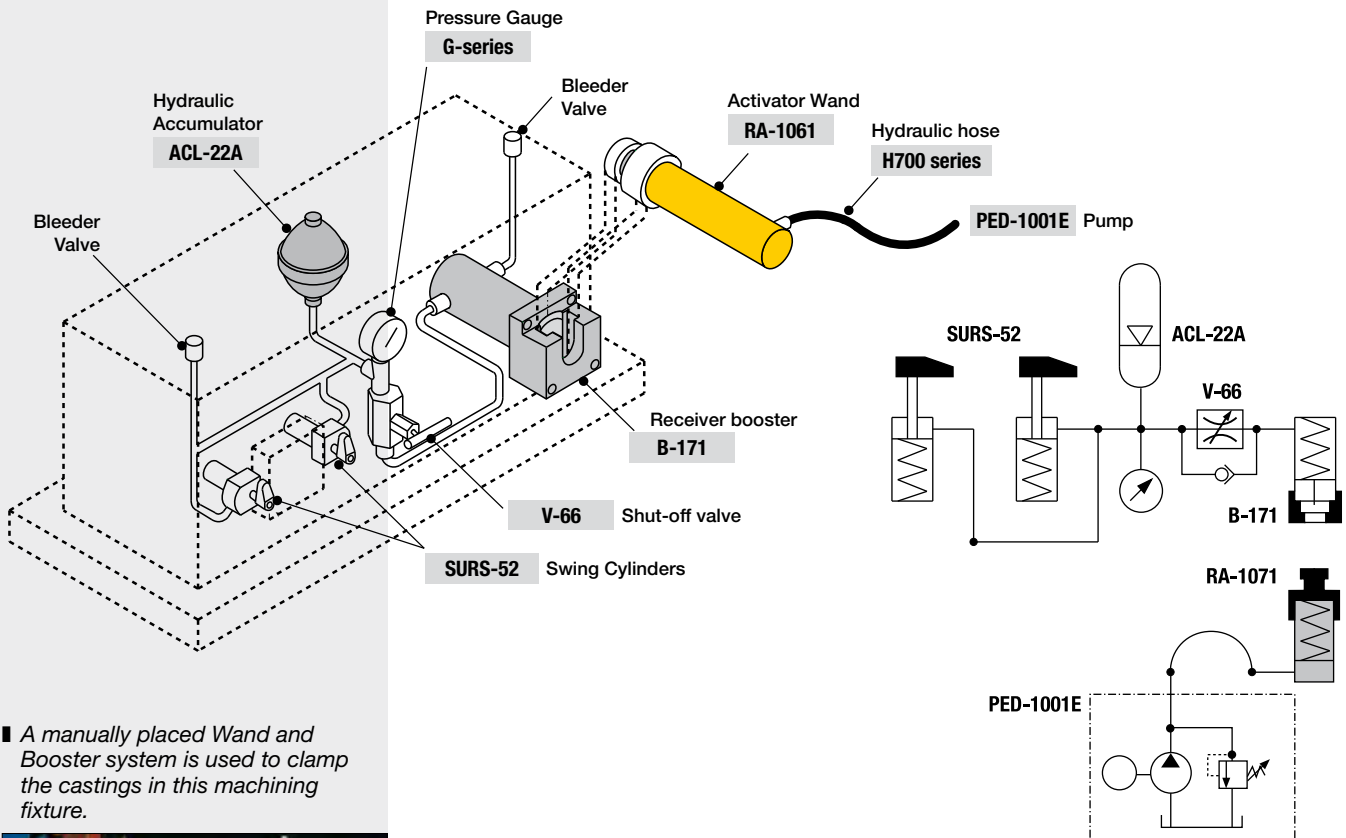
**B and RA-series**  
Mechanical energy transfer system uses external cylinder to operate receiver booster.

## 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.



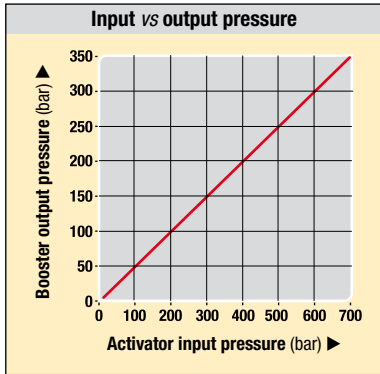
■ A manually placed Wand and Booster system is used to clamp the castings in this machining fixture.



## Product selection

Pressure ratio	Oil flow ratio	Oil volume per stroke cm <sup>3</sup>	Stroke mm	Model number	Effective area cm <sup>2</sup>	Operating pressure bar	kg
<b>▼ Receiver booster</b>							
2 : 1	1,75 : 1	132,7	51,8	<b>B-81</b>	25,7	30 - 350	5,7
2 : 1	1,75 : 1	280,2	109,2	<b>B-171</b>	25,7	30 - 350	7,1
<b>▼ Activator wand</b>							
-	-	162,2	112,7	<b>RA-1061</b>	14,4	60 - 700	5,1



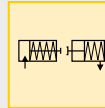


Ratio: 2 : 1

Stroke: 51,8 - 112,7 mm

Pressure: 30 - 350 bar

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



**Options**

**Fittings**

194 ▶

**Hoses and couplers**

192 ▶

For 700 bar pumps, refer to the Enerpac Industrial Tools Catalog E327e.

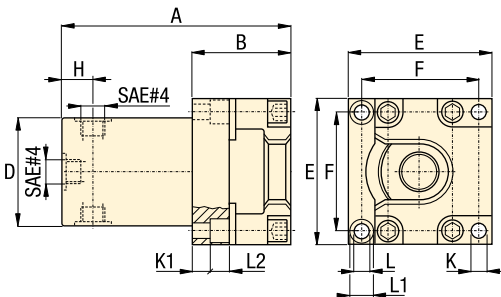
Existing fixtures with manual-connect single-acting circuits can be easily upgraded into the wand and booster.

**Important**

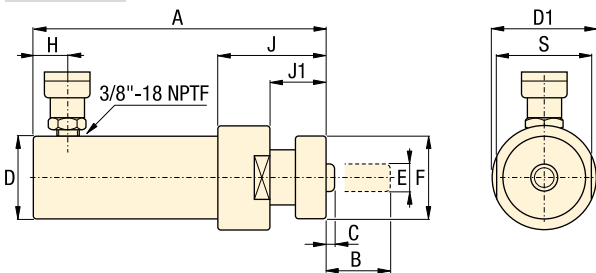
The activator wand has a 2 to 1 ratio of input pressure versus output force.

The booster output flow is 1,75 times the wand input flow.

**B-81, -171**



**RA-1061**



**Product dimensions** in mm [ ]

Model number	A	B	C	D	D1	E	F	H	J	J1	K	K1	L	L1	L2	S
<b>▼ Receiver booster</b>																
<b>B-81</b>	174,2	69,6	44,2	76,2	-	101,6	82,6	28,4	-	-	10,4	57,4	10,4	15,7	10,7	-
<b>B-171</b>	231,6	69,6	44,2	76,2	-	101,6	82,6	28,4	-	-	10,4	57,4	10,4	15,7	10,7	-
<b>▼ Activator wand</b>																
<b>RA-1061</b>	295,1	117,6	4,8	57,2	76,2	19,1	58,9	19,1	76,7	38,9	-	-	-	-	-	69,9

Shown: MCA-62, MPA-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.

■ ACCB-2 Control shown with ZW4020HW-FHLT12U300 Pump.



■ A 4-way auto coupler is 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-2, Automatic coupler control box

175 ▶

- Provides automatic or manual control of your 2 or 4 port auto coupler station.
- Panel view informs 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 ZW4020HW-FHLT12U300 and ZW5020HW-FHLT12U300 pumps.

## Product selection

Station position	Model number <sup>1)</sup>	Adjustable stroke		Oil capacity		Maximum oil flow <sup>2)</sup>
		mm	advance	cm <sup>3</sup> retract	l/min	
<b>▼ 2 port auto coupler</b>						
Base	<b>MCA-62</b>	5 - 15	10,8	10,8	1,0	
Base	<b>WCA-82*</b>	104 - 113	10,8	10,8	1,0	
Pallet	<b>MPA-62</b>	-	-	-	-	
<b>▼ 4 port auto coupler</b>						
Base	<b>MCA-64*</b>	5 - 15	10,8	10,8	1,0	
Pallet	<b>MPA-64*</b>	-	-	-	-	

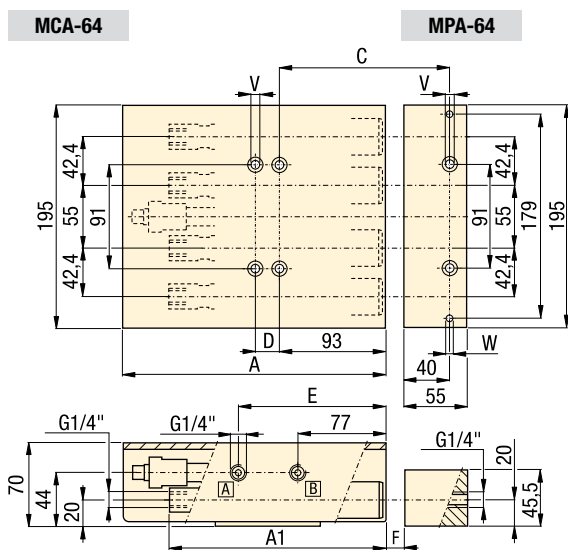
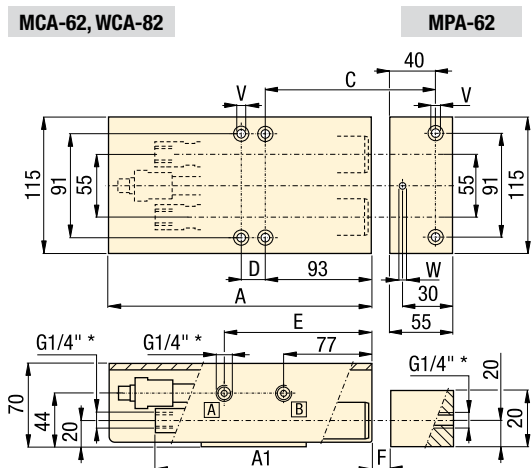
<sup>1)</sup> For additional pallet clearance, WCA-82 long stroke model are available.

<sup>2)</sup> Maximum oil flow of coupler elements is 16 l/min.

\* This product is made to order. Please contact Enerpac for delivery information before specifying in your design.

## Product specifications

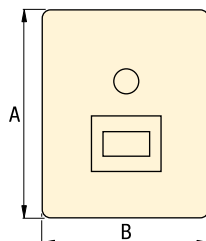
Model number	Required radial alignment accuracy mm	Operating pressure bar	Hydraulic nozzle model number (included)	Air blow-off fitting model No. (included)	Recommended alignment tool
<b>▼ 2 port auto coupler</b>					
MCA-62	± 0,5	40 - 350	CDF-6	FZ-2050	AT-1
WCA-82	± 0,5	40 - 350	CDF-6	FZ-2050	AT-2
MPA-62	± 0,5	40 - 350	CDM-6	FZ-2050	AT-1
<b>▼ 4 port auto coupler</b>					
MCA-64	± 0,5	40 - 350	CDF-6	FZ-2050	AT-1
MPA-64	± 0,5	40 - 350	CDM-6	FZ-2050	AT-1



Model number	Voltage / Current
<b>▼ Automatic Coupler Control Box</b>	
ACCB-2	115 VCA / 10 A

Note: Enclosure rating NEMA 12.

**ACCB-2**  
Operator Station



Connection: 2 - 4 ports

Stroke: 5 - 113 mm

Pressure: 40 - 350 bar

- E** Acopladores automáticos
- F** Coupleurs automatiques
- D** Automatische Kupplungen

## Options

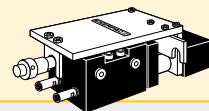
**High pressure filters**

193 ▶



**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 and couplers**

192 ▶



## 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.

## Product dimensions in mm [ ]

Model number	A	A1	B	C	D	E	F max.	V <sup>1)</sup> for mounting bolts thread x length	W <sup>2)</sup>	kg
<b>▼ 2 port auto couplers</b>										
MCA-62	225	190	-	137,7	21	129,3	10,0-10,5	M8 x 90	-	7,6
WCA-82*	398	356	-	237,7	100	208,3	94	M8 x 90	-	13,1
MPA-62	-	-	-	-	-	-	-	M8 x 90	5,8	1,8
<b>▼ 4 port auto couplers</b>										
MCA-64*	225	190	-	137,7	21	129,3	10,0-10,5	M8 x 90	-	13,2
MPA-64*	-	-	-	-	-	-	-	M8 x 90	5,8	3,0
<b>▼ Automatic coupler control box<sup>3)</sup></b>										
ACCB-2	325	-	300	-	-	-	-	-	-	13,6

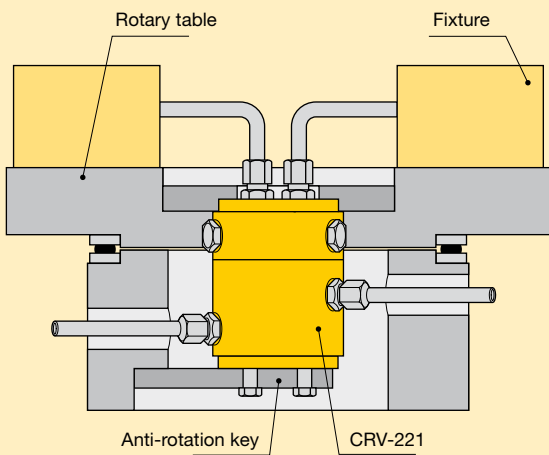
<sup>1)</sup> Mounting bolts are not included. <sup>2)</sup> Drill dowel pin holes after installing MPA. \* This product is made to order. Please contact Enerpac for delivery information before specifying in your design.

# Rotary couplers *Application & selection*

Shown: CRV-222, CR-112



**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.**



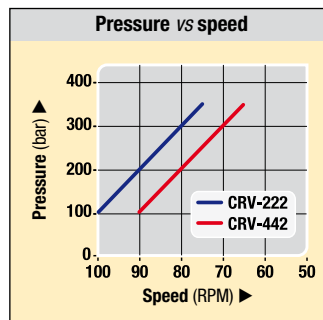
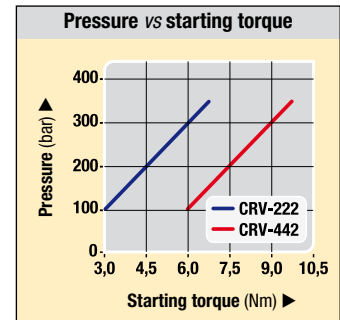
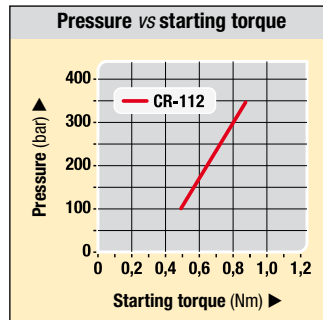
**In this application eight CRV-222 rotary couplers are installed to power the individual presses of an eight station rotary press table.**



## 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



NOTES:  
Maximum oil flow: 9 l/min.  
Oil loss CRV-222 = 30 cm<sup>3</sup>/hour.  
Oil loss CRV-442 = 40 cm<sup>3</sup>/hour.

### Product selection

No. of radial passages	Model number <sup>1)</sup>	Operating pressure range bar	Maximum speed RPM		Starting torque Nm	
			100 bar	350 bar	100 bar	350 bar
1	<b>CR-112</b>	100 - 350	30	30	0,5	0,9
2	<b>CRV-222</b>	100 - 350	100	75	3,0	7,0
4	<b>CRV-442</b>	100 - 350	90	65	6,0	10,0

<sup>1)</sup> Before selecting, note the starting torque and speed diagrams above.  
Maximum oil flow: 9 l/min.

### Manifold mounting adaptor



#### Mounting adaptor AMP-2, AMP-4

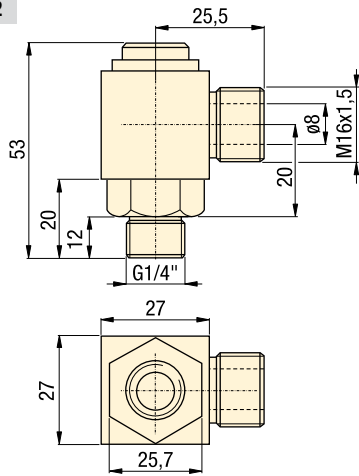
Mounts onto end of two and four passage rotary unions. Allows O-ring mounting directly to fixture.

### Product selection

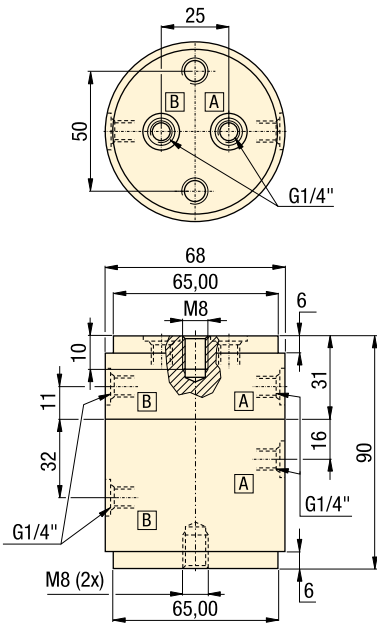
Number of radial passages	Model number	Operating pressure range bar	Used with
2	<b>AMP-2</b>	100 - 350	CRV-222
4	<b>AMP-4</b>	100 - 350	CRV-442

## Product dimensions in mm [ ]

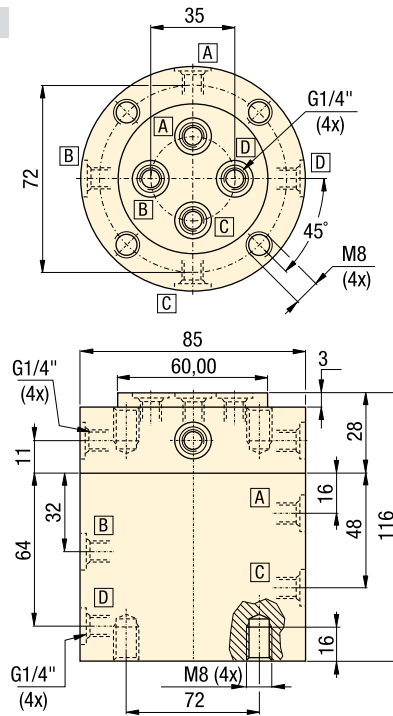
CR-112



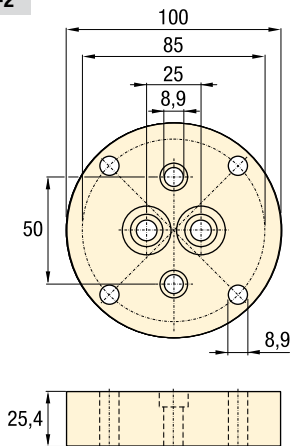
CRV-222



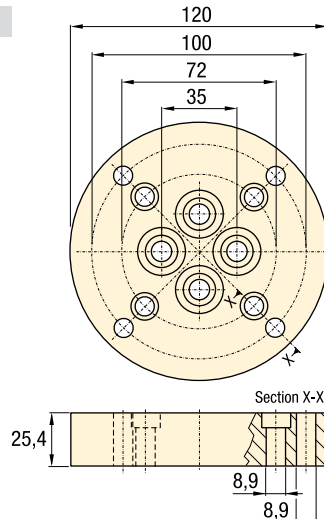
CRV-442



AMP-2



AMP-4



Passages: 1 - 4 lines

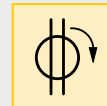
Speed: 30 - 100 RPM max.

