ENERPAC®

POWERFUL SOLUTIONS. GLOBAL FORCE.

GB

E215e

WORKHOLDING

Model number index

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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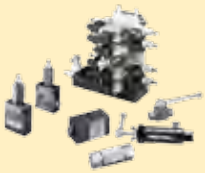

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The World Class Brand

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

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.

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.

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.

ISO 9001 REGISTER

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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:

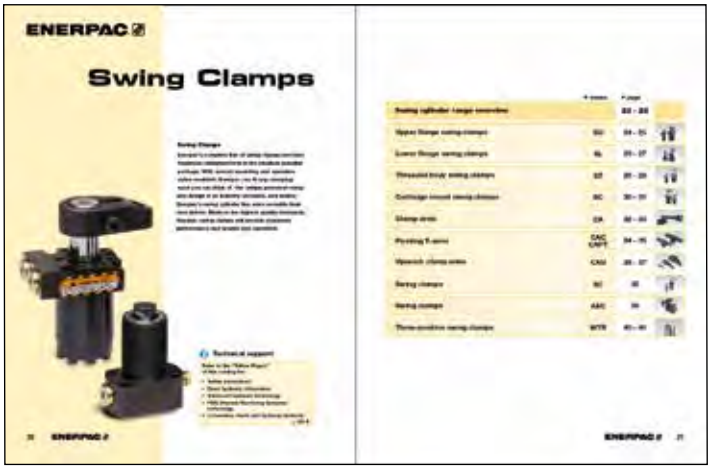
1 **Metric hydraulic product data section**
All Enerpac hydraulic workholding products shown with metric based specifications and dimensions.

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.

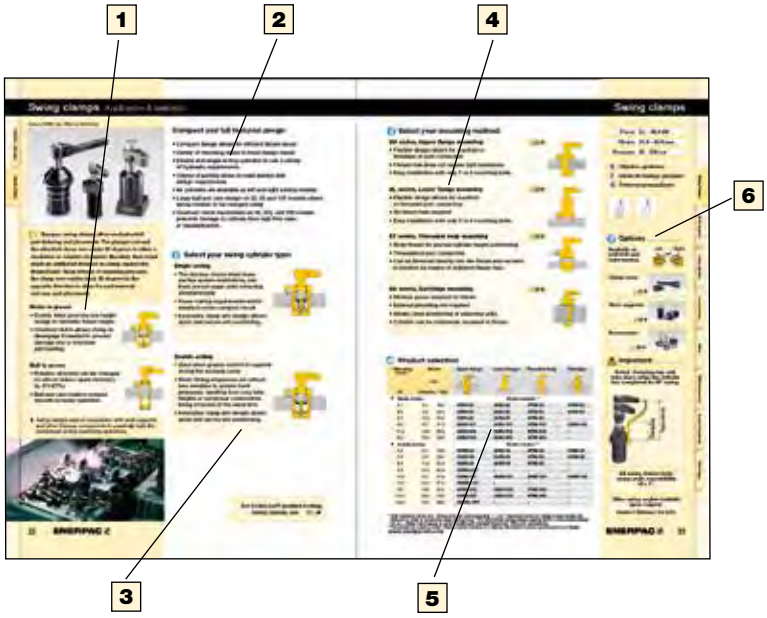
2 Listing of main product features and benefits.

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

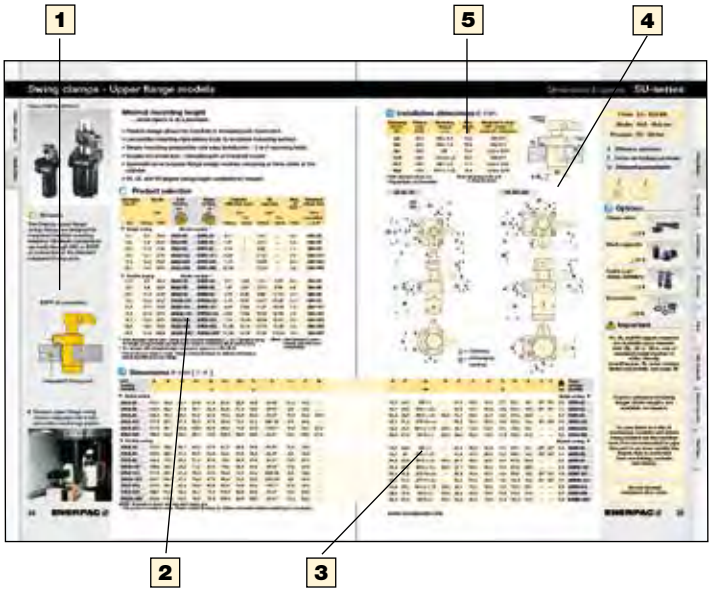
1 Application schematic including real life application example.

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.

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.

Technical support

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

- Safety instructions
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Products

Collet-Lok® *Application & selection*

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.

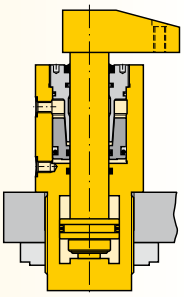
Hydraulic actuation with mechanical lock

- *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.



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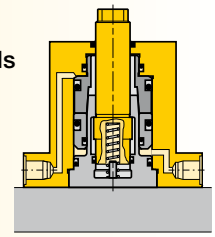
Collet-Lok® Work Supports

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



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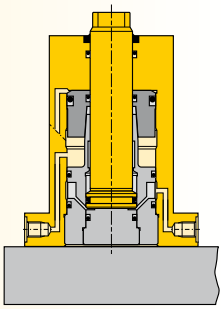
Collet-Lok® Push Cylinders

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



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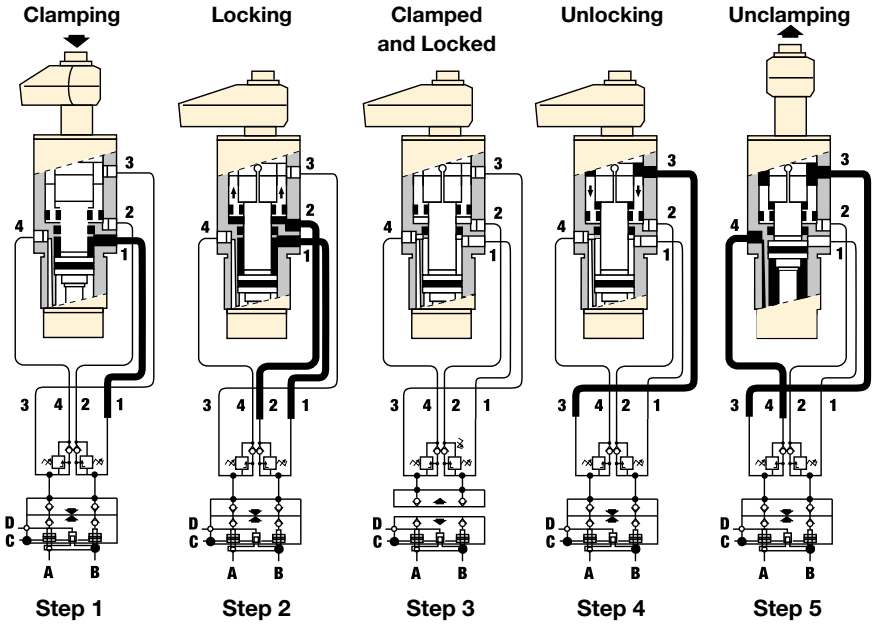
Why use Collet-Lok®?

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.

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 ▶

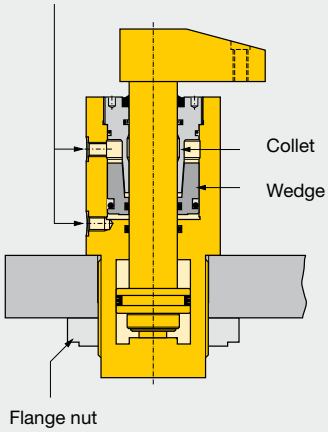
Swing cylinders - Collet-Lok® design

Shown: MPTR-100V, MPFR-100V

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.

BSPP oil connection



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

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

Ideal when live hydraulics are not available

- 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

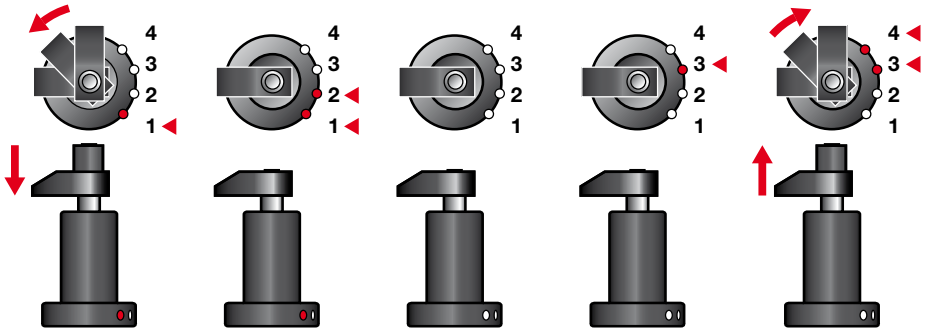
Clamping force [1]	Stroke		Left turning / Right turning (90°)		Cylinder effective area		Oil capacity		Max. oil flow [1]	Standard clamp arm
	mm				cm²		cm³			Sold separately
kN	Clamp	Total			Clamp	Un-clamp	Clamp	Un-clamp	l/min	
▼ Lower flange			Model number							
4,4	8	24,2	MPFL-50V	MPFR-50V	1,6	4,5	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
▼ Threaded body			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

[1] 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



Step 1
Pressurize port #1.
Plunger turns 90° and clamps part.

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

Step 3
Depressurize port #1 and #2.
Uncouple cylinder from hydraulic power source.
Part will be held in place.

Step 4
Pressurize port #3.
Plunger will be unlocked and the clamp force released.

Step 5
Keep port #3 pressurized.
Pressurize port #4.
Plunger will extend and turn to its original position.

Product dimensions in mm [⌲ ⌖]

Left turning models *	A	B	C	C1	D Ø	D1 Ø	F Ø	H1	H2	H3
▼ Lower flange										
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	–
▼ Threaded body										
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

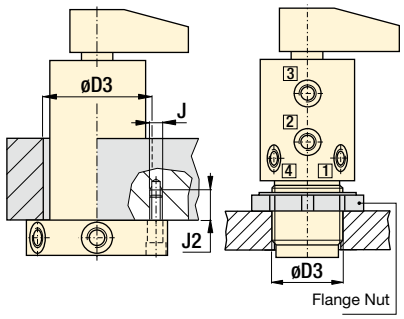
Note: Dimensions shown with standard clamp arm.
* For nonrotational model replace "L" with "N". Example: MPFN-100V.

Installation dimensions
in mm

Clamping force [1] 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 [1] 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

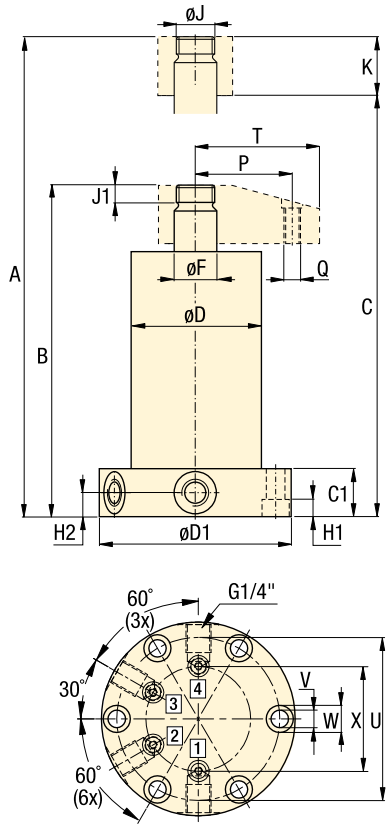
[1] With standard clamp arm.



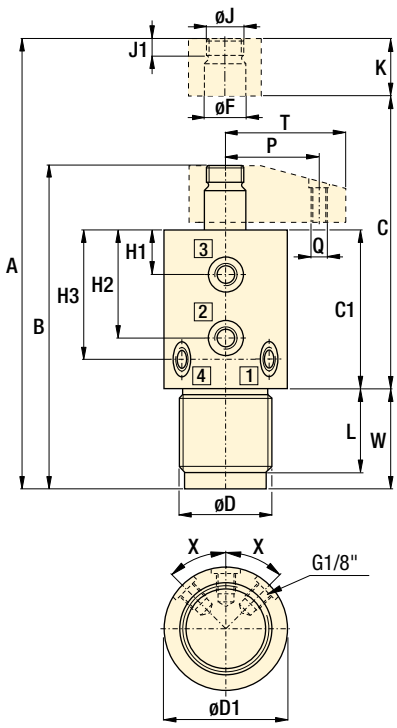
Oil port functions

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

MPF models



MPT models

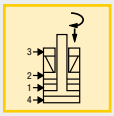


X = 45° MPT-100 models
X = 30° MPT-300 models

J	J1	K	L	P	Q	T	U Ø	V Ø	W	X Ø	kg	Right turning models
												Lower flange ▼
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*
												Threaded body ▼
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*

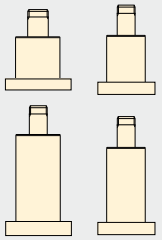
Force: 4,4 - 37,8 kN
Stroke: 24,0 - 42,0 mm
Pressure: 100 - 350 bar

E Cilindros giratorios
F Vérins de bridage pivotants
D Schwenkspannzylinder

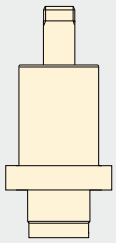


Custom Options Available

Intermediate capacities



Different flange locations



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

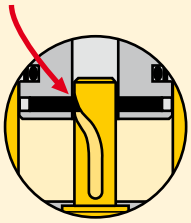
Important

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 mechanisme



Options

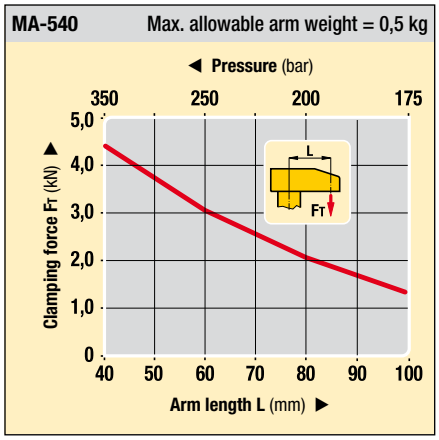
Gauges ▯190 ▶

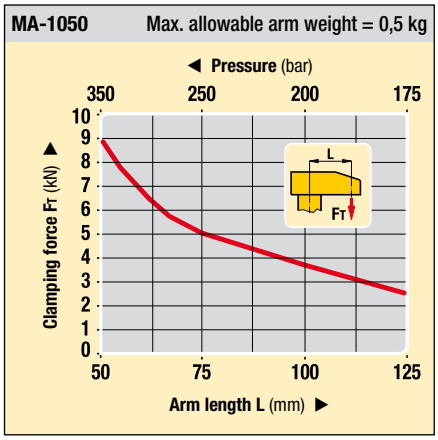
Flow control valves ▯155 ▶

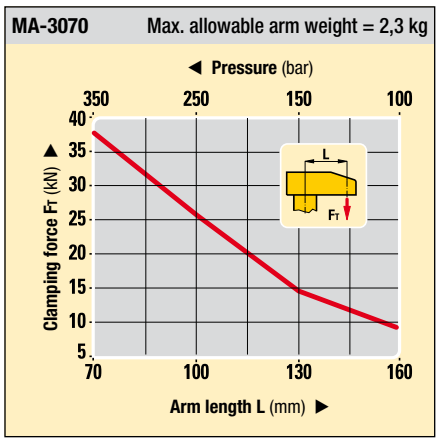
Sequence valves ▯152 ▶

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

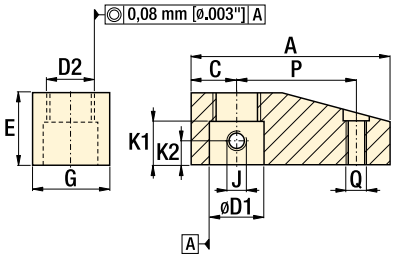
The maximum operating pressure, clamping force and length of the clamp arm will determine your size of swing cylinder. The real operating pressure is a function of both the clamp arm length and clamping force.
In the diagrams below you select the required clamp arm length and clamping force. The use of different length clamp arms requires reduction in apllied pressure and resulting clamp force. The diagrams below show this relation.







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



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	**MA-540**	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	**MA-1050**	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	**MA-3070**	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

Special configurations are available

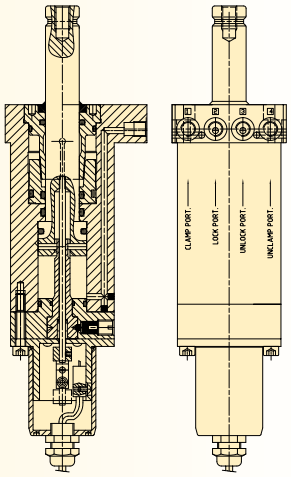
Model: MPFL100PE001-S

Body style: Upper flange

Clamp capacity: 9 kN (2000 lbs)

Clamping stroke: 18 mm (.71 in.)

Special feature: Position sensing



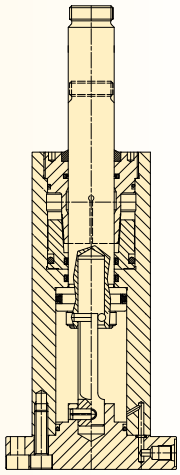
Model: MPFN300VE002

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



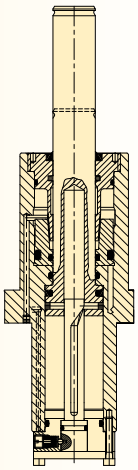
Model: MPFL200VE100

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



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.

Work supports - Collet-Lok® design

Shown: MPFS-100, MPTS-100

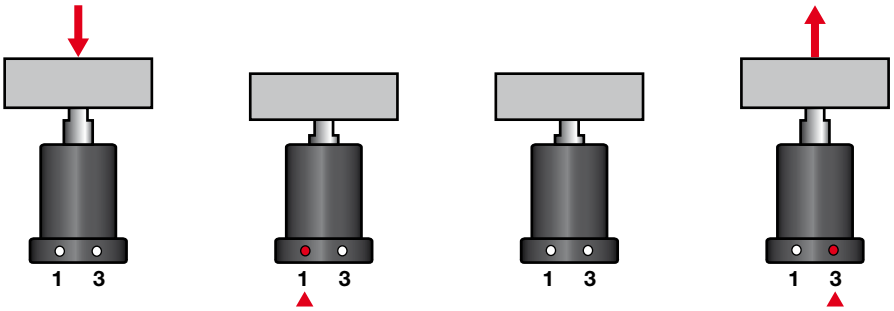
Hydraulically locked, mechanically maintained work support

- *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.

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.

Collet-Lok® sequence

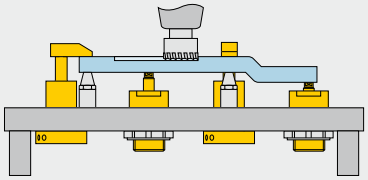


Step 1
Install the workpiece on the support cylinder. The plunger position will adjust to the contour of the workpiece.

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.

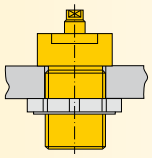
Step 4
Pressurize oil port #3. The plunger will be unlocked. When the workpiece is removed, plunger will extend into its original position.



Mounting style

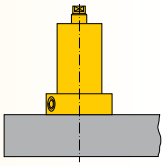
MPT series, Threaded mount

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.



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

Product selection

Max. support force	Support plunger stroke	Flange models	Threaded models	Operating pressure		Locking system displacement		Plunger contact spring force	Max. oil flow
				bar		cm^3			
kN	mm			min.	max.	lock	unlock	N	l/min
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

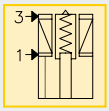
Stroke: 10 - 19,6 mm

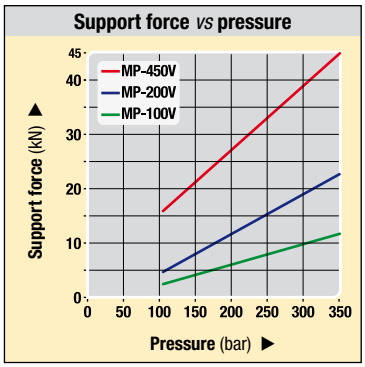
Pressure: 100 - 350 bar

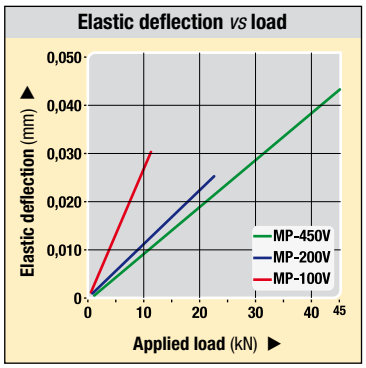
E Cilindros de soporte

F Vérin anti-vibreur

D Abstützzylinder

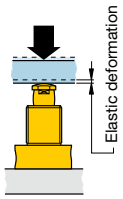






Deflection chart:

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



Options

Collet-Lok® swing cylinders 12 ▶

Auto couplers 174 ▶

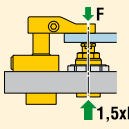
Positive clamping cylinders 80 ▶

Sequence valves 152 ▶

Important

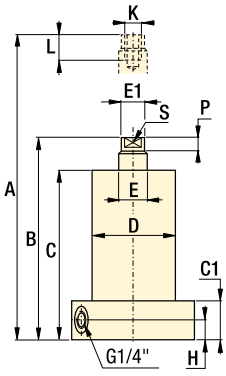
WARNING!

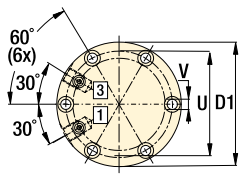
Support force and clamping force must be matched. Support force should be at least 150% of clamping force.



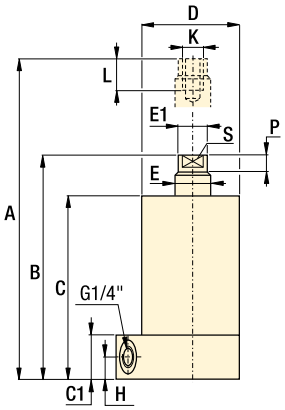
For proper application, clamp force, pressures and timing, consult Enerpac for support.

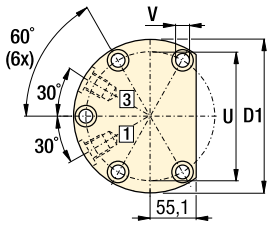
MPFS-100V, -200V



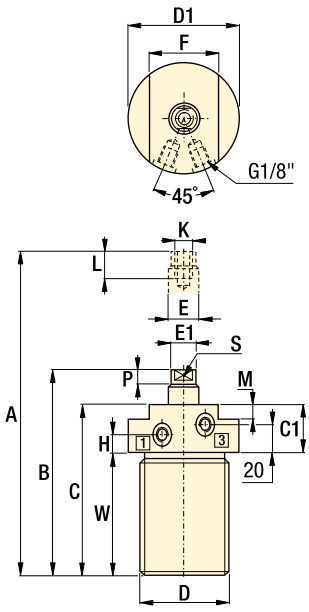


MPFS-450V





MPTS-100V, -200V



Product dimensions in mm [ ]

Model number	A	B	C	C1	D	D1 Ø	E Ø	E1 Ø	F	H	K	L	M	P	S*	U Ø	V Ø	W	X Ø	kg
▼ Flange models																				
MPFS-100V	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
MPFS-200V	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
MPFS-450V	193,4	173,8	161	25	Ø 130	165	50	48	–	12,5	M20 x 2	30	–	10	30 **	147	11	–	125	16,0
▼ Threaded models																				
MPTS-100V	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
MPTS-200V	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.

www.enerpacwh.com

Push cylinders - Collet-Lok® design

Shown: MPTC-110, MPFC-210

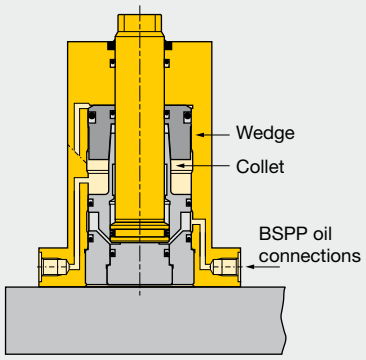
Ideal when live hydraulics are not available

...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.

MP series

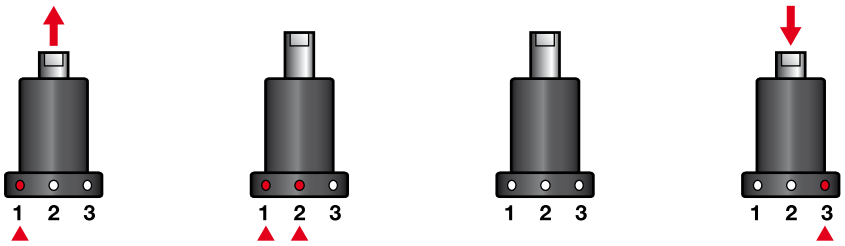
Collet-Lok® positive locking push cylinders are designed to mechanically hold the workpiece after hydraulic pressure is removed. Push capacities range from 11,1 kN to 22,2 kN.



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.

Collet-Lok® sequence



Step 1

Pressurize port #1. Plunger extends and clamps workpiece.

Step 2

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

Step 3

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

Step 4

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

Product selection

Max. push force	Hydr. plunger stroke	Lower flange	Threaded body	Operating pressure		Hydraulic effective area	Oil capacity			Max. oil flow
				bar		cm^2	cm^3			
kN	mm			min.	max.	adv.	adv.	unlock	retr.	l/min
		Model number								
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

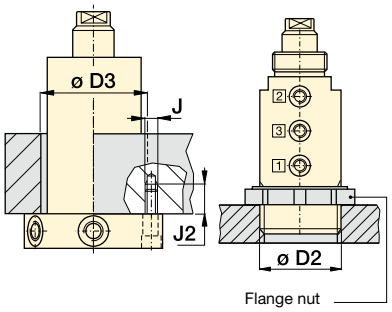
Maximum cycle rate: 8 cycles/min.
Note: Call Enerpac to order models with UNF thread and SAE port connections.
Capacities up to 39,9 kN available on request.

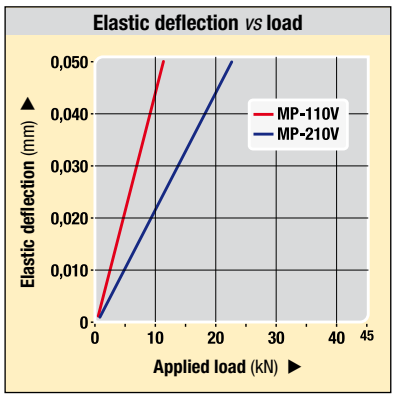
Dimensions in mm [⌯]

Model number	A	B	C	C1	D	D1 Ø	D2	E Ø	E1 Ø	F Ø
▼ **Lower flange**										
MPFC-110V	155,8	140,5	131	–	Ø 70,0	100	–	15,8	15	–
MPFC-210V	176,7	161,5	149	-	Ø 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

Installation dimensions in mm

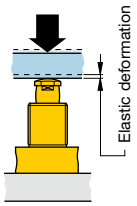
Push force kN	Fixture hole ø D3	Mounting thread J	Minimum depth J2
▼ Lower flange			
11,1	71	M6 x 1,0	17
22,2	79	M8 x 1,0	18
▼ Threaded body			
11,1	M60 x 2	–	–
22,2	M70 x 2	–	–



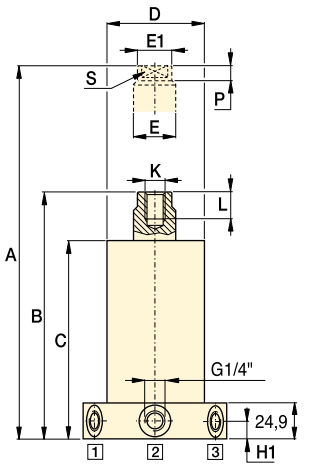


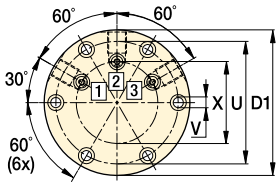
Deflection chart:

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



MPFC

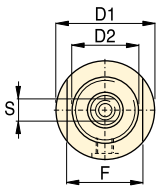


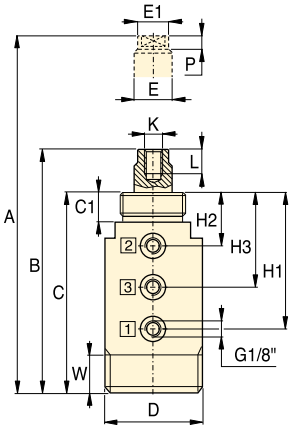


Oil port functions

1. Clamp
2. Lock
3. Unlock/Retract

MPTC





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

* Spanner holes (x 2)

Force: 11,1 - 22,2 kN

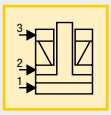
Stroke: 15,0 mm

Pressure: 50 - 350 bar

E Cilindros de empuje

F Vérins pousseurs

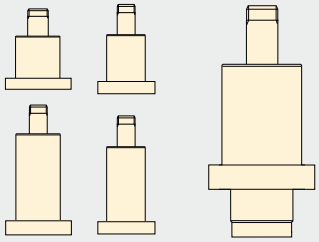
D Gesicherter Druckzylinder



Custom Options Available

Intermediate capacities

Different flange locations



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 ▶

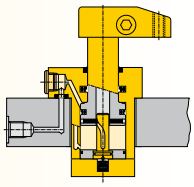
Swing clamps *Application & selection*

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.

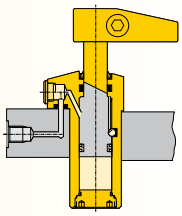
Roller in groove

- 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.

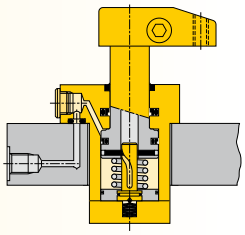
Compact and full featured design

- 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.

Select your swing cylinder type:

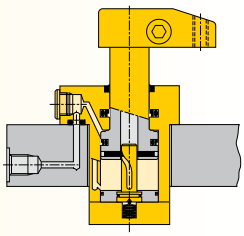
Single acting

- 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.

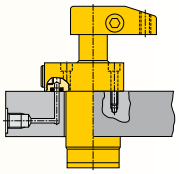


For *Collet-Lok*® positive locking swing clamps, see 12 ▶

Select your mounting method:

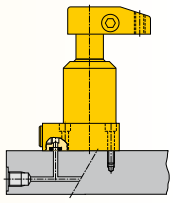
SU series, Upper flange mounting 24

- 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.



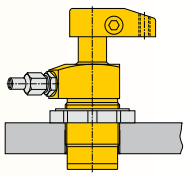
SL series, Lower flange mounting 26

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



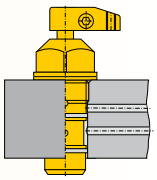
ST series, Threaded body mounting 28

- 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.

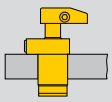
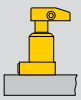
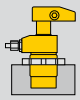


SC series, Cartridge mounting 30

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



Product selection

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

[1] 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. [2] 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

Force: 2,1 - 33,8 kN

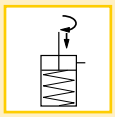
Stroke: 16,4 - 48,4 mm

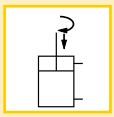
Pressure: 35 - 350 bar

E Cilindros giratorios

F Vérins de bridage pivotants

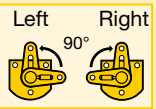
D Schwenkspannzylinder





Options

Available as both left and right turning



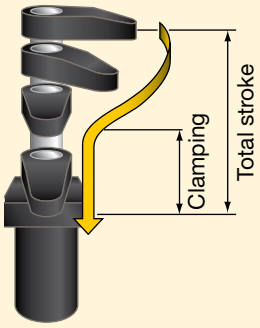
Clamp arms 32

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 ± 1°.

Other swing angles available upon request.

Contact Enerpac for info.

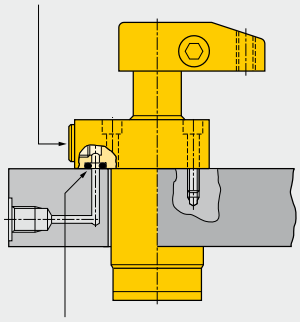
Swing clamps - Upper flange models

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 BSPP oil connection or the standard integrated O-ring ports.

BSPP 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[1] kN	Stroke mm Clamp	Stroke mm Total	Left turning 90°	Right turning 90°	Cylinder effective area cm² Clamp	Cylinder effective area cm² Un-clamp	Oil capacity cm³ Clamp	Oil capacity cm³ Un-clamp	Max. oil flow[1] l/min	Standard clamp arm Sold separately ▭ 32 ▶
▼ **Single acting**			**Model number** [2]							
2,1	8,1	16,4	**SULS-22**	**SURS-22**	0,77	–	1,31	–	0,2	**CAS-22**
4,9	9,9	22,6	**SULS-52**	**SURS-52**	1,81	–	4,10	–	0,4	**CAS-52**
8,0	11,9	23,0	**SULS-92**	**SURS-92**	3,16	–	6,88	–	1,0	**CAS-92**
10,7	12,7	27,9	**SULS-121**	**SURS-121**	4,06	–	11,47	–	1,6	**CAS-121**
17,4	14,0	29,5	**SULS-202**	**SURS-202**	7,10	–	19,99	–	2,3	**CAS-202**
33,1	16,0	32,6	**SULS-352**	**SURS-352**	12,39	–	37,20	–	3,9	**CAS-352**
▼ **Double acting**			**Model number** [2]							
2,2	8,1	16,4	**SULD-22**	**SURD-22**	0,77	1,55	1,31	2,62	0,2	**CAS-22**
5,6	9,9	22,6	**SULD-52**	**SURD-52**	1,81	3,81	4,10	8,69	0,4	**CAS-52**
9,0	11,9	23,0	**SULD-92**	**SURD-92**	3,16	8,06	6,88	17,70	1,0	**CAS-92**
9,0	32,0	43,0	**SULDL-92***	**SURDL-92***	3,16	8,06	13,27	30,48	1,0	**CAS-92**
11,6	12,7	27,9	**SULD-121**	**SURD-121**	4,06	7,94	11,47	22,94	1,6	**CAS-121**
11,6	31,8	47,0	**SULDL-121**	**SURDL-121**	4,06	7,94	15,90	37,69	1,6	**CAS-121**
18,7	14,0	29,5	**SULD-202**	**SURD-202**	7,10	15,16	19,99	42,61	2,3	**CAS-202**
33,8	16,0	32,6	**SULD-352**	**SURD-352**	12,39	23,74	37,20	71,28	3,9	**CAS-352**
33,8	31,8	48,4	**SULDL-352***	**SURDL-352***	12,39	23,74	57,85	110,94	3,9	**CAS-352**

[1] 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.

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

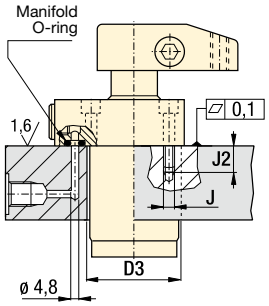
NOTE: dimensions shown with standard clamp arm.
* This product is made to order. Please contact Enerpac for delivery information before specifying in your design.

Installation dimensions in mm

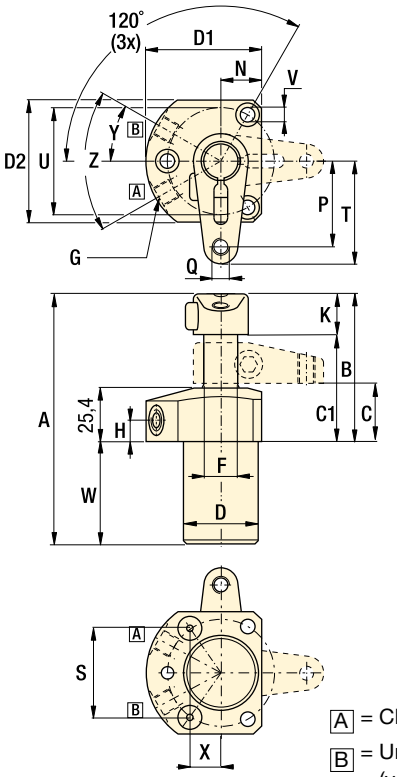
Clamping force[1] kN	Fixture hole Ø D3	Mounting thread J	Min. depth J2	Manifold O-ring[2] ARP number or inside Ø x thickness
2,2	28,5	M5 x 0,8	16,5	568-010
5,6	35,5	M6 x 1,0	16,5	568-011
9,0	49,0	M6	15,0	4,32 x 3,53
11,6	49,0	.312-24 UNF	20,3	568-011
18,7	63,5	M8 x 1,0	17,0	4,32 x 3,53
33,8	78,0	M10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

[1] With standard clamp arm.
[2] Polyurethane, 92 Durometer

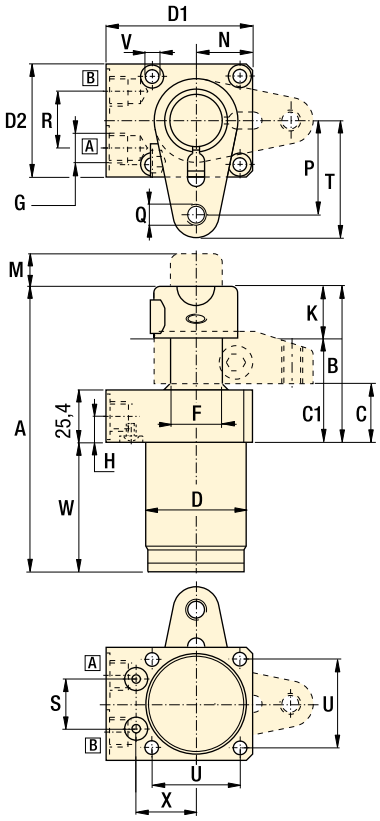
Note: Mounting bolts and O-rings included.



-22, 52, 121



-92, 202, 352



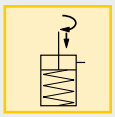
N	P	Q	R	S	T	U	V ø	W	X	Y	Z	kg	Right turning models
													Single acting ▼
15,5	24,6	M6 x 1	-	21,0	30,9	41,9	5,7	53,1	18,1	30°	60°	0,5	**SURS-22**
19,1	40,0	M8 x 1,25	-	41,0	47,9	50,0	6,8	66,0	14,4	30°	60°	1,1	**SURS-52**
26,4	45,9	M10 x 1,5	26,0	23,7	56,0	42,0	6,5	67,9	28,6	–	–	2,0	**SURS-92**
25,1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

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

No fixture hole required

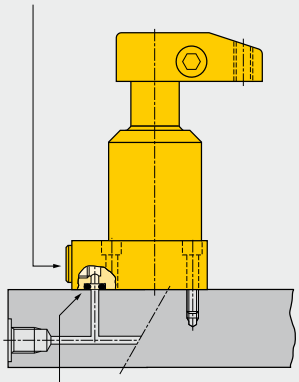
...cylinder can be bolted directly to fixture

- 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.

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.

BSPP oil connection



Integrated O-ring port

Product selection

Clamping force[1] kN	Stroke mm Clamp	Stroke mm Total	Left turning 90°	Right turning 90°	Cylinder effective area cm² Clamp	Cylinder effective area cm² Un-clamp	Oil capacity cm³ Clamp	Oil capacity cm³ Un-clamp	Max. oil flow[1] l/min	Standard clamp arm Sold separately 32 ▶
▼ **Single acting**			**Model number** [2]							
2,1	8	16,5	**SLLS-22**	**SLRS-22**	0,77	–	1,31	–	0,2	**CAS-22**
4,9	10	22,6	**SLLS-52**	**SLRS-52**	1,81	–	4,10	–	0,4	**CAS-52**
8,0	12	23,0	**SLLS-92**	**SLRS-92**	3,16	–	6,88	–	1,0	**CAS-92**
10,7	13	27,9	**SLLS-121**	**SLRS-121**	4,06	–	11,47	–	1,6	**CAS-121**
17,4	14	29,5	**SLLS-202**	**SLRS-202**	7,10	–	19,99	–	2,3	**CAS-202**
33,1	16	32,6	**SLLS-352**	**SLRS-352**	12,39	–	37,20	–	3,9	**CAS-352**
▼ **Double acting**			**Model number** [2]							
2,2	8	16,5	**SLLD-22**	**SLRD-22**	0,77	1,55	1,31	2,62	0,2	**CAS-22**
5,6	10	22,6	**SLLD-52**	**SLRD-52**	1,81	3,81	4,10	8,69	0,4	**CAS-52**
9,0	12	23,0	**SLLD-92**	**SLRD-92**	3,26	8,06	6,88	17,70	1,0	**CAS-92**
11,6	13	27,9	**SLLD-121**	**SLRD-121**	4,06	7,94	11,47	22,94	1,6	**CAS-121**
18,7	14	29,5	**SLLD-202**	**SLRD-202**	7,10	15,26	19,99	42,61	2,3	**CAS-202**
33,8	16	32,6	**SLLD-352**	**SLRD-352**	12,39	23,74	37,20	71,38	3,9	**CAS-352**

[1] 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.»

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

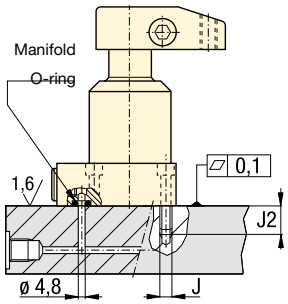
Lower flange swing clamps mounted to the face of the fixture.

Installation dimensions in mm

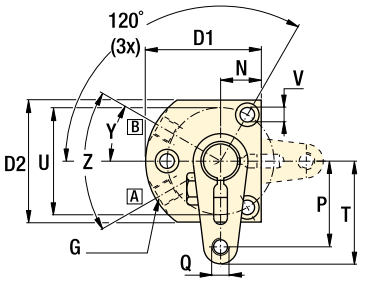
Clamping force[1] kN	Mounting thread J	Minimum thread depth J2	Manifold O-ring [2] ARP number or inside Ø x thickness
2,2	M5 x 0,8	16,5	568-010
5,6	M6 x 1,0	16,5	568-011
9,0	M6 x 1,0	15,0	4,32 x 3,53
11,6	312-24 UNF	20,3	568-011
18,7	M8 x 1,0	17,0	4,32 x 3,53
33,8	M10 x 1,25	18,8	4,32 x 3,53

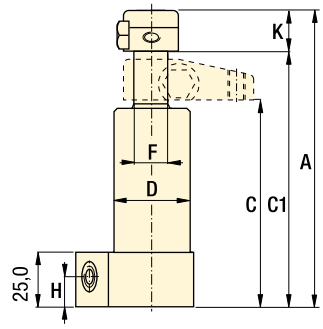
[1] With standard clamp arm.
[2] Polyurethane, 92 Durometer

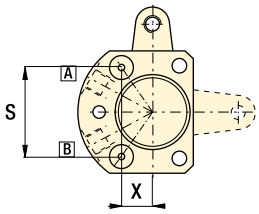
Note: Mounting bolts and O-rings included.



-22, 52 , 121

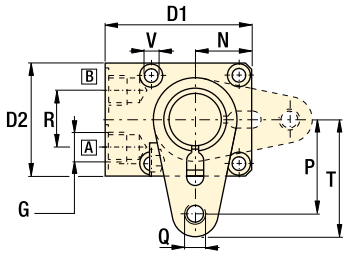


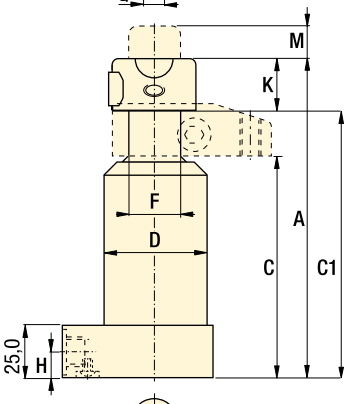


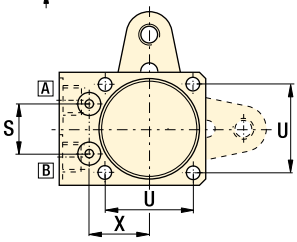


A = Clamping
B = Unclamping (venting)

-92, 202, 352







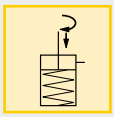
N	P	Q	R	S	T	U ø	V	X	Y	Z	kg	Right turning models
												Single acting ▼
15,5	24,5	M6 x 1	-	21,0	31,0	40,1	5,8	18,1	30°	60°	0,5	**SLRS-22**
19,1	40,0	M8 x 1,25	-	41,0	48,0	50,0	6,9	14,4	30°	60°	1,1	**SLRS-52**
26,4	45,1	M10 x 1,5	25,9	23,7	56,1	41,9	6,6	28,7	–	–	2,0	**SLRS-92**
25,1	51,4	0,375-16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

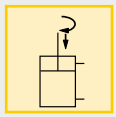
Force: 2,1 - 33,8 kN

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.

Swing clamps - Threaded body models

Shown: STRD-52, STRD-202

Cylinders can be threaded directly into fixture

...can be secured at any height

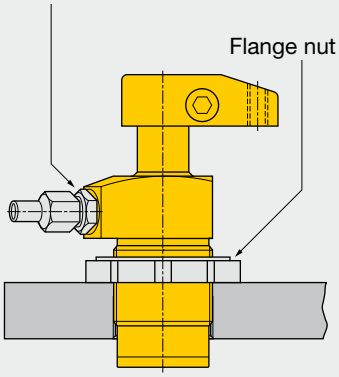
- Body thread for precise cylinder height positioning
- Threaded port connection
- Easy installation and removal
- Greatest flexibility in fixture design
- 30, 45 and 60 degree swing angles available on request

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).

BSPP 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.

Product selection

Clamping force[1] kN	Stroke mm Clamp	Stroke mm Total	Left turning 90°	Right turning 90°	Cylinder effective area cm² Clamp	Cylinder effective area cm² Un-clamp	Oil capacity cm³ Clamp	Oil capacity cm³ Un-clamp	Max. oil flow[1] l/min	Standard clamp arm Sold separately □32 ▶
▼ **Single acting**			**Model number** [2]							
2,1	8	16,5	**STLS-22**	**STRS-22**	0,77	–	1,31	–	0,2	**CAS-22**
4,9	10	22,6	**STLS-52**	**STRS-52**	1,81	–	4,10	–	0,4	**CAS-52**
8,0	12	23,0	**STLS-92**	**STRS-92**	3,16	–	6,88	–	1,0	**CAS-92**
10,7	13	27,7	**STLS-121**	**STRS-121**	4,06	–	11,47	–	1,6	**CAS-121**
17,4	14	29,5	**STLS-202**	**STRS-202**	7,10	–	19,99	–	2,3	**CAS-202**
33,1	16	32,6	**STLS-352**	**STRS-352**	12,39	–	37,20	–	3,9	**CAS-352**
▼ **Double acting**			**Model number** [2]							
2,2	8	16,5	**STLD-22**	**STRD-22**	0,77	1,55	1,31	2,46	0,2	**CAS-22**
5,6	10	22,6	**STLD-52**	**STRD-52**	1,81	3,81	4,10	8,52	0,4	**CAS-52**
9,0	12	23,0	**STLD-92**	**STRD-92**	3,16	8,06	6,88	17,70	1,0	**CAS-92**
11,6	13	27,7	**STLD-121**	**STRD-121**	4,06	7,94	11,47	22,94	1,6	**CAS-121**
18,7	14	29,5	**STLD-202**	**STRD-202**	7,10	15,16	19,99	42,61	2,3	**CAS-202**
33,8	16	32,6	**STLD-352**	**STRD-352**	12,39	23,74	37,20	71,28	3,9	**CAS-352**

[1] 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.

[2] 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 [⊕]

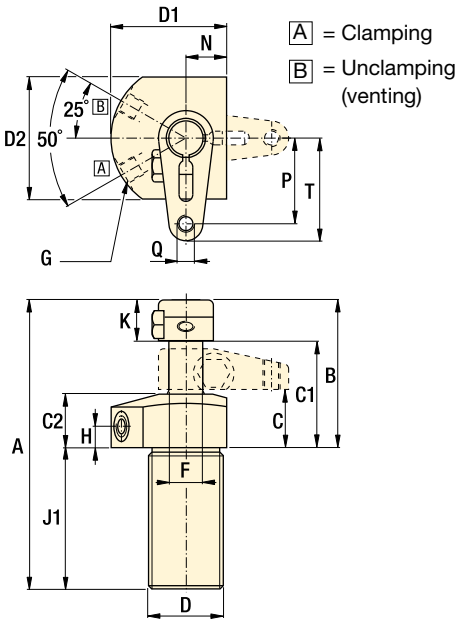
Left turning models	A	B	C	C1	C2	D Ø	D1	D2	F Ø	G	H	J1
▼ **Single acting**												
STLS-22	112	59	26,4	43,0	24,9	M28 x 1,5	39,4	33	10	G1/8"	10	–
STLS-52	135	69	27,4	50,1	24,9	M35 x 1,5	47,5	38	16	G1/8"	10	–
STLS-92	143	80	33,5	56,4	30,2	M48 x 1,5	62,5	48	25	G1/4"	13	43
STLS-121	171	86	27,7	55,3	25,4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

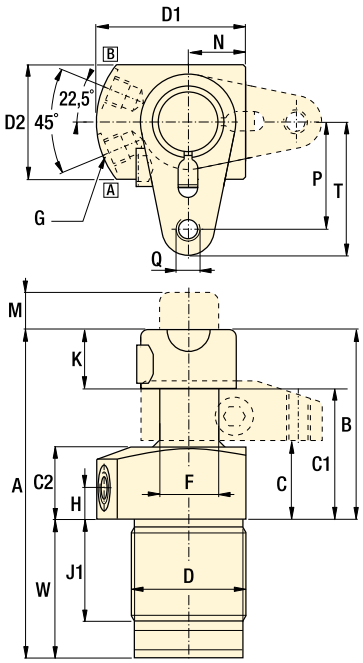
Accessory Chart

Model Nos. Left turning	Model Nos. Right turning	Mounting flange Sold Separately	Flange nut Sold Separately
▼ **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	kg	Right turning models
										Single acting ▼
16	–	15,5	24	M6 x 1	31	–	25°	50°	0,5	**STRS-22**
19	–	19,1	40	M8 x 1,25	48	–	25°	50°	1,1	**STRS-52**
25	15,5	23,9	45	M10 x 1,5	56	63,0	22.5°	45°	2,0	**STRS-92**
30	–	25,4	51	0.375-16 UNC	62	–	25°	50°	1,6	**STRS-121**
30	23,6	32,5	55	M12 x 1,75	70	71,9	22.5°	45°	3,2	**STRS-202**
40	27,9	39,9	68	M16 x 2	83	81,5	22.5°	45°	5,5	**STRS-352**
										Double acting ▼
16	–	15,5	24	M6 x 1	31	–	25°	50°	0,5	**STRD-22**
19	–	19,1	40	M8 x 1,25	48	–	25°	50°	1,1	**STRD-52**
25	–	23,9	45	M10 x 1,5	56	63,0	22.5°	45°	2,0	**STRD-92**
30	–	25,4	51	0.375-16 UNC	62	–	25°	50°	1,6	**STRD-121**
30	–	32,5	55	M12 x 1,75	70	71,9	22.5°	45°	3,5	**STRD-202**
40	–	39,9	68	M16 x 2	83	81,5	22.5°	45°	5,5	**STRD-352**

Force: 2,1 - 33,8 kN

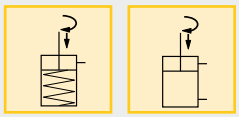
Stroke: 16,5 - 32,6 mm

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.

Swing clamps - Cartridge models

Shown: SCRD-122, SCRD-52

Eliminates the need for tubing and fittings

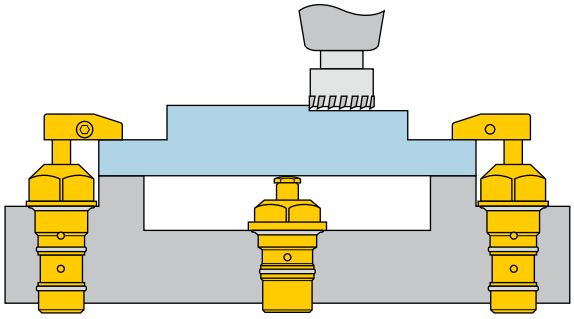
- Minimal space required on fixture
- Can be completely recessed in fixture
- External plumbing not required
- Allows close positioning of adjoining units
- 30, 45 and 60 degree swing angles available on request

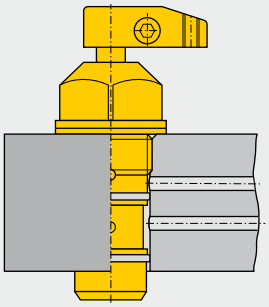
SC series

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.

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





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

Product selection

Clamping force[1] kN	Stroke mm Clamp	Stroke mm Total	Left turning	Right turning	Cylinder effective area cm² Clamp	Cylinder effective area cm² Un-clamp	Oil capacity cm³ Clamp	Oil capacity cm³ Un-clamp	Max. oil flow[1] l/min	Standard clamp arm Sold separately ▯32 ▸
▼ **Single acting**			**Model number** [2]							
2,1	8,1	16,8	**SCLS-22**	**SCRS-22**	0,77	-	1,31	-	0,2	**CAS-22**
4,9	9,9	22,6	**SCLS-52**	**SCRS-52**	1,81	-	4,09	-	0,4	**CAS-52**
10,7	12,7	27,7	**SCLS-122**	**SCRS-122**	4,06	-	11,47	-	1,6	**CAS-121**
▼ **Double acting**			**Model number** [2]							
2,2	8,1	16,8	**SCLD-22**	**SCRD-22**	0,77	1,55	1,31	2,49	0,2	**CAS-22**
5,6	9,9	22,6	**SCLD-52**	**SCRD-52**	1,81	3,81	4,09	8,52	0,4	**CAS-52**
11,6	12,7	27,7	**SCLD-122**	**SCRD-122**	4,06	7,94	11,47	22,94	1,6	**CAS-121**

[1] 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.

[2] For models with straight plunger movement, replace **L** or **R** with **S**.

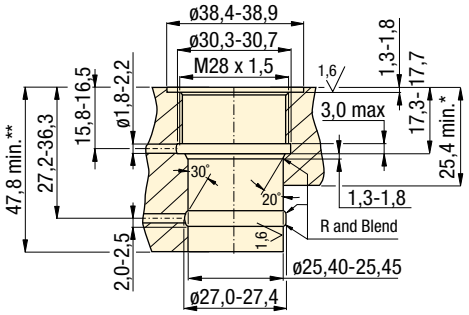
Dimensions in mm [⌖]

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

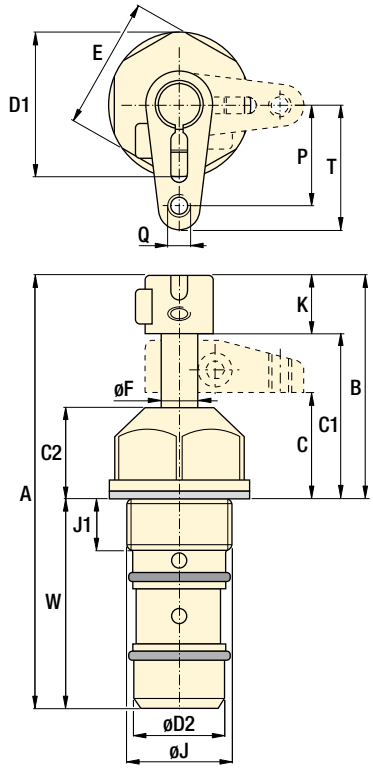
NOTE: dimensions shown with standard clamp arm.

Installation dimensions in mm

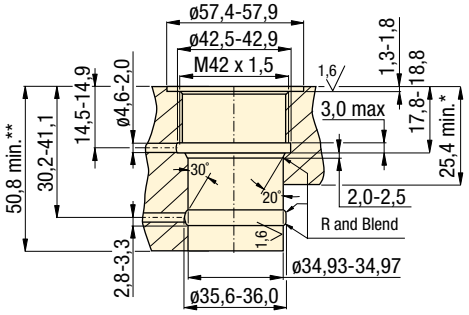
-22 models



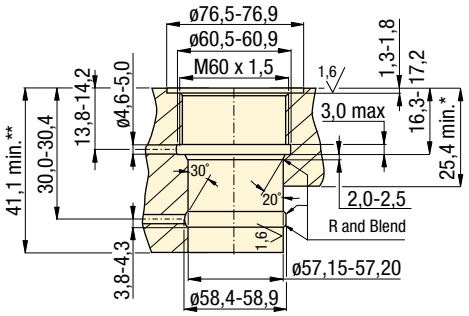
-22, 52, 122 models



-52 models



-122 models



* Minimum plate height for single-acting models.

** Minimum plate height for double-acting models.

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

Force: 2,1 - 11,6 kN

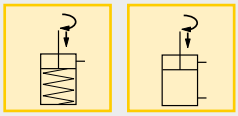
Stroke: 16,8 - 27,7 mm

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.

Clamp arms *for swing clamps*

Shown: CAS-122, CAL-122

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.

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		

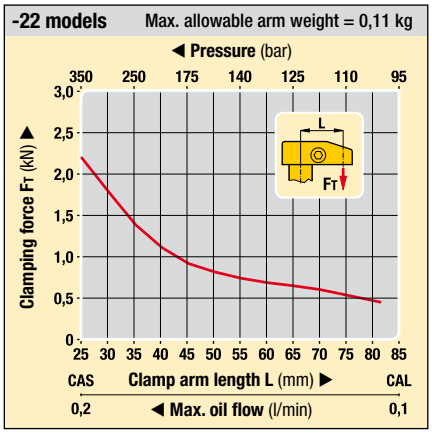
Example:

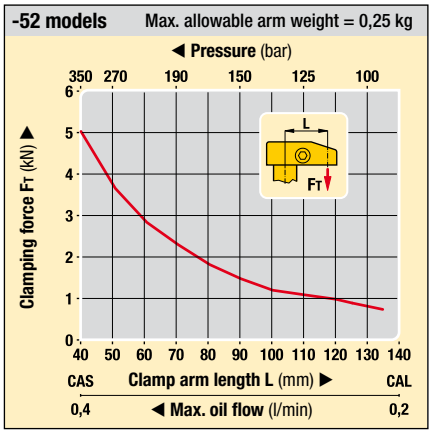
SP-12 45-186 converts a 11,6 kN swing cylinder to 45 degree rotation.

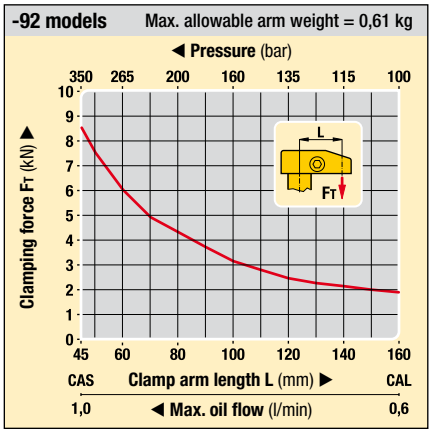
The addition of this spacer requires minor disassembly of the clamp. If you are uncomfortable doing this, please contact an authorized Enerpac Service Center.

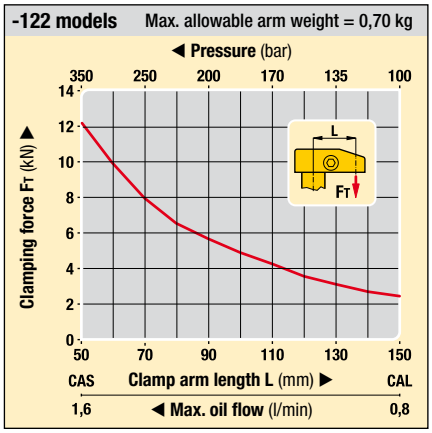
Pressure vs clamping force

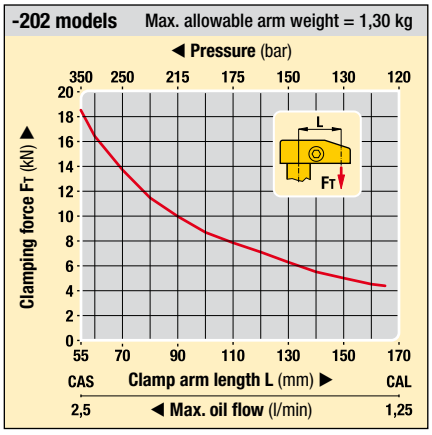
The use of different length clamp arms requires reduction in applied pressure and resulting clamp force. The charts below show this relationship.

