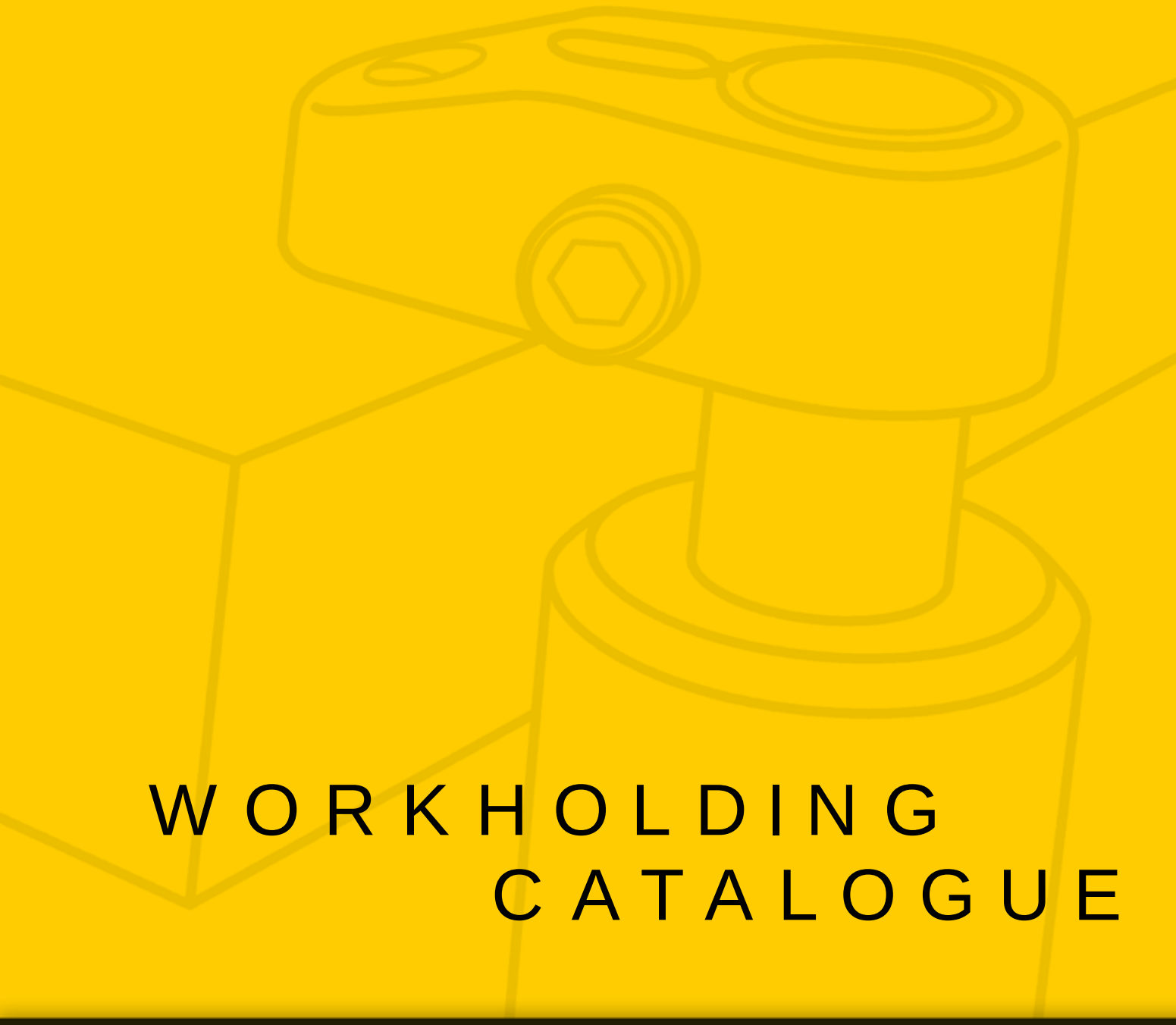
E213e

ENERPAC®



WORKHOLDING CATALOGUE

A global resource of workholding solutions

2D & 3D CAD-Files at www.enerpac.com

Product Index

Yellow Pages

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

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

113

Model Number Index

Section Index

The world

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

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

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

# of Enerpac

10 Good Reasons to Work with Enerpac

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

Workholding CAD Library

Dealing with us couldn't be easier!

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

Total Quality

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

Logistics Excellence

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

The right products for the job

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

ENERPAC®
Hydraulic Technology Worldwide

A Guide to your new Enerpac Workholding Catalog

- Helps you design more efficient workholding fixtures
- 2D and 3D CAD files available at www.enerpac.com
- A global resource of workholding solutions

This catalog is set-up in 2 main sections:

1 **Hydraulic product data section**
All Enerpac hydraulic workholding products shown with 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 2. This index shows page numbers of each section of the catalog.

2 From here you go to the selected product *range overview*. For an example see pages 8 and 9 for the swing cylinders and work supports overview. On this page you will find the main groups with regard to functional and mounting style options.

3 From here you proceed to pages 12 and 13 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, 14 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.

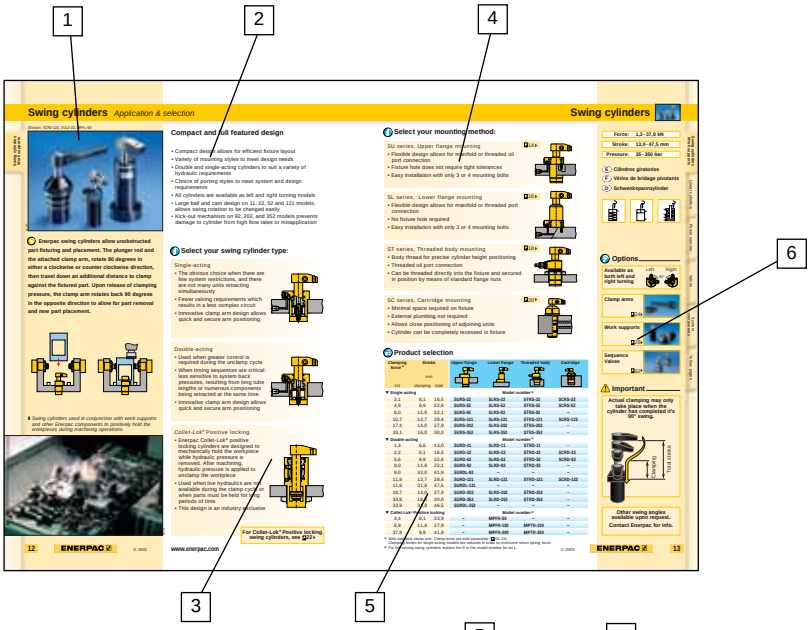
2 Listing of main product features and benefits.

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

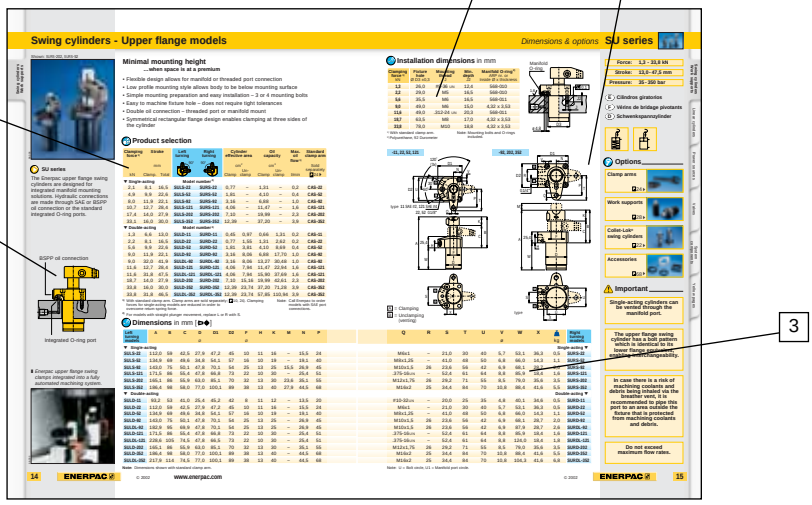
1 Application schematic including real life application example.

2 Product selection.

3 Detailed dimensional data.

4 Product dimensional drawings.

5 Installation specifications.



Swing cylinders

Swing Cylinders

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

Work Supports

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

Technical support

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

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

113

& Work supports

Selecting the swing cylinder for your applications

Clamp arms transmit the force generated by swing cylinders

02_001

The clamp arms transmit the force generated by the swing cylinder to the workpiece. Clamp arms are available in a variety of lengths. After you have determined the required clamp arm length and the clamping force you can select the swing cylinder type and mounting method.

The maximum clamp arm length of a given size of swing clamp is limited. This limitation is due to the bending moment on the plunger. The bending moment applied to the plunger is a function of the real clamping force and length of the clamp arm. Never exceed the maximum pressure or flow for any given clamp arm length. Excessive weight will limit flow.

The unique Enerpac swing clamp and patented clamp arm guarantee the lowest frictional losses and most efficient clamp design available on the market today.

Hydraulic fixture with swing cylinders on two faces for more efficient production.

02_002

Determine the right size of your swing cylinder

Clamp arm length and clamping force

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

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

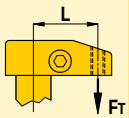
Pivoting T-arms

Oil flow versus arm length

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

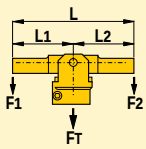
Important

When using the standard and long clamp arms from the CAS and CAL series consult the diagrams shown on the next page.



11

When using T-arms use the formula below.



$$L = L1 + L2 \qquad F1 = FT \times \frac{L2}{L1 + L2}$$

$$FT = F1 + F2 \qquad F2 = FT \times \frac{L1}{L1 + L2}$$

For diagrams of allowable oil flow vs T-arm length see:

26

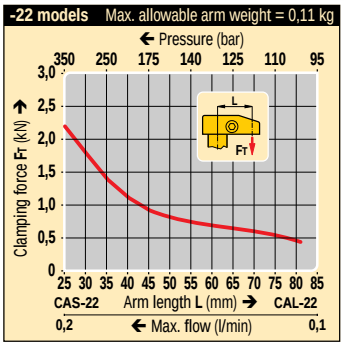
Product selection

Clamp arm length L mm min. - max.	Clamping force FT kN max. - min	For Swing Cylinder Model	With Clamp Arm Model number
▼ **Swing Cylinders SU, SL, ST and SC series**			
25 - 78	2,2 - 0,5	22	CAS, CAL-22
40 - 130	5,6 - 1,0	52	CAS, CAL-52
45 - 155	9,0 - 2,2	92	CAS, CAL-92
51 - 157	11,6 - 2,0	121, 122	CAS-121, CAL-122
55 - 173	18,7 - 4,0	202	CAS, CAL-202
68 - 175	33,8 - 9,0	352	CAS, CAL-352
▼ **Collet-Lok® Swing Cylinders MP series**			
40 - 100	4,1 - 1,1	50	MA-540
50 - 125	8,9 - 2,5	100	MA-1050
70 - 160	37,8 - 9,5	300	MA-3070
▼ **Pivoting T-arms for SU, SL, ST and SC series swing cylinders**			
152 [1]	2 x 2,8	52	CAC, CAPT-52
203 [1]	2 x 4,5	92	CAC, CAPT-92
203 [1]	2 x 5,8	122	CAC, CAPT-122
203 [1]	2 x 9,3	202	CAC, CAPT-202
228 [1]	2 x 16,9	352	CAC, CAPT-352

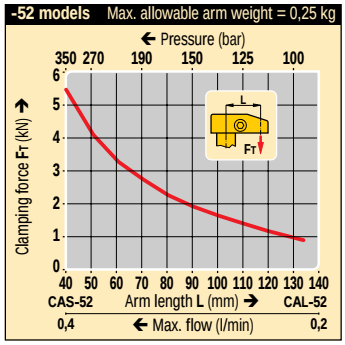
[1] Lmax. for T-arms.

ENERPAC

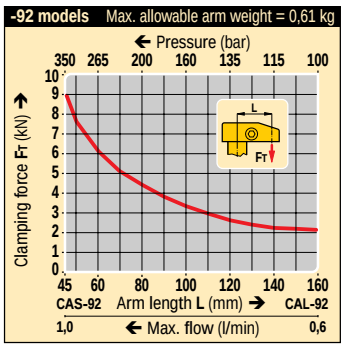
-22 models Max. allowable arm weight = 0,11 kg



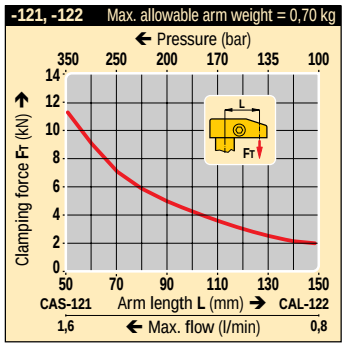
-52 models Max. allowable arm weight = 0,25 kg



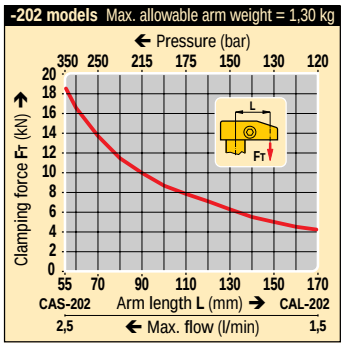
-92 models Max. allowable arm weight = 0,61 kg



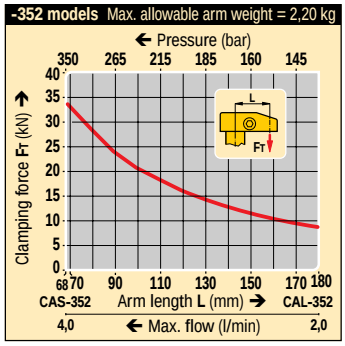
-121, -122 Max. allowable arm weight = 0,70 kg



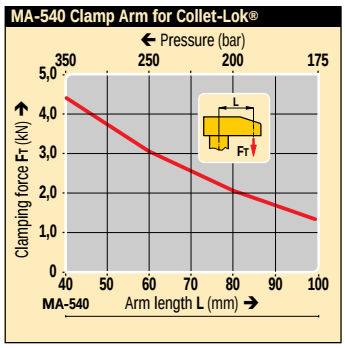
-202 models Max. allowable arm weight = 1,30 kg



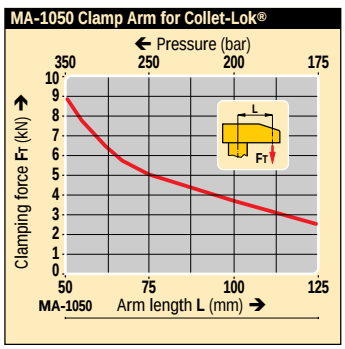
-352 models Max. allowable arm weight = 2,20 kg



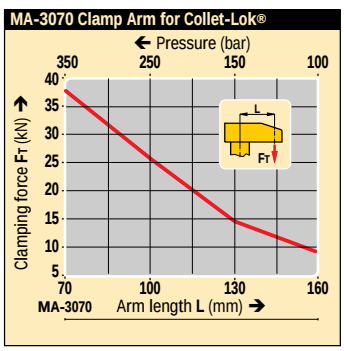
MA-540 Clamp Arm for Collet-Lok®



MA-1050 Clamp Arm for Collet-Lok®



MA-3070 Clamp Arm for Collet-Lok®



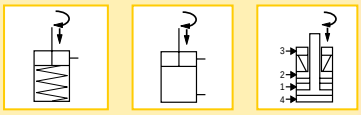
Arm length: 25 - 175 mm

Clamp force: 0,5 - 37,8 kN

(E) Cilindros giratorios

(F) Vérins de bridage pivotants

(D) Schwenkspannzylinder



Important

Do not exceed maximum oil flow. If flow rates are exceeded, swing cylinder indexing mechanism may be permanently damaged.

Do not exceed maximum operating pressure If operating pressures are exceeded swing cylinder and other components may be permanently damaged.

Options

Swing cylinders
12

Collet-Lok® swing cylinders
22

Clamp arms
24

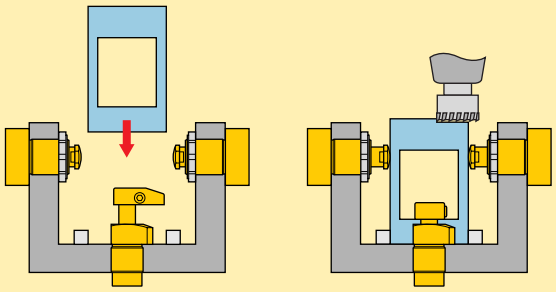
For actual clamping force at reduced pressures, we invite you to download our “Swing Clamp Selection Tool” through the Internet at www.enerpac.com.

Swing cylinders *Application & selection*

Shown: SCRD-122, SULD-22, MPFL-50

98-037

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



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

98-001

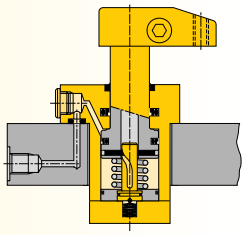
Compact and full featured design

- 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
- Kick-out mechanism on 92, 202, and 352 models prevents damage to cylinder from high flow rates or misapplication

Select your swing cylinder type:

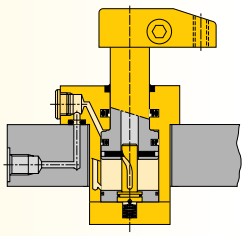
Single-acting

- 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



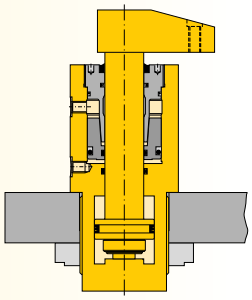
Double-acting

- 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



Collet-Lok® Positive locking

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



For Collet-Lok® Positive locking swing cylinders, see ▭22▸

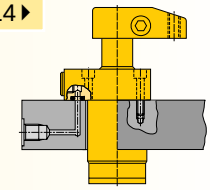
www.enerpac.com

Select your mounting method:

SU series, Upper flange mounting

14

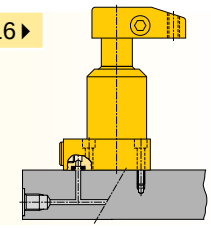
- Flexible design allows for manifold or threaded oil port connection
- Fixture hole does not require tight tolerances
- Easy installation with only 3 or 4 mounting bolts



SL series, Lower flange mounting

16

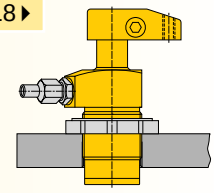
- Flexible design allows for manifold or threaded port connection
- No fixture hole required
- Easy installation with only 3 or 4 mounting bolts



ST series, Threaded body mounting

18

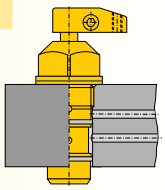
- Body thread for precise cylinder height positioning
- Threaded oil port connection
- Can be threaded directly into the fixture and secured in position by means of standard flange nuts



SC series, Cartridge mounting

20

- 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 mm		Upper flange	Lower flange	Threaded body	Cartridge
kN	clamping	total				
▼ Single-acting			Model number [2]			
2,1	8,1	16,5	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	22,1	SURS-92	SLRS-92	STRS-92	–
10,7	12,7	28,4	SURS-121	SLRS-121	STRS-121	SCRS-122
17,4	14,0	27,9	SURS-202	SLRS-202	STRS-202	–
33,1	16,0	30,0	SURS-352	SLRS-352	STRS-352	–
▼ Double-acting			Model number [2]			
2,2	8,1	16,5	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	22,1	SURD-92	SLRD-92	STRD-92	–
9,0	32,0	41,9	SURDL-92	–	–	–
11,6	12,7	28,4	SURD-121	SLRD-121	STRD-121	SCRD-122
11,6	31,8	47,5	SURDL-121	–	–	–
18,7	14,0	27,9	SURD-202	SLRD-202	STRD-202	–
33,8	16,0	30,0	SURD-352	SLRD-352	STRD-352	–
33,8	31,8	46,5	SURDL-352	–	–	–
▼ Collet-Lok® Positive locking			Model number [2]			
4,4	8,1	23,9	–	MPFR-50	–	–
8,9	11,9	27,9	–	MPFR-100	MPTR-100	–
37,8	9,9	41,9	–	MPFR-300	MPTR-300	–

[1] With standard clamp arm. Clamp arms are sold separately (10, 24).
Clamping forces for single-acting models are reduced in order to overcome return spring force.

[2] For left turning swing cylinders replace the R in the model number for an L.

Force: 2,1 - 37,8 kN

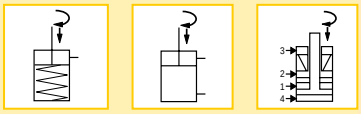
Stroke: 16,5 - 47,5 mm

Pressure: 35 - 350 bar

(E) Cilindros giratorios

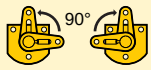
(F) Vérins de bridage pivotants

(D) Schwenkspannzylinder



Options

Available as both left and right turning



Clamp arms

24

Work supports

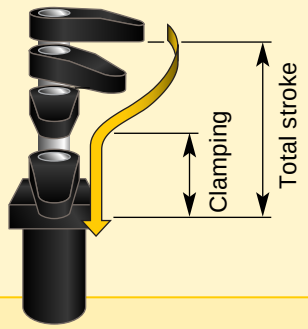
28

Sequence Valves

92

Important

Actual clamping may only take place when the cylinder has completed it's 90° swing.



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

Swing cylinders - Upper flange models

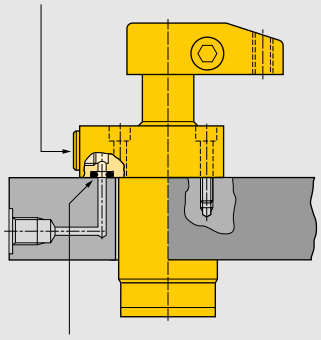
Shown: SURS-202, SURS-52

98-038

SU series

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

BSPP oil connection



Integrated O-ring port

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

98-003

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
- Easy to machine fixture hole – does not require tight tolerances
- Double oil connection – threaded port or manifold mount
- Symmetrical rectangular flange design enables clamping at three sides of the cylinder

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 ▯24 ▶
▼ **Single-acting**			**Model number** [2]							
2,1	8,1	16,5	**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	22,1	**SULS-92**	**SURS-92**	3,16	–	6,88	–	1,0	**CAS-92**
10,7	12,7	28,4	**SULS-121**	**SURS-121**	4,06	–	11,47	–	1,6	**CAS-121**
17,4	14,0	27,9	**SULS-202**	**SURS-202**	7,10	–	19,99	–	2,3	**CAS-202**
33,1	16,0	30,0	**SULS-352**	**SURS-352**	12,39	–	37,20	–	3,9	**CAS-352**
▼ **Double-acting**			**Model number** [2]							
2,2	8,1	16,5	**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	22,1	**SULD-92**	**SURD-92**	3,16	8,06	6,88	17,70	1,0	**CAS-92**
9,0	32,0	41,9	**SULDL-92**	**SURDL-92**	3,16	8,06	13,27	30,48	1,0	**CAS-92**
11,6	12,7	28,4	**SULD-121**	**SURD-121**	4,06	7,94	11,47	22,94	1,6	**CAS-121**
11,6	31,8	47,5	**SULDL-121**	**SURDL-121**	4,06	7,94	15,90	37,69	1,6	**CAS-121**
18,7	14,0	27,9	**SULD-202**	**SURD-202**	7,10	15,16	19,99	42,61	2,3	**CAS-202**
33,8	16,0	30,0	**SULD-352**	**SURD-352**	12,39	23,74	37,20	71,28	3,9	**CAS-352**
33,8	31,8	46,5	**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 (▯ 10, 24). 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	D ø	D1	D2	F ø	H	K	M	N	P
▼ **Single-acting**												
SULS-22	112,0	59	42,5	27,9	47,2	45	10	11	16	–	15,5	24
SULS-52	134,9	69	49,6	34,8	54,1	57	16	10	19	–	19,1	40
SULS-92	143,0	75	50,1	47,8	70,1	54	25	13	25	15,5	26,9	45
SULS-121	171,5	86	55,4	47,8	66,8	73	22	10	30	–	25,4	51
SULS-202	165,1	86	55,9	63,0	85,1	70	32	13	30	23,6	35,1	55
SULS-352	186,4	98	58,0	77,0	100,1	89	38	13	40	27,9	44,5	68
▼ **Double-acting**												
SULD-22	112,0	59	42,5	27,9	47,2	45	10	11	16	–	15,5	24
SULD-52	134,9	69	49,6	34,8	54,1	57	16	10	19	–	19,1	40
SULD-92	143,0	75	50,1	47,8	70,1	54	25	13	25	–	26,9	45
SULDL-92	182,9	95	69,9	47,8	70,1	54	25	13	25	–	26,9	45
SULD-121	171,5	86	55,4	47,8	66,8	73	22	10	30	–	25,4	51
SULDL-121	228,6	105	74,5	47,8	66,5	73	22	10	30	–	25,4	51
SULD-202	165,1	86	55,9	63,0	85,1	70	32	13	30	–	35,1	55
SULD-352	186,4	98	58,0	77,0	100,1	89	38	13	40	–	44,5	68
SULDL-352	217,9	114	74,5	77,0	100,1	89	38	13	40	–	44,5	68

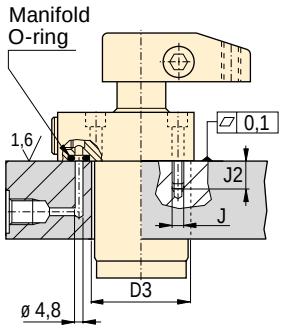
Note: Dimensions shown with standard clamp arm.