Pressure: 100 - 350 bar

**E** Acoplamiento giratorios

**F** Joints tournants

**D** Drehdurchführungen



## Options

Fittings

 194



Couplers

 192



Hoses and couplers

 192



## 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.



# Oil/oil intensifiers

Shown: PID-402



## PID-series

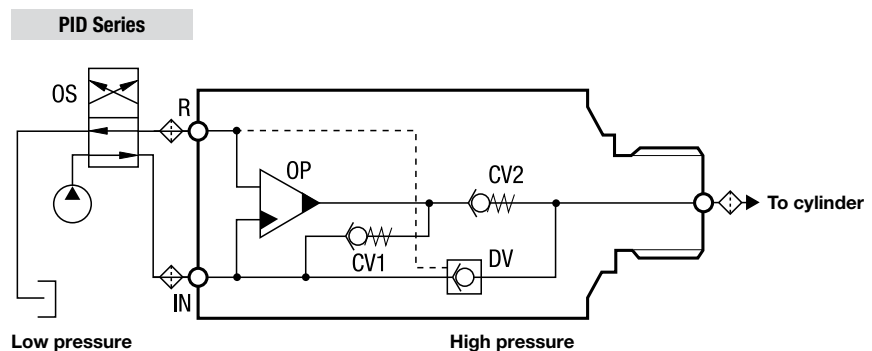
When hydraulic pressure from an existing power source is limited, Enerpac oil-to-oil intensifiers serve to increase output pressure to satisfy the required application.

## 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
- Includes 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 on all ports in the circuit to ensure trouble free operation. Filters and flow control included.



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



## Product selection

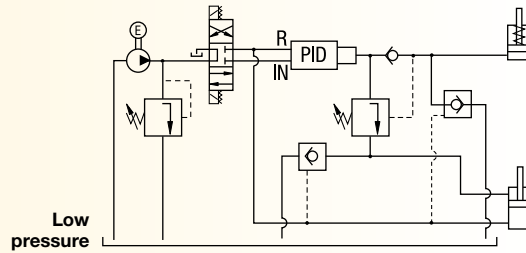
Maximum pressure	Pressure intensification ratio	Maximum input flow	Maximum output flow	Model number	Inlet pressure range	kg
bar		l/min	l/min	with dump valve	bar	
700	1 : 3,2	10,0	2,5	<b>PID-322F</b>	21 - 107	1,2
700	1 : 4,0	9,5	2,0	<b>PID-402F</b>	21 - 86	1,2
700	1 : 5,0	9,0	1,5	<b>PID-502F</b>	21 - 69	1,2
700	1 : 6,6	8,7	1,2	<b>PID-662F</b>	21 - 56	1,2

\* Operating pressures above 350 bar require high pressure fittings or intensifier models with BSPP ports. Contact Enerpac for details.

**i System set-up information:**

**With dump valve (PID models)**

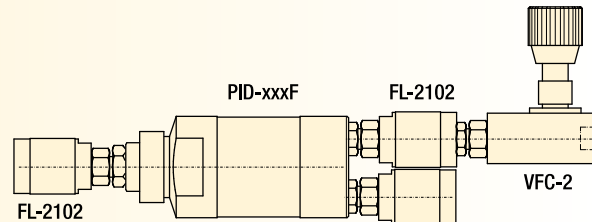
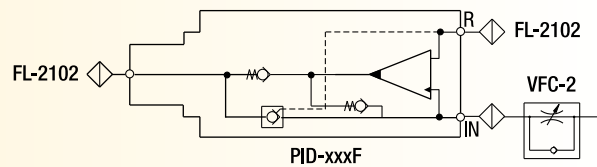
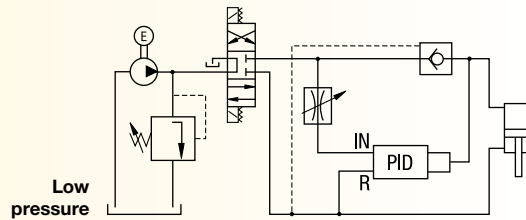
The intensifier with the dump valve is used to achieve high pressure on the advance side of a double-acting cylinder.



**With external dump valve**

In a 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: 1,2 - 2,5 l/min

Pressure: 65 - 700 bar

**E** Multiplicadores

**F** Multiplicateur

**D** Öl-Öl Druckübersetzer



**i Options**

**FL-series, high-pressure filters**

193 ▶



**Directional valves**

135 ▶



**FZ-series fittings**

194 ▶



**! Important**

Do not exceed maximum allowable inlet pressure.

10 micron filtration is included to ensure trouble-free operation.

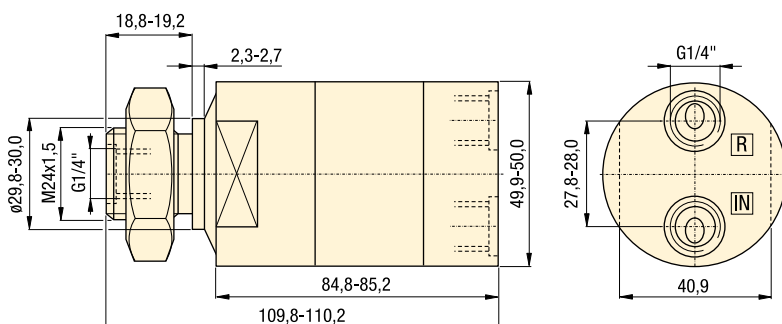
Applications above 350 bar require high pressure fittings or intensifier models with BSPP ports. Contact Enerpac for details.

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

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

**i Product dimensions in mm [  $\pm$  ]**

PID-series



Shown: SLS-2



**▶ SafeLink provides wireless communication between the fixture mounted SEND unit and the machine control interfaced RECEIVE unit.**

A pressure switch is used on the fixture to monitor the circuit pressure. If the pressure switch on the fixture goes open, the RECEIVE unit communicates the changed status to the machine control through either 24 VDC, Modbus RTU RS485 or Ethernet IP protocol or Modbus TCP/IP.

The machine control would interrupt the machining process. The SEND unit can also be used with limit switch based position sensing clamps to verify clamped or unclamped status for robotically loaded systems.

## WIRELESS communication between a fixture circuit and the machine control

- Fixture mounted “SEND” unit uses radio communication to monitor pressure and/or clamp position
- 2.4 GHz Frequency Band for global acceptance
- “Frequency Hopping” used for signal stability, even in busy production environments
- “SEND” units are easily reassigned to a different “RECEIVE” unit so fixtures can be moved between machines
- No limit to the number of systems used in a production area
- “SEND” units are internally powered by a replaceable 3,6 VDC Lithium battery – provides up to 3-year battery life
- “SEND” units are sealed to IP-67 for protection from contamination and coolant
- LED lights for visual status indication
- LCD Display window for set-up and status display.

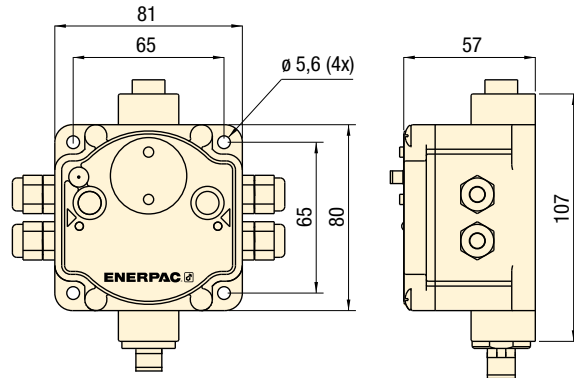
## Product selection

Model Number	Description
<b>SLS-1</b>	“SEND” Unit with Internal Antenna
<b>SLS-2</b>	“SEND” Unit with External Antenna
<b>SLS-3</b>	“SEND” Unit with External Antenna, 3 Inputs
<b>SLR-1</b>	“RECEIVE” Unit with External Antenna
<b>SLR-2</b>	“RECEIVE” Unit with External Antenna, 3 Inputs
<b>SLS-2AC</b>	0,2 meter Antenna Cable
<b>SLEM-1</b>	Expansion Module for SLR
<b>SLEB-1</b>	Ethernet Bridge for SLR-1
<b>SLSC-1</b>	Power and Communication Splitter Cable for SLEB-1
<b>SLDB-1</b>	DIN Rail Mounting Bracket

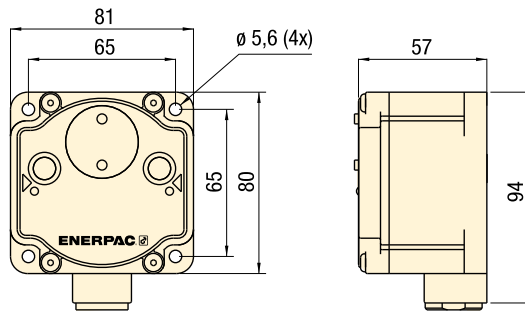
## Product specifications

IP Rating	Radio Frequency	Transmit Power	Input Power for RECEIVE Unit	Output	FCC Rating	Receiver Communication Protocols	Additional Outputs available from Receiver
IP 67	2.4 GHz	21 dBm	+10 VDC	+24 VDC	FCC	Modbus	24 VDC
		conducted	to		Part 15,	RTU RS485	
			+30 VDC		Subpart C,	Ethernet IP	
					15.247		
Dust tight, immersion up to 1 meter	Global Standard		Supplied by machine control	NMOS Sinking		Ethernet IP Modbus TCP/IP	Max. from Receiver: 6

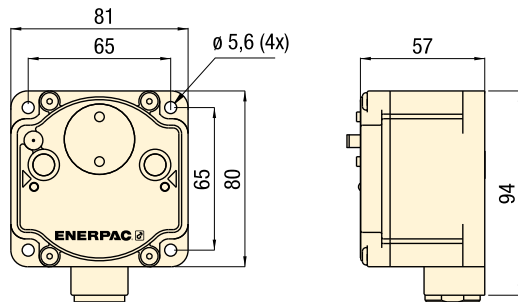
SLR-1, SLR-2 Receive Unit



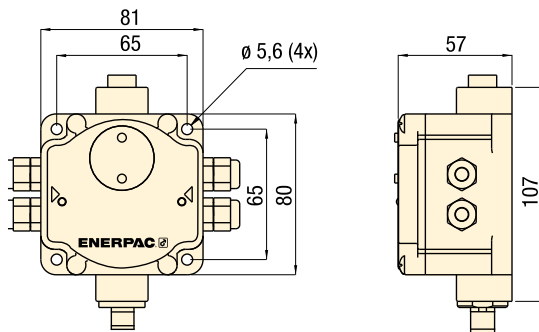
SLS-1 Send Unit



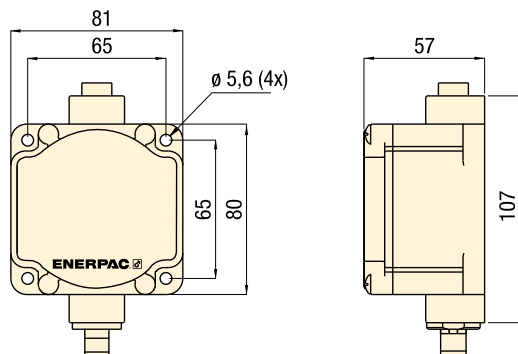
SLS-2, SLS-3 Send Unit



SLEM-1 Expansion Module



SLEB-1 Ethernet Bridge



Radio Frequency: 2,4 GHz

IP Rating: 67

Communication protocols:  
Modbus RTU RS485  
Ethernet TCP IP

- E** Monitoreo Inalámbrico
- F** Contrôle sans fil
- D** Drahtlose Überwachung

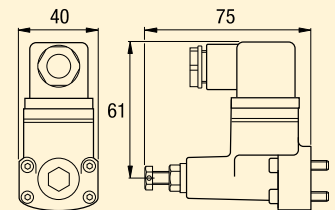
**⚠ Important**

A Pressure Switch is required to monitor the pressure in the fixture circuit. For a convenient manifold mount model, use the **PSCK-8** or **PSCK-9** from Enerpac.

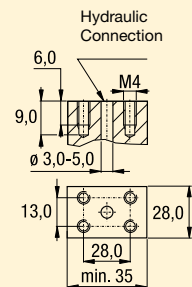


**Manifold Mount Pressure Switch**

IP Rating: 65 (Dust and Water Jet)  
**PSCK-8:** Range 100 - 345 bar  
**PSCK-9:** Range 20 - 210 bar



**Mounting Dimensions**



Shown: SLS-1



## SafeLink

SafeLink can provide a discrete 24 VDC output signal for systems of up to 4 fixtures. Each SEND unit can provide up to three outputs to the RECEIVE unit. The RECEIVE unit has 6 terminal stations, which are assigned to SEND units in groups of 3. So each RECEIVE unit can be paired with 2 SEND units when using the 24VDC output. For extra capacity, an EXPANSION MODULE provides an additional terminal strip, adding 2 more sets of three terminal stations.

Collet-Lok® products

Swing clamps

Work Supports

Linear Cylinders

Power Sources

Valves

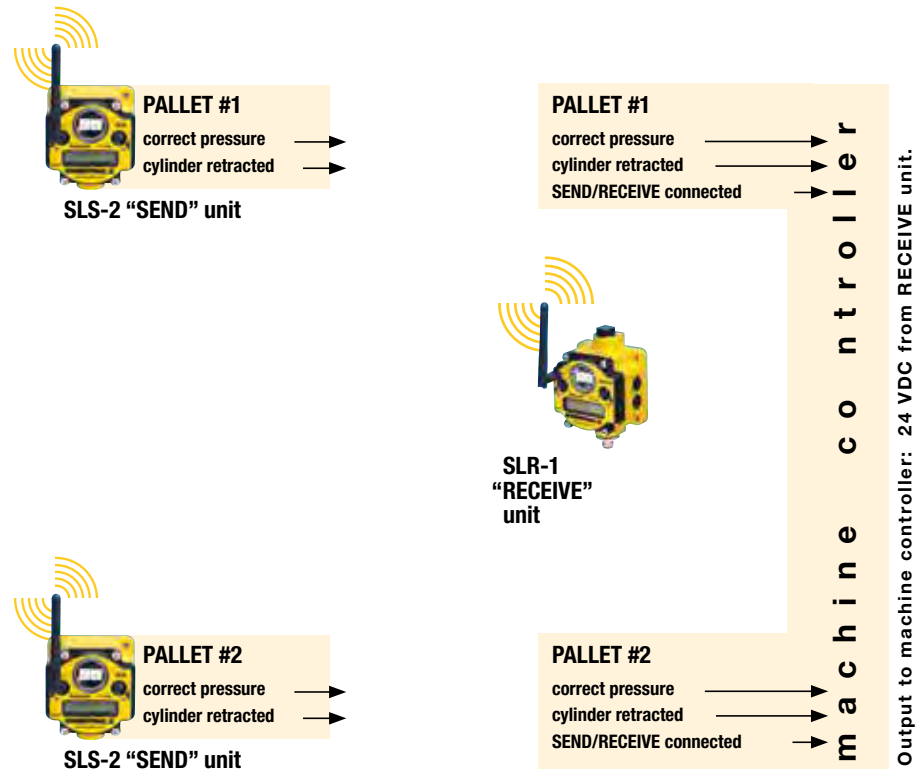
Pallet Components

### SLCS-1 Splitter Cable

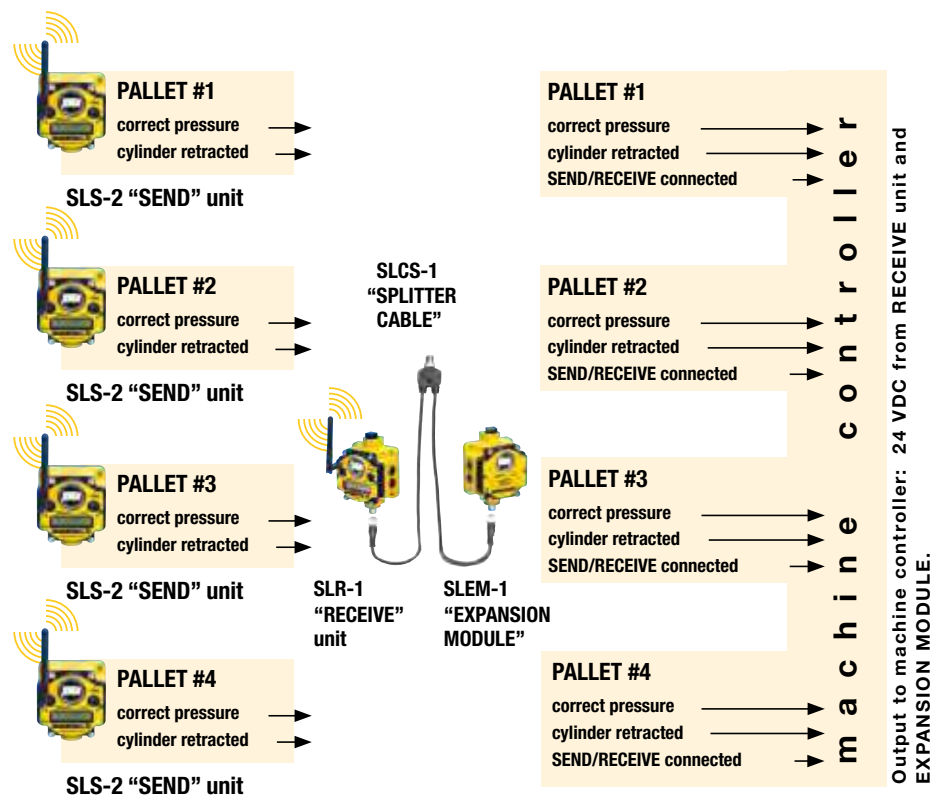


The **SLCS-1 Splitter Cable** is used with the **SLEM-1** Expansion Module and the **SLEB-1** Ethernet Bridge to connect to the **SLR-1** RECEIVE unit and the machine control circuit.