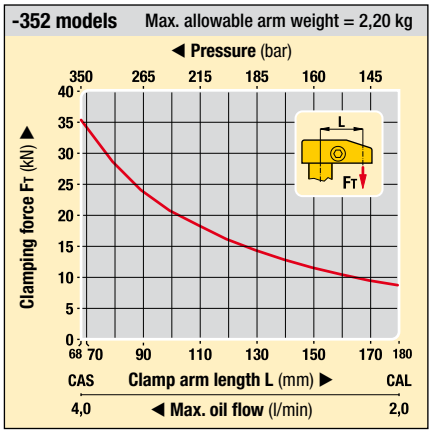




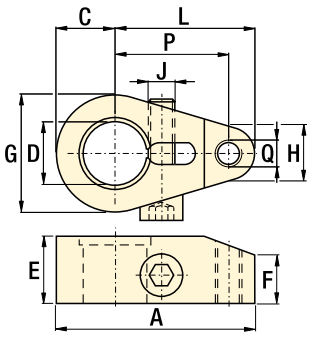




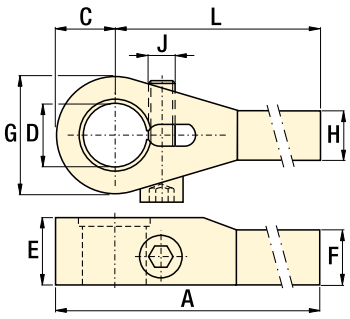




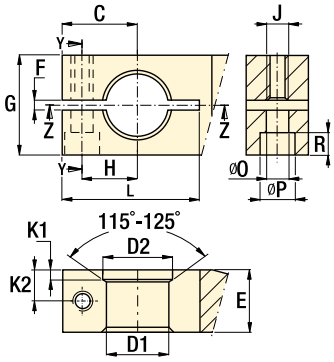
CAS models Standard clamp arms



CAL models Long clamp arms



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



Dimensions in mm [⊳◎]

Clamp. force kN	Model number	A	C	D ø	E	F	G ø	H	J	L	P	Q	kg
▼ **Standard clamp arms**													
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
▼ **Long clamp arms**													
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[1] ø	D2 ø	E	F	G	H	J	K1	K2	L	O ø	P ø	R
▼ **Custom design clamp arms**[2] (Recommended machining dimensions)														
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

[1] Surface roughness for D1 should be l,6 micro meters.
[2] 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

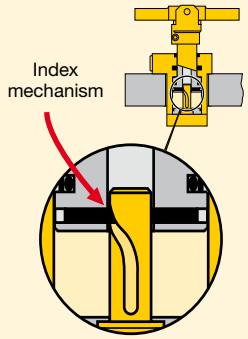
Gauges and accessories
190

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

Clamping two workpieces with one cylinder

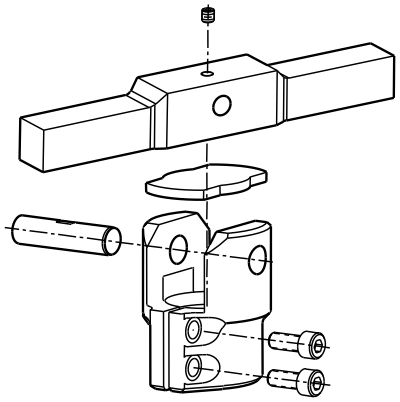
...quick and precise clamp arm positioning

- 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.

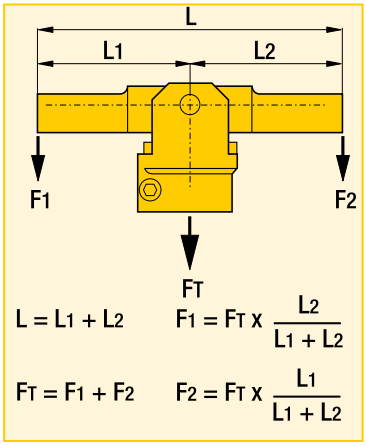
Clamp arms are used to transmit the force generated by the swing cylinder to the workpiece. The T-arm clamps two workpieces simultaneously with one swing cylinder. Enerpac recommends using the pivoting T-arms with double-acting swing clamps of the SU, SL, ST and SC-series.

Allowable flow vs arm length

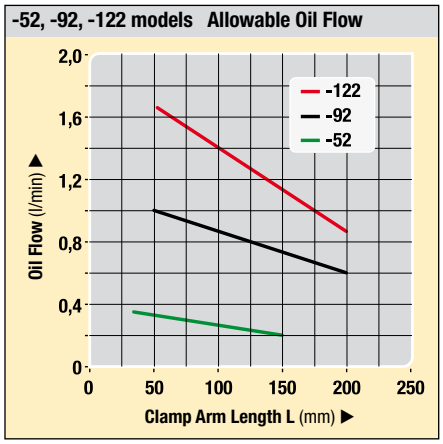
The distribution of the clamp arm force is based upon the length of the T-arm as measured from the pivoting point.

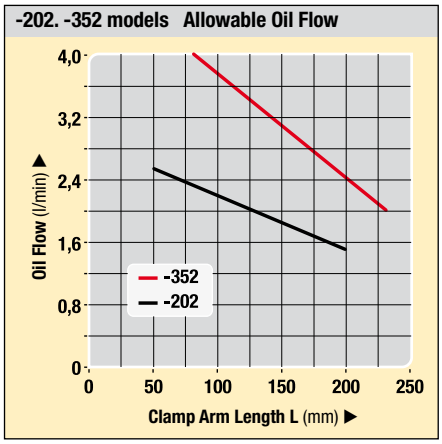


Important



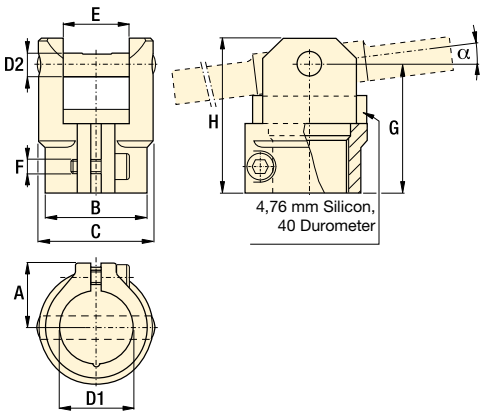
Two workpieces are clamped simultaneously with one double-acting swing cylinder by using the Enerpac pivoting T-arm.





Shown: CAC-202

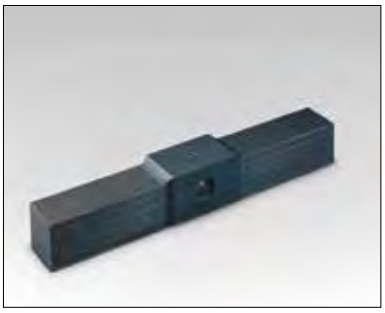
CA models **Collars for T-arms**



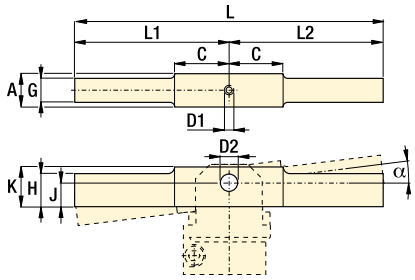
Collars - Dimensions in mm [⊳⊕]

Clamp. force kN	Model number	Max. tilt angle α	A	B	C	D1	D2	E	F	G	H	kg
									mm			
▼ **Collars for T-arms**												
5,6	**CAC-52**	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	**CAC-92**	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	**CAC-122**	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	**CAC-202**	10°	27,2	46,6	54,5	32,0	10,0	10,7	M6 x 1	51,2	63,0	0,4
33,8	**CAC-352**	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



CAPT models **T-arms** (for SU, SL, ST and SC swing clamps)



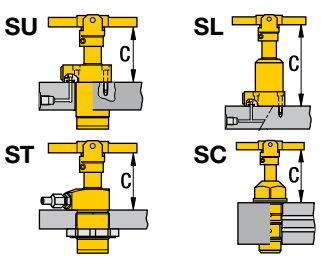
T-arms – Dimensions in mm [⊳⊕]

Clamp. force kN	Model number	A	C	D1*	D2	G	H	J	K	L	L1	L2	kg
▼ **Pivoting T-arms**													
5,6	**CAPT-52**	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	**CAPT-92**	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	**CAPT-122**	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	**CAPT-202**	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	**CAPT-352**	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
▼ **T-arm installation dimensions - Fully unclamped position**						
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

E **Brazos de amarre**

F **Bras de bridage**

D **Spannarme**

Options

Gauges and accessories 190

Flow control valves 155

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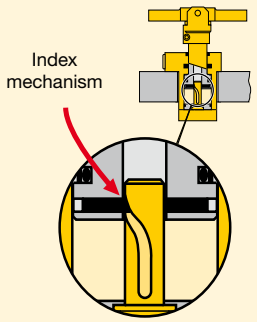
30, 45, and 60 degree rotations are available upon request.

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

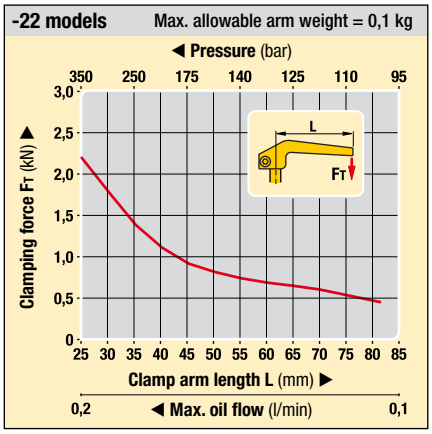
Enerpac's patented upreach clamp arm design attaches to the hydraulic swing cylinder, allowing parts to be clamped at various distances from the hydraulic cylinder. Clamp arms are available in an extended length which can be machined to fit your unique requirements.

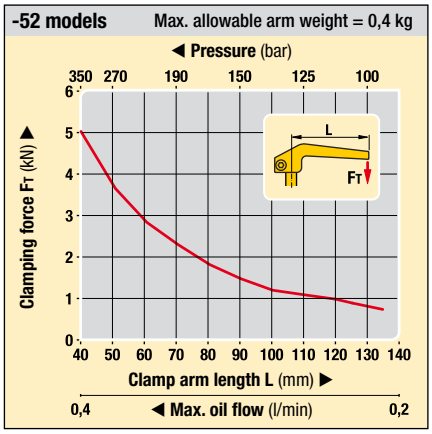
Patented Design

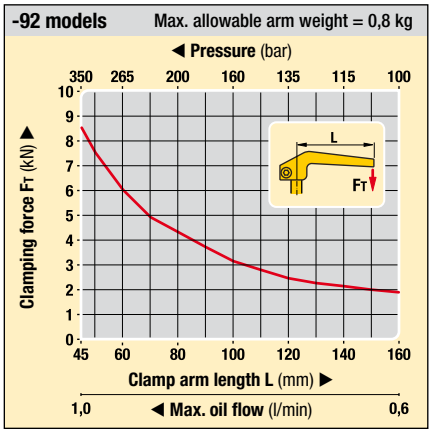
- Upreach design allows more flexible part clamping
- Arm can be easily installed and fastened while the cylinder is mounted in the fixture to allow exact arm positioning
- Vise not required for fastening arms
- Arm length can be cut to desired size
- Angled arm with minimal deflection achieves maximum workpiece contact.

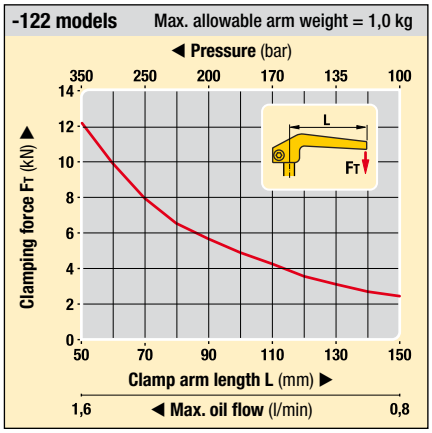
Pressure vs clamping force

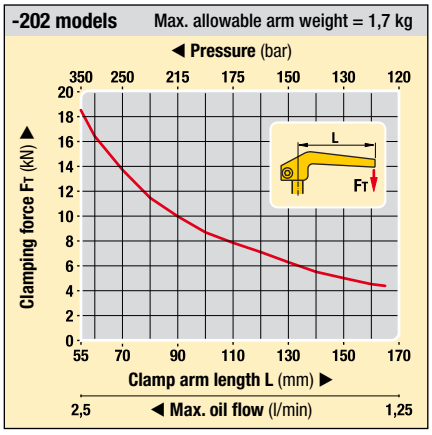
The use of different length clamp arms requires reduction in applied pressure and resulting clamp force. The charts below show this relationship.

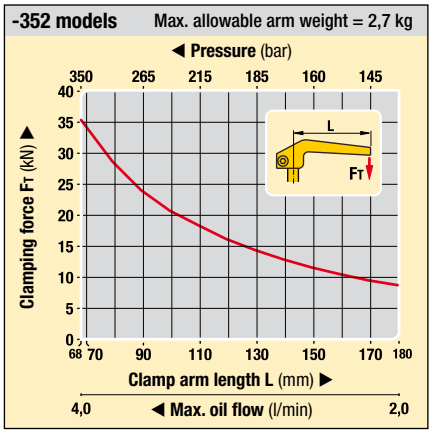








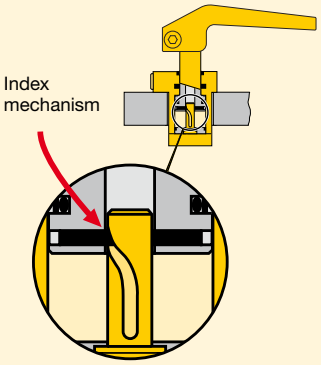




Important

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%.

Angled arms use deflection to improve clamping

Force: 0,4 - 33,8 kN

Pressure: 35 - 350 bar

E Brazos de amarre

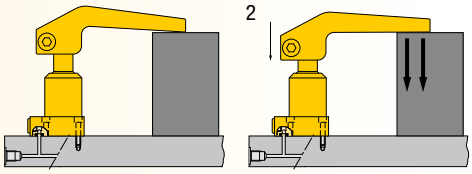
F Bras de bridage

D Spannarme

Angled arms

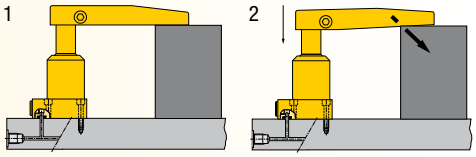
Tip engages part first and contact increases as clamping force is applied.

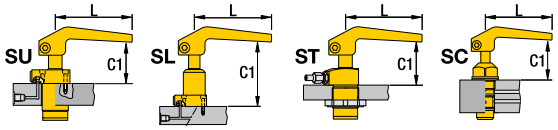
Eliminates “push” effect caused by straight arms deflecting under load.



Straight Arms

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





Options

Sequence valves 152 ▶

Flow control valves 155 ▶

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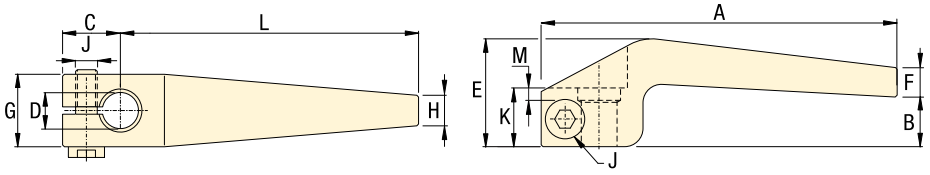
Installation dimensions in mm [⌲ ⌖]

Model number	Clamp force	L	SU-Series C1	SL-Series C1	ST-Series C1	SC-Series C1
▼ Stock length dimensions						
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	-
▼ Minimum length dimensions						
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 [⌲ ⌖]

Model number	A	B Std.	B Min.	C	D	E	F Std.	F Min.	G	H Std.	H Min.	J	K	L Std.	L Min.	M	kg
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.

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

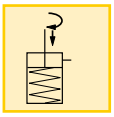
Stroke: 19,1 - 38,1 mm

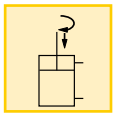
Pressure: 138 - 207 bar

(E) Cilindros giratorios

(F) Vérins de bridage pivotants

(D) Schwenkspannzylinder





Selection chart

Clamping force[1] kN	Stroke mm Clamp	Stroke mm Total	Model number	Cylinder effective area cm² Pull	Cylinder effective area cm² Push	Oil capacity cm³ Pull	Oil capacity cm³ Push
9,6	12,7	38,1	**SC-1**	6,3	11,4	24,1	43,4
2,2	6,4	19,1	**SC-3**	1,6	2,9	3,0	5,4

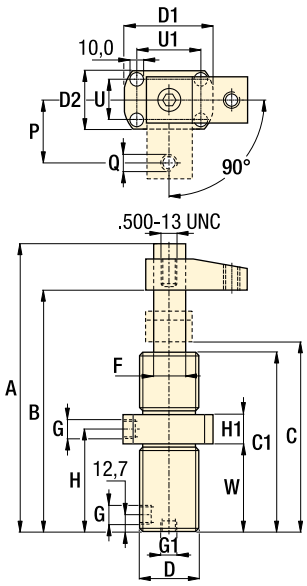
[1] With standard clamp arm (included with cylinder).

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

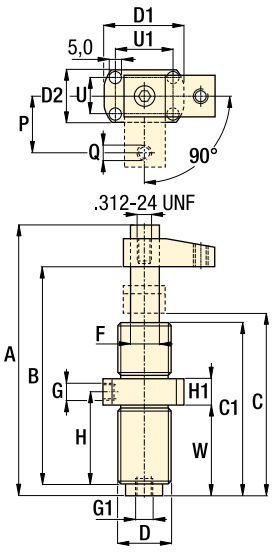
Arm length mm	Max. pressure bar	Clamping force kN
▼ **SC-1**		
–	207	11,7
51 [2]	207	9,6
76	207	8,7
102	207	7,7
127	166	5,3
152	138	3,7
▼ **SC-3**		
–	207	3,1
25 [2]	207	2,2
51	138	1,1

[2] Standard clamp arm (included).

SC-1



SC-3



Product dimensions in mm [⌀]

Model number	A	B	C	C1	D	D1	D2	F Ø	G NPT	G1 NPT	H	H1	P	Q UNC	U	U1	W	kg
SC-1	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
SC-3	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

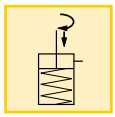
Stroke: 6,4 - 10,9 mm

Pressure: 80 - 170 bar

(E) **Cilindros giratorios**

(F) **Vérins de bridage pivotants**

(D) **Schwenkspannzylinder**



Adjustable clamping stroke

...turns clockwise or counter-clockwise

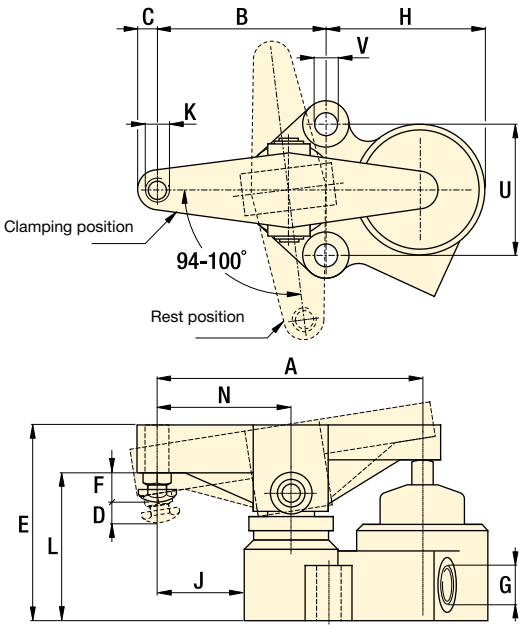
- Adjustable bolt in clamp arm for clamping stroke adjustment
- Low profile, ideal for limited space applications
- Quick swing action allows clamp arm to swing free of cutter and reclamp after it has passed
- 94-100° clamp arm swing arc.

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^2	cm^3	l/min	kg
6,1	6,4	**ASC-30**	80 - 170	3,5	4,9	1,9	2,7
19,5	10,9	**ASC-100**	80 - 170	11,4	20,0	1,9	8,2

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

Product dimensions in mm [⌲⌾]

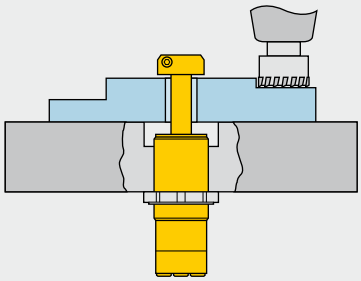
Model number	A	B	C	D	E	F	G	H	J	K	L	N	U	V
							NPT			UN				ø
ASC-30	127,0	85,9	12,7	6,4	88,9	19,1	.125-27	69,9	41,4	.500-13	69,9	63,5	63,5	10,4
ASC-100	177,8	114,3	13,5	10,9	133,4	18,5	.125-27	108	57,2	.500-13	101,6	88,9	88,9	16,0

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.

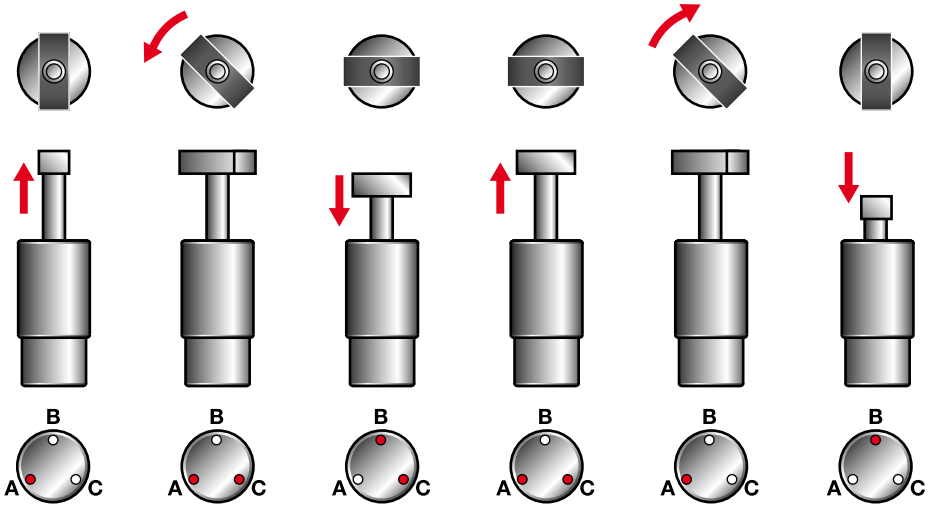


Unobstructed part loading

- 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° flat rotation.

Step 6
Pressurize port B.
Plunger retracts through workpiece.

Selection chart

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

[1] When using optional CA-28 clamp arm, max. operating pressure is 138 bar.
[2] Standard clamp arm included.
* This product is made to order. Please contact Enerpac for delivery information before specifying in your design.

Force: 8,7 - 22,2 kN

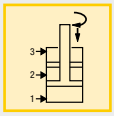
Stroke: 63,5 mm

Pressure: 140 - 350 bar

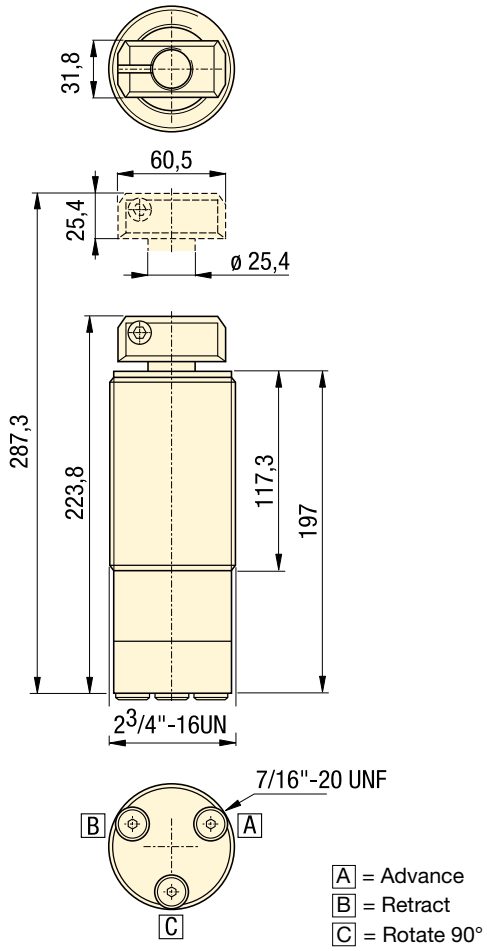
E Cilindros giratorios

F Vérins de bridage pivotants

D Schwenkspannzylinder



WTR-24



Options

High pressure filters 193 ▶

Fittings 194 ▶

Valves 136 ▶

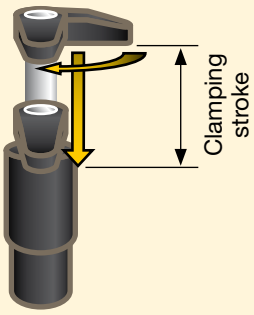
Important

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

Do not exceed maximum pressure and flow rates.

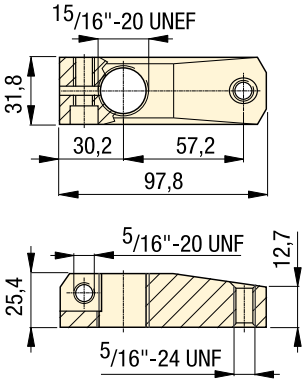
For recommended valving schemes, please refer to page 42.

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



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.



WTR-series schematics

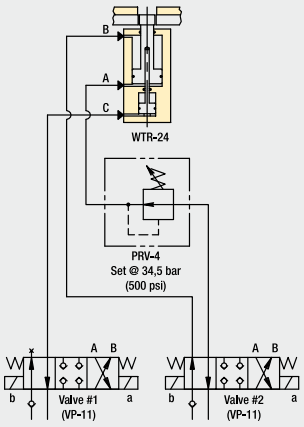
Important

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.

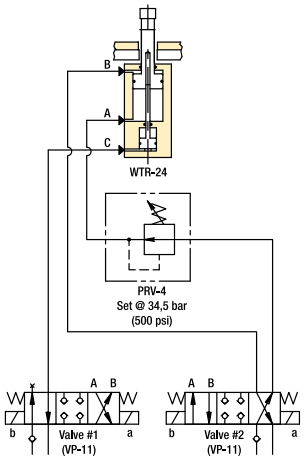
Recommended valving system for WTR-24

- 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.

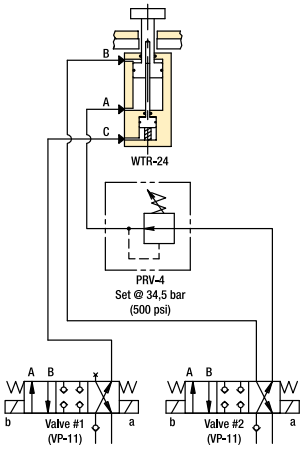
Home Position (Power Off)



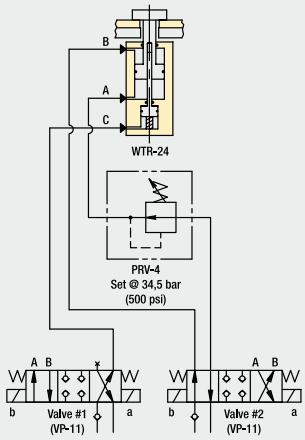
Extend



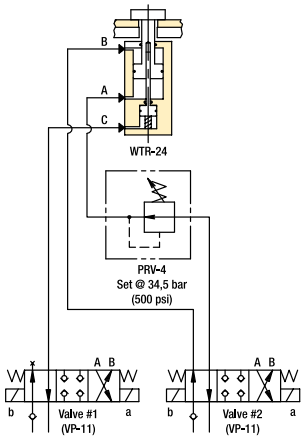
90° Flat Rotation



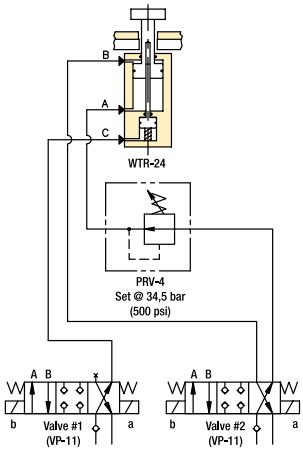
Clamp



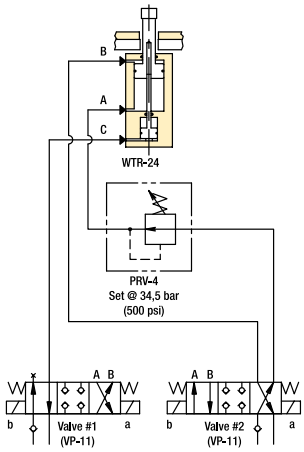
Clamp Hold



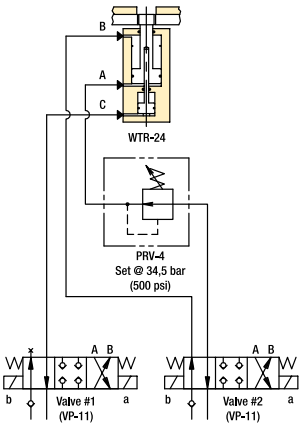
Unclamp



-90° Flat Rotation



Home Position



Work supports

Work Supports

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

Technical support

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

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

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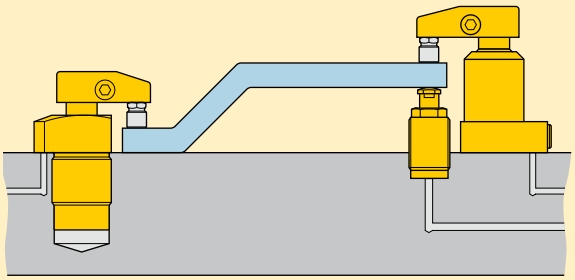
Work supports *Application & Selection*

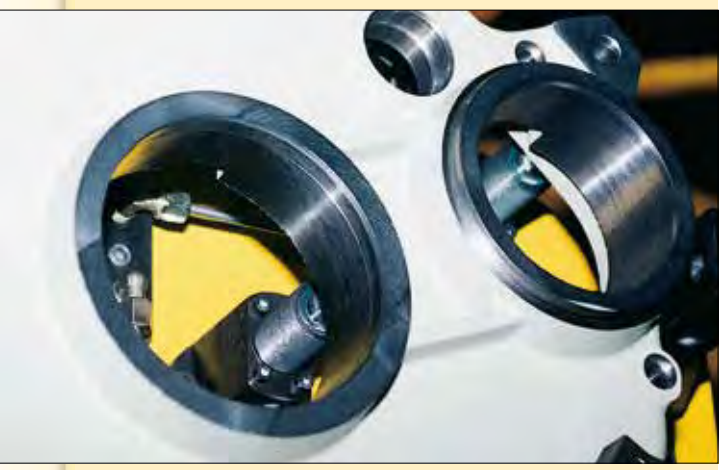
Shown: WFL-112, WFC-72, WFL-442

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.



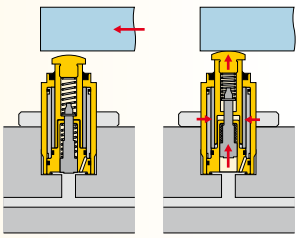
Wide range of sizes and types to efficiently support workpiece

- 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

Select your work support method:

WF series, Hydraulic advance

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



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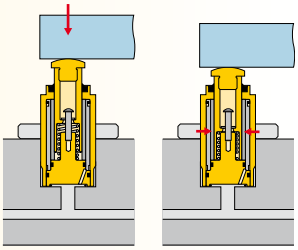
WS series, Spring advance

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



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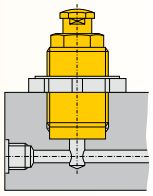
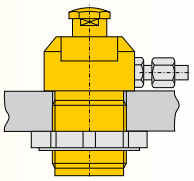
Select your mounting method:

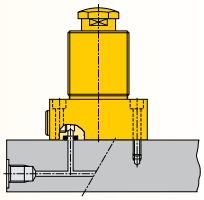
Manifold mount
- Does not require external plumbing
- Compact design, when space is at a premium
- Internal plunger thread for optional contacts



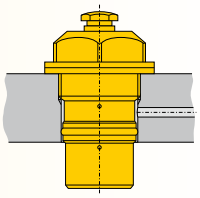
Threaded body
- Ability to adjust height
- Plumbed from either side or bottom
- Internal plunger thread for optional contacts



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



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



Product selection

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

Force: 7,3 - 44,5 kN

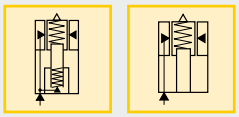
Stroke: 9,1 - 16,8 mm

Pressure: 48 -3 50 bar

(E) Cilindros de soporte

(F) Vérin anti-vibreur

(D) Abstützzylinder



Options

Swing cylinders 22 ▶

Accessories 86 ▶

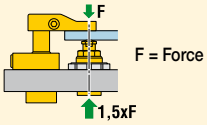
In-line filters 193 ▶

Sequence valves 152 ▶

Important

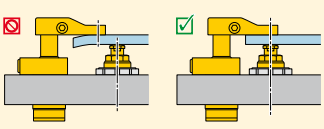
WARNING!

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

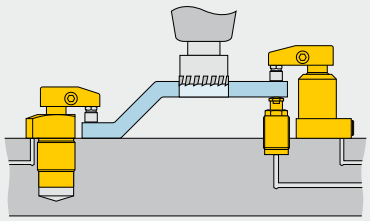
Shown: WFM-72, WFL-112

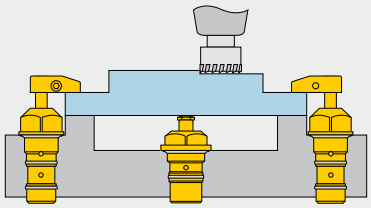
For unobstructed part loading

- 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

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.



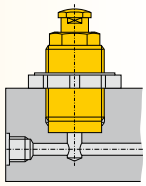


In order to load the workpiece sideways over the work supports, hydraulic advanced models are being used.

Four mounting styles

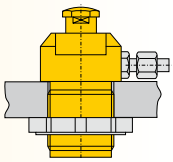
WFM series, Manifold models

Eliminates the need for fittings and tubing on the fixture.



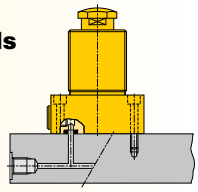
WFT series, Threaded models

Offers the flexibility of side or bottom porting.



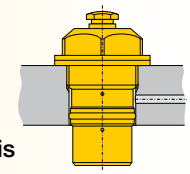
WFL series, Lower flange models

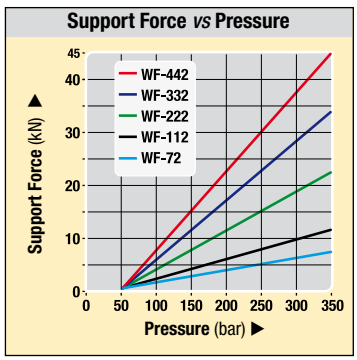
Plumbed directly – no fixture hole required.

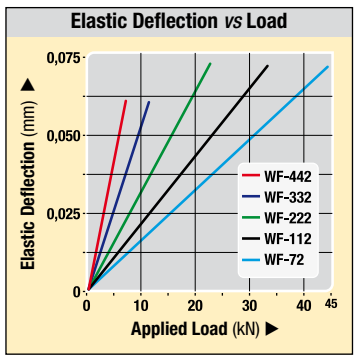


WFC series, Cartridge models

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

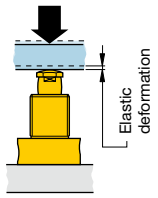






Deflection chart:

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

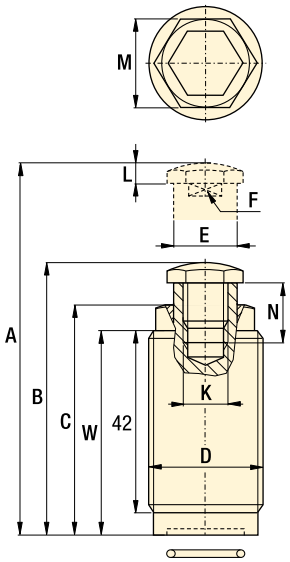


Product selection

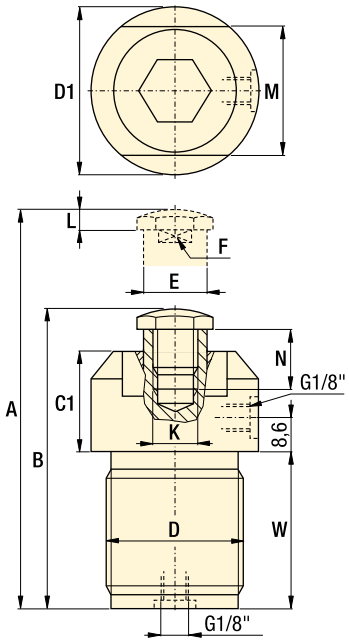
Max. support force	Support plunger stroke	Manifold mount	Threaded body	Lower flange	Cartridge style	Operating pressure		Plunger contact spring force		Oil capacity	Max. oil flow
						bar		N			
kN	mm					min.	max.	ext.	retr.	cm³	l/min
7,3	9,9	**WFM-72**	–	–		48	350	8,9	25,8	0,66	0,7
7,3	10,2	–	**WFT-72**	–	–	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.

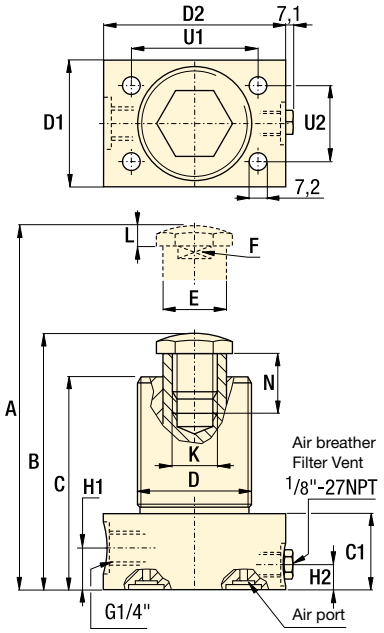
WFM series



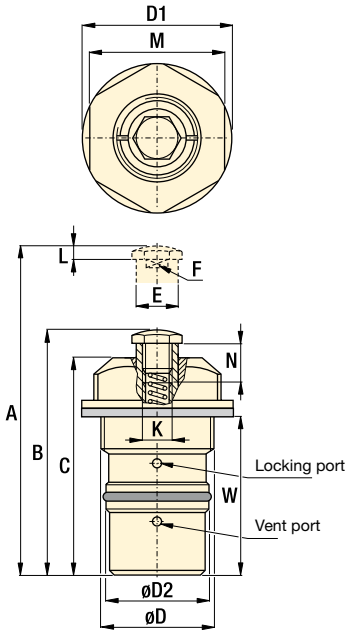
WFT series



WFL series



WFC series

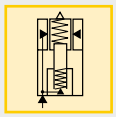


Force: 7,3 - 44,5 kN

Stroke: 9,1 - 16,5 mm

Pressure: 50 - 350 bar

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



Options

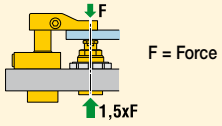
Accessories 86

In-line filters 193

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 [⊳◎]

Mounting dimensions 50

Model number	Capacity	A	B	C	C1	D	D1	D2	E	F	H1	H2	K	L	M	N**	U1	U2	W	kg
	kN								Ø											
WFM-72	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
WFT-72	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
WFL-112	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
WFL-222	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
WFL-332	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
WFL-442*	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
WFC-72	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
WFC-112	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
WFC-222	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 (50).

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Work supports - Spring advance

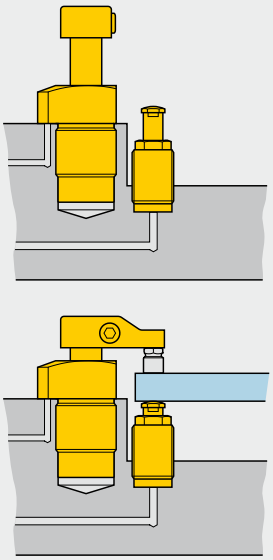
Shown: WSL-112, WSM-72

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

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.

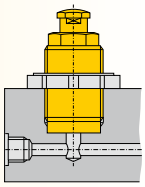


Spring advance work supports with extended plungers, waiting for the next workpiece.

Mounting style

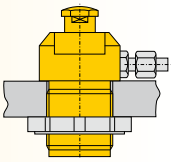
WSM series, Manifold mount

Eliminates the need for fittings and tubing on the fixture.



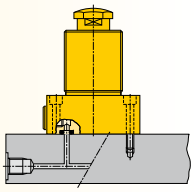
WST series, Threaded body

Offers the flexibility of side or bottom porting.



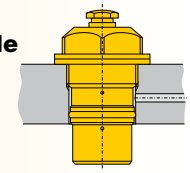
WSL series, Lower flange

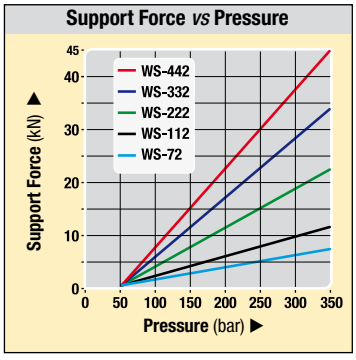
Plumbed directly – no fixture hole required.

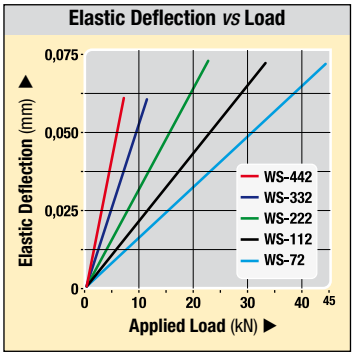


WSC series, Cartridge mount style

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

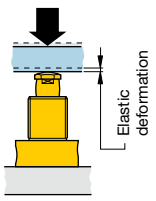






Deflection chart:

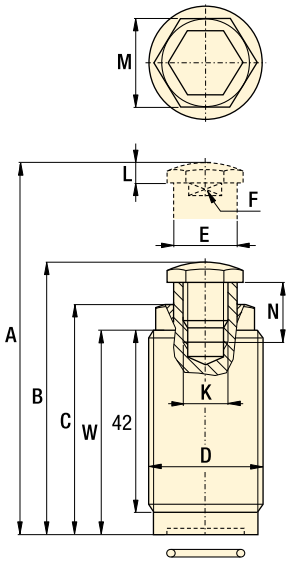
Elastic deformation of the work support resulting from the application of load.



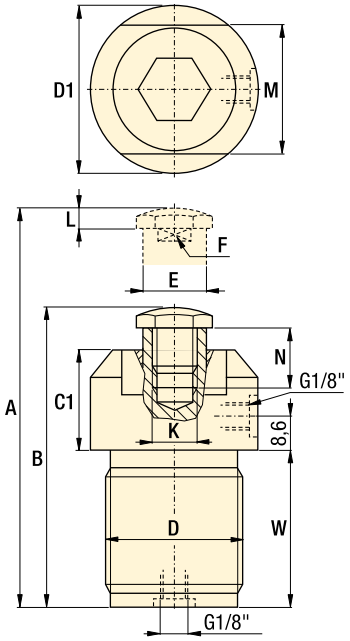
Product selection

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
						bar		N			
kN	mm					min.	max.	ext.	retr.	cm³	l/min
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

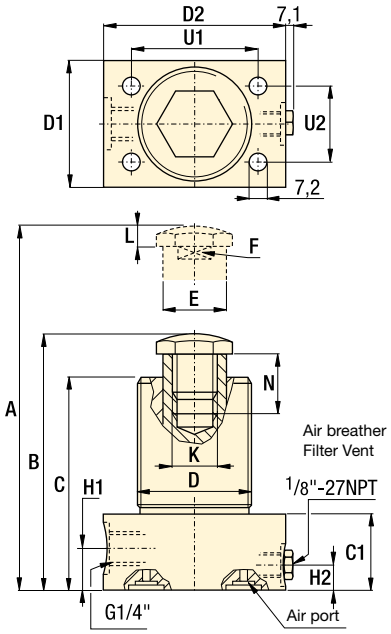
WSM series



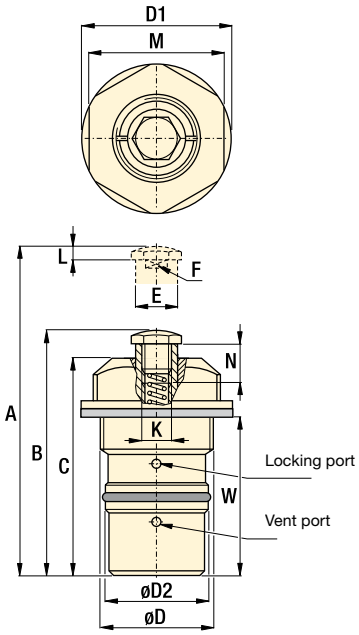
WST series



WSL series



WSC series



Force: 7,3 - 44,5 kN

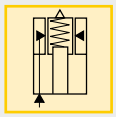
Stroke: 9,7 - 16,8 mm

Pressure: 50 - 350 bar

E Cilindros de soporte

F Vérin anti-vibreur

D Abstützzylinder



Options

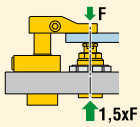
Accessories 86

In-line filters 193

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 [⊳⊕]

Mounting dimensions 50

Model number	Capacity kN	A	B	C	C1	D	D1	D2	EØ	F	H1	H2	K	L	M	N**	U1	U2	W	kg
WSM-72	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
WST-72	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
WSL-112	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
WSL-222	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
WSL-332	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
WSL-442*	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
WSC-72	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
WSC-112	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
WSC-222	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).

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Mounting dimensions *for work supports*

Shown: WFL-112 holding a casting in place.

Mounting work supports

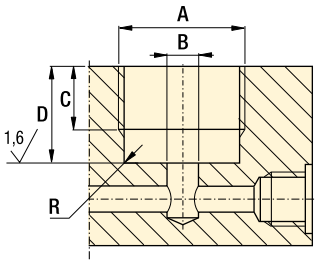
Enerpac work supports are offered in a wide variety of mounting styles. Dimensions for fixture holes and cavity preparation are specified for each mounting style separately.

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.

WFM, WSM



Product dimensions in mm [⌖]

Model number	A	B ø	C	D	R	Manifold O-ring [1]	Flange nut
▼ For manifold mount work supports							
WFM-72	M30 x 1,5	9,4-9,9	13,2-13,7	18,8-19,3	0,4	ARP-017	FN-302
WSM-72	M30 x 1,5	9,4-9,9	13,2-13,7	18,8-19,3	0,4	ARP-017	FN-302

[1] Polyurethane 92 duro.

Threaded work support mounting dimensions

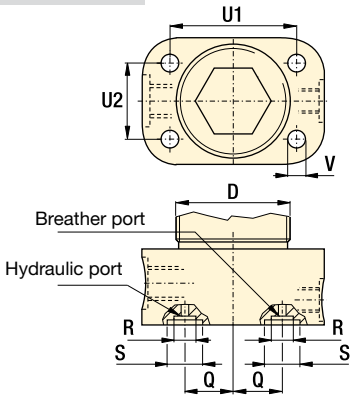
Threaded body work supports can be mounted directly into a fixture. The thread size (D) can be found in the dimension charts on ⍁47 (WFT) and ⍁49 (WST models). Use a flange nut to secure your threaded work support in the required position.

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.

WFL/WSL series



Product dimensions in mm [⌖]

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

[1] Polyurethane 92 duro.

Force: 7,3 - 44,5 kN

Stroke: 9,7 - 16,8 mm

Pressure: 48 - 350 bar

(E) Cilindros de soporte

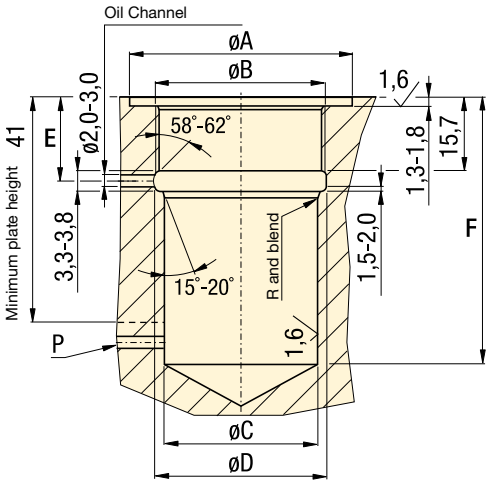
(F) Vérin anti-vibreur

(D) Abstützzylinder

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 min	Ventilation below force required
▼ **Hydraulic advance**							
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
▼ **Spring advance**							
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.

Options

Accessories 86 ▶

In-line filters 193 ▶

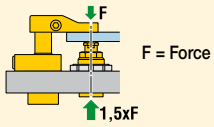
Fittings 194 ▶

Swing cylinders 22 ▶

Important

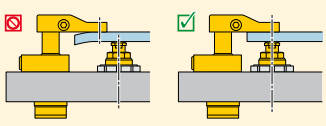
WARNING!

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



Do not exceed maximum flow rates to avoid premature lockup.

Always center load over work support.



Linear cylinders

Linear Cylinders

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

Technical support

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

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

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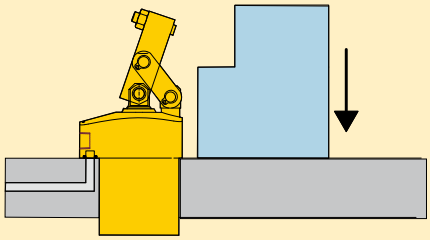
Link clamps *Application & selection*

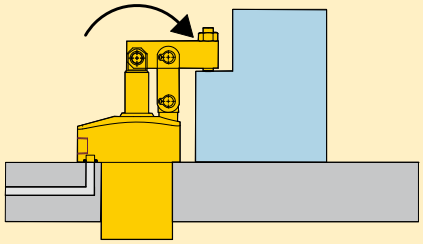
Shown: LUCS-32

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

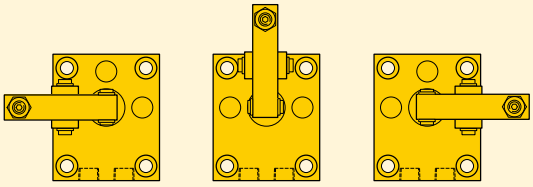
Arm completely retracts to allow part loading.



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



Arm location is changed easily without the use of tools.



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[1] kN	Stroke mm	Model number	Cylinder effective area cm²	Oil capacity cm³	Standard clamp arm (Sold separately)	Long clamp arm (Sold separately)
▼ **Single acting**						
2,9	18,5	**LUCS-32**	1,23	2,27	**LCAS-32**	**LCAL-32**
7,8	23,4	**LUCS-82**	3,10	7,28	**LCAS-82**	**LCAL-82**
11,8	29,7	**LUCS-122**	4,13	12,59	**LCAS-122**	**LCAL-122**
18,7	34,5	**LUCS-192**	6,39	22,67	**LCAS-192**	**LCAL-192**
27,2	44,7	**LUCS-282***	9,61	45,18	**LCAS-282**	**LCAL-282**
▼ **Double acting**						
3	18,5	**LUCD-32**	1,23	2,27	**LCAS-32**	**LCAL-32**
8	23,5	**LUCD-82**	3,10	7,28	**LCAS-82**	**LCAL-82**
12	29,7	**LUCD-122**	4,13	12,59	**LCAS-122**	**LCAL-122**
19	34,5	**LUCD-192**	6,39	22,67	**LCAS-192**	**LCAL-192**
28	44,7	**LUCD-282***	9,61	45,18	**LCAS-282**	**LCAL-282**

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

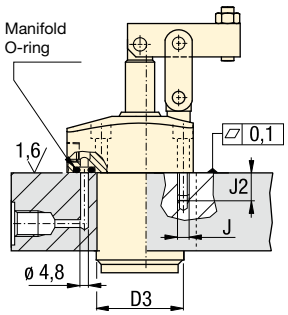
Contact Enerpac for models with imperial threads and SAE ports.
* This product is made to order. Please contact Enerpac for delivery information before specifying in your design.

Installation dimensions in mm

Clamp[1] force kN	Fixture hole Ø D3	Mounting thread J	Min. depth J2	Manifold O-ring[2] 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

[1] With standard clamp arm.
[2] Polyurethane, 92 Durometer

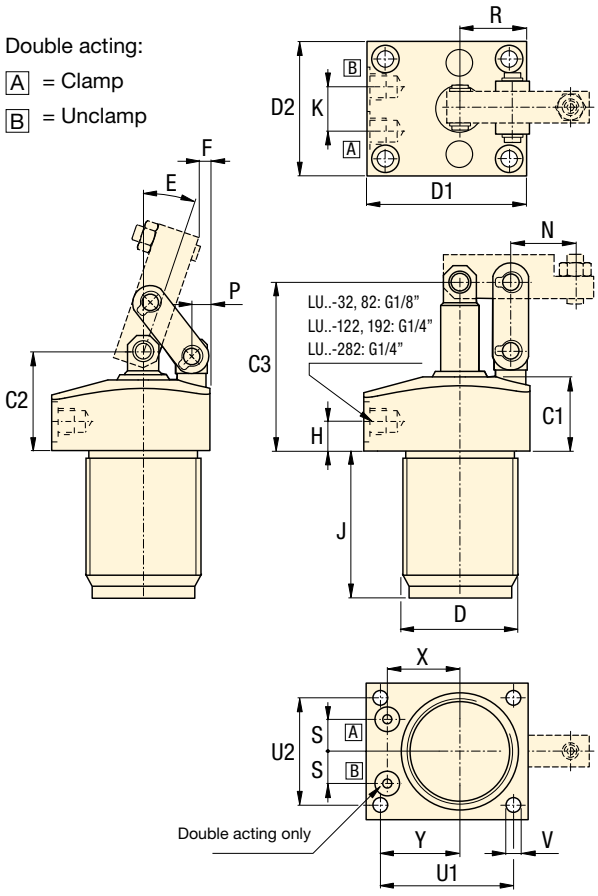
Note: Mounting bolts and O-rings included.



all models

Dimensions shown with standard clamp arm.

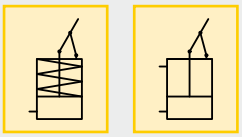
Double acting:
A = Clamp
B = Unclamp



F	H	J	K	N	P	R	S	U1	U2	V Ø	X	Y	kg
													Single acting ▼
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
													Double acting ▼
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

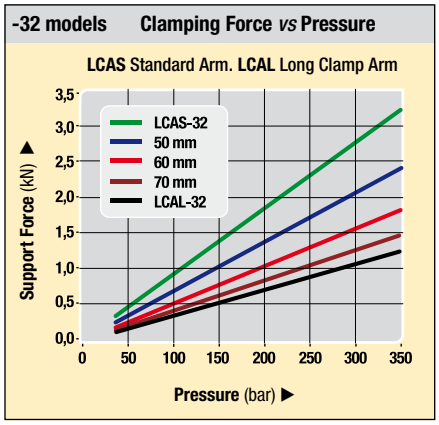
Standard arms are readily available from Enerpac to meet most applications. In applications that require a custom designed arm, the machining information is supplied on page 57.

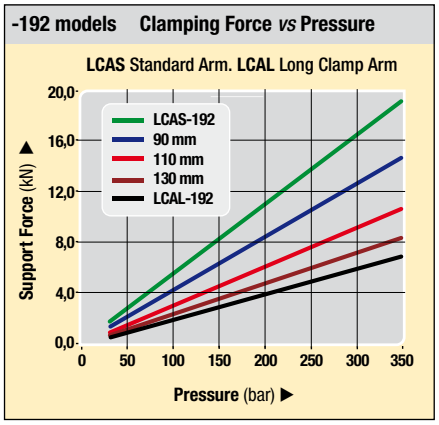
Standard or custom built

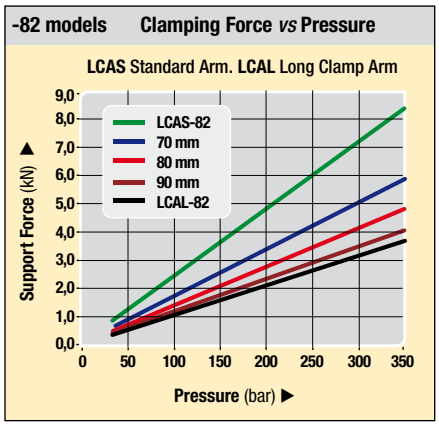
- Available from Enerpac in standard or extended length
- Standard arm includes set screw and lock nut
- Long arm is machinable
- Make your own custom arm to suit specific applications.

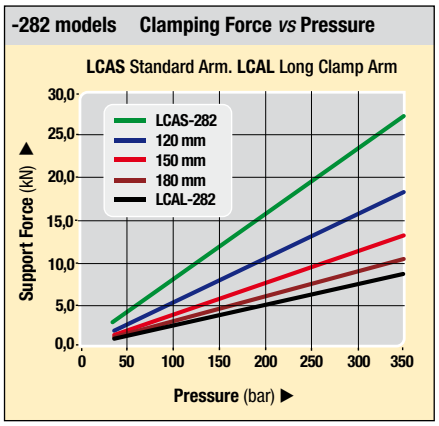
Pressure vs clamping force

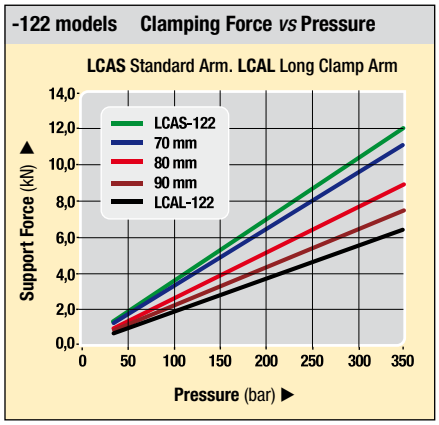
Different length clamp arms will determine the amount of clamping force transferred to the workpiece. As the length increases, the clamping force decreases.







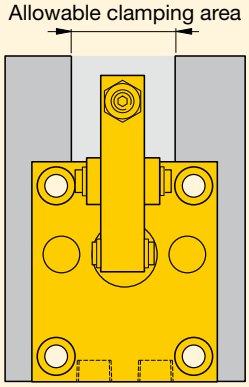




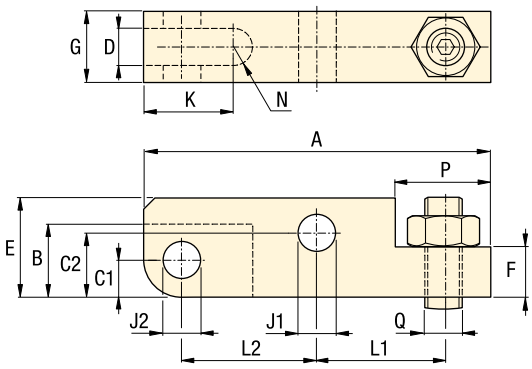
Important

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



LCAS models Standard Arm

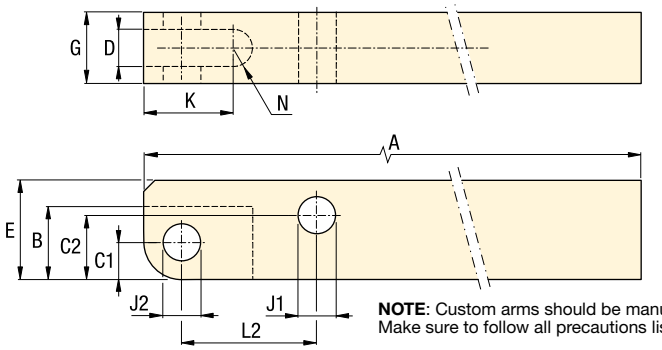


Dimensions in mm [ ]

Clamp capacity kN	Model number	A	B	C1	C2	D	E	F	G
▼ Standard clamp arms									
3	**LCAS-32**	54,0	13,0	6	9,5	6	16	8	11,85
8	**LCAS-82**	74,5	17,5	8	15,5	10	25	13	18,85
12	**LCAS-122**	87,5	22,0	10	19,5	11	32	16	21,85
19	**LCAS-192**	102,5	26,0	11	24,0	13	38	22	24,85
28	**LCAS-282**	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	**LCAS-32**	6,02-6,07	6,02-6,07	13	23,5	18,5	3	13	M6 x 1,0
8	**LCAS-82**	10,05-10,10	8,05-8,10	16	32,0	24,5	5	22	M10 x 1,5
12	**LCAS-122**	12,05-12,10	10,05-10,10	20	37,5	30,0	5,5	25	M12 x 1,75
19	**LCAS-192**	15,05-15,10	12,05-12,10	24	41,5	36,0	6,5	31	M16 x 2,0
28	**LCAS-282**	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	**LCAL-32**	85	13,0	6	9,50	6	16	11,85	6,02-6,07	6,02-6,07	13	18,5	3,0
8	**LCAL-82**	105	17,5	8	15,50	10	25	18,85	10,05-10,10	8,05-8,10	16	24,5	5,0
12	**LCAL-122**	110	22,0	10	19,50	11	32	21,85	12,05-12,10	10,05-10,10	20	30,0	5,5
19	**LCAL-192**	160	26,0	11	24,00	13	38	24,85	15,05-15,10	12,05-12,10	24	36,0	6,5
28	**LCAL-282**	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

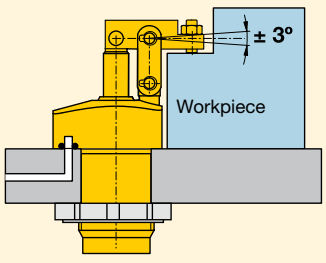
Options

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

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.

Pull cylinders

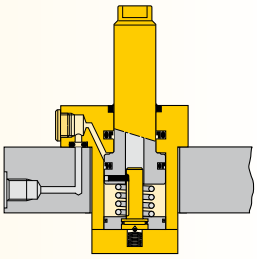
Hydraulic pull cylinders utilize hydraulic pressure to hold down parts in a fixture. The guided plunger maintains orientation during the full clamping cycle, eliminating the need for an external guide. Internally threaded plunger ends accept various custom attachments to assist in the clamping process.

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.

Select your pull cylinder type:

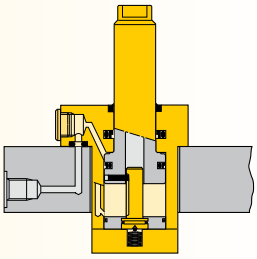
Single acting

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

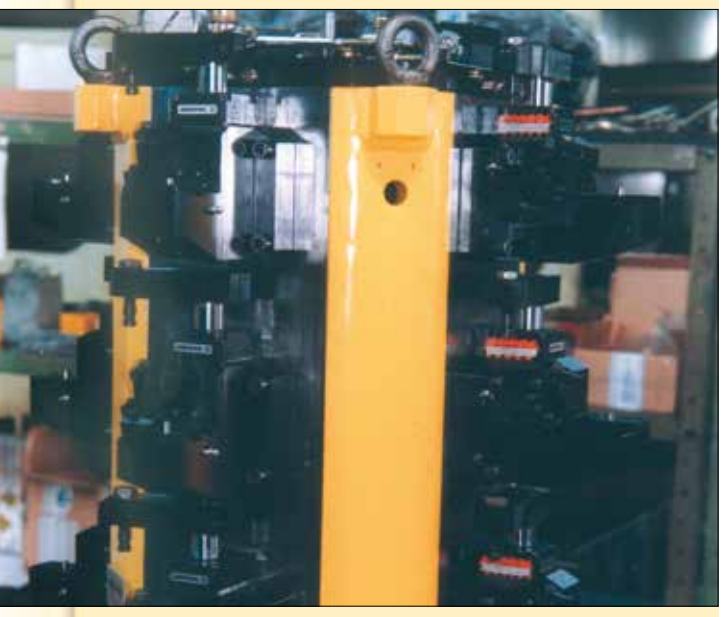


Double acting

- 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.