Installation dimensions in mm

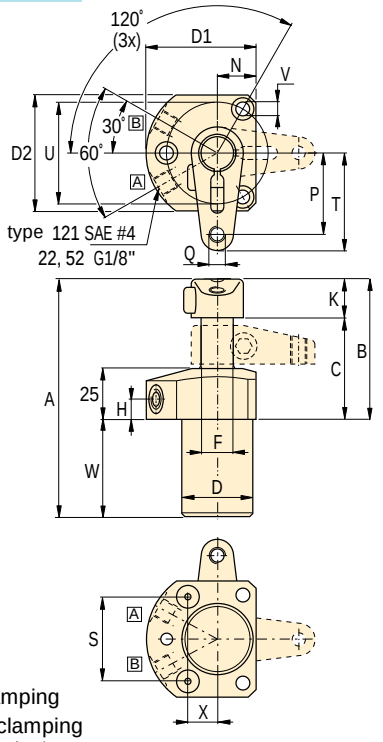
Clamping force [1] kN	Fixture hole Ø D3 ±0,3	Mounting thread J	Min. depth J2	Manifold O-ring [2] ARP nr. or Inside Ø x thickness
2,2	29,0	M5	16,5	568-010
5,6	35,5	M6	16,5	568-011
9,0	49,0	M6	15,0	4,32 x 3,53
11,6	49,0	.312-24 UN	20,3	568-011
18,7	63,5	M8	17,0	4,32 x 3,53
33,8	78,0	M10	18,8	4,32 x 3,53

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

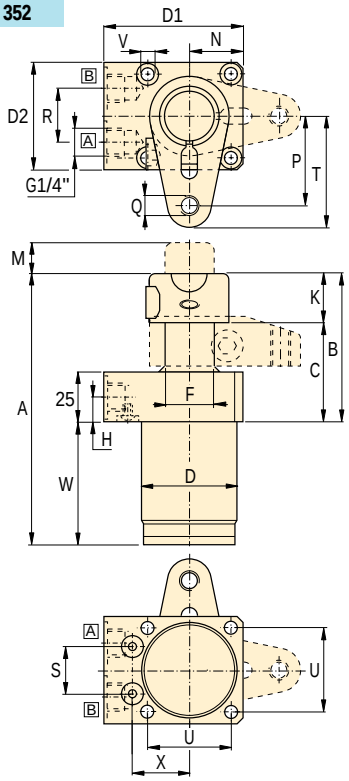
Note: Mounting bolts and O-rings included.



-22, 52, 121



-92, 202, 352



A = Clamping
B = Unclamping (venting)

Q	R	S	T	U	V ø	W	X	kg	Right turning models
									Single-acting ▼
M6x1	–	21,0	30	40	5,7	53,1	18,1	0,5	**SURS-22**
M8x1,25	–	41,0	48	50	6,8	66,0	14,3	1,1	**SURS-52**
M10x1,5	26	23,6	56	42	6,9	68,1	28,7	2,0	**SURS-92**
.375-16UN	–	52,4	61	64	8,8	85,9	18,4	1,6	**SURS-121**
M12x1,75	26	29,2	71	55	8,5	79,0	35,6	3,5	**SURS-202**
M16x2	25	34,4	84	70	10,8	88,4	41,6	5,5	**SURS-352**
									Double-acting ▼
M6x1	–	21,0	30	40	5,7	53,1	18,1	0,5	**SURD-22**
M8x1,25	–	41,0	48	50	6,8	66,0	14,3	1,1	**SURD-52**
M10x1,5	26	23,6	56	42	6,9	68,1	28,7	2,0	**SURD-92**
M10x1,5	26	23,6	56	42	6,9	87,9	28,7	2,6	**SURDL-92**
.375-16UN	–	52,4	61	64	8,8	85,9	18,4	1,6	**SURD-121**
.375-16UN	–	52,4	61	64	8,8	124,0	18,4	1,8	**SURDL-121**
M12x1,75	26	29,2	71	55	8,5	79,0	35,6	3,5	**SURD-202**
M16x2	25	34,4	84	70	10,8	88,4	41,6	5,5	**SURD-352**
M16x2	25	34,4	84	70	10,8	104,3	41,6	6,8	**SURDL-352**

Note: U = Bolt circle, U1 = Manifold port circle.

Force: 2,1 - 33,8 kN
Stroke: 16,5 - 47,5 mm
Pressure: 35 - 350 bar

E Cilindros giratorios
F Vérins de bridage pivotants
D Schwenkspannzylinder

Options

Clamp arms 24

Work supports 28

Collet-Lok® swing cylinders 22

Sequence Valves 92

Important

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

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

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

Do not exceed maximum flow rates.

Swing cylinders - Lower flange models

Shown: SLRD-52, SLRS-202

98-039

No fixture hole required

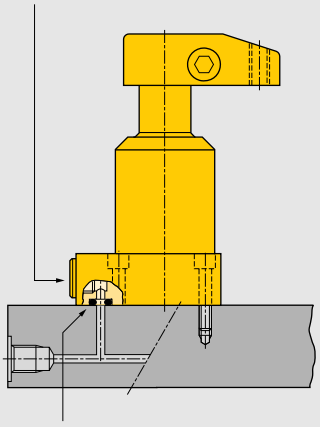
...cylinder can be bolted directly to fixture

- 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

SL series

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

BSPP oil connection



Integrated O-ring port

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

98-002

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 24
▼ **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	22,1	**SLLS-92**	**SLRS-92**	3,16	–	6,88	–	1,0	**CAS-92**
10,7	13	28,4	**SLLS-121**	**SLRS-121**	4,06	–	11,47	–	1,6	**CAS-121**
17,4	14	27,9	**SLLS-202**	**SLRS-202**	7,10	–	19,99	–	2,3	**CAS-202**
33,1	16	30,0	**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	22,1	**SLLD-92**	**SLRD-92**	3,26	8,06	6,88	17,70	1,0	**CAS-92**
11,6	13	28,4	**SLLD-121**	**SLRD-121**	4,06	7,94	11,47	22,94	1,6	**CAS-121**
18,7	14	27,9	**SLLD-202**	**SLRD-202**	7,10	15,26	19,99	42,61	2,3	**CAS-202**
33,8	16	30,0	**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 (10, 24). 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	D ø	D1	D2	F ø	H	K	M	N	P
▼ **Single-acting**											
SLLS-22	112	96,5	27,9	47,2	45	10	14	16	–	15,5	24
SLLS-52	134,9	115,6	34,8	54,1	57	16	14	19	–	19,1	40
SLLS-92	151	126,1	47,8	70,1	54	25	12	25	15,5	26,9	45
SLLS-121	171	141,4	47,8	66,8	73	22	16	30	–	25,4	51
SLLS-202	173	142,9	63,8	85,1	70	32	12	30	23,6	35,1	55
SLLS-352	195	151,0	80,0	100,1	89	38	12	40	27,9	44,5	68
▼ **Double-acting**											
SLLD-22	112	96,5	27,9	47,2	45	10	14	16	–	15,5	24
SLLD-52	134,9	115,6	34,8	54,1	57	16	14	19	–	19,1	40
SLLD-92	151	126,1	47,8	70,1	54	25	12	25	–	26,9	45
SLLD-121	171	126,0	47,8	66,8	73	22	16	30	–	25,4	51
SLLD-202	173	142,9	63,8	85,1	70	32	12	30	–	35,1	55
SLLD-352	195	151,0	80,0	100,1	89	38	12	40	–	44,5	68

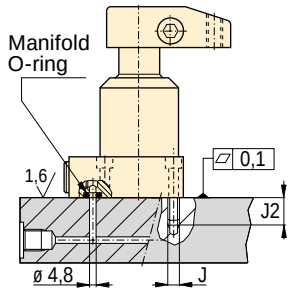
Note: Dimensions shown with standard clamp arm.

Installation dimensions in mm

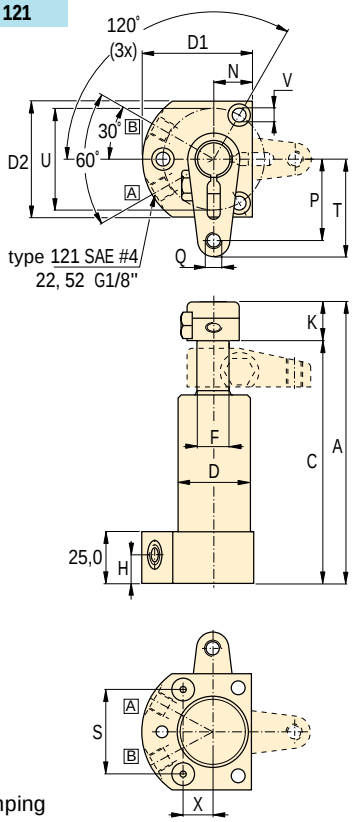
Clamping force [1] kN	Mounting thread J	Minimum thread depth J2	Manifold O-ring [2] ARP nr. or Inside Ø x thickness
2,2	M5	16,5	568-010
5,6	M6	16,5	568-011
9,0	M6	15,0	4,32 x 3,53
11,6	.312-24 UNF	20,3	568-011
18,7	M8	17,0	4,32 x 3,53
33,8	M10	18,8	4,32 x 3,53

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

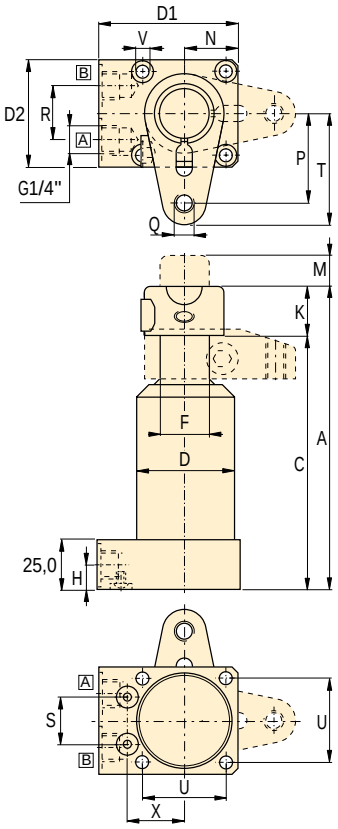
Note: Mounting bolts and O-rings included.



-22, 52, 121



-92, 202, 352



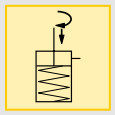
A = Clamping
B = Unclamping (venting)

	Q	R	S	T	U	V ø	X	kg	Right turning models
									Single-acting ▼
	M6x1	–	21,0	31	40	5,6	18,1	0,5	**SLRS-22**
	M8x1,25	–	41,0	48	50	6,9	14,3	1,1	**SLRS-52**
	M10x1,5	26	23,6	56	42	6,9	28,7	2,0	**SLRS-92**
	.375-16UN	–	52,4	62	64	8,9	18,4	1,6	**SLRS-121**
	M12x1,75	26	29,0	70	55	8,4	35,1	3,5	**SLRS-202**
	M16x2	25	34,4	83	70	10,7	41,6	5,5	**SLRS-352**
									Double-acting ▼
	M8x1,25	–	21,0	31	40	5,6	18,1	0,5	**SLRD-22**
	.312-18UN	–	41,0	48	50	6,9	14,3	1,1	**SLRD-52**
	M10x1,5	–	23,6	56	42	6,9	28,7	2,0	**SLRD-92**
	.375-16UN	–	52,4	62	64	8,9	18,4	1,6	**SLRD-121**
	M12x1,75	26	29,0	70	55	8,4	35,1	3,5	**SLRD-202**
	M16x2	25	34,4	83	70	10,7	41,6	5,5	**SLRD-352**

Note: U = Bolt circle, U1 = Manifold port circle.

Force: 2,1 - 33,8 kN
Stroke: 16,5 - 30,0 mm
Pressure: 34 - 350 bar

E Cilindros giratorios
F Vérins de bridage pivotants
D Schwenkspannzylinder



Options

Clamp arms 24

Work supports 28

Collet-Lok® swing cylinders 22

Sequence Valves 92

Important

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

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

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

Do not exceed maximum flow rates.

Swing cylinders - Threaded body models

Shown: STRD-52, STRD-202

98-040

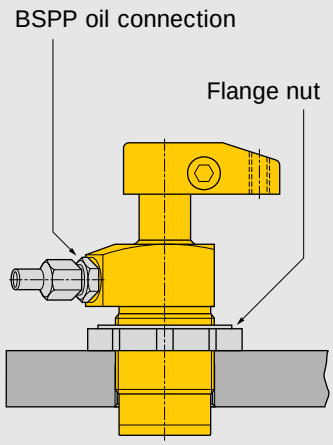
Cylinders can be threaded directly into fixture

...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

ST series

Enerpac threaded body swing cylinders are threaded directly into the fixture.
The cylinder height is adjusted to the appropriate height, and then locked in place using a flange nut (72).



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 24
▼ **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	22,1	**STLS-92**	**STRS-92**	3,16	–	6,88	–	1,0	**CAS-92**
10,7	13	28,4	**STLS-121**	**STRS-121**	4,06	–	11,47	–	1,6	**CAS-121**
17,4	14	27,9	**STLS-202**	**STRS-202**	7,10	–	19,99	–	2,3	**CAS-202**
33,1	16	30,0	**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	22,1	**STLD-92**	**STRD-92**	3,16	8,06	6,88	17,70	1,0	**CAS-92**
11,6	13	28,4	**STLD-121**	**STRD-121**	4,06	7,94	11,47	22,94	1,6	**CAS-121**
18,7	14	27,9	**STLD-202**	**STRD-202**	7,10	15,16	19,99	42,61	2,3	**CAS-202**
33,8	16	30,0	**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 (10, 24). 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 imperial thread and SAE port connections.

Dimensions in mm [⊳⊕]

Left turning models	A	B	C	C1	D Ø	D1	D2	F Ø	G	H
▼ **Single-acting**										
STLS-22	112	59	42,5	25	M28 x 1,5	39,4	33	10	G1/8”	10
STLS-52	135	69	49,6	25	M35 x 1,5	47,5	38	16	G1/8”	10
STLS-92	143	80	55,1	30	M48 x 1,5	62,5	48	25	G1/4”	13
STLS-121	171	86	55,4	25	1.875-16 UNF	60,5	51	22	SAE#4	10
STLS-202	165	93	62,9	32	M65 x 1,5	75,9	65	32	G1/4”	13
STLS-352	186	105	65,0	32	M80 x 2	88,4	80	38	G1/4”	13
▼ **Double-acting**										
STLD-22	112	59	42,5	25	M28 x 1,5	39,4	33	10	G1/8”	10
STLD-52	135	69	49,6	25	M35 x 1,5	47,5	38	16	G1/8”	10
STLD-92	143	80	55,1	30	M48 x 1,5	62,5	48	25	G1/4”	13
STLD-121	171	86	55,4	25	1.875-16 UNF	60,5	51	22	SAE#4	10
STLD-202	165	93	62,9	32	M65 x 1,5	75,9	65	32	G1/4”	13
STLD-352	186	105	65,0	32	M80 x 2	88,4	80	38	G1/4”	13

Note: Dimensions shown with standard clamp arm.

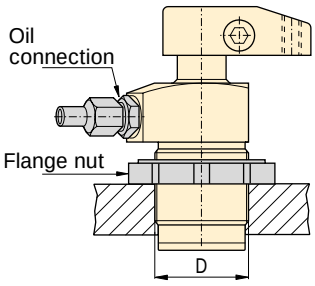
▮ *Threaded body swing cylinders allow the clamp to be buried in the fixture to minimize the required area, while the height remains adjustable.*

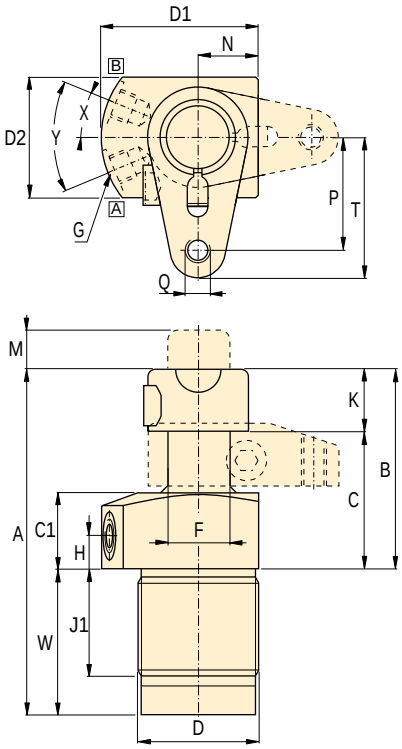
98-014

Installation dimensions
in mm

Clamping[1] Force kN	Fixtured hole thread size D
2,2	M28 x 1,5
5,6	M35 x 1,5
9,0	M48 x 1,5
11,6	1.875-16 UNF
18,7	M65 x 1,5
33,8	M80 x 2

[1] With standard clamp arm.



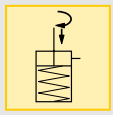


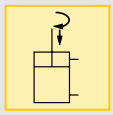
A = Clamping
B = Unclamping (venting)

	J1	K	M	N	P	Q	T	W	X	Y	kg	Right turning models
											Single-acting ▼	
	53,5	16	–	15,5	24	M6 x 1	31	53,5	25°	–	0,5	STRS-22
	66,4	19	–	19,1	40	M8 x 1,25	48	66,4	25°	50°	1,1	STRS-52
	43	25	15,5	23,9	45	M10 x 1,5	56	63,0	22,5°	45°	2,0	STRS-92
	85,8	30	–	25,4	51	.375-16 UNC	62	85,8	25°	50°	1,6	STRS-121
	55	30	23,6	32,5	55	M12 x 1,75	70	71,9	22,5°	45°	3,2	STRS-202
	65	40	27,9	39,9	68	M16 x 2	83	81,5	22,5°	45°	5,5	STRS-352
											Double-acting ▼	
	53	16	–	15,5	24	M6 x 1	31	53,5	25°	50°	0,5	STRD-22
	66	19	–	19,1	40	M8 x 1,25	48	66,4	25°	50°	1,1	STRD-52
	43	25	–	23,9	45	M10 x 1,5	56	63,0	22,5°	45°	2,0	STRD-92
	85,8	30	–	25,4	51	.375-16 UNC	62	85,8	25°	50°	1,6	STRD-121
	55	30	–	32,5	55	M12 x 1,75	70	71,9	22,5°	45°	3,5	STRD-202
	65	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 - 30,0 mm**
Pressure:	**35 - 350 bar**

E Cilindros giratorios
F Vérins de bridage pivotants
D Schwenkspannzylinder





Options

Clamp arms 24

Work supports 28

Collet-Lok® swing cylinders 22

Accessories 72

Sequence valves 92

Important

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

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

Do not exceed maximum flow rates.

Swing cylinders - Cartridge models

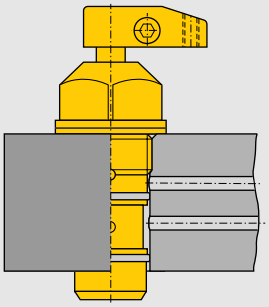
Shown: SCRD-122, SCRD-52

98-041

SC series

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

Cartridge swing cylinders simplify mounting and optimize clamping effectiveness.



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

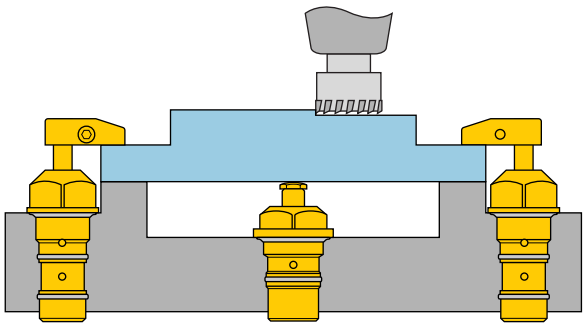
30007_4

Eliminates the need for tubing and fittings

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

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

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



Product selection

Clamping force [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 ▯24 ▶
▼ **Single-acting**			**Model number** [2]							
2,1	8	16,5	**SCLS-22**	**SCRS-22**	0,77	-	1,31	-	0,2	**CAS-22**
4,9	10	22,6	**SCLS-52**	**SCRS-52**	1,81	-	4,09	-	0,4	**CAS-52**
10,7	13	28,4	**SCLS-122**	**SCRS-122**	4,06	-	11,47	-	1,6	**CAS-121**
▼ **Double-acting**			**Model number** [2]							
2,2	8	16,5	**SCLD-22**	**SCRD-22**	0,77	1,55	1,31	2,49	0,2	**CAS-22**
5,6	10	22,6	**SCLD-52**	**SCRD-52**	1,81	3,81	4,09	8,52	0,4	**CAS-52**
11,6	13	28,4	**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 (▯ 10, 24). 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.

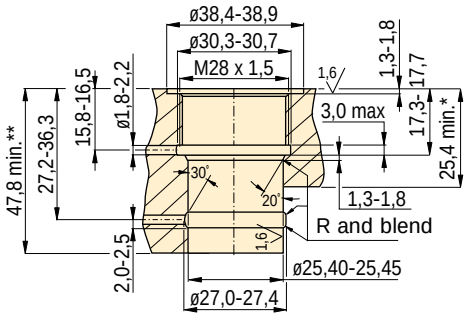
Dimensions in mm [⊳⊕]

Left turning models	A	B	C	C1	D1 ø	D2 ø	E hexagon	F
▼ **Single-acting**								
SCLS-22	112,0	55	39,4	21	38,1	25,4	35,1	10
SCLS-52	134,9	76	57,1	32	57,2	34,8	50,8	16
SCLS-122	171,5	94	63,5	34	76,2	57,2	69,9	22
▼ **Double-acting**								
SCLD-22	112,0	55	39,4	21	38,1	25,4	35,1	10
SCLD-52	134,9	76	57,1	32	57,2	34,8	50,8	16
SCLD-122	171,5	94	63,5	34	76,2	57,2	69,9	22

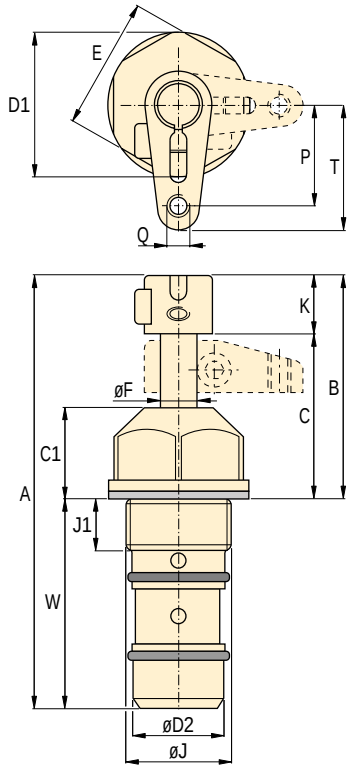
Note: Dimensions shown with standard clamp arm.

Installation dimensions
in mm

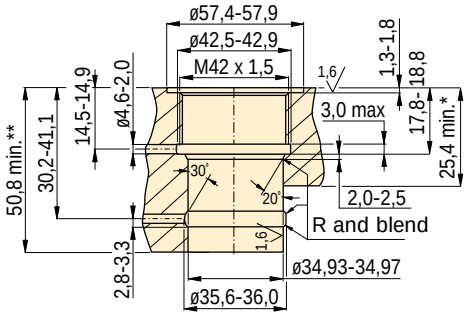
-22 models



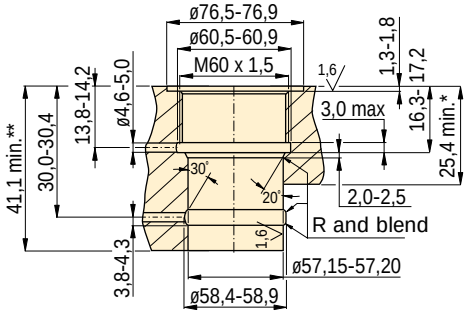
-22, 52, 122 models



-52 models



-122 models

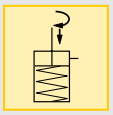


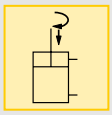
* Minimum plate height for single-acting models.
** Minimum plate height for double-acting models.

	J mm	J1	K	P	Q	T	W	kg	Right turning models
									Single-acting ▼
	M28 x 1,5	15,0	16	24	M6 x 1	31	56,6	0,5	SCRS-22
	M42 x 1,5	16,8	19	40	M8 x 1,25	48	58,7	0,9	SCRS-52
	M60 x 1,5	15,7	30	51	.375-16 UNC	62	74,6	2,5	SCRS-122
									Double-acting ▼
	M28 x 1,5	15,0	16	24	M6 x 1	31	56,6	0,5	SCRD-22
	M42 x 1,5	16,8	19	40	M8 x 1,25	48	58,7	0,9	SCRD-52
	M60 x 1,5	15,7	30	51	.375-16 UNC	62	74,6	2,5	SCRD-122

Force: 2,1- 11,6 kN
Stroke: 16,5 - 28,4 mm
Pressure: 35 - 350 bar

E Cilindros giratorios
F Vérins de bridage pivotants
D Schwenkspannzylinder





Options

Clamp arms 24

Work supports 28

Collet-Lok® swing cylinders 22

Accessories 72

Sequence valves 92

Important

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

Do not exceed maximum flow rates.