## Basic System with I/O Machine Interface

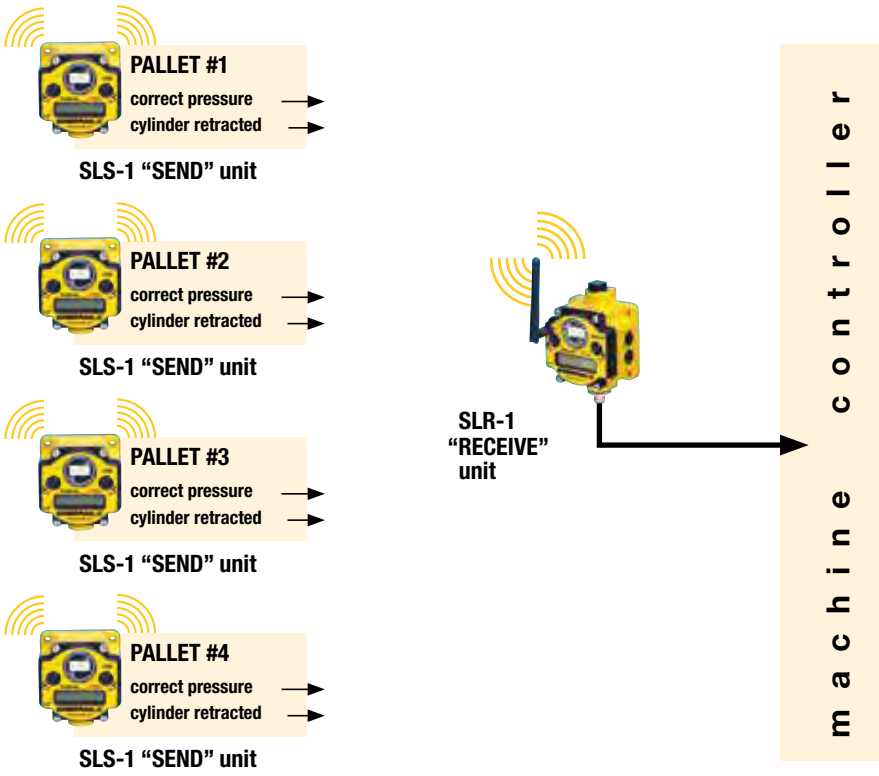


## Larger System with I/O Machine Interface





**Larger System with Modbus RTU Machine Interface**



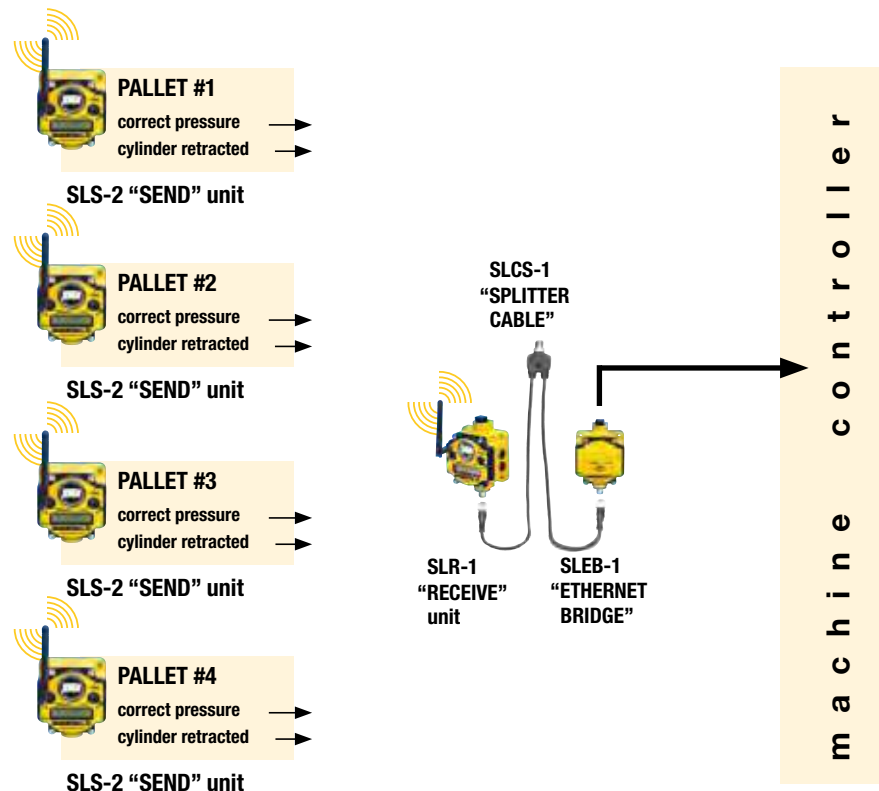
Output to machine controller: Modbus RTU RS-485.

Shown: SLR-1



▶ SafeLink RECEIVE units can supply the outputs by using the standard Modbus RTU RS-485 protocol. This output uses the 5 pin connector on the RECEIVE unit. If Ethernet protocol is preferred, an ETHERNET BRIDGE is available to convert the Modbus RTU R-485 to ETHERNET IP or Modbus TCP/IP.

**Larger System with Ethernet IP Machine Interface**



Output to machine controller: Ethernet IP or Modbus TCP/IP.

Shown: SLEB-1



▶ The SLEB-1 Ethernet Bridge is used with the SLR-1 Receiver when Ethernet connection is available in the machine control. Use of the SLEB-1 will allow the monitoring of more fixtures in a large pallet pool system.

Shown: SLR-1



▶ SafeLink provides wireless communication between the fixture mounted SEND unit and the machine control interfaced RECEIVE unit. If the pressure switch on the fixture goes open, the RECEIVE unit communicates the changed status to the machine control through either 24 VDC Modbus RTU RS485 or Ethernet TCP IP protocol. The machine control would interrupt the machining process. The SEND unit can also be used with limit switch based position sensing clamps to verify clamped or unclamped status for robotically loaded systems.

## ▶ WHAT IS SAFE LINK?

SafeLink is a wireless way to communicate between a palletized fixture and a machine control.

## ▶ WHY USE SAFE LINK?

SafeLink can monitor the fixture pressure and clamp position in real time- even when parts are being machined. The system can also be used to verify that the operator has properly pressurized the fixture before it is sent in to be machined. If there is a pressure deficiency, the signal between the Send and Receive units is interrupted, and the machine control can respond before expensive damage occurs.

## ▶ HOW DOES SAFE LINK WORK?

SafeLink uses 2,4 GHz radios to allow the SEND unit on the fixture to communicate with the RECEIVE unit that is interfaced with the machine control. The RECEIVE unit provides both 24 VDC outputs and a standard Modbus RTU RS485 communication protocol. An optional Ethernet Bridge will convert this to an Ethernet TCP IP protocol. The machine control must be set up to respond to this protocol to initiate a Feed Hold command, turn on a warning light, or even activate a Machine Stop command.

A pressure switch for pressure monitoring or a limit switch for position sensing is used with the SEND unit. If the pressure or position is lost, the switch goes open and the signal to the RECEIVE unit is interrupted.

## ▶ WHAT POWERS THE SEND UNIT?

The SEND unit uses a 3,6 VDC size D Lithium battery that is supplied with the unit. Projected battery life is 3 years.

## ▶ WHAT POWERS THE RECEIVE UNIT?

The receive unit requires 24 VDC power, usually from the power supply in the machine control.

## ▶ WILL THE MACHINE FAULT IF THE PALLET IS IN THE LOADING STATION AND THE CLAMPS ARE UNCLAMPED?

The Receive unit is just an input source for the machine control. The machine control must be able to identify which fixture is in the machine being run and which one is in the loading station. When in the loading station, the machine control must be able to ignore the signal loss when the clamps are unclamped to remove the completed parts.

## ▶ HOW MANY FIXTURES CAN BE MONITORED BY ONE RECEIVE UNIT?

By using either Modbus RTU RS485 or Ethernet TCP IP, up to 56 SLS-1 or SLS-2 Send Units on fixtures can be monitored by a single SLR-1 Receive Unit.

## ▶ IS INSTALLATION AVAILABLE FROM ENERPAC?

Enerpac has partnered with a CNC control specialist that can quote custom installation services. Contact your Enerpac Territory Manager for details.

# SafeLink Monitoring System Worksheet

## SAFELINK PALLET MONITORING SYSTEM

FOR CUSTOMERS WHO REQUIRE CUSTOM INSTALLATION OF THE ENERPAC SAFELINK PALLET MONITORING SYSTEM, PLEASE PROVIDE THE FOLLOWING INFORMATION FOR EACH MACHINE TOOL TO BE EVALUATED:

COMPANY: \_\_\_\_\_ CITY, STATE, ZIP: \_\_\_\_\_  
 CONTACT: \_\_\_\_\_ CONTACT PHONE (EXT): \_\_\_\_\_  
 ADDRESS: \_\_\_\_\_ CONTACT EMAIL: \_\_\_\_\_

### BUDGET

BUDGET FOR CUSTOM INSTALLATION OF SAFELINK SYSTEM ON THIS MACHINE TOOL:

200 EURO	1500 EURO	1000 EURO	2000+ EURO
----------	-----------	-----------	------------

### MACHINE INFORMATION

MACHINE MAKE	
MACHINE MODEL	
MACHINE SERIAL NUMBER	
MACHINE TYPE	
SINGLE BED HORIZONTAL MACHINING CENTER	
PALLET POOL CELL WITH HORIZONTAL MACHINING CENTERS	
NUMBER OF MACHINES IN CELL	
SINGLE BED VERTICAL MACHINING CENTER	
TWO PALLET VERTICAL MACHINING CENTER	
SLIDE BY	
VERTICAL TURRET LATHE (VTL)	
OTHER/DESCRIBE	
NUMBER OF FIXTURES ASSOCIATED WITH THIS MACHINE	
TOTAL NUMBER OF CIRCUITS IN FIXTURE GROUP	

### MACHINE CONTROL INFORMATION

MACHINE CONTROL/MAKE									
MACHINE CONTROL/MODEL NUMBER									
MACHINE CONTROL/SERIAL NUMBER									
MACHINE CONTROL INTERFACE AVAILABLE	<table border="1"> <tr> <td>MODBUS</td> <td>ETHERNET</td> <td>DEVICENET</td> <td>RELAY</td> </tr> <tr> <td>SERIAL RS-232</td> <td colspan="3">OTHER/DESCRIBE</td> </tr> </table>	MODBUS	ETHERNET	DEVICENET	RELAY	SERIAL RS-232	OTHER/DESCRIBE		
MODBUS	ETHERNET	DEVICENET	RELAY						
SERIAL RS-232	OTHER/DESCRIBE								
MACHINE CONTROL IP ADDRESS									
ACTION IF FAULT IS DETECTED	<table border="1"> <tr> <td>FEEDHOLD</td> <td>ACTIVATE A LIGHT</td> </tr> <tr> <td>MACHINE STOP</td> <td>OTHER/DESCRIBE</td> </tr> </table>	FEEDHOLD	ACTIVATE A LIGHT	MACHINE STOP	OTHER/DESCRIBE				
FEEDHOLD	ACTIVATE A LIGHT								
MACHINE STOP	OTHER/DESCRIBE								

CONTACT ENERPAC: INFO@ENERPAC.COM • PHONE +31 318 535 911 • FAX +31 318 535 848

# 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.












## Technical support

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

 197 ▶

# components

	▼ series	▼ pages	
Pressure switches	IC, PB PSCK	188	
Digital pressure gauge	DGR	189	
Pressure gauges	G	190	
Gauge accessories	GA, GS NV, FM	191	
Manifolds, couplers, tubing	A, AH, AR CH, CR, T	192	
Hydraulic safety hoses	H700	192	
Hydraulic oil	HF95	193	
High pressure filters	FL	193	
High pressure fittings	BFZ, FZ	194-196	



Shown: PSCK-8, IC-51



**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.

### PB-4 Adaptor

The PB-4 is an adaptor for the PSCK-8 or PSCK-9 pressure switches. The G1/4" male end of the adaptor can be installed in the port of a manifold or valve body.

**Integrated in your hydraulic system, the pressure switch can be used to automate your clamping cycles.**



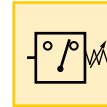
## Reliable electrical control of hydraulic power

- Compact design minimizes space requirements on fixture
- Switch is easily adjustable to meet system requirements.

**Pressure: 20 - 515 bar**

**Accuracy: 2%**

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



### Options

#### Fittings

□ 194 ▶



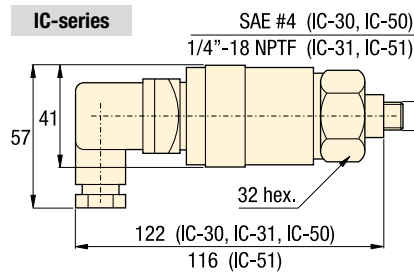
#### Gauges

□ 190 ▶

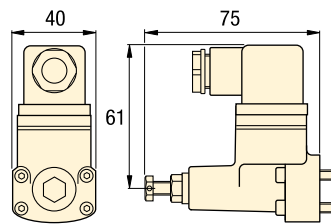


### Important

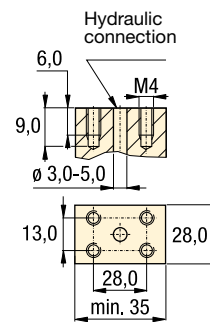
**Do not exceed the maximum pressure.**



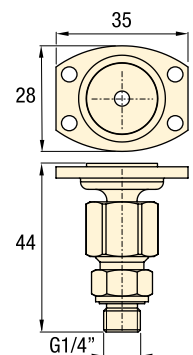
### PSCK-8, 9



### Mounting dimensions



### PB-4



## Product selection

Adjustable pressure range	Electrical specifications	Model number	Deadband	Switch point repeatability	Oil port	kg
bar	at 50/60 Hz		bar	% of range		
<b>▼ Electrical pressure switches</b>						
35 - 240	125 VAC @ 5 A	<b>IC-30</b>	7 - 35	+/-2	SAE #4	0,5
35 - 240	125 VAC @ 5 A	<b>IC-31</b>	7 - 35	+/-2	1/4"-18 NPTF	0,5
205 - 515	125 VAC @ 5 A	<b>IC-50</b>	17 - 55	+/-2	SAE #4	0,5
205 - 515	125 VAC @ 5 A	<b>IC-51</b>	17 - 55	+/-2	1/4"-18 NPTF	0,5
100 - 350	115 VAC @ 2 A	<b>PSCK-8</b>	17 - 55	+/-2	Manifold mount	0,4
20 - 210	115 VAC @ 2 A	<b>PSCK-9</b>	17 - 55	+/-2	Manifold mount	0,4
<b>▼ Mounting adaptor for PSCK-pressure switches</b>						
-	-	<b>PB-4</b>	-	-	G 1/4"	0,1

Pressure: 0 - 1380 bar

Accuracy: ± 0,25%

Voltage: 3 VDC (battery)

- E** Manómetros digitales
- F** Manomètres digitaux
- D** Digitale Manometer



## Options

### Fittings

194 ▶



### Gauge adaptors

190 ▶



## Important

Do not exceed the maximum pressure.

Gauges can be easily installed into the hydraulic system using GA-3 gauge adaptor.

191 ▶

### Protective cover included

Fits over face of gauge for protection in harsh environments.

## Easy and precise pressure monitoring

- Rated for system pressure up to 1380 bar
- Displays in multiple units: bar, psi, mPA, kg/cm<sup>2</sup> (user selectable)
- Zero reset – ensures that gauge reads actual system pressure
- Batteries included, condition indicator on readout
- IP65 rated case design
- Shut off selectable – menu driven
- UL listed, CE and RoHS compliant.

Shown: DGR-2



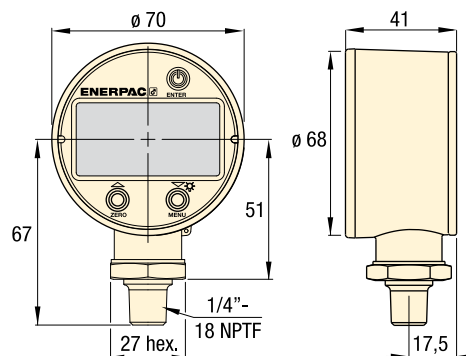
Enerpac digital pressure gauges offer greater accuracy and are easier to read than conventional dial gauges, greatly enhancing your ability to monitor and control hydraulic system pressure.

### DGR-2 Remote Operation

Battery operated for additional flexibility. Includes maximum and minimum pressure capture.

### Back-lit Readout

Back-lit readout allows easy reading in less than ideal lighting.



## Product selection

Pressure rating	Model	Pressure rating	Pressure rating	Pressure rating	
bar		psi	MPa	Kg/cm <sup>2</sup>	
Range Resolution		Range Resolution	Range Resolution	Range Resolution	kg
0 - 1380 0,1	<b>DGR-2</b>	0 - 20.000 1	0 - 140 0,01	0 - 1400 0,1	0,2

Shown: GS-2, G-2512L, GS-3



**Enerpac gauges provide a safe and inexpensive monitoring system for your hydraulic circuit**

**Highly reliable and accurate pressure sensing**

- ± 1,5% accuracy of full scale
- G-series: All pressure sensing parts sealed and damped by glycerine for long life
- Includes safety blow-out disk and pressure equalizing membrane to prevent overpressurization
- Copper alloy, coiled safety Bourdon tube for 70 bar and higher
- Dual bar and psi scale readings, ø63 mm gauge face.

**Gauge accessories for easy installation**

- Needle valves providing positive shut-off
- 303 stainless steel stem (NV-251)
- 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 ø63 mm gauges.

**Product selection**

Pressure gauge mounting style	Pressure range		Model number	Bar graduation		PSI graduation		A mm	B mm	D mm	G
	bar	psi		Major bar	Minor bar	Major psi	Minor psi				
<b>▼ Pressure gauge – Lower mount</b>											
	0 - 7	0 - 100	<b>G-2509L</b>	1	0,01	10	2	84	37	63	1/4" NPTF
	0 - 11	0 - 160	<b>G-2510L</b>	1	0,02	10	2	84	37	63	1/4" NPTF
	0 - 14	0 - 200	<b>G-2511L</b>	1	0,02	50	5	84	37	63	1/4" NPTF
	0 - 20	0 - 300	<b>G-2512L</b>	5	0,05	50	5	84	37	63	1/4" NPTF
	0 - 40	0 - 600	<b>G-2513L</b>	10	1	100	10	84	37	63	1/4" NPTF
	0 - 70	0 - 1000	<b>G-2514L</b>	10	1	100	20	84	37	63	1/4" NPTF
	0 - 140	0 - 2000	<b>G-2515L</b>	10	2	500	50	84	37	63	1/4" NPTF
	0 - 200	0 - 3000	<b>G-2516L</b>	50	5	500	50	84	37	63	1/4" NPTF
	0 - 400	0 - 6000	<b>G-2517L</b>	100	10	1000	100	84	37	63	1/4" NPTF
	0 - 700	0 - 10.000	<b>G-2535L</b>	100	10	2000	200	84	37	63	1/4" NPTF
	0 - 70	0 - 1000	<b>G-2514SL</b>	10	1	100	20	93	31	63	SAE #4
	0 - 200	0 - 3000	<b>G-2516SL</b>	50	5	500	50	93	31	63	SAE #4
	0 - 400	0 - 6000	<b>G-2517SL</b>	100	10	1000	100	93	31	63	SAE #4
	0 - 700	0 - 10.000	<b>G-2535SL</b>	100	10	2000	200	93	31	63	SAE #4
<b>▼ Pressure gauge – Rear mount</b>											
	0 - 70	0 - 1000	<b>G-2531R</b>	10	1	100	20	63	37	63	1/4" NPTF
	0 - 400	0 - 6000	<b>G-2534R</b>	100	10	1000	100	63	37	63	1/4" NPTF
	0 - 700	0 - 10.000	<b>G-2537R</b>	100	10	2000	200	63	37	63	1/4" NPTF
	0 - 70	0 - 1000	<b>G-2531SR</b>	10	1	100	20	62	31	63	SAE #4
	0 - 200	0 - 3000	<b>G-2533SR</b>	50	5	500	50	62	31	63	SAE #4
	0 - 400	0 - 6000	<b>G-2534SR</b>	100	10	1000	100	62	31	63	SAE #4
	0 - 700	0 - 10.000	<b>G-2537SR</b>	100	10	2000	200	62	31	63	SAE #4
	0 - 70	0 - 1000	<b>1531R *</b>	10	1	100	20	50	25	38	1/8" NPTF
	0 - 200	0 - 3000	<b>1533R *</b>	50	10	500	100	50	25	38	1/8" NPTF
	0 - 400	0 - 6000	<b>1534R *</b>	100	10	1000	100	50	25	38	1/8" NPTF
	0 - 700	0 - 10.000	<b>1537R *</b>	100	10	2000	200	50	25	38	1/8" NPTF

\* Dry gauges.