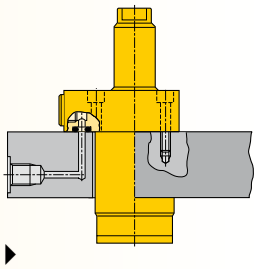
Hydraulic fixture with pull and swing cylinders, manifold and threaded cylinders for positioning and holding the work piece during milling process of gun breeches.



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.



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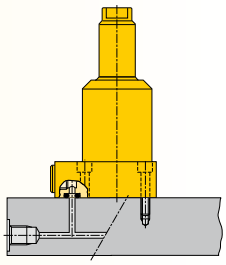
PL series, Lower flange mounting

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



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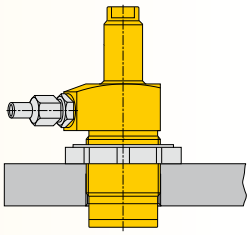
PT series, Threaded body mounting

- 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.



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Product selection

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

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

Pull force: 5,6 - 43,5 kN

Push force: 13,3 - 81,9 kN

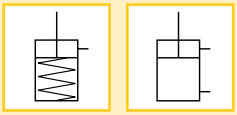
Stroke: 22,1 - 30,5 mm

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

Minimal mounting height

...when space is at a premium

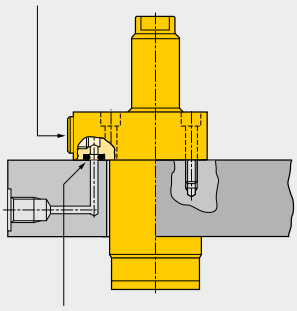
- Guided linear plunger movement
- Flexible design allows for manifold or threaded port connection
- Low profile mounting style allows body to be below mounting surface
- Internal plunger thread allows easy mounting of attachments
- Simple mounting preparation
- Easy to machine fixture hole: does not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

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

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

Product selection

Cylinder capacity kN Pull	Cylinder capacity kN Push	Stroke mm	Model number	Cylinder effective area cm² Pull	Cylinder effective area cm² Push	Oil capacity cm³ Pull	Oil capacity cm³ Push
▼ Single acting							
5,6	–	22,6	**PUSS-52**	1,81	–	4,10	–
13,3	–	27,9	**PUSS-121**	4,06	–	11,47	–
▼ Double acting							
6,3	13,3	22,6	**PUSD-52**	1,81	3,81	4,10	8,69
11,2	28,0	22,1	**PUSD-92**	3,16	8,06	6,88	17,70
14,3	27,4	27,9	**PUSD-121**	4.06	7,94	11,47	22,94
43,5	81,9	30,5	**PUSD-352**	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.

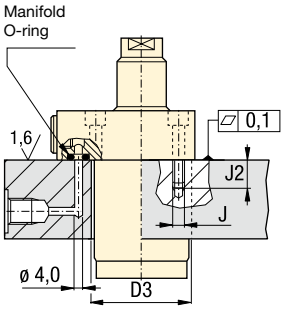
Dimensions in mm [⌲]

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

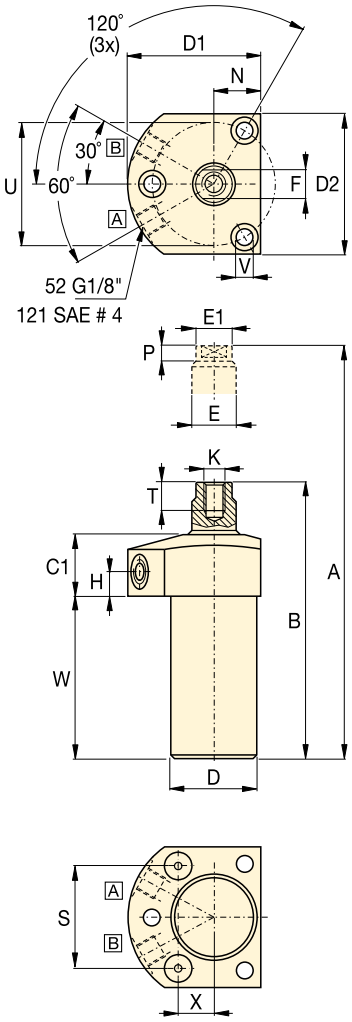
Installation dimensions in mm

Pull force kN	Fixture hole Ø D3	Mounting thread J	Min. depth J2	Manifold O-ring [1] 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

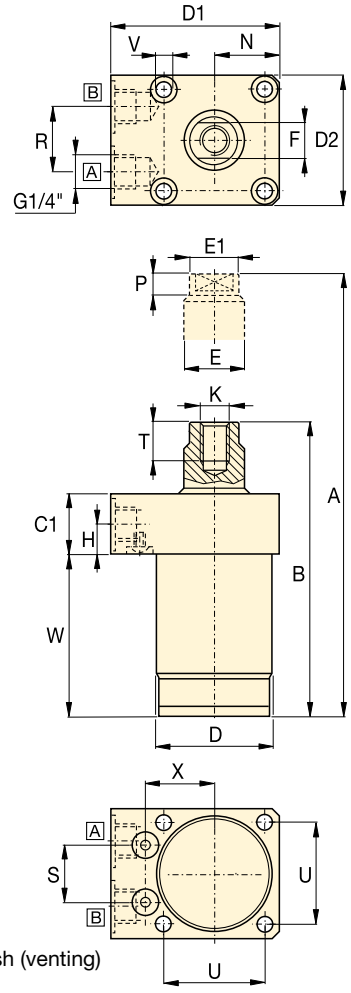
[1] O-ring material: polyurethane, 92 Durometer



-52, 121



-92, -352



A = Pull
B = Push (venting)

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

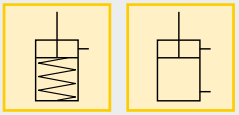
Pull force: 5,6 - 43,5 kN

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.

Pull cylinders - Lower flange models

Shown: PLSS-52, PLSS-121

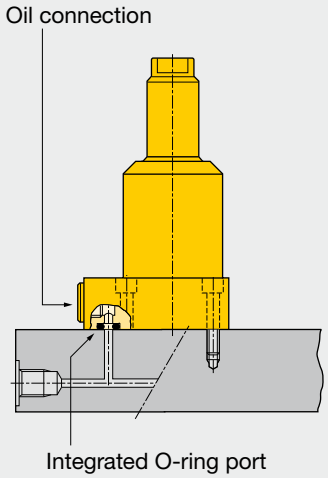
Minimal mounting height

...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.

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.



Product selection

Cylinder capacity kN Pull	Cylinder capacity kN Push	Stroke mm	Model number	Cylinder effective area cm² Pull	Cylinder effective area cm² Push	Oil capacity cm³ Pull	Oil capacity cm³ Push
▼ **Single acting**							
5,6	–	22,6	**PLSS-52**	1,81	–	4,10	–
13,3	–	27,9	**PLSS-121**	4,06	–	11,47	–
▼ **Double acting**							
6,3	13,3	22,6	**PLSD-52**	1,81	3,81	4,10	8,69
11,2	28,0	22,1	**PLSD-92**	3,16	8,06	6,88	17,70
14,3	27,4	27,9	**PLSD-121**	4,06	7,94	11,47	22,94
43,5	81,9	30,5	**PLSD-352**	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.

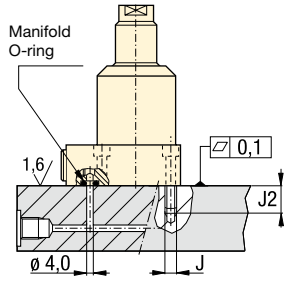
Dimensions in mm [⌯ ◎]

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

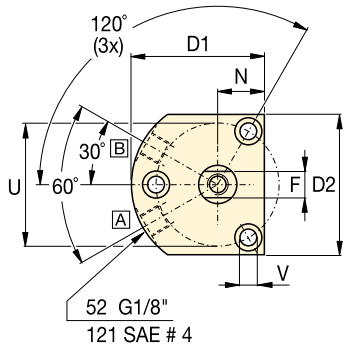
Installation dimensions in mm

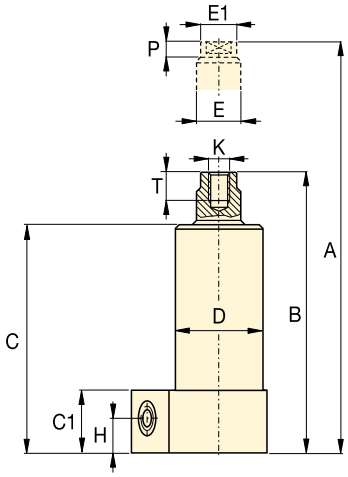
Pull force kN	Mounting thread J	Minimum depth J2	Manifold O-ring [1] ARP numbers or inside Ø x thickness
6,3	M6 x 1	16,5	568-011
11,2	M6 x 1	15,0	4,32 x 3,53
14,3	M8 x 1	20,3	568-011
14,5	M10 x 1,25	18,8	4,32 x 3,53

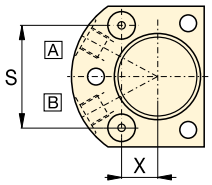
[1] O-ring material: polyurethane, 92 Durometer



-52, -121

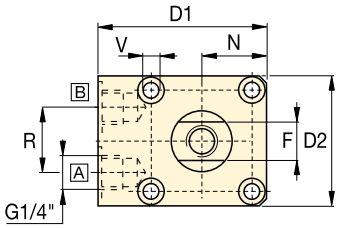


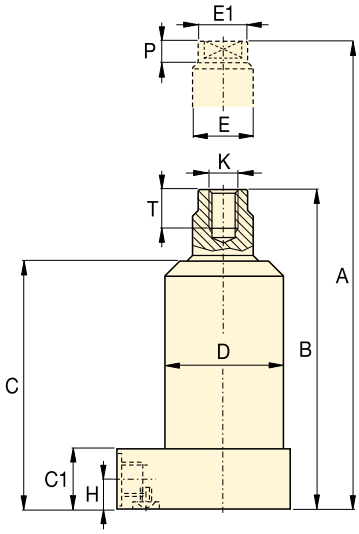


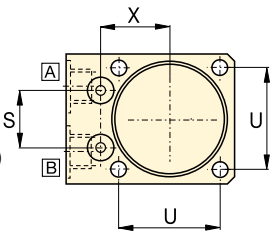


A = Pull
B = Push (venting)

-352, -92







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

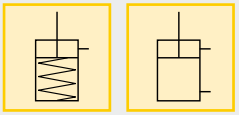
Pull force: 5,6 - 43,5 kN

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 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.

Pull cylinders - Threaded body models

Shown: PTSS-52, PTSD-121

Threaded directly into the fixture

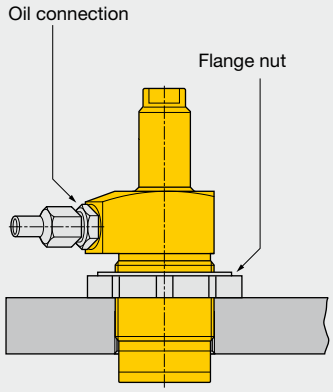
…can be secured at any height

- 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.

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).



Product selection

Cylinder capacity kN Pull	Cylinder capacity kN Push	Stroke mm	Model number	Cylinder effective area cm² Pull	Cylinder effective area cm² Push	Oil capacity cm³ Pull	Oil capacity cm³ Push
▼ **Single acting**							
5,6	–	22,6	**PTSS-52**	1,81	–	4,10	–
13,3	–	27,9	**PTSS-121**	4,06	–	11,47	–
▼ **Double acting**							
6,3	13,3	22,6	**PTSD-52**	1,81	3,81	4,10	8,69
11,2	28,0	22,1	**PTSD-92**	3,16	8,06	6,88	17,70
14,3	27,4	27,9	**PTSD-121**	4,06	7,94	11,47	22,94
43,5	81,9	30,5	**PTSD-352**	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.

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

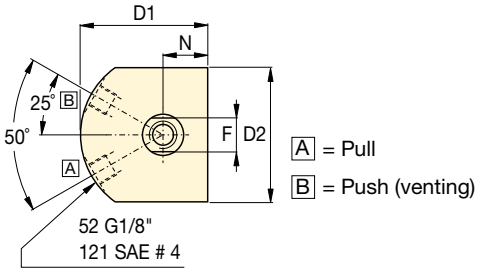
Dimensions in mm [⌯]

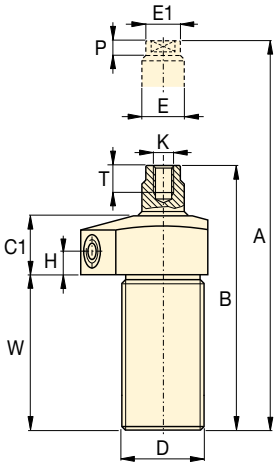
Model number	A	B	C1	D	D1	D2	E Ø
▼ **Single acting**							
PTSS-52	128,8	106,2	24,9	M35 x 1,5	47,8	37,8	16,0
PTSS-121	160,3	132,6	25,4	1,875-16 UN	60,5	50,8	22,1
▼ **Double acting**							
PTSD-52	128,8	106,2	24,9	M35 x 1,5	47,8	37,8	16,0
PTSD-92	130,0	108,0	30,2	M48 x 1,5	62,7	48,3	24,9
PTSD-121	160,3	132,6	25,4	1.875-16 UN	60,5	50,8	22,1
PTSD-352	196,1	165,6	32,0	M80 x 2	88,4	80,0	38,1

Installation dimensions in mm

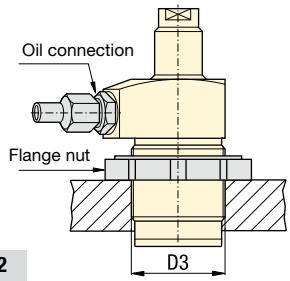
Pull force kN	Fixture hole thread size D3
6,3	M35 x 1,5
11,2	M48 x 1,5
14,3	1.875-16 UNF
43,5	M80 x 2

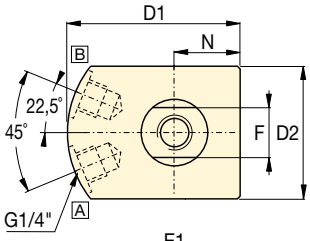
-52, 121

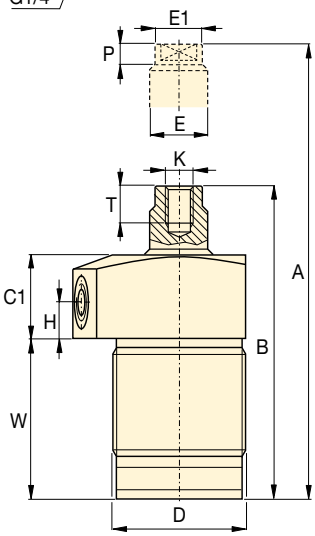




-92, -352







Accessory chart

Model number	Mounting flange Sold separately 87 ▶	Flange nut Sold separately 86 ▶
▼ 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 Ø	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

Pull force: 5,6 - 43,5 kN

Push force: 13,3 - 81,9 kN

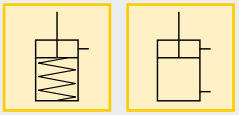
Stroke: 22,1 - 30,5 mm

Pressure: 35 - 350 bar

E Cilindros de tracción

F Verins traction

D Zugzylinder



Options

Accessories 86 ▶

Collet-Lok® swing cylinders 18 ▶

Swing cylinders 22 ▶

Sequence valves 152 ▶

Important

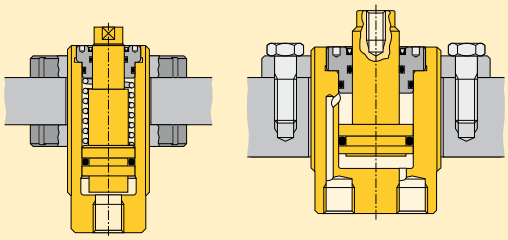
Single-acting cylinders can be vented through the manifold port.

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

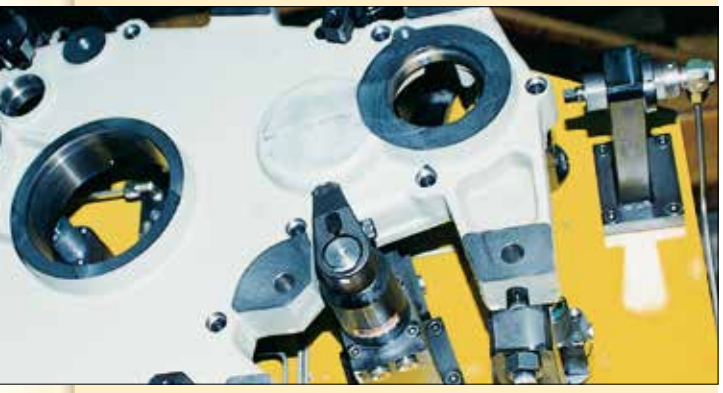
Threaded cylinders are designed for workpiece positioning, holding and ejecting applications where space is at a premium. Double-acting models are also suited to manufacturing applications, such as production punching.



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

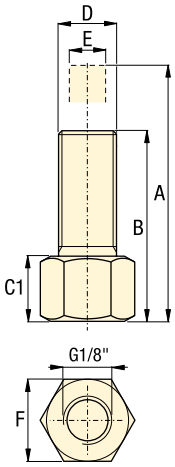
- Minimum cylinder diameter combined with maximized clamping forces
- Threaded body allows fine positioning and easy installation
- Internal plunger wipers allow maintenance-free, high-cycle performance
- Center-tapped plungers will hold workpiece contact buttons
- Single-acting models with spring return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

Product selection

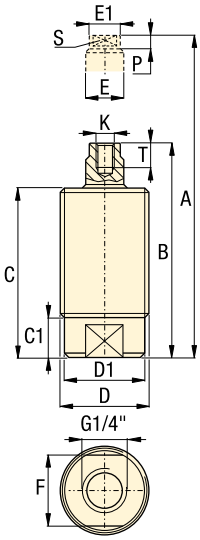
Cylinder capacity at 350 bar kN push	pull	Stroke mm	Model number	Effective area cm² push	pull	Oil capacity cm³ push	pull
▼ **Single acting**							
1,7	–	7,3	**CST-272**	0,52	–	0,36	–
1,7	–	10,3	**CST-2102**	0,52	–	0,52	–
1,7	–	12,0	**CST-2132**	0,52	–	0,67	–
4,4	–	7,0	**CST-572**	1,29	–	0,82	–
4,4	–	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	–
▼ **Double acting**							
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.

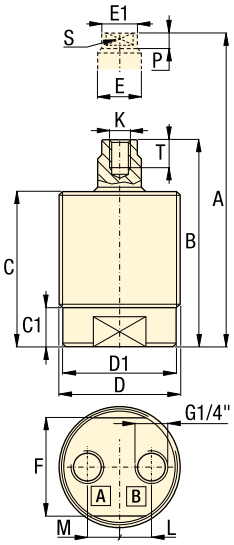
CST-2...., CST-5....



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 ø	D1 ø	E ø	E1 ø	F	K	L	M	P	S	T	kg
▼ Single acting																
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
▼ Double acting																
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.

Single or Double acting

Single acting

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

Double acting

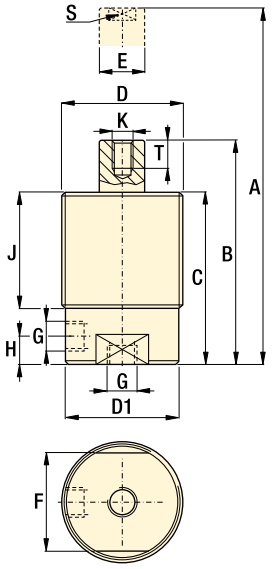
- Used when greater control is required during the unclamp cycle
- When timing sequences are critical
- Less sensitive to system back pressures, resulting from long tube lengths or numerous components being retracted at the same time.

Product selection

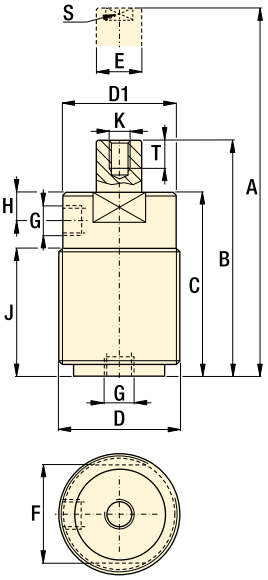
Cylinder capacity at maximum pressure kN push	pull	Stroke mm	Model number	Effective area cm^2 push	pull	Oil capacity cm^3 push	pull	Operating pressure bar
▼ **Single acting**								
17,4	–	12,7	**WRT-21**	5,10	–	0,33	–	40-350
17,4	–	25,4	**WRT-22**	5,10	–	0,66	–	40-350
▼ **Double acting**								
5,3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

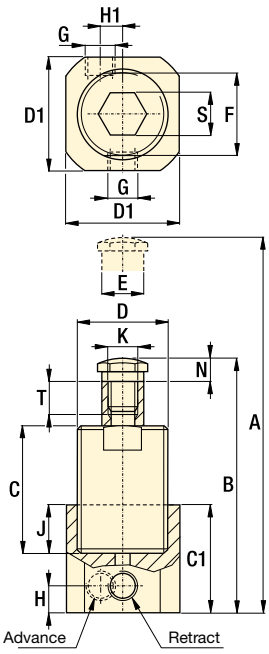
WRT



WMT



CYDA



Force: 5,3 - 17,4 kN

Stroke: 11,9 - 39,6 mm

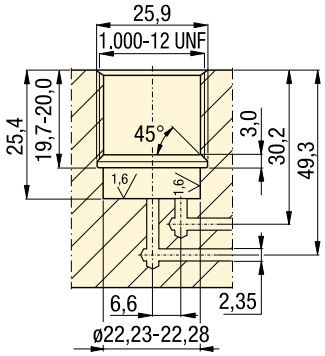
Pressure: 10 - 350 bar

(E) Cilindros roscados

(F) Vérins corps filetés

(D) Einschraubzylinder

Manifold dimensions using CYDA-15 without base



Surface roughness must be 1,6 microns

Options

Cylinder accessories 86 ▸

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.

Accessory chart

Body Thread	Mounting Flange	Flange Nut	Plunger Thread	Contact Bolt
D	Sold separately ⬚87 ▸	Sold separately ⬚86 ▸	K	Sold separately ⬚86 ▸
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

Product dimensions in mm [⌲ ⌖]

Model number	A	B	C	C1	D	D1 ø	E ø	F	G	H	H1	J	K UNF	N	S	T	kg
▼ Single acting																	
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
▼ Double acting																	
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

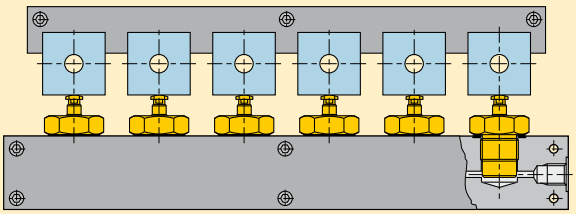
Manifold cylinders *Application & selection*

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.

Compact, fixture-integrated positioning and holding

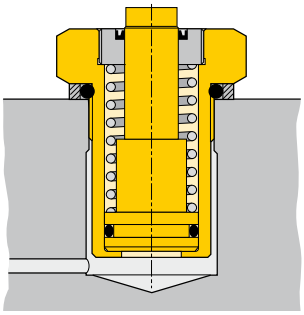
- Design eliminates the need for fittings and tubing, minimizing space requirements and facilitating easy removal of chips and dirt
- Minimal cylinder height enables extremely compact fixture designs
- High-strength bodies and internal plunger wipers allow maintenance-free, high cycle performance
- Center-tapped plungers will hold workpiece contact buttons.



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.

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.



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

Product selection

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

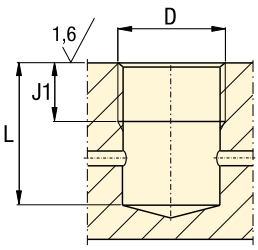
Note: - Seal material: Buna-N, Polyurethane.

Installation dimensions in mm [ ]

Model number	D Thread	D2 min. ø	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

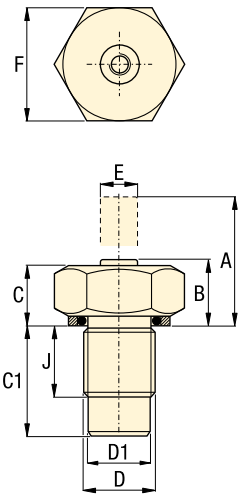
F Vérins pour bloc foré

D Einbauzylinder

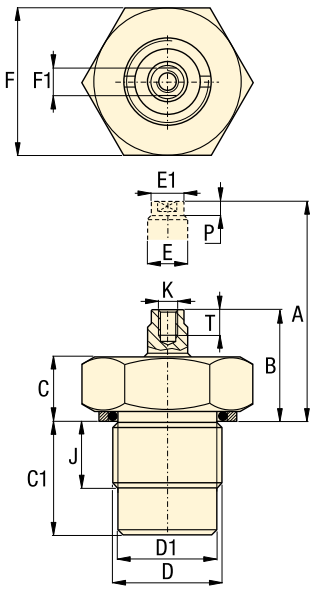
Accessory chart

Plunger Thread K	Contact Bolt ⌀86 ▶
M4 x 0,7	BS-42
M6 x 1	BS-62
M8 x 1,25	BS-82

CSM-272, 2132



other models



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.

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.

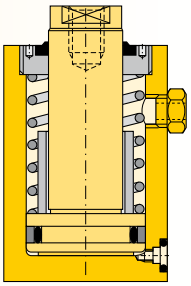
Versatile, all purpose cylinder

- 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:

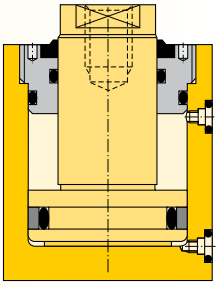
BMS, BS series, single-acting

- 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.

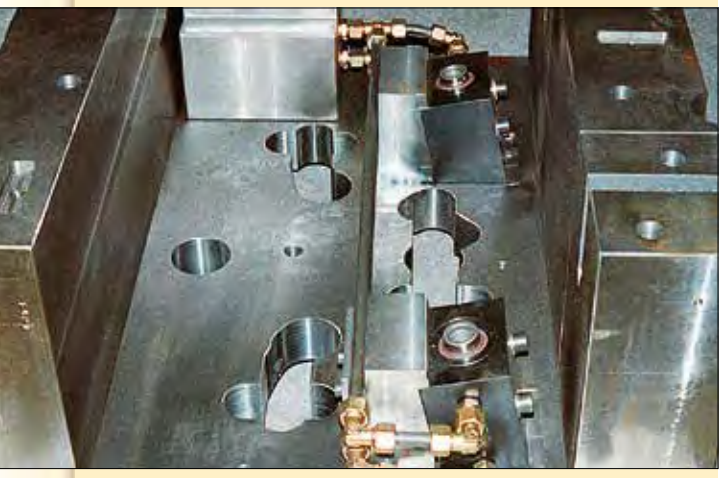


BMD, BD series, double-acting

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



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

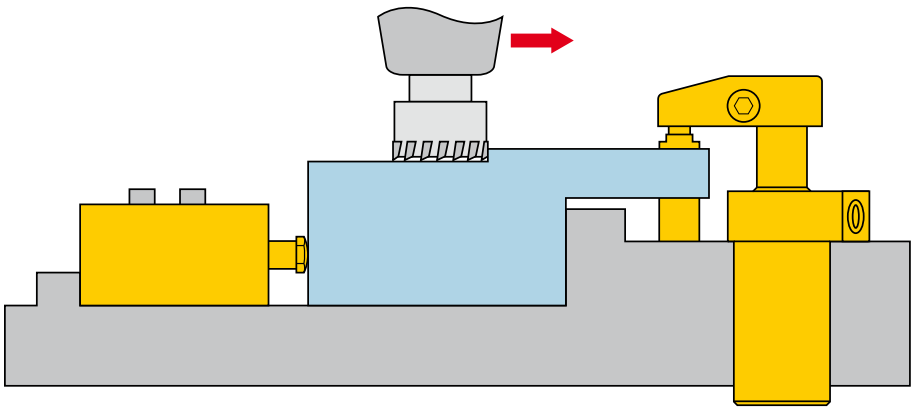


Application example

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 kN		Stroke	Model Nr. Manifold O-ring oil port	Model Nr. BSPP threaded oil port	Cylinder effective area cm²		Cylinder oil capacity cm³		Minimum spring return force	
mm	mm	push	pull	mm			push	pull	push	pull	N	kg
▼ **Single acting**												
20	12	10,9	–	8	**BMS-1082**	**BS-1082**	3,1	–	2,5	–	93	0,9
20	12	10,9	–	18	**BMS-10182**	**BS-10182**	3,1	–	5,7	–	108	1,2
25	16	17,0	–	10	**BMS-18102**	**BS-18102**	4,9	–	4,9	–	168	1,3
25	16	17,0	–	25	**BMS-18252**	**BS-18252**	4,9	–	12,3	–	157	1,8
40	25	43,6	–	12	**BMS-40122**	**BS-40122**	12,6	–	15,1	–	378	2,0
40	25	43,6	–	25	**BMS-40252**	**BS-40252**	12,6	–	31,4	–	381	2,7
50	32	68,2	–	12	**BMS-70122**	**BS-70122**	19,6	–	23,6	–	471	3,3
50	32	68,2	–	25	**BMS-70252**	**BS-70252**	19,6	–	49,1	–	425	4,4
80	50	174,9	–	20	**BMS-180202**	**BS-180202**	50,2	–	100,5	–	917	12,0
100	63	273,4	–	25	**BMS-280252**	**BS-280252**	78,5	–	196,3	–	1419	19,0
▼ **Double acting**												
20	12	11,0	7,0	16	**BMD-10162**	**BD-10162**	3,1	2,0	5,0	3,2	–	0,9
20	12	11,0	7,0	36	**BMD-10362**	**BD-10362**	3,1	2,0	11,3	7,2	–	1,2
25	16	17,2	10,1	20	**BMD-18202**	**BD-18202**	4,9	2,9	9,8	5,8	–	1,3
25	16	17,2	10,1	50	**BMD-18502**	**BD-18502**	4,9	2,9	24,5	14,8	–	1,8
40	25	44,0	26,8	25	**BMD-40252**	**BD-40252**	12,6	6,3	31,4	15,8	–	1,9
40	25	44,0	26,8	50	**BMD-40502**	**BD-40502**	12,6	6,3	62,8	31,6	–	2,6
50	32	68,7	40,6	25	**BMD-70252**	**BD-70252**	19,6	11,6	49,1	29,0	–	3,2
50	32	68,7	40,6	50	**BMD-70502**	**BD-70502**	19,6	11,6	98,2	58,0	–	4,3
80	50	175,8	107,2	25	**BMD-180252**	**BD-180252**	50,2	30,6	125,6	76,6	–	9,3
80	50	175,8	107,2	50	**BMD-180502**	**BD-180502**	50,2	30,6	251,2	153,1	–	11,5
100	63	274,8	165,7	28	**BMD-280282**	**BD-280282**	78,5	47,3	219,8	132,6	–	14,7
100	63	274,8	165,7	56	**BMD-280562**	**BD-280562**	78,5	47,3	439,6	265,1	–	18,2

Block cylinders *Dimensions & options*

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

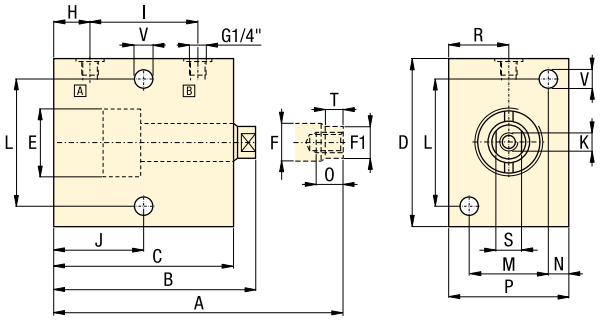
BD, BMD, BMS, BS-series

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

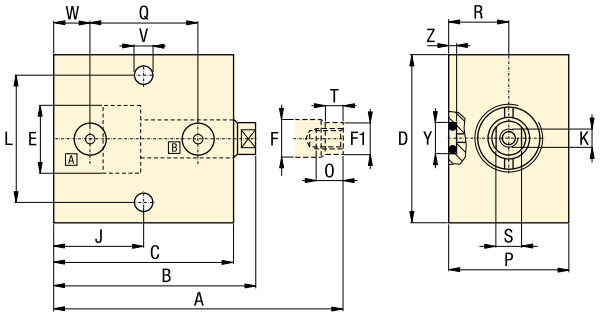
They can be used for positioning, clamping, pushing, pressing or punching operations.

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

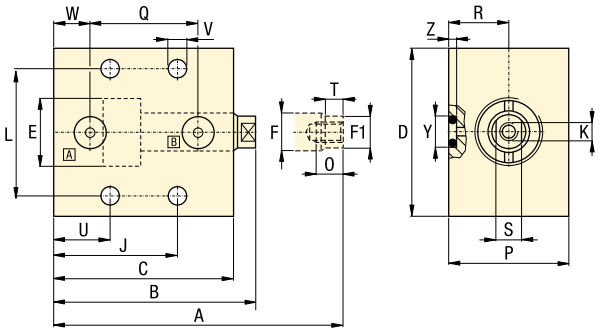
All BS and BD models



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-402522	BMD-40502
BMS-70252	BMD-70502
BMS-180252	BMD-180502
BMS-280252	BMD-280562



Dimensions in mm [ ]

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

Block cylinder used for punching applications.

Installation instructions

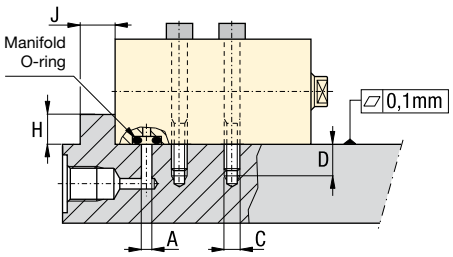
When operating above 140 bar in applications as shown in the figure below, provide cylinder back-up using a support to eliminate shear loads on the mounting bolts.

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.



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.

Installation dimensions in mm [⊟ ◎]

Clamping force at 350 bar	Oil channel diameter	Mounting thread	Mininum 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

[1] Manifold O-rings included

Accessory chart

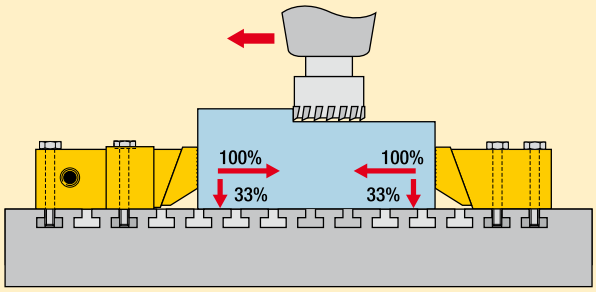
Plunger Thread K	Contact Bolt ⊟ 86 ▶
M6 x 1	**BS-62**
M8 x 1,25	**BS-82**
M16 x 2	**BS-16**
M20 x 2,5	**BS-20**
M30 x 3,5	**BS-30**
M36 x 4	**BS-36**

K	L	M	N	O	P	Q	R	S	T	U	V ø	W	Y ø	Z	Model Nr. Manifold O-ring	Model Nr. BSPP port
															Single acting ▼	
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	**BMS-1082**	**BS-1082**
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	**BMS-10182**	**BS-10182**
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	**BMS-18102**	**BS-18102**
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	**BMS-18252**	**BS-18252**
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	**BMS-40122**	**BS-40122**
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	**BMS-40252**	**BS-40252**
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	**BMS-70122**	**BS-70122**
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	**BMS-70252**	**BS-70252**
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	**BMS-180202**	**BS-180202**
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	**BMS-280252**	**BS-280252**
															Double acting ▼	
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	**BMD-10162**	**BD-10162**
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	**BMD-10362**	**BD-10362**
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	**BMD-18202**	**BD-18202**
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	**BMD-18502**	**BD-18502**
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	**BMD-40252**	**BD-40252**
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	**BMD-40502**	**BD-40502**
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	**BMD-70252**	**BD-70252**
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	**BMD-70502**	**BD-70502**
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	**BMD-180252**	**BD-180252**
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	**BMD-180502**	**BD-180502**
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	**BMD-280282**	**BD-280282**
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	**BMD-280562**	**BD-280562**

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.

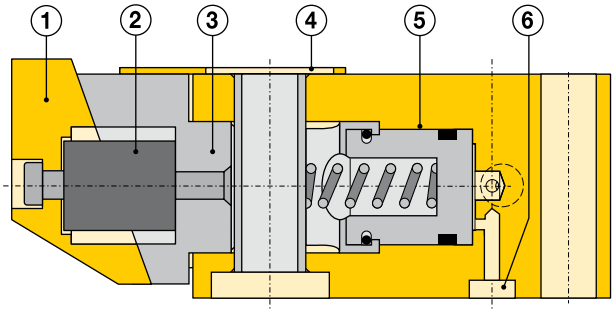
Enerpac hydraulic pull down clamps and their mechanical counter parts used to manufacture tie-rod cylinder end caps.

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.

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.

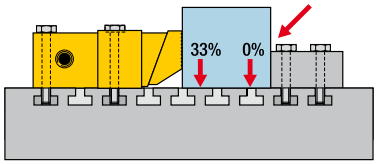
Product selection

Lateral clamping force at 350 bar	Pull down force at 350 bar	Stroke	Model number	Effective area	Oil capacity	Mounting bolts [1] (included)
kN	kN	mm		cm^2	cm^3	
▼ **Hydraulic pull down clamps**						
3,9	1,3	5,1	**ECH-52**	1,16	0,13	M8 x 45
17,4	5,8	7,9	**ECH-202**	5,03	1,07	M12 x 80

Holding force	For pull down down clamp model number	Model number	Mounting bolts included [1] number	Replaceable ribbed jaws model
kN				
▼ **Mechanical counter holds**				
3,9	ECH-52	**ECM-5**	M8 x 35	ECJR-5
17,4	ECH-202	**ECM-20**	M12 x 65	ECJR-20

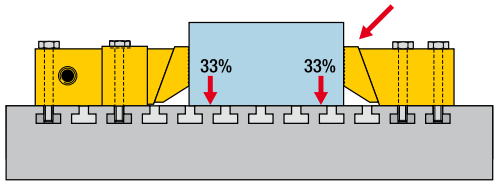
[1] Torque M8 with 24,4 Nm, M12 with 85,4 Nm.
The use of T-nuts requires longer bolts.

Pull down force



Fixed stop set-up

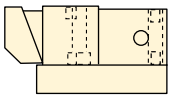
A very workable set-up for workpieces that are not larger or wider than twice the width of the edge clamp. The pull down force of the hydraulic actuated edge clamp is sufficient to pull down and hold the product during actual machining.



Counter hold set-up

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

The mounting surface must extend out under the jaw.



Force: 3,9 - 17,4 kN

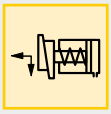
Stroke: 5,1 - 7,9 mm

Pressure: 15 - 350 bar

E Garras de empuje oblicuo

F Crampons plaqueurs

D Niederzugspanner



Options

Fittings 194

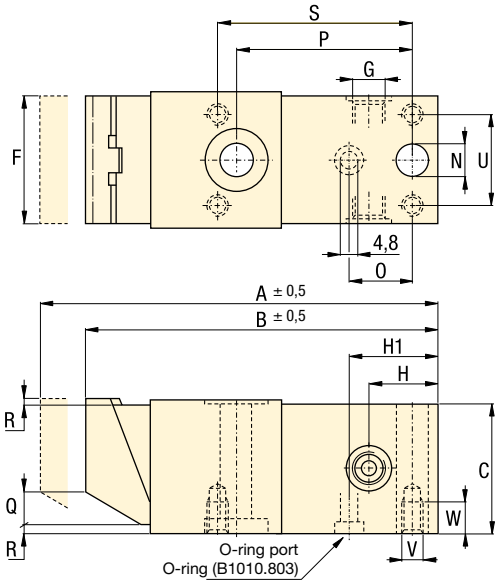
Threaded cylinders 66

Positive clamping cylinders 80

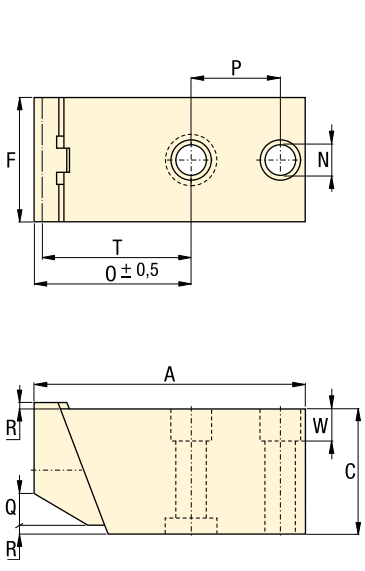
Important

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

ECH-52, -202



ECM-5, -20



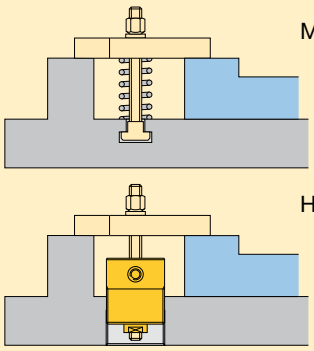
Product dimensions in mm [⊟ ⌖]

Model number	A	B	C	F	G	H	H1	N	O	P	Q	R	S	T	U	V	W	kg
▼ Hydraulic pull down clamps																		
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
▼ Mechanical counter holds																		
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*

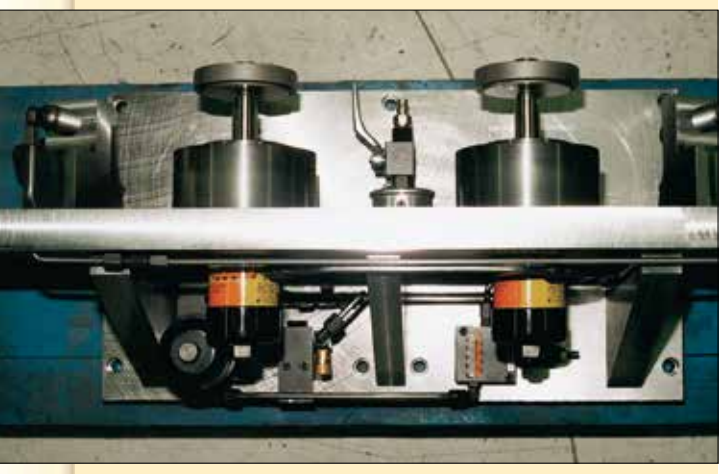
Shown: HCS-20, RWH-121, RWH-202

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

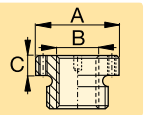
Cylinder capacity [1]	Stroke	Center hole diameter	Model number	Effective area	Oil capacity	Operating pressure
kN	mm	mm		cm^2	cm^3	bar
11,6	6,4	9,9	**CY1254-25**	5,61	3,61	210
17,8	8,4	13,5	**MRH-20**	8,58	6,72	210
17,8	8,4	13,5	**RWH-20**	8,58	6,72	210
17,8	8,4	13,5	**RWH-20T**	8,58	6,72	210
21,5	10,2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

[1] 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.

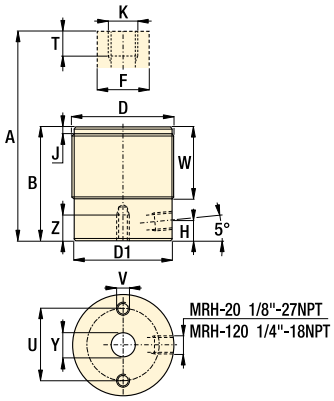
Optional Heat Treated Hollow Saddles

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

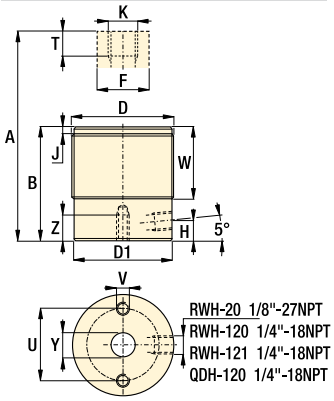


Smooth hollow saddles are standard on all RWH-20 and 30-models
(RWH-12 models are not equipped with saddles).

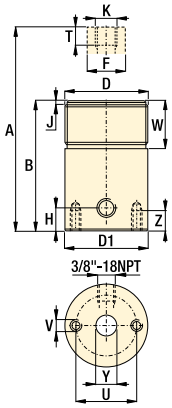
MRH-20, 120



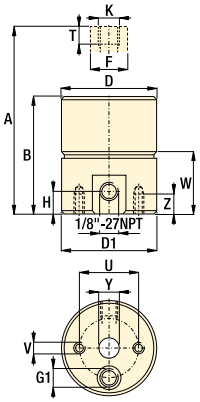
RWH-20, 120, 121, QDH-20



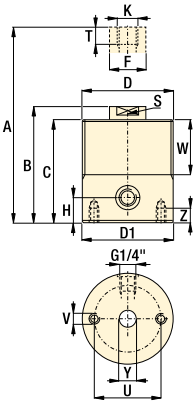
other RWH model



CY models



HCS models



Product dimensions in mm [⌀]

Model nr.	A	B	C	D	D1 ⌀	F ⌀	H	J	K	S	T	U ⌀	V	W	Y	Z	kg
CY1254-25	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
MRH-20	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
RWH-20	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
RWH-20T	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
HCS-20*	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
CY2129-25[1]	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
CY2129-5[1]	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
HCS-50*	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
CY2754-5[1]	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
MRH-120	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
QDH-120	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
RWH-120	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
RWH-121	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
HCS-80*	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
RWH-200	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
RWH-202	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
HCS-110*	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
RWH-300	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
RWH-301	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
RWH-302	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

[1] For these models G1 = manifold and 1/8-27 NPTF

Force: 11,6 - 160,2 kN

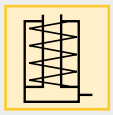
Stroke: 6,4 - 63,2 mm

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.

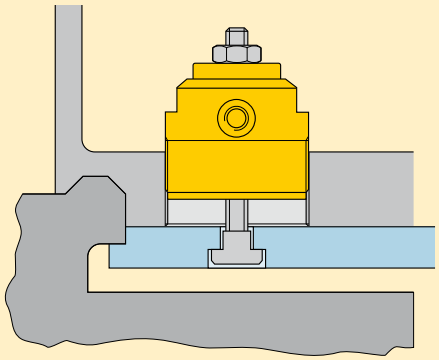
RWH cylinders can be used up to 700 bar maximum working pressure (except RWH-20 and RWH120).

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.

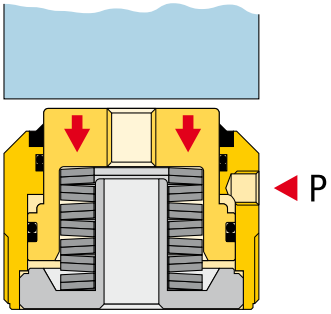
Ideal for palletized applications

- 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.

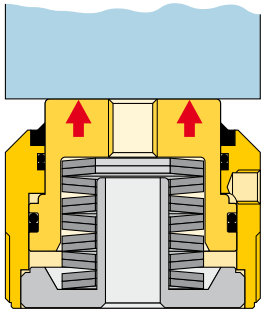
Positive clamping operation

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.



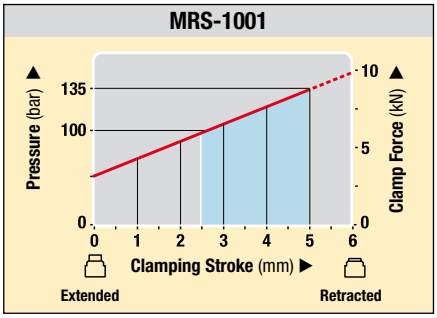
Hydraulic pressure released
- Springs apply force
- Workpiece is clamped
- Machining can take place.

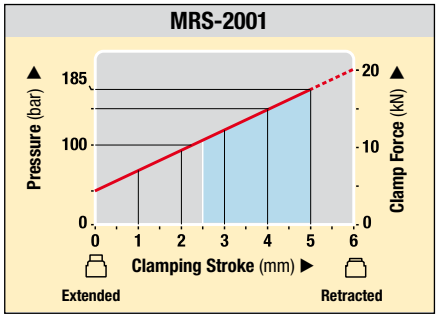
Product selection

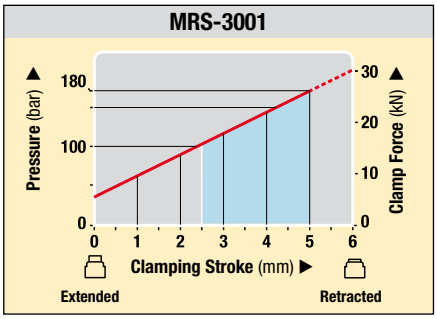
Cylinder capacity at 350 bar	Effective clamping stroke	Model number	Required operating pressure [1]	Max. tensioning stroke	Oil capacity
kN	mm		bar	mm	cm^3
12,0	2,3	**MRS-1**	350	2,3	8,36
26,7	2,3	**MRS-2**	350	2,3	4,26
51,2	2,3	**MRS-5**	350	2,3	8,19
8,5	2,5	**MRS-1001**	140	5,1	8,85
16,5	2,5	**MRS-2001**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

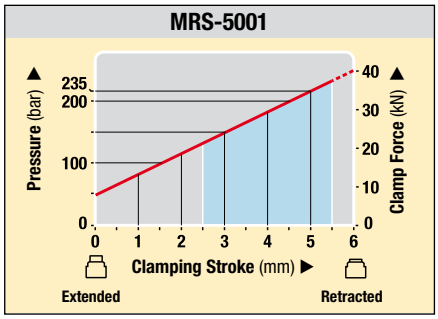
[1] Minimum operating pressure to fully retract the plunger.
Note: Seal material Buna-N, Polyurethane.

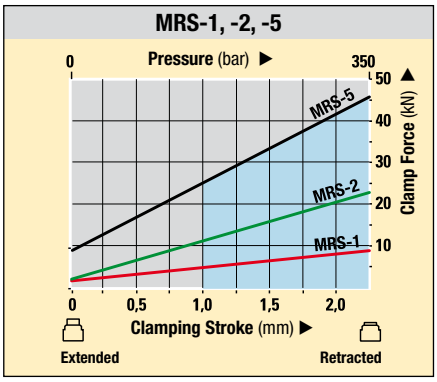
Pressure/Stroke/Force diagrams





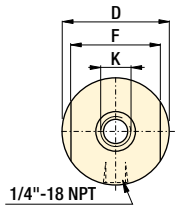


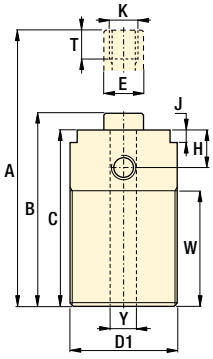




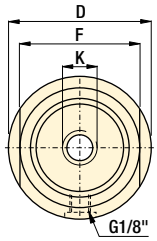
= Suggested Clamping Range

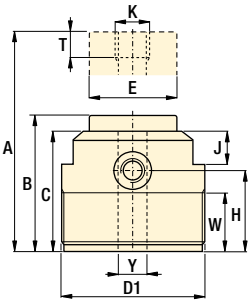
MRS-1, 2, 5





other MRS models





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.

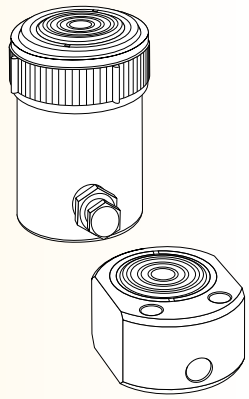
Block and cylindrical models

Cylindrical models

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

Block models

- Easily mounted
- Compact design

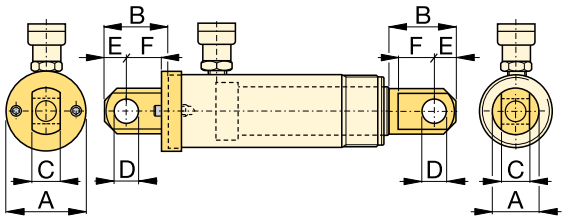


Enerpac RW-101 cylinders used in a high pressure toggle style clamping set-up.

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.



REB REP

Type	Model number	Clevis eye dimensions (mm)						Pin to pin*
		A	B	C	D	E	F	mm
Base [1]	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	—

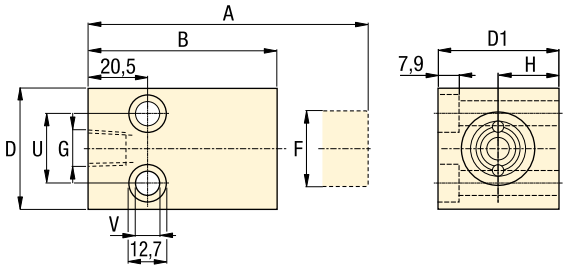
* Pin to Pin– REB and REP Clevises fitted. Add cylinder stroke length.
[1] Mounting screws are included.

Product selection

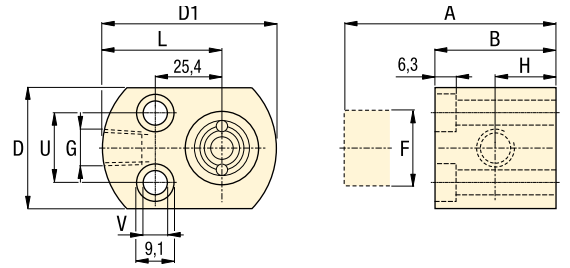
Cylinder capacity at 350 bar	Stroke	Model number	Effective area	Oil capacity	Operating pressure
kN	mm		cm^2	cm^3	bar
▼ **Block models**					
22,1	15,7	**RW-41**	6,39	10,16	6-550
22,1	15,7	**RW-50**	6,39	10,16	40-700
22,1	15,0	**MRW-50F**	6,39	10,16	6-550
22,1	15,0	**MRW-50M**	6,39	10,16	6-550
▼ **Cylindrical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

Note: Seal material Buna-N, Polyurethan.

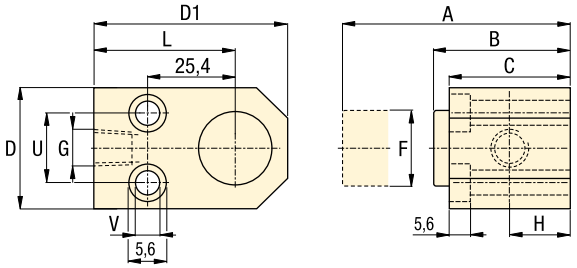
RW-41



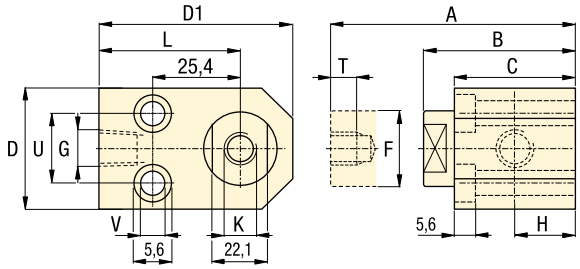
RW-50



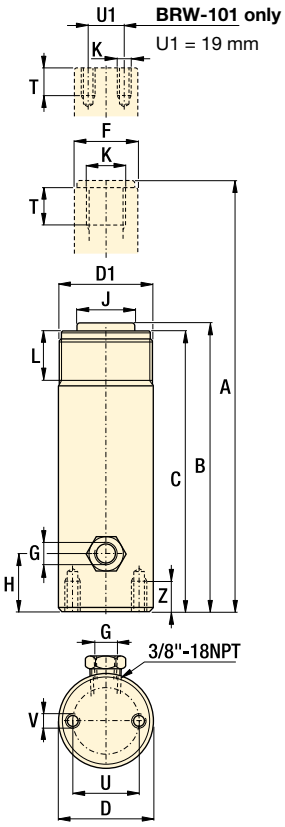
MRW-50F



MRW-50M



BRW-series



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

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Important

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

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

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

Product dimensions in mm [ ]

Model number	A	B	C	D	D1	F	G NPTF	H	J	K	L	T	U	V	Z	kg
▼ Block models																
RW-41	80,8	65,0	–	41,1	41,1	25,4	¼ -18	20,6	–	–	–	–	25,4	8,9	–	0,8
RW-50	56,9	41,4	–	41,1	58,9	25,4	⅜ -18	19,1	–	–	38,1	–	28,4	5,6	–	0,8
MRW-50F	55,9	40,9	40,9	41,1	65,0	25,4	⅜ -18	20,6	–	–	44,5	–	28,4	5,6	–	0,8
MRW-50M	66,0	51,1	40,9	41,1	65,0	25,4	⅜ -18	20,6	–	M8 x 1,25	44,5	6,1	28,4	5,6	–	0,8
▼ Cylindrical models																
BRW-51	137,7	112,0	103,9	38.1	M38 x 1,5	25,4	¼ -18	19,1	25,4	M18 x 2,5	30,0	15,5	25,4	M6 x 1	14,0	1,0
BRW-53	247,1	166,6	158,8	38.1	M38 x 1,5	25,4	¼ -18	19,1	25,4	M18 x 2,5	30,0	15,5	25,4	M6 x 1	14,0	1,4
BRW-55	349,0	217,7	209,6	38.1	M38 x 1,5	25,4	¼ -18	19,1	25,4	M18 x 2,5	30,0	15,5	25,4	M6 x 1	14,0	1,8
BRW-101	115,1	89,9	86,6	57.2	M56 x 2	38,1	¼ -18	19,1	–	M5 x 0,8	29,2	6,1	39,6	M8 x 1,25	12,4	1,7
BRW-102	177,0	121,7	115,1	57.2	M56 x 2	38,1	¼ -18	19,1	35,1	M22 x 1,5	29,2	17,3	39,6	M8 x 1,25	12,4	2,2
BRW-104	278,6	172,5	165,9	57.2	M56 x 2	38,1	¼ -18	19,1	35,1	M22 x 1,5	29,2	17,3	39,6	M8 x 1,25	12,4	3,2
BRW-106	401,8	246,6	241,3	57.2	M56 x 2	38,1	¼ -18	19,1	35,1	M22 x 1,5	29,2	17,3	39,6	M8 x 1,25	12,4	4,4
BRW-1010	606,6	349,3	342,9	57,2	M56 x 2	38,1	¼ -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.

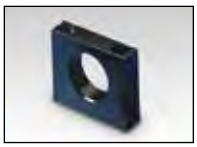
Heavy-duty cylinders

...provide push as well as pull forces

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

Optional cylinder attachments

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



Foot mounting

Mounts onto cylinder collar thread. Retainer nut included. 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

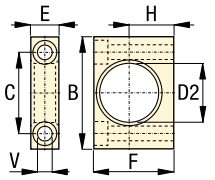
Threads onto plunger or base.

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

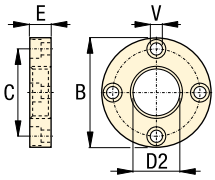
Product selection

Cylinder capacity at 350 bar kN push	kN pull	Stroke mm	Model number	Effective area cm² push	cm² pull	Oil capacity cm³ push	cm³ pull
17,4	7,7	28,2	**BRD-41**	5,10	2,19	14,58	6,55
17,4	7,7	78,9	**BRD-43**	5,10	2,19	40,48	18,03
17,4	7,7	155,2	**BRD-46**	5,10	2,19	79,31	34,41
40,0	21,8	31,6	**BRD-91**	11,42	6,32	32,77	18,03
40,0	21,8	82,3	**BRD-93**	11,42	6,32	90,78	49,16
40,0	21,8	158,0	**BRD-96**	11,42	6,32	178,29	98,32
40,0	21,8	260,2	**BRD-910**	11,42	6,32	293,98	162,23
69,0	36,9	157,2	**BRD-166**	20,32	10,71	322,33	170,42
69,0	36,9	258,8	**BRD-1610**	20,32	10,71	528,64	278,58
109,0	47,8	159,7	**BRD-256**	31,74	13,87	503,57	219,59
109,0	47,8	261,1	**BRD-2510**	31,74	13,87	825,90	360,51

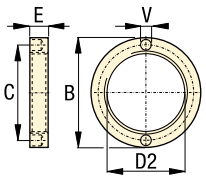
Foot mounting



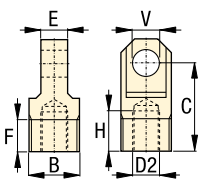
Flange mounting



Retainer nut



Clevis eye



Force: 17,4 - 109 kN

Stroke: 28,2 - 261,1 mm

Pressure: 35 - 700 bar

E Cilindros universales

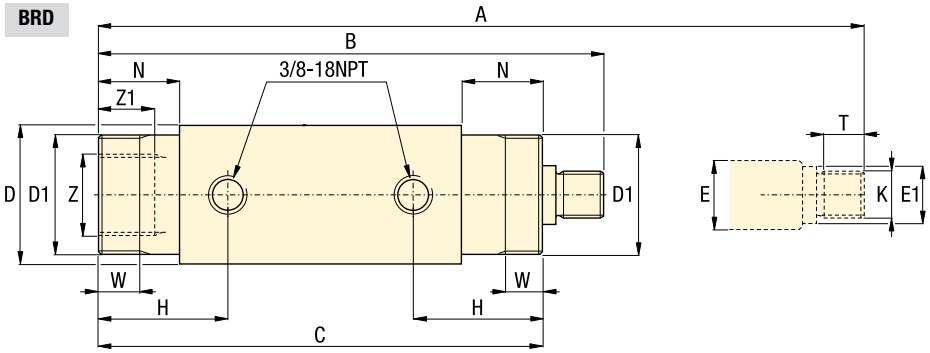
F Vérins universels

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

BRD



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
BRD-41	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
BRD-43	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
BRD-46	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
BRD-91	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
BRD-93	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
BRD-96	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
BRD-910	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
BRD-166	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
BRD-1610	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
BRD-256	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
BRD-2510	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

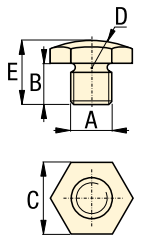
These accessories are provided so that you can effectively position, mount and actuate Enerpac hydraulic cylinders according to your specific fixturing or production applications.

For optimum mounting and fixture flexibility

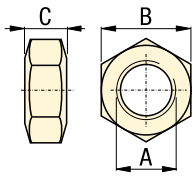
...to match specific applications

- **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.