Swing cylinders - *Collet-Lok® design*

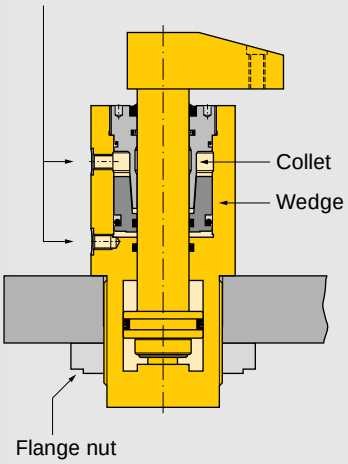
Shown: MPFR-100, MPTR-100

98-042

MP series

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

98-004

Ideal when live hydraulics are not available

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

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

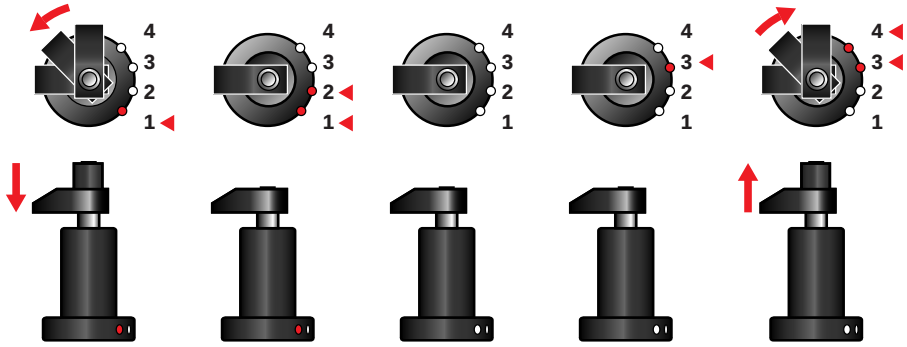
Product selection

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
▼ Lower flange			Model number							
4,4	8	24	MPFL-50	MPFR-50	1,61	4,58	3,93	10,98	2	MA-540
8,9	12	28	MPFL-100	MPFR-100	3,22	7,16	9,01	19,99	5	MA-1050
37,8	10	42	MPFL-300	MPFR-300	13,23	22,25	55,71	93,41	10	MA-3070
▼ Threaded body			Model number							
8,9	12	28	MPTL-100	MPTR-100	3,22	7,16	9,01	19,99	5	MA-1050
37,8	10	42	MPTL-300	MPTR-300	13,23	22,25	55,72	93,41	10	MA-3070

[1] Using standard clamp arm. Clamp arms are sold separately (□ 10, 24).

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

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 [⊳⊕]

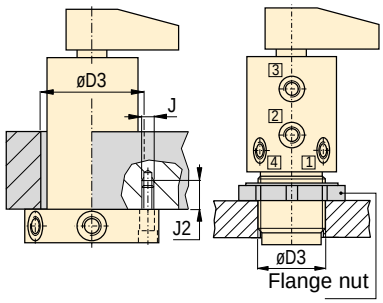
Left turning models	A	B	C	C1	D ø	D1 ø	F ø	H1	H2	H3
▼ Lower flange										
MPFL-50	201	177	171	25	58	85	19	10	12,7	–
MPFL-100	223	195	193	25	68	100	22	10	12,7	–
MPFL-300	321	280	275	25	90	132	35	11	12,7	–
▼ Threaded body										
MPTL-100	213	185	121	90	M48 x 1,5	70	22	31	66,8	75,2
MPTL-300	310	268	163	115	M80 x 2	93	35	38	91,4	100,6

Note: Dimensions shown with standard clamp arm.

Installation dimensions
in mm

Clamping force [1] kN	Fixture hole ØD3	Mounting Thread J	Minimum depth J2
▼ **Lowerflange**			
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
▼ **Threaded body**			
8,9	M48 x 1,5	–	–
37,8	M80 x 2	–	–

[1] With standard clamp arm.



Oil port functions

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

Force: 4,4 - 37,8 kN

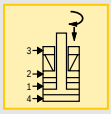
Stroke: 24 - 42 mm

Pressure: 100 - 350 bar

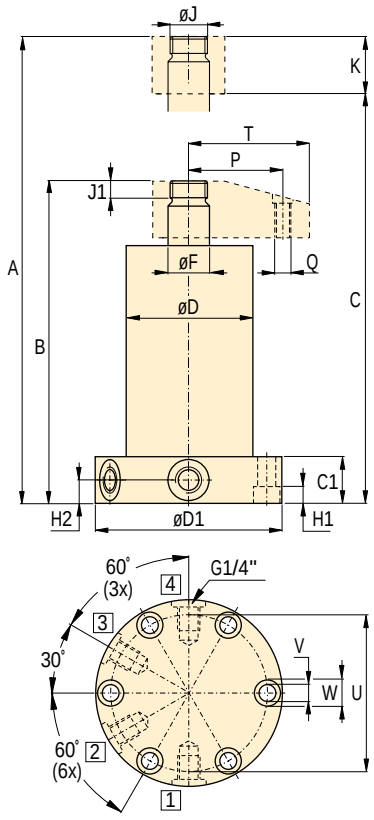
E Cilindros giratorios

F Vérins de bridage pivotants

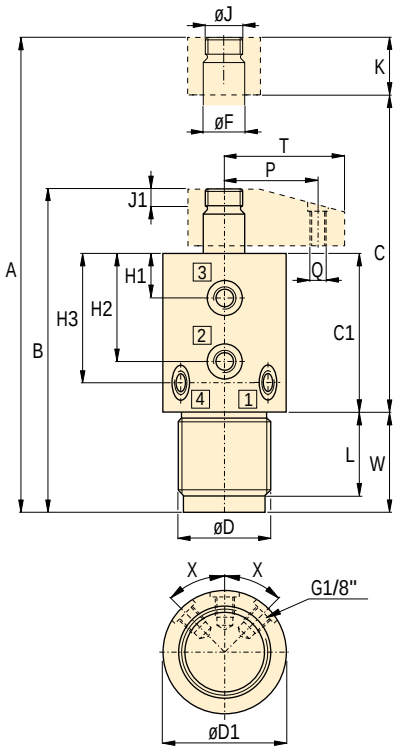
D Schwenkspannzylinder



MPF models



MPT models



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

J	J1	K	L	P	Q	T	U	V	W	kg	Right turning models
											Lower flange ▼
M16x1,5	8	30	–	40	M8x1,25	54	70	9	14	2,3	**MPFR-50**
M20x1,5	9	30	–	50	M10x1,5	64	84	9	14	3,5	**MPFR-100**
M33x2	10	47	–	70	M16x2	93	112	11	14	12,0	**MPFR-300**
											Threaded body ▼
M20x1,5	9	30	41	50	M10x1,5	64	–	–	30	3,0	**MPTR-100**
M33x2	10	47	85	70	M16x2	93	–	–	30	11,0	**MPTR-300**

Flexible Machining Systems
See Yellow Pages (136)

Options

Clamp arms 24 ▸

Positive locking work supports 34 ▸

Positive clamping cylinders 66 ▸

Auto couplers 100 ▸

Sequence valves 92 ▸

Accessories 72 ▸

Important

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

Clamp arms *for swing cylinders*

Shown: CAL-122, CAS-121

98-045

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

Pressure vs clamping force

The use of different length clamp arms requires reduction in applied pressure and resulting clamp force. The diagrams on page 10 below show this relationship.

Product selection

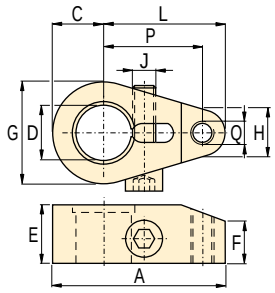
Clamp arm length L mm min. - max.	Clamping force F_T kN max. - min.	For Swing Cylinder Model	Clamp Arm Model Number	See Diagrams on page	Technical Specifications on page
▼ Clamp arms for Swing Cylinders SU, SL, ST and SC series					
25 - 78	2,2 - 0,5	**22**	**CAS-22, CAL-22**	11	25
40 - 130	5,6 - 1,0	**52**	**CAS-52, CAL-52**	11	25
45 - 155	9,0 - 2,2	**92**	**CAS-92, CAL-92**	11	25
51 - 157	11,6 - 2,0	**121, 122**	**CAS-121, CAL-122**	11	25
55 - 173	18,7 - 4,0	**202**	**CAS-202, CAL-202**	11	25
68 - 175	33,8 - 9,0	**352**	**CAS-352, CAL-352**	11	25
▼ Clamp arms for Collet-Lok® Swing Cylinders MP series					
40 - 100	4,1 - 1,1	**50**	**MA-540**	11	25
50 - 125	8,9 - 2,5	**100**	**MA-1050**	11	25
70 - 160	37,8 - 9,5	**300**	**MA-3070**	11	25
▼ Pivoting T-arms for SU, SL, ST and SC series swing cylinders					
152 [1]	2 x 2,8	**52**	**CAC-52, CAPT-52**	11	26
203 [1]	2 x 4,5	**92**	**CAC-92, CAPT-92**	11	26
203 [1]	2 x 5,8	**122**	**CAC-122, CAPT-122**	11	26
203 [1]	2 x 9,3	**202**	**CAC-202, CAPT-202**	11	26
228 [1]	2 x 16,9	**352**	**CAC-352, CAPT-352**	11	26

[1] Lmax. for T-arms.

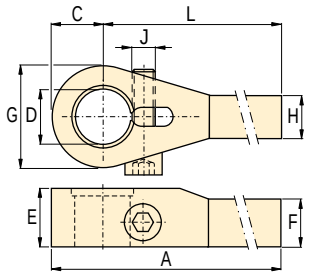
Hydraulic fixture with swing cylinders and standard clamp arms on two faces for more efficient production.

02-002

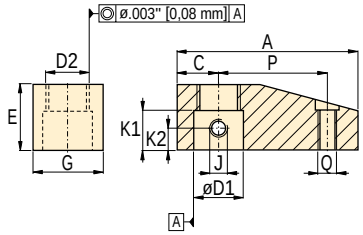
CAS models **Standard clamp arms**



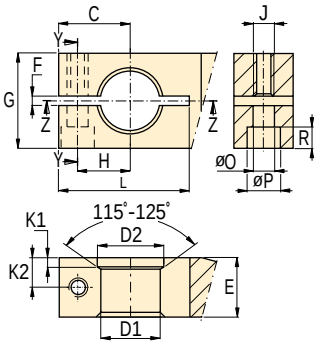
CAL models **Long clamp arms**



MA models For Collet-Lok® Swing cylinders serie MP



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



Dimensions in mm [⊳⊕]

Clamp. force kN	Model number	A	C	D	E	F	G	H	J	L	P	Q	kg
▼ **Standard clamp arms**													
2,2	**CAS-22**	41	9,7	9,95-10,05	16	10	19	13	M6x1	31	25	M6x1	0,1
5,6	**CAS-52**	61	12,7	15,95-16,05	19	11	25	16	M8x1	48	40	M8x1,25	0,1
9,0	**CAS-92**	76	20,1	24,94-25,04	25	16	40	23	M10x1,25	56	45	M10x1,5	0,3
11,6	**CAS-121**	80	17,8	22,17-22,27	30	16	35	21	.375-24UNF	62	51	.375-16UN	0,5
18,7	**CAS-202**	94	24,1	31,93-32,03	30	21	48	30	M12x1,25	70	55	M12x1,75	0,5
33,8	**CAS-352**	118	35,1	37,95-38,05	40	29	70	31	M16x1,5	83	68	M16x2	1,4
▼ **Long clamp arms**													
2,2	**CAL-22**	92	9,7	9,95-10,05	16	10	19	11	M6x1	83	–	–	0,1
5,6	**CAL-52**	148	12,7	15,95-16,05	19	11	25	14	M8x1	135	–	–	0,3
9,0	**CAL-92**	180	20,1	24,94-25,04	25	16	40	18	M10x1,25	160	–	–	0,6
11,6	**CAL-122**	179	17,8	22,17-22,27	30	16	35	18	M10x1,5	162	–	–	0,7
18,7	**CAL-202**	202	24,1	31,93-32,03	30	21	48	25	M12x1,25	178	–	–	0,7
33,8	**CAL-352**	215	35,1	37,95-38,05	40	34	70	30	M16x1,5	180	–	–	1,9

Clamp. force kN	Model number	A	C	D1 ø	D2	E	G	J	K1	K2	P	Q	kg
▼ **Clamp arms for Collet-Lok® swing cylinders**													
4,4	**MA-540**	72	18	19,02-19,05	M16x1,5	30	32	M8x1,25	19	10	40	M8x1,25	0,5
8,9	**MA-1050**	83	19	22,30-22,33	M20x1,5	30	35	M8x1,25	18	10	50	M10x1,5	0,5
37,8	**MA-3070**	128	35	34,97-35,00	M33x2	47	59	M8x1,25	32	17	70	M16x2	2,3

Clamp. force kN	C	D1[1] ø	D2 ø	E	F	G ø	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	M6x1	3,1-3,5	8	25-28	7,0	12	2
5,6	20,1	16,00-16,03	18,47-18,51	19	1,5-3,0	30	13,5	M8x1	4,1-4,5	10	35-40	9,0	13	2
9,0	30,0	25,00-25,03	27,85-27,95	25	1,5-3,0	40	22,1	M10x1,25	3,9-4,2	12	55-60	10,0	17	2
11,6	28,4	22,24-22,27	25,46-25,55	30	1,5-3,0	35	17,8	M10x1,5	6,9-7,3	13	52-57	10,0	17	3
18,7	35,1	32,00-32,04	35,50-35,60	30	1,5-3,0	60	24,9	M12x1,25	5,1-5,5	15	62-67	13,0	19	3
33,8	39,9	38,00-38,04	41,50-41,60	40	1,5-3,0	70	30,0	M16x1,5	4,9-5,3	20	80-85	17,0	25	4

[1] Surface roughness for D1 should be 1,6 micrometers.
[2] Not for use with Collet-Lok® swing cylinders.

Force: 0,5 - 37,8 kN
Pressure: 35 - 350 bar

E Brazos de amarre
F Bras de bridage
D Spannarme

Options

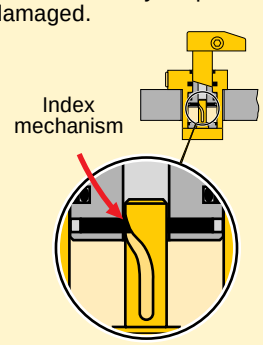
Gauges 106

Flow control valves 96

Important

Do not exceed maximum oil flow

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



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

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

Pivoting T-arms — CAC, CAPT series

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

01_001_1

The T-arm clamps two workpieces simultaneously with one swing cylinder. Enerpac recommend to use the pivoting T-arms with double-acting swing cylinders of the SU, SL, ST and SC-series.

Clamping two workpieces with one cylinder

...quick and precise clamp arm positioning

- Pivoting clamp arm compensates large differences in workpiece height
- The clamp arm design allows quick random positioning
- CAC series can be installed without removing the cylinder from the fixture
- Silicone spring is compatible with all coolants and protects against contamination
- Simple design allows easy creation of your own T-arm

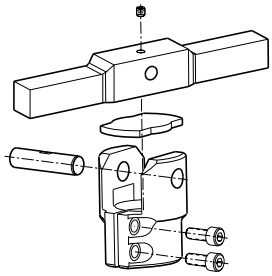
Force: 5,6 - 33,8 kN

Pressure: 35 - 350 bar

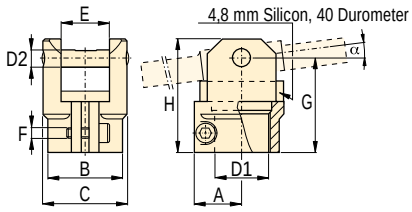
(E) Brazos de amarre

(F) Bras de bridage

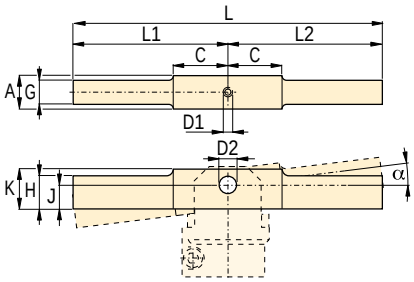
(D) Spannarme

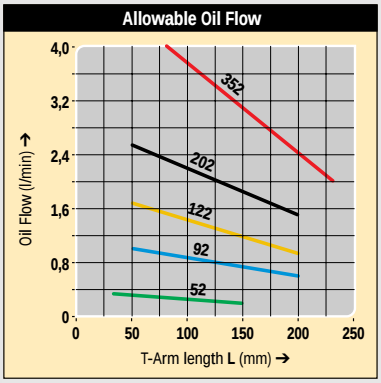


CAC models

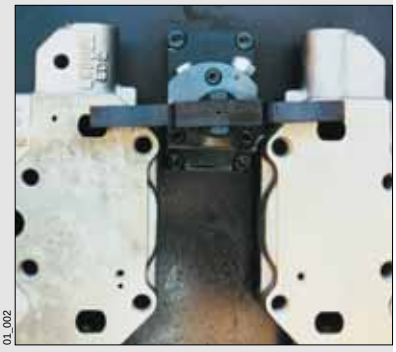


CAPT models





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



01_002

Collars – Dimensions in mm [⊳◎]

Clamp. force kN	Model number	Max. Tilt Angle α	A	B	C	D1	D2	E	F	G	H	kg
▼ **Collars for T-Arms**												
5,6	CAC-52	20°	16,5	24,0	28,0	16,0	6,0	16,1	M4x0,7	32,0	40,0	0,09
9,0	CAC-92	14°	22,0	34,6	39,0	25,0	8,0	22,5	M5x0,8	43,2	52,6	0,20
11,6	CAC-122	14°	22,0	34,6	39,0	22,3	8,0	22,5	M5x0,8	43,2	52,6	0,20
18,7	CAC-202	10°	27,2	46,6	54,5	32,0	10,0	28,8	M6x1,0	51,2	63,0	0,47
33,8	CAC-352	10°	34,0	54,6	63,0	38,0	14,0	35,2	M8x1,25	63,4	79,0	0,80

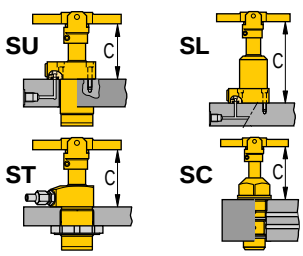
T-Arms – Dimensions in mm [⊳◎]

Clamp. force kN	Model number	A	C	D1*	D2	G	H	J	K	L	L1	L2	kg
▼ **Pivoting T-Arms**													
5,6	CAPT-52	15,6	25,5	M3x0,5	6,02-6,12	12,7	12,7	10,0	19,0	152,4	76,2	76,2	0,27
9,0	CAPT-92	22,0	38,1	M4x0,7	8,02-8,12	18,3	18,3	15,1	22,2	203,2	101,6	101,6	0,66
11,6	CAPT-122	22,0	38,1	M4x0,7	8,02-8,12	18,3	18,3	15,1	22,2	203,2	101,6	101,6	0,66
18,7	CAPT-202	28,3	31,8	M6x1,0	10,02-10,12	22,0	22,0	16,2	28,6	203,2	101,6	101,6	0,96
33,8	CAPT-352	34,7	25,0	M6x1,0	14,02-14,12	30,0	30,0	18,4	34,8	228,6	114,3	114,3	1,78

* 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	Swing cyl. and T-arm model	SU-series C	SL-series C	ST-series C	SC-series C
▼ **T-arm installation dimensions - Fully unclamped position**					
5,6	**52**	73,7	139,7	73,7	81,0
9,0	**92**	79,5	155,5	84,6	–
11,6	**122**	90,2	176,0	90,2	98,3
18,7	**202**	90,7	177,5	90,7	–
33,8	**352**	102,6	199,1	109,5	–



ENERPAC

Force: 6,1 - 19,5 kN

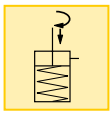
Stroke: 6,4 - 10,9 mm

Pressure: 80 - 170 bar

(E) **Cilindros giratorios**

(F) **Verins de bridage pivotants**

(D) **Schwenkspannzylinder**



Options

Fittings 110

Hoses and couplers 108

Flow control valves 96

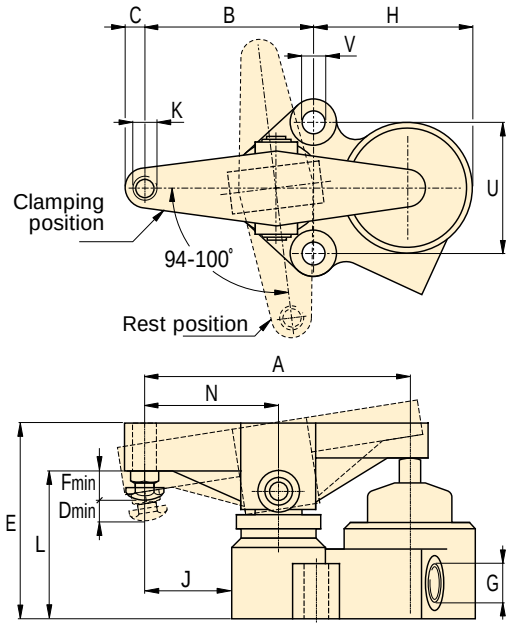
Gauges 106

Adjustable clamping stroke

...turns clockwise or counter clockwise

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

ASC-30, -100



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.

Selection chart

Cylinder capacity	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

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

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

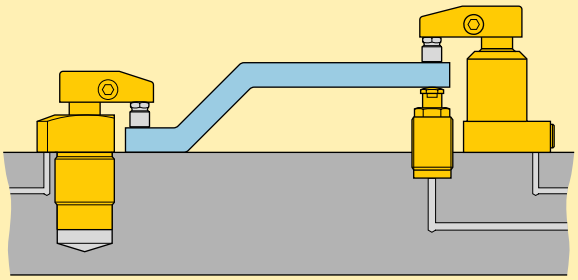
Work supports *Application & selection*

Shown: MPFS-100, WFL-112, WFC-72, WFL-442

98-046

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.

99-044

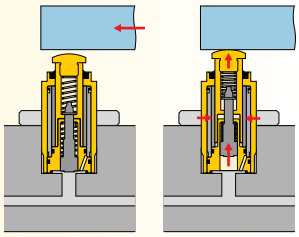
Wide range of sizes and types to efficiently support workpiece

- 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
- Collet-Lok® positive locking models:
  Hydraulic actuation / mechanical holding allows for palletized systems which do not permit live hydraulics

Select your work support method:

WF series, Hydraulic advance

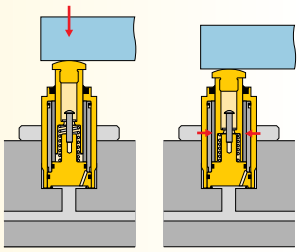
- Retracted plunger allows unobstructed workpiece loading.
- Internal hydraulic plunger advances allowing external plunger to advance under spring load. Bronze sleeve squeezes and holds plunger in fixed position.



30

WS series, Spring advance

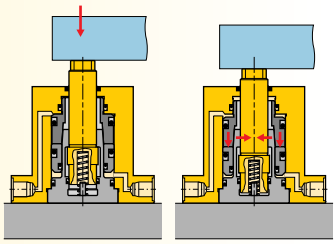
- Workpiece weight compresses the spring of the extended plunger.
- When pressurized, the internal bronze sleeve squeezes and holds the plunger in fixed position.
- Can be operated as air advance.



32

MP series, Collet-Lok® positive locking

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



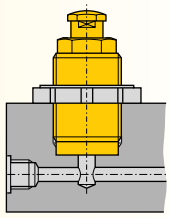
34

ENERPAC

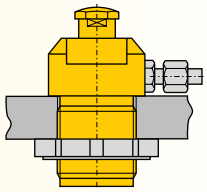
www.enerpac.com

Select your mounting method:

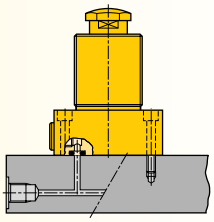
Manifold mount
- Does not require external plumbing
- Compact design, when space is at a premium
- Internal plunger thread for optional contacts



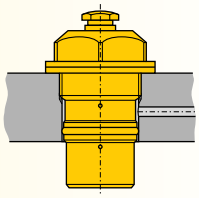
Threaded body
- Ability to adjust height
- Plumbed from either side or bottom
- Internal plunger thread for optional contacts



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



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



Product selection

Maximum support force	Stroke	Manifold mount	Threaded body	Lower flange	Cartridge style
kN	mm				
▼ Hydraulic advance			Model number		
7,3	9,7	WFM-72	WFT-72	–	WFC-72
11,1	9,7	–	–	WFL-112	WFC-112
22,2	10,4	–	–	WFL-222	WFC-222
33,4	13,5	–	–	WFL-332	–
44,5	16,5	–	–	WFL-442	–
▼ Spring advance			Model number		
7,3	9,7	WSM-72	WST-72	–	WSC-72
11,1	9,7	–	–	WSL-112	WSC-112
22,2	10,4	–	–	WSL-222	WSC-222
33,4	13,5	–	–	WSL-332	–
44,5	16,5	–	–	WSL-442	–
▼ Collet-Lok®			Model number		
8,9	9,9	–	MPTS-100	MPFS-100	–
17,8	9,9	–	MPTS-200	MPFS-200	–

Force: 7,3 - 44,5 kN

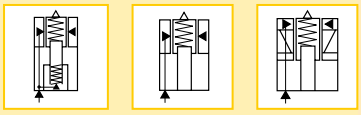
Stroke: 9,7 - 16,5 mm

Pressure: 50 - 350 bar

(E) Cilindros de soporte

(F) Vérin anti-vibreur

(D) Abstützzylinder



Options

Swing cylinders 12

Accessories 72

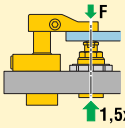
In line filters 109

Sequence valves MVPM-5 92

Important

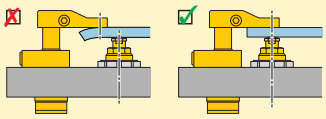
Warning!