Pressure: 0 - 700 bar

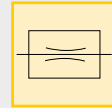
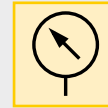
Accuracy: 1,5% /full scale

Gauge face: ø 63 mm

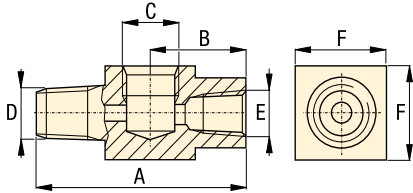
**E** Manómetros

**F** Manomètres

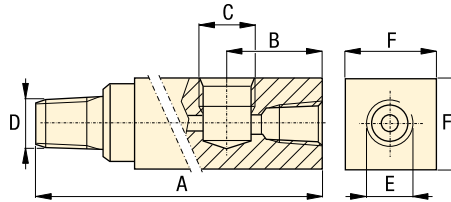
**D** Manometer



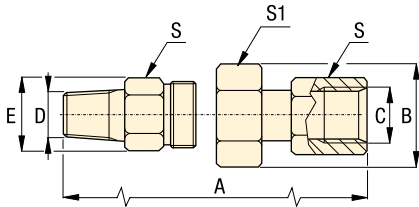
**GA-1**



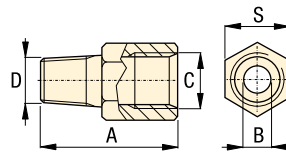
**GA-2, -3, -4**



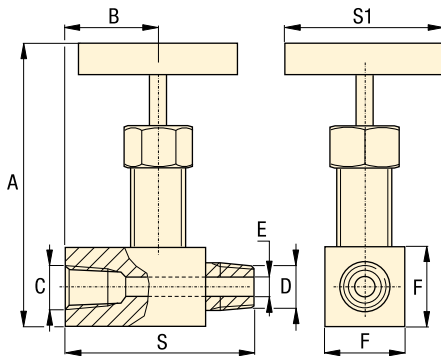
**GA-918**



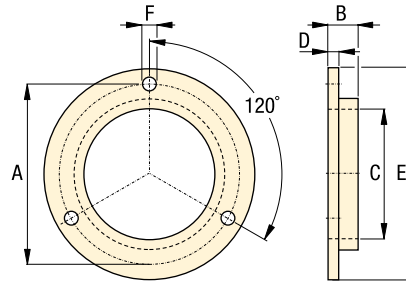
**GS-2, -3**



**NV-251, V-91**



**FM-25NG**



**Product dimensions** in mm [ ]

Gauge port NPTF	Max. pressure bar	Model number	Dimensions							
			A	B	C	D	E	F	S	S1
<b>▼ Gauge adaptors</b>										
1/2"	700	<b>GA-1</b>	71	31	1/2"NPTF	3/8"NPTF	3/8"NPTF	32	-	-
1/2"	700	<b>GA-2</b>	155	35	1/2"NPTF	3/8"NPTF	3/8"NPTF	32	-	-
1/4"	700	<b>GA-3</b>	133	35	1/4"NPTF	3/8"NPTF	3/8"NPTF	32	-	-
1/2"	700	<b>GA-4</b>	111	35	1/2"NPTF	1/4"NPTF	3/8"NPTF	32	-	-
<b>▼ Swivel gauge adaptor</b>										
1/2"	700	<b>GA-918</b>	57	44	1/2"NPTF	1/2"NPTF	33	-	29	38
<b>▼ Gauge shut-off valves</b>										
1/4"	700	<b>NV-251</b>	57	29	1/4"NPTF	1/4"NPTF	4,3	19	57	63
1/2"	700	<b>V-91</b>	89	32	1/2"NPTF	1/2"NPTF	4,8	37	64	63
<b>▼ Gauge snubber valves</b>										
1/4"	350	<b>GS-2</b>	41	0,5	1/4"NPTF	SAE #4	-	-	19	-
1/4"	350	<b>GS-3</b>	41	0,5	1/4"NPTF	G 1/4"	-	-	19	-
<b>▼ Flange mounting for panel mounting of G-series gauges</b>										
-	-	<b>FM-25NG</b>	75	4,3	64	1,8	85	3,5	-	-

**Options**

Hoses and couplers

192 ▶



Digital gauges

189 ▶



Pressure switches

188 ▶



V-10 Auto Damper® valve

157 ▶



**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.

202 ▶

# Manifolds, hoses, couplers, tubing

Shown: Hoses, Couplers, Manifolds



**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.

## H700-series, Hoses

High pressure hydraulic hoses, for demanding applications. Thermo-plastic safety hoses for use on all Enerpac pumps and cylinders.

## C-series, High Flow Couplers

High pressure couplers recommended for use with all Enerpac pumps and cylinders.

## AH, AR-series, Couplers

Spee-D® quick disconnect low leakage couplers for easy connection of hydraulic circuits.

## T-series, Tubing

High pressure steel tubing, available in 1,5 m lengths.

## Manifolds

- Easy to connect
- Mounting holes on all models

## Couplers

- For more safety: couplers cannot be connected or disconnected while under hydraulic pressure

## Hydraulic hoses and tubings

- Thermo-plastic safety hoses (max. 700 bar)
- Four layer design, including two high strength wire braids
- High pressure steel tubing for permanent installations.

## Important

**Do not exceed the maximum pressure.**

**Inspect hoses and tubing frequently and replace as required.**

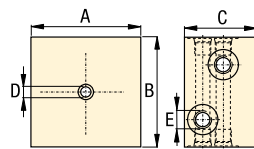
## Options

### Fittings

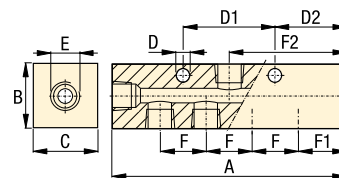
194 ▶



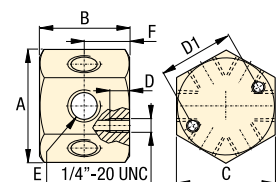
A-63



A-60, -61, -64, -65



A-66



## Manifolds dimensions in mm [ $\pm 0.1$ ]

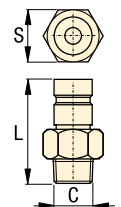
Number of ports	Model number	A	B	C	D	D1	D2	E	F	F1	F2	kg
2 x 4	<b>A-63</b>	76	76	51	6,3	-	-	SAE #4	-	-	-	0,9
5	<b>A-60</b>	89	32	32	7,1	38	25	SAE #4	38	25	44	0,5
7	<b>A-61</b>	165	32	32	7,1	38	32	SAE #4	25	32	83	0,6
7	<b>A-64</b>	178	32	32	6,3	76	32	3/8"-18 NPTF	38	32	89	1,5
7	<b>A-65</b>	368	32	32	6,3	203	32	3/8"-18 NPTF	102	32	184	2,7
6	<b>A-66</b>	58	42	51	13,2	38	-	3/8"-18 NPTF	-	-	-	0,9

## Thermoplastic Safety Hoses

Hose length m	Hose End one NPTF	Hose End two NPTF	Internal diameter mm	Model Number	Maximum Pressure bar	kg
0,6	3/8"	3/8"	6,4	<b>H-7202</b>	700	0,5
0,9	3/8"	3/8"	6,4	<b>H-7203</b>	700	0,7
1,8	3/8"	3/8"	6,4	<b>H-7206</b>	700	0,9
3,0	3/8"	3/8"	6,4	<b>H-7210</b>	700	1,4

## Couplers

Max. pressure bar	Max. oil flow l/min	Model Nr. coupler complete	Model Nr. female half	Model Nr. male half	Thread size C	L mm	S mm
700	40	<b>C-604</b>	<b>CR-400</b>	<b>CH-604</b>	3/8" NPTF	64	22
700	40	<b>A-604</b>	<b>AR-400</b>	<b>AH-604</b>	3/8" NPTF	42	19
350	17	-	<b>AR-650 *</b>	<b>AH-650</b>	1/4" NPTF	38	17,5
350	17	-	<b>AR-650 *</b>	<b>AH-652</b>	G 1/4"	34	17,5
350	17	-	<b>AR-650 *</b>	<b>AH-654</b>	SAE #4	41	17,5



\* Note: Thread size **AR-650** is 1/4" NPTF, dimension S is 20,6 mm. Use **FZ-1055** fitting to connect to 3/8" hose ends.

## Tubing

Maximum Pressure bar	Length m	Model number	Internal diameter mm	External diameter inch
350	1,5	<b>T-2560</b>	ø 3,8	ø 1/4"

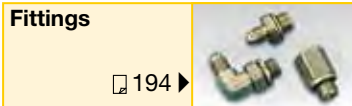


# Hydraulic oil, high-pressure filters

- E** Mangueras, Filtros, Aceite, Acoplamientos
- F** Flexibles, Filtres, Huile, Raccords
- D** Schläuche, Filter, Öl, Kupplungen



## Options



## Premium hydraulic oil

- Ensures effective lubricity
- Protects essential parts
- Prevents pump cavitation
- Maximum internal heat transfer
- Additives prevent rust, oxidation and sludge.

## High-pressure filters

- Plated stainless steel wire mesh screen construction provides large filter area in a compact size
- 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

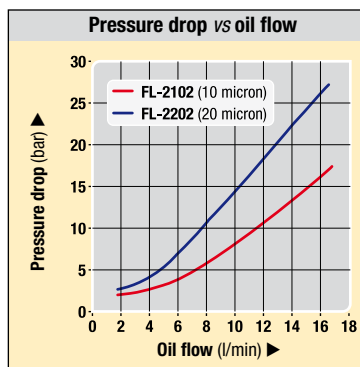
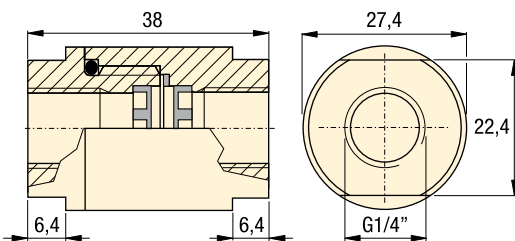
Jerrycan content litres	Model number	kg
1	<b>HF-95X</b>	1,1
5	<b>HF-95Y</b>	5,3
20	<b>HF-95T</b>	21,5

HF-95 Hydraulic Oil Specification	
Viscosity Index	100 min
Viscosity (cSt @ 40 °C)	32
API Gravity	31-33
Density (cSt @ 15 °C)	875
Flash point	204 °C
Pour point	32 °C
Colour	Blue
Working Temperature Range	0 - 60 °C
Ideal working temperature	40 °C



## Filtration

**20 micron filter** provides the longest service life before element replacement.  
**10 micron filter** recommended for more sensitive hydraulic components.



## High in-line pressure filters

Model number *	Filtration micron		Filter element set	Maximum Pressure bar	kg
	Nominal	Absolute			
<b>FL-2102</b>	10	25	<b>FL-2101K</b>	350	0,25
<b>FL-2202</b>	20	40	<b>FL-2201K</b>	350	0,25

\* Also available with Viton seals; model numbers **FL-2102V** and **FL-2202V**.

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

Shown: HF-95T, HF-95X, HF-95Y



## HF-serie, Hydraulic oil

Genuine Enerpac hydraulic oil to guarantee optimal performance and long life of your hydraulic equipment.

## FL-series, 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.



## Important

**Do not exceed the maximum pressure.**

**Use only genuine Enerpac hydraulic oil. The use of any other fluid will render your Enerpac warranty null and void.**

Hydraulic power is distributed by manifolds and transported by hoses and tubing.



**ENERPAC** **193**

# High Pressure Fittings *Selection & dimensions*

Shown: FZ-2052, FZ-2054, FZ-2023



**Fitting 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.**

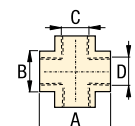
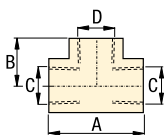
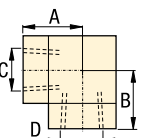
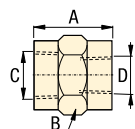
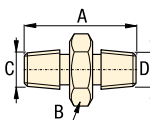
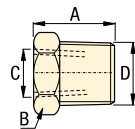
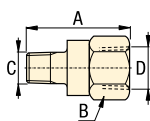


## Proper connection for hydraulic components

- Male and female BSPP, NPTF and SAE threaded fittings in common sizes allow easy connection of all components.
- BFZ and FZ-1000 models are 700 bar maximum pressure
- FZ-2000 models are 350 bar maximum pressure.

## Product selection

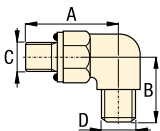
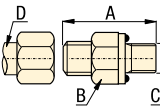
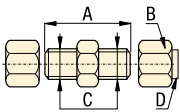
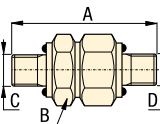
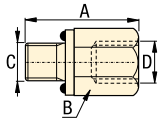
From	To	Maximum pressure bar	Model number	Dimensions			
				A mm	B mm	C	D
<b>▼ Adapters</b>							
G 1/4"	1/8" NPTF	700	<b>BFZ-16411</b>	35	19	1/4"-18 NPTF	G 1/4"
G 1/4"	1/8" NPTF	700	<b>BFZ-16421</b>	31	19	1/8"-27 NPTF	G 1/4"
G 3/8"	1/4" NPTF	700	<b>BFZ-16323</b>	43	24	1/4"-27 NPTF	G 3/8"
G 3/8"	3/8" NPTF	700	<b>BFZ-16324</b>	43	24	3/8"-27 NPTF	G 3/8"
1/4" NPTF	1/8" NPTF	700	<b>FZ-1642</b>	31	19	1/8"-27 NPTF	1/4"-18 NPTF
3/8" NPTF	1/4" NPTF	700	<b>FZ-1055</b>	37	24	1/4"-18 NPTF	3/8"-18 NPTF
1/2" NPTF	1/4" NPTF	700	<b>FZ-1633</b>	43	29	1/4"-18 NPTF	1/2"-14 NPTF
1/2" NPTF	3/8" NPTF	700	<b>FZ-1634</b>	43	29	3/8"-18 NPTF	1/2"-14 NPTF
SAE #4	1/4" NPTF	350	<b>FZ-2007</b>	29	19	7/16"-20 UN	1/4"-18 NPTF
SAE #4	1/8" NPTF	350	<b>FZ-2008</b>	25	14	7/16"-20 UN	1/8"-27 NPTF
SAE #4	SAE #2	350	<b>FZ-2022</b>	29	17	5/16"-24 UN	7/16"-20 UN
<b>▼ Reducers</b>							
1/4" NPTF	3/8" NPTF	700	<b>FZ-1630</b>	22	22	1/4"-18 NPTF	3/8"-18 NPTF
1/4" NPTF	1/2" NPTF	700	<b>FZ-1661</b>	28	22	1/4"-18 NPTF	1/2"-14 NPTF
SAE #6	SAE #8	350	<b>FZ-2029</b>	35	27	3/4"-16 UN	9/16"-18 UN
3/8" NPTF	G 1/4"	700	<b>BFZ-16301</b>	19	19	G 1/4"	3/8"-18 NPTF
<b>▼ Male Nipples</b>							
1/4" NPTF	1/4" NPTF	700	<b>FZ-1608</b>	37	16	1/4"-18 NPTF	1/4"-18 NPTF
3/8" NPTF	3/8" NPTF	700	<b>FZ-1617</b>	37	19	3/8"-18 NPTF	3/8"-18 NPTF
3/8" NPTF	3/8" NPTF	700	<b>FZ-1619</b>	51	19	3/8"-18 NPTF	3/8"-18 NPTF
3/8" NPTF	G 1/4"	700	<b>BFZ-305</b>	36	19	3/8"-18 NPTF	G 1/4"
<b>▼ Female Connectors</b>							
1/4" NPTF	1/4" NPTF	700	<b>FZ-1605</b>	29	19	1/4"-18 NPTF	1/4"-18 NPTF
3/8" NPTF	1/4" NPTF	700	<b>FZ-1615</b>	29	22	3/8"-18 NPTF	1/4"-18 NPTF
3/8" NPTF	3/8" NPTF	700	<b>FZ-1614</b>	29	22	3/8"-18 NPTF	3/8"-18 NPTF
1/2" NPTF	3/8" NPTF	700	<b>FZ-1625</b>	38	29	1/2"-14 NPTF	3/8"-18 NPTF
<b>▼ Elbows</b>							
1/4" NPTF	1/4" NPTF	700	<b>FZ-1638</b>	23	19	1/4"-18 NPTF	1/4"-18 NPTF
3/8" NPTF	3/8" NPTF	700	<b>FZ-1610</b>	26	22	3/8"-18 NPTF	3/8"-18 NPTF
<b>▼ Tee</b>							
1/4" NPTF	1/4" NPTF	700	<b>FZ-1637</b>	45	19	1/4"-18 NPTF	1/4"-18 NPTF
3/8" NPTF	3/8" NPTF	700	<b>FZ-1612</b>	52	22	3/8"-18 NPTF	3/8"-18 NPTF
<b>▼ Cross</b>							
3/8" NPTF	3/8" NPTF	700	<b>FZ-1613</b>	52	7/8"	3/8"-18 NPTF	3/8"-18 NPTF