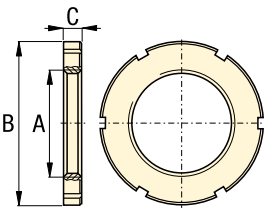
All BS Models



FN-121, 201, 251



All other FN models



Product dimensions in inches [⊟ ⌖]

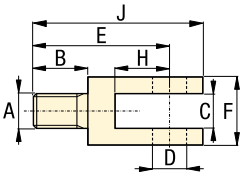
A thread	Model number	B	C	D	E
			rad.		
▼ Spherical contact bolts					
#6-32 UNC	**BS-21**	5,1	6,4	6,0	8,9
#8-32 UNC	**BS-41**	7,1	7,9	7,9	10,9
M4 x 0,7	**BS-42**	7,1	7,9	7,9	10,9
.250-28 UNF	**BS-61**	7,9	11,1	11,1	14,0
M6 x 1	**BS-62**	7,9	11,1	11,1	14,0
.313-24 UNF	**BS-81**	9,9	14,2	14,0	17,0
M8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

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

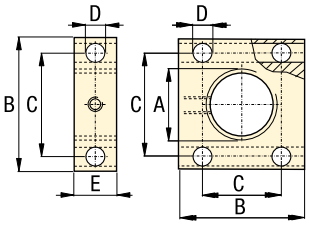
Enerpac worksupport locked in position using an FN series self-locking flange nut.

Product dimensions in mm [⊟ ⌖]

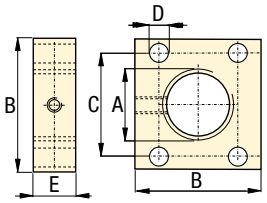
A thread	Model number	B	C	D ø	E	F	H	J
▼ Yoke								
.312-24 UN	**Y-3121**	12,7	7,9	7,9	31,8	16	12,7	39,6



MF and AW-51 models



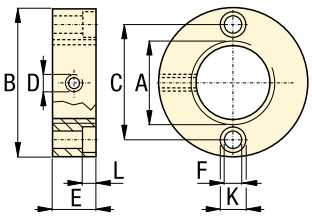
other AW models



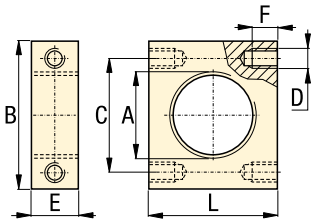
Product dimensions in mm [ ]

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

AW-53, -121



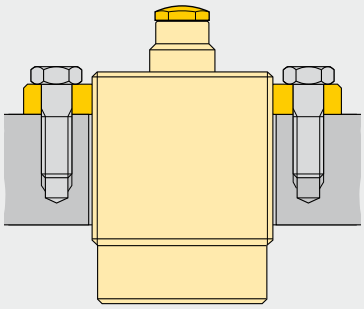
AW-102

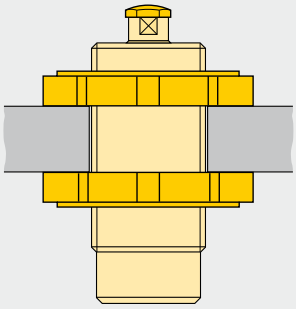


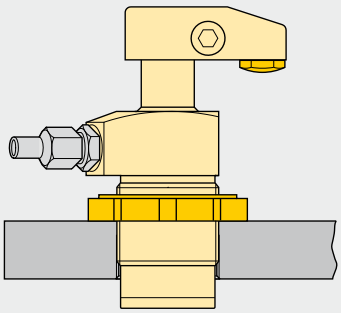
Product dimensions in mm [ ]

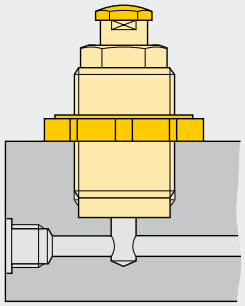
A thread	Model number	B ø	C	D thread	E	F ø	K ø	L
▼ **Mounting flanges – Cylindrical**								
1.500-16 UN	**AW-53**	73,2	57,2	.250-20 UNC	19,1	7,1	10,4	7,9
2.750-16 UN	**AW-121**	114,3	92,2	.250-20 UNC	19,1	8,6	12,7	9,7
▼ **Mounting flanges – Rectangular**								
2.250-14 UNS	**AW-102**	101,6	76,2	.438-20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

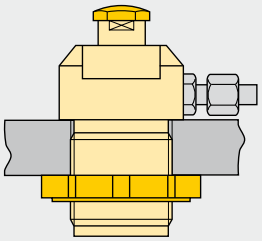
E Accesorios de cilindro
F Accessoires pour vérins
D Zubehör für Zylinder











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.

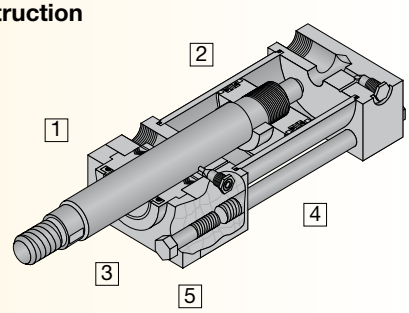
Enerpac tie rod cylinders are designed to the highest industry standards to provide long life and worry-free performance in the most demanding applications.

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



Standard bore sizes

Bore diameter	Rod diameter	Capacity at 350 bar		Effective area	
mm	mm	Push kN	Pull kN	Push cm^2	Pull cm^2
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

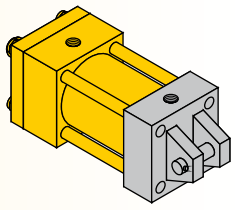
Bore diameter	Rod diameter	Capacity at 350 bar	
mm	mm	Push kN	Pull kN
127,0	88,9	437	223
152,4	101,6	629	349
177,8	127,0	856	419
203,2	139,7	1118	590

Contact Enerpac for ordering information on addional bore sizes.

Tie Rod cylinder mounting styles

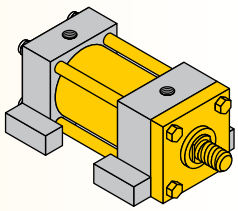
Clevis Mount – TRCM Series

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



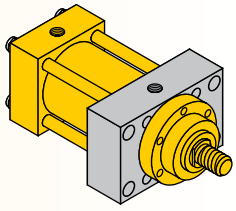
Foot mount – TRFM series

- 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 mm	Rod diameter mm	Stroke mm	Clevis mount	Foot mount	Flange mount
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	304,81	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 **Product Type**
- **TR** = Tie Rod

2 **Mounting**
- **CM** = Clevis Mount
- **FM** = Foot Mount
- **FL** = Flange Mount

3 **Bore Diameter** (mm)
- **15** = 38,1 mm
- **20** = 50,8
- **25** = 63,5
- **32** = 82,5
- **40** = 101,6

4 **Stroke** (mm)
- **02** = 50,8
- **04** = 101,6
- **06** = 152,4
- **10** = 254,0
- **12** = 304,8

5 **Cushions**
- **Blank** = None
- **C** = Cushions both ends

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.

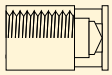
350 bar Tie Rod Cylinders — TRCM-series

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

Force: 39 - 280 kN

Stroke: 50,8 - 304,8 mm

Pressure: 35 - 350 bar

(E) **Cilindros Atirantados**

(F) **Vérins à tirants**

(D) **Zugankerzylinder**

Options

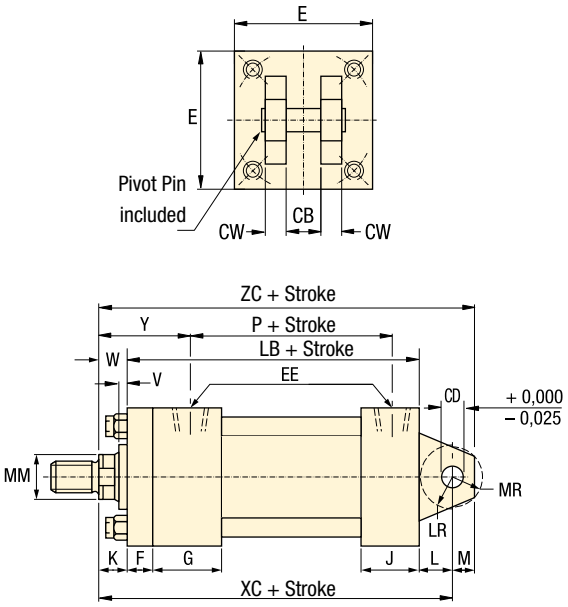
Accessories 93 ▶

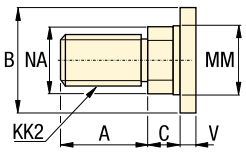
ZW Series Pumps 114 ▶

VP Series Valves 136 ▶

Fittings 194 ▶

TRCM models Clevis mount





Dimensions in 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

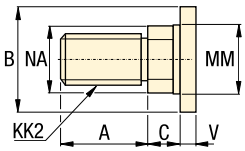
VP Series Valves 136

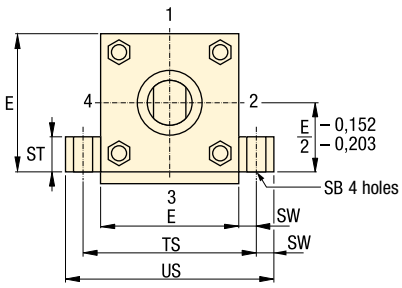
Fittings 194

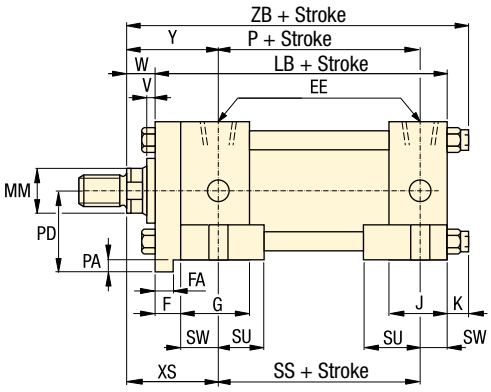
Ease of installation

- 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

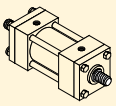
TR series foot mount

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	50,80	**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.

350 bar Tie Rod cylinders TRFL-series

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.

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

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

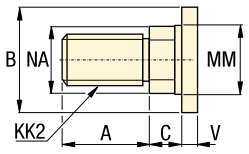
Accessories 86 ▶

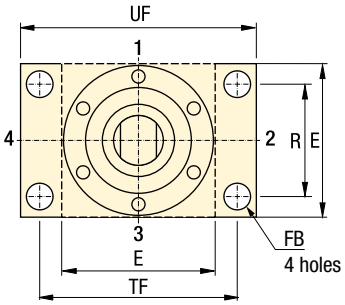
ZW Series Pumps 114 ▶

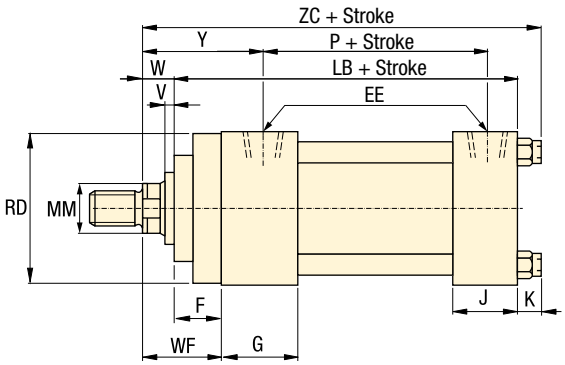
VP Series Valves 136 ▶

Fittings 194 ▶

TRFL models Flange Mount







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	kg
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

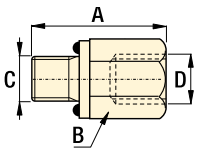
- Fit any style of Enerpac tie-rod cylinder
- Rod eyes and rod clevises
  - Required for proper mounting of TRCM series cylinders
  - Pivot pins supplied separately
- Pivot pins for rod eyes and clevises
  - Provided with cotter pins
  - Must be ordered separately
- Linear alignment coupler
  - Prevents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

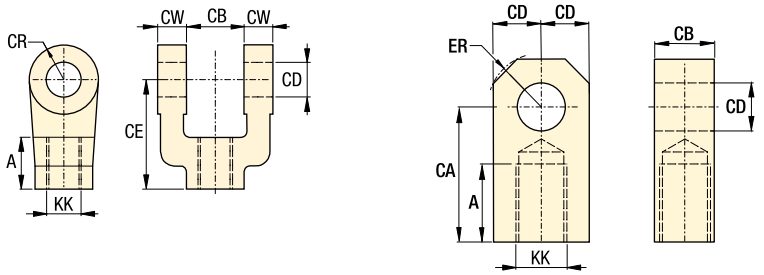
TRRE-15, TRCC-15, TRPP-15, TRAC-15

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

Fittings dimensions in mm [⊳⊕]

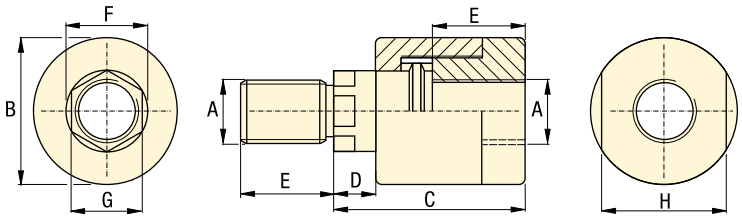
From	To	Model number	A	B	C	D
SAE #10	3/8" NPT	**FZ2077**	33,2	25,4	SAE #10	3/8" NPT
SAE #12	3/8" NPT	**FZ2078**	25,4	31,7	SAE #12	3/8" NPT
SAE #10	SAE #6	**FZ2079**	32,0	25,4	SAE #10	SAE #6
SAE #12	SAE #6	**FZ2080**	24,4	31,7	SAE #12	SAE #6





Rod Clevis and Rod Eye dimensions in mm [⊳⊕]

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



Linear Alignment Coupler in mm [⊳⊕]

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

197 ▶

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 in³ = 16,387 cm³

1 cm³ = 0,061 in³

1 dm³ = 1 litre = 61,02 in³

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

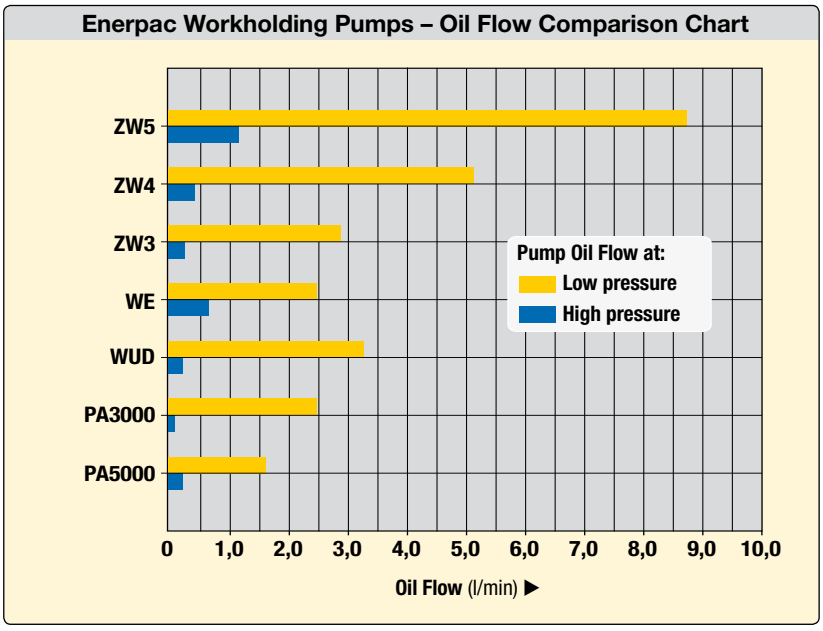
Flow rate: 0,08 - 8,7 l/min

Pressure: 65 - 700 bar

Reservoir: up to 40 liters

Enerpac Workholding Pump Comparison Chart

What oil flow is right for you?



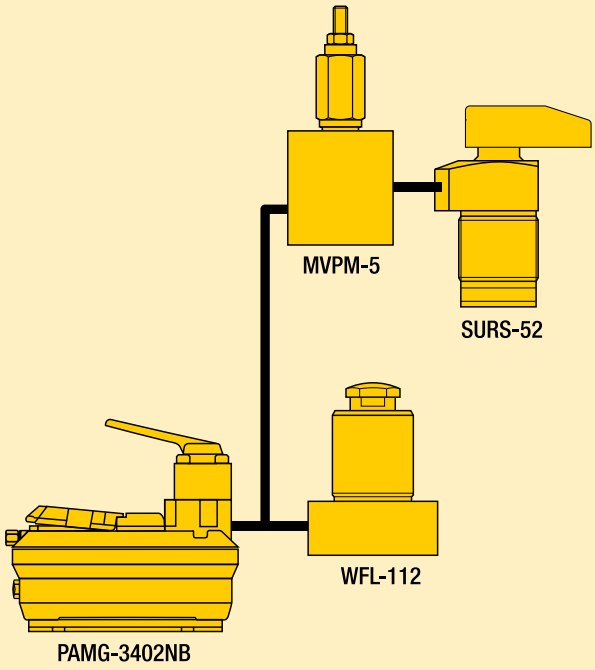
Type of pump	Oil flow at low pressure (l/min)	Oil flow at high pressure (l/min)
ZW5-Series	8,74	1,64
ZW4-Series	5,19	0,82
ZW3-Series	2,80	0,54
WE-Series Submerged	2,45	0,65
WUD-Series Economy	3,28	0,33
Turbo Air PA3000-Series	2,46	0,08
Turbo Air PA5000-Series	1,64	0,33

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

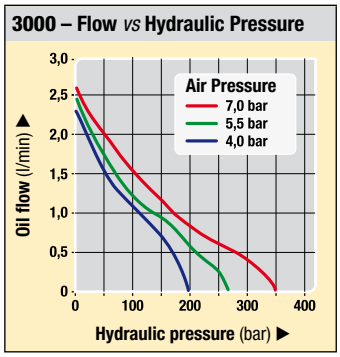
- Hydraulic to air ratio: 45:1

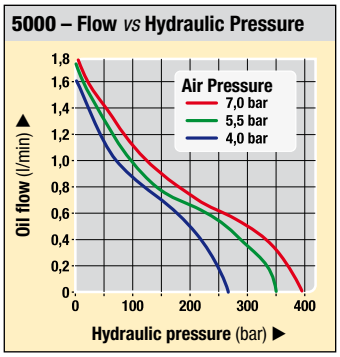
5000 series

- 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:

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

Pressure: 350 bar

Air: 340 l/min

Reservoir: 1,1 - 5,0 litres

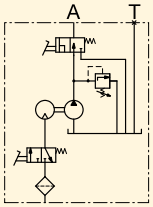
E **Bombas hidroneumáticas**

F **Pompes hydro-pneumatiques**

D **Lufthydraulische pumpen**

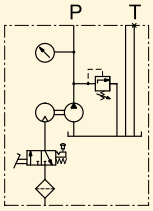
PATG series

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



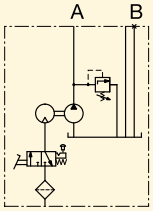
PACG series

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



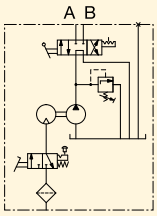
PASG series

- 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).



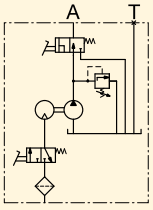
PAMG series

- 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.



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

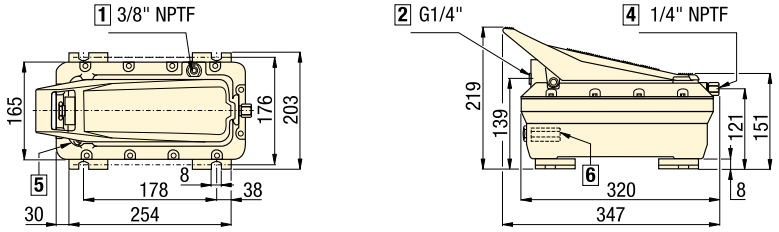
1,9 litre Turbo Air Pump

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.

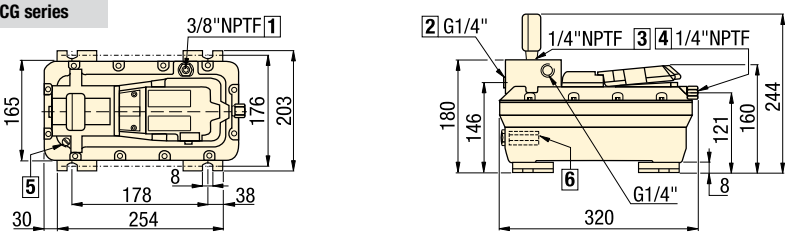
1. Auxiliary vent/tank fill port
2. Hydraulic output
3. Gauge mounting port
4. Swivel air input with filter
5. Filtered permanent tank vent
6. Adjustable pressure relief valve
7. Air pendant air input

1,9 litres reservoir (dimensions in mm)

PATG series

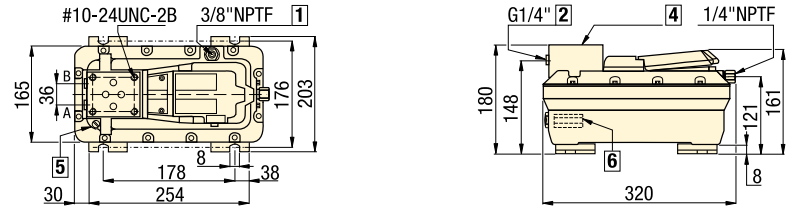


PACG series

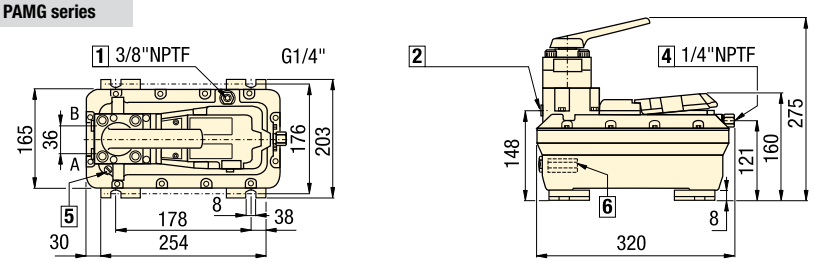


PACG series include pressure gauge **G-2517L**.

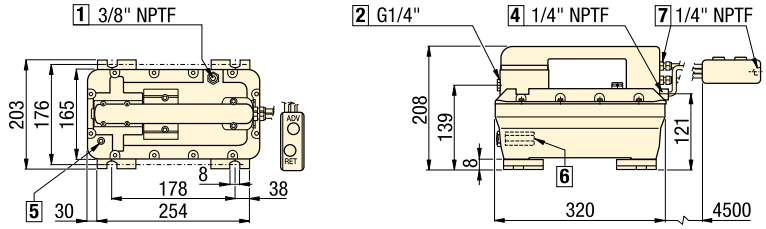
PASG series



PAMG series



PARG series



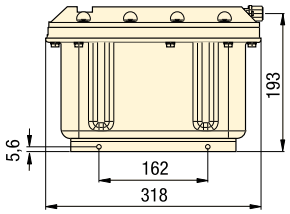
Product selection

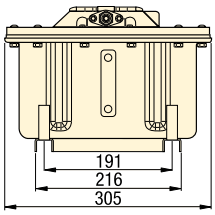
Description	Model numbers 3000 series 2,46 l/min [1]	Model numbers 5000 series 1,64 l/min [1]	Usable oil capacity [2] horizontal mount (litres)	Usable oil capacity [2] vertical mount (litres)	Air pressure range (bar)	Air consumption (l/min)	kg
▼ **Factory supplied valves**							
Hand/foot 3-way	**PATG-3102NB**	**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
▼ **User supplied valves**							
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] At 0 bar hydraulic and 7 bar air pressure.
[2] 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.

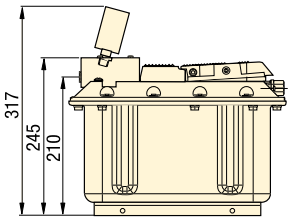
7,5 litres reservoir (dimensions in mm)

All models

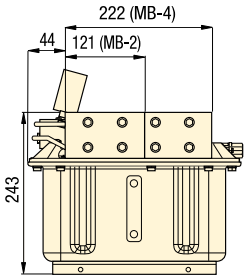


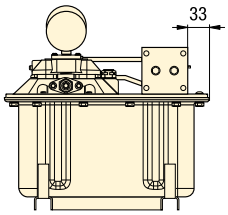


PACG series

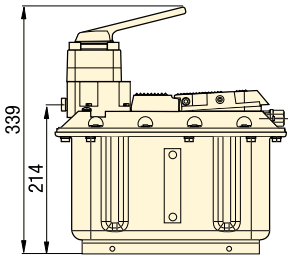


PACG with MB2 or MB4

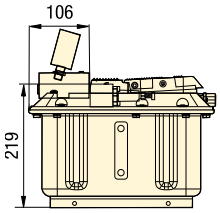


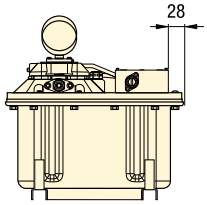


PAMG series

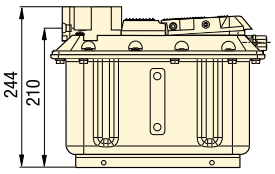


PACG with WM10

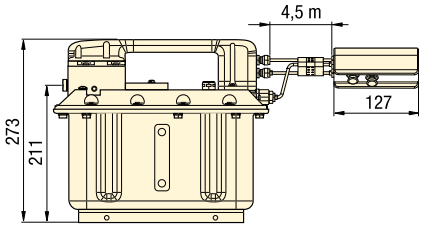




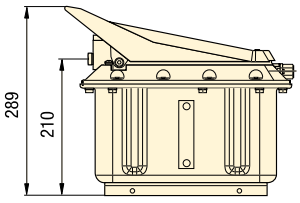
PASG series



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 [1]	1,64 l/min [1]	litres	bar	l/min	kg
▼ **Factory supplied valves**						
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
▼ **User supplied valves**						
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

[1] 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.

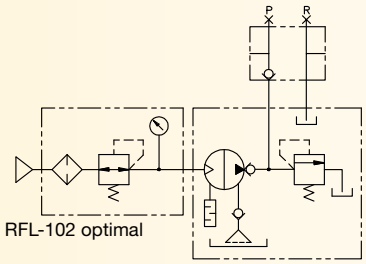
Flow: 2,0 l/min @ 0 bar
1,0 l/min @ 140 bar

Pressure: 350 bar max.

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

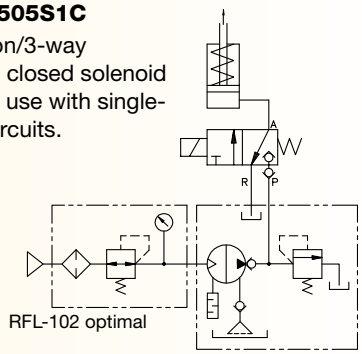
ZAJ-06505M1

Pressure and tank manifold for use with remote mounted valves.



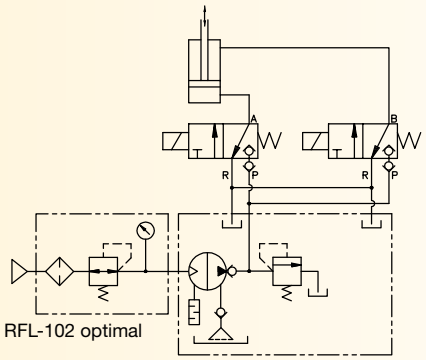
ZAJ-06505S1C

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



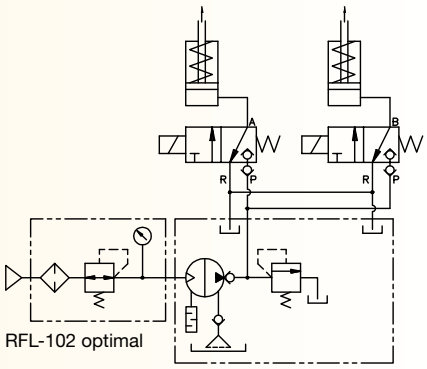
ZAJ-06505S2C

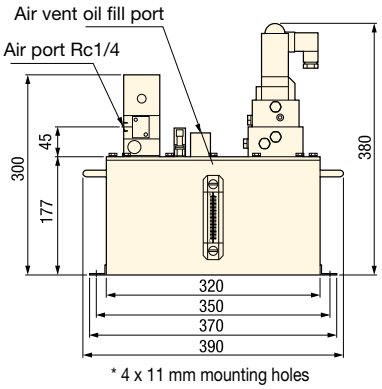
Dual 2 position/3 way normally closed solenoid valves for use with double-acting circuits.

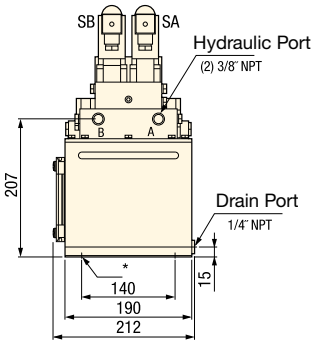


ZAJ-06505S2C

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







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

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

Pressure: 210 - 350 bar

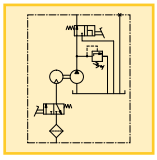
Air: 255 l/min

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.

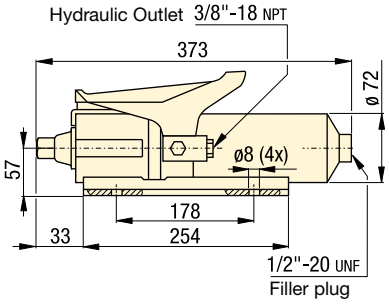
Options

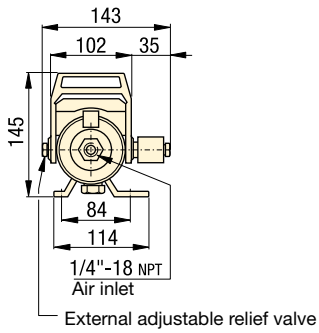
Regulator-filter-lubricator

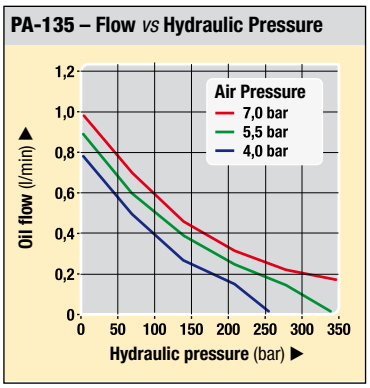
106,158 ▶

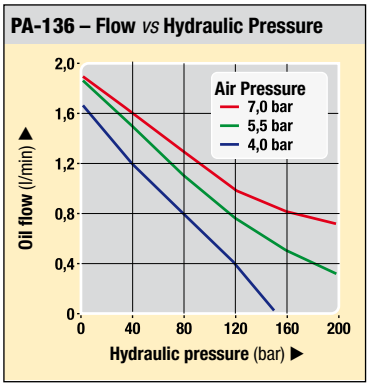
Fittings

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 [1]	Max. hydraulic pressure	Model number	Valve function	Air pressure range	Air consumption	
litres	l/min	bar			bar	l/min	kg
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

[1] At 0 bar hydraulic pressure.
Note: Seal material: Buna-N, Teflon, Polyurethane.

www.enerpacwh.com

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

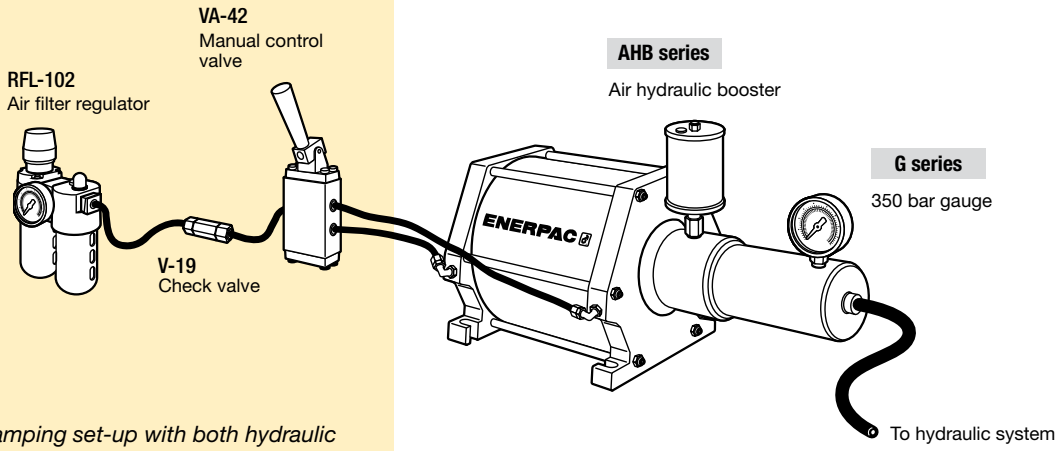
- High speed operation
- Extended service life
- Constant hydraulic output
- Large oil delivery per stroke allows quick filling of cylinders for clamping or punching

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

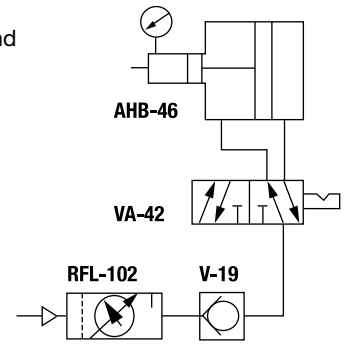
- One-shot spring return
- Steel and cast iron construction
- Built-in stroke sensor for automatic cycle operation
  30 VDC switch closes 25 mm before end of full air piston stroke
- Internal self-bleeding
  Automatically purges air from system when booster piston is at highest point in circuit

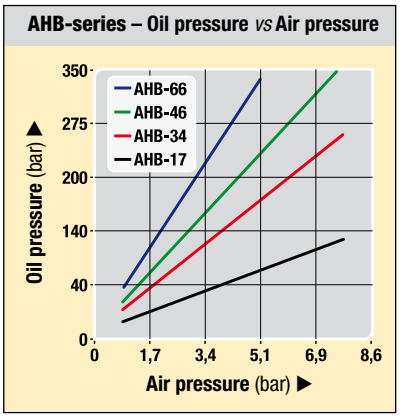


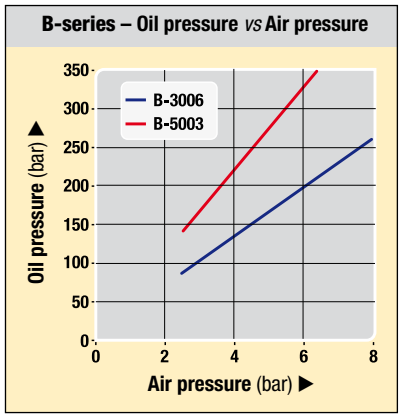
In an automated clamping set-up with both hydraulic and pneumatic components, AHB series boosters are used as a power source for the hydraulic system.

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

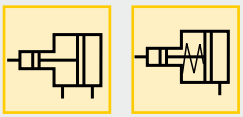
Oil flow: 60-295 cm³/stroke

Air: 27 - 64 dm³/cycle

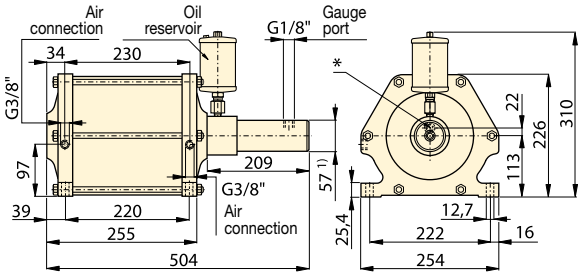
(E) Multiplicadores

(F) Multiplicateurs

(D) Druckübersetzer



AHB series



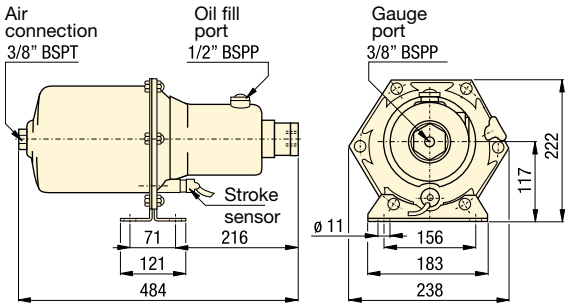
1) Ø 72 mm for model **AHB-17**

* Oil connection (G1/4")

*** Adapter to 3/8" NPT air connection is included.

NOTE: FZ-2060 Adaptor available for gauge port.

B series



Options

Air valves 106,158

Regulator-filter-lubricator 106,158

Fittings 194

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	Air to oil pressure ratio	Model number	Air consumption per cycle 1)	Air piston diameter	Hydraulic piston diameter	Hydraulic stroke	Air operating pressure	
at 5 bar air pressure	at 7 bar air pressure	cm³			dm³ at 6 bar air	mm	mm	mm	bar	kg
▼ **AHB series**										
83	110	295,0	1:16	**AHB-17**	62,6	203	51	145	1-8	18,8
175	235	139,3	1:34	**AHB-34**	63,6	203	35	145	1-8	16,8
240	315	100,0	1:46	**AHB-46**	63,9	203	30	145	1-8	16,4
330	–	73,7	1:64	**AHB-66**	64,1	203	25	145	1-5	16,0
▼ **B series**										
155	210	101,6	1:30	**B-3006**	27	180	31	132	3-9	14,0
260	350	60,6	1:50	**B-5003**	27	180	24	132	3-9	14,0

1) 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.

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.

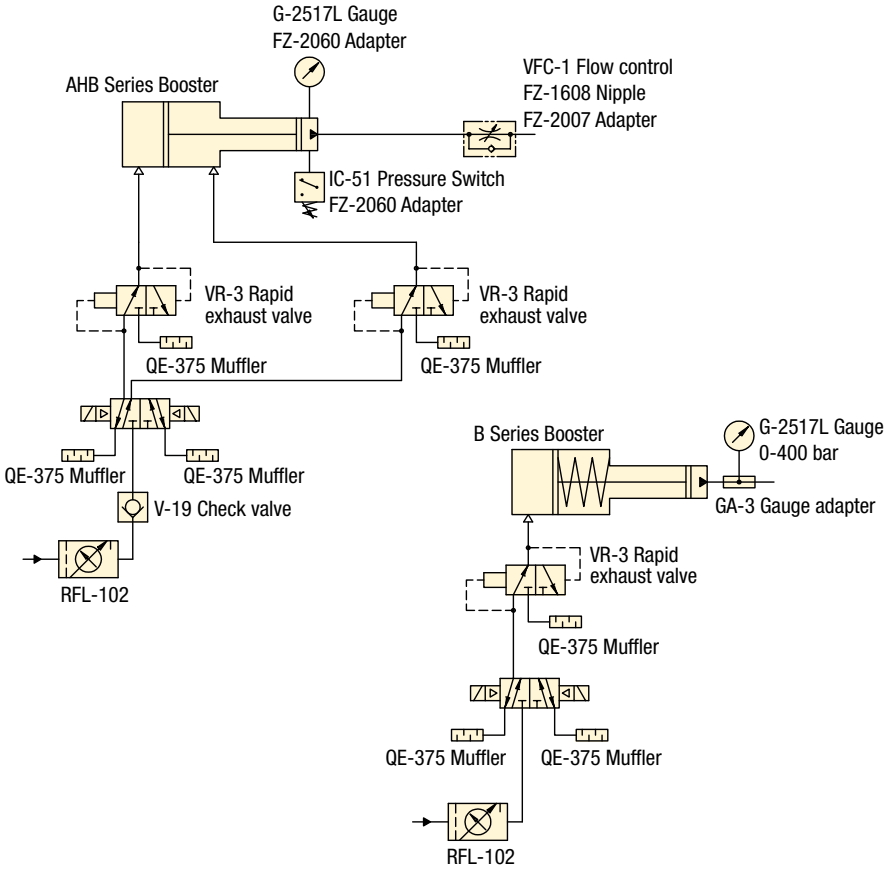
Product selection

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

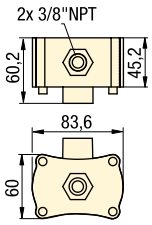
* Maximum hydraulic pressure: 207 bar.

Important

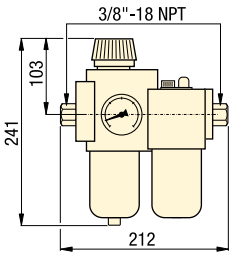
Valving help
See Basic System Set-up and Valve information in our "Yellow Pages".



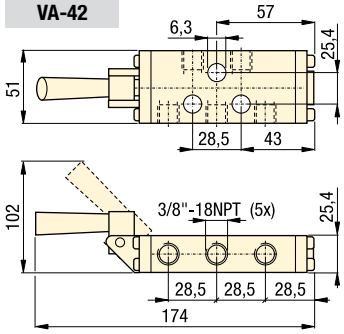
VR-3



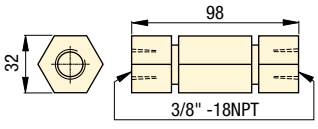
RFL-102



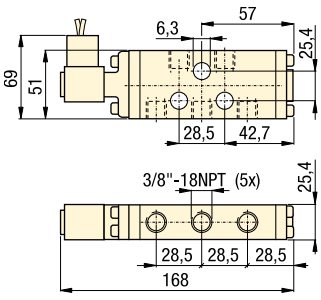
VA-42



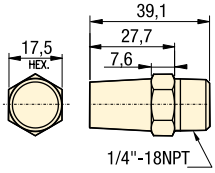
V-19



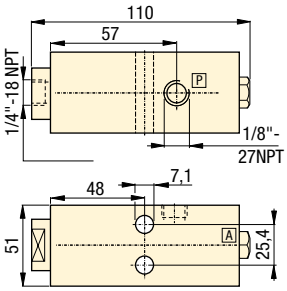
VAS-42



QE-375

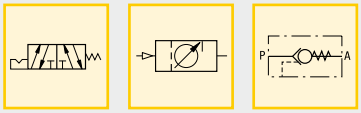


HV-1000A



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 ▶

Economy electric pumps *Application & selection*

Shown: WUD-1301E

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.

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.

WUD-1100 series

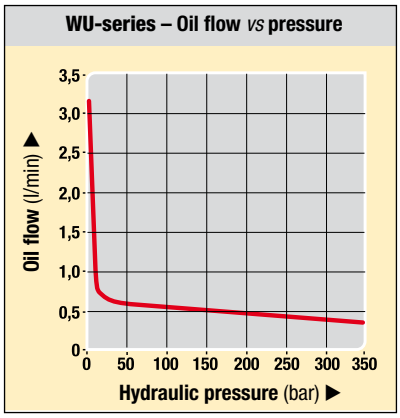
- Provides advance/auto-retract of single-acting cylinders
- 3 meters pendant controls motor and valve operation
- Use with AP-500 accumulator coupler package.

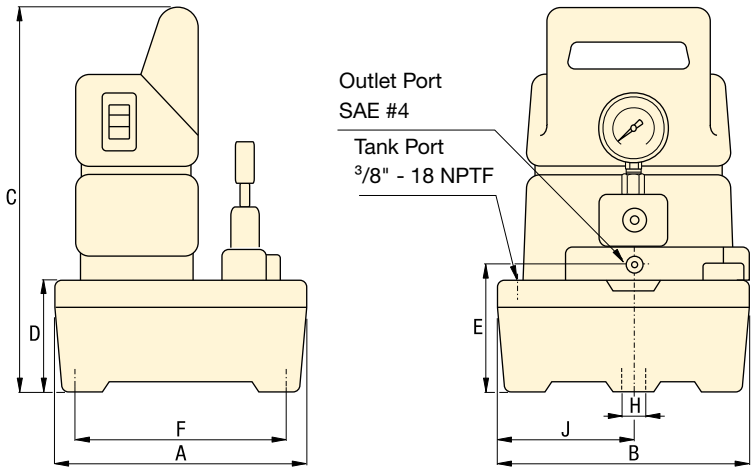
WUD-1300 series

- 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	
litres										kg
1,9	**WUD-1100B**	244	244	362	102	120	203	10	133	11,8
3,8	**WUD-1100B**	368	309	374	105	130	324	10	143	15,9
1,9	**WUD-1100E**	244	244	362	102	120	203	10	133	11,8
3,8	**WUD-1100E**	368	309	374	105	130	324	10	143	15,9
1,9	**WUD-1300B**	244	244	362	102	120	203	10	133	11,8
3,8	**WUD-1300B**	368	309	374	105	130	324	10	143	15,9
1,9	**WUD-1300E**	244	244	362	102	120	203	10	133	11,8
3,8	**WUD-1300E**	368	309	374	105	130	324	10	143	15,9

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

* 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.

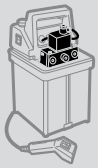
Best performance for mid-range cylinders

- 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

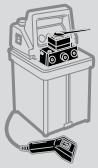
WED-series with dump valve

- 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.

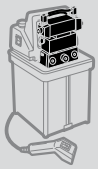


WEM-series with manual valve

- 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

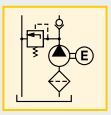
Motor: 0,37 kW

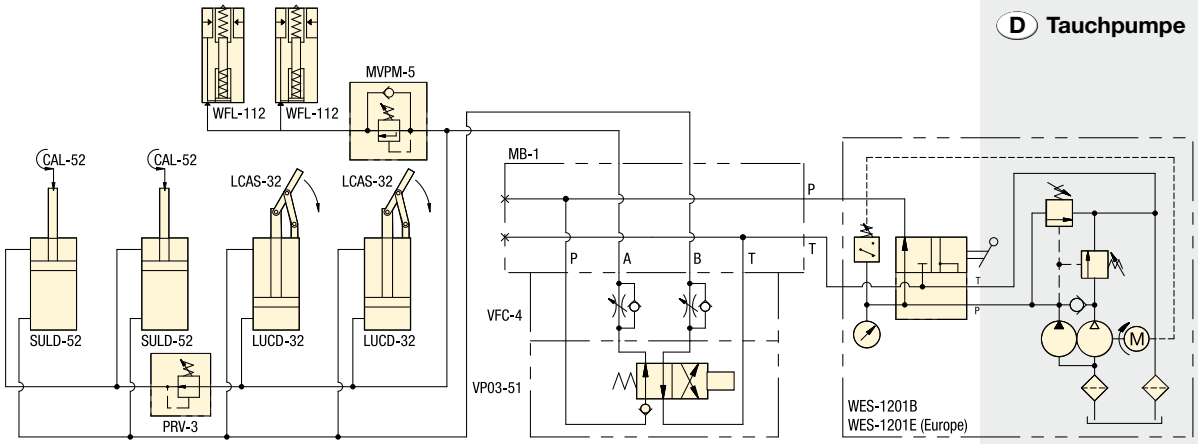
Reservoir: 5,7 litres

(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	**WED-1101B**	115V	
Single-Acting	Advance / Retract	Dump	**WED-1101E**	230V	
Single-Acting	Advance / Retract	Jog	**WEJ-1201B**	115V	
Single-Acting	Adv. / Hold / Retr.	Jog	**WEJ-1301B**	115V	
Double-Acting	Adv. / Hold / Retr.	Jog	**WEJ-1401B**	115V	
Single-Acting	Advance / Retract	Manual 3/2	**WEM-1201B**	115V	
Single-Acting	Advance / Retract	Manual 3/2	**WEM-1201D**	115V	●
Single-Acting	Advance / Retract	Manual 3/2	**WEM-1201E**	230V	
Single-Acting	Advance / Retract	Manual 3/2	**WEM-1201F**	230V	●
Single-Acting	Adv. / Hold / Retr.	Manual 3/3	**WEM-1301B**	115V	
Single-Acting	Adv. / Hold / Retr.	Manual 3/3	**WEM-1301F**	230V	●
Double-Acting	Adv. / Hold / Retr.	Manual 4/3	**WEM-1401D**	115V	●
Double-Acting	Adv. / Hold / Retr.	Manual 4/3	**WEM-1401E**	230V	
Single-Acting	Adv. / Hold / Retr.	Solenoid	**WER-1301B**	115V	
Single-Acting	Adv. / Hold / Retr.	Solenoid	**WER-1301D**	115V	●
Single-Acting	Adv. / Hold / Retr.	Solenoid	**WER-1301E**	230V	
Double-Acting	Adv. / Hold / Retr.	Solenoid	**WER-1401B**	115V	
Double-Acting	Adv. / Hold / Retr.	Solenoid	**WER-1401D**	115V	●
Double-Acting	Adv. / Hold / Retr.	Solenoid	**WER-1401F**	230V	●
Single-Acting	Advance / Retract	Manual 3/2	**WES-1201B**	115V	
Single-Acting	Advance / Retract	Manual 3/2	**WET-1201B**	115V	
Single-Acting	Adv. / Hold / Retr.	Manual 3/3	**WES-1301B**	115V	
Single-Acting	Adv. / Hold / Retr.	Manual 3/3	**WES-1301E**	230V	
Double-Acting	Adv. / Hold / Retr.	Manual 4/3	**WES-1401B**	115V	
Double-Acting	Adv. / Hold / Retr.	Manual 4/3	**WES-1401E**	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

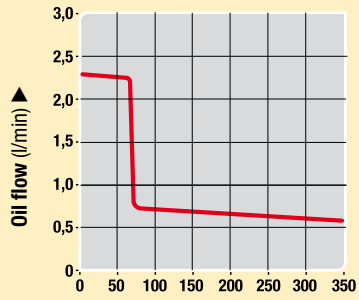
Shown: WEM-1401E

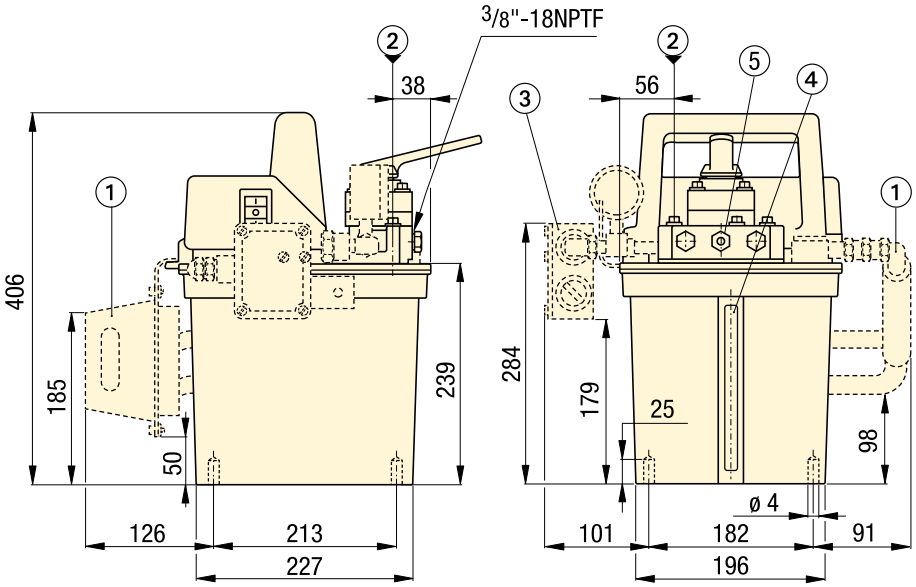
◀ For full features see page 110.

WER series

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

WE-series – Oil flow *vs* pressure





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** l/min		Pressure rating bar		Usable oil capacity	Adjustable relief valve	
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 [1)]
230V-1ph	0,37	6,75	2,45	0,65	70	350	5,5	70 - 350	29 [1]

[1)] Weight for WES and WET models is 37 kg.
** All flow data at 50 Hz.

Electric submerged pumps ordering matrix

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.

W	E	M	-	1	3	01	E
1 Product Type	2 Motor Type	3 Pump Type		4 Pump Series	5 Valve Type	6 Reservoir Capacity	7 Motor Voltage

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

Ordering example 2

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).

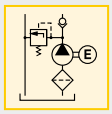
Flow: 0,65 l/min

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.

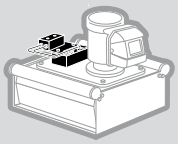
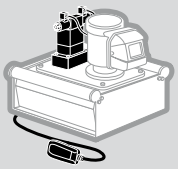
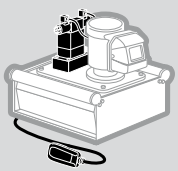
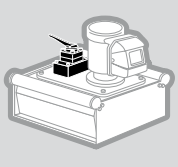
Electric pumps *Application & selection*

Shown: ZW5020HE-FT22

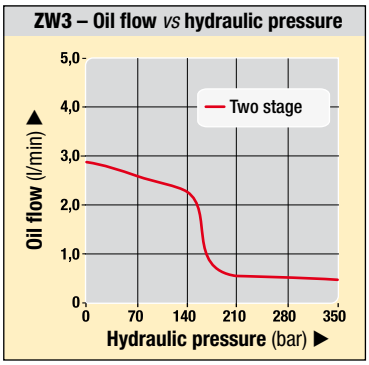
Z-Class electric pumps are designed for use in the harshest manufacturing environments. The pumps provide reliable and durable performance in a wide variety of configurations.

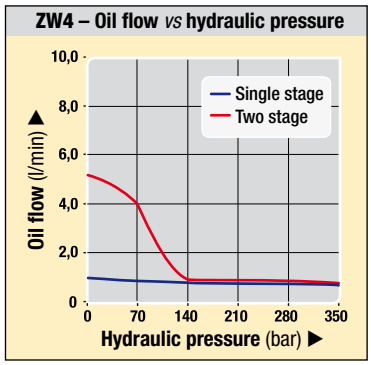
The standard for workholding applications

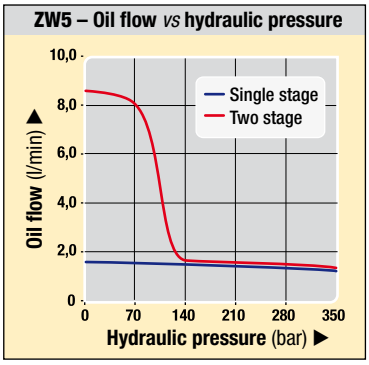
- Features Z-Class high-efficiency pump design; higher oil flow and by-pass pressure, cooler running and requires 18% less current than comparable pumps
- Totally enclosed, fan cooled industrial electric motors supply extended life and stand up to harsh industrial environments
- Multiple valve and reservoir 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.

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

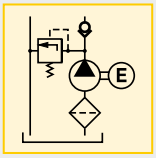
Motor: 0,75 - 1,12 kW

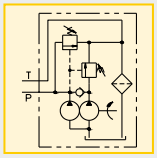
Reservoir: 8 - 40 litres

(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

- 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.

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) **Tauchpumpe**

ZW-series

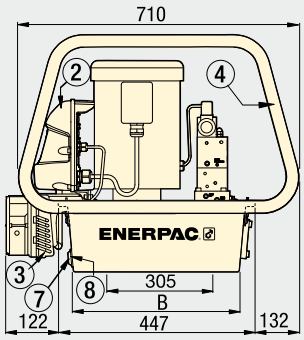
Z-Class electric pumps are designed for use in the harshest manufacturing environments. The pumps provide reliable and durable performance in a wide variety of configurations.

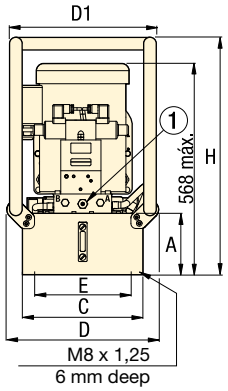
Options

User adjustable relief valve

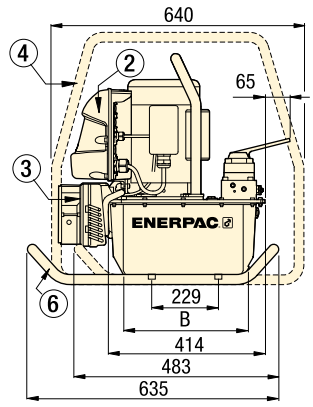
All ZW-Series have a user adjustable relief valve to allow the operator to easily set the optimum working pressure.

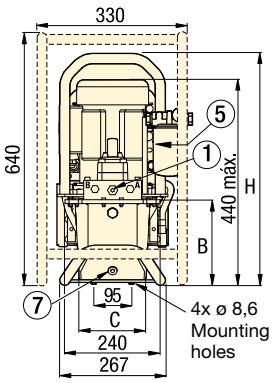
10, 20, 40 litres





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 [ ]

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

Output flow rate at 50 Hz (l/min)					Pump series	Motor size	Relief Valve adjustment range	Sound level
7 bar	50 bar	115 bar	210 bar	350 bar		kW	bar	dBA
2,80	2,68	2,32	0,54	**0,54**	**ZW3 ***	0,75	70 - 350	75
5,19	4,17	–	0,86	**0,82**	**ZW4**	0,75	70 - 350	75
8,74	8,23	–	1,68	**1,64**	**ZW5**	1,12	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:**

Z	W	4	0	20	H	G	-	FG	01
1 Product Type	2 Motor Type	3 Flow Group	4 Valve Type	5 Usable Oil Capacity	6 Valve Operation	7 Voltage	8 Options [1]		9 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**)

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.

7 Power supply
Single Phase
B = 115V, 1 ph, 50-60 Hz [3]
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

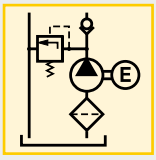
8 Options [*2]
F = Return line filter, 25 micron
G = 0-420 bar pressure gauge, 63,5 mm [5]
H = Heat exchanger [4]
L = Level/temperature switch [4]
N = No handles (lifting eyes only) [2]
P = Pressure switch [4]
R = Roll bars
S = Single stage
T = Pressure transducer [4]
U = Foot switch [4]

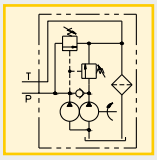
9 Manifold options [5] (Pump types G and H only)
01 = Pressure & tank porting manifold
11 = Single station D03
12 = VP series manifold
13 = Single station CETOP
21 = 2 station D03
22 = 2 station CETOP
41 = 4 station D03
42 = 4 station CETOP

1 Options should be specified in alphabetical order.
2 Unless specified, all pumps are supplied with reservoir handles.
3 115 volt pumps are supplied with CE and CSA approved 15 Amp plug for intermittent use. 20 Amps circuit recommended for frequent full pressure use.
4 These options require LCD electrical package.
5 Pressure gauge not available on pump models with pressure transducer. Pressure transducer provides digital pressure readout on LCD display.
6 Pressure switch option is only used as input to a customer control. It is not used with the LCD electrical package.

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 Spannpumpe





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.

Return line filter — ZPF-series

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

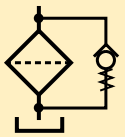
Pressure: max. 13,8 bar

Max. flow: 45,4 l/min

(E) **Filtro**

(F) **Filtre**

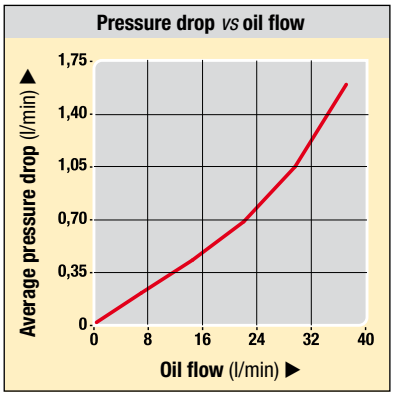
(D) **Filter**



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	
micron		bar	l/min	bar		kg
25	**ZPF**	13,8	45,4	1,7	●	1,5

Transfer: 900 Btu/h

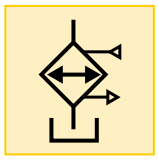
Pressure: max. 21 bar

Voltage: 24V

(E) **Intercambiador de calor**

(F) **Échangeur de chaleur**

(D) **Wärmetauscher**



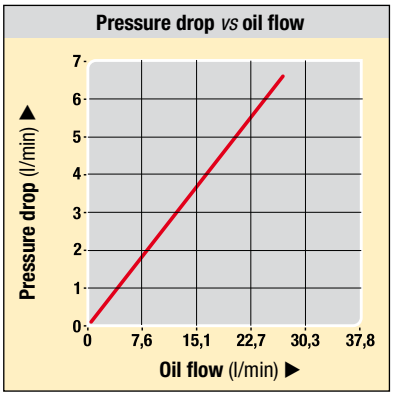
Extends system life

- 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	
VDC		Btu/h	kJoule	A	bar	l/min	kg
24	**ZHE-E10**	900	950	0,95	21	26,5	4,0

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

www.enerpacwh.com

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	**ZLS-U4**	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

Pressure: 3,5 - 700 bar

Voltage: 115 VAC / 24 VDC

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

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

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.

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.

Product Selection

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

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

Pressure: 350 bar

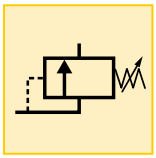
Stations: 1-4 valves horizontal

Stations: 1-8 valves vertical

(E) **Colectores**

(F) **Manifolds**

(D) **Verkettungsblöcke**



Increased flexibility for complex systems

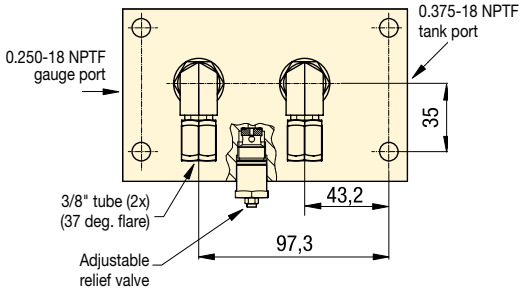
- Manifolds provide hydraulic connection to remote or pump mounted valves
- Used when multiple valves are required for controlling several independent circuits
- Available for 2 and 4 station D03 as well as Enerpac VP series mounting
- Pressure and tank porting manifold available for use with remote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

Shown: MB-2, -4

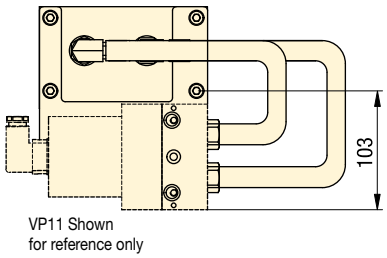
MB series

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.