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

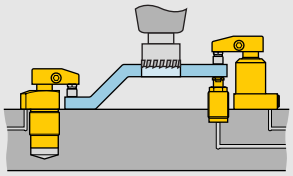
99-047

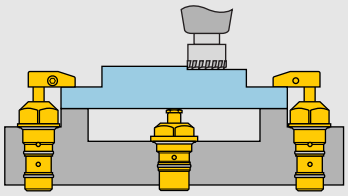
For unobstructed part loading

- 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

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.





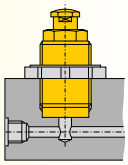
In order to load the workpiece sideways over the work supports, hydraulic advanced models are being used.

99 045

Four mounting styles

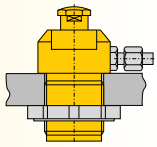
WFM series, Manifold models

Eliminates the need for fittings and tubing on the fixture.



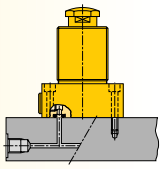
WFT series, Threaded models

Offers the flexibility of side or bottom porting.



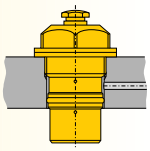
WFL series, Lower flange models

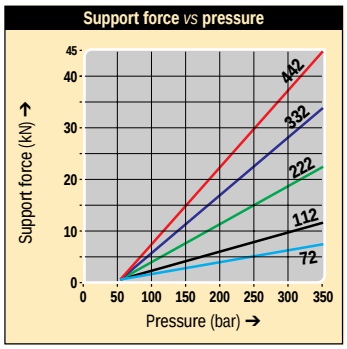
Plumbed directly – no fixture hole required.

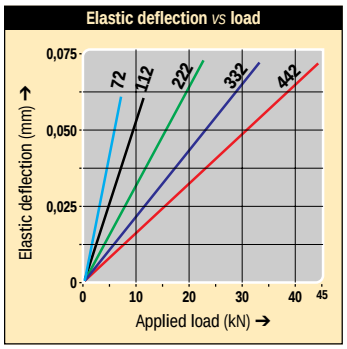


WFC series, Cartridge models

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

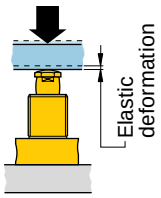






Deflection chart:

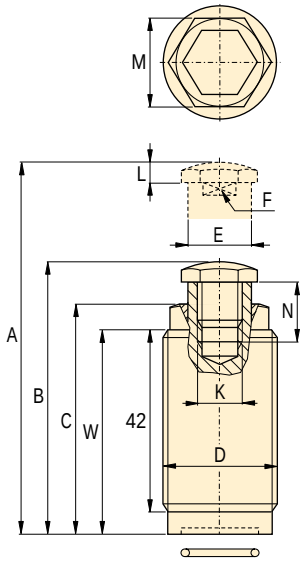
Elastic deformation of the work support resulting from the application of load.



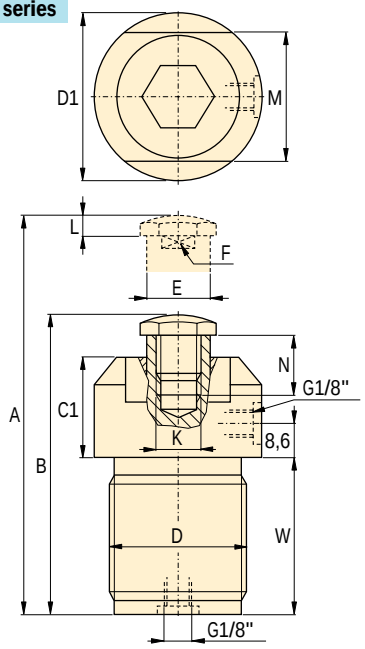
Product selection

Max. support force kN	Support plunger stroke mm	Manifold mount	Threaded body	Lower flange	Cartridge style	Operating pressure bar min.	Operating pressure bar max.	Plunger contact spring force N ext.	Plunger contact spring force N retr.	Oil Capacity cm³	Max. oil flow l/min
7,3	9,7	WFM-72	WFT-72	–	WFC-72	48	350	8,9	25,8	0,66	0,7
11,1	9,7	–	–	WFL-112	WFC-112	48	350	15,1	23,1	0,98	1,0
22,2	10,4	–	–	WFL-222	WFC-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

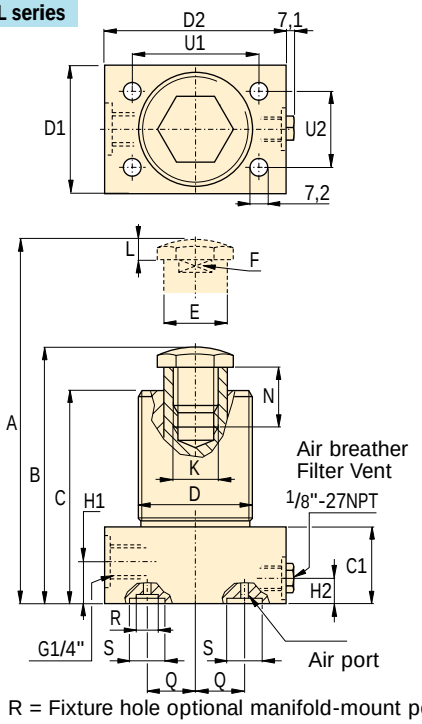
WFM series



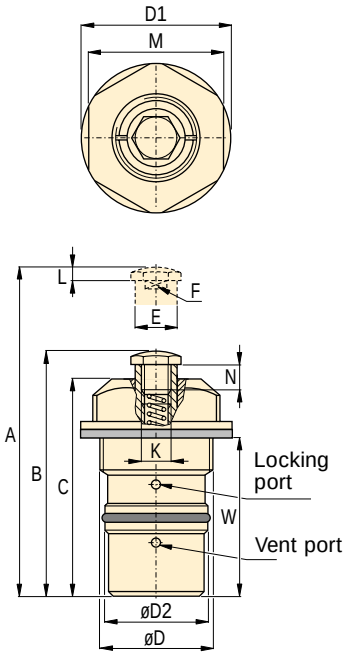
WFT series



WFL series



WFC series



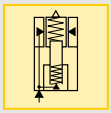
R = Fixture hole optional manifold-mount port.

Force:	**7,3 - 44,5 kN**
Stroke:	**9,7 - 16,5 mm**
Pressure:	**48 - 350 bar**

E Cilindros de soporte

F Vérin anti-vibreur

D Abstützzylinder



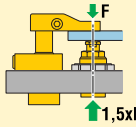
Options

Accessories 72

In line filters 109

Important

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



Do not exceed maximum flow rates to avoid premature lockup.

Always center load over work support.

Product dimensions in mm [⊳⊕]

Mounting dimensions 36

Model number	A	B	C	C1	D	D1	D2	E	F	H1	H2	K	L	M	N *	U1	U2	W	kg
WFM-72	76,2	66,5	54,9	–	M30x1,5	–	–	15,0	13,0	–	–	M10x1,5	4,5	23,9	13,5	–	–	49,8	0,2
WFT-72	89,2	79,5	–	25,9	M35x1,5	43,4	–	15,0	13,0	–	–	M10x1,5	4,5	34,0	13,5	–	–	41,9	0,2
WFL-112	99,3	89,7	78,7	27,4	M35x1,5	38,1	60,5	16,0	12,4	14,2	17,8	M10x1,5	4,5	–	18,5	41,1	23,9	–	0,6
WFL-222	102,1	91,7	78,0	26,4	M68x1,5	69,9	82,6	38,0	25,4	13,7	13,2	M20x2,5	6,1	–	8,0	55,4	55,4	–	2,2
WFL-332	111,8	98,3	87,9	26,9	73,2	76,2	88,9	45,0	30,0	13,5	10,7	M20x2,5	6,1	–	8,0	62,0	62,0	–	2,9
WFL-442	128,8	112,3	102,9	30,0	85,9	88,9	101,6	55,0	36,6	13,5	10,7	M20x2,5	6,1	–	15,9	74,7	74,7	–	4,3
WFC-72	81,3	71,6	62,5	–	M33x1,5	41,1	29,5	15,0	13,0	–	–	M10x1,5	4,5	38,1	13,5	–	–	50,3	0,4
WFC-112	102,4	92,7	82,0	–	M42x1,5	57,2	38,0	16,0	12,4	–	–	M10x1,5	4,5	50,8	18,5	–	–	60,5	0,9
WFC-222	114,8	104,4	91,4	–	M60x1,5	76,2	57,1	38,0	25,4	–	–	M20x2,5	6,1	69,9	8,0	–	–	68,6	1,8

* Note: Dimension N is factory set. May change on types **222**, **332** and **442** due to adjusted contact spring force.

Note: For dimensions **Q**, **R** and **S** see mounting dimensions 36.

Work supports - Spring advance

Shown: WSL-112, WST-72

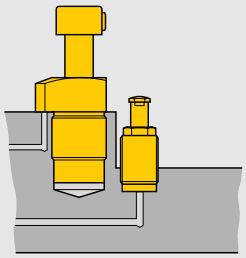
99-048

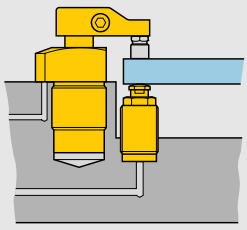
Spring advance work support contacts workpiece as it is loaded into fixture

- 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 for 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.





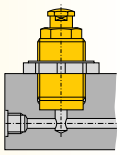
Spring advance work supports with extended plungers, waiting for the next workpiece.

99-046

Mounting style

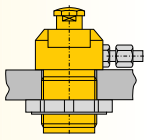
WSM series, Manifold mount

Eliminates the need for fittings and tubing on the fixture.



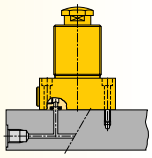
WST series, Threaded body

Offers the flexibility of side or bottom porting.



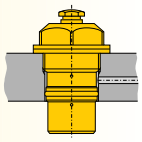
WSL series, Lower flange

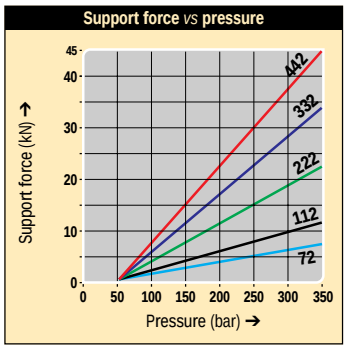
Plumbed directly – no fixture hole required.

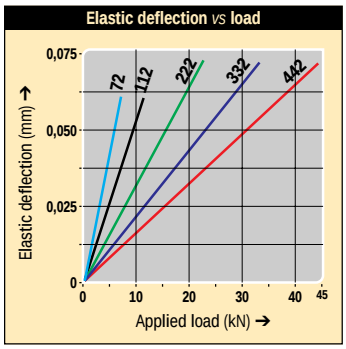


WSC series, Cartridge mount style

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

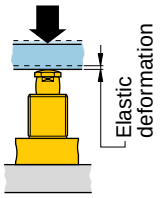






Deflection chart:

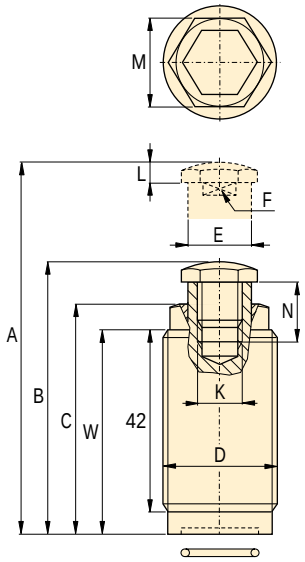
Elastic deformation of the work support resulting from the application of load.



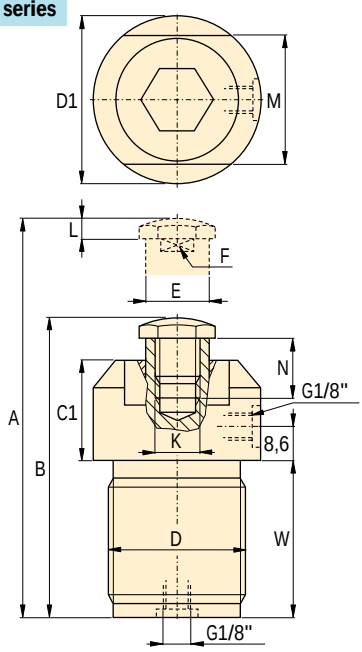
Product selection

Max. support force kN	Support plunger stroke mm	Manifold mount	Threaded body	Lower flange	Cartridge style	Operating pressure bar min.	Operating pressure bar max.	Plunger contact spring force N ext.	Plunger contact spring force N retr.	Oil Capacity cm³	Max. oil flow l/min
7,3	9,7	WSM-72	WST-72	–	WSC-72	48	350	8,9	25,8	0,7	0,7
11,1	9,7	–	–	WSL-112	WSC-112	48	350	15,1	23,1	1,0	1,0
22,2	10,4	–	–	WSL-222	WSC-222	48	350	9,3	86,8	3,1	3,1
33,4	13,5	–	–	WSL-332	–	48	350	17,8	77,9	3,9	3,9
44,5	16,5	–	–	WSL-442	–	48	350	14,7	97,9	4,9	4,9

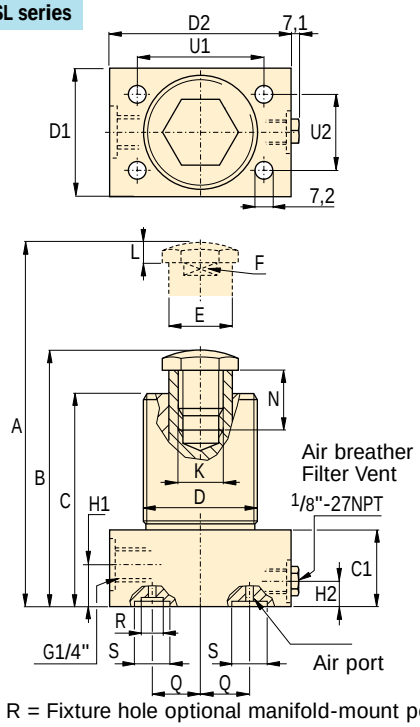
WSM series



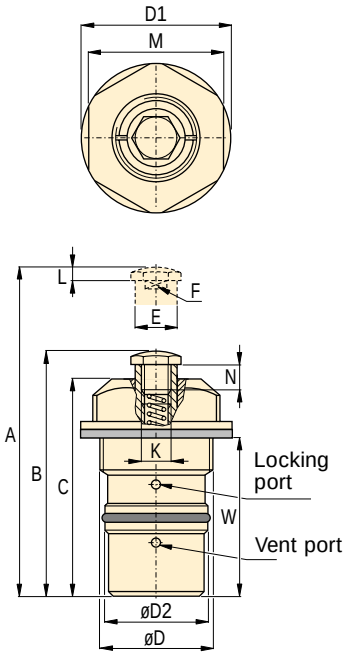
WST series



WSL series



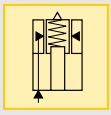
WSC series



R = Fixture hole optional manifold-mount port.

Force: 7,3 - 44,5 kN
Stroke: 9,7 - 16,5 mm
Pressure: 48 - 350 bar

(E) Cilindros de soporte
(F) Vérin anti-vibreur
(D) Abstützzylinder



Options

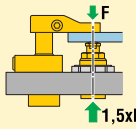
Accessories 72

In line filters 109

Important

Warning!

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



Do not exceed maximum flow rates to avoid premature lockup

Always center load over work support.

Product dimensions in mm [⊳⊕]

Mounting dimensions 36

Model number	A	B	C	C1	D	D1	D2	E	F	H1	H2	K	L	M	N *	U1	U2	W	kg
WSM-72	76,2	66,5	54,9	–	M30x1,5	–	–	15,0	13,0	–	–	M10x1,5	4,5	23,9	13,5	–	–	49,8	0,2
WST-72	89,2	79,5	–	25,9	M35x1,5	43,4	–	15,0	13,0	–	–	M10x1,5	4,5	34,0	13,5	–	–	41,9	0,2
WSL-112	85,1	75,4	64,5	23,9	M35x1,5	38,1	60,5	16,0	12,4	11,2	7,6	M10x1,5	4,5	–	18,5	41,1	23,9	–	0,6
WSL-222	96,5	86,1	74,9	24,9	M68x1,5	69,9	82,6	38,0	25,4	12,2	10,2	M20x2,5	6,1	–	8,0	55,4	55,4	–	2,2
WSL-332	108,7	95,3	85,3	26,9	73,2	76,2	88,9	45,0	30,0	13,5	10,7	M20x2,5	6,1	–	8,0	62,0	62,0	–	2,9
WSL-442	126,5	110,0	100,3	30,0	85,9	88,9	101,6	55,0	36,6	13,5	10,7	M20x2,5	6,1	–	15,9	74,7	74,7	–	4,3
WSC-72	81,3	71,6	62,5	–	M33x1,5	41,1	29,5	15,0	13,0	–	–	M10x1,5	4,5	38,1	13,5	–	–	50,3	0,4
WSC-112	85,3	75,7	65,0	–	M42x1,5	57,2	38,0	16,0	12,4	–	–	M10x1,5	4,5	50,8	18,5	–	–	60,5	0,9
WSC-222	97,8	87,4	76,2	–	M60x1,5	76,2	57,1	38,0	25,4	–	–	M20x2,5	6,1	69,9	8,0	–	–	68,6	1,8

* Note: Dimension N is factory set. May change on types **222**, **332** and **442** due to adjusted contact spring force.
Note: For dimensions **Q**, **R** and **S** see mounting dimensions 36.

Work supports - *Collet-Lok® Design*

Shown: MPFS-100, MPTS-100

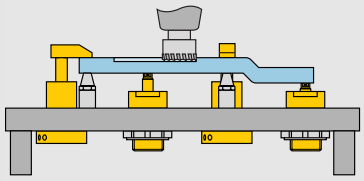
98-049

Hydraulically locked, mechanically maintained work support

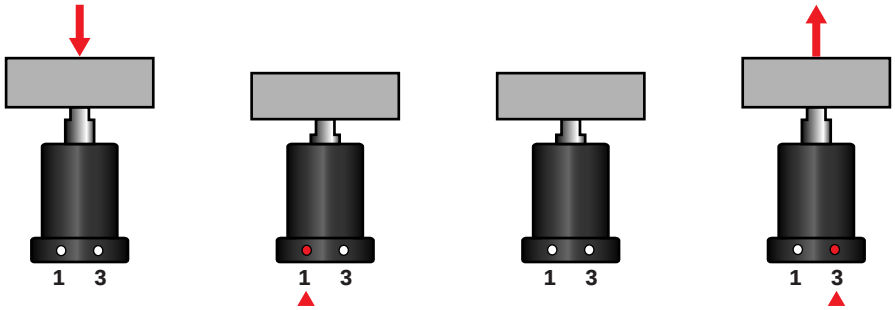
- Collet-Lok® design allows the work support to maintain support position after the hydraulic pressure is removed
- Collet-Lok® maintains a higher level of safety, as it is not dependent on hydraulic supply pressure
- Low deflection: lowest deflection of any work support available
- Threaded or flanged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

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.

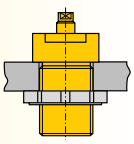
Step 3
Depressurize oil port #1. Cylinder can be uncoupled from hydraulics and still support the workpiece.

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

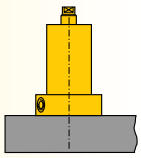
MPT series, Threaded models

Offers the flexibility of side or bottom porting.

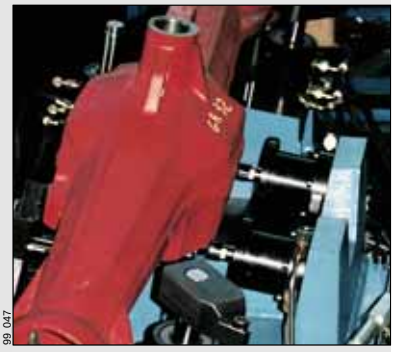


MPF series, Flange models

Plumbed directly, no fixture hole required.



While pallet nr. 1 is in the machining chamber, a new work piece is loaded on to pallet nr. 2.

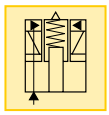


99 047

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		cm³			
kN	mm			min.	max.	lock	unlock	N	l/min
8,9	10	MPFS-100	–	100	350	3,93	3,93	20,0	6,6
17,8	10	MPFS-200	–	100	350	6,06	6,06	35,2	6,6
8,9	10	–	MPTS-100	100	350	3,93	3,93	15,0	6,6
17,8	10	–	MPTS-200	100	350	6,06	6,06	30,0	6,6

Note: - Minimum unlock pressure must be at least 100 bar above lock pressure.

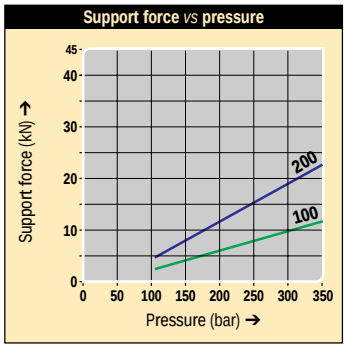


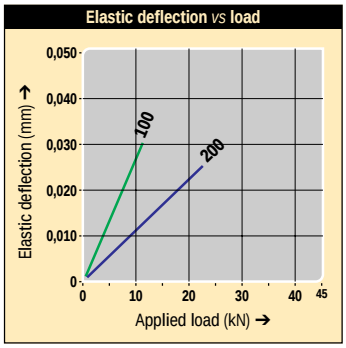
Force:	**8,9 - 17,8 kN**
Stroke:	**10,0 mm**
Pressure:	**100 - 350 bar**

E **Cilindros de soporte**

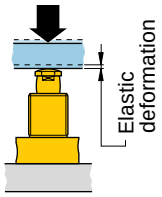
F **Vérin anti-vibreur**

D **Abstützzylinder**

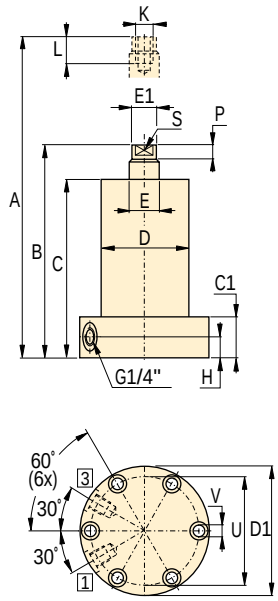




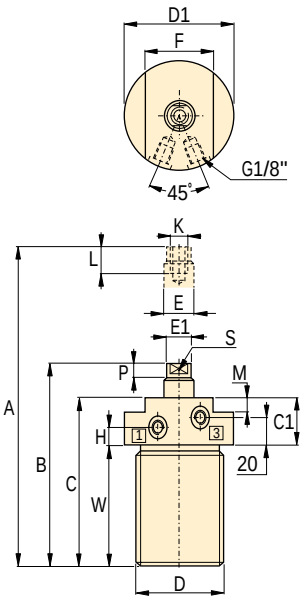
Deflection chart:
Elastic deformation of the work support resulting from the application of load.



MPFS-100, -200



MPTS-100, -200



Options

Collet-Lok® swing cylinders 22

Autocouplers 100

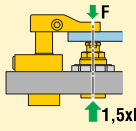
Positive clamping cylinders 66

Sequence Valves 92

Important

Warning!

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



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

Always center load over work support.

Product dimensions in mm [⊳⊕]

Model number	A	B	C	C1	D	D1	E	E1	F	H	K	L	M	P	S	U	V	W	kg
▼ **Flange models**																			
MPFS-100	126	116	106	25	76	110	15,7	14,0	–	12,4	M8x1,25	15	–	5	12	94	9	–	4,0
MPFS-200	130	120	106	25	92	130	24,9	22,9	–	12,4	M12x1,75	20	–	5	19	112	9	–	6,0
▼ **Threaded models**																			
MPTS-100	125	115	105	38,1	M60x2	74,7	15,7	14,0	55	15,7	M8x1,25	15	20	5	12	–	–	66,8	3,0
MPTS-200	129	119	105	38,1	M80x2	95,0	24,9	22,9	70	15,7	M12x1,75	20	20	7	19	–	–	66,8	4,0

Mounting dimensions *for work supports*

Shown: WFL-112 holding a casting in place.

98000

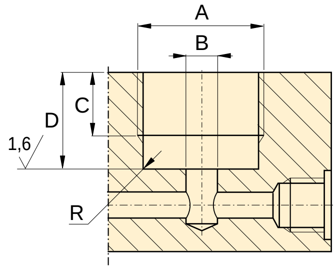
Mounting work supports

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.

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



Dimensions in mm [⊳⊕]

Model number	A	B ø	C	D	R	Manifold O-ring [1]
▼ **For manifold mount work supports**						
WFM-72	M30x1,5	9,4-9,9	13,2-13,7	18,8-19,3	0,4	ARP-017
WSM-72	M30x1,5	9,4-9,9	13,2-13,7	18,8-19,3	0,4	ARP-017

[1] Polyurethane 92 duro.