 **Product selection**

From	To	Maximum pressure bar	Model number	Dimensions			
				A mm	B mm	C	D
<b>▼ Adapters</b>							
1/8" NPTF	SAE #4	350	<b>FZ-2075</b>	27	17	1/8"-27 NPTF	1/4"-18 NPTF
1/4" NPTF	SAE #4	350	<b>FZ-2042</b>	33	17	1/4"-18 NPTF	7/16"-20 UN
1/4" NPTF	G 1/4"	700	<b>BFZ-16411</b>	35	19	1/4"-18 NPTF	G 1/4"
SAE #4	1/8" NPTF	350	<b>FZ-2008</b>	25	14	7/16"-20 UN	1/8"-27 NPTF
SAE #4	1/4" NPTF	350	<b>FZ-2007</b>	29	19	7/16"-20 UN	1/4"-18 NPTF
SAE #2	SAE #4	350	<b>FZ-2022</b>	26	14	5/16"-24 UN	7/16"-20 UN
SAE #6	1/4" NPTF	350	<b>FZ-2056</b>	29	19	9/16"-18 UN	1/4"-18 NPTF
SAE #8	1/4" NPTF	350	<b>FZ-2067</b>	29	22	3/4"-16 UN	1/4"-18 NPTF
SAE #8	3/8" NPTF	350	<b>FZ-2069</b>	33	22	3/4"-16 UN	3/8"-18 NPTF
G 1/8"	1/8" NPTF	350	<b>FZ-2055</b>	25	16	G 1/8"	1/8"-27 NPTF
G 1/8"	1/4" NPTF	350	<b>FZ-2060</b>	33	19	G 1/8"	1/4"-18 NPTF
G 1/8"	SAE #4	350	<b>FZ-2066</b>	25	17	G 1/8"	7/16"-20 UN
G 1/4"	1/4" NPTF	350	<b>FZ-2023</b>	33	19	G 1/4"	1/4"-18 NPTF
G 1/4"	SAE #4	350	<b>FZ-2065</b>	28	19	G 1/4"	7/16"-20 UN
<b>▼ Straight union</b>							
SAE #4	SAE #4	350	<b>FZ-2005</b>	32	14	7/16"-20 UN	7/16"-20 UN
SAE #6	SAE #6	350	<b>FZ-2028</b>	36	17	9/16"-18 UN	9/16"-18 UN
SAE #8	SAE #8	350	<b>FZ-2040</b>	40	22	3/4"-16 UN	3/4"-16 UN
<b>▼ Straight union to tube ends</b>							
ø 1/4"	ø 1/4"	350	<b>FZ-2033 *</b>	35	13	7/16"-20 UN	ø 1/4"
ø 1/4"	ø 1/4"	350	<b>FZ-2013 **</b>	52	13	7/16"-20 UN	ø 1/4"
<b>▼ Adaptors to tube end</b>							
1/8" NPTF	ø 1/4"	350	<b>R-1054 *</b>	31	13	1/8"-27 NPTF	ø 1/4"
1/4" NPTF	ø 1/4"	350	<b>FZ-2020 *</b>	36	14	1/4"-18 NPTF	ø 1/4"
1/4" NPTF	ø 3/8"	350	<b>FZ-2072 *</b>	36	16	1/4"-18 NPTF	ø 3/8"
1/4" NPTF	ø 1/4"	350	<b>FZ-2012 **</b>	34	14	1/4"-18 NPTF	ø 1/4"
3/8" NPTF	ø 1/4"	350	<b>FZ-2061 *</b>	37	19	3/8"-18 NPTF	ø 1/4"
3/8" NPTF	ø 3/8"	350	<b>FZ-2068 *</b>	37	19	3/8"-18 NPTF	ø 3/8"
SAE #2	ø 1/4"	350	<b>FZ-2025 *</b>	26	14	5/16"-24 UN	ø 1/4"
SAE #4	ø 1/4"	350	<b>FZ-2019 *</b>	32	14	7/16"-20 UN	ø 1/4"
SAE #4	ø 1/4"	350	<b>FZ-2001 **</b>	29	14	7/16"-20 UN	ø 1/4"
SAE #6	ø 1/4"	350	<b>FZ-2059 *</b>	33	17	9/16"-18 UN	ø 1/4"
SAE #8	ø 1/4"	350	<b>FZ-2039 *</b>	35	22	3/4"-16 UN	ø 1/4"
SAE #8	ø 3/8"	350	<b>FZ-2070 *</b>	35	22	3/4"-16 UN	ø 3/8"
G 1/8"	ø 1/4"	350	<b>FZ-2053 *</b>	39	14	G 1/8"	ø 1/4"
G 1/4"	ø 1/4"	350	<b>FZ-2054 *</b>	35	19	G 1/4"	ø 1/4"
G 1/4"	ø 3/8"	350	<b>FZ-2064 *</b>	35	19	G 1/4"	ø 3/8"
<b>▼ Elbow to tube end</b>							
1/8" NPTF	ø 1/4"	350	<b>FZ-2074 *</b>	20	11	1/8"-27 NPTF	ø 1/4"
1/4" NPTF	ø 1/4"	350	<b>FZ-2073 *</b>	28	14	1/4"-18 NPTF	ø 1/4"
1/4" NPTF	ø 1/4"	350	<b>FZ-2076 **</b>	26	14	1/4"-18 NPTF	ø 1/4"
1/4" NPTF	ø 3/8"	350	<b>FZ-2081 *</b>	28	14	1/4"-18 NPTF	ø 3/8"
3/8" NPTF	ø 1/4"	350	<b>FZ-2082 *</b>	31	19	3/8"-18 NPTF	ø 1/4"
3/8" NPTF	ø 3/8"	350	<b>FZ-2083 *</b>	31	14	3/8"-18 NPTF	ø 3/8"
SAE #2	ø 1/4"	350	<b>FZ-2024 *</b>	23	11	5/16"-24 UN	ø 1/4"
SAE #4	ø 1/4"	350	<b>FZ-2035 *</b>	26	14	7/16"-20 UN	ø 1/4"
SAE #4	ø 1/4"	350	<b>FZ-2002 **</b>	26	14	7/16"-20 UN	ø 1/4"
SAE #8	ø 3/8"	350	<b>FZ-2071 *</b>	37	22	3/4"-16 UN	ø 3/8"
G 1/8"	ø 1/4"	350	<b>FZ-2051 *</b>	26	14	G 1/8"	ø 1/4"
G 1/4"	ø 1/4"	350	<b>FZ-2052 *</b>	32	19	G 1/4"	ø 1/4"
ø 1/4"	ø 1/4"	350	<b>FZ-2014 **</b>	23	14	ø 1/4"	ø 1/4"

\* Flared  
\*\* Flareless



Pressure: 0 - 350 / 700 bar

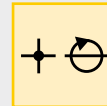
Threads: NPTF, BSPP, SAE

For tubing: ø 1/4 - 3/8", 8 mm

**E** Acoplamientos

**F** Raccords

**D** Verschraubungen



 **Options**

**Gauges and accessories**

 190 ▶

**Hoses, couplers**

 192 ▶

**Hydraulic oil, manifolds**

 193 ▶

 **Important**

**Do not exceed the 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 - 350 / 700 bar

Threads: BSPP, SAE

For tubing:  $\varnothing 1/4 - 3/8'' - 8 \text{ mm}$

- E** Acoplamiento
- F** Raccords
- D** Verschraubungen



## Options

### Gauges and accessories

190 ▶



### Hoses, couplers

192 ▶



### Hydraulic oil, manifolds

193 ▶

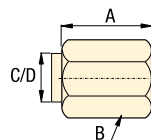
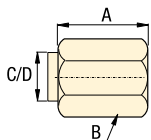
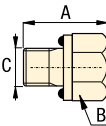
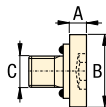
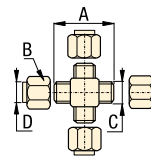
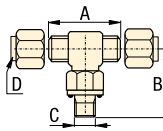
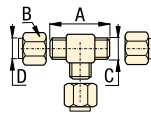
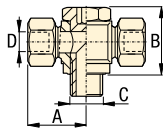
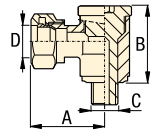


## Important

**Do not exceed the maximum pressure.**

**Use fittings and tubing in high cycle applications and areas having excessive heat or weld splatter.**

Multiple hydraulic line connections are easily installed with Enerpac fittings and manifolds.



## Product selection

From	To	Maximum pressure bar	Model number	Dimensions			
				A mm	B mm	C	D
<b>▼ Swivel banjo BSPP to tube</b>							
G 1/4"	$\varnothing 8$	700	<b>BFZ-307</b>	29	19	G 1/4"	$\varnothing 8$
<b>▼ Swivel T-banjo BSPP to tube</b>							
G 1/4"	$\varnothing 8$	700	<b>BFZ-309</b>	29	19	G 1/4"	$\varnothing 8$
<b>▼ Union tee</b>							
$\varnothing 1/4''$	$\varnothing 1/4''$	350	<b>FZ-2015 **</b>	45	14	7/16"-20 UN	$\varnothing 1/4''$
$\varnothing 1/4''$	$\varnothing 1/4''$	350	<b>FZ-2021 *</b>	45	14	7/16"-20 UN	$\varnothing 1/4''$
<b>▼ Branch tee</b>							
SAE #4	$\varnothing 1/4''$	350	<b>FZ-2036 *</b>	45	14	7/16"-20 UN	$\varnothing 1/4''$
SAE #4	$\varnothing 1/4''$	350	<b>FZ-2004 **</b>	45	14	7/16"-20 UN	$\varnothing 1/4''$
<b>▼ Union cross</b>							
$\varnothing 1/4''$	$\varnothing 1/4''$	350	<b>FZ-2034 *</b>	45	14	7/16"-20 UN	$\varnothing 1/4''$
$\varnothing 1/4''$	$\varnothing 1/4''$	350	<b>FZ-2016 **</b>	45	14	7/16"-20 UN	$\varnothing 1/4''$
<b>▼ SAE plug</b>							
SAE #4	-	350	<b>FZ-2006</b>	3	14	7/16"-20 UN	-
SAE #6	-	350	<b>FZ-2003</b>	3	17	9/16"-20 UN	-
<b>▼ SAE hexagon plug</b>							
SAE #8	-	350	<b>FZ-2041</b>	20	22	3/4"-16 UN	-
<b>▼ Nut and Sleeve for tubing</b>							
$\varnothing 1/4''$	-	350	<b>FZ-2037 *</b>	16	14	37°	$\varnothing 1/4''$
<b>▼ Cap for tubing</b>							
$\varnothing 1/4''$	-	350	<b>FZ-2038 *</b>	16	14	37°	$\varnothing 1/4''$
$\varnothing 1/4''$	-	350	<b>FZ-2017 **</b>	15	14	$\varnothing 1/4''$	$\varnothing 1/4''$
$\varnothing 3/8''$	-	350	<b>FZ-2011 *</b>	19	17	37°	$\varnothing 3/8''$

\* Flared

\*\* Flareless





## 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 better understand the basics of hydraulic system set-ups and the most commonly used hydraulic techniques. By making an educated selection of equipment, you will receive greater benefits from your hydraulic system.

Take the time to go through these “Yellow Pages” and you will benefit even more from Enerpac hydraulic workholding.



### ENERPAC GLOBAL WARRANTY STATEMENT

Visit [www.enerpac.com](http://www.enerpac.com) for the complete Enerpac Global Warranty or call your Enerpac representative or Enerpac Authorized Service Center.

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.

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### UL approved

All electrical components used on Enerpac products carry the UL rating when possible.

### 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 (5000 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.

### 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 by reducing employee lost time due to the injuries that can occur with manual clamping.

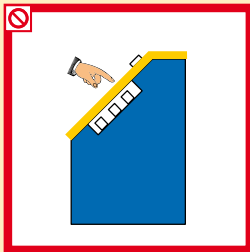
Although hydraulic operation moves the control of the clamping fixture to an area of greater safety, operators must still be alert to several common sense practices. And to that end we offer some DOs and DON'Ts, simple common sense points which apply to all Enerpac hydraulic products.

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.

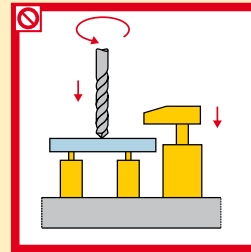
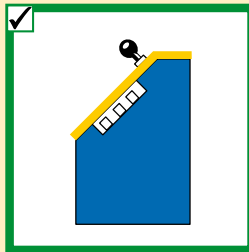
Check to see if all safety measures have been taken to avoid the risk of injury and property damage from your application or system.

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.

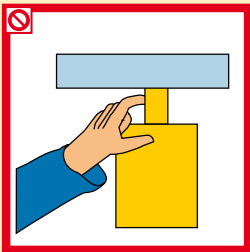
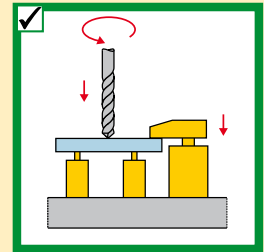
In addition to these tips, every Enerpac product comes with instructions spelling out specific safety information. Please read them carefully.



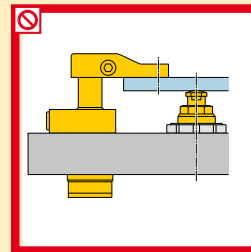
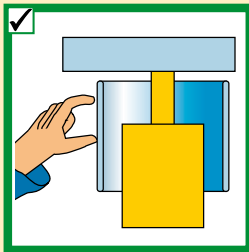
Prevent inadvertent activation of the control units of power operated clamping systems.



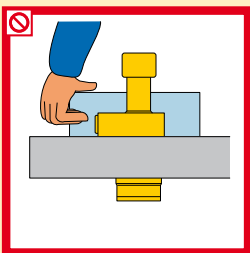
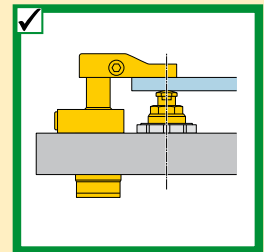
Clamping devices must be activated before main spindle can be started.



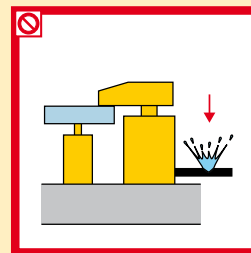
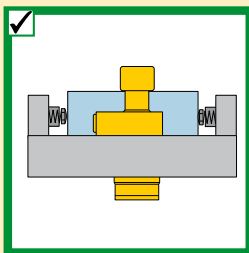
Maintain a safe distance from clamping elements and workpiece to avoid personal injury.



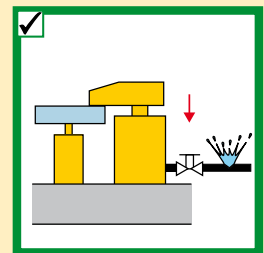
Do not apply off-center load. Clamping force must be directly over the support point.

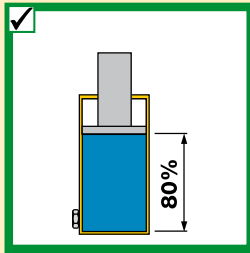
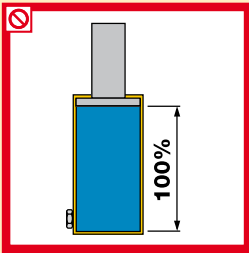


Use mechanical devices and not fingers to hold part until the hydraulics are activated.

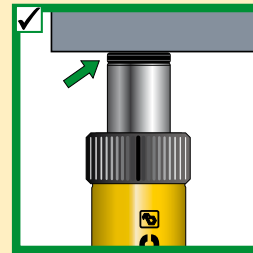
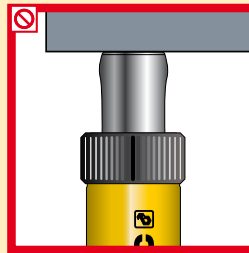


Use check valves to maintain hydraulic pressure to clamping devices in the event of a hydraulic line failure.

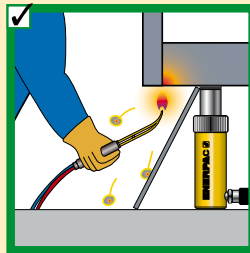




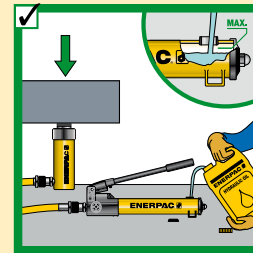
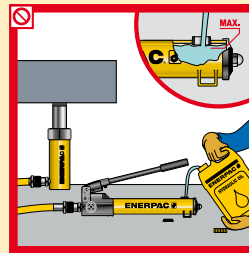
Do not operate cylinders beyond limits of rated stroke or pressure. Use only 80% of usable stroke.



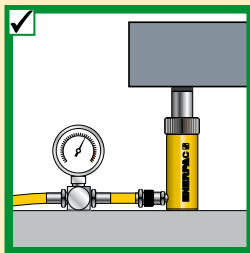
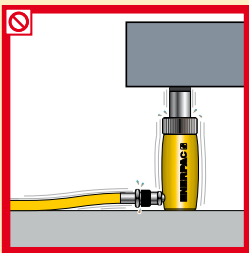
Use saddles or buttons to prevent mushrooming of plungers. Saddles distribute load evenly on the plunger.



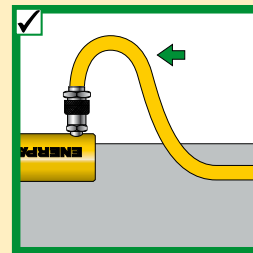
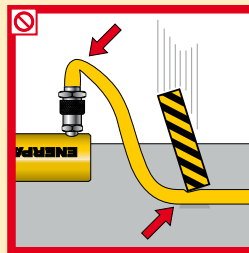
Keep hydraulic equipment away from open fire and temperatures above 65 °C (150 °F).



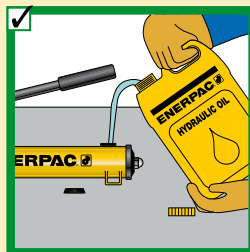
Fill pump only to recommended level. Fill only when connected cylinders are fully retracted.



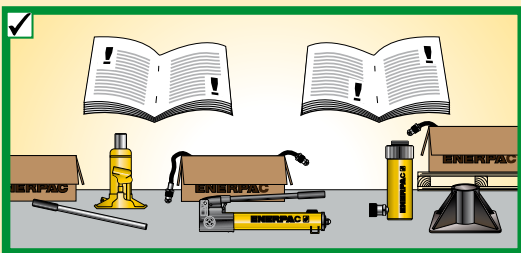
Do not override the factory setting of pressure relief valves. Always use a gauge to check system pressure.



Do not kink hoses. Bending radius must be at least 115 mm. Do not drive over or drop heavy objects on hoses. Use high pressure tubing in high cycle applications.



Always use genuine Enerpac hydraulic oil.



Always read instructions and safety warnings that come with your Enerpac hydraulic equipment.



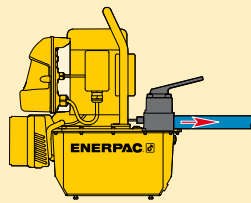
## Oil Flow

A hydraulic pump produces flow. Flow is the amount of fluid coming out of the pump.

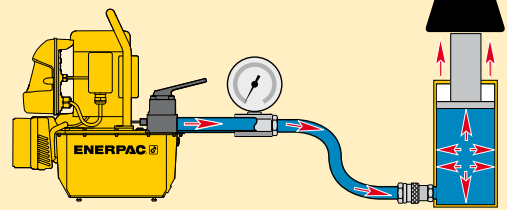
## Pressure

Pressure occurs when there is resistance to flow.

Oil Flow



Pressure



## 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).

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.

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).

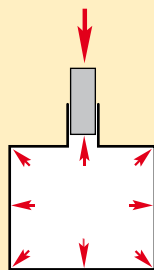


Figure 1

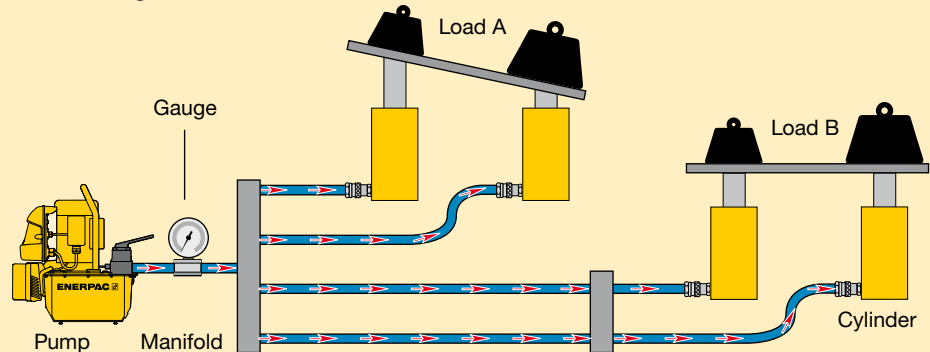


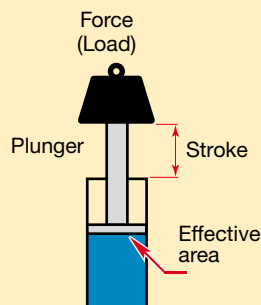
Figure 2

Control valve to provide uniform clamping of the work piece

## 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.

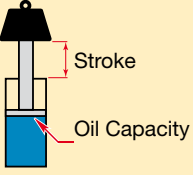


Force	=	Hydraulic Working Pressure	X	Cylinder Effective Area
F	=	P	X	A



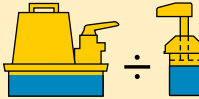
### Cylinder Oil Capacity

The volume of oil required for a cylinder (cylinder oil capacity) is equal to the effective area of the cylinder times the stroke.

$$\text{Cylinder Oil Capacity (cm}^3\text{)} = \text{Cylinder Effective Area (cm}^2\text{)} \times \text{Cylinder Stroke (cm)}$$


### Usable Oil Capacity

The amount of hydraulic oil in the pump's reservoir which can be used to activate one or more cylinders.

$$\text{Pump Usable Oil Capacity (cm}^3\text{)} \div \text{Cylinder Oil Capacity (cm}^3\text{)} = \text{Total Number of Cylinders}$$


### Cylinder Speed

Pressure applied at any point Cylinder speed is determined by dividing the pump flow rate by the cylinder effective area.

$$\text{Cylinder Clamp Speed (mm/sec)} = \frac{\text{Pump Flow Rate (cm}^3\text{/min)}}{\text{Cylinder Effective Area (cm}^2\text{)}} \times \frac{10}{60}$$

### 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.**

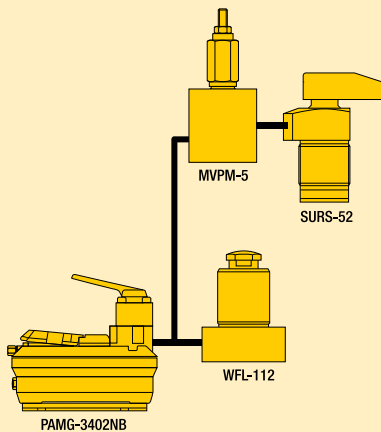
Heat is a crucial factor in seal life. Maximum temperature for good seal life is 150°F (65°C). This is also the maximum temperature of Enerpac hydraulic oil. Above 150°F, the use of Viton and high temperature oil is necessary. Viton has a maximum temperature which is much higher than nitrile or polyurethane. 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.