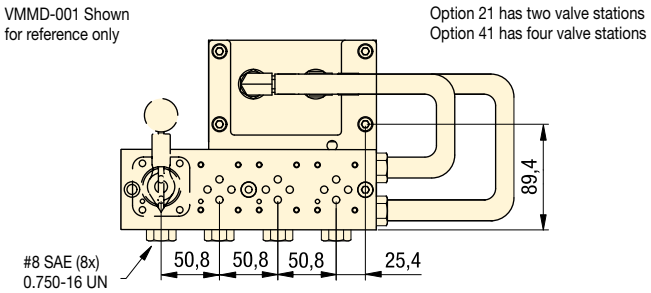
Option 01



Option 12



Option 21, 41



Options

Pressure transducer
120

Level switch
120

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

Product Selection

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

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.

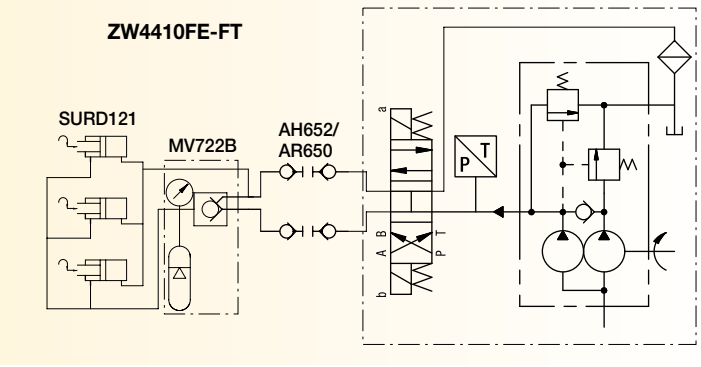
AUTO mode *with timer*
Pump runs until pressure setting is reached, and adjustable timer runs out.

Automatic pressure control for palletized fixtures

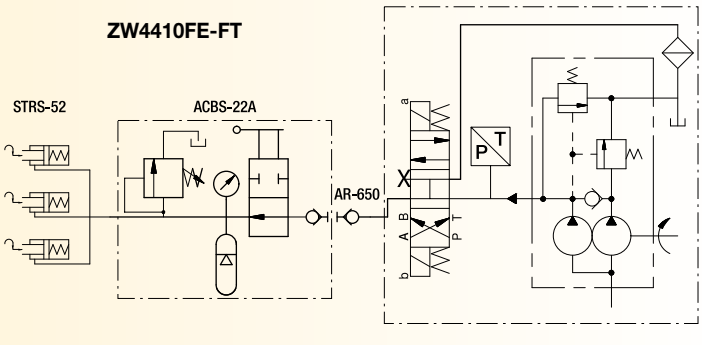
- Programmable clamp and unclamp pressure settings increase automation capability
- Programmable dwell settings ensure desired pressure level is maintained on large circuits or circuits with accumulators
- Remote pendant features sealed switches for improved operator safety
- Backlit LCD provides pump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

Example Circuits

- Double-acting circuit



- Single-acting circuit



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

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	**ZW3408DB-FT**	70-350	75	8	52
		115-1-50	**ZW3410DB-FT**		75	10	61
		230-1-50	**ZW3408DE-FT**		75	8	52
		230-1-50	**ZW3410DE-FT**		75	10	61
0,82	0,75	115-1-50	**ZW4410DB-FT**	70-350	75	10	54
		230-1-50	**ZW4410DE-FT**				
		400-3-50	**ZW4410DW-FT**				
1,64	1,12	115-1-50	**ZW5410DB-FT**	70-350	75	10	58
		230-1-50	**ZW5410DE-FT**				
		400-3-50	**ZW5410DW-FT**				

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.

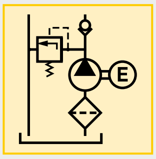
With DWELL timer set greater than zero: operator starts the motor by pressing the up (or down) arrow on the pendant. Once the pump reaches the programmed setting, the DWELL timer starts. When the timer runs out, the motor stops and pressure in the hoses is relieved.

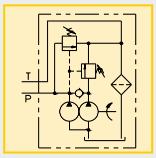
Flow: 0,54 - 1,64 l/min

Pressure: 350 bar

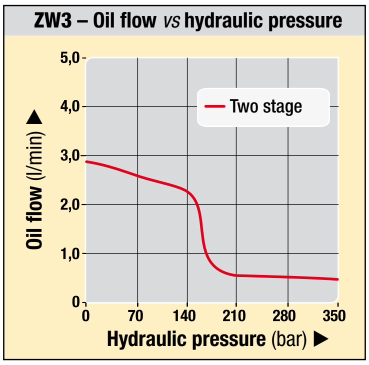
Motor: 0,75 - 1,12 kW

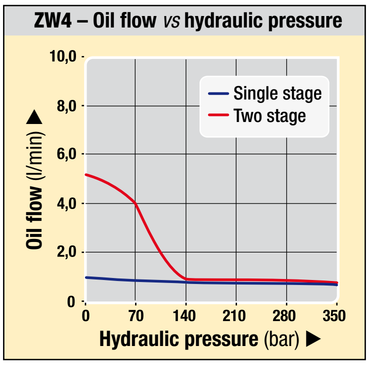
Reservoir: 8,0 - 40,0 litres

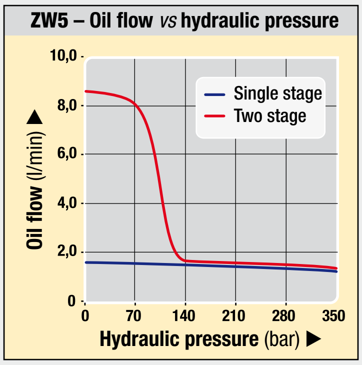




Output oil flow versus hydraulic pressure





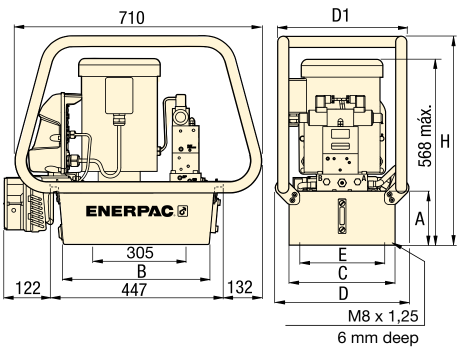


Important

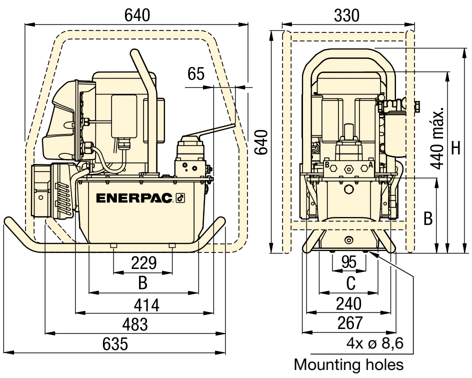
Enerpac recommends a pressure differential of no less than 14 bar for most applications. If you believe your application requires a tighter differential, please contact us directly.

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

10, 20, 40 litres



8 litres



Product dimensions in mm [⊳⊕]

Usable oil capacity (litres)	Model number	A	B	C	D	D1	E	H	kg ZW3	kg ZW4	kg ZW5
8	**ZW**xx**08**xx	206	279	206	—	—	—	574	42	42	47
10	**ZW**xx**10**xx	155	412	305	384	371	279	599	49	49	52
20	**ZW**xx**20**xx	180	412	422	500	488	396	625	61	61	65
40	**ZW**xx**40**xx	269	399	506	577	572	429	714	84	84	87

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.

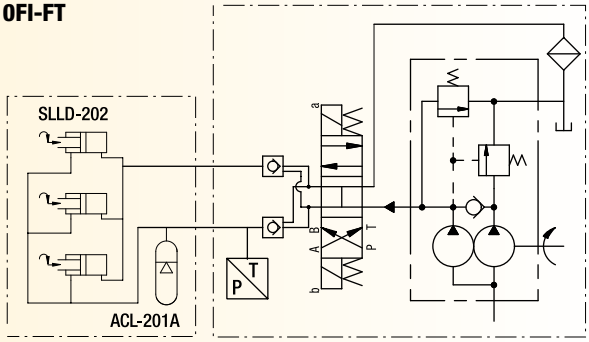
Automatic pressure control for continuous connection fixtures

- 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

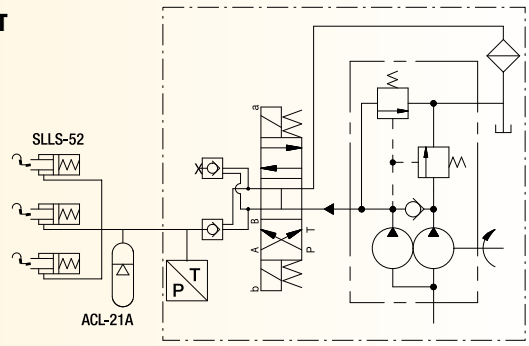
- Double-acting circuit

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	dBA	litres	kg
0,54		0,75	115-1-50	**ZW3408FB-FT**	70-350	75	8	52
			115-1-50	**ZW3410FB-FT**		75	10	61
			230-1-50	**ZW3408FI-FT**		75	8	52
			230-1-50	**ZW3410FI-FT**		75	10	61
0,82		0,75	115-1-50	**ZW4410FB-FT**	70-350	75	10	54
			230-3-50	**ZW4410FG-FT**				
			460-3-50	**ZW4410FJ-FT**				
1,64		1,12	115-1-50	**ZW5410FB-FT**	70-350	75	10	58
			230-3-50	**ZW5410FG-FT**				
			460-3-50	**ZW5410FJ-FT**				

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.

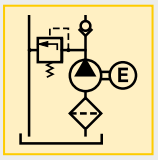
AUTO mode: The operator turns the pump motor on, and then presses and holds the up arrow on the pendant. When the customer-programmed HI PRESS setting is reached, the valve shifts to neutral, but pressure is maintained in the clamp circuit by the pilot-operated check valve. If pressure drops below the 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.

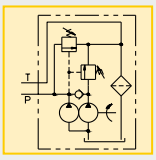
Flow: 0,54 - 1,64 l/min

Pressure: 350 bar

Motor: 0,75 - 1,12 kW

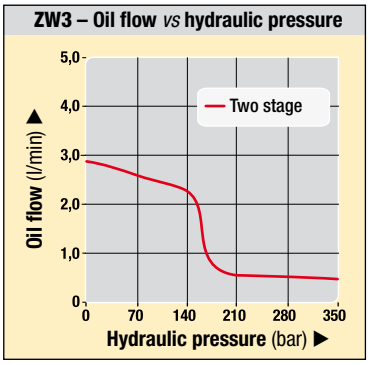
Reservoir: 8 - 40 litres



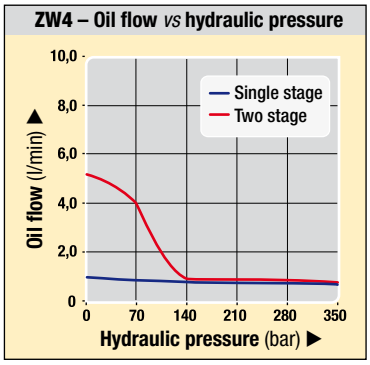


Output oil flow versus hydraulic pressure

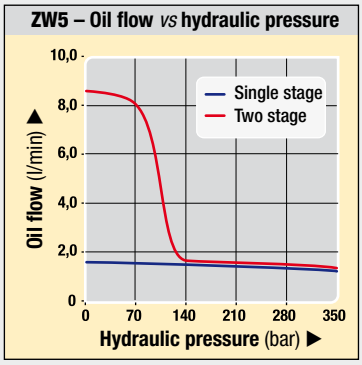
ZW3 – Oil flow *vs* hydraulic pressure



ZW4 – Oil flow *vs* hydraulic pressure



ZW5 – Oil flow *vs* hydraulic pressure

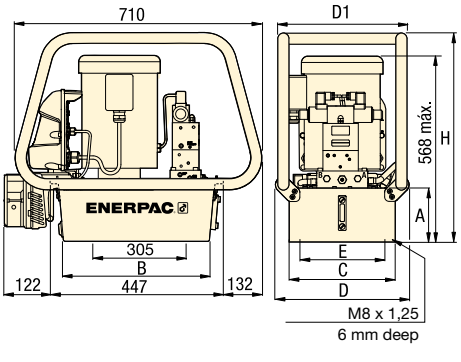


Important

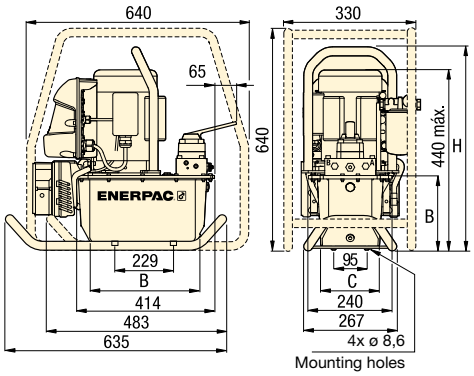
Enerpac recommends a pressure differential of no less than 14 bar for most applications. If you believe your application requires a tighter differential, please contact us directly.

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

10, 20, 40 litres



8 litres



Product dimensions in mm [⊕]

Usable oil capacity litres	Model number	A	B	C	D	D1	E	H	kg ZW3	kg ZW4	kg ZW5
8	**ZW**xx**08**xx	206	279	206	—	—	—	574	42	42	47
10	**ZW**xx**10**xx	155	412	305	384	371	279	599	49	49	52
20	**ZW**xx**20**xx	180	412	422	500	488	396	625	61	61	65
40	**ZW**xx**40**xx	269	399	506	577	572	429	714	84	84	87

Options

Heat exchanger ▶119

Level switch ▶120

Pressure transducer ▶120

Return line filter ▶118

Single station D03 pumps *Application & selection*

Shown: ZW4010GE-11

DO3 valve mounting style

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

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.

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.

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**				

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.

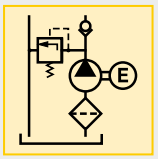
The use of the ZPF Return Line Filter is recommended. If the pump is to be run at pressure at a relief valve setting, the ZHE-E10 Heat Exchanger is also recommended. For monitoring of the oil level and temperature, use the ZLS-U4 Level/Temp Switch. For pump shutdown at pressure, the ZPS-W4 Pressure Switch 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.

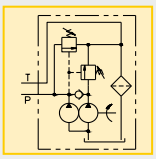
Flow: 0,54 - 1,64 l/min

Pressure: 350 bar

Motor: 0,75 - 1,1 kW

Reservoir: 8 - 40 litres

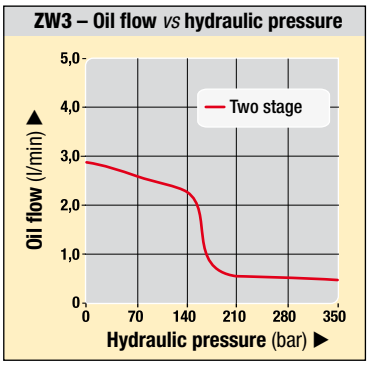


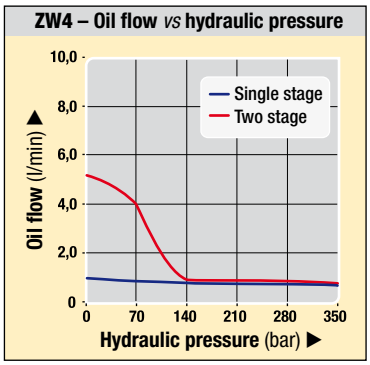


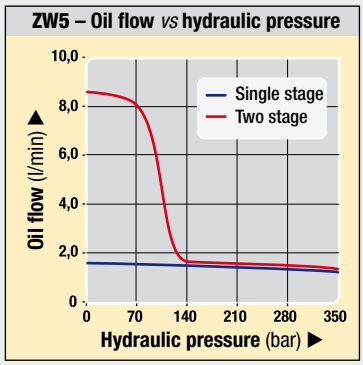
Important

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.

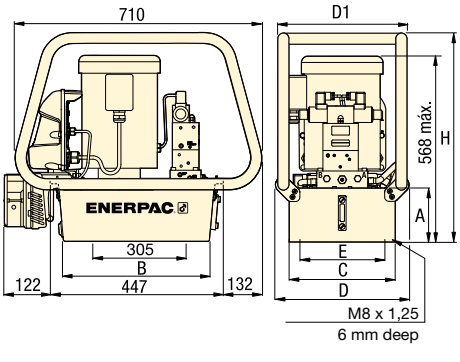
Output oil flow versus hydraulic pressure



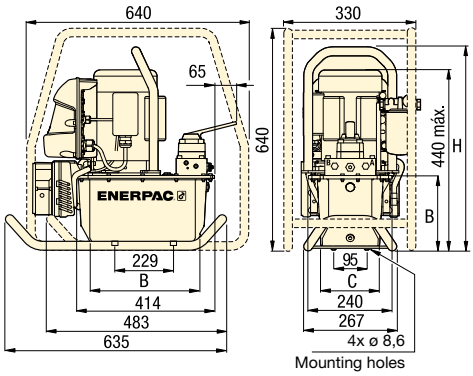




10, 20, 40 litres



8 litres



Product dimensions in mm [⊳⊕]

Usable oil capacity litres	Model number	A	B	C	D	D1	E	H	kg ZW3	kg ZW4	kg ZW5
8	**ZW**xx**08**xx	206	279	206	—	—	—	574	42	42	47
10	**ZW**xx**10**xx	155	412	305	384	371	279	599	49	49	52
20	**ZW**xx**20**xx	180	412	422	500	488	396	625	61	61	65
40	**ZW**xx**40**xx	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

Electric Driven Workholding Pumps *Application & selection*

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.

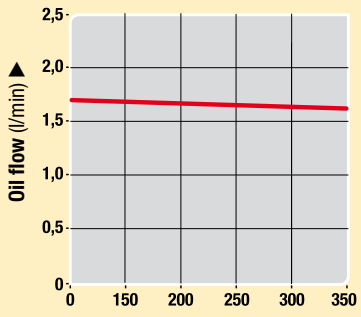
Enerpac electric pump used in conjunction with swing cylinders, work supports, directional valves, control valves and sequence valves can provide a complete clamping solution. The pressure switch allows the unit to be fully automated.

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

ZW5 – Oil flow *vs* hydraulic pressure



Product selection

Oil flow rate	Pressure range	Voltage and current 50 Hz	Usable oil capacity[2]	Valve models included	Model number	
l/min	bar	V @ A	litres			kg
▼ With manifold for VP-series modular valves, no electric controls						
1,64	100-350	230 @ 4,8	10,0	–	**ZW5VPSEE100**	65
1,64	100-350	400 @ 2,4	10,0	–	**ZW5VPSWE100**	65
▼ With manifold for CETOP 03 valves, no electric controls						
1,64	100-350	230 @ 4,8	10,0	–	**ZW5C03SEE100**	65
1,64	100-350	400 @ 2,4	10,0	–	**ZW5C03SWE100**	65
▼ For 2x single-acting circuits						
1,64	100-350	230 @ 4,8	10,0	1x VP-41	**ZW5141SEE100**	77
1,64	100-350	400 @ 2,4	10,0	1x VP-41	**ZW5141SWE100**	77
▼ For 1x double-acting circuits + isolating valve [1] for A-port						
1,64	100-350	230 @ 4,8	10,0	1x VP-11	**ZW5111SEE100**	77
1,64	100-350	400 @ 2,4	10,0	1x VP-11	**ZW5111SWE100**	77
▼ For 2x double-acting circuits + isolating valves [1] for all A-ports						
1,64	100-350	230 @ 4,8	10,0	2x VP-11	**ZW5211SEE100**	80
1,64	100-350	400 @ 2,4	10,0	2x VP-11	**ZW5211SWE100**	80

[1] Isolating valve is pressure switch PSCK-8.
[2] ZW5-series pumps comes standard with 8 litres reservoir. (4 , 8, 20 or 40 reservoir is optional).

Flow: 1,64 l/min

Pressure: 100 - 350 bar

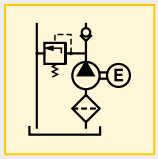
Motor: 1,1 kW

Reservoir: 4 - 40 litres

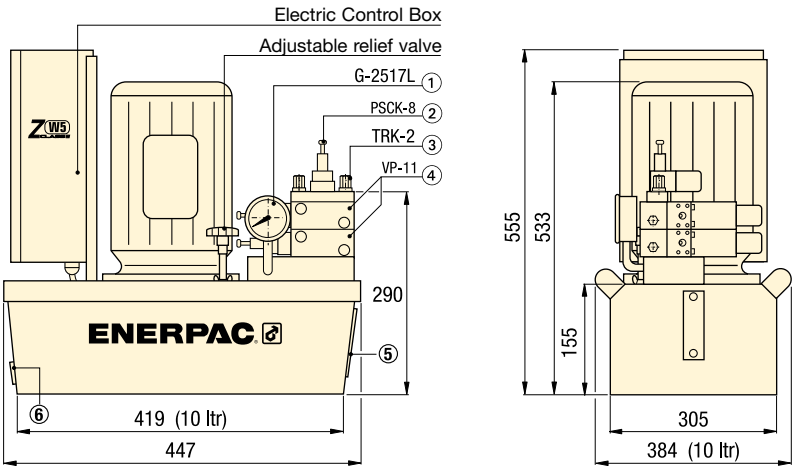
Ⓔ **Bombas eléctricas**

Ⓕ **Centrale hydraulique**

Ⓓ **Modulare Spannpumpe**



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



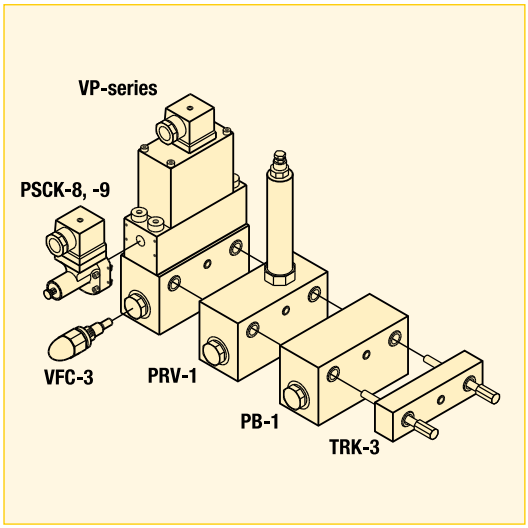
①Pressure gauge
②Pressure switch
③Tie Rod Kit
④Directional valve
⑤Oil level glass
⑥Oil drain

Product selection

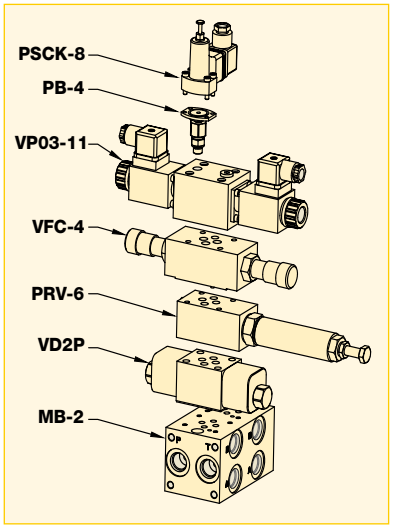
Pump series	Voltage	Phase	Continuous operation at 350 bar	Motor capacity	Motor speed	Motor protection class	Sound Level
	Volt			kW	RPM		dBA
ZW5....	230	1	50%	1,1	1390	IP54	75
ZW5.....	400	3	50%	1,1	1390	IP54	75

Valve options

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



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



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**

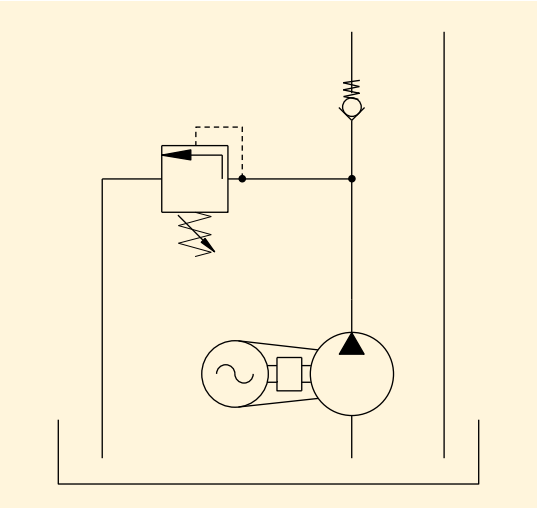
ZW5 series

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.

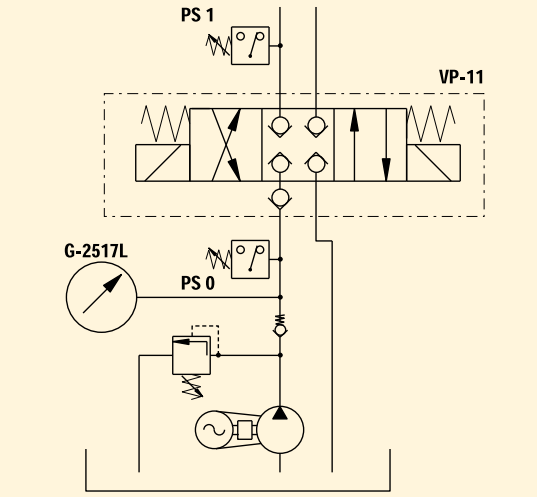
ZW5VPSEE100 with manifold for VP-series or CETOP 03 valves, without electric controls and gauge



Basic pumps

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

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



Isolating valves

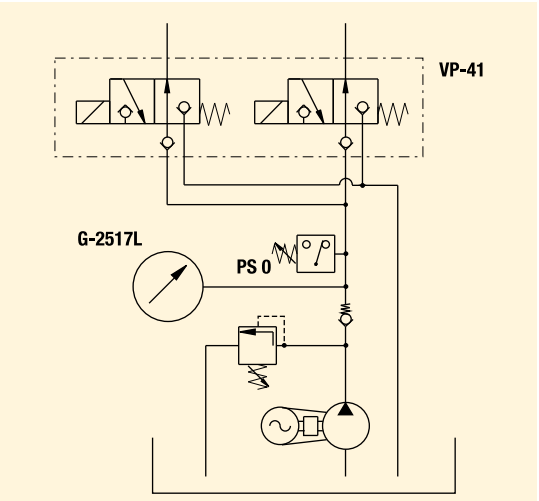
For applications where clamping pressure has to be maintained, isolating valves are an economic and safe solution.

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.

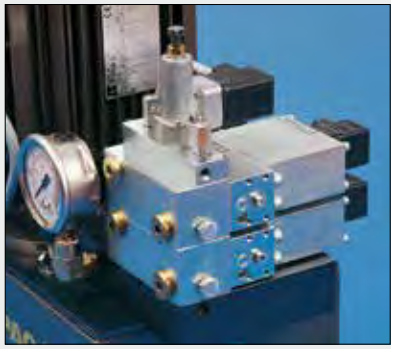
For some particular applications, i.e., when a workpiece has to be positioned and clamped with different forces, you can set different isolating valve pressures for the independent circuits.

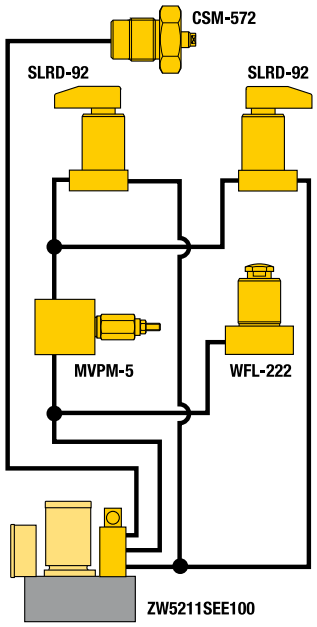
Pressure switch (PS 0) switches the motor off at maximum pressure; in case of pressure drop due to activating circuits, the motor restarts.

ZW5141SEE100 For 2x Single-Acting circuits

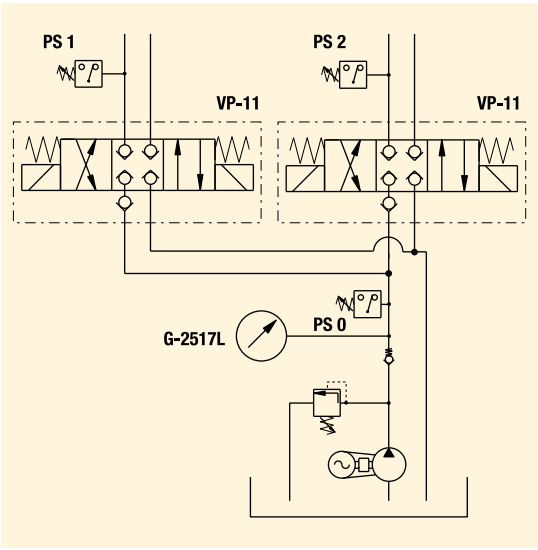


Enerpac VP-series valves stackbuilt on ZW5211SWE100. The pressure switch PSCK-8 is mounted directly onto the endplate of Tie Rod Kit TRK-2.





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



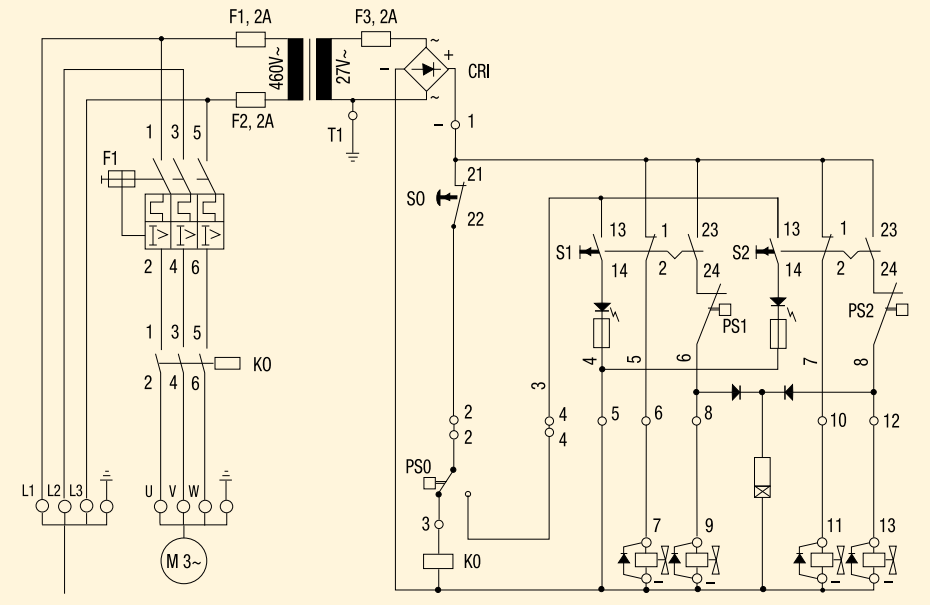
Application example

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

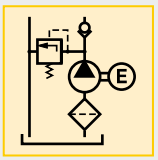
Motor: 1,1 kW

Reservoir: 4 - 40 litres

(E) **Bombas eléctricas**

(F) **Centrale hydraulique**

(D) **Modulare Spannpumpe**



Options

Sequence valves 152 ▶

Flow control valves 155 ▶

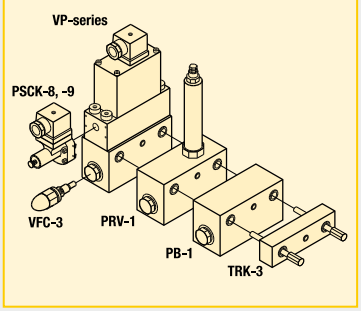
Hoses and couplers 192 ▶

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 cm³/stroke

Pressure: 210 - 700 bar

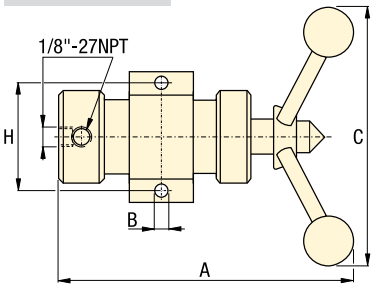
Reservoir: 0,1 - 0,9 litres

(E) Bombas manuales

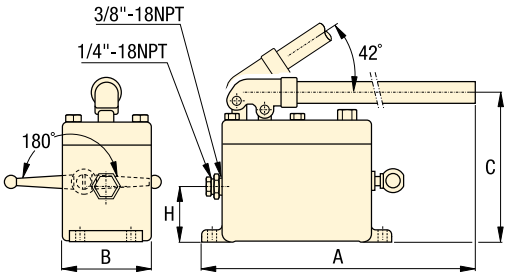
(F) Pompes à main

(D) Handpumpen

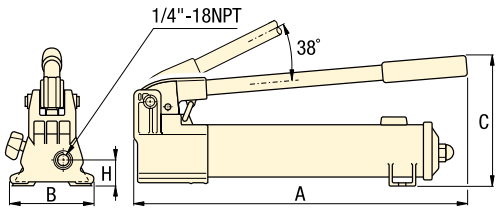
SP-621



P-51



P-141, -142, -202



Options

Fittings ▶194

Hoses ▶192

Hydraulic oil ▶193

Important

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

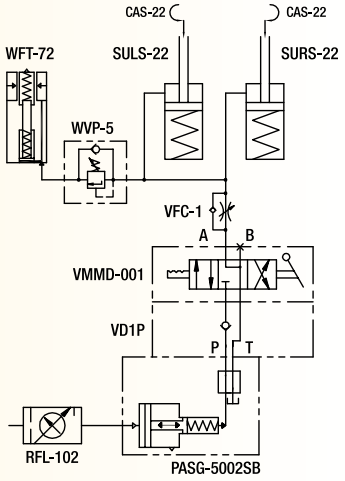
Product selection

Maximum hydraulic pressure	Usable oil capacity	Model number	Pressure rating (bar)		Oil volume per stroke (cm³)		Piston stroke	Maximum handle effort	Dimensions (mm)				
bar	cm³		1st stage	2nd stage	1st stage	2nd stage	mm	kg	A	B	C	H	kg
▼ **Single speed**													
210	100	**SP-621**	–	210	–	[1]	[1]	27 [2]	256	10	315	72	3,2
210	820	**P-51**	–	210	–	4,10	25,4	28	660	92	160	57	5,5
700	325	**P-141**	–	700	–	0,90	12,7	33	336	95	143	29	2,0
▼ **Two speed**													
350	325	**P-142**	13,8	700	3,62	0,90	12,7	35	336	95	143	29	2,0
350	325	**P-142-5000**	13,8	350	3,62	0,90	12,7	35	336	95	143	29	2,0
700	900	**P-202**	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 cm³ of oil.
2) Handle effort on SP-621 is 81 Nm at 210 bar

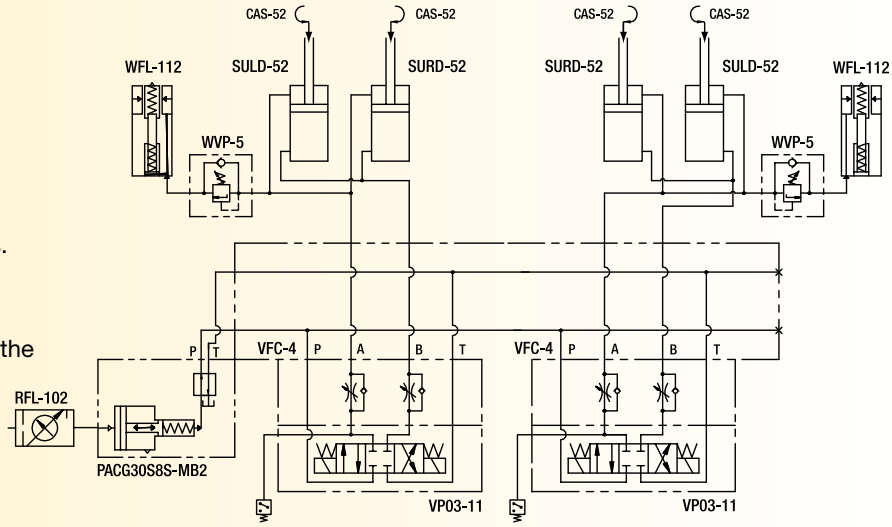
Air Powered Pump with Manual Valve

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.



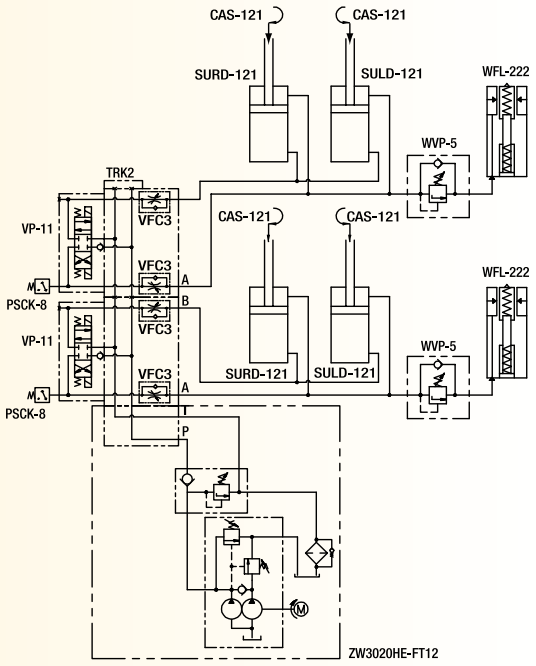
Air Powered Pump with Dual Solenoid Valves

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

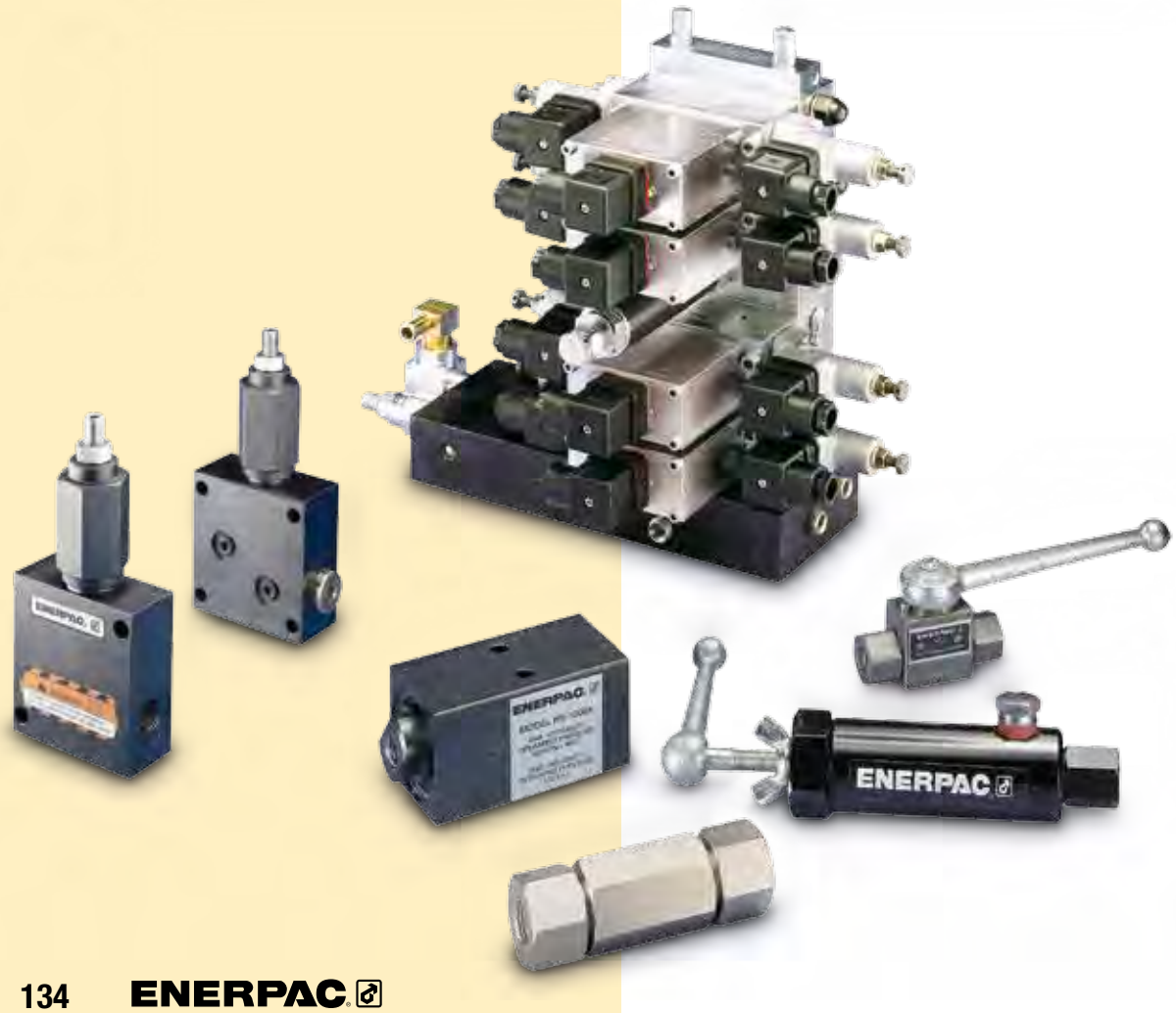
Technical support

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.



Shown: VP-12

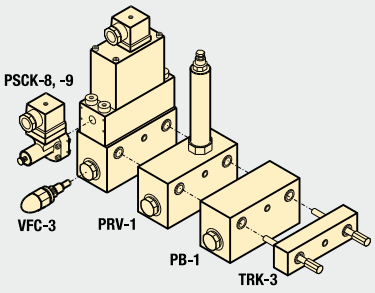
VP-series

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

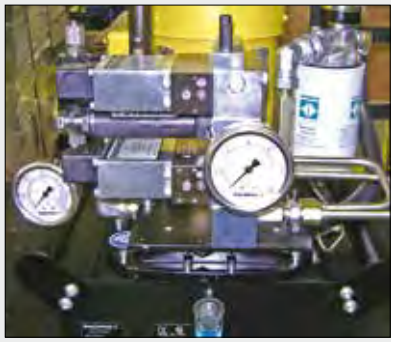
Application

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.

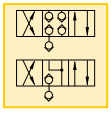
Pressure: 350 bar

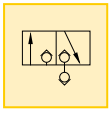
Max. Flow: 15 l/min

(E) **Válvulas de control**

(F) **Electrodistributeurs**

(D) **Wegesitzventile**



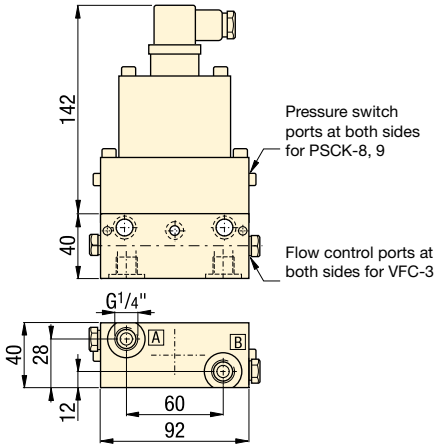


Options

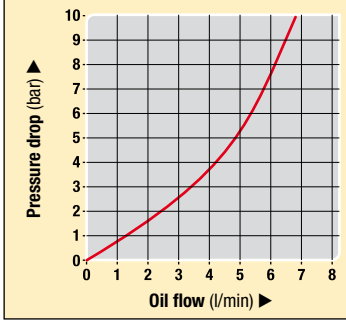
WM-10 remote manifold
139

TRK-series Tie rod kits
139

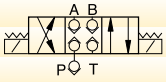
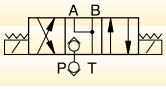
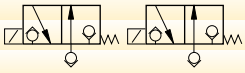
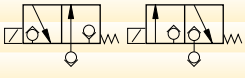
VP series



Oil flow *vs* pressure drop



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	**VP-11**		1x Double-acting
110 VAC @ 500 mA	**VP-12**		1x Double-acting
▼ 4/3 Float center			
24 VDC @ 1,13 A	**VP-21**		1x Double-acting
110 VAC @ 500 mA	**VP-22**		1x Double-acting
▼ 3/2 Normally closed			
24 VDC @ 1,13 A	**VP-31**		1x 1x Dbl-act. / 2x Sgl-act.
110 VAC @ 500 mA	**VP-32**		1x Dbl-act. / 2x Sgl-act.
▼ 3/2 Normally open			
24 VDC @ 1,13 A	**VP-41**		1x Dbl-act. / 2x Sgl-act.
110 VAC @ 500 mA	**VP-42**		1x Dbl-act. / 2x Sgl-act.
▼ 3/2 1 port normally closed, 1 port normally open			
24 VDC @ 1,13 A	**VP-51**		1x Dbl-act. / 2x Sgl-act.
110 VAC @ 500 mA	**VP-52**		1x Dbl-act. / 2x Sgl-act.

Note: DIN 43650 electrical connector included. Valve weight 3,0 kg.

Pressure: 350 bar

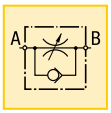
Flow: 7 l/min @ 350 bar

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

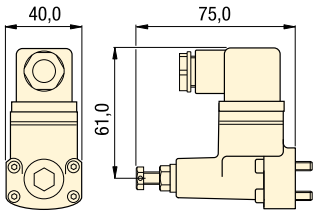
PB-1 Auxiliary block

139

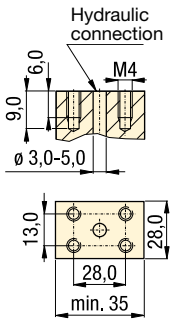
Pressure reducing valves

138

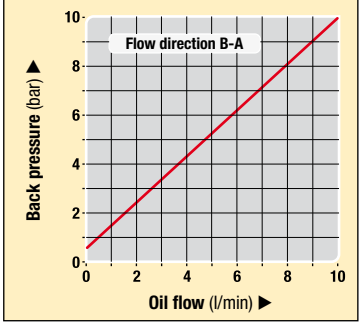
PSCK-8, 9



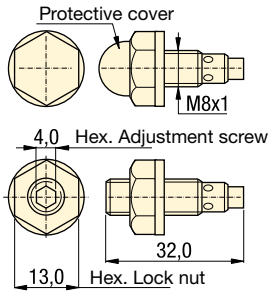
PSCK-8, 9 mounting dimensions



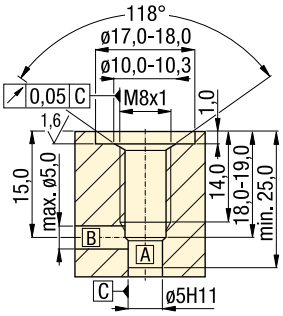
VFC-3 Back pressure *vs* flow return



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.

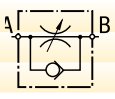
VFC-3

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.

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	**VFC-3**		0-350	–	7
valve					

PSCK-8 and VFC-3 directly mounted on VP-valves.

Shown: PRV-1

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

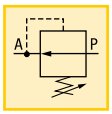
Pressure: 350 bar

Flow: 7 l/min

(E) Válv. reguladora de presión

(F) Valve de pression réglable

(D) Druckreduzierventil



PRV series

These valves regulates 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.

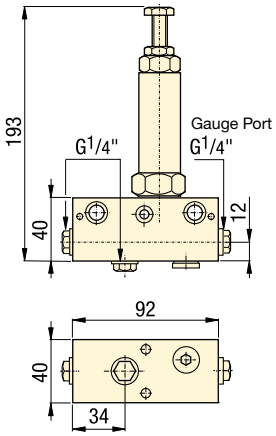
Options

VP-series Modular valves
136

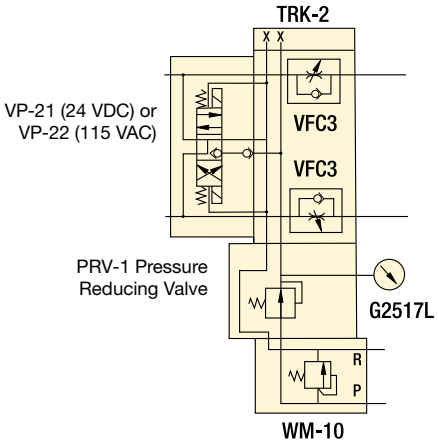
Pressure switches
188

TRK-series Tie rod kits
139

PRV-1, PRV-5



Valve stacking example



▼ *PRV-1 connected with remote manifold WM-10.*

Product selection

Mounting style	Adjustable pressure range	Maximum pressure	Model number	Oil ports	Maximum oil flow	
	bar	bar		BSPP	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

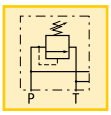
Pressure: 350 bar

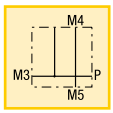
Flow: 15 l/min

(E) Pernos de montaje de válv.

(F) Vis de montage de distrib.

(D) Zugstangen





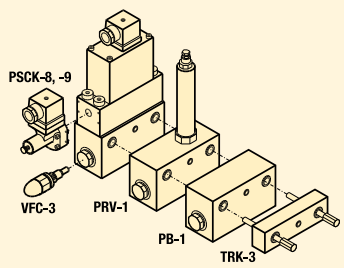
Options

Pressure switches 188

VP-series directional valves 130

Gauges 189

VP-series



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

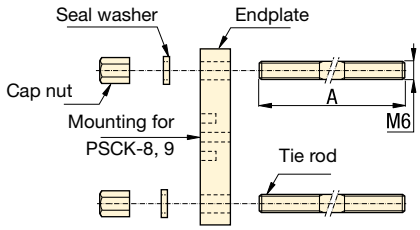
WM-10 remote manifold

- Allows remote VP-series valve mounting
- Adjustable relief valve incorporated
- G1/4" oil connection

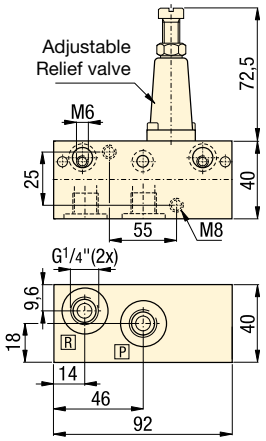
PB-1 porting manifold

- Provide 3 auxiliary pressure lines
- G1/4" oil connection

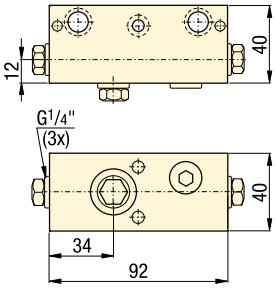
TRK



WM-10



PB-1



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.

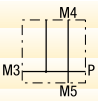
PB-1

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.

Product selection

Quantity of stackable VP-series directional valves	Model number	Tie rod length A	Mounting thread
		mm	mm
▼ Tie rod kits			
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
▼ Remote manifold with pressure relief			
2x G1/4"	WM-10		350
▼ Porting manifold (P port connection)			
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.

Zero leakage poppet valves increase efficiency

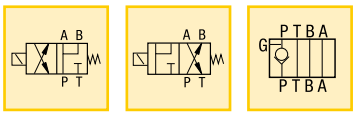
- Poppet valve design for zero leakage
- 4-way, 2-position float offset or normally open
- D03 or CETOP 3 mounting pattern
- DIN-standard rectifier plugs for easy connection to power source
- Air operated models eliminate need for electricity
- Including O-rings and mounting bolts
- SAE manifold ports simplify plumbing
- Inline check valve provides positive load holding

Pressure: 0 - 350 bar

Flow: 11 l/min max.

Voltage: 115 VAC, 24 VDC

(E) Electroválvulas
(F) Electrodistributeurs
(D) Elektromagnetische Ventile



Options

D03 Manifolds MB-series
144

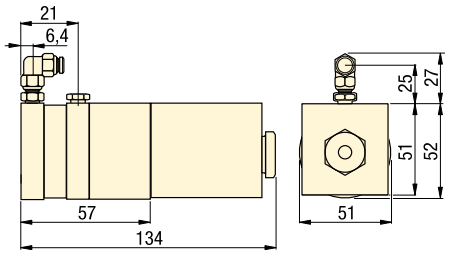
Fittings
194

Important

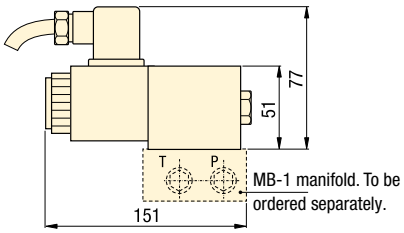
For multiple circuit applications, the VD1P inline check valve is recommended to prevent pressure drop on the holding circuit.

Order bolt kit BKD-71 to mount VD1P with VAS/VSS/VST valves.

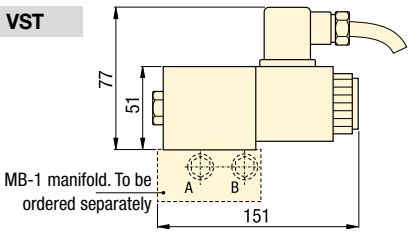
VAS, VAT



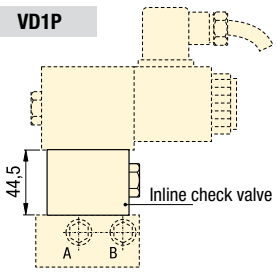
VSS



VST



VD1P



Product selection

Valve flow path	Solenoid voltage @ current at 50/60 Hz	Model number	Hydr. symbol	Pressure range bar	Pressure drop [1] bar	Max. oil flow l/min
▼ **Solenoid poppet valves – Normally open**						
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
▼ **Solenoid poppet valves – Normally closed**						
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
▼ **Inline check valve**						
–	–	**VD1P**		0-350	0	11,3

[1] Pressure drop from P-A or P-B at maximum oil flow of 11 l/min.

VSS-2210D mounted directly on a Turbo II air pump for use on positive clamping fixture.

Pressure: 0 - 350 bar

Flow: 6 - 57 l/min

Voltage: 24 VDC, 110 VAC

(E) **Electrovávulas**

(F) **Electrodistributeurs**

(D) **Elektromagnetische Ventile**

Options

D03 Manifolds MB-series

144

Fittings

194

VP03 Directional Valves and accessories

- D03/CETOP 3 mounting pattern
- Directional valves
- Pilot operated check valve
- Dual flow control
- Pressure reducing valve

Shown: VP03

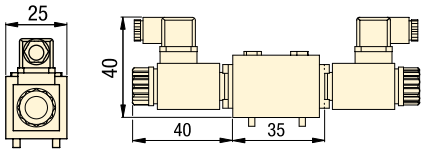
VP03-series

VP03 valves are zero leakage, solenoid operated poppet valves.

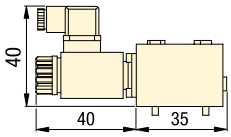
Application

Used to control the advance and retract of single acting and double acting cylinders.

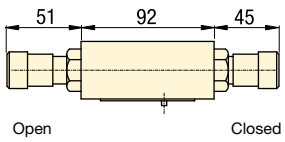
VP03-11, 12, 21, 22



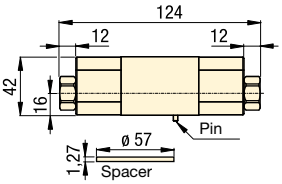
VP03-51, 52



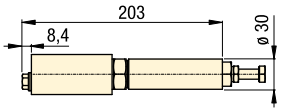
VFC-4



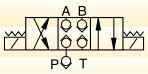
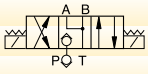
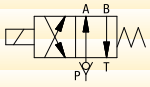
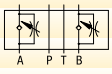
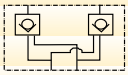
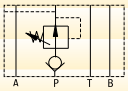
VD2P



PRV-6, PRV-7



Product selection

Valve flow path	Solenoid voltage 50/60 Hz	Model number	Hydraulic symbol	Pressure range bar	Maximum oil flow 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

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.

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) Electrovávulas

(F) Electrodistributeurs

(D) Elektromagnetische Ventile

Options

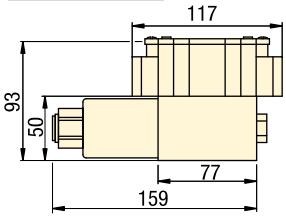
D03 Manifolds MB-series 144 ▶

Fittings 194 ▶

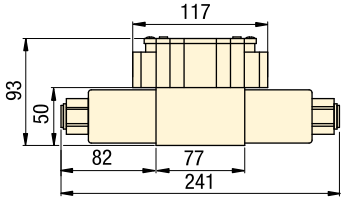
Important

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.

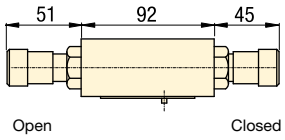
VEW-11



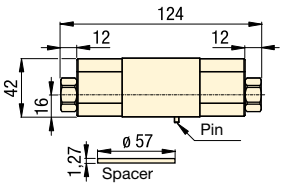
VET-11, VEX-11



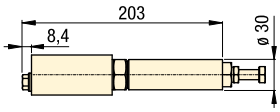
VFC-4



VD2P



PRV-6, PRV-7



Product selection

Valve flow path	Solenoid voltage 50/60 Hz	Model number	Hydraulic symbol	Pressure range bar	Pressure drop bar	Maximum oil flow l/min
4 way, 2 position	24 VDC 1,32 Amps	VEW-11		0-350	9	2,1
4/3 closed center	24 VDC 1,32 Amps	VET-11		0-350	10	2,1
4/3 float center	24 VDC 1,32 Amps	VEX-11		0-350	12	2,1
Dual flow control	–	VFC-4		0-350	–	2,6
Dual pilot operated check valve	–	VD2P		0-350	14	4,0
Pressure reducing valve	–	PRV-6 PRV-7		30-3000 5-138	–	0,8

VEX-11 valve on ZW5020HG-FT21 pump.

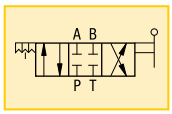
Pressure: 350 bar

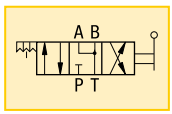
Flow: 0,8 - 4,0 l/min

(E) **Válvulas de control de 4 vias**

(F) **Distributeurs à 4 voies**

(D) **4-Wege-Ventiler**





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.

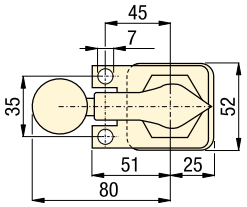
See page 145 for mounting bolt information.

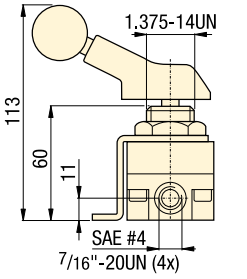
Pressure on return side (tank) should not exceed 17 bar.

Manual control of single and double-acting cylinders

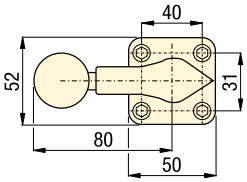
- Near zero leakage pressure seal design
- 4-way, 3-position
- Detented handle positions
- Low handle effort 5 kg, even at full pressure
- Handle can be repositioned for side by side valve mounting
- Compact size for directly mounting on fixture for individual circuit control
- D03/CETOP 3 mounting pattern

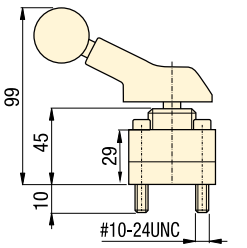
VMTD-001, 003



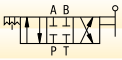


VMMD-001, -003





Product selection

Valve mounting pattern	Mounting bolts included	Oil ports	Model number	Hydraulic symbol	Pressure range bar	Pressure drop [1] bar	Max. oil flow l/min
▼ **4-way, 3-position control valves**							
Panel mtg.	–	SAE #4	**VMTD-001**		0-350	4,8	17
D03/CETOP 3	#10-24UN	–	**VMMD-001**		0-350	4,8	17
Panel mtg.	-	SAE #4	**VMTD-003**		0-350	4,8	17
D03/CETOP 3	#10-24UN	–	**VMMD-003**		0-350	4,8	17

[1] Pressure drop from P-A or P-B at maximum oil flow of 17 l/min.
Seal material: Buna-N, Polyurethane.

www.enerpacwh.com

Shown: VMMD-001, VMTD-001

VMM and VMT-series

Manual directional control valves for single- and double-acting cylinder control. Lapped pressure seal surface provide near zero leakage.

The VMTD 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.

Shown: MB-4, MB-1

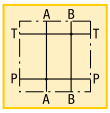
When independent control of multiple cylinders is required

- 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

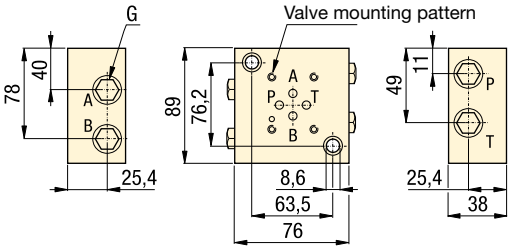
(E) Colectores
(F) Manifolds
(D) Verkettungsblöcke



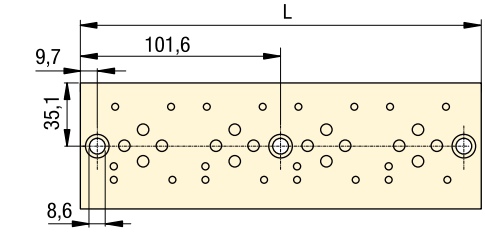
MB-series

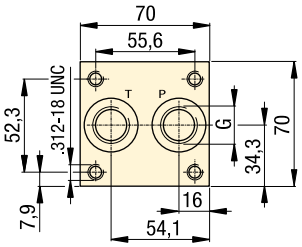
Single or multiple station manifolds allow installation of VSS and VST-series positive seal control valves or other D03/CETOP 3 valves. Ideal in applications where independent control of multiple cylinders is required.

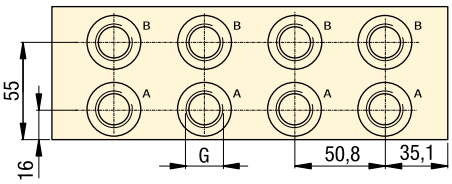
MB-1, MB-12



MB-2, -22, MB-4, -42







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.

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 G	Coverplate model number *	Manifold L mm	kg
▼ **Single station manifold**						
CETOP 3	1	**MB-12**	G1/4"	–	–	0,5
D03	1	**MB-1**	SAE #4	–	–	0,5
▼ **Multipler station manifolds**						
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.