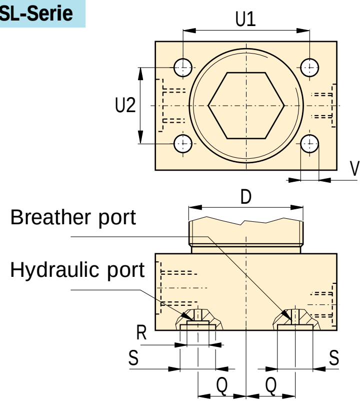
Threaded work support mounting dimensions

Threaded body work supports can be mounted directly into a fixture. The thread size (D) can be found in the dimension charts on □31 (WFT) and □33 (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 to be used to secure the cylinders at the required height.

WFL, WSL-Serie



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

30007 5

Dimensions in mm [⊳⊕]

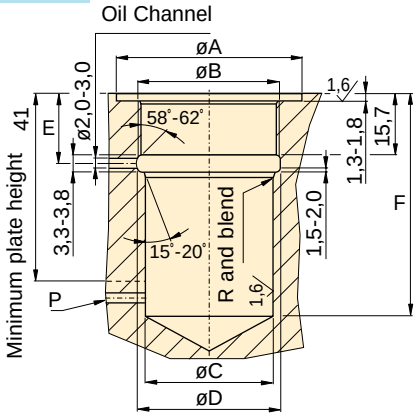
Model number	D	Q	R ø	S ø	U1	U2	V	Manifold O-ring [1]
▼ **For lower flange work supports**								
WFL-112	M35x1,5	14,5	5,9	9,5	41,1	23,9	7,2	ARP-010
WFL-222	M68x1,5	27,4	8,6	14,2	55,4	55,4	7,2	ARP-110
WFL-332	73,2	30,5	8,6	14,2	62,0	62,0	7,2	ARP-110
WFL-442	85,9	36,6	8,6	14,2	74,7	74,7	7,2	ARP-110
WSL-112	M35x1,5	14,5	5,9	9,5	41,1	23,9	7,2	ARP-010
WSL-222	M68x1,5	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.

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 number	A	B	C	D	E	F min.	Ventilation below F required
▼ **Hydraulic advance**							
WFC-72	42,7-43,2	M33x1,5	30,02-30,07	33,3-33,8	15,7-17,3	52,8	–
WFC-112	57,4-57,9	M42x1,5	38,07-38,13	42,4-42,9	17,5-19,0	62,5	•
WFC-222	76,5-77,0	M60x1,5	57,12-57,18	60,5-70,0	17,5-18,3	71,1	•
▼ **Spring advance**							
WSC-72	42,7-43,2	M33x1,5	30,02-30,07	33,3-33,8	15,7-17,3	52,8	–
WSC-112	57,4-57,9	M42x1,5	38,07-38,13	42,4-42,9	17,5-19,0	45,7	•
WSC-222	76,5-77,0	M60x1,5	57,12-57,18	60,5-70,0	17,5-18,3	55,9	•

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

Collet-Lok® work support mounting dimensions

Collet-Lok® work support mounting dimensions are indicated in the dimension chart on ⍰35. For threaded models, use a flange nut to secure the work support in the required position.

Force: 7,3 - 44,5 kN
Stroke: 9,7 - 16,5 mm
Pressure: 48 - 350 bar

E Cilindros de soporte
F Vérin anti-vibreur
D Abstützzylinder

Options

Swing cylinders ⍰12

Accessories ⍰72

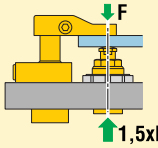
In line filters ⍰109

Fittings ⍰110

Important

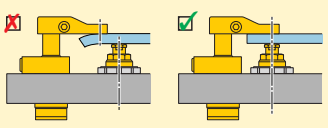
Warning!

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

113

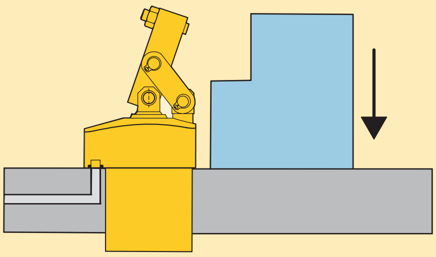
Link Clamps *Application & selection*

Shown: LUCS-32 with LCAS-32

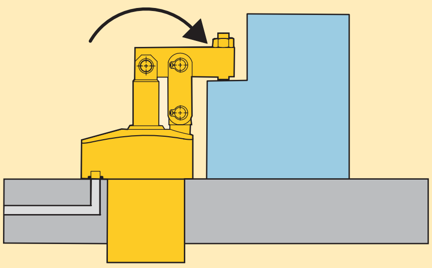
98 056 2

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.

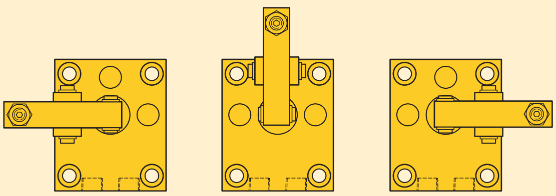


As cylinder extends, arm rotates to clamp part in place.



Clamp arm location is changed easily without the use of tools.

Left Center Right



Quick and accurate clamping action

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

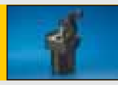
Product selection

Cylinder clamp force at 350 bar kN	Stroke mm	Model number	Effective area cm²	Oil capacity cm³	Clamp arms Model number Standard (sold separately)	Long arm 42 ▶
▼ **Single-acting**						
2,9	18,5	LUCS-32	1,23	2,27	LCAS-32	LCAL-32
7,8	23,5	LUCS-82	3,10	7,28	LCAS-82	LCAL-82
11,8	30,5	LUCS-122	4,13	12,59	LCAS-122	LCAL-122
▼ **Double-acting**						
3,0	18,5	LUCD-32	1,23	2,27	LCAS-32	LCAL-32
8,0	23,5	LUCD-82	3,10	7,28	LCAS-82	LCAL-82
12,0	30,5	LUCD-122	4,13	12,59	LCAS-122	LCAL-122

Call Enerpac for higher clamping capacities or to order models with imperial threads and SAE port connections.

Dimensions in mm [⊳⊕]

Model number	B1	B2	B3	C	D ø	D1	D2	E	E1
▼ **Single-acting**									
LUCS-32	28,0	36,5	55,0	49,0	M48x1,5	62	56	28,0°	1,1
LUCS-82	30,0	39,5	63,0	55,0	M65x1,5	82	70	25,4°	0,1
LUCS-122	37,0	49,5	80,0	70,0	M80x2,0	102	88	27,1°	0,7
▼ **Double-acting**									
LUCD-32	28,0	36,5	55,0	49,0	M48x1,5	62	56	28,0°	1,1
LUCD-82	30,0	39,5	63,0	55,0	M65x1,5	82	70	25,4°	0,1
LUCD-122	37,0	49,5	80,0	70,0	M80x2,0	102	88	27,1°	0,7



Force: 3,0 - 12,0 kN

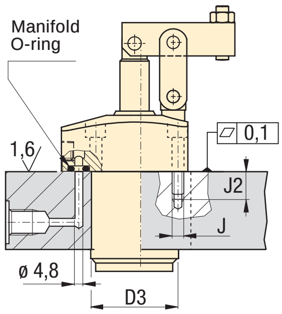
Stroke: 18,5 - 30,5 mm

Pressure: 35 - 350 bar

Installation dimensions in mm [⊳⊕]

Clamp force kN	Fixture hole Ø D3	Mounting thread J	Min. depth J2	Manifold O-ring [1] ARP nr.
3,0	48,3	M6	16,5	010
8,0	65,3	M8	19,0	010
12,0	80,3	M8	19,0	010

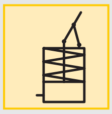
[1] O-rings included. Polyurethane, 92 Durometer. For additional cavity machining information call Enerpac's Technical Service Department.

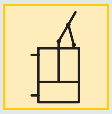


E Cilindros de amarre

F Vérins de bridage à levier

D Gelenkspanner

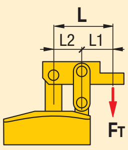




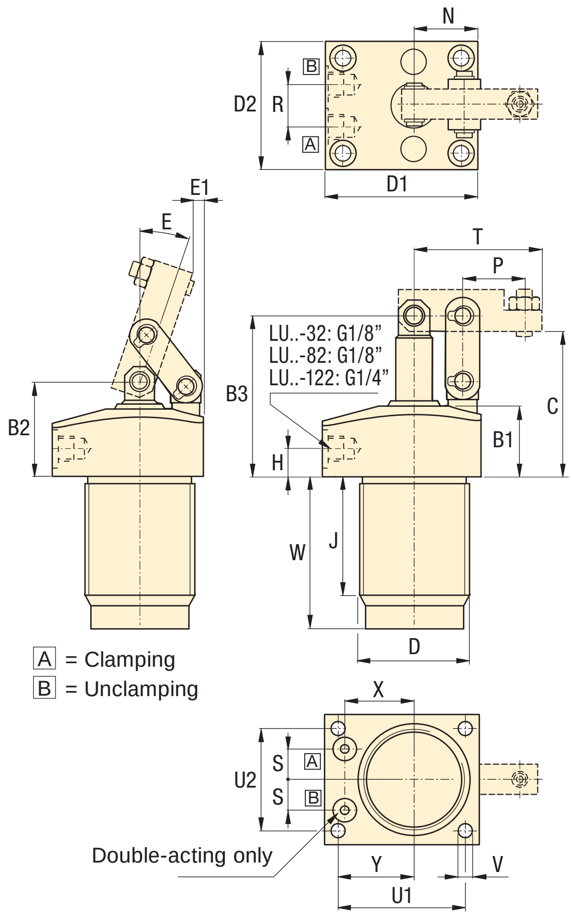
LU-Series

Dimensions shown with standard clamp arm.

When using the standard and long clamp arms from the LCAS and LCAL series consult the diagrams shown on the next page for clamping forces.



42 ▸



Options

Clamp arms for link clamps

42 ▸

Work supports

28 ▸

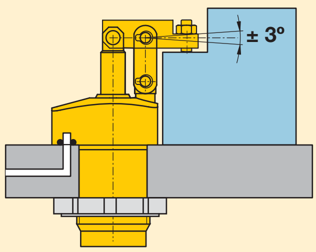
Pull down clamps

62 ▸

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.



H	J	N	P	R	S	T	U1	U2	V	W	X	Y	kg	Model number
													Single-acting ▼	
10,5	44	28	23,5	–	10,46	48,0	52	46	7,0	47	28,7	29	1,3	**LUCS-32**
11,0	65	35	32,0	–	14,02	67,0	68	56	8,2	65	38,5	40	2,7	**LUCS-82**
12,0	71	44	37,5	–	16,07	78,0	88	74	8,2	71	44,2	51	4,8	**LUCS-122**
													Double-acting ▼	
10,5	44	28	23,5	20	21,76	48,0	52	46	7,0	47	20,3	29	1,4	**LUCD-32**
11,0	65	35	32,0	24	25,39	67,0	68	56	8,2	65	30,3	40	2,8	**LUCD-82**
12,0	71	44	37,5	30	26,38	78,0	88	74	8,2	71	37,7	51	5,0	**LUCD-122**

Clamp arms *for link clamps*

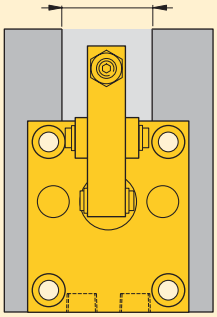
Shown: LCAS-32

98-045

Clamp arms are used to transmit the force generated by the link clamp to the workpiece. Standard clamp 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 43.

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

Allowable clamping area

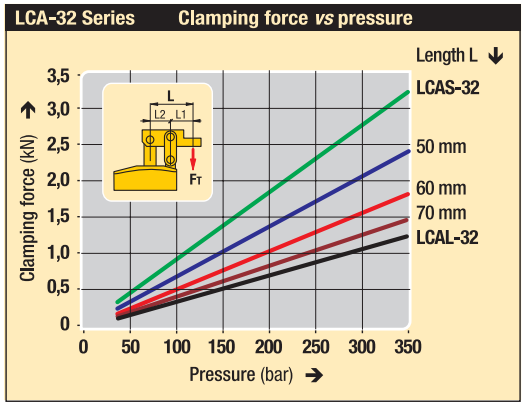


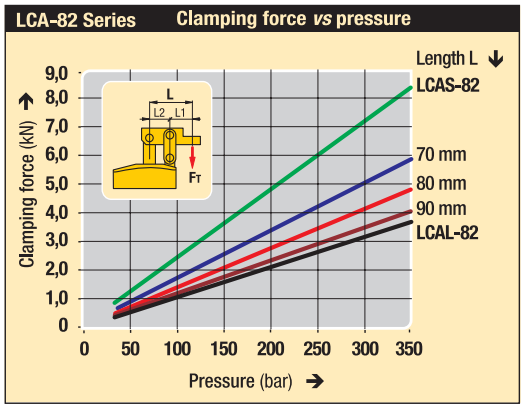
Standard or custom built

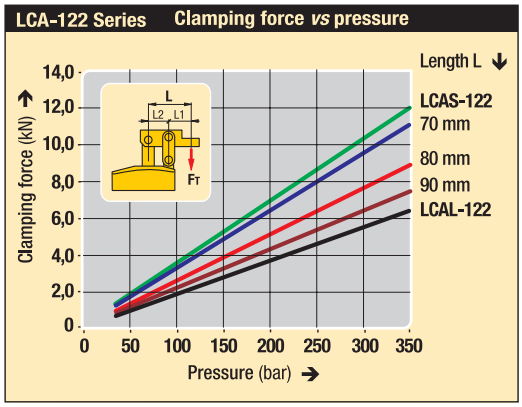
- Available from Enerpac in standard or extended length
- Standard arm includes set screw and lock nut
- Long arm can be machined on-site to match your needs
- Make your own custom arm to suit specific applications

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.







Force: 1,3 - 12,0 kN

Pressure: 35 - 350 bar

(E) **Brazos de amarre**

(F) **Bras de bridage**

(D) **Spannarme**

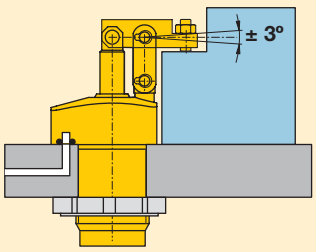
Options

Work supports 28

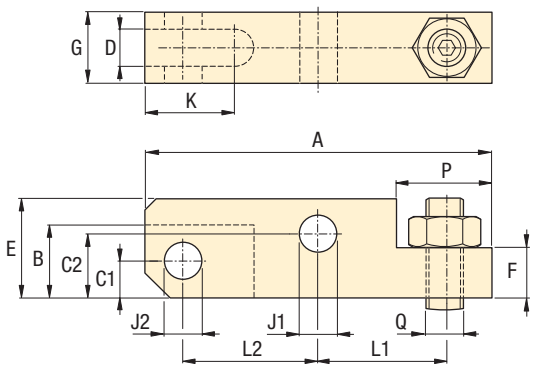
Cylinder accessories 72

Important

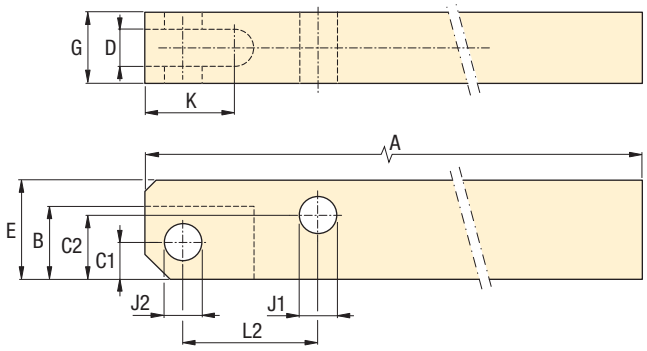
Clamp arm should be parallel to cylinder mounting surface within 3° to avoid damage to cylinder and linkage. Use the included set screw to adjust clamp arm alignment.



LCAS series Standard clamp arms



LCAL series Long clamp arms



Dimensions in mm [⊕]

Clamp arm Model number	Clamping force kN	A	B	C1	C2	D	E	F	G	J1	J2	K	L1	L2	P	Q	kg
▼ **Standard clamp arms**																	
LCAS-32	**3,0**	54,0	13,0	6	9,5	6	16	8	11,9	6,02-6,07	6,02-6,07	13	23,5	18,5	13	M6x1,0	0,1
LCAS-82	**8,0**	74,5	17,5	8	15,5	10	25	13	18,9	10,05-10,10	8,05-8,10	16	32,0	24,5	22	M10x1,5	0,3
LCAS-122	**12,0**	87,5	22,0	10	19,5	11	32	16	21,9	12,05-12,10	10,05-10,10	20	37,5	30,0	25	M12x1,75	0,5
▼ **Long clamp arms**																	
LCAL-32	**1,3**	85,0	13,0	6	9,5	6	16	–	11,9	6,02-6,07	6,02-6,07	13	–	18,5	–	–	0,2
LCAL-82	**3,6**	105,0	17,5	8	15,5	10	25	–	18,9	10,05-10,10	8,05-8,10	16	–	24,5	–	–	0,4
LCAL-122	**6,2**	110,0	22,0	10	19,5	11	32	–	21,9	12,05-12,10	10,05-10,10	20	–	30,0	–	–	0,6

Pull cylinders *Application & selection*

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

99-062

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 2,6 - 43,5 kN for pulling and 5,3 - 81,9 kN for pushing applications.

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

99-062_2

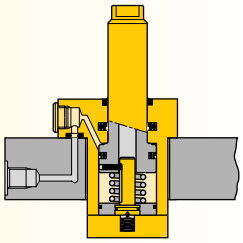
Compact and full featured design

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

Select your pull cylinder type:

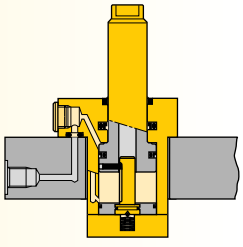
Single-acting

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



Double-acting

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



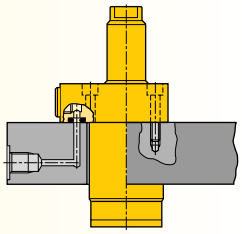
For Collet-Lok® Push cylinders, see 52

Select your mounting method:

PU series, Upper flange mounting

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

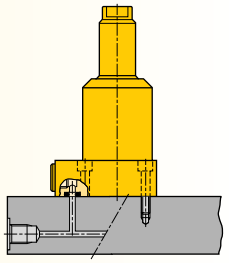
46



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

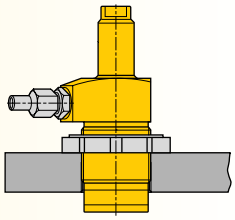
48



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

50



Pull force: 2,6 - 43,5 kN
Push force: 5,3 - 81,9 kN
Stroke: 16,5 - 30,0 mm
Pressure: 35 - 350 bar

(E) Cilindros de tracción
(F) Vérins traction
(D) Zugzylinder

Product selection

Cylinder capacity kN Pull	Push	Stroke mm	Upper flange	Lower flange	Threaded Body
▼ Single-acting				Model number	
2,6	–	16,5	PUSS-22	PLSS-22	PTSS-22
5,6	–	22,6	PUSS-52	PLSS-52	PTSS-52
13,3	–	28,4	PUSS-121	PLSS-121	PTSS-121
▼ Double-acting				Model number	
2,7	5,3	16,5	PUSD-22	PLSD-22	PTSD-22
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	28,4	PUSD-121	PLSD-121	PTSD-121
43,5	81,9	30,0	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 to overcome spring force.

Options

Sequence valves 92

Accessories 72

Collet-Lok® push cylinders 52

Work supports 28

Swing cylinders 10

Pull cylinders - Upper flange models

Shown: PUSS-52, PUSD-121

99-063

Minimal mounting height

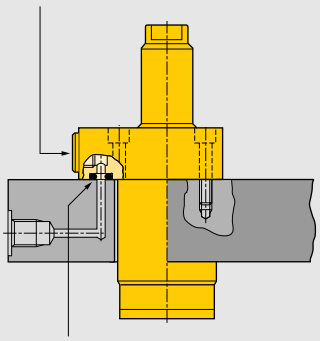
...when space is at a premium

- 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.

BSPP oil connection



Integrated O-ring port

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

99-063_2

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							
2,6	–	16,5	**PUSS-22**	0,77	–	1,31	–
5,6	–	22,6	**PUSS-52**	1,81	–	4,10	–
13,3	–	28,4	**PUSS-121**	4,06	–	11,47	–
▼ Double-acting							
2,7	5,3	16,5	**PUSD-22**	0,77	1,55	1,31	2,62
6,3	13,3	22,6	**PUSD-52**	1,81	3,81	4,10	8,69
11,2	28,0	22,0	**PUSD-92**	3,16	8,06	6,88	17,70
14,3	27,4	28,4	**PUSD-121**	4.06	7,94	11,47	22,94
43,5	81,9	30,0	**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 to overcome spring force.

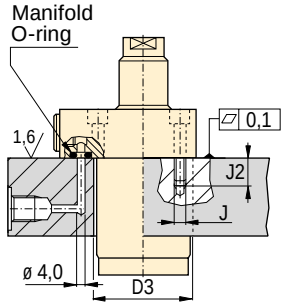
Dimensions in mm [⊳◎]

Model number	A	B	D ø	D1	D2	E ø	E1 ø	F	G1 ø	H	K
▼ Single-acting											
PUSS-22	107	91	28	47,2	45,0	10	8	7,1	9,4	11	M5x0,8
PUSS-52	129	106	35	54,1	57,2	16	15	13,2	11,2	10	M8x1,25
PUSS-121	160	132	48	66,8	73,2	22	21	17,3	11,2	10	.500-20 UNF
▼ Double-acting											
PUSD-22	107	91	28	47,2	45,0	10	8	7,1	9,4	11	M5x0,8
PUSD-52	129	106	35	54,1	57,2	16	15	13,2	11,2	10	M8x1,25
PUSD-92	130	108	48	70,1	53,8	25	24	18,0	11,2	13	M10x1,5
PUSD-121	160	132	48	66,8	73,2	22	21	17,3	11,2	10	.500-20 UNF
PUSD-352	196	166	77	100,1	88,9	38	36	28,4	11,2	13	M16x2

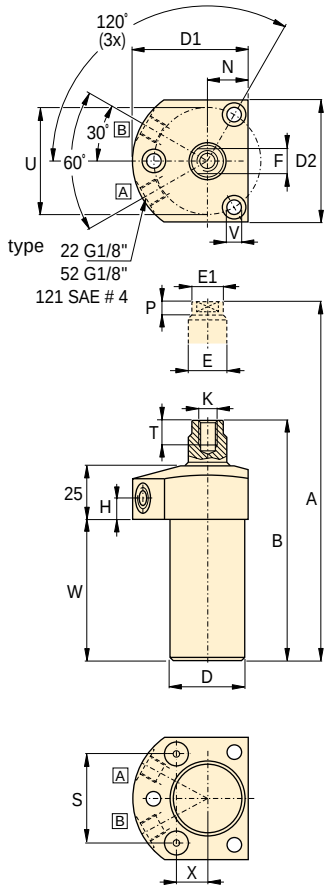
Installation dimensions in mm

Pull Force kN	Fixture hole Ø D3 ±0,3	Mounting thread J	Min. depth J2	Manifold O-ring [1] ARP nr. or Inside Ø x thickness
2,7	28,5	M5	16,5	568-010
6,3	35,5	M6	16,5	568-011
11,2	49,0	M6	15,0	4,32 x 3,53
14,3	49,0	.312-24 UNF	20,3	568-011
43,5	78,0	M10	18,8	4,32 x 3,53

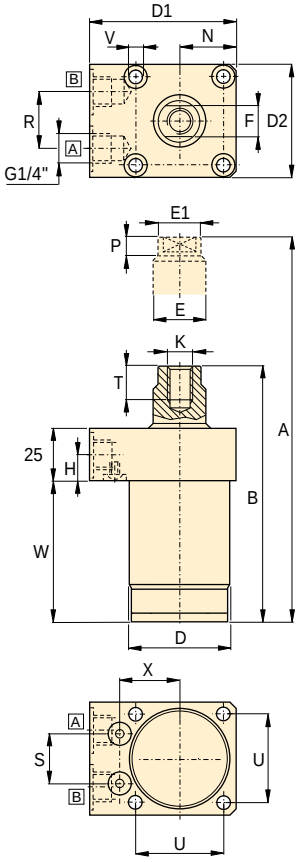
[1] O-ring material: polyurethane, 92 Durometer



-22, 52, 121



-92, -352



A = Pull
B = Push (venting)

N	P	R	S	T	U ø	V ø	X	W	kg	Model number
										Single-acting ▼
15,5	5	–	21,0	8	40,1	5,7	18,1	53,1	0,5	PUSS-22
19,1	6	–	41,0	16	50,0	6,8	14,3	66,0	1,1	PUSS-52
.25,4	10	–	52,4	19	63,5	8,8	18,4	85,9	1,6	PUSS-121
										Double-acting ▼
15,5	5	–	21,0	8	40,1	5,7	18,1	53,1	0,5	PUSD-22
19,1	6	–	41,0	16	50,0	6,8	14,3	66,0	1,1	PUSD-52
26,9	10	26	23,6	16	41,9	6,9	28,7	68,1	2,0	PUSD-92
25,4	10	–	52,4	19	63,5	8,8	18,4	85,9	1,6	PUSD-121
44,5	13	25	34,4	31	70,1	10,8	41,6	88,4	5,1	PUSD-352

Note: U= bolt circle, U1= manifold port circle

Pull force: 2,6 - 43,5 kN
Push force: 5,3 - 81,9 kN
Stroke: 16,5 - 30,0 mm
Pressure: 35 - 350 bar

(E) Cilindros de tracción
(F) Vérins traction
(D) Zugzylinder

Options

Sequence valves 92 ▸

Accessories 72 ▸

Collet-Lok® push cylinders 52 ▸

Swing cylinders 10 ▸

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: PLSD-52, PLSD-121

99-064

Minimal mounting height

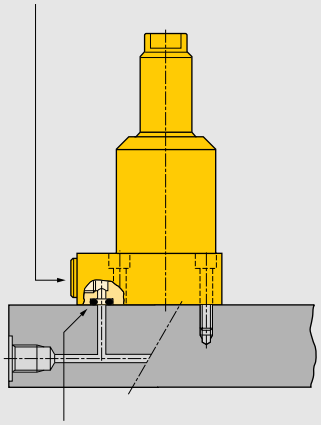
...when space is at a premium

- 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.