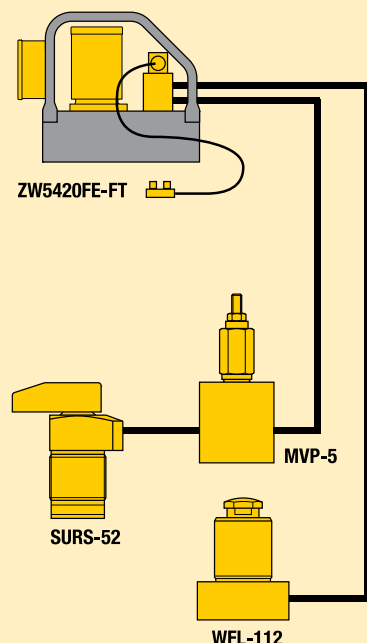
### Work support cylinders

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.

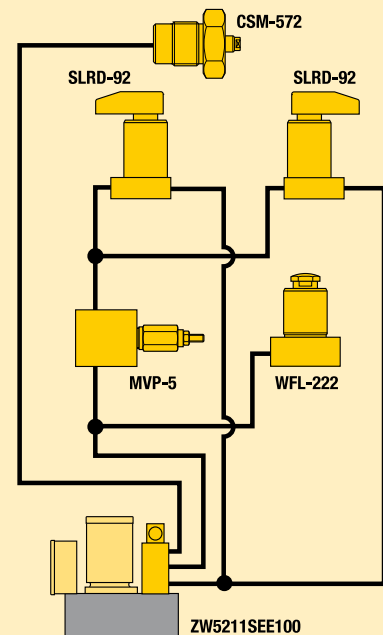
## Step 4

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. **ZW-series** Workholding pump
2. **GA-series** Gauge adaptor
3. **GF or GP-series** Pressure gauge
4. **H700-series** Hoses
5. **FZ-series** Fittings
6. **SU-series** Swing cylinders
7. **WFL-series** Work support cylinders
8. **MVP-5** Sequence valve
9. **HF-95** Hydraulic Oil

Select all these components from their respective catalog sections.







## Swing cylinders and work supports

The combined use of clamping cylinders and work supports in fixturing has become indispensable.

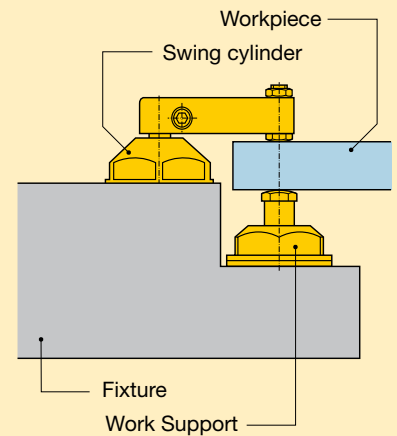
### Swing cylinders

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.



**Figure 1**

The combined use of clamping cylinders and work supports.

## 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.

### Clamping & support force ratio

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.



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

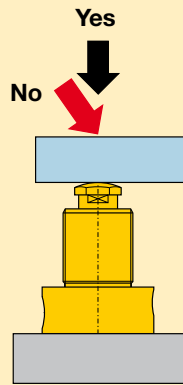
Download the **Swing Clamp Selection Tool**

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.

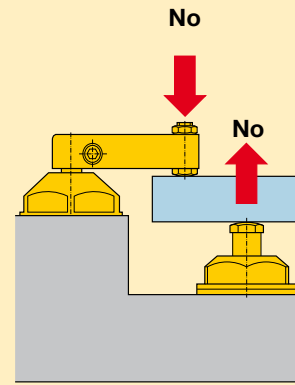


## Point of contact



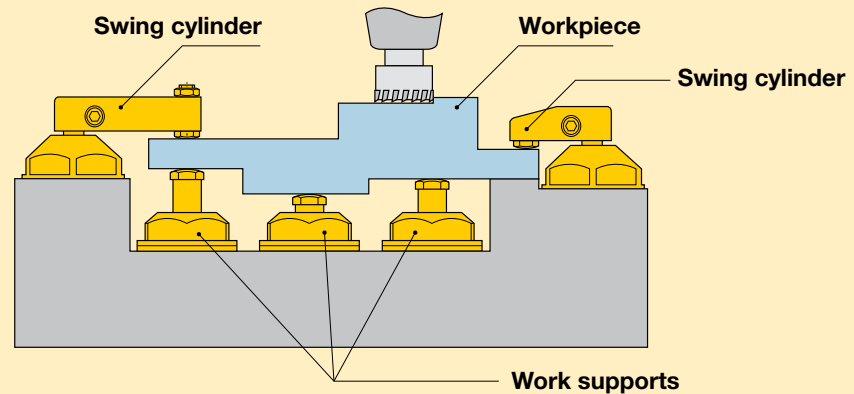
**Figure 2**  
The direction of the clamping force must be axial at the centerline of the work support's plunger for best results in clamping and repeatability of quality.

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



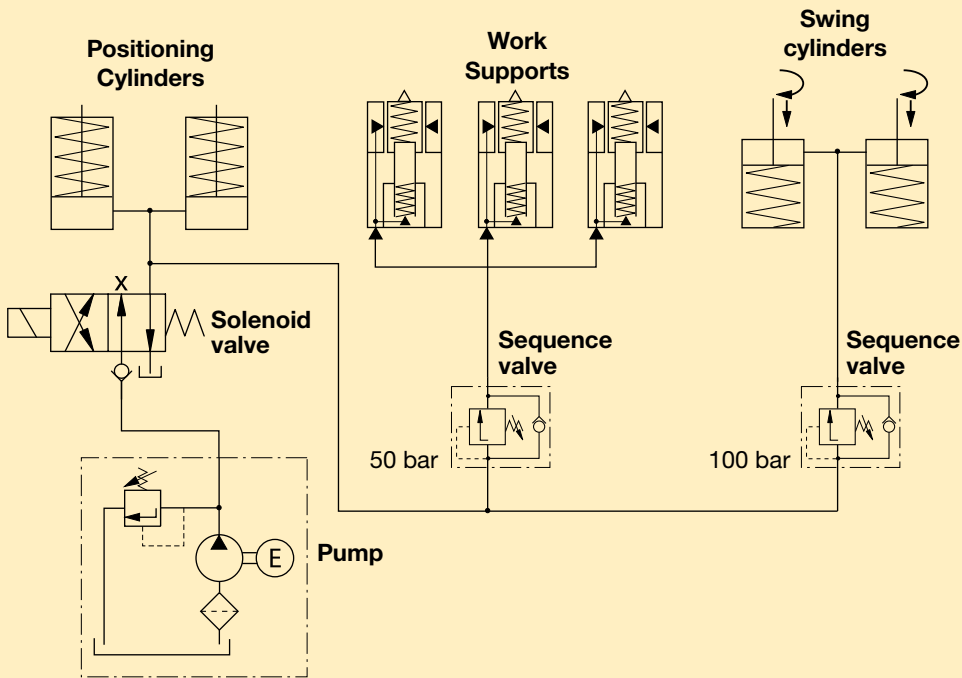
**Figure 4**  
Swing cylinders and hydraulically advancing work supports are very sensitive regarding the oil flow rate applied.

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.

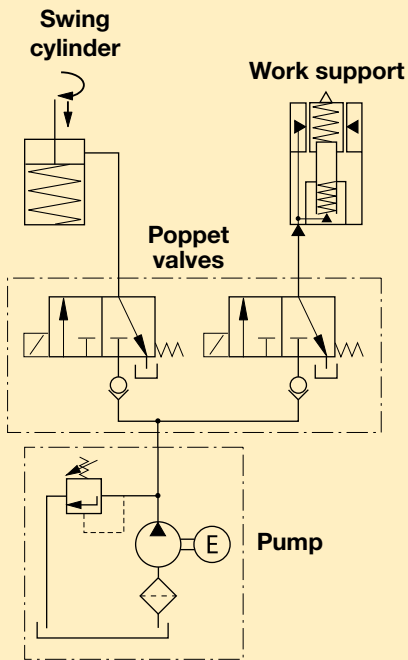


Hydraulic requirements (continued)

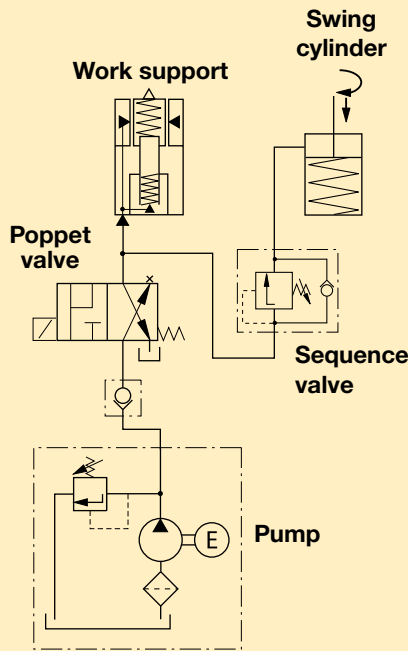


**Figure 5**  
For overhanging areas of the workpiece which have to be supported, the recommended sequence should be as follows (Figure 5):

1. Positioning of the workpiece
2. Actuate work supports
3. Clamp the overhanging area against work support.

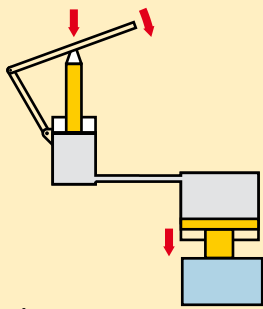


**Figure 6**

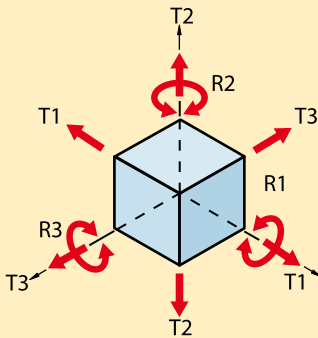


**Figure 7**

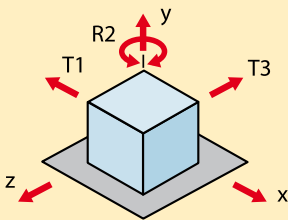
The hydraulic sequence can be controlled either by independently controlled hydraulic circuits (Figure 6) or by sequence valves (Figure 7).



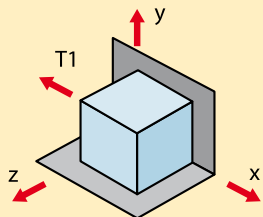
**Figure 1**  
Operating principle of a hydraulic clamping device.



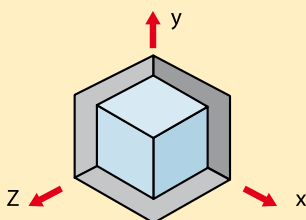
**Figure 2**  
Three-dimensional body.



**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 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

The process of locating and holding a 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.

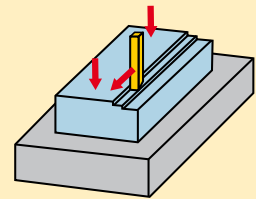
The location process is subject to a number of design guidelines, but exceptions are possible.

- 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.

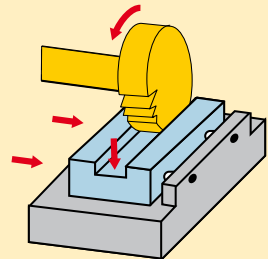
## 3 Clamping

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.

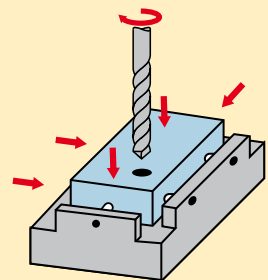
Clamping is invariably associated with force transmission through the device. The force vector should, as far as possible, describe a straight line from the application point of the clamping force through the workpiece to the bearing points.



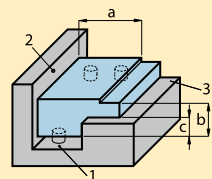
**Figure 4a**  
Semi-constrained Workpiece.



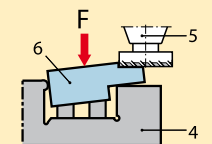
**Figure 4b**  
Constrained Workpiece



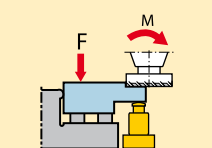
**Figure 4c**  
Fully-constrained Workpiece



**Figure 5a**  
Workpiece with locating planes

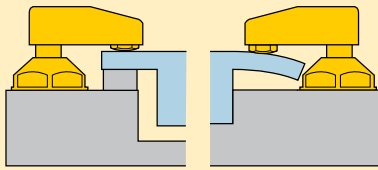


**Figure 5b**  
Incorrectly located workpiece

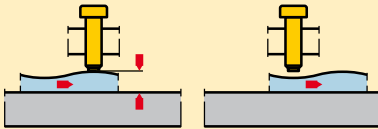


**Figure 5c**  
Correctly located workpiece

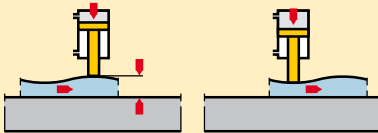




**Figure 6**  
Design guidelines for clamping.



**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).

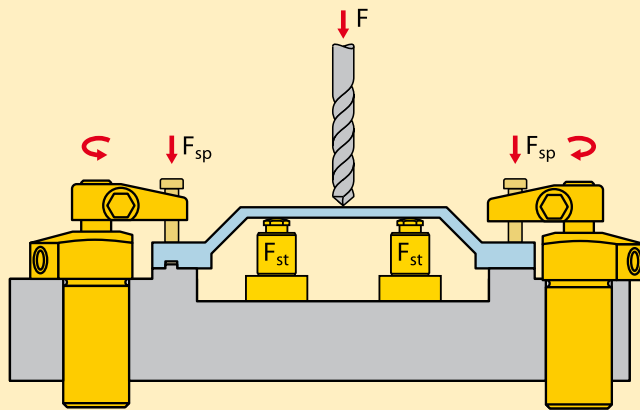
Hydraulic clamping is achieved by:

- Elastometric 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.

## 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.

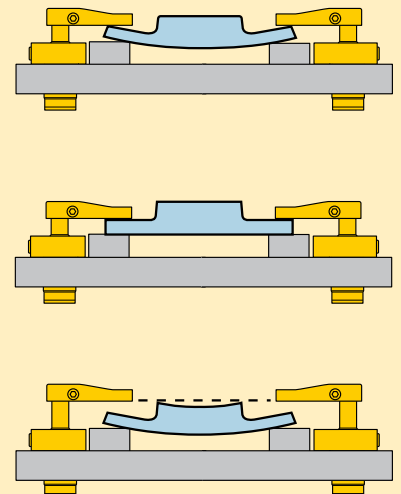
The illustrations in Figure 10 illustrate two different clamping methods. It shows deformation of a workpiece caused by conventional clamping (Figure 10a). As a result of this deformation, the surface area of the workpiece exhibits a greater degree of deformation when unclamped.

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.

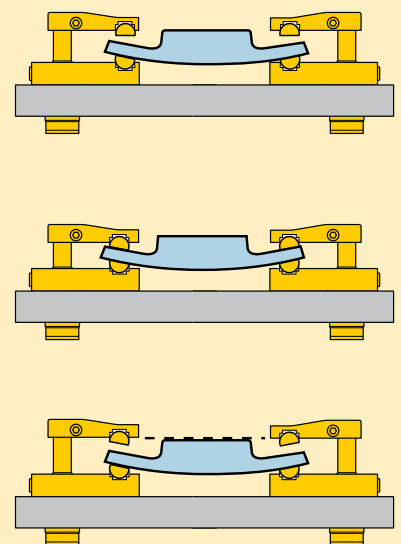
The clamping points illustrated in Figure 10b are spherically shaped, and can therefore largely adapt to the workpiece curvatures (b). The machined surface is therefore flat, and the workpiece is only exposed to possible internal stresses that may be released by machining.

### 4.3 Determination of the clamping force

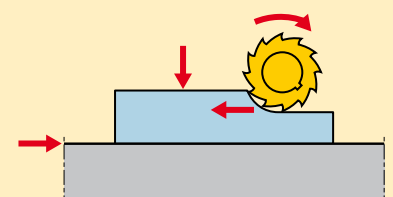
It is important to ensure that a workpiece that is clamped inside a device is not moved from its position by the clamping force and the subsequent action of the cutting force. This risk of movement may be minimized by applying the clamping force to the solid bearing surfaces of the device (Figure 11).



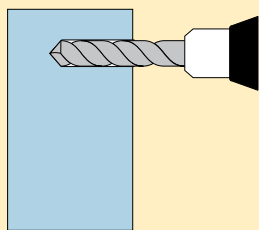
**Figure 10a**  
Deformation caused by conventional clamping.



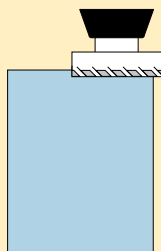
**Figure 10b**  
Eliminate deformation using spherical ball supports.



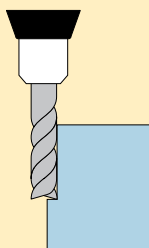
**Figure 11**  
Approximation of the clamping force.



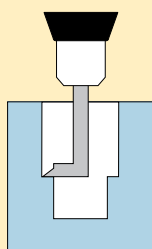
Drilling



Face milling



End mill



Boring

## Introduction

**This introduction will help you use information provided by tool manufacturers 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 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 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.