Example

Description	Model number	Stud Length mm	Stud Length in
Directional valve	**VP03-11**	48	1.87
Dual flow control	**VFC-4**	40	1.57
Dual P.O. check	**VD2P**	40	1.57
Stud nut	**VD2P**	10	0.40
Manifold	**V-19**	10	0.38
Total length:		**147**	**5.79**

Product selection

Description	Model number	Stud Length mm	Stud Length in
Imperial stud kit (#10-24) *	**BKD71**	—	7.00
Metric stud kit (M5) *	**BKD72**	178	—
▼ Valve mounting bolt lengths using stud kits			
Stud Nut	**BKD71, BKD72**	10	0.40
Manifold	**MB1, MB2, MB3**	10	0.38
Solenoid valve	**VAS/VSS/VST**	41	1.63
Solenoid valve	**VEW/VET/VEX**	32	1.25
Solenoid valve	**VP03**	47	1.87
Manual valve	**VMMD001/VMMD003**	29	1.13
Pressure Reducing Valve	**PRV6/PRV7**	40	1.57
Check valve, on "P"	**VD1P**	40	1.57
Dual P.O. check valve	**VD2P**	40	1.57
Dual flow control	**VFC-4**	40	1.57

* Note: Stud kit includes 4 studs and 4 stud nuts

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.

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.

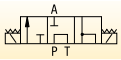
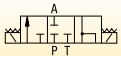
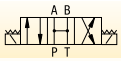
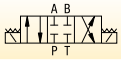
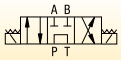
With 11 possible flowpaths and 2 manifolds, for either Enerpac's submerged pump or a remote NPT mount, you can "custom build" a valve for almost any application.

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
▼ 2-way, 2-position (2/2)			
Normally closed	Unloading *	**VEH**	
Normally open	Unloading *	**VEK**	
▼ 3-way, 2-position (3/2)			
Normally open	Single-acting	**VEP**	
▼ 3-way, 3-position (3/3)			
Tandem center	Single-acting	**VEF**	
Closed center	Single-acting	**VEG**	
▼ 4-way, 2-position (4/2)			
Crossover offset	Double-acting	**VEE**	
Float offset	Double-acting	**VEM**	
▼ 4-way, 3-position (4/3)			
Open center	Double-acting	**VEA**	
Closed center	Double-acting	**VEB**	
Tandem center	Double-acting	**VEC**	
Float center	Double-acting	**VED**	

* VEH and VEK valve models require the use of tank port for dump or unloading.

Product spefications

Pressure range	Maximum oil flow	Voltage @ Hz	Amperage draw	
			Amps	
bar	l/min		inrush	holding
0 - 700	15	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:

VEA	-	1	1	600	-	D
1 Valve Flow Path		2 Flow Capacity	3 Voltage	4 Accessory Valves		5 Manifold

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*

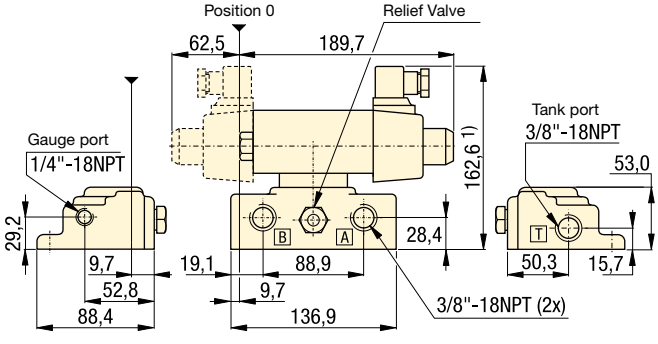
Example

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.

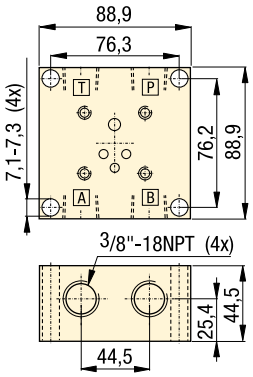
Bolt Kit **BK-2** is included.

VE series

Modular Valve Pump Mounted



Modular Valve Remote Mounted



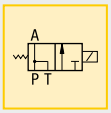
1) add 47 mm for each Accessory Valve.
Note: BK-1 Bolt Kit is included with each modular valve.

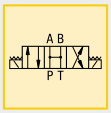
Pressure: 0 - 700 bar

Flow: 15 l/min max.

Voltage: 24, 115, 230 V

(E) Válvulas de control
(F) Electrodistributeurs
(D) Wegesitzventile





Options

Gauges and accessories
190 ▶

Fittings
194 ▶

Accessory Valves and Bolt Kits

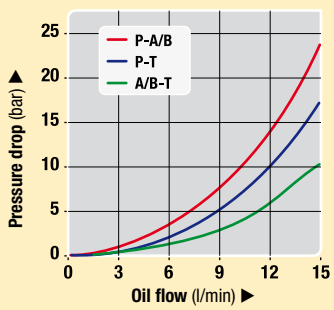
Use **VS-11** relief valve to add system pressure control to VE-series valves.

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.

Pressure drop *vs* oil flow



3-way directional manual control valves *Application & selection*

Shown: VM-2, VM-3

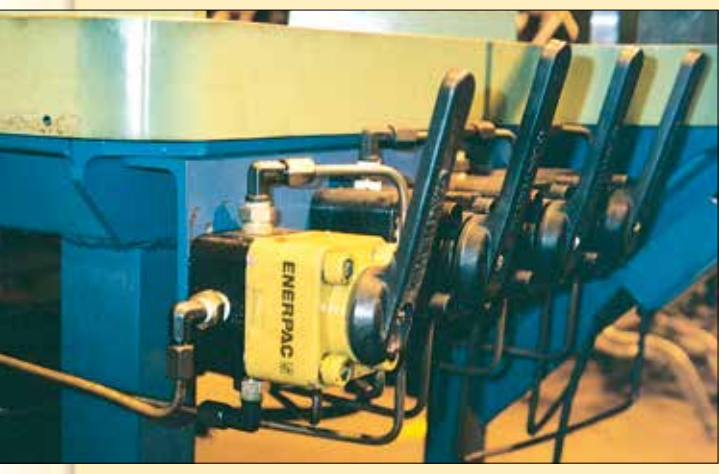
V-series

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

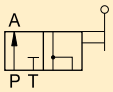
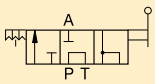
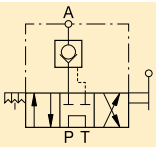
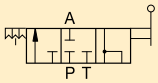
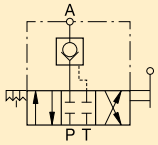
Non-locking
- Use in simple clamping circuits. Has interflow between ports when shifted.

Closed center
- For multiple valve and cylinder operation. All ports blocked in the center position.

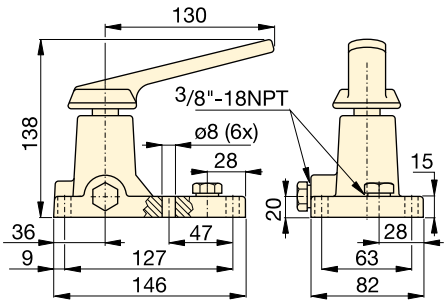
Locking center
- For positive load holding without loss of pressure. Cylinder travel can only resume by shifting valve from hold position.

Tandem center
- For one or multiple cylinder operation. Pump flow is directed back to tank in the center position.

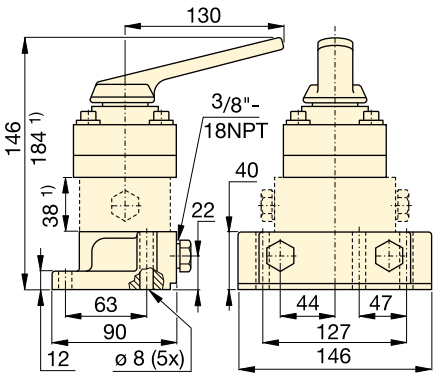
Product selection

Valve type	Valve mounting location	Model number	Hydraulic symbol
▼ **Manual 3-way, 2-position (3/2)**			
–	Pump	**VM-2**	
▼ **Manual 3-way, 3-position (3/3)**			
Tandem center	Pump	**VM-3**	
Tandem center	Remote	**VC-3**	
▼ **Manual 3-way, 3-position (3/3)**			
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

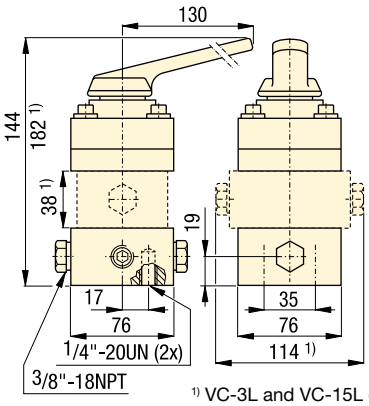


VM-3, VM-3L



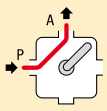
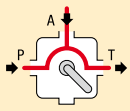
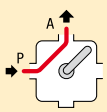
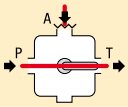
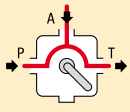
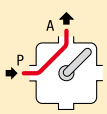
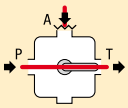
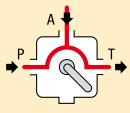
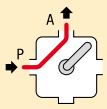
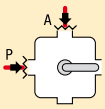
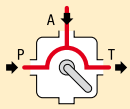
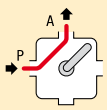
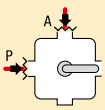
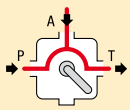
1) VM-3L only

VC-3, VC-3L
VC-15, VC-15L



1) VC-3L and VC-15L only

Product specifications

Model number	Pressure range bar	Used for cylinder	Schematic flowpath: Advance	Hold	Retract	kg
▼ Manual 3-way, 2-position (3/2)						
VM-2	0-700	Single-acting		–		2,2
▼ Manual 3-way, 3-position (3/3)						
VM-3	0-700	Single-acting				2,1
VC-3	0-700	Single-acting				2,9
▼ Manual 3-way, 3-position (3/3)						
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

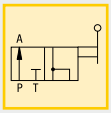
Pressure: 0 - 700 bar

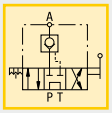
Flow: 17 l/min max.

E Vàlvulas de control

F Distributeurs à 3 voies

D 3-Wege-Ventile





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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".

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4-way directional manual control valves *Application & selection*

Shown: VC-20, VM-4

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

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.

Select the required center position

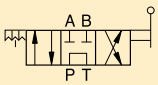
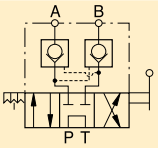
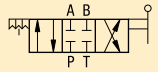
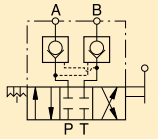
Non-locking
- Use in simple clamping circuits. Has interflow between ports when shifted.

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
▼ **Manual 4-way, 3-position (4/3)**			
Tandem center	Pump	**VM-4**	
Tandem center	Remote	**VC-4**	
Tandem center, locking	Pump	**VM-4L**	
Tandem center, locking	Remote	**VC-4L**	
Closed center	Remote	**VC-20**	
Closed center, locking	Remote	**VC-20L**	

Enerpac VC-4 manual valves mounted to control hydraulic circuit on pallet fixture

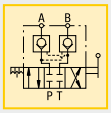
Pressure: 0 - 700 bar

Flow: 17 l/min max.

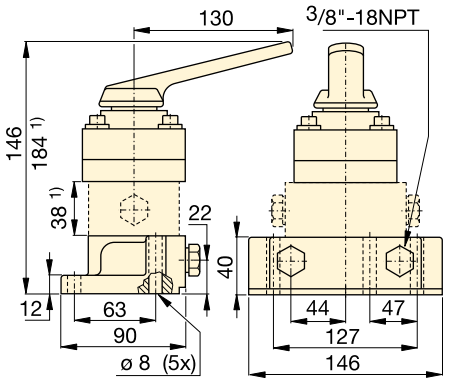
(E) **Vàlvulas de control**

(F) **Distributeurs à 4 voies**

(D) **4-Wege-Ventile**

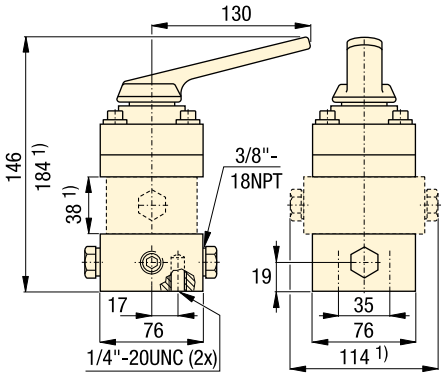


VM-4, VM-4L



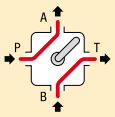
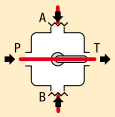
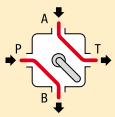
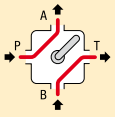
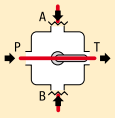
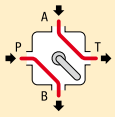
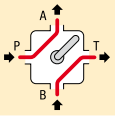
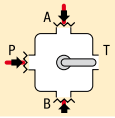
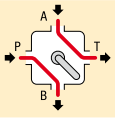
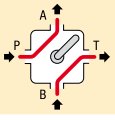
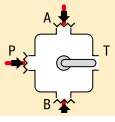
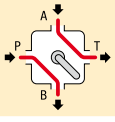
1) VM-4L only

VC-4, VC-3L
VC-20, VC-20L



1) VC-4L and VC-20L only

Product specifications

Model number	Pressure range	Used for cylinder	Schematic flowpath			
	bar		Advance	Hold	Retract	kg
▼ **Manual 4-way, 3-position (4/3)**						
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

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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".

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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

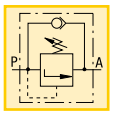
Pressure: 350 bar

Flow: 4 - 10 l/min

(E) **Válvulas de secuencia**

(F) **Valve de séquence**

(D) **Folgeventil**

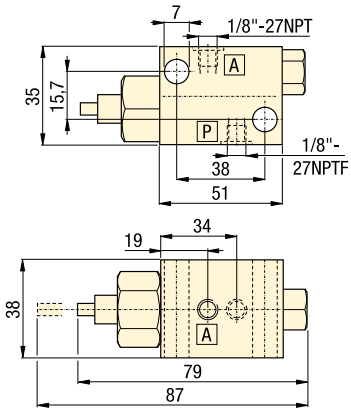


Options

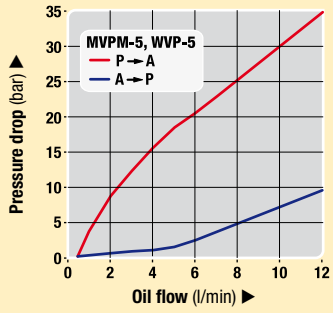
Gauges and accessories

190 ▶

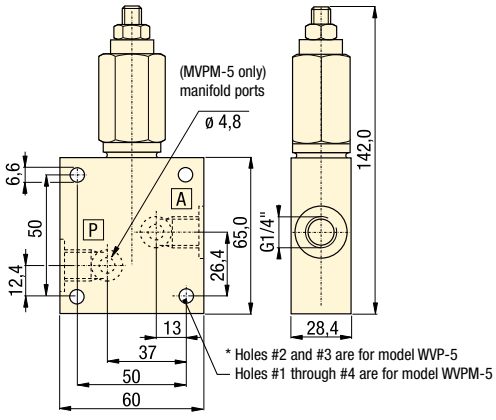
V-2000



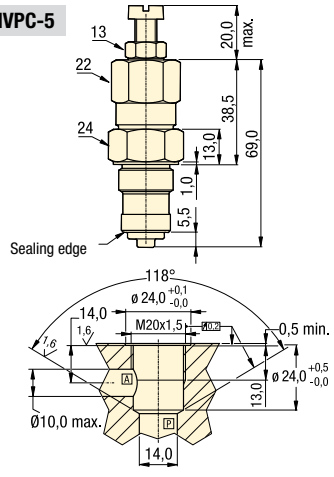
Pressure drop *vs* oil flow



MVPM-5, WVP-5



MVPC-5



Product selection

Pressure adjustment range	Maximum pressure	Maximum oil flow	Model number	Oil ports	Opening pressure check valve	A	
bar	bar	l/min			bar	mm	kg
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.

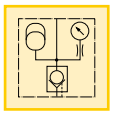
Pilot ratio: 7:1

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

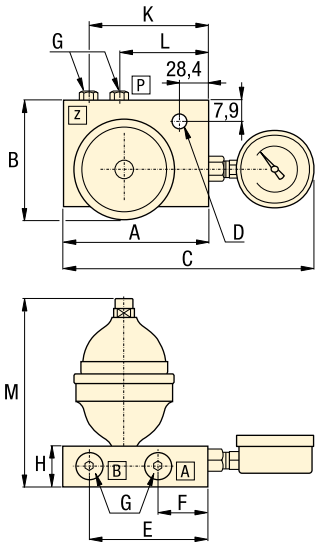
Shown: MV-72

Product selection

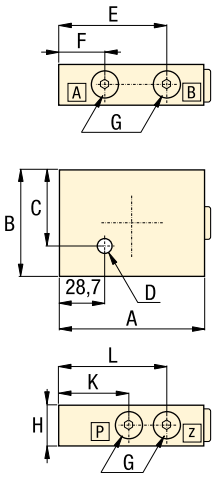
Pilot ratio	Accumulator included	Maximum oil flow l/min	Maximum pressure bar	Model number	Oil ports	Optional charging tool for ACL	kg
7 : 1	–	38	350	**MV-72**	G 1/4”	–	1,8
7 : 1	ACL-22	38	350	**MV-722B**	G 1/4”	**WAT-2**	2,7
7 : 1	ACL-202	38	350	**MV-7202B**	G 1/4”	**WAT-2**	3,4
7 : 1	–	38	350	**MVM-72**	G 1/4”	–	1,4

For more information on ACL-series Accumulators see page 124.

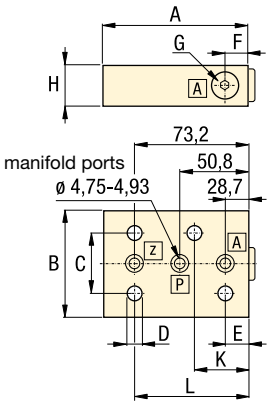
MV-722B, -7202B



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
MV-72	89,0	63,5	55,6	7,1	73,2	28,7	G1/4”	31,8	50,8	73,2	–
MV-722B	89,0	71,1	184,2	7,1	73,2	28,4	G1/4”	31,8	73,2	50,8	145
MV-7202B	89,0	92,4	181,1	7,1	73,2	28,4	G1/4”	31,8	73,2	50,8	185
MVM-72	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

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 regulates 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 ¼" BSPP and manifold ports
  – Gauge port- 1/8" NPT

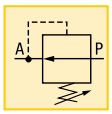
Pressure: 350 bar

Flow: 7 l/min

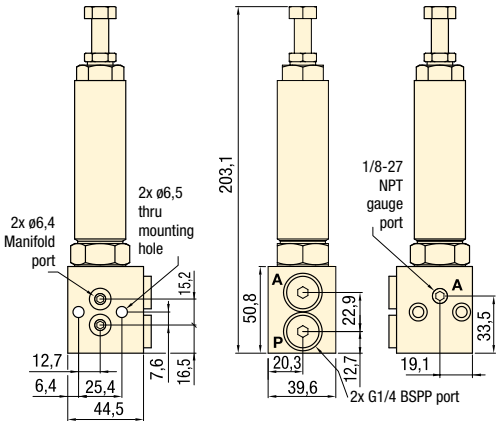
(E) Válv. reguladora de presión

(F) Valve de pression réglable

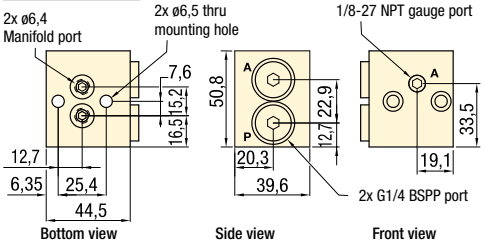
(D) Druckreduzierventil



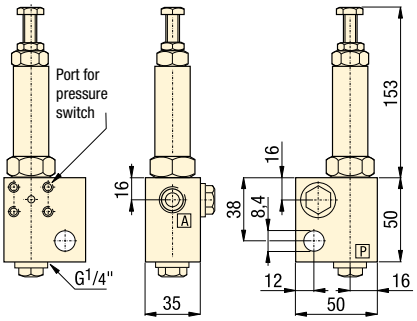
PRV-8, 9



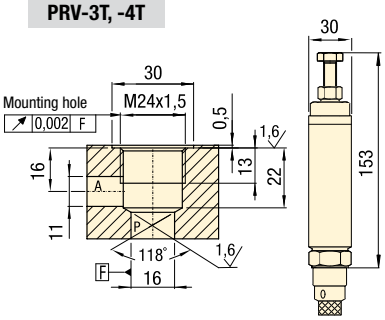
PRVM-2



PRV-3, -4



PRV-3T, -4T



Options

Gauges ▶ 190

Fittings ▶ 194

Product selection

Mounting style	Adjustable pressure range	Maximum pressure	Model number	Oil ports	Maximum oil flow	
	bar	bar		BSPP	l/min	kg
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

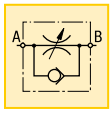
Max. Flow: 38 l/min

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

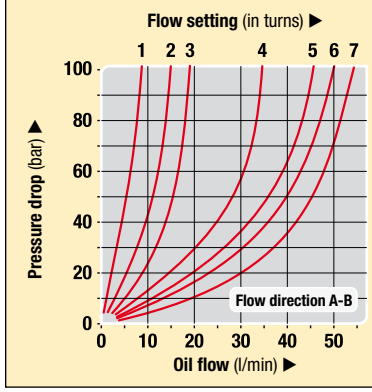
Shown: VFC-1

Options

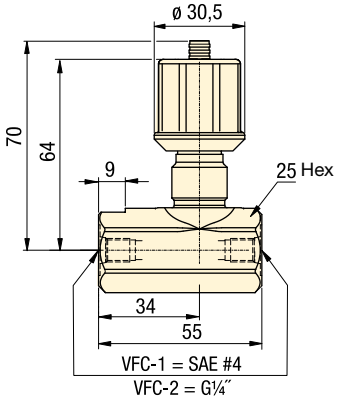
Fittings
194

High pressure filters
193

VFC-1, -2 Pressure drop *vs* oil flow



VFC-1, -2



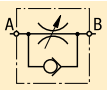
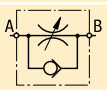
VFC-series

Provide repeatable oil flow control. The internal check valve allows metered flow in one direction and free flow in the opposite direction. Precise control is achieved with a micro-meter style adjustment knob, which can be locked with the set screw.

Application

Use VFC-series flow control valves in-line with the Enerpac WE-series workholding pump to protect your components from damage due to high flow rates.

Product selection

Maximum oil flow	Pressure range	Oil ports	Model number	Flow path	Maximum pressure drop	
l/min	bar				bar	kg
▼ **Flow control valves**						
38	0-350	SAE#4	**VFC-1**		105	0,8
38	0-350	G 1/4"	**VFC-2**		105	0,8

Seal material: Viton

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.

V-17 Safety check valve installed on a fixture.

Your hydraulic control solution

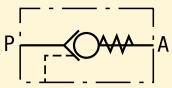
- Regulate oil flow or system pressure
- All valves feature NPT or SAE porting to insure against leakage at rated pressure
- Can easily be installed in any system
- All valves are painted, coated or plated for corrosion resistance.

Product selection

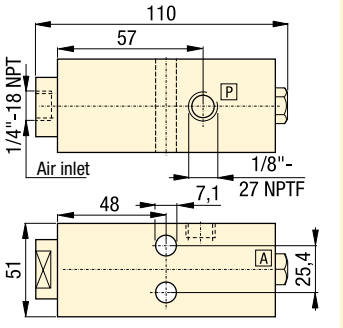
Valve type	Maximum pressure bar	Model number	Oil ports
Holding valve, air pilot	200	**HV-1000A**	1/8" NPTF
Holding valve, modular	200	**MHV-1**	1/8" NPTF
Pressure limiting valve	200	**PLV-40013B**	1/8" NPTF
Manual shut-off valve	350	**V-12**	SAE #4
Auto-damper valve	700	**V-10**	1/2" NPTF
Safety check valve	700	**V-17**	3/8" NPTF
Pressure relief valve	700	**V-152**	3/8" NPTF

Product specification

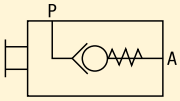
HV-1000A
Air pilot holding valve



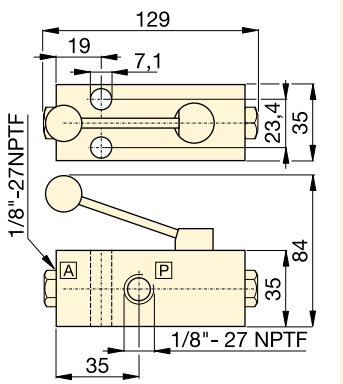
- Holds fluid under pressure offering independent control of different branches of the same fixture
- Valve can control the pilot air and the booster in sequence
- Max. oil flow 5 l/min
- Works with the VA-42 four-way air valve and a booster.



MHV-1
Modular holding valve



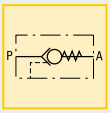
- Allows separate operation of clamping fixtures with a single power source
- Ideal for applications when fluid feed lines are impractical. If system pressure is interrupted, the MHV-1 will hold the pressure beyond the valve.
- Max. oil flow 5 l/min
- To release system pressure, rotate valve handle in either direction 90˚ to release and retract system pressure.

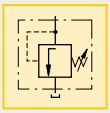


Pressure: 0 - 700 bar

Flow: 5 - 30 l/min max.

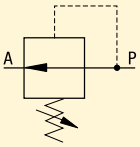
- (E) **Válvulas de control**
- (F) **Valves de contrôle**
- (D) **Regelventile**

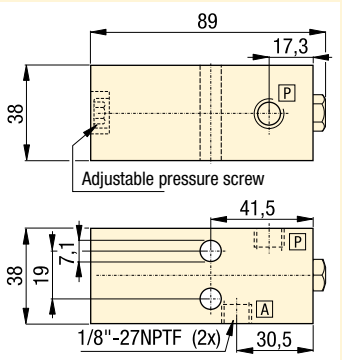




PLV-40013B
Pressure limiting valve

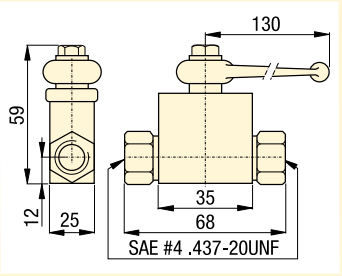
- Allows precise control of pressures reaching specific clamps
- When pressure build-up reaches a preset level, the valve closes, stabilizing pressure to that section of the fixture
- Pressure adjustment between 14-103 bar
- Max. oil flow 5 l/min.





V-12
Manual shut-off valve

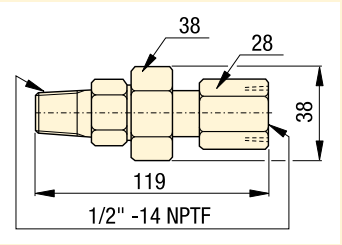
- Ball type valve can be used for the master system shut-off or for isolating separate circuits on a fixture
- Viton seals standard
- Straight through design for easy system plumbing and installation
- Fully open allows high flow return of oil
- Max. oil flow 12 l/min.



V-10 Auto-damper valve

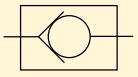
- To protect gauge during high cycle applications
- Creates a flow resistance when load is released suddenly

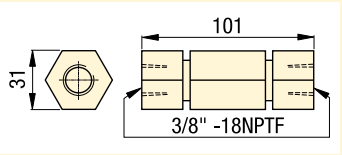
  No adjustments are necessary
- Fits directly into GA-series gauge adaptor.



V-17 Safety check valve

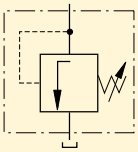
- Ruggedly built to resist shock and operate with low pressure drop
- Closes smoothly without pounding
- Max. oil flow 30 l/min.

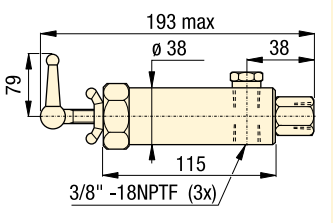




V-152 Pressure relief valve

- 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

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

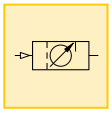
- Regulates air pressure
- Filter air input
- Lubricates air motors with a fine oil vapor mist
- Maximum air flow 1360 l/min

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



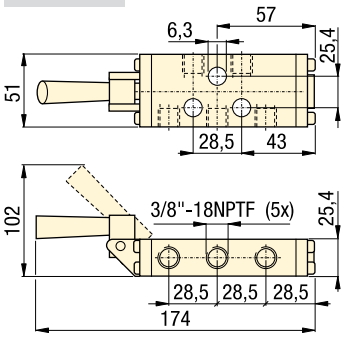
Options

Gauges and adaptors 190 ▶

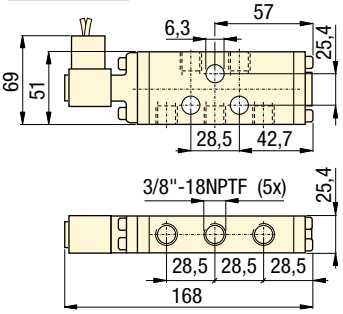
Hoses and couplers 192 ▶

Fittings 194 ▶

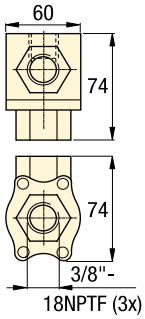
VA-42



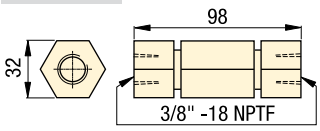
VAS-42



VR-3



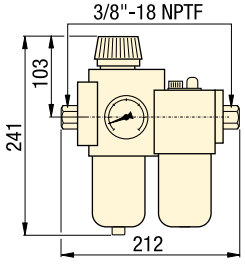
V-19



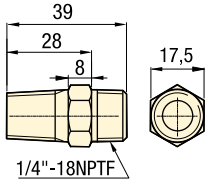
Product selection

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

RFL-102



QE-375



Important

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

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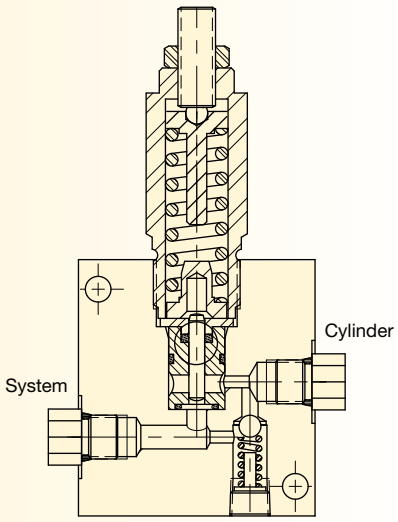
Valve Cutaways

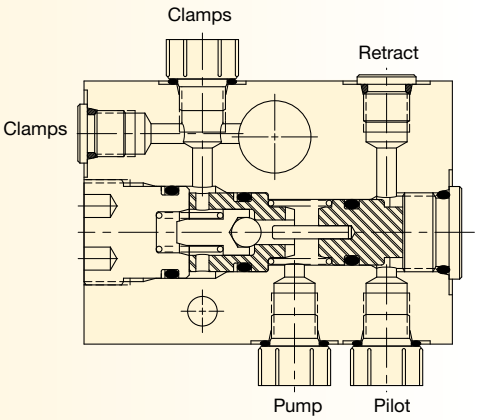
MVPM-5

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.



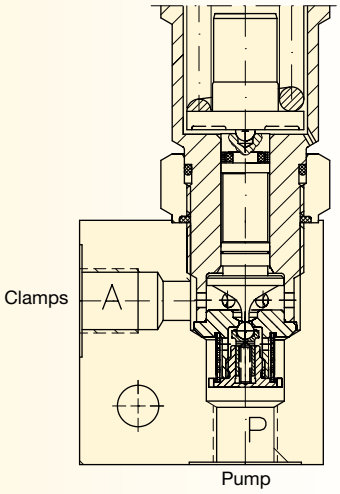
V-72

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

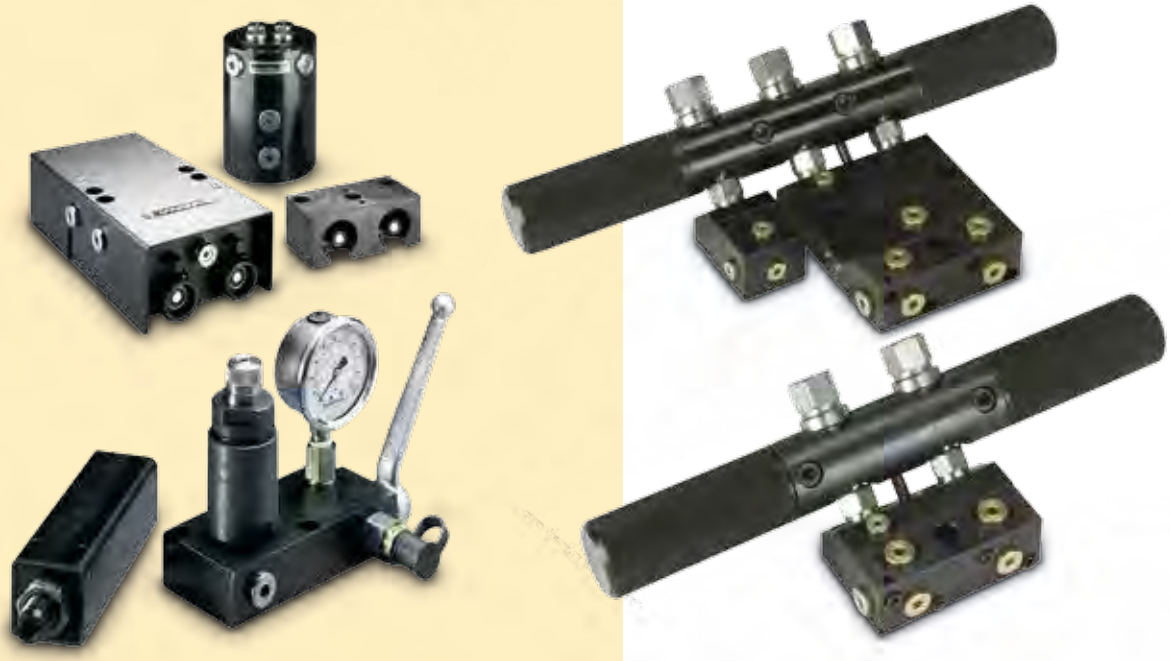
A check ball is held off of the check seat by a spring loaded spindle. The spring setting determines the closing point of the valve. As pressure builds in the cylinder side of the circuit, the spindle is lifted, and the check seats. Closing off further flow through the valve provides a reduced pressure 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.

197 ▶

components

Accumulators *Application & selection*

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.

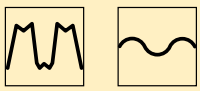
Accumulators
...maintain circuit pressure

- 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 accumultors use internal spring.

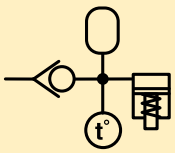
Accumulator applications:

- 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.

Product selection

Operating pressure bar	Model number	Max. rated oil volume cm³	Gas volume cm³	Pre-charged nitrogen pressure bar	Usable oil capacity cm³ at 350 bar
▼ **Pre-charged accumulators**					
0-210	**ACM-1**	1,6	–	–	–
100-350	**ACL-22A**	14,7	20,0	100	8,7
100-350	**ACL-202A**	126,2	169,9	100	73,9
100-350	**ACL-502A**	337,6	450,0	100	196,6
▼ **Uncharged accumulators**					
0-350 [1)]	**WA-502**	41,0	41,0	—	41,0
0-350 [1)]	**WA-5010**	163,9	163,9	—	122,9

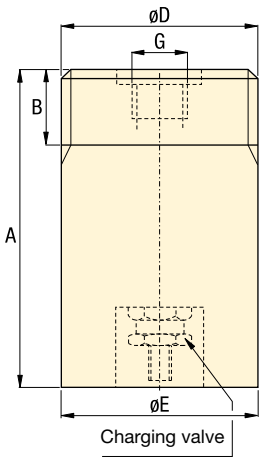
[1)] See pre-charge chart on page 163 for hydraulic operating pressures.

Recommended pre-charge

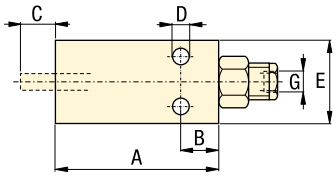
Operating pressure bar	Model number	Nitrogen pressure bar	Usable oil capacity [1] cm³
0 - 70	**WA-502**	35	24,6
70 - 210	**WA-502**	70	32,8
210 - 350	**WA-502**	80	41,0
0 - 70	**WA-5010**	35	90,1
70 - 210	**WA-5010**	70	106,5
210 - 350	**WA-5010**	80	190,5

[1] At maximum operating pressure.

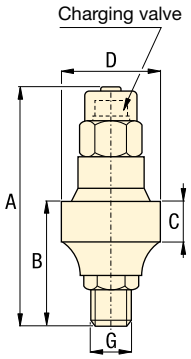
WA-502, WA-5010



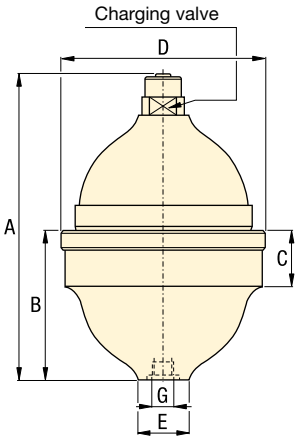
ACM-1



ACL-22A



ACL-202A, 502A



Product dimensions in mm [ ]

Model number	A	B	C	D	E	F	G	Recommended charging tool	kg
▼ **Pre-charged accumulators**									
ACM-1	133	19	13	6,7	45	–	¼"-27 NPTF	–	1,0
ACL-22A	91	37	18	42,9	23	–	G¼"	WAT-2	0,5
ACL-202A	137	69	29	84,5	29	–	G¼"	WAT-2	1,2
ACL-502A	171	89	35	114,0	40	–	G⅜"	WAT-2	2,8
▼ **Uncharged accumulators**									
WA-502	119	30	–	2¾" -16 UN	70	–	SAE #8	WAT-1	3,2
WA-5010	181	30	–	2¾"-16 UN	70	–	SAE #8	WAT-1	5,2

Pressure: 0 - 350 bar

Oil volume: 1,6 - 337,6 cm³

Gas volume: 20 - 450 cm³

E Acumuladores

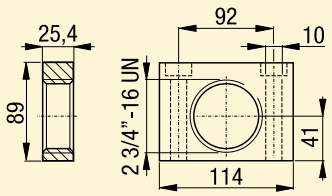
F Accumulateurs

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.

ACBS-202A Accumulator package used to maintain pressure on a machine tool fixture.

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.

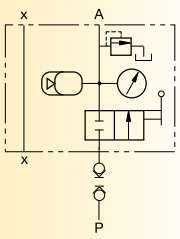
MHV-1 Modular holding valve

- 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.

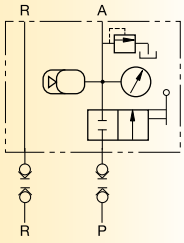
Coupler package circuits

ACBS

Single-acting circuit

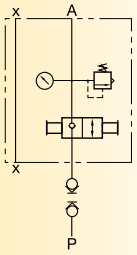


Double-acting circuit

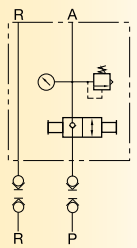


AP-500

Single-acting circuit

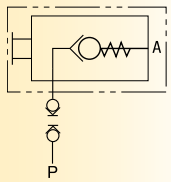


Double-acting circuit



MHV-1

Single-acting circuit



Product selection

Operating pressure	Model number	Max. rated oil volume	Gas volume	Pre-charged nitrogen pressure	Usable oil capacity
bar		cm^3	cm^3	bar	cm^3 at 350 bar
▼ Accumulator coupler packages					
100 - 350	**ACBS-22A**	16,4	20,0	100	8,7
100 - 350	**ACBS-202A**	163,9	169,9	100	73,9
0 - 350	**AP-500**	**AP-500 uses WA-502 or WA-5010 [1]**			
0 - 207	**MHV-1**	–		–	– –

[1] See pre-charge chart on page 163 for hydraulic operating pressures.

Pressure: 0 - 350 bar

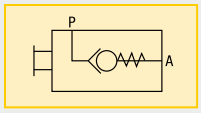
Oil volume: 16,4 - 163,9 cm³

Gas volume: 20 - 169,9 cm³

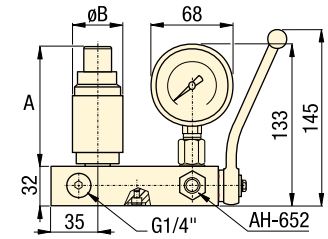
(E) Acopladores manuales

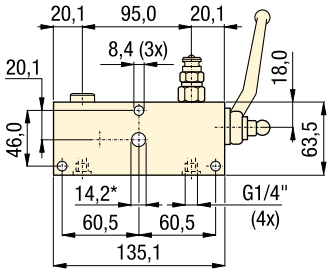
(F) Manuel coupleur

(D) Manuelle kupplung



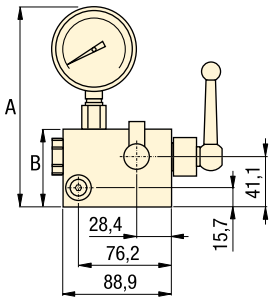
ACBS

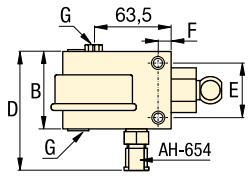




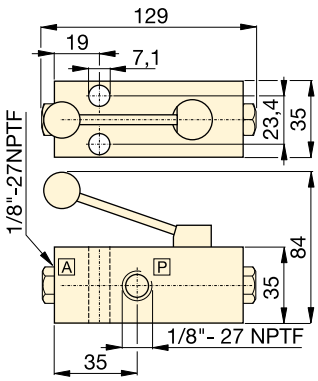
[1] Manifold hole should not exceed ø 7,6 mm when port is utilized.

AP-500





MHV-1



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

Product dimensions in mm [ ]

Model number	A	B	C	D	E	F	G	Recommended charging tool	kg
▼ **Pre-charged accumulator coupler packages**									
ACBS-22A	68	42	–	–	–	–	G1/4"	WAT-2	4,6
ACBS-202A	106	85	–	–	–	–	G1/4"	WAT-2	5,4
AP-500	163,6	63,5	89,0	97,5	44,5	9,7	SAE #4	–	3,9
MHV-1	–	–	–	–	–	–	1/8" NPTF	–	–

Manual Couplers *Application & selection*

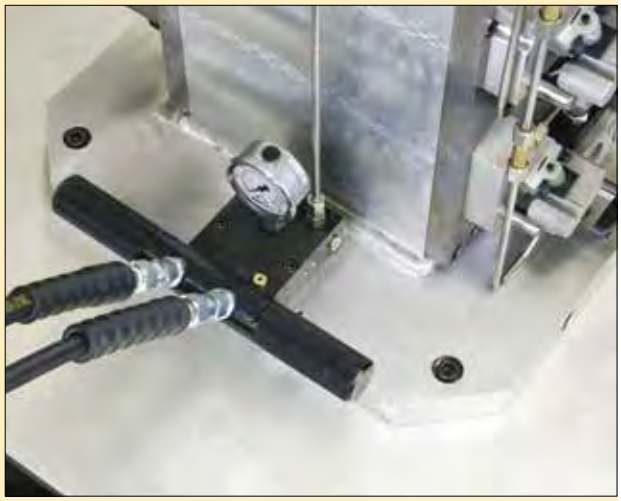
Shown: MCH-31, MCRA-11, MCRC-21, MCH-21, MCR-21

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.

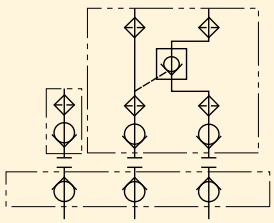
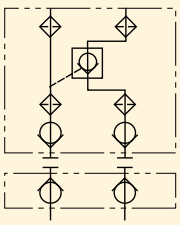
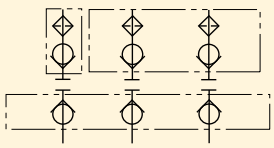
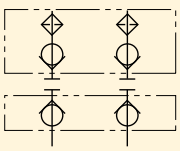


Manual Couplers

...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

	With auxiliary air circuit	Without auxiliary air circuit
With P.O. check		
Without P.O. check		

Product selection

Model number	Basic configurations	Circuits
MCRC-21	Pallet receiver with P.O. check	Two Hydraulic
MCR-21	Pallet receiver without P.O. check	Two Hydraulic
MCRA-11	Auxiliary air circuit receiver block	One Air
MCH-21	Operator handle	Two Hydraulic
MCH-31	Operator handle	Two Hydraulic, One Air
MCSB-21	Storage block	–
MCPS-21	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.

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

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.

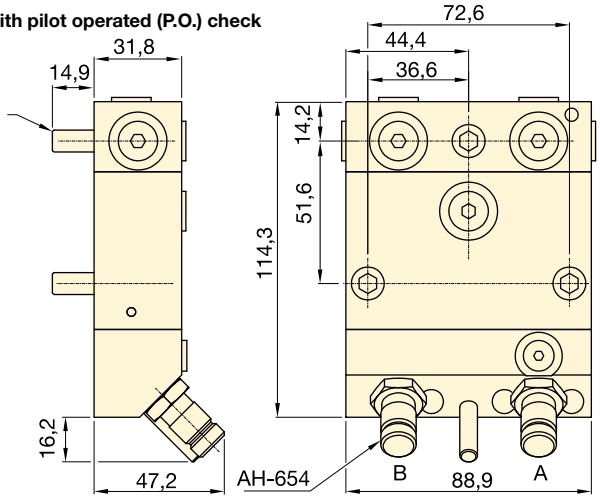
Shown: MCH-21, MCR-21

MCR and MCH-series

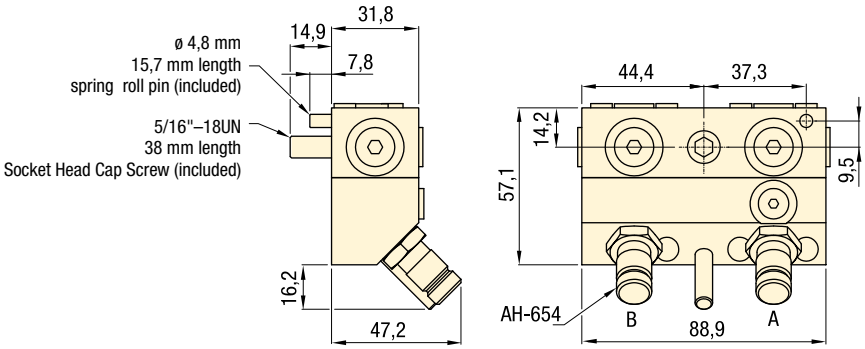
The Enerpac MCH-21 two passage operator handle conveniently connects and disconnects to the MCR-21 two passage receiver utilizing a simple push-on, pull-off action.

MCRC-21 **Receiver with pilot operated (P.O.) check**

See page 170 for mounting pattern.

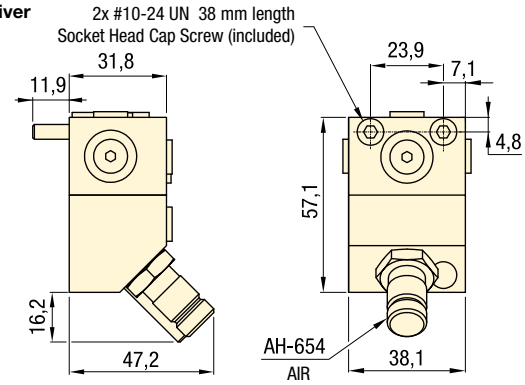


MCR-21 **Receiver without pilot operated check**

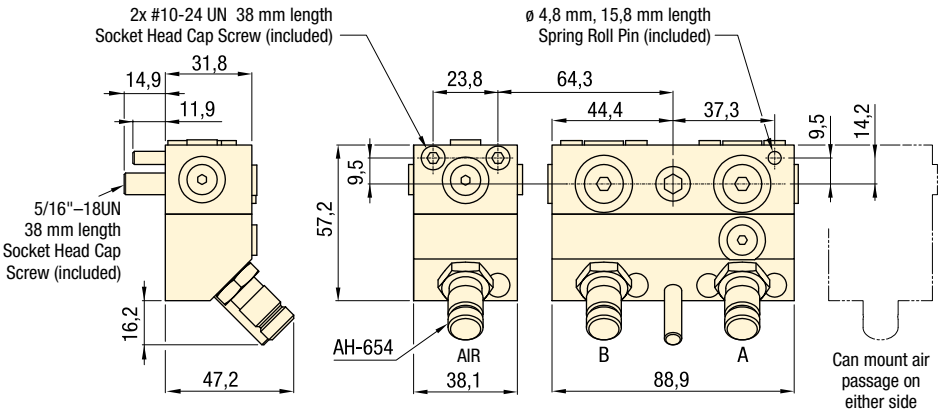


MCRA-11 **Auxiliary air circuit receiver**

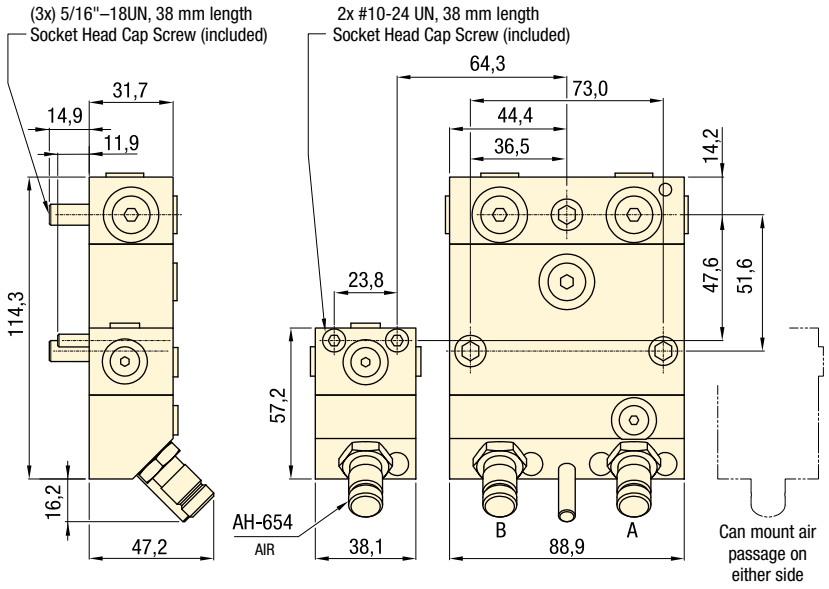
See page 170 for mounting pattern.



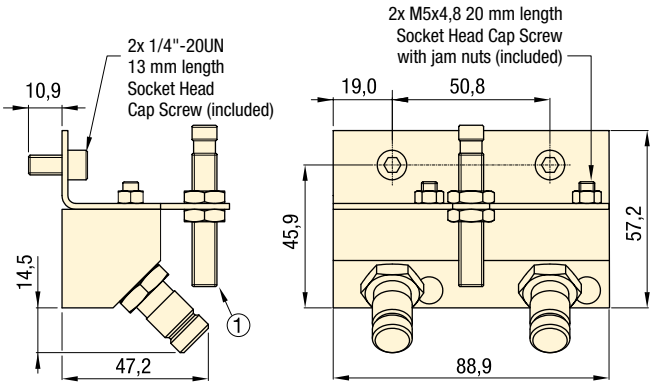
MCR-21 with MCRA-11 **Receiver with air passage and without P.O. check**



MCRC-21 with MCRA-11 See page 170 for mounting pattern.



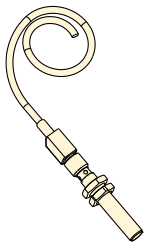
MCSB-21 **Storage block.** See page 171 for mounting pattern.



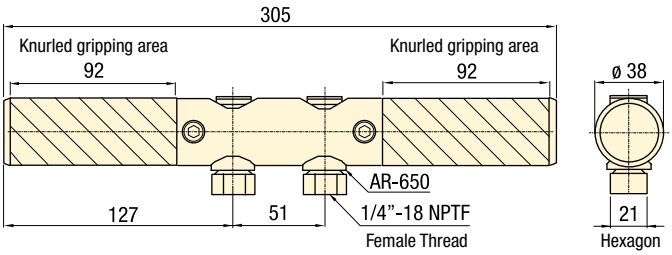
① **Optional proximity switch is available.**
See MCPS-21

MCSB-21

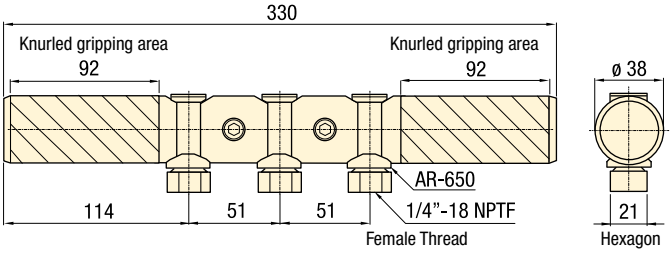
Optional proximity switch



MCH-21 **Operator handle**



MCH-31 **Operator handle**



Max. Flow: 15 l/min

Pressure: 0 - 350 bar

- (E) **Acopladores manuales**
- (F) **Manuel 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.

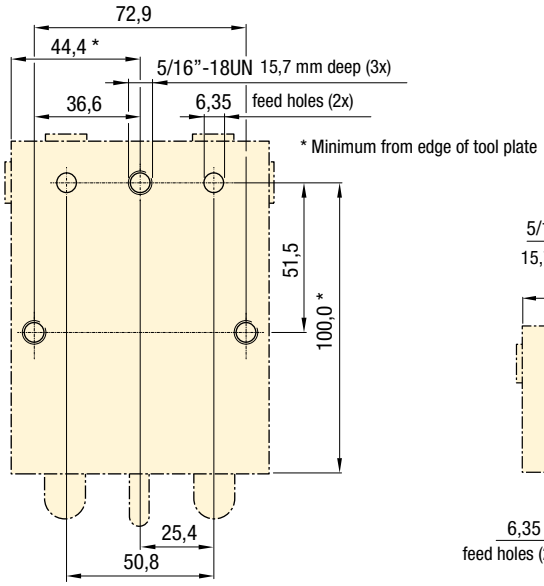
Manual Couplers *Mounting patterns*

Shown: MCR-21

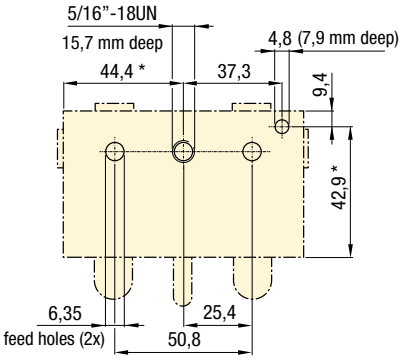
MCR-series

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.

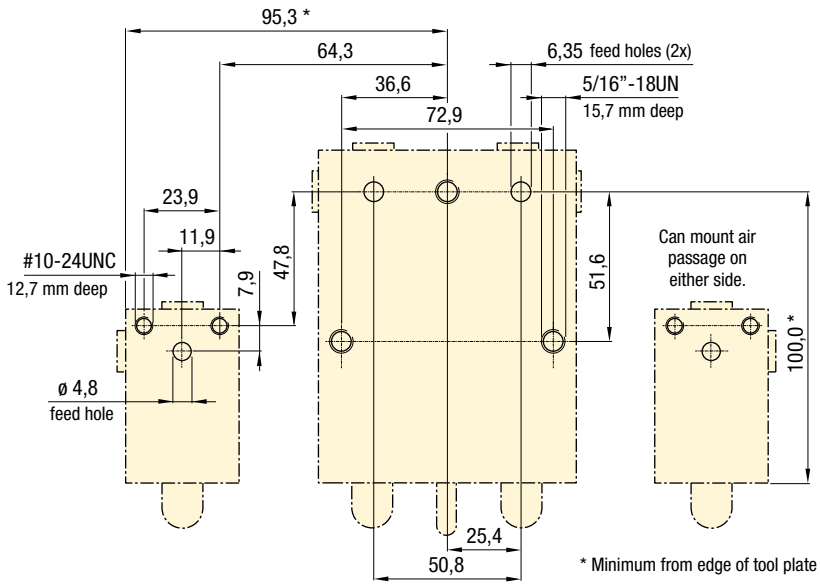
MCRC-21 **Receiver with P.O. check – Mounting hole pattern**



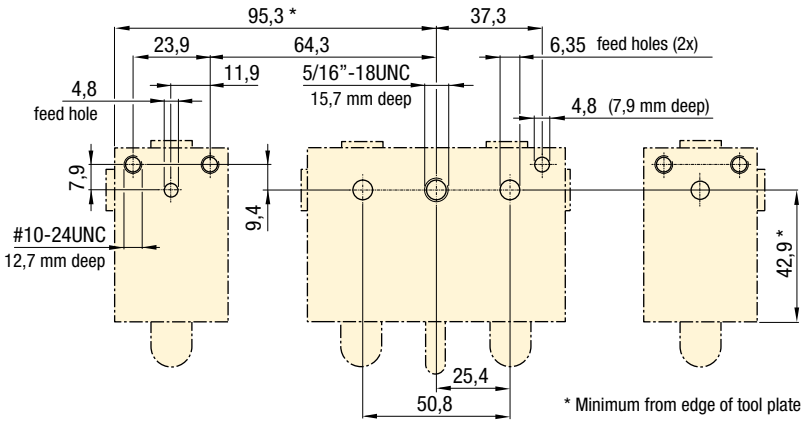
MCR-21 **Receiver without P.O. check – Mounting hole pattern**



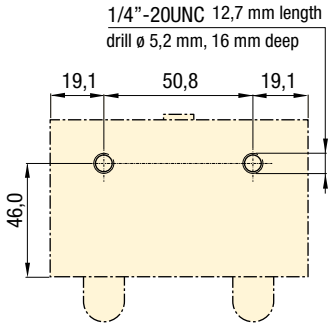
MCRC-21 with MCRA-11 **Receiver with air passage and with P.O check – Mtg. hole pattern**



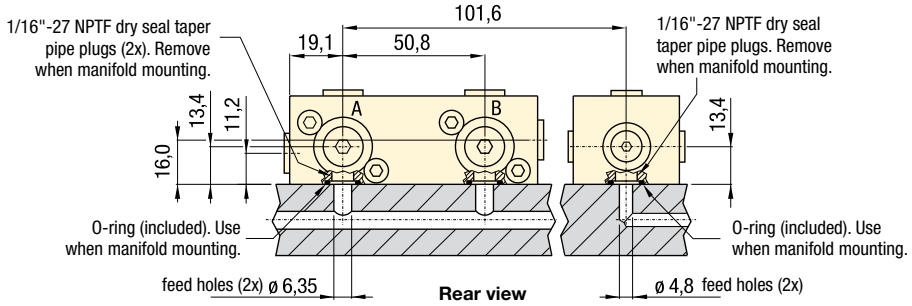
MCR-21 with MCRA-11 **Receiver with air passage and without P.O check – Mtg. hole pattern**



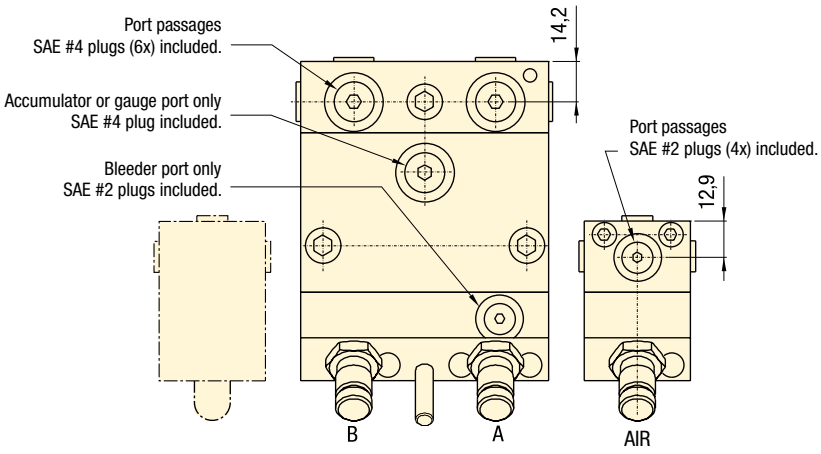
MCSB-21 **Storage Block – Mounting Hole Pattern**



Manifold and Port Dimensions



Rear view



Top view

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

Contamination resistant closed hydraulic system

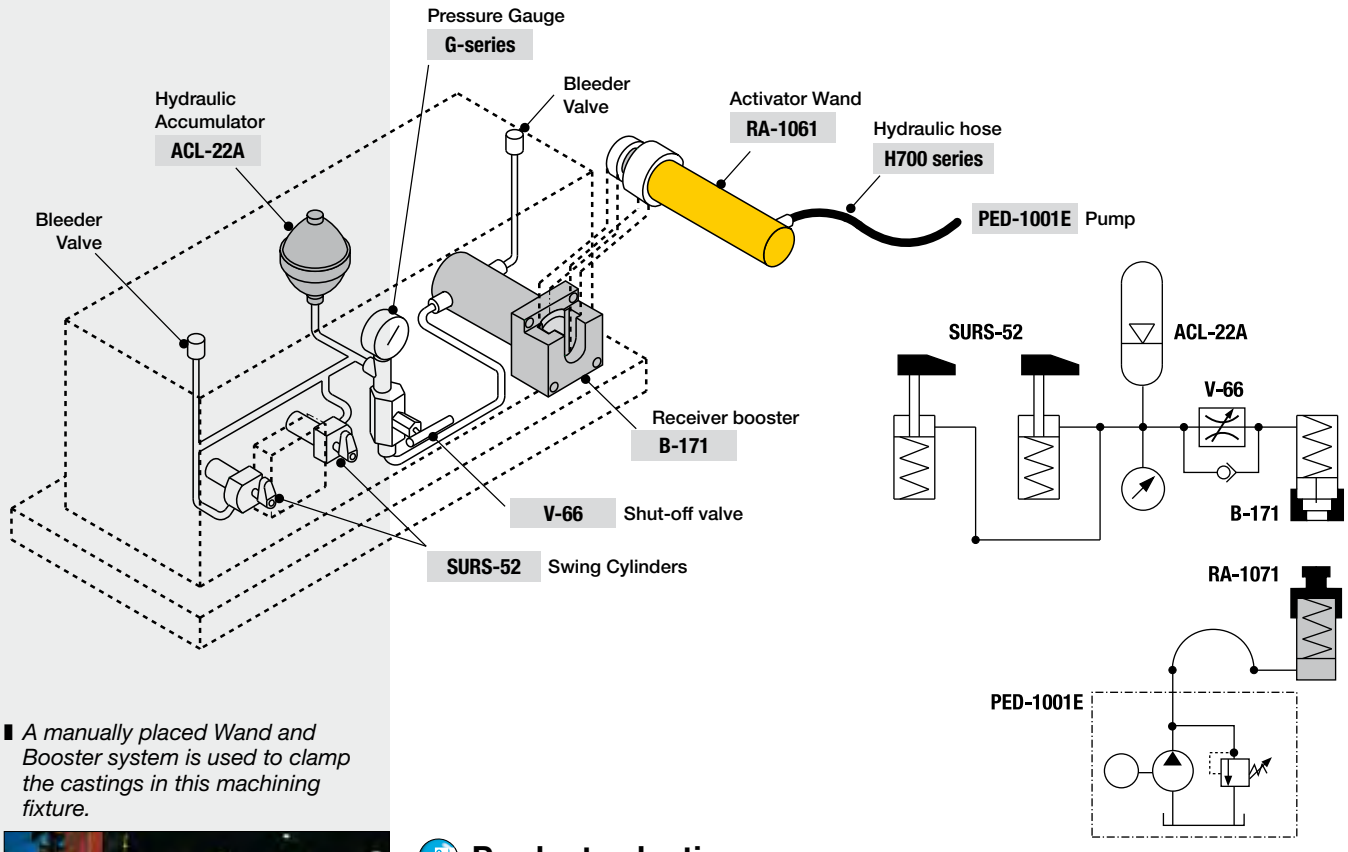
- No-leak palletized system, eliminates oil loss at connection point
- Closed design prevents machining chips and coolant from entering the hydraulic circuit
- Booster can be mounted in either horizontal or vertical position for flexible fixture design.