BSPP oil connection



Integrated O-ring port

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**							
2,6	–	16,5	**PLSS-22**	0,77	–	1,31	–
5,6	–	22,6	**PLSS-52**	1,81	–	4,10	–
13,3	–	28,4	**PLSS-121**	4,06	–	11,47	–
▼ **Double-acting**							
2,7	5,3	16,5	**PLSD-22**	0,77	1,55	1,31	2,62
6,3	13,3	22,6	**PLSD-52**	1,81	3,81	4,10	8,69
11,2	28,0	22,0	**PLSD-92**	3,16	8,06	6,88	17,70
14,3	27,4	28,4	**PLSD-121**	4,06	7,94	11,47	22,94
43,5	81,9	30,0	**PLSD-352**	12,39	23,74	37,20	71,28

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

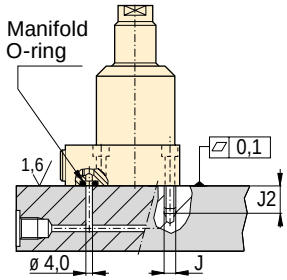
Dimensions in mm [⊳ ◎]

Model number	A	B	C	D Ø	D1	D2	E Ø	E1	F	H	K
▼ **Single-acting**											
PLSS-22	107	91	78	28	47	45	10	9	7	14	M5x0,8
PLSS-52	129	106	91	35	54	57	16	15	13	14	M8x1,25
PLSS-121	160	132	111	48	67	73	22	21	17	16	.500-20 UNF
▼ **Double-acting**											
PLSD-22	107	91	78	28	47	45	10	9	7	14	M5x0,8
PLSD-52	129	106	91	35	54	57	16	15	13	14	M8x1,25
PLSD-92	138	116	101	48	70	54	25	24	18	13	M10x1,5
PLSD-121	160	132	111	48	67	73	22	21	17	16	.500-20 UNF
PLSD-352	204	173	121	80	100	89	38	36	28	12	M16x2

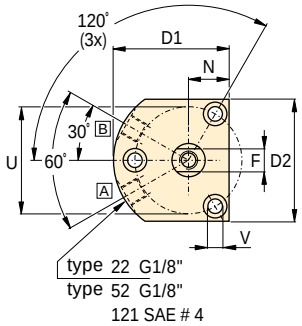
Installation dimensions in mm

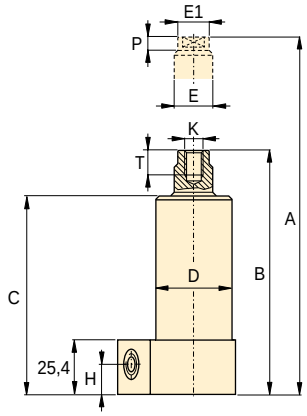
Pull Force kN	Mounting thread J	Minimum depth J2	Manifold O-ring [1] ARP nr. or Inside Ø x thickness
2,7	M5	16,5	568-010
6,3	M6	16,5	568-011
11,2	M6	15,0	4,32 x 3,53
14,3	M8	20,3	568-011
43,5	M10	18,8	4,32 x 3,53

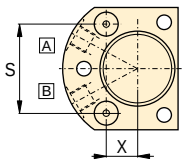
[1] O-ring material: polyurethane, 92 Durometer



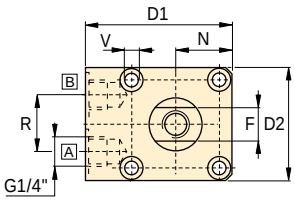
-22, 52, 121

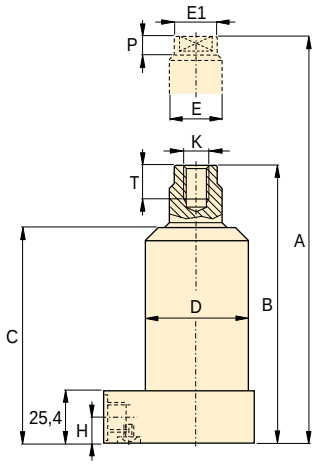


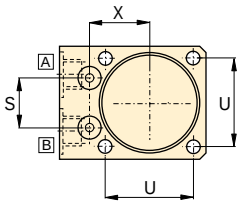




-92, -352







A = Pull
B = Push (venting)

N	P	R	S	T	U	V ø	X	kg	Model number
									Single-acting ▼
15,5	5	–	21,0	8	40	5,7	18,1	0,5	PLSS-22
19,1	6	–	41,0	16	50	6,8	14,3	1,1	PLSS-52
25,4	10	–	52,4	19	64	8,8	18,4	1,6	PLSS-121
									Double-acting ▼
15,5	5	–	21,0	8	40	5,7	18,1	0,5	PLSD-22
19,1	6	–	41,0	16	50	6,8	14,3	1,1	PLSD-52
10,4	10	26	23,6	16	42	6,9	28,7	2,0	PLSD-92
25,4	10	–	52,4	19	64	8,8	18,4	1,6	PLSD-121
44,5	13	25	34,4	31	70	10,8	41,6	5,6	PLSD-352

Pull force:	**2,6 - 43,5 kN**
Push force:	**5,3 - 81,9 kN**
Stroke:	**16,5 - 30,0 mm**
Pressure:	**35 - 350 bar**

E Cilindros de tracción
F Vérins traction
D Zugzylinder

Options

Sequence valves 92

Accessories 72

Collet-Lok® push cylinder 52

Swing cylinders 10

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-22, PTSD-52

99-065

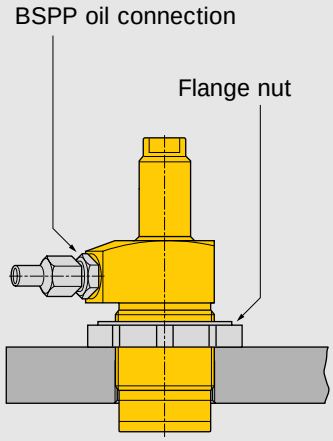
Threaded directly into the fixture

...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 (72).



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

98-026

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**							
2,6	–	16,5	**PTSS-22**	0,77	–	1,31	–
5,6	–	22,6	**PTSS-52**	1,81	–	4,10	–
13,3	–	28,4	**PTSS-121**	4,06	–	11,47	–
▼ **Double-acting**							
2,7	5,3	16,5	**PTSD-22**	0,77	1,55	1,31	2,62
6,3	13,3	22,6	**PTSD-52**	1,81	3,81	4,10	8,69
11,2	28,0	22,0	**PTSD-92**	3,16	8,06	6,88	17,70
14,3	27,4	28,4	**PTSD-121**	4,06	7,94	11,47	22,94
43,5	81,9	30,0	**PTSD-352**	12,39	23,74	37,20	71,28

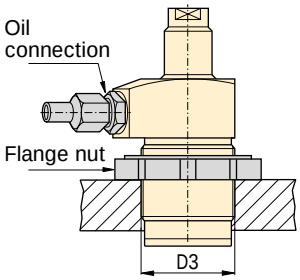
Note: - Call Enerpac to order models with imperial thread and SAE port connections.
- Pull forces for single-acting cylinders reduced to overcome spring force.

Dimensions in mm [⊳⌖]

Model number	A	B	C1	D ø	D1	D2	E ø
▼ **Single-acting**							
PTSS-22	107	91	25,4	M28 x 1,5	39,4	33,0	10
PTSS-52	129	106	25,4	M35 x 1,5	50,0	38,1	16
PTSS-121	160	132	25,4	1.875-16 UN	60,5	50,8	22
▼ **Double-acting**							
PTSD-22	107	91	25,4	M28 x 1,5	39,4	33,0	10
PTSD-52	129	106	25,4	M35 x 1,5	50,0	38,1	16
PTSD-92	130	108	30,0	M48 x 1,5	62,5	48,0	25
PTSD-121	160	132	25,4	1.875-16 UN	60,5	50,8	22
PTSD-352	196	166	32,0	M80 x 2	88,4	80,0	38

Installation dimensions
in mm

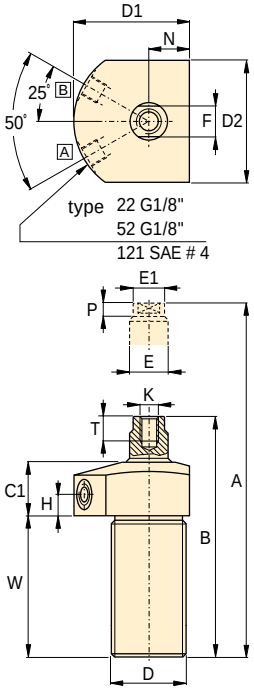
Pull Force kN	Fixture hole thread size D3
2,7	M28 x 1,5
6,3	M35 x 1,5
11,2	M48 x 1,5
14,3	1.875-16 UNF
43,5	M80 x 2



Pull force: 2,6 - 43,5 kN
Push force: 5,3 - 81,9 kN
Stroke: 16,5 - 30,0 mm
Pressure: 35 - 350 bar

E Cilindros de tracción
F Vérins traction
D Zugzylinder

-22, 52, 121



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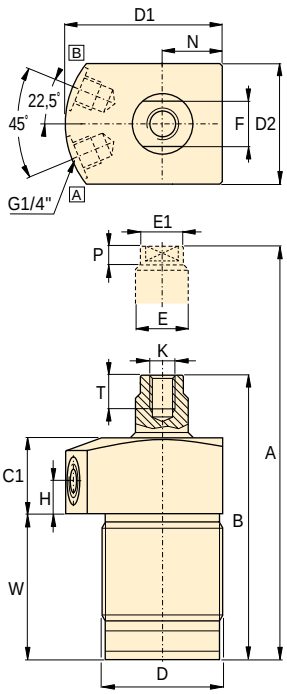


A = Pull
B = Push (venting)

E1 ø	F	H	K	N	P	T	W	kg	Model number
									Single-acting ▼
9	7	10	M5 x 0,8	15,5	5	8	52,6	0,5	PTSS-22
15	13	10	M8 x 1,25	19,1	6	16	65,6	1,1	PTSS-52
21	17	10	.500-20 UNF	25,4	10	19	85,8	1,6	PTSS-121
									Double-acting ▼
9	7	10	M5 x 0,8	15,5	5	8	52,6	0,5	PTSD-22
15	13	10	M8 x 1,25	19,1	6	16	65,6	1,1	PTSD-52
24	18	13	M10 x 1,5	23,9	10	16	63,0	2,0	PTSD-92
21	17	10	.500-20 UNF	25,4	10	19	85,8	1,6	PTSD-121
36	28	13	M16 x 2	39,9	13	31	82,0	4,7	PTSD-352

Options

Sequence valve 92 ▸


Accessories 72 ▸


Collet-Lok® push cylinders 52 ▸


Swing cylinders 10 ▸


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.

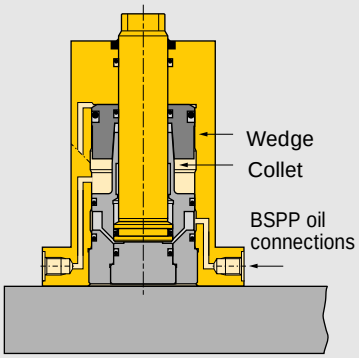
Push cylinders - *Collet-Lok® Design*

Shown: MPTC-110, MPFC-210

99-066

MP series

Collet-Lok® 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.

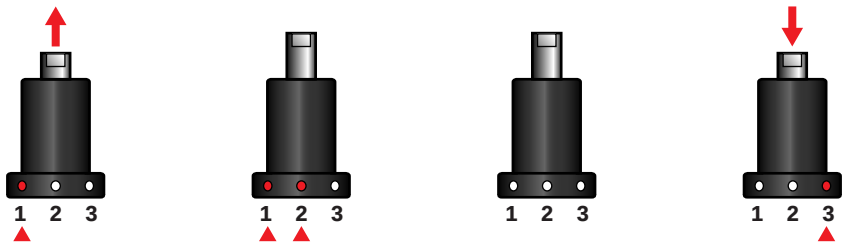
99-048

Ideal when live hydraulics are not available

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

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

Collet-Lok® sequence



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

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

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

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

Product selection

Max. push force	Hydr. plunger stroke	Lower flange	Threaded body	Operating pressure		Hydraulic effective area	Oil capacity			Max. oil flow
				bar		cm^2		cm^3		
kN	mm	Model number		min.	max.	lock	adv.	unlock	retr.	l/min
11,1	15,0	MPFC-110	MPTC-110	50	350	3,23	4,92	6,06	3,93	9,8
22,2	15,0	MPFC-210	MPTC-210	50	350	6,39	10,00	10,00	6,06	9,8

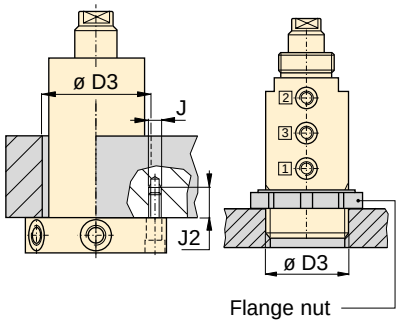
Maximum cycle rate: 8 cycles/min.
Note: Call Enerpac to order models with imperial thread and SAE port connections.

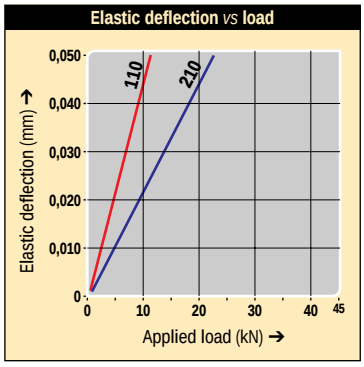
Dimensions in mm [⊕]

Model number	A	B	C	C1	D	D1	D2	E	E1	F
					Ø	Ø		Ø	Ø	Ø
▼ Lower flange										
MPFC-110	154	139	131	–	70,1	100	–	16	15	–
MPFC-210	172	157	149	–	78,0	110	–	22	20	–
▼ Threaded body										
MPTC-110	154	139	130	19	M60 x 2	64	M36 x 1,5	16	15	46
MPTC-210	171	156	148	18	M70 x 2	74	M48 x 1,5	22	20	55

Installation dimensions in mm

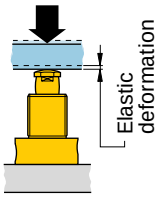
Push force kN	Fixture hole øD3	Mounting Thread J	Minimum depth J2
▼ **Lower flange**			
11,1	71	M6	17
22,2	79	M8	18
▼ **Threaded body**			
11,1	M60 x 2	–	–
22,2	M70 x 2	–	–





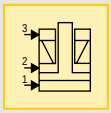
Deflection chart:

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

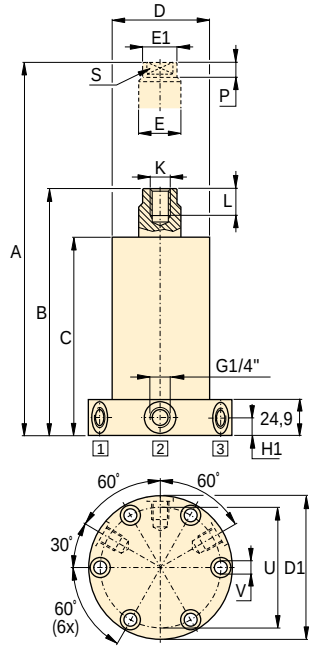


Push force: 11,1 - 22,2 kN
Stroke: 15,0 mm
Pressure: 50 - 350 bar

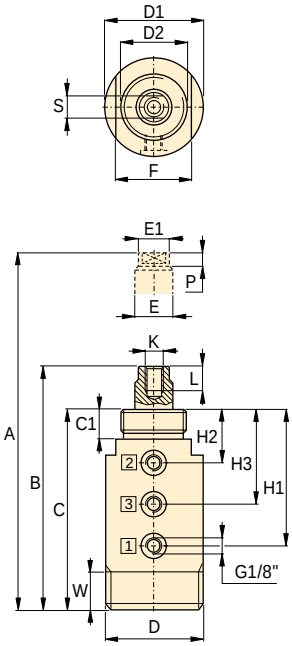
E Cilindros de empuje
F Vérins pousseurs
D Gesicherter Druckzylinder



MPFC



MPTC



Oil port functions

1 Clamp
2 Lock
3 Unlock/Retract

H1	H2	H3	K	L Ø	P	S	U Ø	V	W	kg	Model number
											Lower flange ▼
12,4	–	–	M8 x 1,25	15	7	12	84	7	–	4,0	**MPFC-110**
12,4	–	–	M10 x 1,5	20	9	16	94	9	–	5,0	**MPFC-210**
											Threaded body ▼
96,0	33	65	M8 x 1,25	15	7	12	–	–	19	3,0	**MPTC-110**
111,0	32	72	M10 x 1,5	20	9	16	–	–	20	3,4	**MPTC-210**

Options

Auto couplers 100 ▸


Sequence valves 92 ▸


Accessories 72 ▸


Swing cylinders 10 ▸


Contact bolts 72 ▸


Important

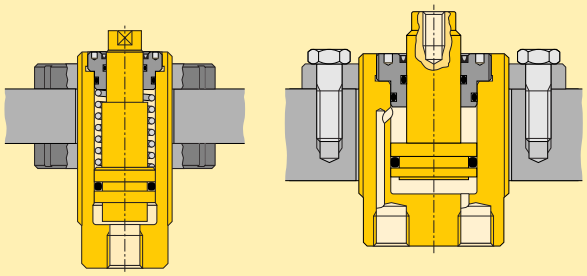
For proper application, clamp forces, pressures and timing consult Enerpac for support.

Threaded cylinders *Application & selection*

Shown: CST-382, CST-572, CST-18252, CDT-18132, CDT-40252

98_050_2

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



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

98019

High clamping forces in a compact design

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

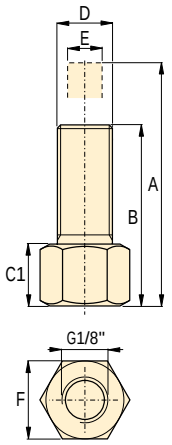
Product selection

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
▼ **Single-acting**							
1,7	–	7	**CST-272**	0,50	–	0,36	–
1,7	–	10	**CST-2102**	0,50	–	0,52	–
1,7	–	13	**CST-2132**	0,50	–	0,67	–
5,6	–	7	**CST-572**	1,61	–	1,08	–
5,6	–	13	**CST-5132**	1,61	–	2,01	–
5,6	–	19	**CST-5192**	1,61	–	2,94	–
5,6	–	25	**CST-5252**	1,61	–	3,87	–
5,6	–	38	**CST-5382**	1,61	–	5,88	–
11,7	–	7	**CST-1072**	3,35	–	2,32	–
11,7	–	13	**CST-10132**	3,35	–	4,31	–
11,7	–	19	**CST-10192**	3,35	–	6,30	–
11,7	–	25	**CST-10252**	3,35	–	8,29	–
11,7	–	38	**CST-10382**	3,35	–	12,60	–
17,8	–	13	**CST-18132**	5,08	–	6,63	–
17,8	–	25	**CST-18252**	5,08	–	12,74	–
17,8	–	38	**CST-18382**	5,08	–	19,37	–
17,8	–	50	**CST-18502**	5,08	–	25,48	–
27,8	–	15	**CST-27152**	7,93	–	11,82	–
27,8	–	25	**CST-27252**	7,93	–	19,70	–
27,8	–	50	**CST-27502**	7,93	–	39,40	–
39,9	–	13	**CST-40132**	11,42	–	14,76	–
39,9	–	25	**CST-40252**	11,42	–	28,39	–
39,9	–	38	**CST-40382**	11,42	–	43,15	–
39,9	–	50	**CST-40502**	11,42	–	56,78	–
▼ **Double-acting**							
17,4	10,5	13	**CDT-18132**	4,99	3,01	6,63	3,94
17,4	10,5	25	**CDT-18252**	4,99	3,01	12,74	7,58
17,4	10,5	38	**CDT-18382**	4,99	3,01	19,37	11,52
17,4	10,5	50	**CDT-18502**	4,99	3,01	25,48	15,16
27,4	18,5	15	**CDT-27152**	7,82	5,29	11,81	7,94
27,4	18,5	25	**CDT-27252**	7,82	5,29	19,68	13,23
27,4	18,5	50	**CDT-27502**	7,82	5,29	39,35	26,45
39,8	26,5	13	**CDT-40132**	11,37	7,58	14,76	9,81
39,8	26,5	25	**CDT-40252**	11,37	7,58	28,39	18,87
39,8	26,5	38	**CDT-40382**	11,37	7,58	43,15	28,68
39,8	26,5	50	**CDT-40502**	11,37	7,58	56,77	37,74

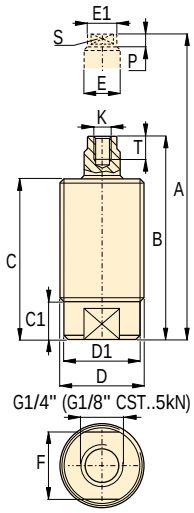
Note: - Seal material: Buna-N, Polyurethane.
- Minimum operating pressure for single-acting models (to overcome return spring force) is 40 bar.