Diameter (Inch) x .2618 = 1432 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.

$$\text{Cutting Force}^1 = \frac{\text{Spindle Hp} \times 26406^2}{\text{Cutting Speed}^3}$$

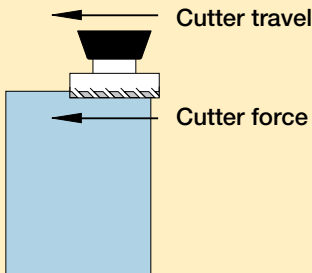
- <sup>1)</sup> Cutting Force in Pounds
- <sup>2)</sup> Spindle Horsepower to foot-pounds at 80% efficiency
- <sup>3)</sup> Cutting Tool surface speed in feet per minute.

$$\text{MRR}^1 = W \times D \times F \times N \times \text{RPM}^2$$

- <sup>1)</sup> Material Removal rate (in<sup>3</sup>/min)
- <sup>2)</sup> **W** = Width of cut (inch)  
**D** = Depth of cut (inch)  
**F** = Feed per tooth (inch)  
**N** = Number of cutting teeth  
**RPM** = Spindle Speed

$$\text{Tool RPM} = \frac{\text{SFM}^1}{\text{Diameter} \times 0.2618}$$

- <sup>2)</sup> **SFM** = Surface Feet per Minute



**Unit Power for dull tools [imperial system]**

Material	Hardness	Unit Power hp/in <sup>3</sup> /min		
		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	35-40 Rc	1.7	1.7	1.9
Alloy steels	40-50 Rc	1.9	2.1	2.2
Tool steels	50-55 Rc	2.5	2.6	2.6
	55-58 Rc	4.2	3.2	3.2
<b>CAST IRONS</b>	110-190 Bhn	0.9	1.2	0.8
Gray, ductile and malleable	190-320 Bhn	1.7	2.0	1.4
<b>STAINLESS STEELS</b>	135-275 Bhn	1.6	1.4	1.7
	30-45 Rc	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>ALUMINIUM 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>	10-80 Rb	0.8	0.6	0.8
	80-100 Rb	1.2	1.0	1.2



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$$\text{Cutting Force } ^1 = \frac{\text{Spindle kW} \times 48000 ^2}{\text{Cutting Speed } ^3}$$

- <sup>1</sup> Cutting Force in Newtons (N)
- <sup>2</sup> Spindle Power (kW) required 80% efficiency
- <sup>3</sup> Cutting Tool surface speed in metres per minute (m/min).

$$\text{MRR } ^1 = \frac{W \times D \times F \times N \times \text{RPM } ^2}{1000}$$

- <sup>1</sup> Material Removal rate (cm<sup>3</sup>/min)
- <sup>2</sup> **W** = Width of cut (mm)  
**D** = Depth of cut (mm)  
**F** = Feed per tooth (mm)  
**N** = Number of cutting teeth  
**RPM** = Spindle Speed (rotation per Minute)

$$\text{Tool RPM} = \frac{\text{MPM} \times 1000 ^1}{\pi \times \text{Tool diameter } ^2}$$

- <sup>1</sup> **MPM** = Surface Speed in m/min
- <sup>2</sup> Tool diameter in millimetres (mm).

## 2 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 aluminium at 1000 MPM (meters per minute).

Solving Tool RPM = MPM x 1000  
Diameter (mm) x π (= 1592 Tool RPM).

The same tool catalogue 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 N(ewtons) = 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 aluminium has a coefficient of 0,12 (flooded with coolant), the clamping force becomes 1378/0,12 = 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 at 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 HSS and Carbide Tools Feed 0,12 - 0,50 (mm/r)	Drilling P HSS Drills Feed 0,05 - 0,20 (mm/r)	Milling Pd HSS and Carbide Tools Feed 0,12 - 0,30 (mm/r)
<b>STEELS, WROUGHT</b>				
<b>AND CAST</b>	85 - 200 Bhn	0,064	0,059	0,064
Plain Carbon	35 - 40 Rc	0,077	0,077	0,086
Alloy Steels	40 - 50 Rc	0,086	0,096	0,100
Tool Steels	50 - 55 Rc	0,114	0,118	0,118
	55 - 58 Rc	0,191	0,146	0,146
<b>CAST IRONS</b>	110 - 190 Bhn	0,41	0,055	0,036
Gray, ductile and malleable	190 - 320 Bhn	0,077	0,091	0,064
<b>STAINLESS STEELS,</b>				
<b>WROUGHT AND CAST</b>	135 - 275 Bhn	0,073	0,064	0,077
Ferritic, austenitic and martensitic	30 - 45 Rc	0,077	0,068	0,086
<b>TITANIUM</b>	250 - 375 Bhn	0,068	0,064	0,064
<b>NICKEL ALLOYS</b>	80 - 360 Bhn	0,114	0,100	0,109
<b>ALUMINIUM ALLOYS</b>	30 - 150	0,014	0,009	0,018
<b>MAGNESIUM ALLOYS</b>	40 - 90 Bhn	0,009	0,009	0,009
<b>COPPER ALLOYS</b>	10 - 80 RB	0,036	0,027	0,036
	80 - 100 RB	0,055	0,046	0,055





## Key to measurements

All capacities and measurements in the catalog are expressed in uniform values. The conversion chart provides helpful information for their translation into equivalent systems.

### Pressure:

1 psi	= 0,069 bar
1 bar	= 14,50 psi
1 MPa	= 145 psi

### Volume:

1 in <sup>3</sup>	= 16,387 cm <sup>3</sup>
1 cm <sup>3</sup>	= 0,061 in <sup>3</sup>
1 liter	= 61,02 in <sup>3</sup>
	= 0,264 gal
1 US gal	= 3,785 cm <sup>3</sup>
	= 3,785 l
	= 231 in <sup>3</sup>

### Weight:

1 pound (lb)	= 0,4536 kg
1 kg	= 2,205 lbs
1 metric ton	= 2205 lbs
	= 1000 kg
1 ton (short)	= 2000 lbs
	= 907,18 kg

### Other measurements:

1 in	= 25,4 mm
1 mm	= 0,039 in
1 in <sup>2</sup>	= 6,452 cm <sup>2</sup>
1 cm <sup>2</sup>	= 0,155 in <sup>2</sup>
1 hp	= 0,746 kW
1 kW	= 1,340 hp
1 Nm	= 0,738 Ft.lbs
1 Ft.lbs	= 1,356 Nm
1 kN	= 224,82 lbs
1 lb	= 4,448 N

### Temperature:

To Convert °C to °F:  
 $T\text{ °F} = (T\text{ °C} \times 1,8) + 32$

To Convert °F to °C:  
 $T\text{ °C} = (T\text{ °F} - 32) \div 1,8$

## Imperial to metric

Inches	Decimal	Millimeters
1/16	.0625	1,59
1/8	.125	3,18
3/16	.187	4,76
1/4	.250	6,35
5/16	.312	7,94
3/8	.375	9,53
7/16	.437	11,11
1/2	.500	12,70
9/16	.562	14,29
5/8	.625	15,88
11/16	.687	17,46
3/4	.750	19,05
13/16	.812	20,64
7/8	.875	22,23
15/16	.937	23,81
1	1.000	25,40

## Metric to imperial

Millimeters	Inches	Millimeters	Inches
1	.039	14	.551
2	.078	15	.591
3	.118	16	.630
4	.157	17	.670
5	.197	18	.709
6	.236	19	.748
7	.275	20	.787
8	.315	21	.827
9	.354	22	.866
10	.394	23	.906
11	.433	24	.945
12	.472	25	.983
13	.512		



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 (40 l/min 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.

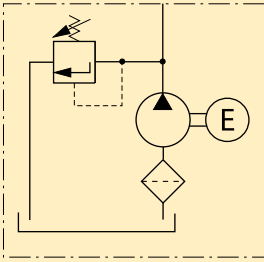
## Manifold mounting

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.

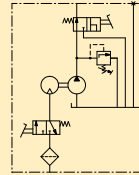
Be sure to include a passage for the breather vents where necessary. This passage should be routed to a large open area, not an enclosed cavity. Eventually, an enclosed cavity may fill up with chips and coolant and begin to work into the cylinders.



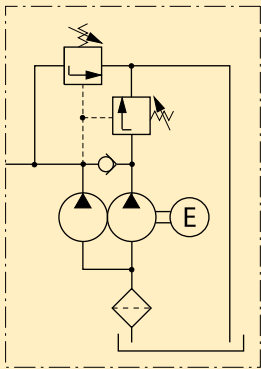
**Power sources**



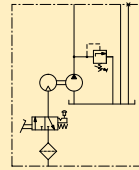
Single-stage electric pump  
Example  
**ZW4010NE-S**



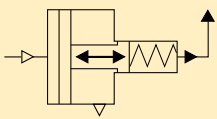
Turbo air pump  
Example  
**PATG-3102NB**



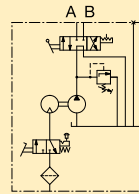
Two-stage electric pump  
Example  
**ZW5020NG**



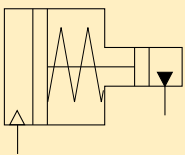
Turbo air pump  
Example  
**PASG-3002SB**



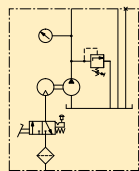
Reciprocating air pump  
Example  
**PA-136**



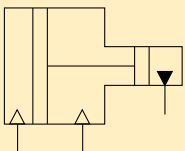
Turbo air pump  
Example  
**PAMG-3402NB**



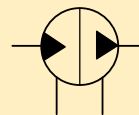
Single-acting booster  
Example  
**B-3006**



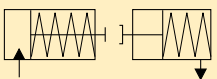
Turbo air pump  
Example  
**PACG-3002NB**



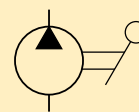
Double-acting booster  
Example  
**AHB-34**



Hydraulic intensifier  
Example  
**PID-321**



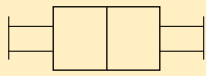
Activator wand and booster  
Example  
**B-171**  
**RA-1061**



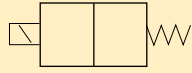
Hand pump  
Example  
**P-142**



## Valves



2-position manual



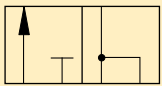
2-position solenoid



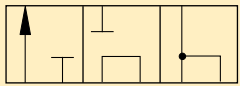
3-position manual



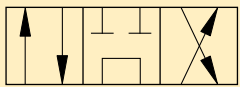
3-position solenoid



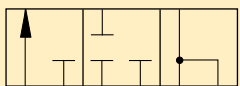
3-way, 2-position, Normally open  
Series **V** Example **VM-2**



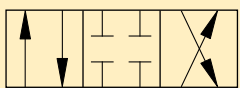
3-way, 3-position, Tandem center  
Series **V** Example **VM-3, VC-3**  
**VE** **VEF-15000D**



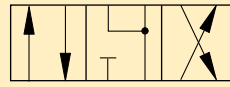
4-way, 3-position, Tandem center  
Series **V** Example **VM-4, VC-4**  
**VE** **VEC-15000D**



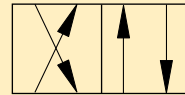
3-way, 3-position, Closed center  
Series **V** Example **VC-15**  
**VE** **VEG-15000A**



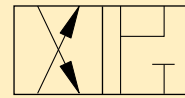
4-way, 3-position, Closed center  
Series **V** Example **VC-20**  
**VE** **VEB-15000A**



4-way, 3-position, Float center  
Series **VE** Example **VED-15000A**  
**VMM** **VMMD-001**



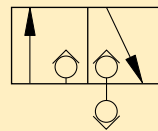
4-way, 2-position, Crossover offset  
Series **VE** Example **VEE-15000A**



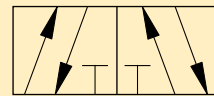
4-way, 2-position, Normally open  
Series **VSS/VAS** Example **VSS-1410D**



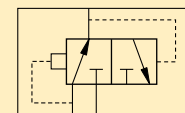
4-way, 2-position, Normally closed  
Series **VST/VAT** Example **VST-1410D**



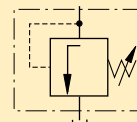
3-way, 2-position, Normally closed  
Series **VP** Example **VP-31**



4-way, 2-position, Air valve  
Series **VA** Example **VA-42**  
**VAS-42**



Rapid air exhaust valve  
Series **VR** Example **VR-3**



Pressure relief valve  
Series **V** Example **V-152**

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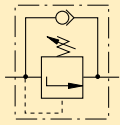
Pallet Components

System components

Yellow Pages

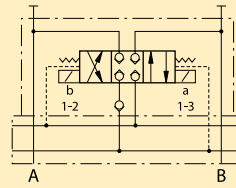


Valves

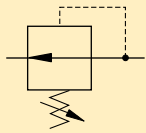


Sequence valve  
Series  
**MVP**  
**WVP**

Example  
**MVPM-5**  
**WVP-5**

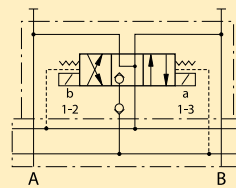


4-way, 3-position, Closed center  
Example  
**VP-11, -12**

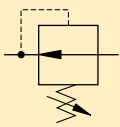


Pressure limiting valve  
Series  
**PLV**

Example  
**PLV-40013B**

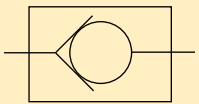


4-way, 3-position, Float center  
Example  
**VP-21, -22**



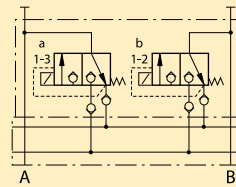
Pressure reducing valve  
Series  
**PRV**

Example  
**PRV-3**

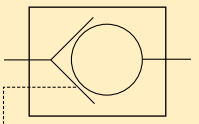


Check valve  
Series  
**V**

Example  
**V-17**

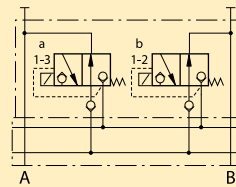


3-way, 2-position, Normally closed  
Example  
**VP-31, -32**

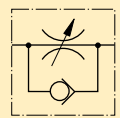


Check valve, Pilot operated  
Series  
**MV**  
**V**

Example  
**MV-72**  
**V-72**

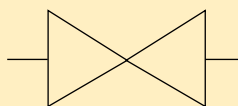


3-way, 2-position, Normally open  
Example  
**VP-41, -42**



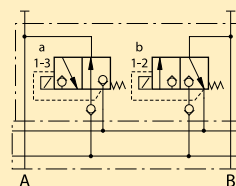
Flow control valve, Free flow check  
Series  
**VFC**

Example  
**VFC-1**

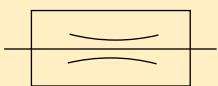


Shut-off valve  
Series  
**V**

Example  
**V-12**



3-way, 2-position,  
one port normally open and  
one port normally closed  
Example  
**VP-51, -52**



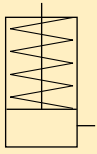
Auto-damper valve  
Series  
**GS, V**

Example  
**GS-2, V-10**

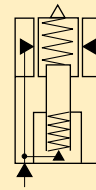




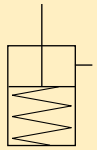
## Cylinders



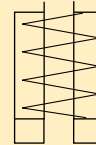
Single-acting cylinder, Push  
Example  
**CSB-18252**  
**CST-5132**  
**CSM-18132**



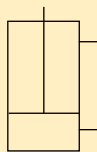
Fluid advance work support  
Example  
**WFL-112**



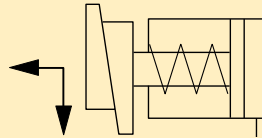
Single-acting cylinder, Pull  
Example  
**PLSS-52**  
**PTSS-52**  
**PUSS-52**



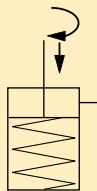
Single-acting hollow plunger cylinder  
Example  
**CY-21295**  
**HCS-80**  
**RWH-202**



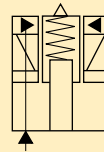
Double-acting cylinder  
Example  
**CDB-18252**  
**RD-96**  
**CDT-18132**



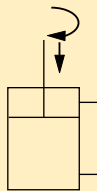
Pull down clamp  
Example  
**ECH-202**



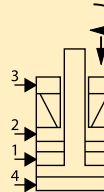
Single-acting swing cylinder  
Example  
**SLRS-92**  
**STRS-92**  
**SURS-92**



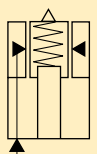
Collet-Lok® work support  
Example  
**MPFS-200**  
**MPTS-200**



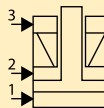
Double-acting swing cylinder  
Example  
**SLRD-92**  
**STRD-92**  
**SURD-92**



Collet-Lok® swing cylinder  
Example  
**MPFR-100**  
**MPTR-100**



Spring advance work support  
Example  
**WSL-112**



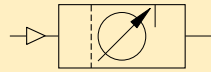
Collet-Lok® push cylinder  
Example  
**MPFS-100**  
**MPTS-100**



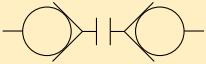
System components



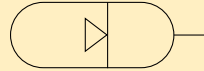
Pressure gauges  
Example  
**DGR-2**  
**G-2534R**



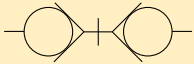
Air regulator  
Example  
**RFL-102**



Hydraulic couplers, Uncoupled  
Example  
**AH-650**  
**AH-652**  
**AH-654**



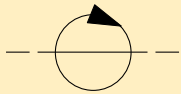
Accumulator, Gas charged  
Example  
**ACL-202**  
**WA-502**



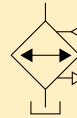
Hydraulic couplers, Coupled  
Example  
**AH-650**  
**AH-652**  
**AH-654**



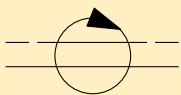
Accumulator, Spring loaded  
Example  
**ACM-1**



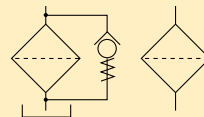
Rotary coupler, Single passage  
Example  
**CR-112**



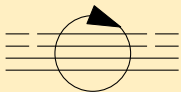
Heat exchanger  
Example  
**ZHE-1**



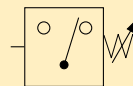
Rotary coupler, Double passage  
Example  
**CRV-222**



Return line filter,  
high pressure filter, in line  
Example  
**PFK-25**  
**FL-2102**



Rotary coupler, Four passage  
Example  
**CRV-442**



Pressure switch  
Example  
**IC-50**



Collet-Lok® products

Swing clamps

Work Supports

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## Valve types and functions

Hydraulic valves can be divided into **3 groups:**

1. Directional Control Valves
2. Pressure Control Valves
3. Flow Control Valves

### 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.

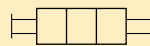
Double-acting cylinders require a 4-way valve, providing control of the flow to each cylinder port.

#### Positions – the number of control points a valve can provide

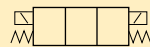


A 2-position valve has the ability to control only the advance or retraction of the cylinder. To be able to control the cylinder with a hold position, the valve requires a third position.

#### Operation – the way to shift the valve into position



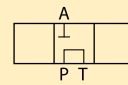
The valve position can be **manually operated** with the use of the handle.



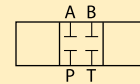
The valve position can be **solenoid operated** using power supply.

#### 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.

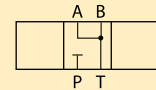


The most common is the **Tandem Center**. This configuration provides for no movement of the cylinder and the unloading of the pump. This provides for minimum heat build-up.

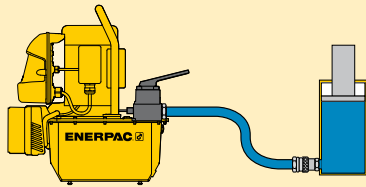


The next most common is the **Closed Center** configuration, which is used mostly for independent control of multi-cylinder applications. This configuration again provides for no movement of the cylinder, but also dead-heads the pump, isolating it from the circuit.