B and RA-series

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

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 cm³	Stroke mm	Model number	Effective area cm²	Operating pressure bar	kg
▼ Receiver booster							
2 : 1	1,75 : 1	132,7	51,8	**B-81**	25,7	30 - 350	5,7
2 : 1	1,75 : 1	280,2	109,2	**B-171**	25,7	30 - 350	7,1
▼ Activator wand							
–	–	162,2	112,7	**RA-1061**	14,4	60 - 700	5,1

Ratio: 2 : 1

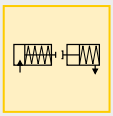
Stroke: 51,8 - 112,7 mm

Pressure: 30 - 350 bar

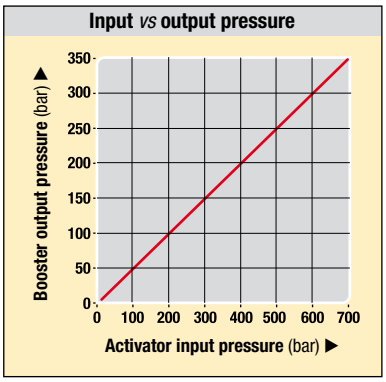
(E) **Multiplicadores**

(F) **Multiplicateur**

(D) **Betätigungszylinder und Druckverstärker**



Input *vs* output pressure



Options

Fittings 194 ▶

Hoses and couplers 192 ▶

For 700 bar pumps, refer to the Enerpac Industrial Tools Catalog E327e.

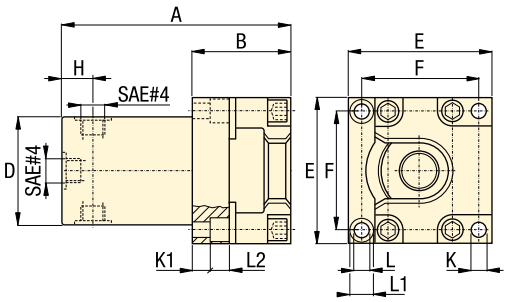
Existing fixtures with manual-connect single-acting circuits can be easily upgraded into the wand and booster.

Important

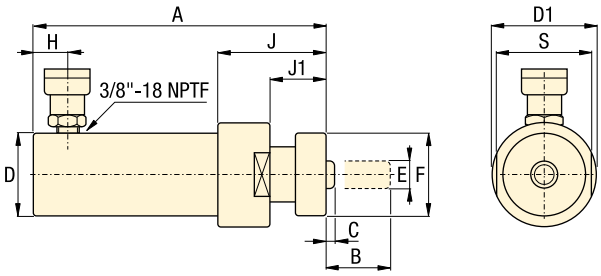
The activator wand has a 2 to 1 ratio of input pressure versus output force.

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 ø	D1	E	F ø	H	J	J1	K	K1	L	L1	L2	S
▼ Receiver booster																
B-81	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-171	231,6	69,6	44,2	76,2	–	101,6	82,6	28,4	–	–	10,4	57,4	10,4	15,7	10,7	–
▼ Activator wand																
RA-1061	295,1	117,6	4,8	57,2	76,2	19,1	58,9	19,1	76,7	38,9	–	–	–	–	–	69,9

Auto-coupler systems *Application & selection*

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.

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.

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.

Product selection

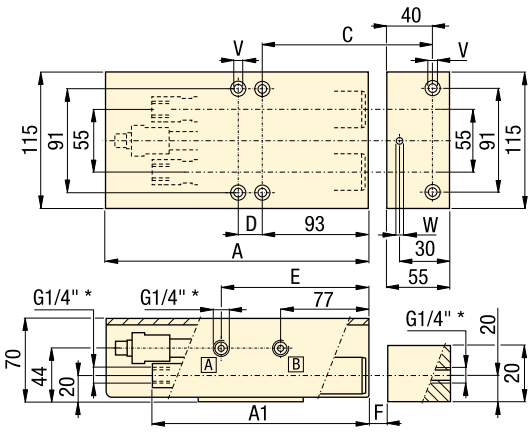
Station position	Model number[1]	Adjustable stroke	Oil capacity		Maximum oil flow [2]
			cm³		
		mm	advance	retract	l/min
▼ 2 port auto coupler					
Base	**MCA-62**	5 - 15	10,8	10,8	1,0
Base	**WCA-82***	104 - 113	10,8	10,8	1,0
Pallet	**MPA-62**	–	–	–	–
▼ 4 port auto coupler					
Base	**MCA-64***	5 - 15	10,8	10,8	1,0
Pallet	**MPA-64***	–	–	–	–

[1] For additional pallet clearance, WCA-82 long stroke model are available.
[2] 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
▼ 2 port auto coupler					
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**
▼ 4 port auto coupler					
MCA-64	± 0,5	40 - 350	**CDF-6**	**FZ-2050**	**AT-1**
MPA-64	± 0,5	40 - 350	**CDM-6**	**FZ-2050**	**AT-1**

MCA-62, WCA-82



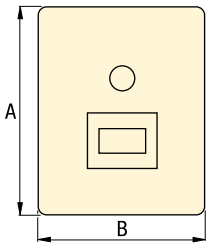
MPA-62

Model number	Voltage / Current
▼ Automatic Coupler Control Box	
ACCB-2	115 VCA / 10 A

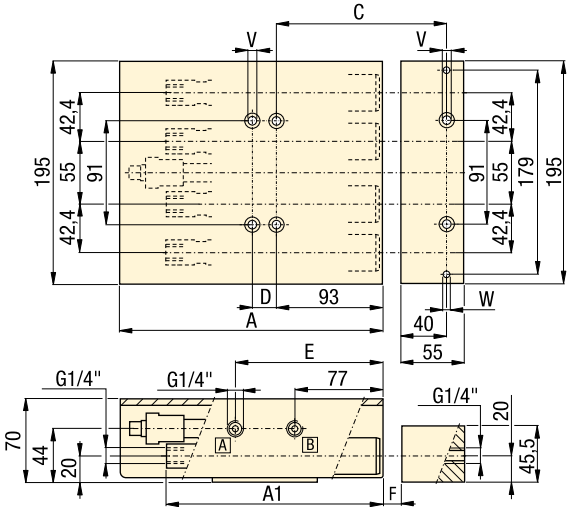
Note: Enclosure rating NEMA 12.

ACCB-2

Operator Station



MCA-64



MPA-64

Product dimensions in mm [ ]

Model number	A	A1	B	C	D	E	F max.	V [1] for mounting bolts thread x length	W [2]	kg
▼ 2 port auto couplers										
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
▼ 4 port auto couplers										
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
▼ Automatic coupler control box [3]										
ACCB-2	325	–	300	–	–	–	–	–	–	13,6

[1] Mounting bolts are not included. [2] Drill dowel pin holes after installing MPA. * This product is made to order. Please contact Enerpac for delivery information before specifying in your design.

www.enerpacwh.com

Connection: 2 - 4 ports

Stroke: 5 - 113 mm

Pressure: 40 - 350 bar

(E) Acopladores automáticos

(F) Coupleurs automatiques

(D) Automatische Kupplungen

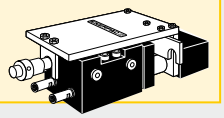
Options

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.

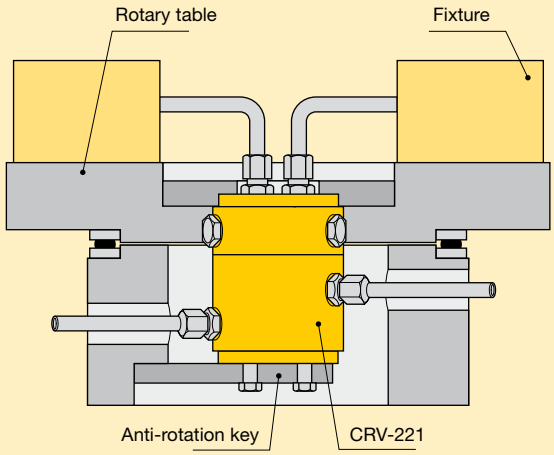
Do not couple or uncouple with the hydraulic nozzles under pressure. This could damage the internal coupler seals.

Do not exceed maximum flow and pressure.

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.

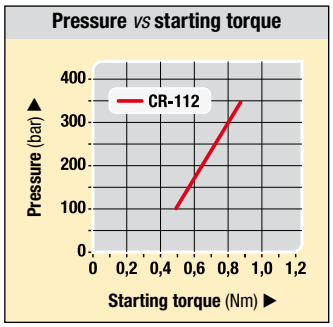


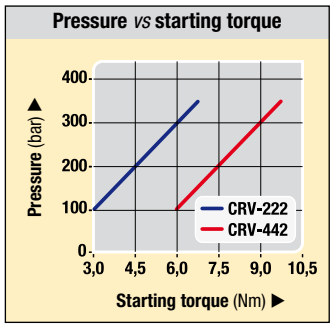
In this application eight CRV-222 rotary couplers are installed to power the individual presses of an eight station rotary press table.

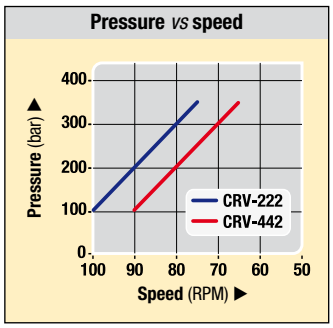
Permanent hydraulic connection on indexing and rotating work stations

- 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 cm³/hour.
Oil loss CRV-442 = 40 cm³/hour.

Product selection

No. of radial passages	Model number [1]	Operating pressure range	Maximum speed		Starting torque	
			RPM		Nm	
		bar	100 bar	350 bar	100 bar	350 bar
1	**CR-112**	100 - 350	30	30	0,5	0,9
2	**CRV-222**	100 - 350	100	75	3,0	7,0
4	**CRV-442**	100 - 350	90	65	6,0	10,0

[1] Before selecting, note the starting torque and speed diagrams above.
Maximum oil flow: 9 l/min.

Manifold mounting adaptor

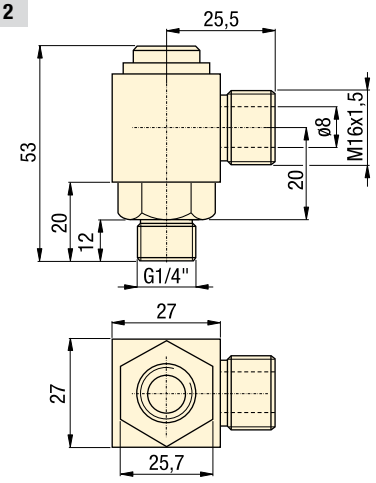
Mounting adaptor AMP-2, AMP-4
Mounts onto end of two and four passage rotary unions. Allows O-ring mounting directly to fixture.

Product selection

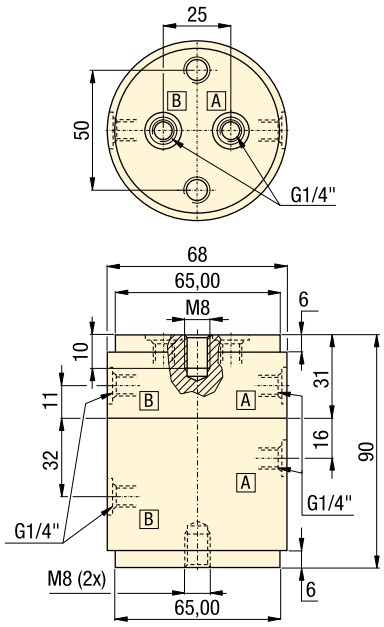
Number of radial passages	Model number	Operating pressure range	Used with
		bar	
2	**AMP-2**	100 - 350	CRV-222
4	**AMP-4**	100 - 350	CRV-442

Product dimensions in mm [ ]

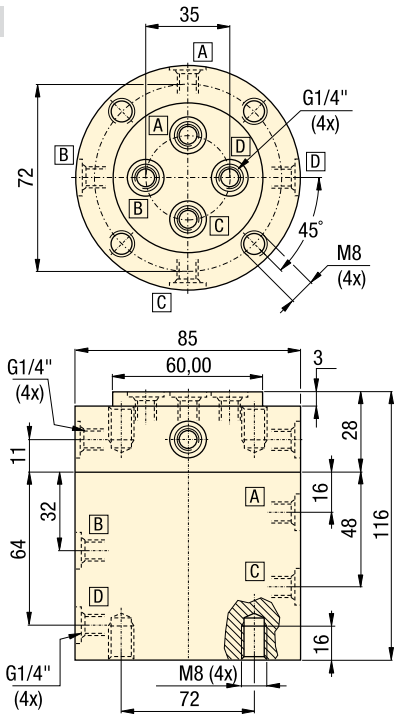
CR-112



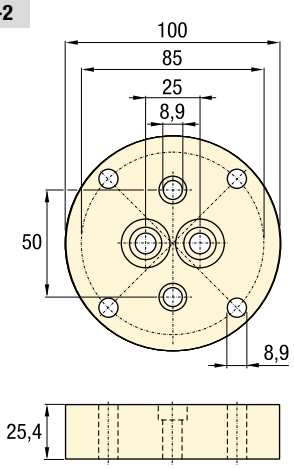
CRV-222



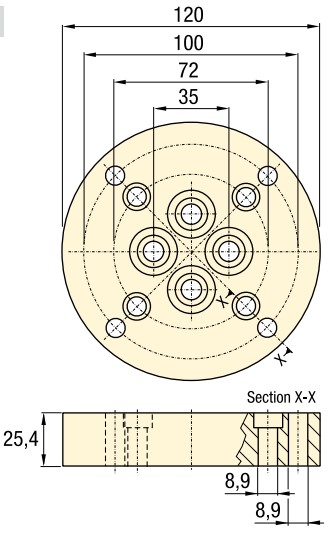
CRV-442



AMP-2



AMP-4



Passages: 1 - 4 lines

Speed: 30 - 100 RPM max.

Pressure: 100 - 350 bar

E Acoplamientos 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

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.

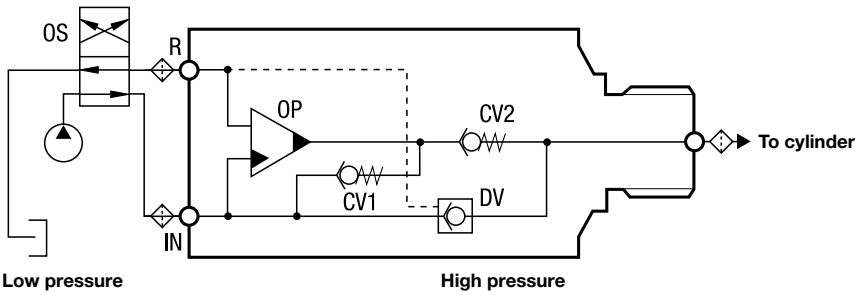
PID-series

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.

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



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

Product selection

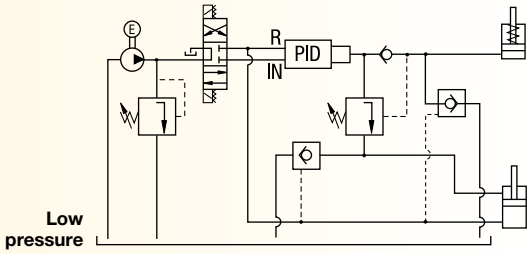
Maximum pressure	Pressure intensification ratio	Maximum input flow	Maximum output flow	Model number with dump valve	Inlet pressure range	
bar		l/min	l/min		bar	kg
700	1 : 3,2	10,0	2,5	**PID-322F**	21 - 107	1,2
700	1 : 4,0	9,5	2,0	**PID-402F**	21 - 86	1,2
700	1 : 5,0	9,0	1,5	**PID-502F**	21 - 69	1,2
700	1 : 6,6	8,7	1,2	**PID-662F**	21 - 56	1,2

* Operating pressures above 350 bar require high pressure fittings or intensifier models with BSPP ports. Contact Enerpac for details.

System set-up information:

With dump valve (PID models)

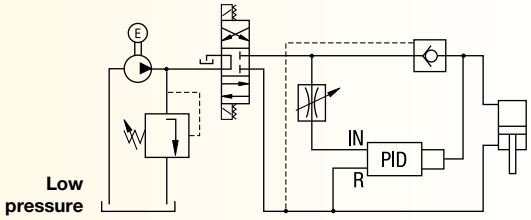
The intensifier with the dump valve is used to achieve high pressure on the advance side of a double-acting cylinder.

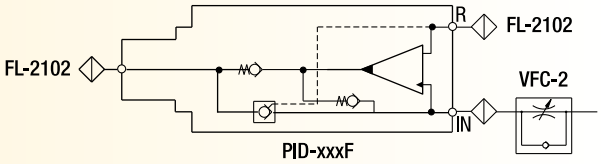


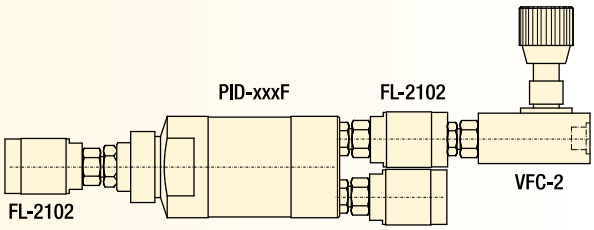
With external dump valve

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.

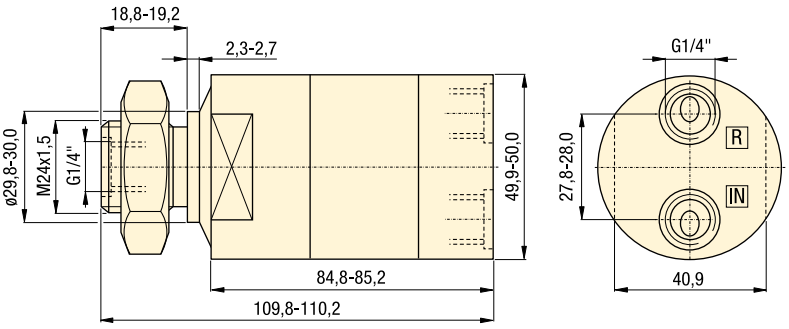






Product dimensions in mm [ ]

PID-series



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

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).

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 to 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.

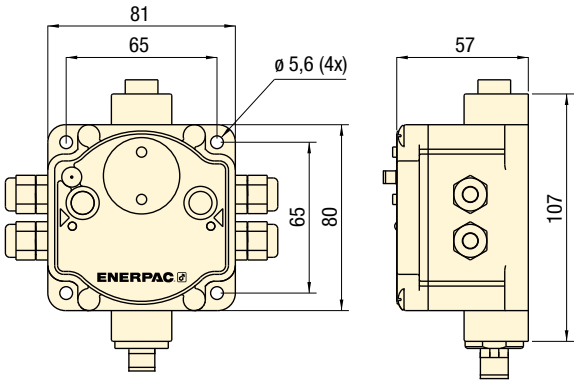
Product selection

Model Number	Description
SLS-1	“SEND” Unit with Internal Antenna
SLS-2	“SEND” Unit with External Antenna
SLS-3	“SEND” Unit with External Antenna, 3 Inputs
SLR-1	“RECEIVE” Unit with External Antenna
SLR-2	“RECEIVE” Unit with External Antenna, 3 Inputs
SLS-2AC	0,2 meter Antenna Cable
SLEM-1	Expansion Module for SLR
SLEB-1	Ethernet Bridge for SLR-1
SLSC-1	Power and Communication Splitter Cable for SLEB-1
SLDB-1	DIN Rail Mounting Bracket

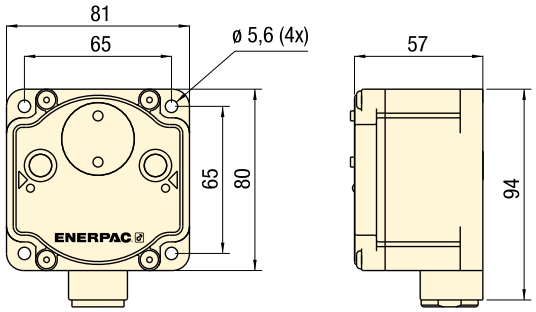
Product specifications

IP Rating	Radio Frequency	Transmit Power	Input Power for RECEIVE Unit	Output	FCC Rating	Receiver Commu-nication 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,**		
					15.247	Ethernet IP	
Dust tight,	Global		Supplied	**NMOS**			**Max. from**
immersion	Standard		by machine	**Sinking**		Modbus	**Receiver: 6**
up to			control			TCP/IP	
1 meter							

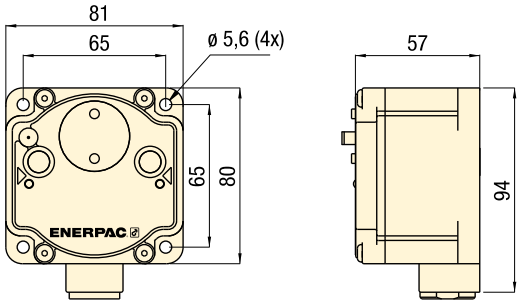
SLR-1, SLR-2 Receive Unit



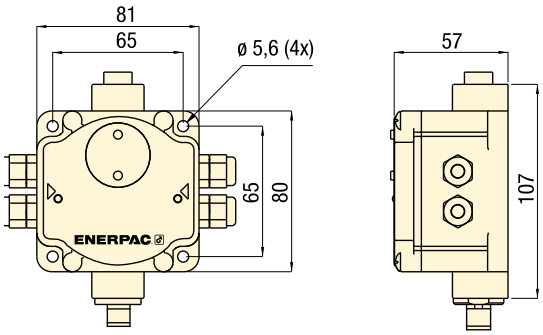
SLS-1 Send Unit



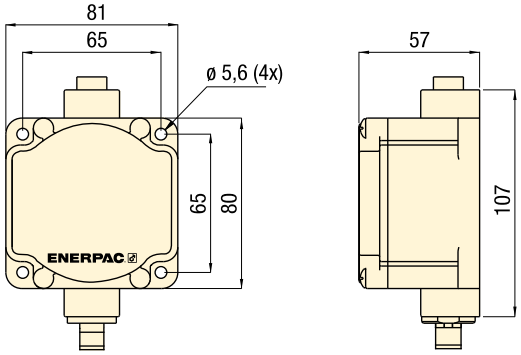
SLS-2, SLS-3 Send Unit



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

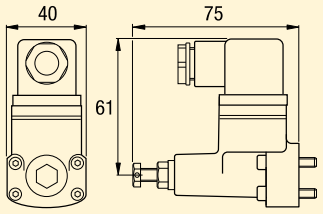
(D) Drahtlose Überwachung

Important

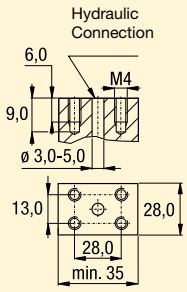
A Pressure Switch is required to monitor the pressure in the fixture circuit. For a convenient manifold mount model, use the PSCK-8 or PSCK-9 from Enerpac.

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



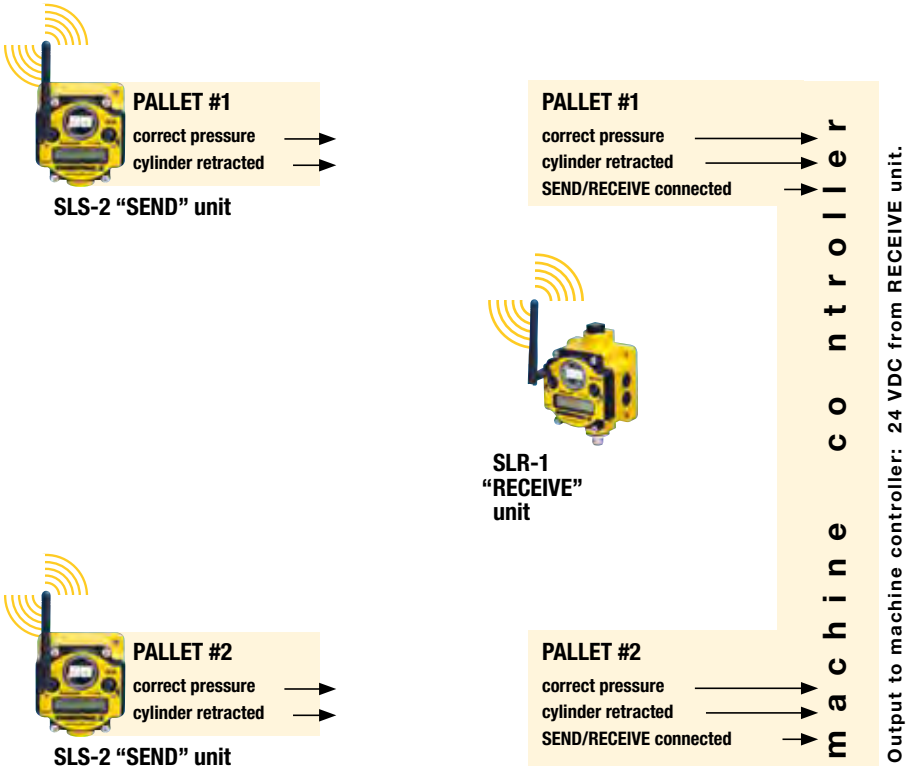
SafeLink *Systems using 24 VDC output*

Shown: SLS-1

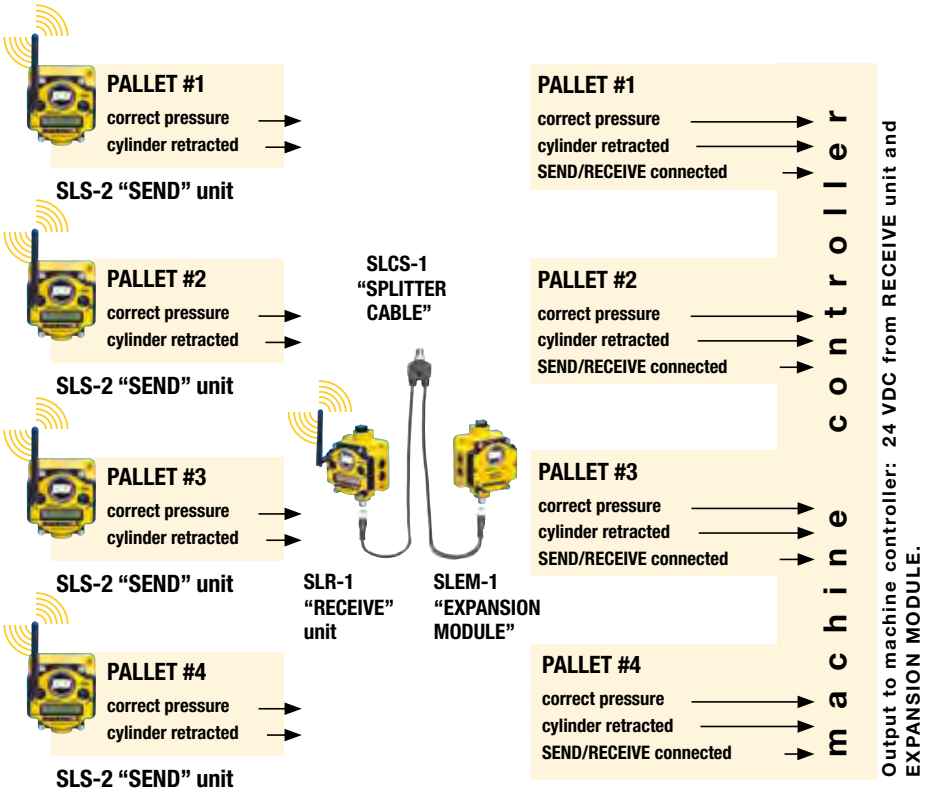
SafeLink

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.

Basic System with I/O Machine Interface



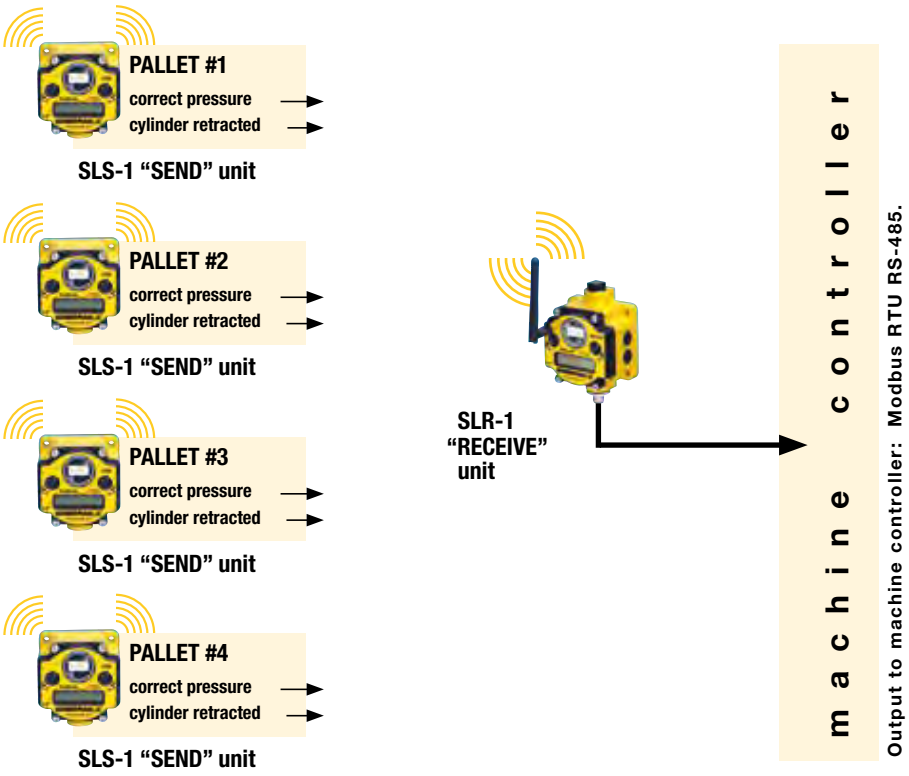
Larger System with I/O Machine Interface



SLCS-1 Splitter Cable

The **SLSC-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.

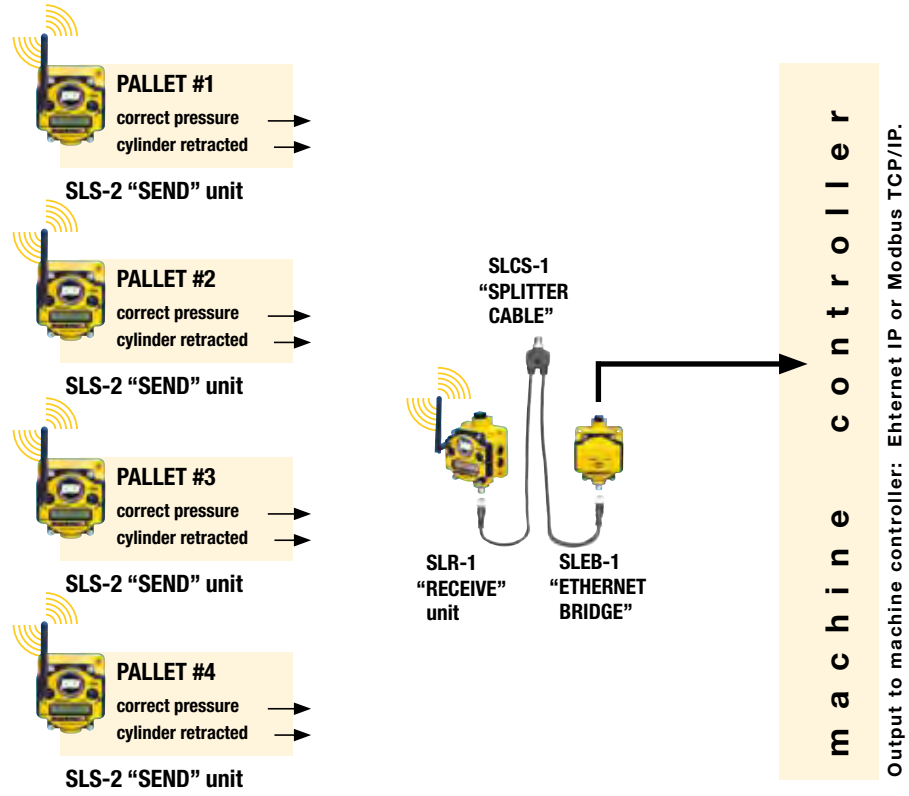
Larger System with Modbus RTU Machine Interface



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



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.

SafeLink *Frequently Asked Questions*

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 SAFELINK?

SafeLink is a wireless way to communicate between a palletized fixture and a machine control.

▶ WHY USE SAFELINK?

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 SAFELINK 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-1Receive 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	Modbus	Ethernet	DeviceNet	Relay
	Serial RS-232	Other/describe		
Machine control IP address				
Action if fault is detected	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

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

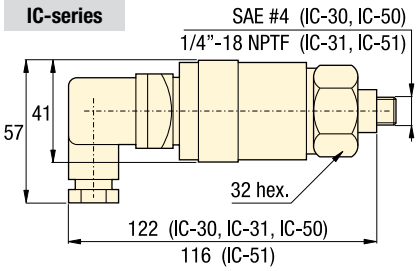
Fittings 194

Gauges 190

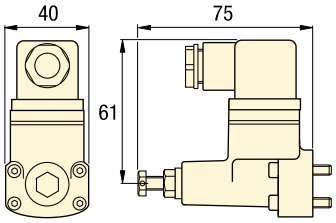
Important

Do not exceed the maximum pressure.

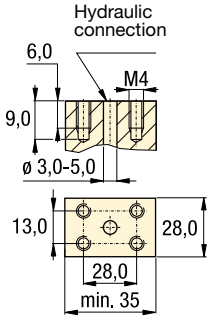
IC-series



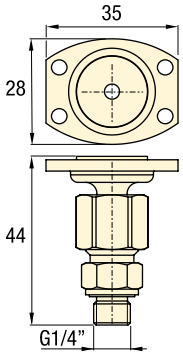
PSCK-8, 9



Mounting dimensions



PB-4



Product selection

Adjustable pressure range	Electrical specifications	Model number	Deadband	Switch point repeatability	Oil port	
bar	at 50/60 Hz		bar	% of range		kg
▼ Electrical pressure switches						
35 - 240	125 VAC @ 5 A	**IC-30**	7 - 35	+ /-2	SAE #4	0,5
35 - 240	125 VAC @ 5 A	**IC-31**	7 - 35	+ /-2	1/4"-18 NPTF	0,5
205 - 515	125 VAC @ 5 A	**IC-50**	17 - 55	+ /-2	SAE #4	0,5
205 - 515	125 VAC @ 5 A	**IC-51**	17 - 55	+ /-2	1/4"-18 NPTF	0,5
100 - 350	115 VAC @ 2 A	**PSCK-8**	17 - 55	+ /-2	Manifold mount	0,4
20 - 210	115 VAC @ 2 A	**PSCK-9**	17 - 55	+ /-2	Manifold mount	0,4
▼ Mounting adaptor for PSCK-pressure switches						
–	–	**PB-4**	–	–	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**

Easy and precise pressure monitoring

- Rated for system pressure up to 1380 bar
- Displays in multiple units: bar, psi, mPA, kg/cm² (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.

Options

Fittings

194

Gauge adaptors

190

Important

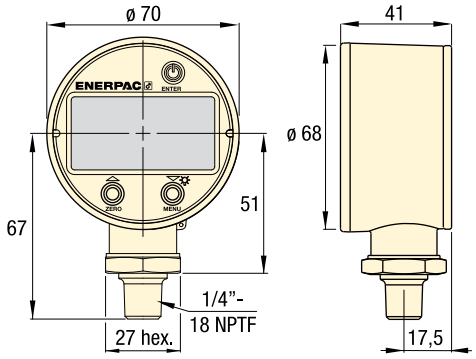
Do not exceed the maximum pressure.

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.



Product selection

Pressure rating		Model	Pressure rating		Pressure rating		Pressure rating		
bar			psi		MPa		Kg/cm²		
Range	Resolution		Range	Resolution	Range	Resolution	Range	Resolution	kg
0 - 1380	0,1	**DGR-2**	0 - 20.000	1	0 - 140	0,01	0 - 1400	0,1	0,2

Pressure gauges and accessories *Application & selection*

Shown: GS-2, G-2512L, GS-3

Enerpac gauges provide a safe and inexpensive monitoring system for your hydraulic circuit

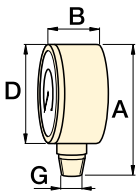
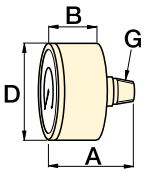
Highly reliable and accurate pressure sensing

- ± 1,5% accuracy of full scale
- G-series: All pressure sensing parts sealed and dampened by glycerine for long life
- Includes safety blow-out disk and pressure equalizing membrane to prevent overpressurization
- Copper alloy, coiled safety Bourdon tube for 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 bar	Pressure range psi	Model number	Bar graduation Major bar	Bar graduation Minor bar	PSI graduation Major psi	PSI graduation Minor psi	A mm	B mm	D mm	G
▼ Pressure gauge – Lower mount											
	0 - 7	0 - 100	**G-2509L**	1	0,01	10	2	84	37	63	1/4" NPTF
	0 - 11	0 - 160	**G-2510L**	1	0,02	10	2	84	37	63	1/4" NPTF
	0 - 14	0 - 200	**G-2511L**	1	0,02	50	5	84	37	63	1/4" NPTF
	0 - 20	0 - 300	**G-2512L**	5	0,05	50	5	84	37	63	1/4" NPTF
	0 - 40	0 - 600	**G-2513L**	10	1	100	10	84	37	63	1/4" NPTF
	0 - 70	0 - 1000	**G-2514L**	10	1	100	20	84	37	63	1/4" NPTF
	0 - 140	0 - 2000	**G-2515L**	10	2	500	50	84	37	63	1/4" NPTF
	0 - 200	0 - 3000	**G-2516L**	50	5	500	50	84	37	63	1/4" NPTF
	0 - 400	0 - 6000	**G-2517L**	100	10	1000	100	84	37	63	1/4" NPTF
	0 - 700	0 - 10.000	**G-2535L**	100	10	2000	200	84	37	63	1/4" NPTF
	0 - 70	0 - 1000	**G-2514SL**	10	1	100	20	93	31	63	SAE #4
	0 - 200	0 - 3000	**G-2516SL**	50	5	500	50	93	31	63	SAE #4
	0 - 400	0 - 6000	**G-2517SL**	100	10	1000	100	93	31	63	SAE #4
	0 - 700	0 - 10.000	**G-2535SL**	100	10	2000	200	93	31	63	SAE #4
▼ Pressure gauge – Rear mount											
	0 - 70	0 - 1000	**G-2531R**	10	1	100	20	63	37	63	1/4" NPTF
	0 - 400	0 - 6000	**G-2534R**	100	10	1000	100	63	37	63	1/4" NPTF
	0 - 700	0 - 10.000	**G-2537R**	100	10	2000	200	63	37	63	1/4" NPTF
	0 - 70	0 - 1000	**G-2531SR**	10	1	100	20	62	31	63	SAE #4
	0 - 200	0 - 3000	**G-2533SR**	50	5	500	50	62	31	63	SAE #4
	0 - 400	0 - 6000	**G-2534SR**	100	10	1000	100	62	31	63	SAE #4
	0 - 700	0 - 10.000	**G-2537SR**	100	10	2000	200	62	31	63	SAE #4
	0 - 70	0 - 1000	**1531R ***	10	1	100	20	50	25	38	1/8" NPTF
	0 - 200	0 - 3000	**1533R ***	50	10	500	100	50	25	38	1/8" NPTF
	0 - 400	0 - 6000	**1534R ***	100	10	1000	100	50	25	38	1/8" NPTF
	0 - 700	0 - 10.000	**1537R ***	100	10	2000	200	50	25	38	1/8" NPTF

* Dry gauges.

Pressure: 0 - 700 bar

Accuracy: 1,5% /full scale

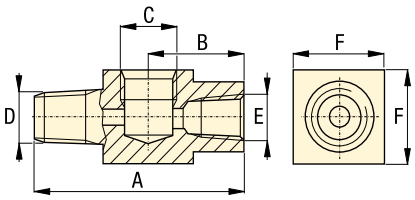
Gauge face: ø 63 mm

E Manómetros

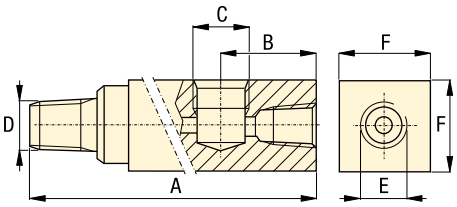
F Manomètres

D Manometer

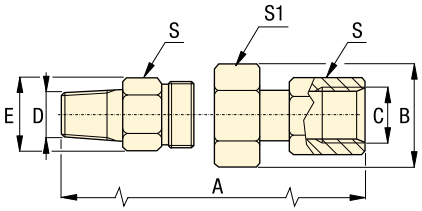
GA-1



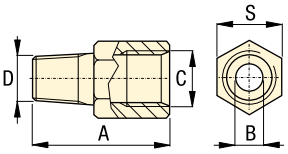
GA-2, -3, -4



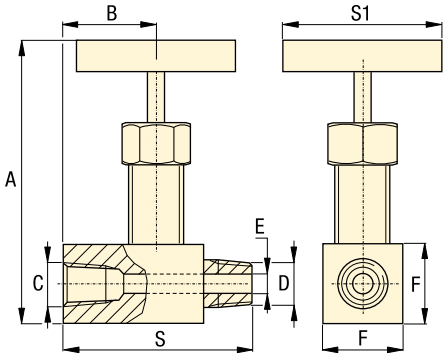
GA-918



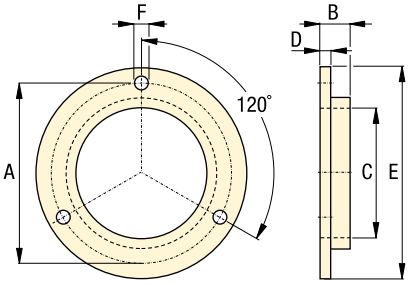
GS-2, -3



NV-251, V-91



FM-25NG



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

Product dimensions in mm [ ]

Gauge port NPTF	Max. pressure bar	Model number	Dimensions A	B	C	D	E	F	S	S1
▼ Gauge adaptors										
1/2"	700	**GA-1**	71	31	1/2"NPTF	3/8"NPTF	3/8"NPTF	32	–	–
1/2"	700	**GA-2**	155	35	1/2"NPTF	3/8"NPTF	3/8"NPTF	32	–	–
1/4"	700	**GA-3**	133	35	1/4"NPTF	3/8"NPTF	3/8"NPTF	32	–	–
1/2	700	**GA-4**	111	35	1/2"NPTF	1/4"NPTF	3/8"NPTF	32	–	–
▼ Swivel gauge adaptor										
1/2"	700	**GA-918**	57	44	1/2"NPTF	1/2"NPTF	33	–	29	38
▼ Gauge shut-off valves										
1/4"	700	**NV-251**	57	29	1/4"NPTF	1/4"NPTF	4,3	19	57	63
1/2"	700	**V-91**	89	32	1/2"NPTF	1/2"NPTF	4,8	37	64	63
▼ Gauge snubber valves										
1/4"	350	**GS-2**	41	0,5	1/4"NPTF	SAE #4	–	–	19	–
1/4"	350	**GS-3**	41	0,5	1/4"NPTF	G 1/4"	–	–	19	–
▼ Flange mounting for panel mounting of G-series gauges										
–	–	**FM-25NG**	75	4,3	64	1,8	85	3,5	–	–

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.

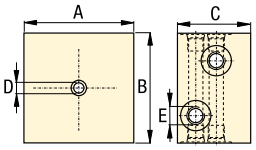
Inspect hoses and tubing frequently and replace as required.

Options

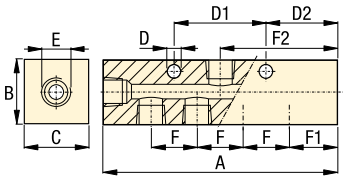
Fittings

194

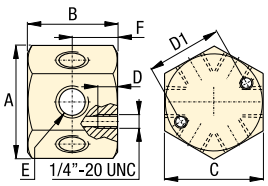
A-63



A-60, -61, -64, -65



A-66



Manifolds dimensions in mm [⊳⊕]

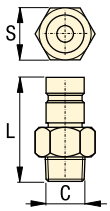
Number of ports	Model number	A	B	C	D	D1	D2	E	F	F1	F2	kg
2 x 4	**A-63**	76	76	51	6,3	–	–	SAE #4	–	–	–	0,9
5	**A-60**	89	32	32	7,1	38	25	SAE #4	38	25	44	0,5
7	**A-61**	165	32	32	7,1	38	32	SAE #4	25	32	83	0,6
7	**A-64**	178	32	32	6,3	76	32	3/8"-18 NPTF	38	32	89	1,5
7	**A-65**	368	32	32	6,3	203	32	3/8"-18 NPTF	102	32	184	2,7
6	**A-66**	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	**H-7202**	700	0,5
0,9	3/8"	3/8"	6,4	**H-7203**	700	0,7
1,8	3/8"	3/8"	6,4	**H-7206**	700	0,9
3,0	3/8"	3/8"	6,4	**H-7210**	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	**C-604**	**CR-400**	**CH-604**	3/8" NPTF	64	22
700	40	**A-604**	**AR-400**	**AH-604**	3/8" NPTF	42	19
350	17	–	**AR-650 ***	**AH-650**	1/4" NPTF	38	17,5
350	17	–	**AR-650 ***	**AH-652**	G 1/4"	34	17,5
350	17	–	**AR-650 ***	**AH-654**	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	**T-2560**	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

Fittings
194 ▶

Hoses
194 ▶

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.

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.

Hydraulic oil

Jerrycan content litres	Model number	kg
1	**HF-95X**	1,1
5	**HF-95Y**	5,3
20	**HF-95T**	21,5

HF-95 Hydraulic Oil Specification	
Viscocity Index	100 min
Viscocity (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

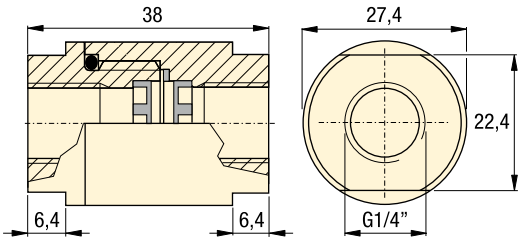
Important

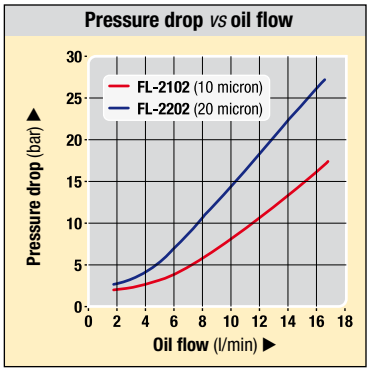
Do not exceed the maximum pressure.

Use only genuine Enerpac hydraulic oil. The use of any other fluid will render your Enerpac warranty null and void.

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 Nominal	Filtration micron Absolute	Filter element set	Maximum Pressure bar	kg
FL-2102	10	25	**FL-2101K**	350	0,25
FL-2202	20	40	**FL-2201K**	350	0,25

* Also available with Viton seals; model numbers **FL-2102V** and **FL-2202V**.

Hydraulic power is distributed by manifolds and transported by hoses and tubing.

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
▼ **Adapters**							
G 1/4"	1/8" NPTF	700	**BFZ-16411**	35	19	1/4"-18 NPTF	G 1/4"
G 1/4"	1/8" NPTF	700	**BFZ-16421**	31	19	1/8"-27 NPTF	G 1/4"
G 3/8"	1/4" NPTF	700	**BFZ-16323**	43	24	1/4"-27 NPTF	G 3/8"
G 3/8"	3/8" NPTF	700	**BFZ-16324**	43	24	3/8"-27 NPTF	G 3/8"
1/4" NPTF	1/8" NPTF	700	**FZ-1642**	31	19	1/8"-27 NPTF	1/4"-18 NPTF
3/8" NPTF	1/4" NPTF	700	**FZ-1055**	37	24	1/4"-18 NPTF	3/8"-18 NPTF
1/2" NPTF	1/4" NPTF	700	**FZ-1633**	43	29	1/4"-18 NPTF	1/2"-14 NPTF
1/2" NPTF	3/8" NPTF	700	**FZ-1634**	43	29	3/8"-18 NPTF	1/2"-14 NPTF
SAE #4	1/4" NPTF	350	**FZ-2007**	29	19	7/16"-20 UN	1/4"-18 NPTF
SAE #4	1/8" NPTF	350	**FZ-2008**	25	14	7/16"-20 UN	1/8"-27 NPTF
SAE #4	SAE #2	350	**FZ-2022**	29	17	5/16"-24 UN	7/16"-20 UN
▼ **Reducers**							
1/4" NPTF	3/8" NPTF	700	**FZ-1630**	22	22	1/4"-18 NPTF	3/8"-18 NPTF
1/4" NPTF	1/2" NPTF	700	**FZ-1661**	28	22	1/4"-18 NPTF	1/2"-14 NPTF
SAE #6	SAE #8	350	**FZ-2029**	35	27	3/4"-16 UN	9/16"-18 UN
3/8" NPTF	G 1/4"	700	**BFZ-16301**	19	19	G 1/4"	3/8"-18 NPTF
▼ **Male Nipples**							
1/4" NPTF	1/4" NPTF	700	**FZ-1608**	37	16	1/4"-18 NPTF	1/4"-18 NPTF
3/8" NPTF	3/8" NPTF	700	**FZ-1617**	37	19	3/8"-18 NPTF	3/8"-18 NPTF
3/8" NPTF	3/8" NPTF	700	**FZ-1619**	51	19	3/8"-18 NPTF	3/8"-18 NPTF
3/8" NPTF	G 1/4"	700	**BFZ-305**	36	19	3/8"-18 NPTF	G 1/4"
▼ **Female Connectors**							
1/4" NPTF	1/4" NPTF	700	**FZ-1605**	29	19	1/4"-18 NPTF	1/4"-18 NPTF
3/8 NPTF	1/4" NPTF	700	**FZ-1615**	29	22	3/8"-18 NPTF	1/4"-18 NPTF
3/8" NPTF	3/8" NPTF	700	**FZ-1614**	29	22	3/8"-18 NPTF	3/8"-18 NPTF
1/2" NPTF	3/8" NPTF	700	**FZ-1625**	38	29	1/2"-14 NPTF	3/8"-18 NPTF
▼ **Elbows**							
1/4" NPTF	1/4" NPTF	700	**FZ-1638**	23	19	1/4"-18 NPTF	1/4"-18 NPTF
3/8" NPTF	3/8" NPTF	700	**FZ-1610**	26	22	3/8"-18 NPTF	3/8"-18 NPTF
▼ **Tee**							
1/4" NPTF	1/4" NPTF	700	**FZ-1637**	45	19	1/4"-18 NPTF	1/4"-18 NPTF
3/8" NPTF	3/8" NPTF	700	**FZ-1612**	52	22	3/8"-18 NPTF	3/8"-18 NPTF
▼ **Cross**							
3/8" NPTF	3/8" NPTF	700	**FZ-1613**	52	7/8"	3/8"-18 NPTF	3/8"-18 NPTF

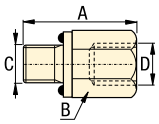
Pressure: 0 - 350 / 700 bar

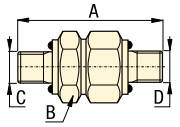
Threads: NPTF, BSPP, SAE

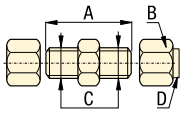
For tubing: ø 1/4 - 3/8", 8 mm

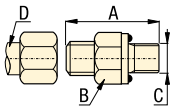
(E) Acoplamientos
(F) Raccords
(D) Verschraubungen

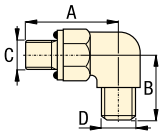
Product selection











From	To	Maximum pressure bar	Model number	Dimensions A mm	B mm	C	D
▼ Adapters							
1/8" NPTF	SAE #4	350	**FZ-2075**	27	17	1/8"-27 NPTF	1/4"-18 NPTF
1/4" NPTF	SAE #4	350	**FZ-2042**	33	17	1/4"-18 NPTF	7/16"-20 UN
1/4" NPTF	G 1/4"	700	**BFZ-16411**	35	19	1/4"-18 NPTF	G 1/4"
SAE #4	1/8" NPTF	350	**FZ-2008**	25	14	7/16"-20 UN	1/8"-27 NPTF
SAE #4	1/4" NPTF	350	**FZ-2007**	29	19	7/16"-20 UN	1/4"-18 NPTF
SAE #2	SAE #4	350	**FZ-2022**	26	14	5/16"-24 UN	7/16"-20 UN
SAE #6	1/4" NPTF	350	**FZ-2056**	29	19	9/16"-18 UN	1/4"-18 NPTF
SAE #8	1/4" NPTF	350	**FZ-2067**	29	22	3/4"-16 UN	1/4"-18 NPTF
SAE #8	3/8" NPTF	350	**FZ-2069**	33	22	3/4"-16 UN	3/8"-18 NPTF
G 1/8"	1/8" NPTF	350	**FZ-2055**	25	16	G 1/8"	1/8"-27 NPTF
G 1/8"	1/4" NPTF	350	**FZ-2060**	33	19	G 1/8"	1/4"-18 NPTF
G 1/8"	SAE #4	350	**FZ-2066**	25	17	G 1/8"	7/16"-20 UN
G 1/4"	1/4" NPTF	350	**FZ-2023**	33	19	G 1/4"	1/4"-18 NPTF
G 1/4"	SAE #4	350	**FZ-2065**	28	19	G 1/4"	7/16"-20 UN
▼ Straight union							
SAE #4	SAE #4	350	**FZ-2005**	32	14	7/16"-20 UN	7/16"-20 UN
SAE #6	SAE #6	350	**FZ-2028**	36	17	9/16"-18 UN	9/16"-18 UN
SAE #8	SAE #8	350	**FZ-2040**	40	22	3/4"-16 UN	3/4"-16 UN
▼ Straight union to tube ends							
ø 1/4"	ø 1/4"	350	**FZ-2033 ***	35	13	7/16"-20 UN	ø 1/4"
ø 1/4"	ø 1/4"	350	**FZ-2013 ****	52	13	7/16"-20 UN	ø 1/4"
▼ Adaptors to tube end							
1/8" NPTF	ø 1/4"	350	**R-1054 ***	31	13	1/8"-27 NPTF	ø 1/4"
1/4" NPTF	ø 1/4"	350	**FZ-2020 ***	36	14	1/4"-18 NPTF	ø 1/4"
1/4" NPTF	ø 3/8"	350	**FZ-2072 ***	36	16	1/4"-18 NPTF	ø 3/8"
1/4" NPTF	ø 1/4"	350	**FZ-2012 ****	34	14	1/4"-18 NPTF	ø 1/4"
3/8" NPTF	ø 1/4"	350	**FZ-2061 ***	37	19	3/8"-18 NPTF	ø 1/4"
3/8" NPTF	ø 3/8"	350	**FZ-2068 ***	37	19	3/8"-18 NPTF	ø 3/8"
SAE #2	ø 1/4"	350	**FZ-2025 ***	26	14	5/16"-24 UN	ø 1/4"
SAE #4	ø 1/4"	350	**FZ-2019 ***	32	14	7/16"-20 UN	ø 1/4"
SAE #4	ø 1/4"	350	**FZ-2001 ****	29	14	7/16"-20 UN	ø 1/4"
SAE #6	ø 1/4"	350	**FZ-2059 ***	33	17	9/16"-18 UN	ø 1/4"
SAE #8	ø 1/4"	350	**FZ-2039 ***	35	22	3/4"-16 UN	ø 1/4"
SAE #8	ø 3/8"	350	**FZ-2070 ***	35	22	3/4"-16 UN	ø 3/8"
G 1/8"	ø 1/4"	350	**FZ-2053 ***	39	14	G 1/8"	ø 1/4"
G 1/4"	ø 1/4"	350	**FZ-2054 ***	35	19	G 1/4"	ø 1/4"
G 1/4"	ø 3/8"	350	**FZ-2064 ***	35	19	G 1/4"	ø 3/8"
▼ Elbow to tube end							
1/8" NPTF	ø 1/4"	350	**FZ-2074 ***	20	11	1/8"-27 NPTF	ø 1/4"
1/4" NPTF	ø 1/4"	350	**FZ-2073 ***	28	14	1/4"-18 NPTF	ø 1/4"
1/4" NPTF	ø 1/4"	350	**FZ-2076 ****	26	14	1/4"-18 NPTF	ø 1/4"
1/4" NPTF	ø 3/8"	350	**FZ-2081 ***	28	14	1/4"-18 NPTF	ø 3/8"
3/8" NPTF	ø 1/4"	350	**FZ-2082 ***	31	19	3/8"-18 NPTF	ø 1/4"
3/8" NPTF	ø 3/8"	350	**FZ-2083 ***	31	14	3/8"-18 NPTF	ø 3/8"
SAE #2	ø 1/4"	350	**FZ-2024 ***	23	11	5/16"-24 UN	ø 1/4"
SAE #4	ø 1/4"	350	**FZ-2035 ***	26	14	7/16"-20 UN	ø 1/4"
SAE #4	ø 1/4"	350	**FZ-2002 ****	26	14	7/16"-20 UN	ø 1/4"
SAE #8	ø 3/8"	350	**FZ-2071 ***	37	22	3/4"-16 UN	ø 3/8"
G 1/8"	ø 1/4"	350	**FZ-2051 ***	26	14	G 1/8"	ø 1/4"
G 1/4"	ø 1/4"	350	**FZ-2052 ***	32	19	G 1/4"	ø 1/4"
ø 1/4"	ø 1/4"	350	**FZ-2014 ****	23	14	ø 1/4"	ø 1/4"

* Flared
** Flareless

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 presure hydraulic fittings allow connection of many components with minimum effort.

Pressure: 0 - 350 / 700 bar

Threads: BSPP, SAE

For tubing: ø1/4 - 3/8" - 8 mm

(E) Acoplamientos
(F) Raccords
(D) Verschraubungen

Options

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Important

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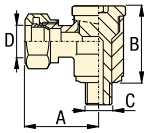
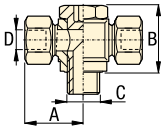
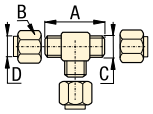
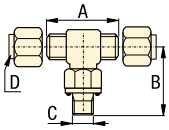
Multiple hydraulic line connections are easily installed with Enerpac fittings and manifolds.

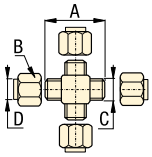
Product selection

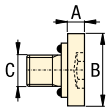


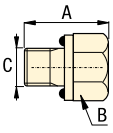


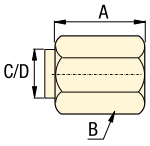


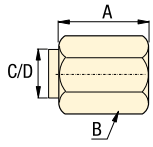












From	To	Maximum pressure bar	Model number	Dimensions A mm	B mm	C	D
▼ Swivel banjo BSPP to tube							
G 1/4"	ø 8	700	**BFZ-307**	29	19	G 1/4"	ø 8
▼ Swivel T-banjo BSPP to tube							
G 1/4"	ø 8	700	**BFZ-309**	29	19	G 1/4"	ø 8
▼ Union tee							
ø 1/4"	ø 1/4"	350	**FZ-2015 ****	45	14	7/16"-20 UN	ø 1/4"
ø 1/4"	ø 1/4"	350	**FZ-2021 ***	45	14	7/16"-20 UN	ø 1/4"
▼ Branch tee							
SAE #4	ø 1/4"	350	**FZ-2036 ***	45	14	7/16"-20 UN	ø 1/4"
SAE #4	ø 1/4"	350	**FZ-2004 ****	45	14	7/16"-20 UN	ø 1/4"
▼ Union cross							
ø 1/4"	ø 1/4"	350	**FZ-2034 ***	45	14	7/16"-20 UN	ø 1/4"
ø 1/4"	ø 1/4"	350	**FZ-2016 ****	45	14	7/16"-20 UN	ø 1/4"
▼ SAE plug							
SAE #4	–	350	**FZ-2006**	3	14	7/16"-20 UN	–
SAE #6	–	350	**FZ-2003**	3	17	9/16"-20 UN	–
▼ SAE hexagon plug							
SAE #8	–	350	**FZ-2041**	20	22	3/4"-16 UN	–
▼ Nut and Sleeve for tubing							
ø 1/4"	–	350	**FZ-2037 ***	16	14	37°	ø 1/4"
▼ Cap for tubing							
ø 1/4"	–	350	**FZ-2038 ***	16	14	37°	ø 1/4"
ø 1/4"	–	350	**FZ-2017 ****	15	14	ø 1/4"	ø 1/4"
ø 3/8"	–	350	**FZ-2011 ***	19	17	37°	ø 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** 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.