ENERPAC

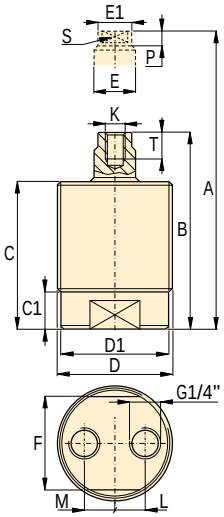
CST-272, -2102, -2132



Other CST models



CDT models



Force:	**1,7- 39,8 kN**
Stroke:	**7,0 - 50,0 mm**
Pressure:	**40 -350 bar**

(E) Cilindros roscados
(F) Vérins corps filetés
(D) Einschraubzylinder

Options

Flange nuts

72

Product dimensions mm [⊟ ⌖]

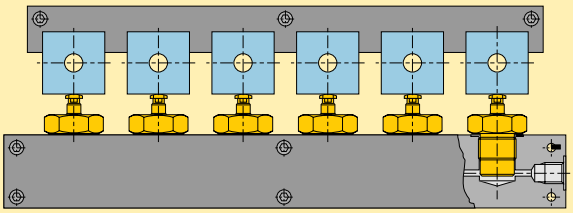
Model number	A Ext. height	B Retr. height	C	C1	D ø	D1 ø	E ø	E1 ø	F	K	L	M	P	S	T	kg
▼ **Single-acting**																
CST-272	49,0	42,0	-	13,5	M12x1,5	-	4,8	-	16,0	-	-	-	-	-	-	0,09
CST-2102	52,8	42,8	-	14,3	M12x1,5	-	4,8	-	16,0	-	-	-	-	-	-	0,14
CST-2132	63,2	50,2	-	14,2	M12x1,5	-	4,8	-	16,0	-	-	-	-	-	-	0,14
CST-572	58,1	51,1	47,0	7,5	M20x1,5	18,0	7,9	7,0	15,9	M4x0,7	-	-	4,0	5,9	7,0	0,14
CST-5132	72,6	59,6	55,5	7,5	M20x1,5	18,0	7,9	7,0	15,9	M4x0,7	-	-	4,0	5,9	7,0	0,18
CST-5192	83,3	64,3	60,0	7,5	M20x1,5	18,0	7,9	7,0	15,9	M4x0,7	-	-	4,0	5,9	7,0	0,23
CST-5252	98,3	73,3	70,2	7,5	M20x1,5	18,0	7,9	7,0	15,9	M4x0,7	-	-	4,0	5,9	7,0	0,32
CST-5382	131,2	93,2	89,0	7,5	M20x1,5	18,0	7,9	7,0	15,9	M4x0,7	-	-	4,0	5,9	7,0	0,41
CST-1072	64,4	57,4	52,0	10,5	M28x1,5	26,0	11,9	11,0	24,0	M6x1,0	-	-	5,5	9,0	8,0	0,27
CST-10132	76,4	63,4	58,0	10,5	M28x1,5	26,0	11,9	11,0	24,0	M6x1,0	-	-	5,5	9,0	8,0	0,32
CST-10192	97,9	78,9	73,5	10,5	M28x1,5	26,0	11,9	11,0	24,0	M6x1,0	-	-	5,5	9,0	8,0	0,36
CST-10252	113,0	88,0	84,3	10,5	M28x1,5	26,0	11,9	11,0	24,0	M6x1,0	-	-	5,5	9,0	8,0	0,41
CST-10382	141,4	103,4	98,0	10,5	M28x1,5	26,0	11,9	11,0	24,0	M6x1,0	-	-	5,5	9,0	8,0	0,45
CST-18132	82,9	69,9	63,5	12,5	M35x1,5	32,5	15,9	15,0	30,0	M8x1,25	-	-	6,5	12,0	12,0	0,55
CST-18252	114,9	89,9	83,5	12,5	M35x1,5	32,5	15,9	15,0	30,0	M8x1,25	-	-	6,5	12,0	12,0	0,59
CST-18382	146,4	108,4	102,0	12,5	M35x1,5	32,5	15,9	15,0	30,0	M8x1,25	-	-	6,5	12,0	12,0	0,68
CST-18502	174,4	124,4	118,0	12,5	M35x1,5	32,5	15,9	15,0	30,0	M8x1,25	-	-	6,5	12,0	12,0	0,77
CST-27152	87,9	72,9	66,5	13,5	M42x1,5	39,8	17,9	17,0	36,0	M8x1,25	-	-	6,5	15,0	12,0	0,64
CST-27252	118,4	93,4	87,0	13,5	M42x1,5	39,8	17,9	17,0	36,0	M8x1,25	-	-	6,5	15,0	12,0	0,91
CST-27502	195,9	145,9	139,5	13,5	M42x1,5	39,8	17,9	17,0	36,0	M8x1,25	-	-	6,5	15,0	12,0	1,32
CST-40132	89,4	76,4	68,5	11,0	M48x1,5	45,5	19,9	19,0	41,4	M10x1,5	-	-	8,0	16,9	12,0	1,00
CST-40252	120,8	95,8	88,0	11,0	M48x1,5	45,5	19,9	19,0	41,4	M10x1,5	-	-	8,0	16,9	12,0	1,18
CST-40382	164,9	126,9	119,0	11,0	M48x1,5	45,5	19,9	19,0	41,4	M10x1,5	-	-	8,0	16,9	12,0	1,50
CST-40502	188,9	138,9	131,0	11,0	M48x1,5	45,5	19,9	19,0	41,4	M10x1,5	-	-	8,0	16,9	12,0	1,77
▼ **Double-acting**																
CDT-18132	81,0	68,0	61,5	16,0	M48x1,5	45,6	15,9	15,0	41,0	M8x1,25	12,8	12,8	6,5	12,7	12,0	1,09
CDT-18252	107,0	82,0	75,5	16,0	M48x1,5	45,6	15,9	15,0	41,0	M8x1,25	12,8	12,8	6,5	12,7	12,0	1,32
CDT-18382	131,5	93,0	86,5	16,0	M48x1,5	45,6	15,9	15,0	41,0	M8x1,25	12,8	12,8	6,5	12,7	12,0	1,55
CDT-18502	155,5	105,0	98,5	16,0	M48x1,5	45,6	15,9	15,0	41,0	M8x1,25	12,8	12,8	6,5	12,7	12,0	1,77
CDT-27152	86,0	71,0	64,8	17,0	M55x1,5	52,6	17,9	17,0	46,0	M8x1,25	16,0	10,0	6,5	15,8	12,0	1,18
CDT-27252	107,0	82,0	75,8	17,0	M55x1,5	52,6	17,9	17,0	46,0	M8x1,25	16,0	10,0	6,5	15,8	12,0	1,41
CDT-27502	157,0	107,0	100,8	17,0	M55x1,5	52,6	17,9	17,0	46,0	M8x1,25	16,0	10,0	6,5	15,8	12,0	1,86
CDT-40132	91,5	78,5	70,5	17,5	M65x1,5	62,0	22,0	21,0	55,0	M10x1,5	20,2	9,8	8,0	16,9	15,0	1,82
CDT-40252	115,5	90,5	82,5	17,5	M65x1,5	62,0	22,0	21,0	55,0	M10x1,5	20,2	9,8	8,0	16,9	15,0	2,09
CDT-40382	141,5	103,5	95,5	17,5	M65x1,5	62,0	22,0	21,0	55,0	M10x1,5	20,2	9,8	8,0	16,9	15,0	2,55
CDT-40502	165,5	115,5	117,5	17,5	M65x1,5	62,0	22,0	21,0	55,0	M10x1,5	20,2	9,8	8,0	16,9	15,0	3,00

Manifold Cylinders *Application & selection*

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

98_056_2

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



Six 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 cylinders are installed in the fixture to position engine manifolds for drilling, tapping and mill finish.

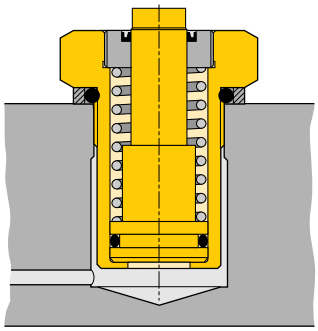
98_056_3

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 relative to the plunger stroke enables extremely compact fixture designs
- Cylinder body is fully recessed within the fixture allowing the workpiece to be positioned near-flush with the fixture surface, saving space
- Nitro carburized bodies and internal plunger wipers allow maintenance-free, high cycle performance
- Center-tapped plungers will hold workpiece contact buttons
- Single-acting design with spring return simplifies hydraulic requirements

Manifold mount

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



Product selection

Cylinder capacity at 350 bar	Stroke	Model number	Effective area	Oil capacity
kN	mm		cm^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.

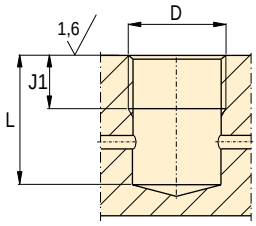
ENERPAC

Installation dimensions in mm [⊳◎]

Model number	D	J1 min.	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. For additional cavity machining information call Enerpac's Technical Service Department.

Installation dimensions



Force: 1,7 - 26,9 kN

Stroke: 7,0 - 25,0 mm

Pressure: 40 - 350 bar

GB Manifold cylinder

D Einschraubzylinder

E Cilindros roscados

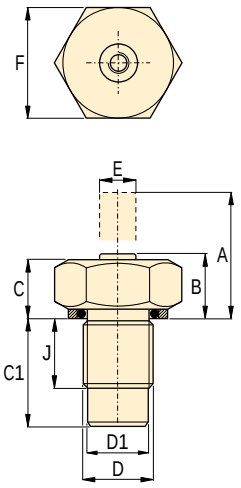
Options

Contact bolts 72

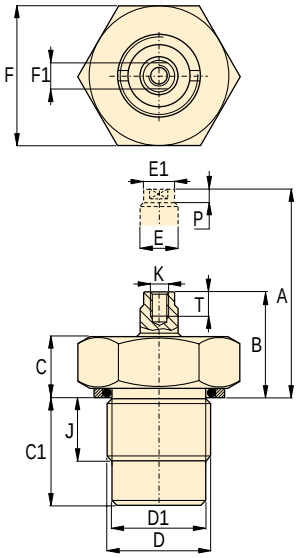
Gauges 106

Power sources 74

CSM-272, -2132



other CSM models



Important

Tighten manifold cylinders according to specifications in the instruction sheet.

Return springs in CSM-cylinders should not be used to pull back heavy attachments consistently.

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	M12x1,5	10,1	4,8	–	19	–	11,4	–	–	–	0,1
CSM-2132	24,4	11,4	11,2	32,2	M12x1,5	10,1	4,8	–	19	–	11,4	–	–	–	0,1
CSM-572	23,5	16,5	12,5	27,5	M20x1,5	17,5	7,9	7	27	5,9	12,5	M4x0,7	4,0	7	0,2
CSM-5132	29,5	16,5	12,5	36,0	M20x1,5	17,5	7,9	7	27	5,9	12,5	M4x0,7	4,0	7	0,3
CSM-1072	27,3	20,3	14,8	27,1	M28x1,5	25,6	11,9	11	36	9,0	14,1	M6x1	5,5	8	0,5
CSM-10132	33,3	20,3	14,8	33,1	M28x1,5	25,6	11,9	11	36	9,0	14,1	M6x1	5,5	8	0,6
CSM-10192	39,3	20,3	14,8	48,6	M28x1,5	25,6	11,9	11	36	9,0	14,1	M6x1	5,5	8	0,7
CSM-18132	36,2	23,2	16,8	36,6	M36x1,5	34,2	15,9	15	46	12,0	18,1	M8x1,25	6,5	12	0,5
CSM-18252	48,2	23,2	16,8	56,1	M36x1,5	34,2	15,9	15	46	12,0	18,1	M8x1,25	6,5	12	0,6
CSM-27152	42,2	27,2	20,8	37,5	M42x1,5	39,7	17,9	17	55	15,0	16,9	M8x1,25	6,5	12	0,7
CSM-27252	52,8	27,8	21,3	56,0	M42x1,5	39,7	17,9	17	55	15,0	16,9	M8x1,25	6,5	12	0,9

Block cylinders *Application & selection*

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

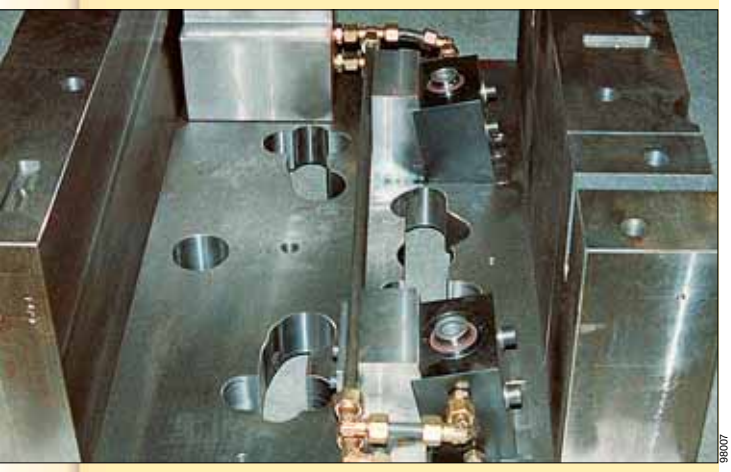
895E01

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 capabilities, enable you to choose the right size for your application
- Variety of strokes, to meet design needs
- Double acting and single-acting (spring return), allows selection of cylinder that best conforms to your hydraulic system
- Two oil connection possibilities:
  – with BSPP threaded oil ports
  – 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

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

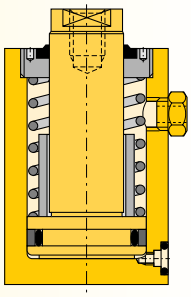


980D07

Select your block cylinder type

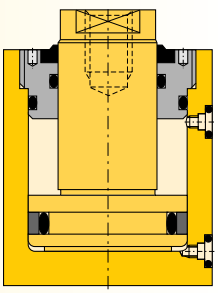
BMS, BS series, Single-acting

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



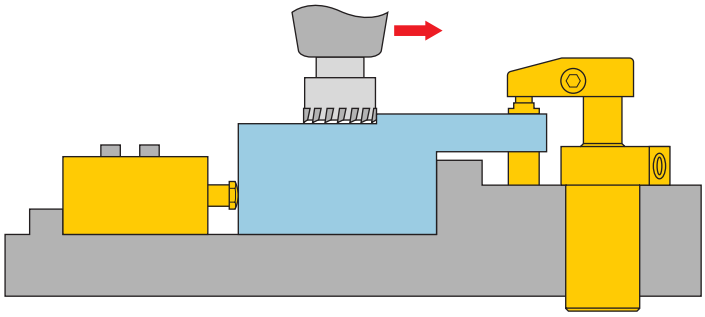
BMD, BD series, Double-acting

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



Application example

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



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 72

Fittings 110

Valves 86

Product selection

Piston Ø mm	Rod Ø mm	Clamping force at 350 bar kN push	kN pull	Stroke mm	Model number Manifold O-ring oil port	Model number BSPP threaded oil port	Cylinder effective area cm² push	cm² pull	Cylinder oil capacity cm³ push	cm³ pull	Minimum spring return force 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

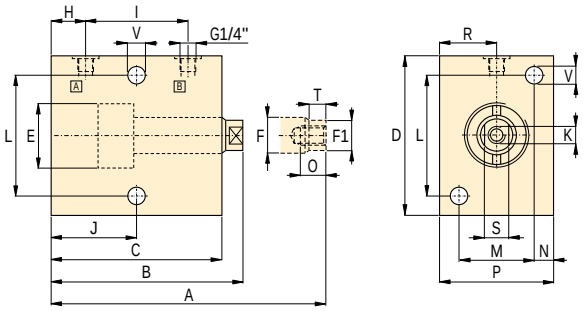
Block cylinders *Dimensions & options*

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

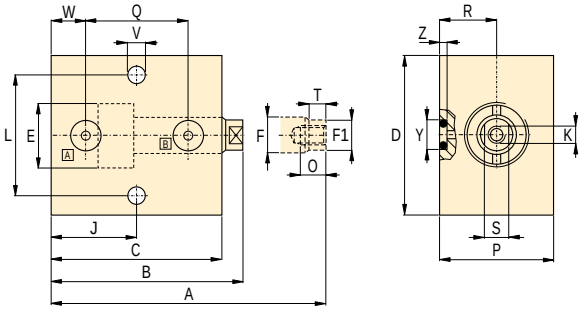
These compact block cylinders are easily mounted in horizontal or vertical position for a range of special tooling applications. They can be used for positioning, clamping, pushing, pressing or punching operations. The plunger has an internal thread to accommodate accessories such as contact bolts.

Block cylinder used for punching applications.

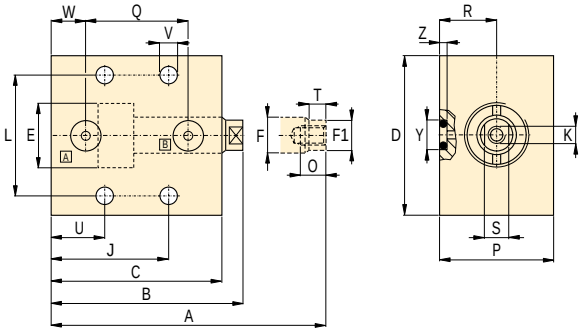
All BS and BD models



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

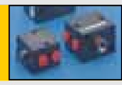


BMS-10182	BMD-10362
BMS-18252	BMD-18502
BMS-402522	BMD-40502
BMS-70252	BMD-70502
BMS-180252	BMD-180502
BMS-280252	BMD-280562



Product 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



Installation Instructions

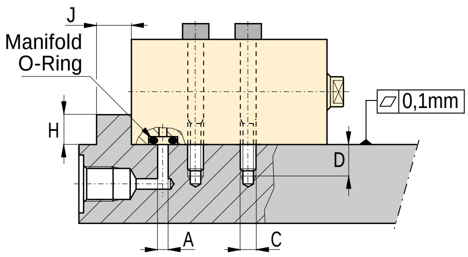
When operating above 140 bar in applications as shown in the figure below, provide cylinder back-up using a support to eliminate shear loads on the mounting bolts.

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 micometers.

Single-acting cylinders

If the risk of machining coolants or debris 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

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	øA	C	D	Nm	H	J	Di x W	Partnumber
11	ø 4	M6	11	17	5	7	4,34x3,53	CZ392.041
17	ø 4	M8	13	40	5	8	4,34x3,53	CZ392.041
44	ø 4	M10	16	85	5	10	4,34x3,53	CZ392.041
68	ø 4	M12	19	145	5	13	4,34x3,53	CZ392.041
175	ø 6	M16	24	353	10	16	7,52x3,53	CZ935.041
275	ø 6	M20	30	675	10	21	7,52x3,53	CZ935.041

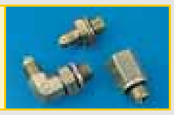
Note: Manifold O-rings included.

Options

Contact bolts

72 ▸

Fittings



110 ▸

Important

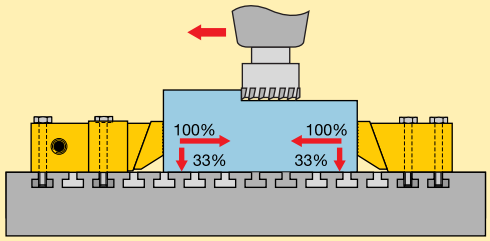
Linear cylinder support is required at operating pressures above 140 bar Follow the instructions on this page.

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 thread
															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*

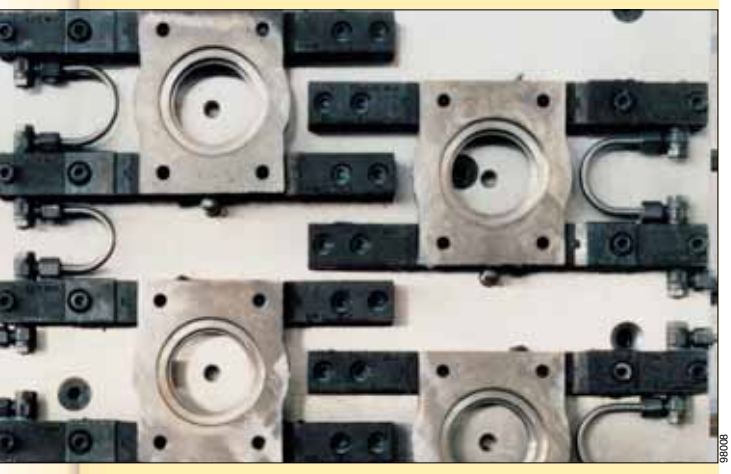
Shown: ECM-20, ECH-202, ECM-5, ECH-52

Enerpac pull down clamps are designed to allow unobstructed top face machining. Independant 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.

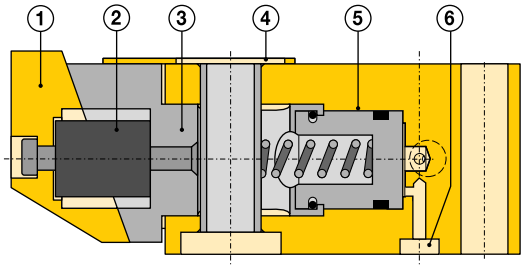


Low profile clamp

...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. Rollerfinished 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

▼ **Hydraulic pull down clamps**

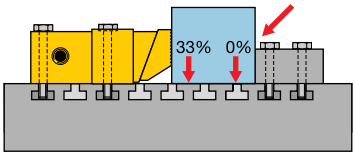
Lateral clamping force at 350 bar kN	Pull down force at 350 bar kN	Stroke mm	Model number	Effective area cm^2	Oil capacity cm^3	Mounting bolts [1] (included) mm
3,9	1,3	5,1	**ECH-52**	1,16	0,13	M8x 45
17,4	5,8	7,9	**ECH-202**	5,03	1,07	M12x 80

▼ **Mechanical counter holds**

Holding force kN	For pull down clamp Model number	Model number	Mounting bolts included [1] mm	Replaceable ribbed jaws Model number
3,9	ECH-52	**ECM-5**	M8x 35	ECJR-5
17,4	ECH-202	**ECM-20**	M12x 65	ECJR-20

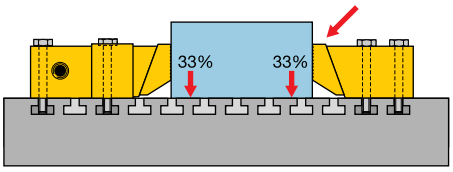
[1] Torque M8 with 25 Nm, M12 with 85 Nm
The use of T-nuts requires longer bolts.

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 counterhold. 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.

Force: 3,9 - 17,4 kN

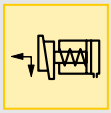
Stroke: 5,1 - 7,9 mm

Pressure: 15 - 350 bar

(E) Garras de empuje oblicuo

(F) Crampons plaqueurs

(D) Niederzugspanner



Options

Link clamps 40

Threaded cylinders 54

Positive clamping cylinders 66

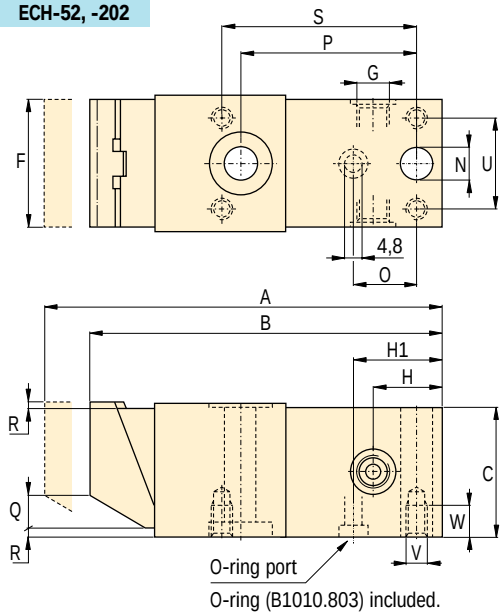
Power sources 74

Important

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

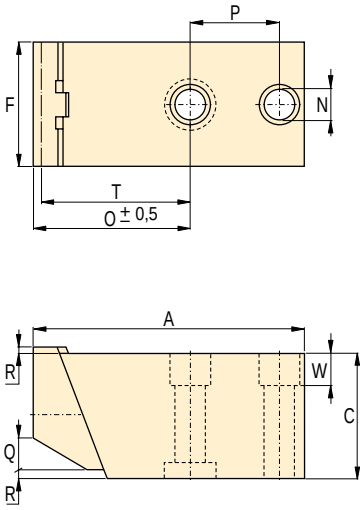
Do not allow the clamping jaw to extend below the lower surface of the clamp body.

ECH-52, -202



O-ring (B1010.803) included.

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
																mm		
▼ **Hydraulic pull down clamps**																		
ECH-52	105,2	100,1	30,0	30,0	G1/8"	19,1	18,8	8,5	11,6	53,1	3,0	2,0	58,9	–	22,1	M5x0,8	6,1	0,7
ECH-202	142,7	134,9	50,0	50,0	G1/4"	24,9	23,6	12,5	13,6	67,1	14,0	3,0	73,9	–	36,1	M8x1,25	11,9	2,5
▼ **Mechanical counter holds**																		
ECM-5	79,0	–	30,0	30,0	–	–	–	8,5	37,0	11,2	3,0	2,0	–	40,9	–	–	7,9	0,6
ECM-20	102,1	–	50,0	50,0	–	–	–	12,5	42,2	12,2	14,0	3,0	–	58,9	–	–	13,0	1,9

Hollow plunger cylinders *Application & selection*

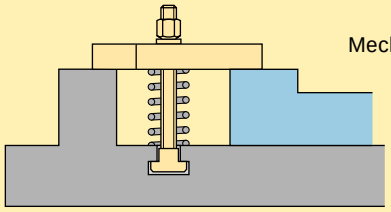
Shown: MRH-120, HCS-20, HCS-80

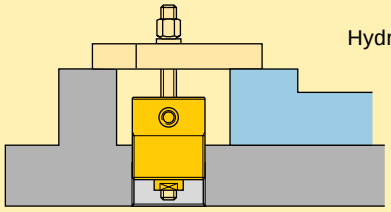
02_006

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

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

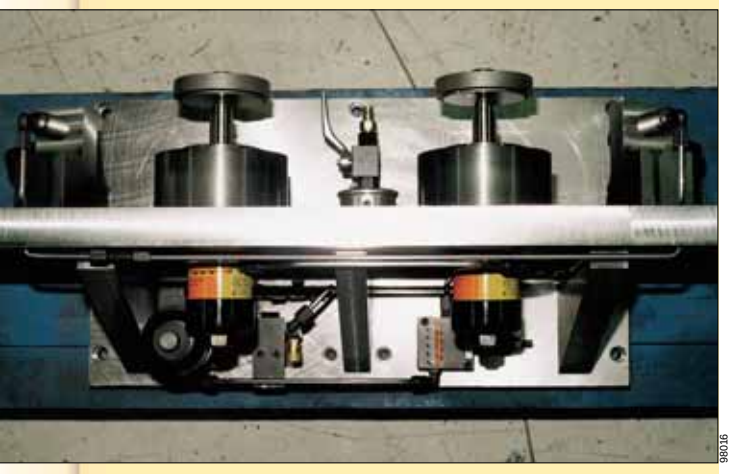
These cylinders are regularly used for upgrading mechanical clamping to faster and easier hydraulic clamping. Other typical applications include production pressing, punching and crimping operations.





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

Two Enerpac MRH-120 hollow cylinders mounted at the back side of a fixture.



980016

Product selection

Cylinder capacity [1]	Stroke	Center hole diameter	Model number	Effective area	Oil capacity	Maximum operating pressure
kN	mm	mm		cm^2	cm^3	bar
17,8	7,9	13,5	**MRH-20**	8,58	6,72	210
21,5	9,9	10,9	**HCS-20**	6,19	6,23	350
56,3	11,9	13,0	**HCS-50**	16,26	19,50	350
61,4	7,9	19,6	**MRH-120**	17,81	14,09	350
83,7	14,0	17,0	**HCS-80**	23,42	32,61	350
113,4	16,0	21,1	**HCS-110**	32,65	52,27	350

[1] At maximum operating pressure.
Note: Seal material Buna-N, Polyurethane, Teflon.