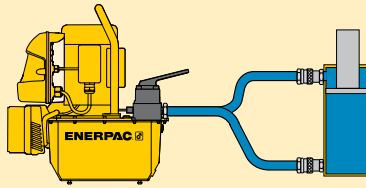
The use of this type of valve requires some means of unloading the pump to prevent heat build-up.



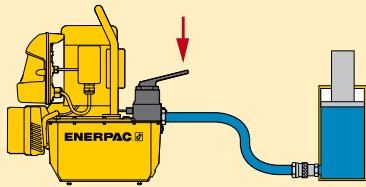
Another commonly used valve configuration is **Float Center**. This type of valve allows the cylinder ports to drain pressure back to tank. Used with a pallet mounted pilot operated check, it allows the hydraulics to be disconnected from the pallet.



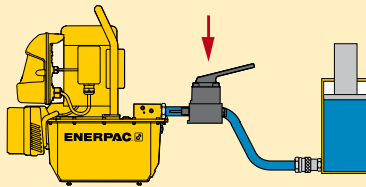
**3-way valve** used with single-acting cylinder.



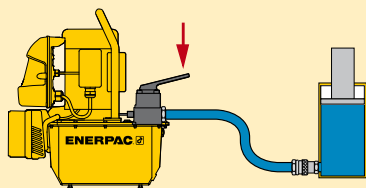
**4-way valve** used with double-acting cylinder.



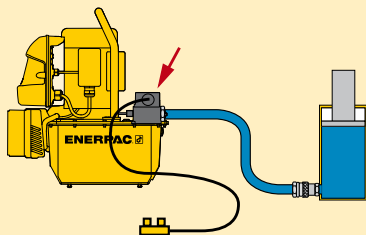
Valves can be **pump mounted**.



Valves can be **remote mounted**.



Valves can be **manually operated**.



Valves can be **solenoid operated**.

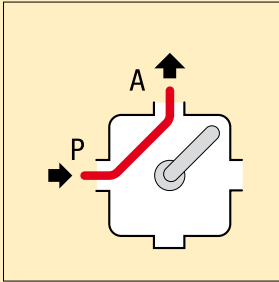


**Advance, hold and retract**

The direction of the oil flow can be controlled depending on valve type, valve positions and port functions.

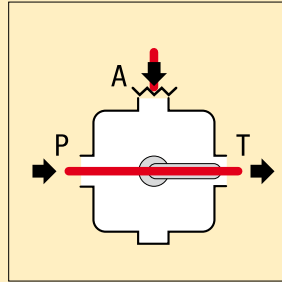
**Single-acting cylinder**

Controlled by a 3-way, 3-position valve.



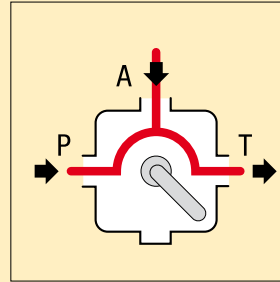
**Advance**

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.

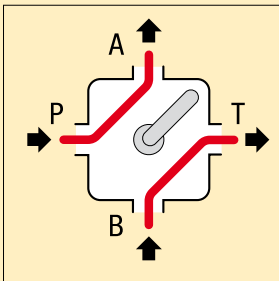


**Retract**

The oil flows from the pump and cylinder port A to the tank T: the cylinder plunger will retract.

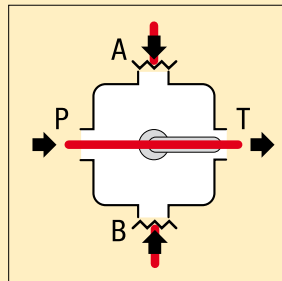
**Double-acting cylinder**

Controlled by a 4-way, 3-position valve.



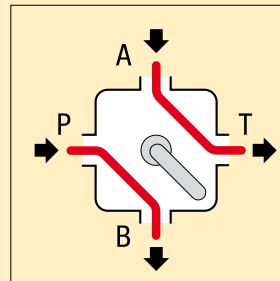
**Advance**

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 its 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.



Collet-Lok® products

Swing clamps

Work Supports

Linear Cylinders

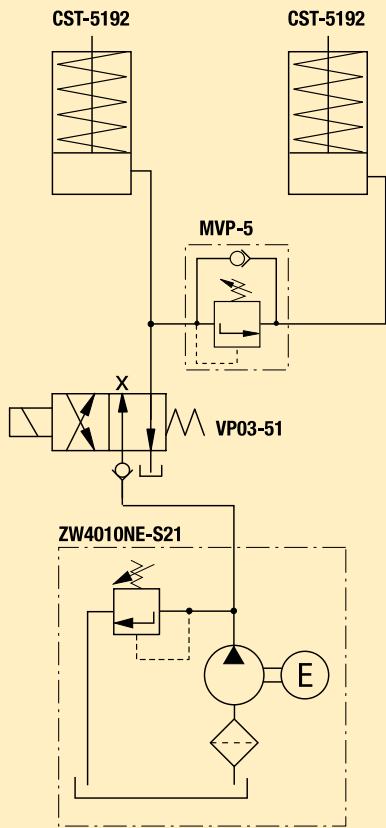
Power Sources

Valves

Pallet Components

System components

Yellow Pages



## 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 the 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 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.

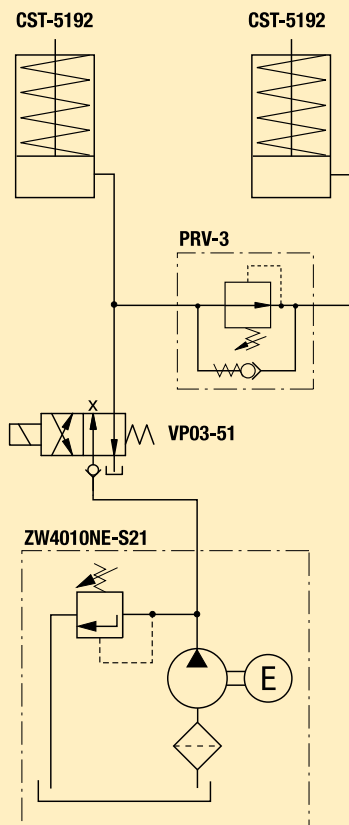
Enerpac sequence valves have a free flow return check meaning that there is no sequence action when the circuit is unclamping. There is however a small bias spring that will open at about 2 bar. This will ensure a positive seal when the valve must provide sequence action in the forward direction. When multiple sequence valves are used they should be used in parallel and not in series. If used in series, these 2 bar bias springs will restrict the flow in an accumulative effect.

For example, if three valves are used, there would be about  $3 \times 2 = 6$  bar of backpressure on components after the sequence valve in the system. While on a 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 210 bar and the reduced pressure is 140 bar, the pressure in the secondary part of the circuit would need to drop 5% of the system pressure,  $[0,05 \times 210 = 10,5 \text{ bar}]$  before the valve would open.

In this case the secondary part of the circuit would drop to 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 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.



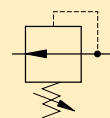




## 2 Pressure control (continued)

### 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.



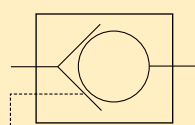
## 3 Flow control

### Flow control valve

Flow controls permit the change of speed of a hydraulic component through the use of an adjustable orifice.

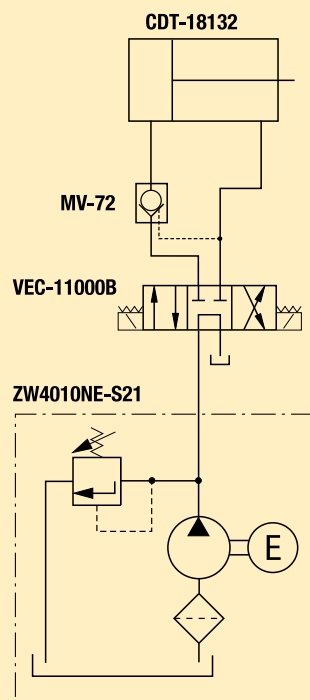
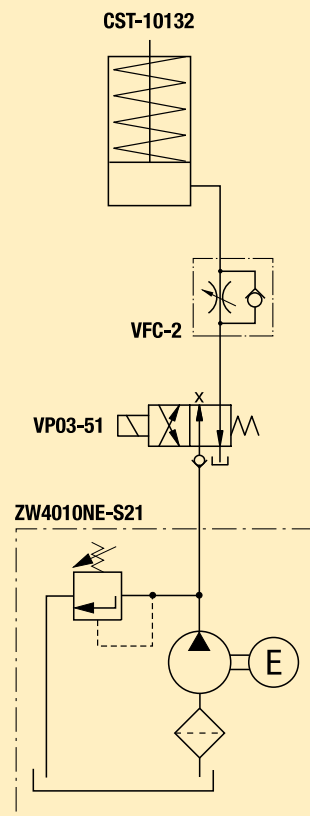
Unlike a regular flow control that provides the same flow restriction in both directions, these flow controls provide a free flow reverse check. This allows restricted flow in one direction and unrestricted flow in the other. This is a very important feature when using a flow control to regulate the 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.

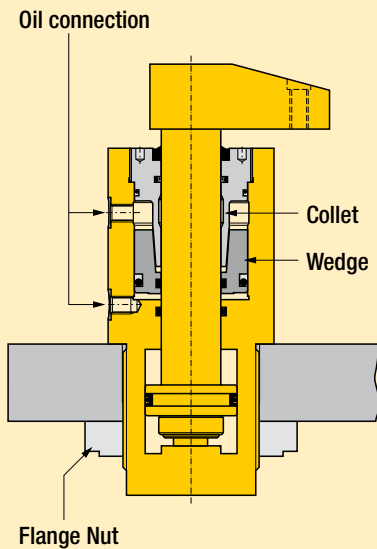
### Pilot operated check valves



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.

#### Enerpac's exclusive Collet-Lok® Technology

There is another solution to palletized clamping. Enerpac'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.

Enerpac 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.

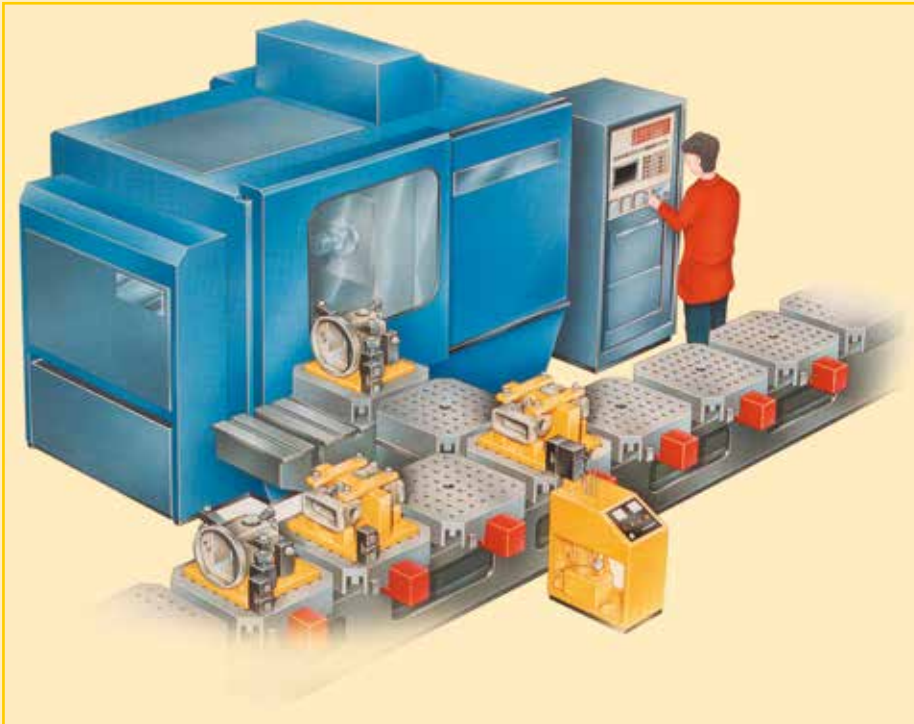
Once the machining cycle is complete, and the workpiece needs to be changed, the lock can be very easily removed. Pressure should be applied to **Port #3** to unlock the wedge system. Once the wedge is unlocked, and the plunger is free, pressure can be applied to **Port #4** to allow the plunger to retract. 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 Enerpac to receive additional literature and installation instructions.

■ Fixture for machining exhaust manifolds.

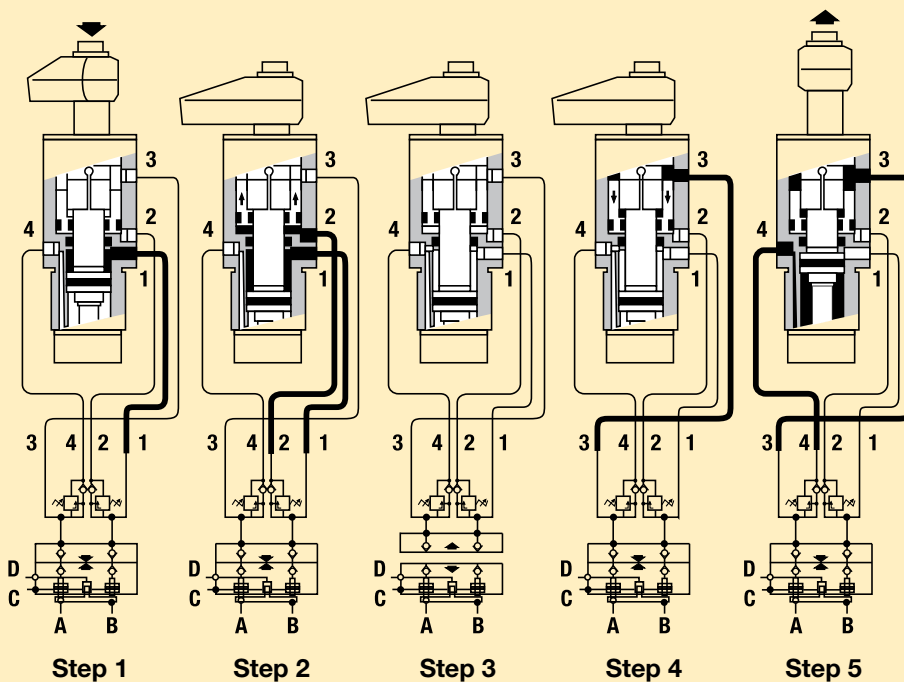


## Palletized machining



■ MPTL-100 and MPTR-100 Collet-Lok® Swing Clamps are used to securely clamp these exhaust manifolds.

## Hydraulic Clamping and Hydraulic Mechanical Locking



### MPTR-100 Collet-Lok® swing cylinder

- 1 = 90° Rotation + Clamp
- 2 = Lock
- 3 = Unlock
- 4 = Unclamp + 90° Rotation.

### MCA-62, MPA-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

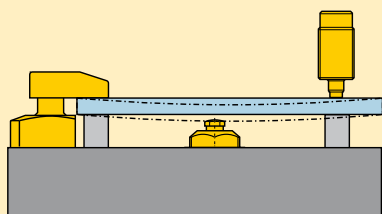
The wedge system secures the plunger position mechanically and the hydraulic pressure is taken off, then the auto coupler retracts. The product on the pallet is now securely clamped, without being connected to a power source.

### Step 4

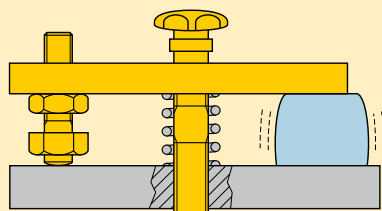
After being in the center of the machine the pallet returns to the loading and unloading position and the auto coupler is connected again to release the wedge.

### 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 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.

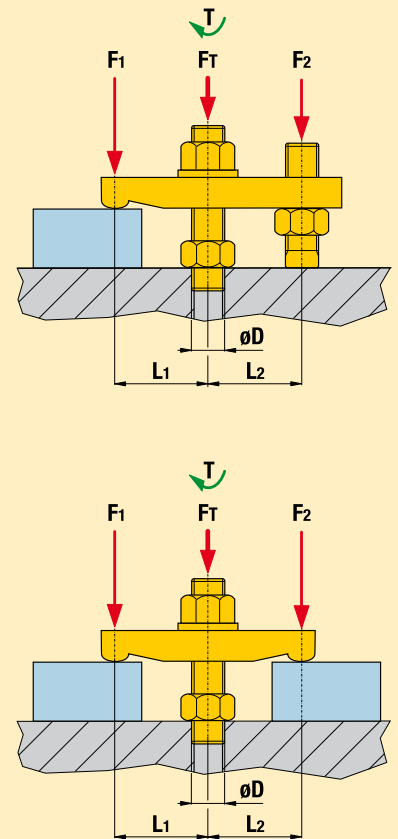
Many factors must be taken into account to decide on either mechanical clamping or hydraulic clamping. For example, taking labor into account can significantly add to the cost of mechanical clamping, since it is a much slower process. These examples are very simple and do not include all of the variable 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.

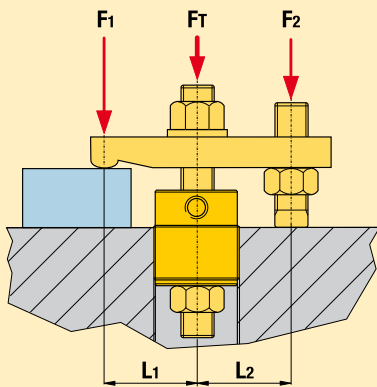
- F** = Clamping Force
- T** = Torque on the clamping stud (Nm or Ft.lbs)
- D** = Thread diameter and pitch (for example M8 or 3/8"-16UN)
- L1** = Distance from center of clamping stud to contact point on the workpiece
- L2** = Distance from center of clamping stud to reaction point (or contact point 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**  
Hollow plunger 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 L1 and L2, 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.

$$F1 = L2 / (L1 + L2) \times FT$$

$$F2 = L1 / (L1 + L2) \times FT$$

When L1 = L2 (when the clamping stud is exactly halfway between the clamping points),  $F1 = F2 = \frac{1}{2} FT$ .

## Stud sizes

Dry Threads K = 0,20		
Stud size	Torque (Nm)	Applied load (kN)
M6	5	5
	6	6
	7	7
	8	8
M8	20	15
	22	16
	24	18
	26	19
M10	32	19
	38	22
	44	26
	48	28
M12	80	39
	88	42
	96	46
	104	50
M16	165	58
	180	64
	195	69
	210	74
M20	270	76
	300	85
	330	93
	360	102
M22	425	108
	475	121
	525	134
	575	146
M24	600	142
	750	177
	900	212
	1050	248

Lubricated Threads K = 0,15		
Stud size	Torque (Nm)	Applied load (kN)
M6	5	7
	6	8
	7	9
	8	11
M8	20	20
	22	21
	24	23
	26	25
M10	32	25
	38	29
	44	34
	48	37
M12	80	51
	88	57
	96	62
	104	67
M16	165	78
	180	85
	195	92
	210	99
M20	270	102
	300	113
	330	125
	360	136
M22	425	144
	475	161
	525	178
	575	195
M24	600	189
	750	236
	900	283
	1050	330

Note: Values in the charts 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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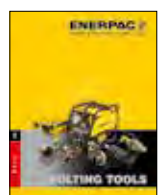
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