ISO 9001 REGISTERED

Enerpac worked hard to earn the quality rating ISO 9001, in its ongoing pursuit of excellence.

UL approved
All electrical components used on Enerpac products carry the UL rating when possible.

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.

Safety instructions *Correct use of hydraulic power*

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.

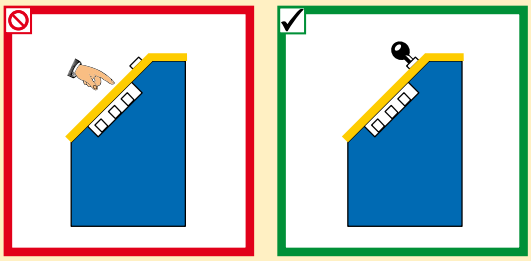
Although hydraulic operation moves the control of the clamping fixture to an area of greater safety, operators must still be alert to several common sense practices. And to that end we offer some DOs and DON'Ts, simple common sense points which apply to all Enerpac hydraulic products.

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.

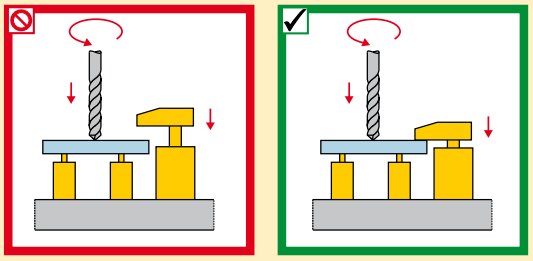
Check to see if all safety measures have been taken to avoid the risk of injury and property damage from your application or system.

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.

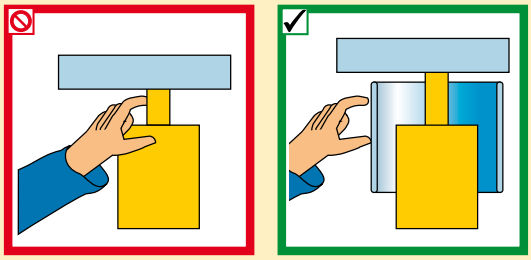
In addition to these tips, every Enerpac product comes with instructions spelling out specific safety information. Please read them carefully.



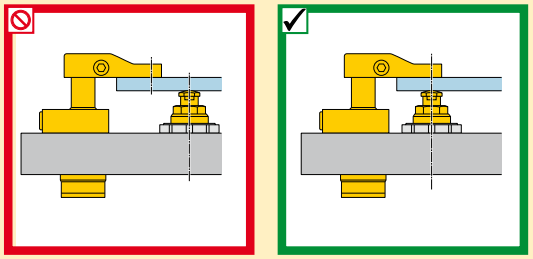
Prevent inadvertent activation of the control units of power operated clamping systems.



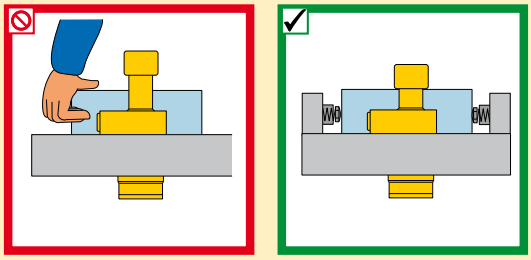
Clamping devices must be activated before main spindle can be started.



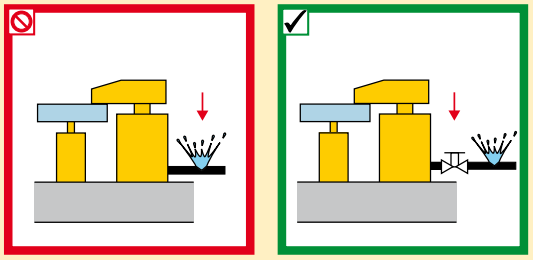
Maintain a safe distance from clamping elements and workpiece to avoid personal injury.



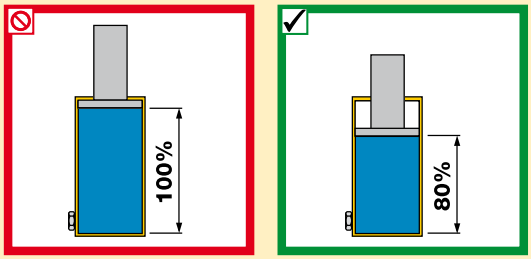
Do not apply off-center load. Clamping force must be directly over the support point.



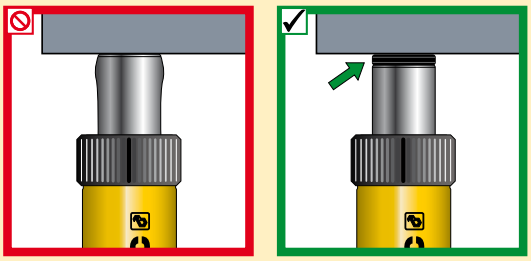
Use mechanical devices and not fingers to hold part until the hydraulics are activated.



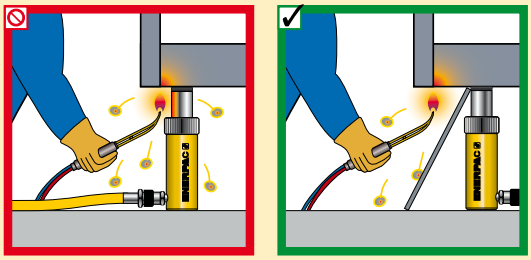
Use check valves to maintain hydraulic pressure to clamping devices in the event of a hydraulic line failure.



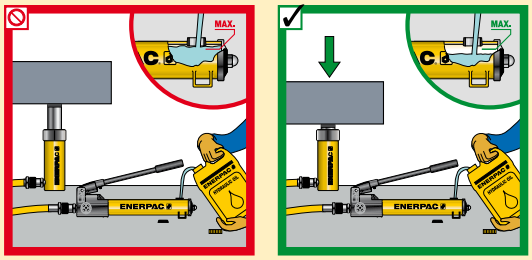
Do not operate cylinders beyond limits of rated stroke or pressure. Use only 80% of usable stroke.



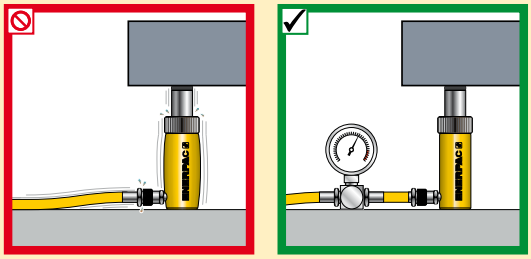
Use saddles or buttons to prevent mushrooming of plungers. Saddles distribute load evenly on the plunger.



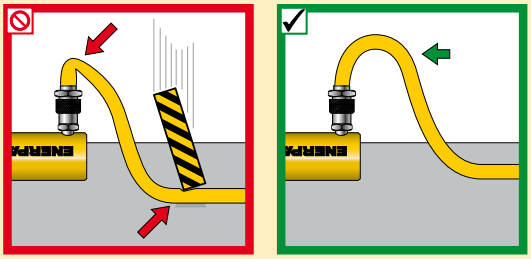
Keep hydraulic equipment away from open fire and temperatures above 65 °C (150 °F).



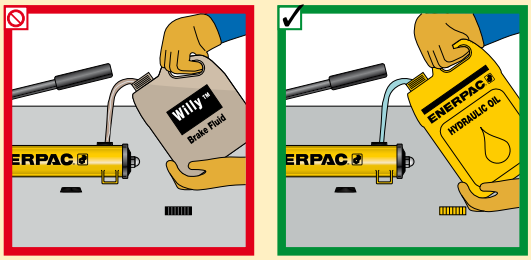
Fill pump only to recommended level. Fill only when connected cylinders are fully retracted.



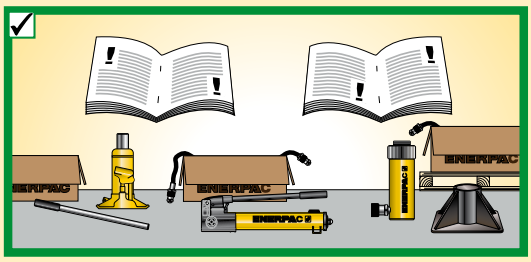
Do not override the factory setting of pressure relief valves. Always use a gauge to check system pressure.



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.

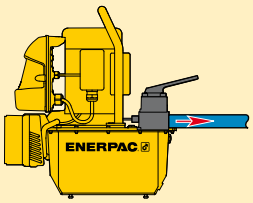
Oil Flow

A hydraulic pump produces flow. Flow is the amount of fluid coming out of the pump.

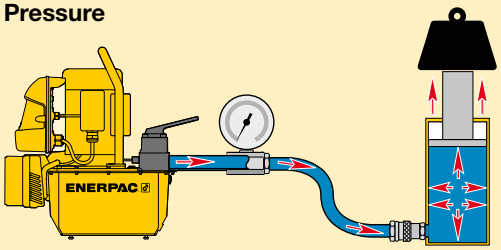
Pressure

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).

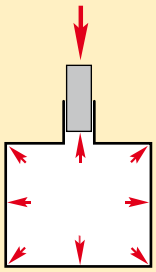


Figure 1

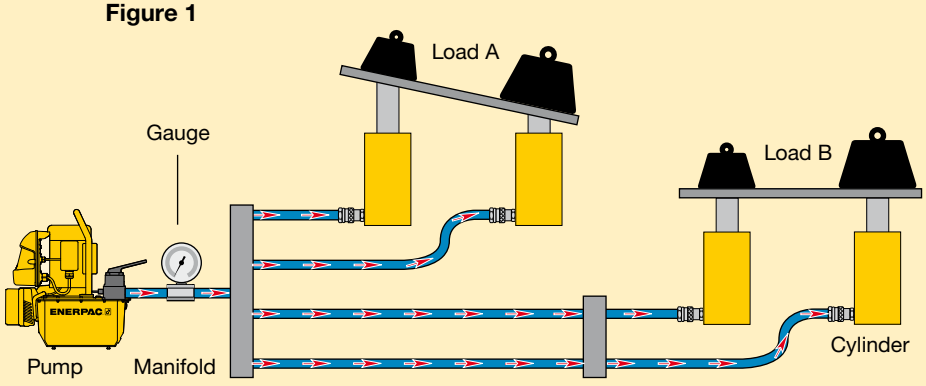
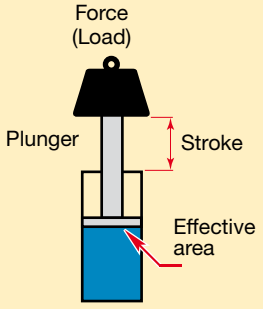


Figure 2

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 x A** to determine either force, pressure or effective area if two of the variables are known.

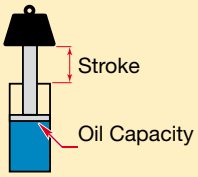


Force	=	Hydraulic Working Pressure	X	Cylinder Effective Area
F	=	P	X	A

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.

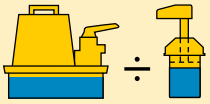
Cylinder Oil Capacity (cm^3) = **Cylinder Effective Area** (cm^2) x **Cylinder Stroke** (cm)



Usable Oil Capacity

The amount of hydraulic oil in the pump's reservoir which can be used to activate one or more cylinders.

Pump Usable Oil Capacity (cm^3) ÷ **Cylinder Oil Capacity** (cm^3) = **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.

Cylinder Clamp Speed (mm/sec) = $\frac{\text{Pump Flow Rate } (cm^3/min)}{\text{Cylinder Effective Area } (cm^2)}$ x $\frac{10}{60}$

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.

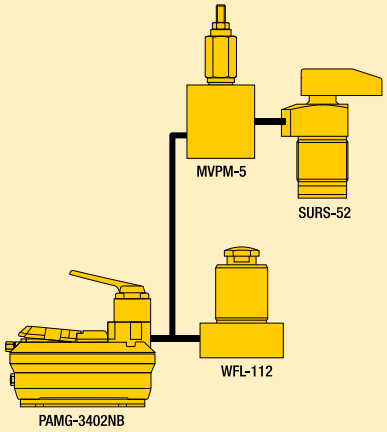
Heat is a crucial factor in seal life. Maximum temperature for good seal life is 150°F (65°C). This is also the maximum temperature of Enerpac hydraulic oil. Above 150°F, the use of Viton and high temperature oil is necessary. Viton has a maximum temperature which is much higher than nitrate or polyurethane. 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.

Basic system set-up *The four essential steps*

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.

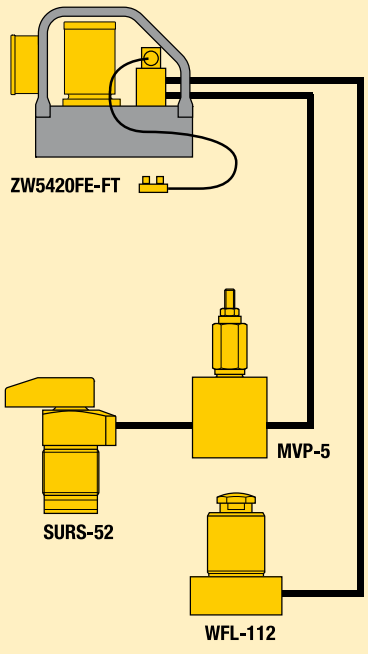
Pull cylinders
are used where the workpiece shape or fixture dictates clamping by pull forces, this type of cylinder with hydraulic or spring return can be selected to match particular needs.

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.

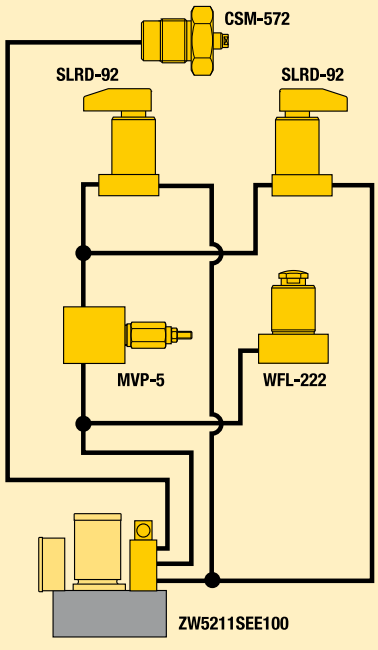
Step 4

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.

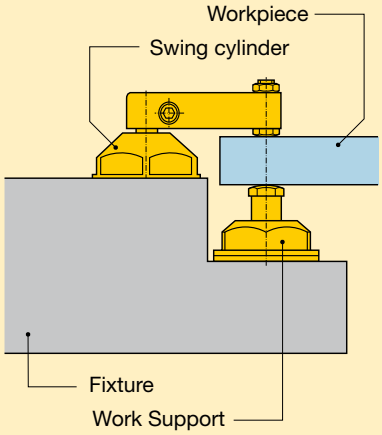


Figure 1
The combined use of clamping cylinders and work supports.

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

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

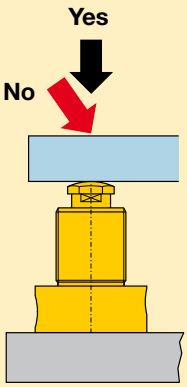


Figure 2
The direction of the clamping force must be axial at the centerline of the work support's plunger for best results in clamping and repeatability of quality.

Side loading of the work support must be avoided in order to ensure reliable and safe function (Figure 2).

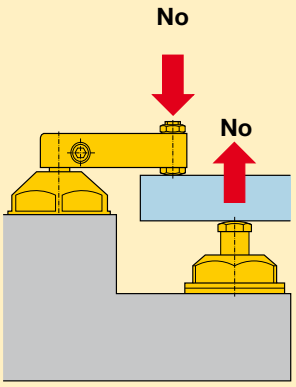


Figure 3
An off-set load will cause bending of the workpiece and uncontrolled deflection (Figure 3).

Hydraulic requirements

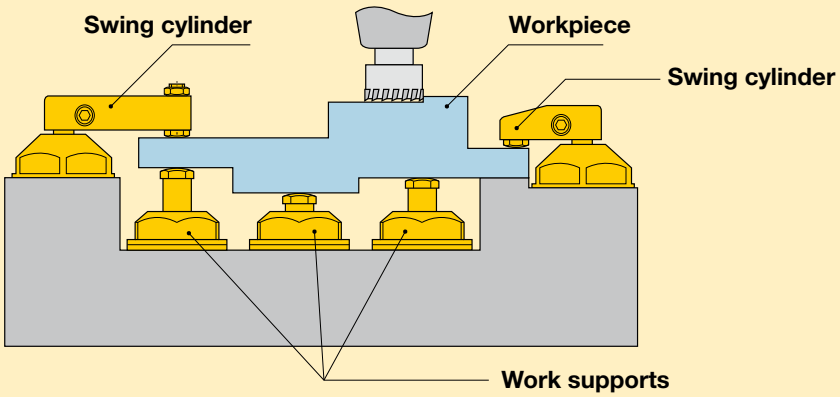


Figure 4
Swing cylinders and hydraulically advancing work supports are very sensitive regarding the oil flow rate applied.

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)

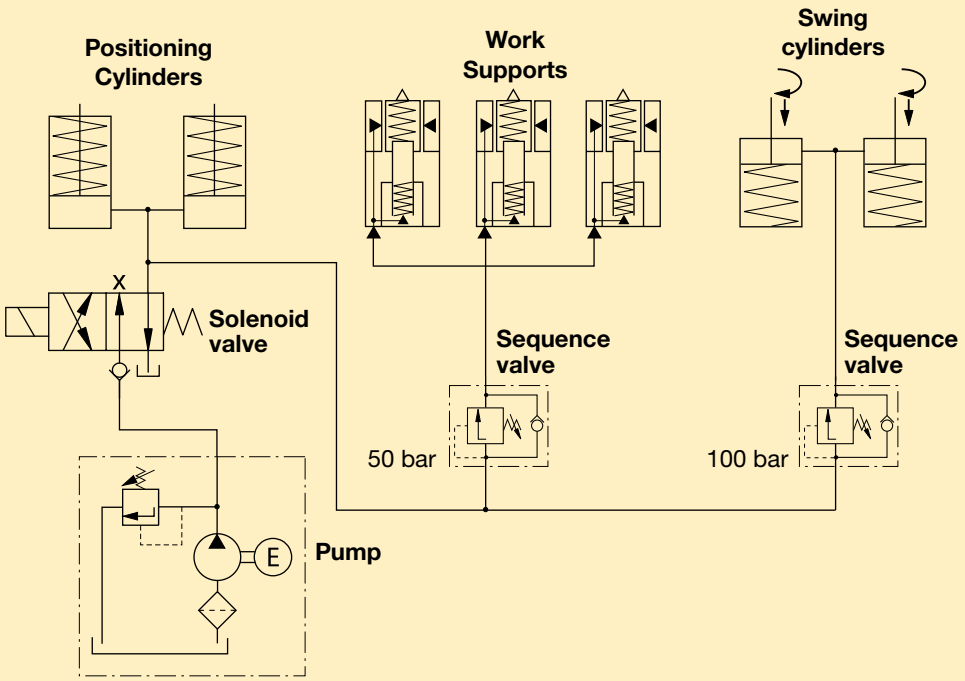


Figure 5
For overhanging areas of the workpiece which have to be supported, the recommended sequence should be as follows (Figure 5):

1. Positioning of the workpiece
2. Actuate work supports
3. Clamp the overhanging area against work support.

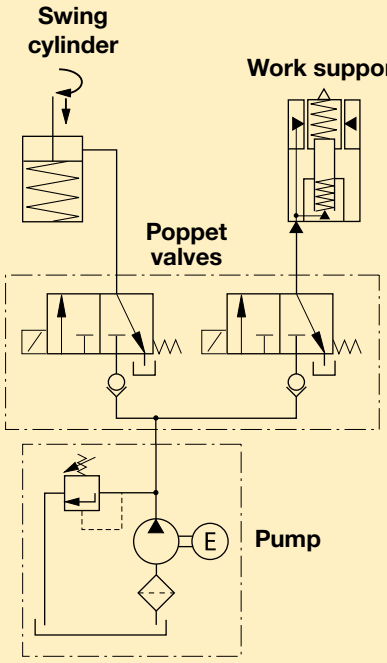


Figure 6

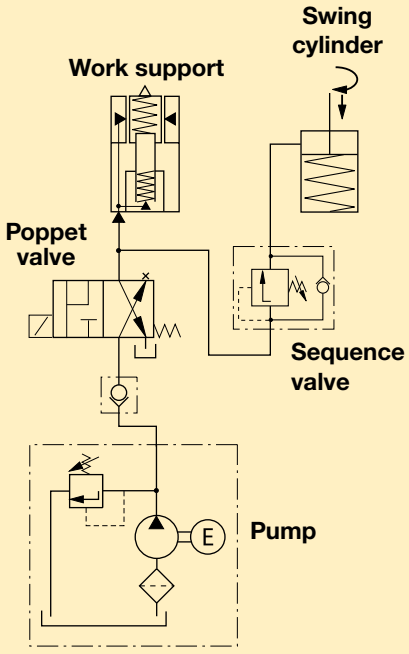


Figure 7

The hydraulic sequence can be controlled either by independently controlled hydraulic circuits (Figure 6) or by sequence valves (Figure 7).

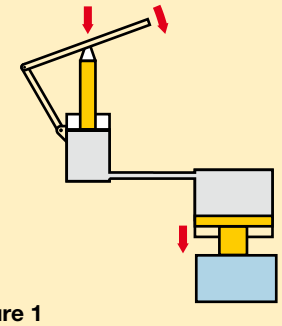


Figure 1
Operating principle of a hydraulic clamping device.

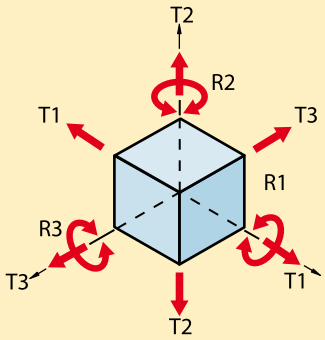


Figure 2
Three-dimensional body.

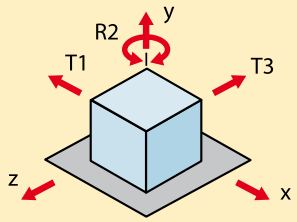


Figure 3a
Three degrees of freedom.

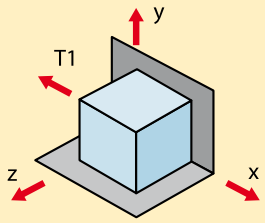


Figure 3b
One degree of freedom.

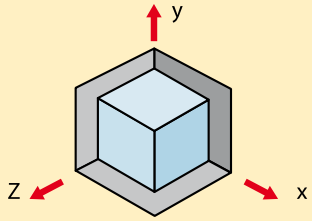


Figure 3c
Zero degree of freedom.

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

a. Workpiece with locating planes
b. Incorrectly located workpiece
c. 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.

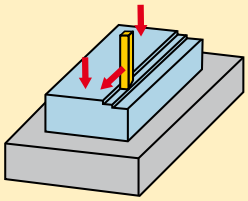


Figure 4a
Semi-constrained Workpiece.

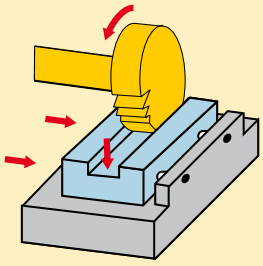


Figure 4b
Constrained Workpiece

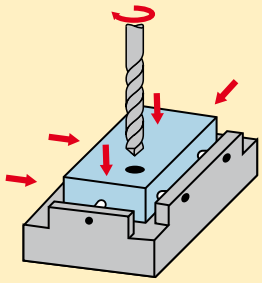


Figure 4c
Fully-constrained Workpiece

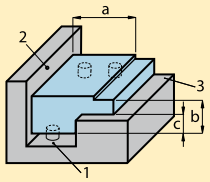


Figure 5a
Workpiece with locating planes

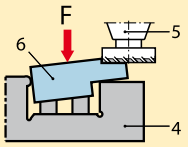


Figure 5b
Inorrectly located workpiece

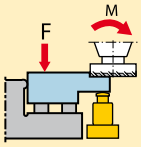


Figure 5c
Correctly located workpiece

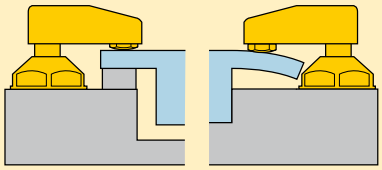


Figure 6
Design guidelines for clamping.

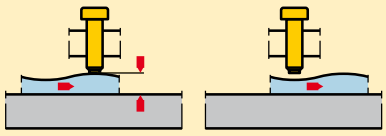


Figure 7
Mechanical clamping

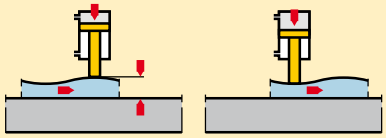


Figure 8
Hydraulic clamping

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.

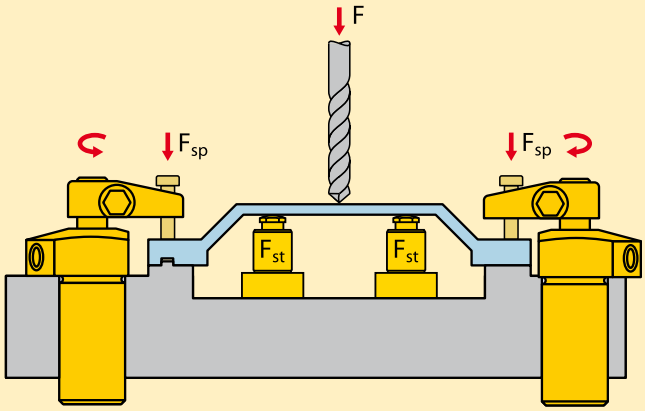


Figure 9
Supported workpieces.

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

a. Unclamped workpiece
b. Clamped workpiece
c. 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).

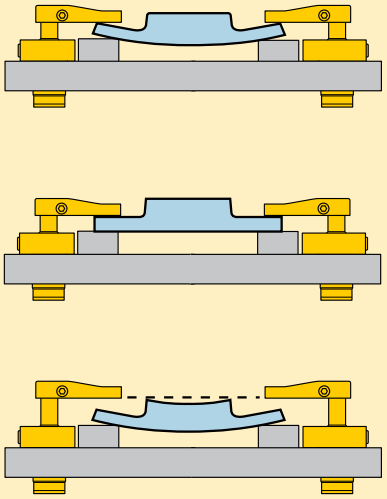


Figure 10a
Deformation caused by conventional clamping.

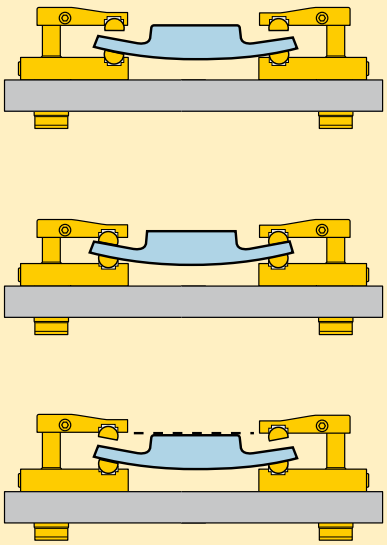


Figure 10b
Eliminate deformation using spherical ball supports.

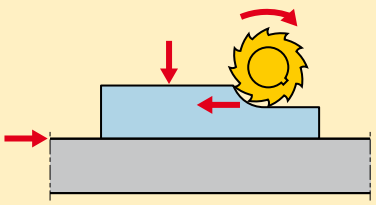
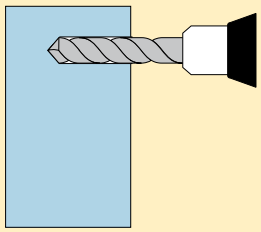
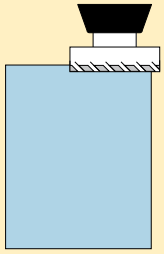


Figure 11
Approximation of the clamping force.

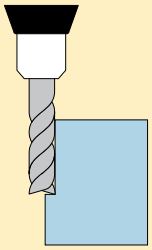
Cutting technology



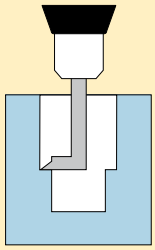
Drilling



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 hp x 26,400/3000 SFM = 322 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.

$$\text{Cutting Force}^{1)} = \frac{\text{Spindle Hp x 26406}^{2)}}{\text{Cutting Speed}^{3)}}$$

1) Cutting Force in Pounds

2) Spindle Horsepower to foot-pouds at 80% efficiency

3) Cutting Tool surface speed in feet per minute.

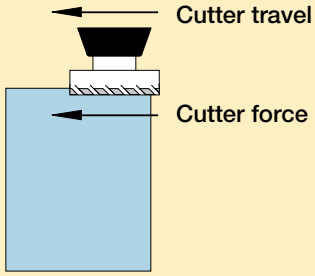
$$\text{MRR}^{1)} = \text{W x D x F x N x RPM}^{2)}$$

1) Material Removal rate (in^3/min)

2) **W** = Width of cut (inch)
D = Depth of cut (inch)
F = Feed per tooth (inch)
N = Number of cutting teeth
RPM = Spindle Speed

$$\text{Tool RPM} = \frac{\text{SFM}^{1)}}{\text{Diameter x 0.2618}}$$

2) **SFM** = Surface Feet per Minute



Unit Power for dull tools [imperial system]

Material	Hardness	Unit Power hp/in^3/min Turning	Drilling	Milling
		HSS & Carbide Tools	HSS Drills	HSS & Carbide Tools
STEELS	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
CAST IRONS	110-190 Bhn	0.9	1.2	0.8
Gray, ductile	190-320 Bhn	1.7	2.0	1.4
and malleable				
STAINLESS STEELS	135-275 Bhn	1.6	1.4	1.7
	30-45 Rc	1.7	1.5	1.9
TITANIUM	250-375 Bhn	1.5	1.4	1.4
NICKEL ALLOYS	80-360 Bhn	2.5	2.2	2.4
ALUMINIUM ALLOYS	30-150 Bhn	0.3	0.2	0.4
MAGNESIUM ALLOYS	40-90 Bhn	0.3	0.2	0.2
COPPER ALLOYS	10-80 Rb	0.8	0.6	0.8
	80-100 Rb	1.2	1.0	1.2

Cutting Force [1] = **Spindle kW x 48000** [2] / **Cutting Speed** [3]

1) Cutting Force in Newtons (N)

2) Spindle Power (kW) required 80% efficiency

3) Cutting Tool surface speed in metres per minute (m/min).

MRR [1] = **W x D x F x N x RPM** [2] / **1000**

1) Material Removal rate (cm^3/min)

2) **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)

Tool RPM = **MPM x 1000** [1] / **π x Tool diameter** [2]

1) **MPM** = Surface Speed in m/min

2) 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^3/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 coefficents of friction when using clamp cylinders. For example, if the aluminium has a coefficent 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)
STEELS, WROUGHT				
AND CAST	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
CAST IRONS	110 - 190 Bhn	0,41	0,055	0,036
Gray, ductile and malleable	190 - 320 Bhn	0,077	0,091	0,064
STAINLESS STEELS,				
WROUGHT AND CAST	135 - 275 Bhn	0,073	0,064	0,077
Ferritic, austenitic and				
martensitic	30 - 45 Rc	0,077	0,068	0,086
TITANIUM	250 - 375 Bhn	0,068	0,064	0,064
NICKEL ALLOYS	80 - 360 Bhn	0,114	0,100	0,109
ALUMINIUM ALLOYS	30 - 150	0,014	0,009	0,018
MAGNESIUM ALLOYS	40 - 90 Bhn	0,009	0,009	0,009
COPPER ALLOYS	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
	= 10 N/cm^2
1 MPa	= 145 psi

Volume:

1 in^3	= 16,387 cm^3
1 cm^3	= 0,061 in^3
1 liter	= 61,02 in^3
	= 0,264 gal
1 US gal	= 3,785 cm^3
	= 3,785 l
	= 231 in^3

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^2	= 6,452 cm^2
1 cm^2	= 0,155 in^2
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 °F = (T °C x 1,8) + 32

To Convert °F to °C:
T °C = (T °F – 32) ÷ 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
1	.039
2	.078
3	.118
4	.157
5	.197
6	.236
7	.275
8	.315
9	.354
10	.394
11	.433
12	.472
13	.512

Millimeters	Inches
14	.551
15	.591
16	.630
17	.670
18	.709
19	.748
20	.787
21	.827
22	.866
23	.906
24	.945
25	.983

Best practices in hydraulic system design

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

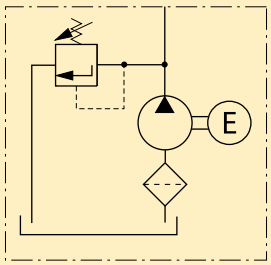
Work supports are rated based upon a somewhat constant load. Sharp vibrations from an interrupted cut or a large impact load (such as dropping a part on the fixture) will cause the work support to slip.
Because of the design, once the work support has been subjected to a high impact load, it may no longer function. Be aware of this fact and limit impact loading wherever possible.

Manifold mounting

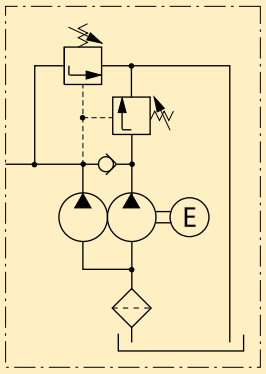
Manifold mounting of cylinders significantly decreases the amount of space required on a fixture. It also makes installation and service much simpler. Be sure to clean and de-burr all passages in the fixture manifold. Burrs can break loose over time and be ingested into the hydraulic cylinders, causing 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.

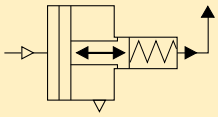
Power sources



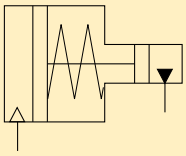
Single-stage electric pump
Example
ZW4010NE-S



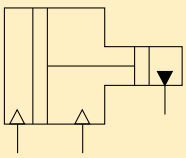
Two-stage electric pump
Example
ZW5020NG



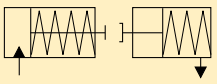
Reciprocating air pump
Example
PA-136



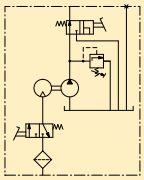
Single-acting booster
Example
B-3006



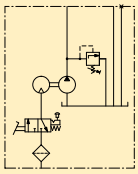
Double-acting booster
Example
AHB-34



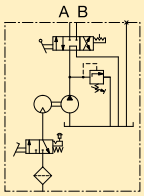
Activator wand and booster
Example
B-171
RA-1061



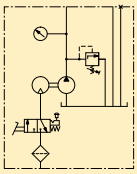
Turbo air pump
Example
PATG-3102NB



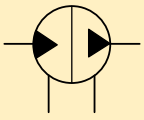
Turbo air pump
Example
PASG-3002SB



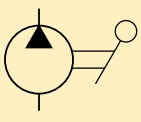
Turbo air pump
Example
PAMG-3402NB



Turbo air pump
Example
PACG-3002NB



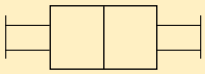
Hydraulic intensifier
Example
PID-321



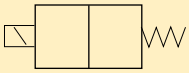
Hand pump
Example
P-142

Hydraulic symbols *Most common system elements*

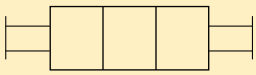
Valves



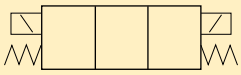
2-position manual



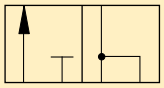
2-position solenoid



3-position manual

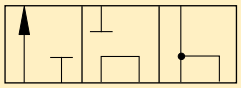


3-position solenoid



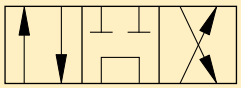
3-way, 2-position, Normally open

Series	Example
V	**VM-2**



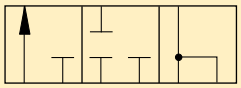
3-way, 3-position, Tandem center

Series	Example
V	**VM-3, VC-3**
VE	**VEF-15000D**



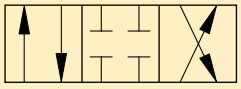
4-way, 3-position, Tandem center

Series	Example
V	**VM-4, VC-4**
VE	**VEC-15000D**



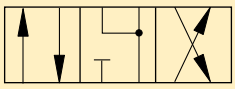
3-way, 3-position, Closed center

Series	Example
V	**VC-15**
VE	**VEG-15000A**



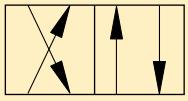
4-way, 3-position, Closed center

Series	Example
V	**VC-20**
VE	**VEB-15000A**



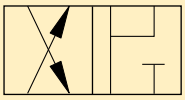
4-way, 3-position, Float center

Series	Example
VE	**VED-15000A**
VMM	**VMMD-001**



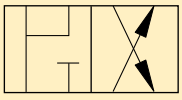
4-way, 2-position, Crossover offset

Series	Example
VE	**VEE-15000A**



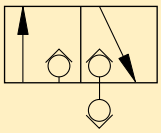
4-way, 2-position, Normally open

Series	Example
VSS/VAS	**VSS-1410D**



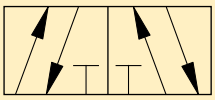
4-way, 2-position, Normally closed

Series	Example
VST/VAT	**VST-1410D**



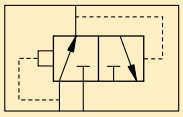
3-way, 2-position, Normally closed

Series	Example
VP	**VP-31**



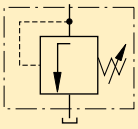
4-way, 2-position, Air valve

Series	Example
VA	**VA-42**
	VAS-42



Rapid air exhaust valve

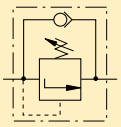
Series	Example
VR	**VR-3**



Pressure relief valve

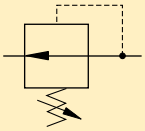
Series	Example
V	**V-152**

Valves



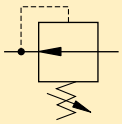
Sequence valve

Series	Example
MVP	**MVPM-5**
WVP	**WVP-5**



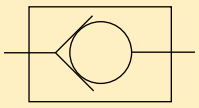
Pressure limiting valve

Series	Example
PLV	**PLV-40013B**



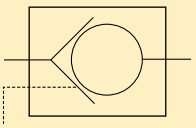
Pressure reducing valve

Series	Example
PRV	**PRV-3**



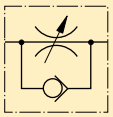
Check valve

Series	Example
V	**V-17**



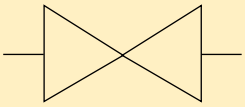
Check valve, Pilot operated

Series	Example
MV	**MV-72**
V	**V-72**



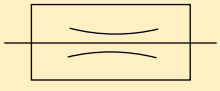
Flow control valve, Free flow check

Series	Example
VFC	**VFC-1**



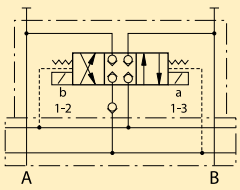
Shut-off valve

Series	Example
V	**V-12**



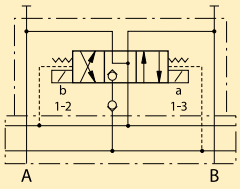
Auto-damper valve

Series	Example
GS, V	**GS-2, V-10**



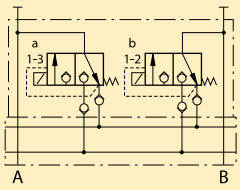
4-way, 3-position, Closed center

Example
VP-11, -12



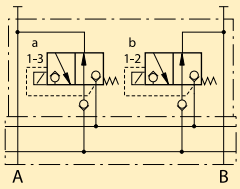
4-way, 3-position, Float center

Example
VP-21, -22



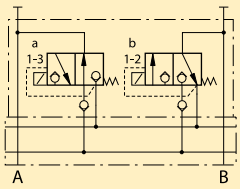
3-way, 2-position, Normally closed

Example
VP-31, -32



3-way, 2-position, Normally open

Example
VP-41, -42

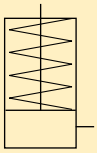


3-way, 2-position,
one port normally open and
one port normally closed

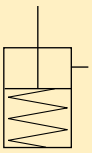
Example
VP-51, -52

Hydraulic symbols *Most common system elements*

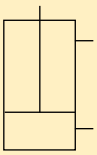
Cylinders



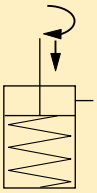
Single-acting cylinder, Push
Example
CSB-18252
CST-5132
CSM-18132



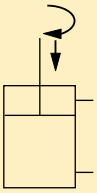
Single-acting cylinder, Pull
Example
PLSS-52
PTSS-52
PUSS-52



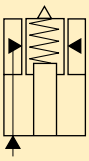
Double-acting cylinder
Example
CDB-18252
RD-96
CDT-18132



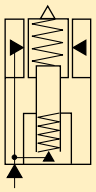
Single-acting swing cylinder
Example
SLRS-92
STRS-92
SURS-92



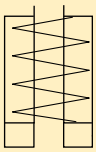
Double-acting swing cylinder
Example
SLRD-92
STRD-92
SURD-92



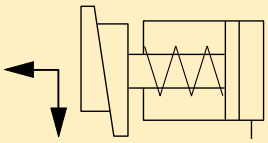
Spring advance work support
Example
WSL-112



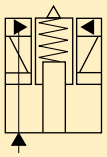
Fluid advance work support
Example
WFL-112



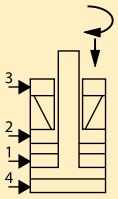
Single-acting hollow plunger cylinder
Example
CY-21295
HCS-80
RWH-202



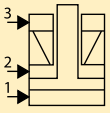
Pull down clamp
Example
ECH-202



Collet-Lok® work support
Example
MPFS-200
MPTS-200



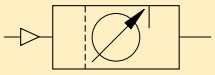
Collet-Lok® swing cylinder
Example
MPFR-100
MPTR-100



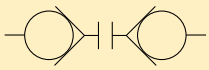
Collet-Lock® push cylinder
Example
MPFS-100
MPTS-100

System components

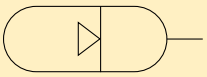
Pressure gauges
Example
DGR-2
G-2534R



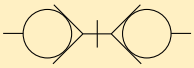
Air regulator
Example
RFL-102



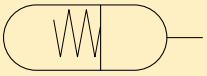
Hydraulic couplers, Uncoupled
Example
AH-650
AH-652
AH-654



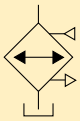
Accumulator, Gas charged
Example
ACL-202
WA-502



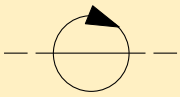
Hydraulic couplers, Coupled
Example
AH-650
AH-652
AH-654



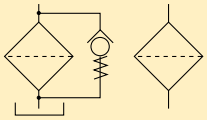
Accumulator, Spring loaded
Example
ACM-1



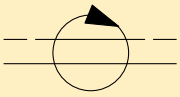
Heat exchanger
Example
ZHE-1



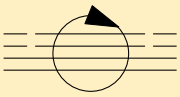
Rotary coupler, Single passage
Example
CR-112



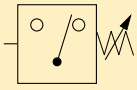
Return line filter,
high pressure filter, in line
Example
PFK-25
FL-2102



Rotary coupler, Double passage
Example
CRV-222

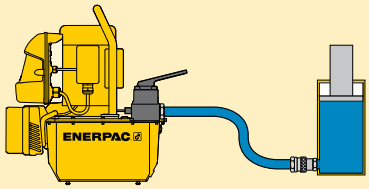


Rotary coupler, Four passage
Example
CRV-442

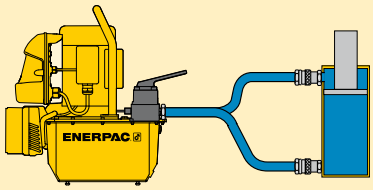


Pressure switch
Example
IC-50

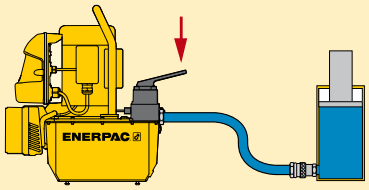
Valving Technology *How and when to use hydraulic valves*



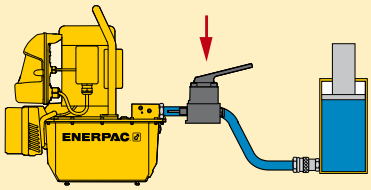
3-way valve used with single-acting cylinder.



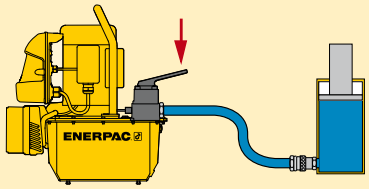
4-way valve used with double-acting cylinder.



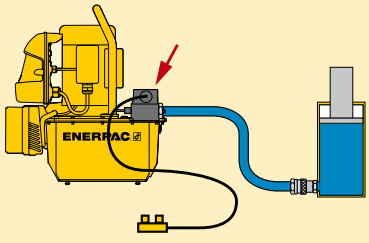
Valves can be **pump mounted.**



Valves can be **remote mounted.**



Valves can be **manually operated.**



Valves can be **solenoid operated.**

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

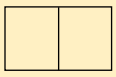
A 3-way valve has 3 ports: pressure (P), tank (T), and cylinder (A).

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.

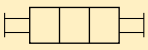
Double-acting cylinders require a 4-way valve, providing control of the flow to each cylinder port.

Positions – the number of control points a valve can provide

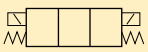


A 2-position valve has the ability to control only the advance or retraction of the cylinder. To be able to control the cylinder with a hold position, the valve requires a third position.

Operation – the way to shift the valve into position



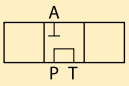
The valve position can be **manually operated** with the use of the handle.



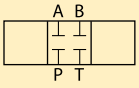
The valve position can be **solenoid operated** using power supply.

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.

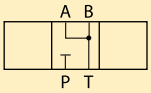


The most common is the **Tandem Center**. This configuration provides for no movement of the cylinder and the unloading of the pump. This provides for minimum heat build-up.



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.

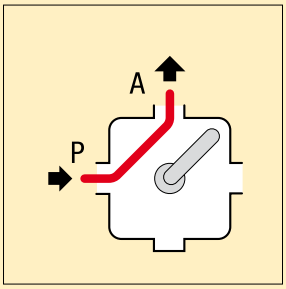
The use of this type of valve requires some means of unloading the pump to prevent heat build-up.



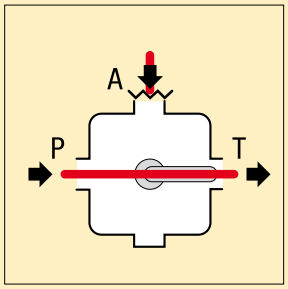
Another commonly used valve configuration is **Float Center**. This type of valve allows the cylinder ports to drain pressure back to tank. Used with a pallet mounted pilot operated check, it allows the hydraulics to be disconnected from the pallet.

Advance, hold and retract
The direction of the oil flow can be controlled depending on valve type, valve positions and port functions.

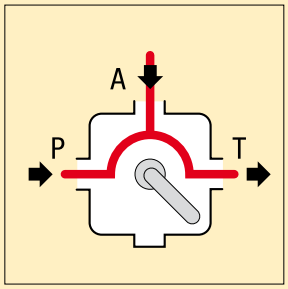
Single-acting cylinder
Controlled by a 3-way, 3-position valve.



Advance
The oil flows from the pump pressure port P to the cylinder port A: the cylinder plunger will extend.

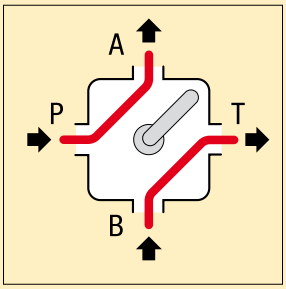


Hold (tandem center)
The oil flows from the pump pressure port P to the tank T. The cylinder port A is closed: the cylinder plunger will maintain i ts position.

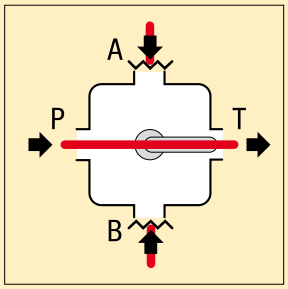


Retract
The oil flows from the pump and cylinder port A to the tank T: the cylinder plunger will retract.

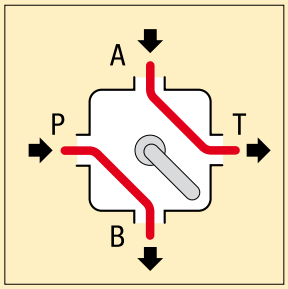
Double-acting cylinder
Controlled by a 4-way, 3-position valve.



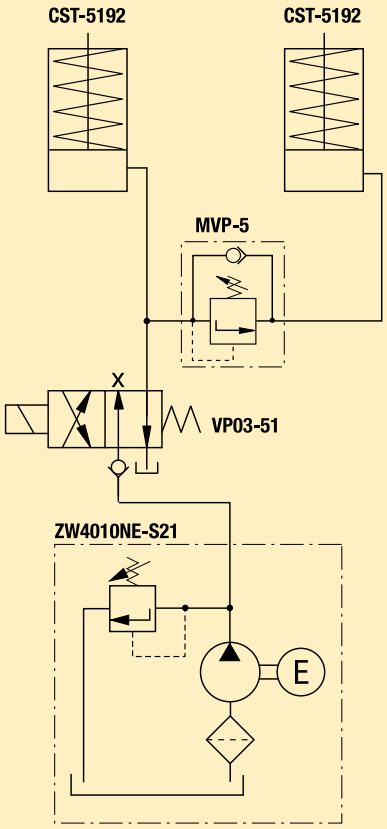
Advance
The oil flows from the pump pressure port P to the cylinder port A and from cylinder port B to tank T.

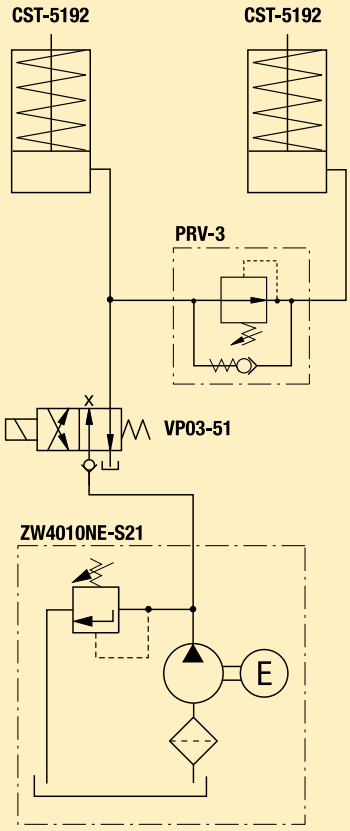


Hold (tandem center)
The oil flows from the pump pressure port P to the tank T. The cylinder ports A and B are closed: the cylinder plunger will maintain its position.



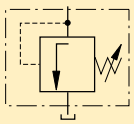
Retract
The oil flows from the pump pressure port P to cylinder port B and from cylinder port A to tank T: the cylinder plunger will retract.





2 Pressure control

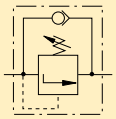
Relief valve



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 thorough 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

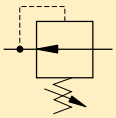


This valve controls the order in which various branches of the hydraulic circuit operate. It sequences the order of the actions.
In practice, one part of the circuit will reach a preset pressure at which point the sequence valve will open and permit oil to flow to the secondary part of the circuit. When 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 x 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

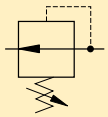


As the name implies, this valve will reduce the pressure to a lower value for a secondary part of the circuit. This is useful, for example, when you must reduce the capacity of a swing cylinder that might be clamping over a work support. The pressure reducing valve will automatically make-up pressure 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 x 210 = 10,5 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)

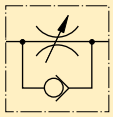
Pressure limiting valve



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.

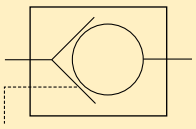
3 Flow control

Flow control valve

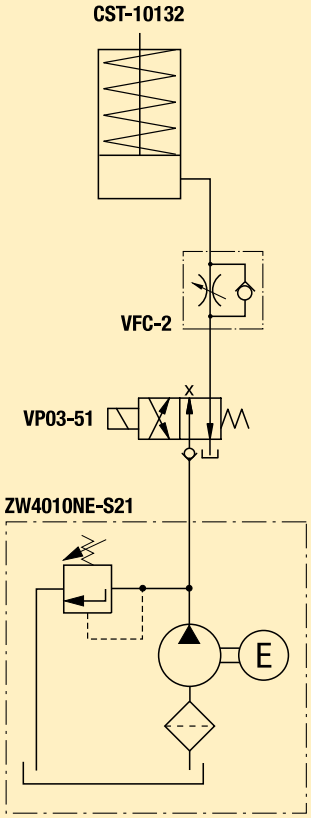


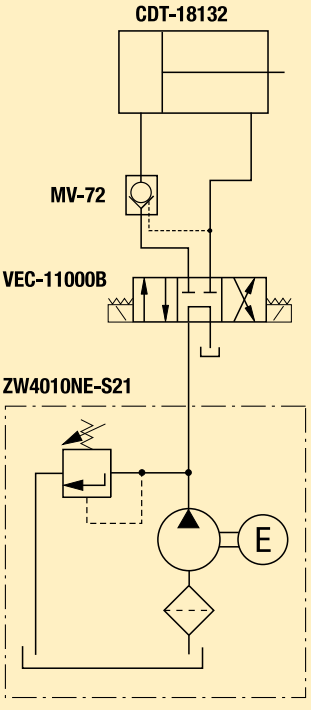
Flow controls permit the change of speed of a hydraulic component through the use of an adjustable orifice.
Unlike a regular flow control that provides the same flow restriction in both directions, these flow controls provide a free flow reverse check. This allows restricted flow in one direction and 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

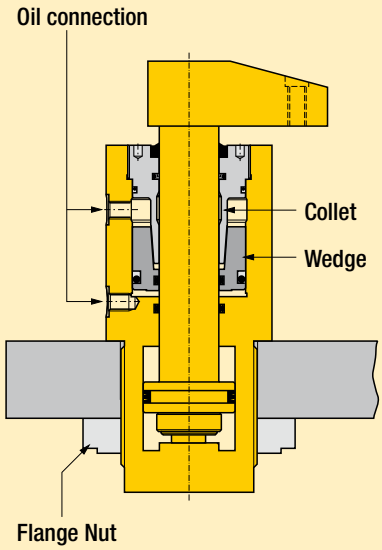


A check valve only permits the flow of oil in one direction. The pilot operated check valve works the same as a regular check valve but also has an additional port for a pressure signal. Pressure to this extra port will mechanically open the check valve to permit the oil to flow in both directions. The 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.





Flexible machining systems



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.

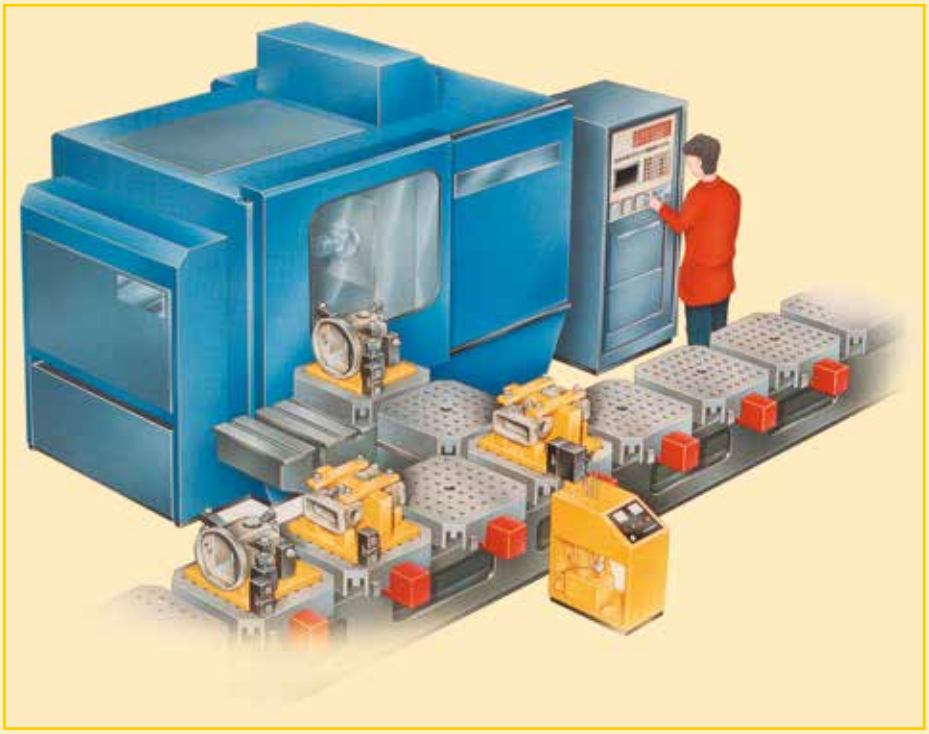
Port #1 is first pressurized to apply the appropriate clamping force. Once this pressure is reached, a sequence valve opens, sending pressure to **Port #2,** which mechanically locks a wedge into place. This wedge locks the plunger in place, preventing movement, and maintaining the clamping force on 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.

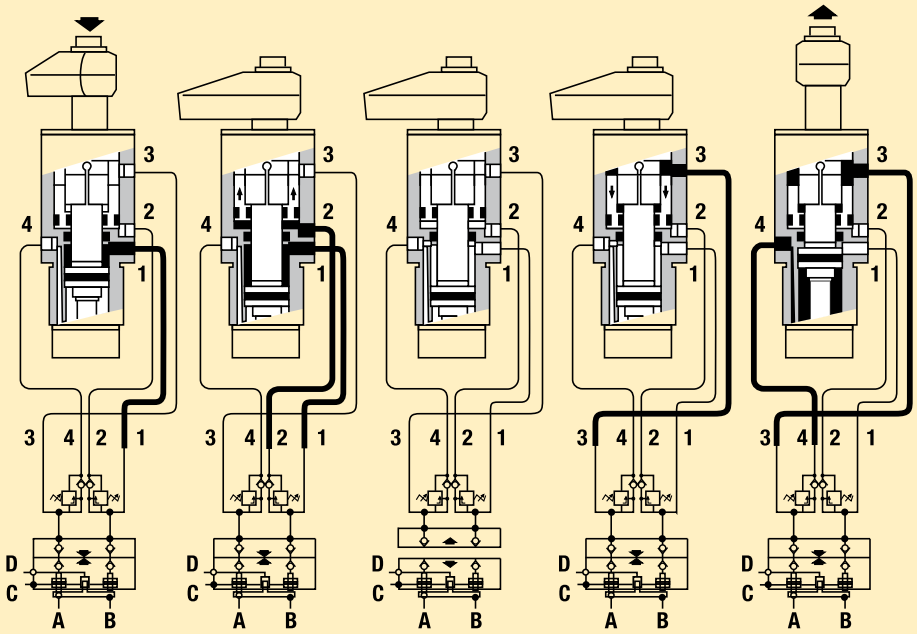
Fixture for machining exhaust manifolds.

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.

Mechanical clamping technology

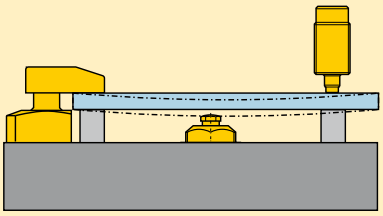


Figure 1
Simple hydraulic fixture with minimal workpiece deflection.

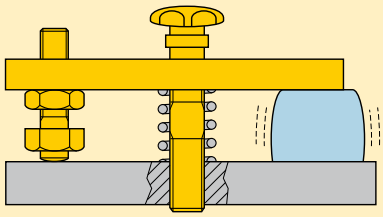


Figure 2
Simple mechanical fixture with larger workpiece deflection.

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.

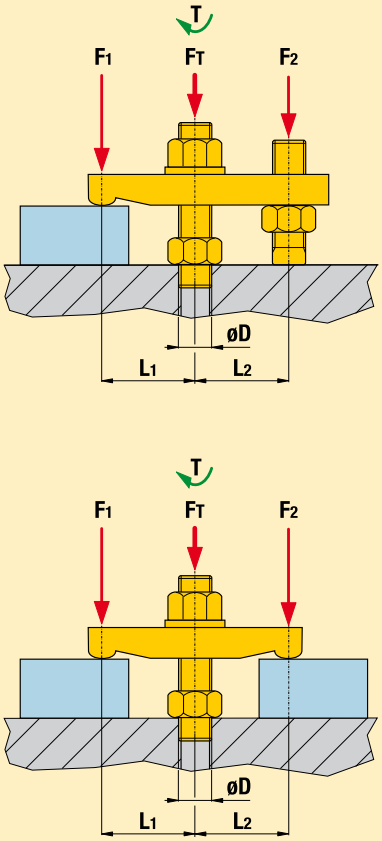


Figure 3
Typical mechanical clamping set-up.

Mechanical clamping technology

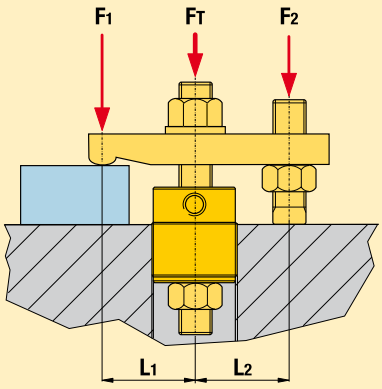


Figure 4
Hollow plunger cylinder used in hydraulic clamping set-up.

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) x FT
F2 = L1 / (L1 + L2) x FT

When L1 = L2 (when the clamping stud is exactly halfway between the clamping points), F1 = F2 = ½ 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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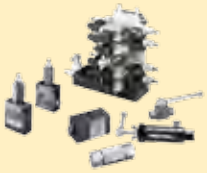

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