Force: 17,8 - 113,4 kN

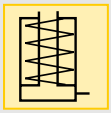
Stroke: 7,9 - 16,0 mm

Pressure: 55 - 350 bar

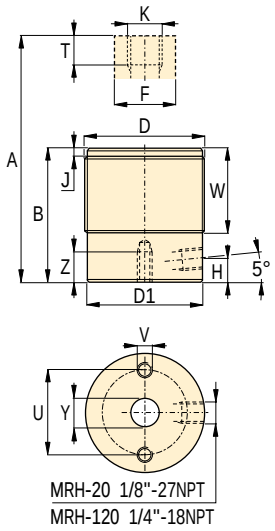
E Garras de empuje oblicuo

F Vérins a piston creux

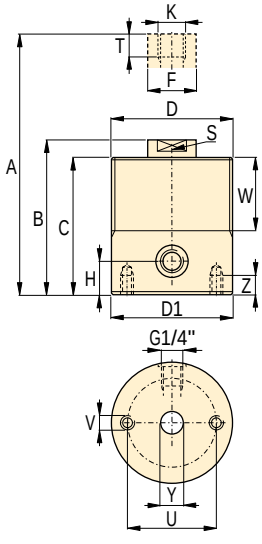
D Hohlkolbenzylinder



MWH-20, 120



HCS models



Options

Flange nuts 72

Power sources 74

Gauges 106

Fittings 110

Important

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

Product dimensions in mm [⊳⊕]

Model number	A	B	C	D Ø	D1 Ø	F Ø	H	J	K Ø	S	T	U Ø	V Ø	W	Y Ø	Z	kg
MRH-20	60,5	52,3	–	M48 x 1,5	45,5	25,4	7,1	3,0	13,0	–	22,4	35,1	M6 x 1,0	38,1	12,7	6,4	0,6
HCS-20	84,1	74,2	66,0	M58 x 1,5	57,9	16,0	10,9	–	M10 x 1,5	14,0	25,9	39,9	M6 x 1,0	39,9	10,9	9,9	1,1
HCS-50	96,0	84,1	74,9	M65 x 1,5	65,0	27,9	14,0	–	M12 x 1,75	22,1	24,4	45,0	M8 x 1,25	45,0	13,0	11,9	1,5
MRH-120	63,5	55,6	–	M70 x 1,5	69,9	35,1	9,9	4,8	M18 x 1,5	–	16,0	50,8	M6 x 1,0	30,2	19,6	6,4	1,4
HCS-80	109,0	95,0	85,1	M75 x 1,5	74,9	32,0	17,0	–	M16 x 2,0	23,9	32,5	54,9	M8 x 1,25	50,0	17,0	11,9	2,3
HCS-110	119,9	103,9	93,0	M90 x 2,0	89,9	39,9	19,1	–	M20 x 2,5	32,0	36,3	65,0	M10 x 1,5	59,9	21,1	15,0	3,6

Positive clamping cylinders *Application & selection*

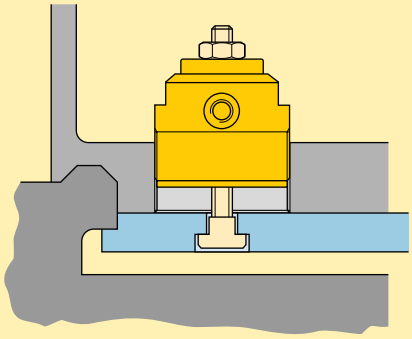
Shown: MRS-1, MRS-1001, MRS-5001

Ideal for palletized applications

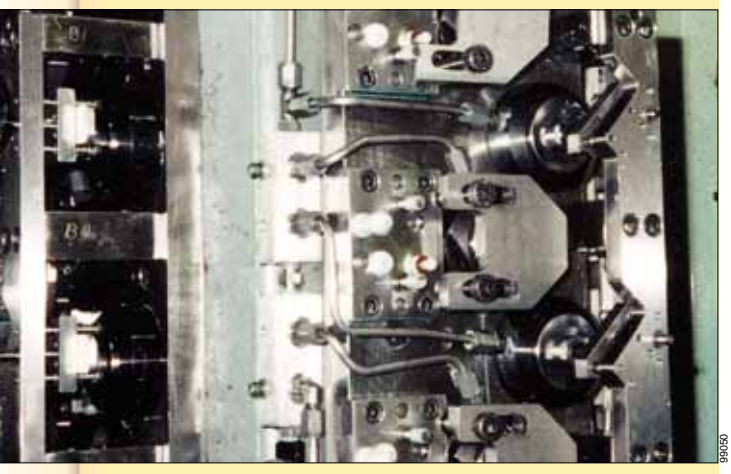
- Heavy disk springs maintain the clamping force - hydraulic pressure is used for release
- Single acting design allows easy setup of hydraulic system
- Hollow plunger design allows easy retrofit for mechanical clamping
- Custom buttons can be fitted into the plunger for clamping directly against a workpiece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

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.

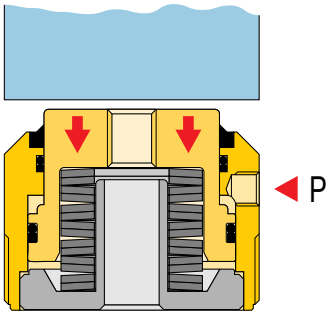


When pressure is released, the Enerpac MRS cylinders clamp the workpiece by pushing it against the frame that is attached to the fixture.

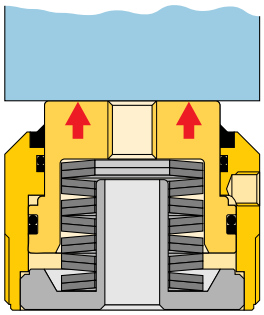


Positive clamping operation

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
- Workpiece is released
- New workpiece is loaded



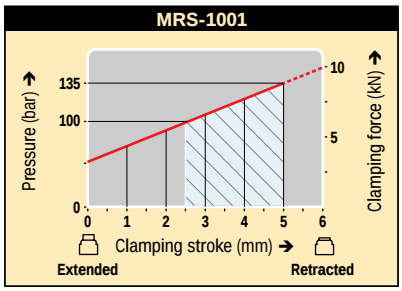
Hydraulic pressure released
- Springs apply force
- Workpiece is clamped
- Machining can take place

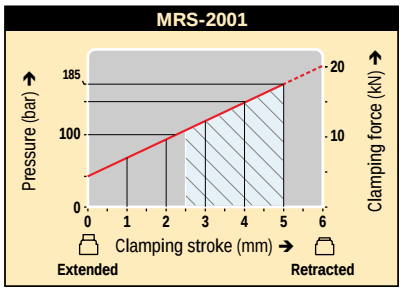
Product selection

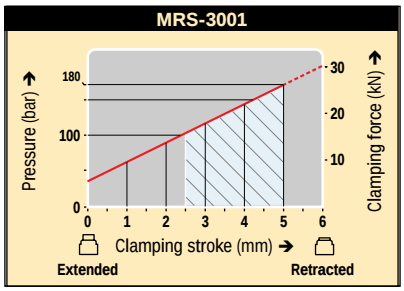
Cylinder capacity at 350 bar	Effective clamping stroke	Model number	Required operating pressure [1]	Max. tensioning stroke	Oil capacity
kN	mm		bar	mm	cm^3
8,6	2,2	**MRS-1**	350	2,2	0,8
22,5	2,2	**MRS-2**	350	2,2	1,7
45,9	2,2	**MRS-5**	350	2,2	3,2
8,5	2,5	**MRS-1001**	135	5,0	3,5
16,5	2,5	**MRS-2001**	185	5,0	4,7
26,0	2,5	**MRS-3001**	180	5,0	7,9
38,0	3,0	**MRS-5001**	235	5,5	8,7

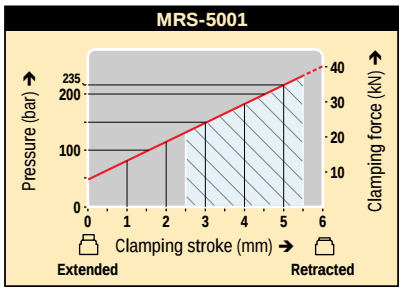
[1] Minimum operating pressure to fully retract the plunger.
Note: Seal material Buna-N, Polyurethane.

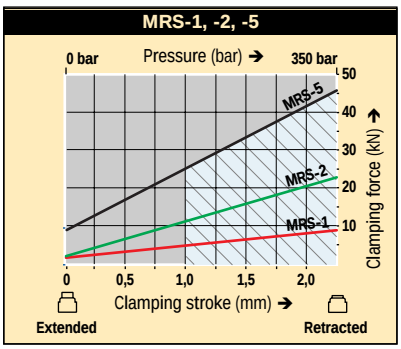
Stroke/force diagrams





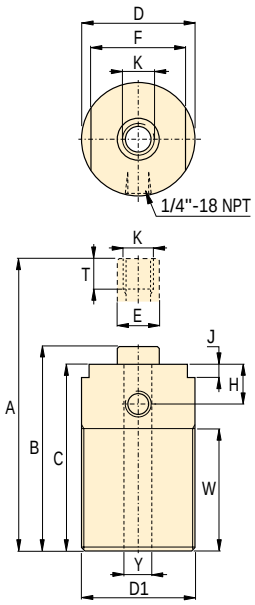




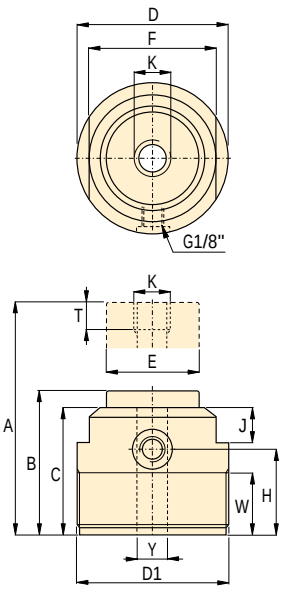


= Suggested Clamping Range

MRS-1, 2, 5



other MRS models



Force:	**8,5 - 45,9 kN**
Stroke:	**2,2 - 5,5 mm**
Pressure:	**135 - 350 bar**

E Cilindros de amarre
F Vérins de bridage positif
D Federspannzylinder

Options

Contact bolts 72

Flange nuts 72

Collet-Lok® work supports 34

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 to variations in clamping force.

Depending on the number of cycle operations and the extent to which the full stroke is used 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	82,8	79	36	M36 x 1,5	12,7	30	18	6	M8 x 1,25	36	50	9	0,5
MRS-2	90	87,8	84	48	M48 x 1,5	17,4	40	20	7	M10 x 1,5	38	50	11	0,9
MRS-5	125	122,8	119	60	M60 x 2	22,1	50	21	7	M16 x 2	40	85	17	1,8
MRS-1001	62	57,0	53	65	M65 x 1,5	40,0	55	35	15	M12 x 1,75	20	25	13	1,2
MRS-2001	65	60,0	57	80	M80 x 2	55,0	65	38	15	M 16 x 2	20	29	17	2,1
MRS-3001	74	69,0	66	95	M95 x 2	60,0	80	46	17	M20 x 2,5	20	37	21	3,0
MRS-5001	96	90,5	66	95	M95 x 2	60,0	80	46	17	M20 x 2,5	20	37	21	3,5

Universal cylinders - Single-acting *Application & selection*

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

99108

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

Heavy duty cylinders

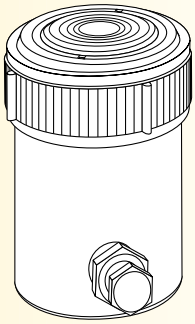
...handle a variety of applications

- 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

Block and cylindrical models

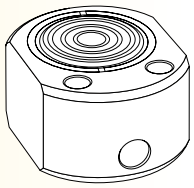
Cylindrical models

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



Block models

- Easily mounted
- Compact design



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

99051

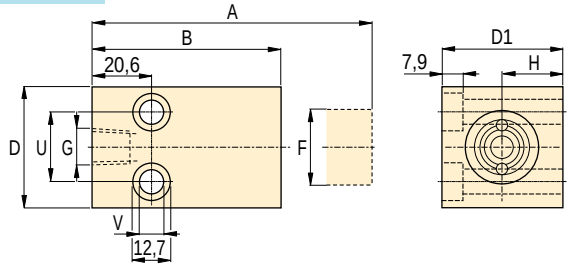
Product selection

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	25,4	**BRW-51**	6,39	16,22	40-700
22,1	76,2	**BRW-53**	6,39	48,67	40-700
22,1	127,0	**BRW-55**	6,39	81,12	40-700
50,6	25,4	**BRW-101**	14,39	36,54	40-700
50,6	54,1	**BRW-102**	14,39	77,84	40-700
50,6	104,9	**BRW-104**	14,39	150,92	40-700
50,6	155,7	**BRW-106**	14,39	224,01	40-700
50,6	257,3	**BRW-1010**	14,39	370,18	40-700

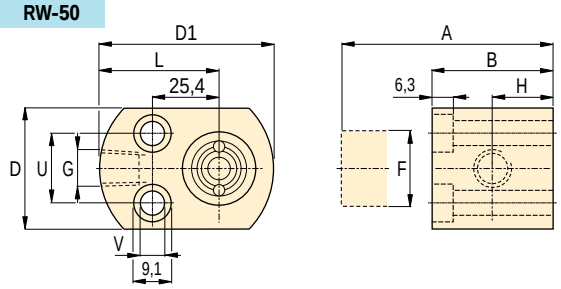
Note: Seal material: Buna-N, Polyurethane, Teflon.

www.enerpac.com

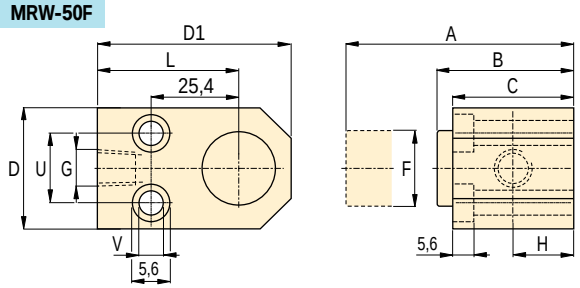
RW-41



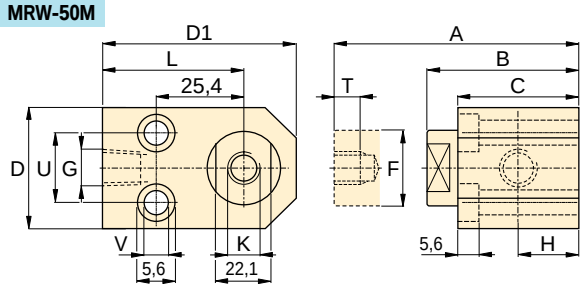
RW-50



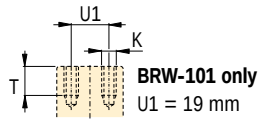
MRW-50F



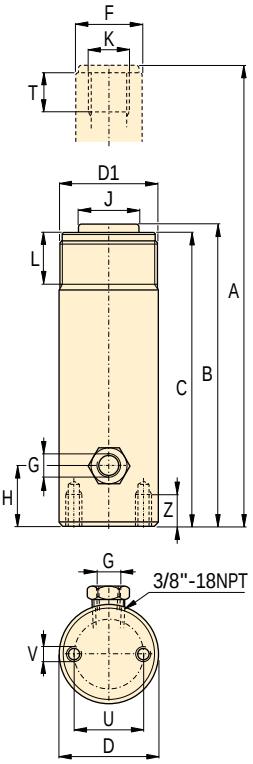
MRW-50M



BRW-Serie



BRW-101 only
U1 = 19 mm



Force:	**22,1 - 101,2 kN**
Stroke:	**15,7 - 257,3 mm**
Pressure:	**6 - 700 bar**

E Universal cylinders
F Vérins universels
D Universelle Linearzylinder

Options

Cylinder accessories
72

Important

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

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

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

Product dimensions in mm [⊳⊕]

Model number	A	B	C	D	D1	F	G NPT	H	J	K	L	T	U	V	Z	kg
▼ **Block models**																
RW-41	80,8	65,0	–	41,1	41,1	25,4	.250-18	20,6	–	–	–	–	25,4	8,6	–	0,8
RW-50	57,2	41,4	–	41,1	58,7	28,4	.375-18	19,1	–	–	38,1	–	28,4	5,6	–	0,8
MRW-50F	55,9	40,9	40,9	41,1	65,0	25,4	.375-18	20,6	–	–	44,5	–	28,4	5,6	–	0,8
MRW-50M	66,0	51,1	40,9	41,1	65,0	25,4	.375-18	20,6	–	M8 x 1,25	44,5	6,1	28,4	5,6	–	0,8
▼ **Cylindrical models**																
BRW-51	135,6	110,2	103,9	38,1	M38 x 1,5	25,4	.250-18	19,1	25,4	M18 x 2,5	28,7	14,2	25,4	M6 x 1	14,2	1,0
BRW-53	241,3	165,1	158,8	38,1	M38 x 1,5	25,4	.250-18	19,1	25,4	M18 x 2,5	28,7	14,2	25,4	M6 x 1	14,2	1,4
BRW-55	342,9	215,9	209,6	38,1	M38 x 1,5	25,4	.250-18	19,1	25,4	M18 x 2,5	28,7	14,2	25,4	M6 x 1	14,2	1,8
BRW-101	115,1	89,7	83,3	57,2	M56 x 2	38,1	.250-18	19,1	–	M5 x 0,8	26,9	6,4	39,6	M8 x 1,25	12,7	1,7
BRW-102	175,5	121,4	115,1	57,2	M56 x 2	38,1	.250-18	19,1	35,1	M22 x 1,5	28,7	19,1	39,6	M8 x 1,25	12,7	2,2
BRW-104	276,4	171,5	165,1	57,2	M56 x 2	38,1	.250-18	19,1	35,1	M22 x 1,5	28,7	19,1	39,6	M8 x 1,25	12,7	3,2
BRW-106	403,4	247,7	241,3	57,2	M56 x 2	38,1	.250-18	19,1	35,1	M22 x 1,5	28,7	19,1	39,6	M8 x 1,25	12,7	4,4
BRW-1010	606,6	349,3	342,9	57,2	M56 x 2	38,1	.250-18	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

99142

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

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

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

99-049

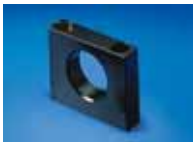
Heavy duty cylinders

...provide push as well as pull forces

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

Optional cylinder attachments

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



Foot mounting

Mounts onto cylinder collar thread. Retainer nut included.

Flange mounting

Mounts onto cylinder collar thread. Retainer nut included.

Retainer nut

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

Clevis eye

Threads onto plunger or base.

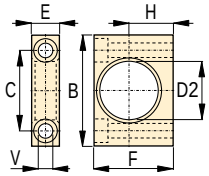
Product selection

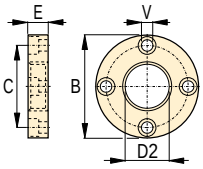
Cylinder capacity at 350 bar kN push	Cylinder capacity at 350 bar kN pull	Stroke mm	Model number	Effective area cm² push	Effective area cm² pull	Oil capacity cm³ push	Oil capacity cm³ pull
17,4	7,7	28,7	**BRD-41**	5,10	2,19	14,58	6,55
17,4	7,7	79,5	**BRD-43**	5,10	2,19	40,48	18,03
17,4	7,7	155,7	**BRD-46**	5,10	2,19	79,31	34,41
40,0	21,8	28,7	**BRD-91**	11,42	6,32	32,77	18,03
40,0	21,8	79,5	**BRD-93**	11,42	6,32	90,78	49,16
40,0	21,8	155,7	**BRD-96**	11,42	6,32	178,29	98,32
40,0	21,8	257,3	**BRD-910**	11,42	6,32	293,98	162,23
69,0	36,9	158,8	**BRD-166**	20,32	10,71	322,33	170,42
69,0	36,9	260,4	**BRD-1610**	20,32	10,71	528,64	278,58
109,0	47,8	158,8	**BRD-256**	31,74	13,87	503,57	219,59
109,0	47,8	260,4	**BRD-2510**	31,74	13,87	825,90	360,51

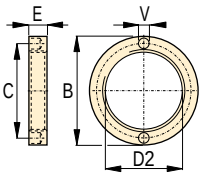
Call Enerpac to order models with imperial mounting threads.

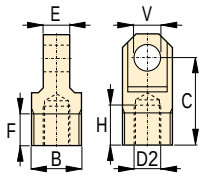
ENERPAC

Foot mounting	Flange mounting	Retainer nut	Clevis eye









Force: 17,4 - 109,0 kN

Stroke: 28,7 - 260,4 mm

Pressure: 35 - 700 bar

E Cilindros universales

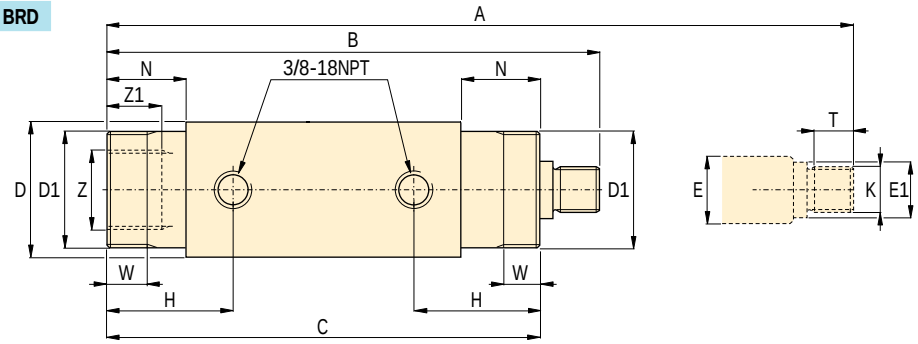
F Vérins universels

D Universelle Linearzylinder

Cylinder attachments in mm [⊳⊕]

Cylinder capacity at 350 bar kN	700 bar kN	D2	Model number	B	C	E	F	H	V ø	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	–	–	13,4	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	30,2	25,0	1,3
109,0	218,0	M42 x 1,5	**BAD-153**	M70 x 2	77,8	38,2	25,4	27,0	32,0	2,1

BRD



Options

Cylinder accessories □72 ▸

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	214,4	185,7	162,1	50,8	M42x1,5	19,1	17,5	46,7	M16x1,5	28,7	19,1	11,2	M30x1,5	8,9	2,2
BRD-43	316,0	236,5	212,9	50,8	M42x1,5	19,1	17,5	46,7	M16x1,5	28,7	19,1	11,2	M30x1,5	8,9	2,9
BRD-46	468,4	312,7	289,1	50,8	M42x1,5	19,1	17,5	46,7	M16x1,5	28,7	19,1	11,2	M30x1,5	8,9	4,1
BRD-91	251,0	222,3	198,1	63,5	M56x2	25,4	23,9	57,2	M22x1,5	38,1	19,1	14,2	M42x1,5	14,0	4,1
BRD-93	353,3	273,8	248,9	63,5	M56x2	25,4	23,9	57,2	M22x1,5	38,1	19,1	14,2	M42x1,5	14,0	5,0
BRD-96	505,7	350	325,1	63,5	M56x2	25,4	23,9	57,2	M22x1,5	38,1	19,1	14,2	M42x1,5	14,0	6,3
BRD-910	708,9	451,6	427,0	63,5	M56x2	25,4	23,9	57,2	M22x1,5	38,1	19,1	14,2	M42x1,5	14,0	8,6
BRD-166	547,6	388,9	358,9	76,2	M70x2	35,1	32,0	73,2	M30x1,5	54,1	25,4	22,4	M56x2	23,9	10,0
BRD-1610	750,8	490,5	460,0	76,2	M70x2	35,1	32,0	73,2	M30x1,5	54,1	25,4	22,4	M56x2	23,9	13,2
BRD-256	582,7	423,9	397,0	92,2	M85x2	47,8	45,0	88,9	M42x1,5	69,9	25,4	28,7	M70x2	25,9	16,3
BRD-2510	785,9	525,5	498,1	92,2	M85x2	47,8	45,0	88,9	M42x1,5	69,9	25,4	28,7	M70x2	25,9	20,9

Cylinder accessories *Dimensions*

Shown: Cylinder accessories

99-067_1

For optimum mounting and fixture flexibility

...to match specific applications

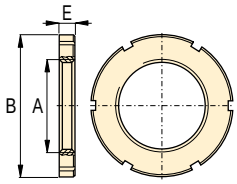
These accessories are provided so that you can effectively position, mount and actuate Enerpac hydraulic cylinders according to your specific fixturing or production applications.

- **Mounting flanges**
  For bolting cylinders to suit the application
- **Flange nuts**
  For mounting threaded body cylinders in any position
- **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

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

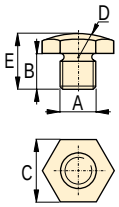
99-053

FN



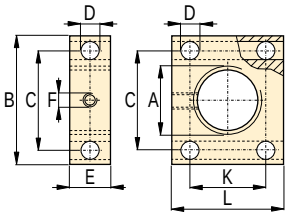
A mm	Model number	B	E
▼ **Flange Nuts – self-locking DIN 1804**			
M12 x 1,5	**FN-122**	27,9	6,1
M20 x 1,5	**FN-202**	36,1	7,9
M28 x 1,5	**FN-282**	50,0	9,9
M35 x 1,5	**FN-352**	55,1	10,9
M42 x 1,5	**FN-422**	62,0	11,9
M48 x 1,5	**FN-482**	74,9	13,0
M55 x 1,5	**FN-552**	80,0	13,0
M65 x 1,5	**FN-652**	95,0	14,0
M80 x 2	**FN-802**	115,1	16,0

BS

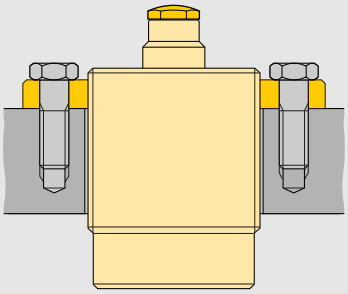


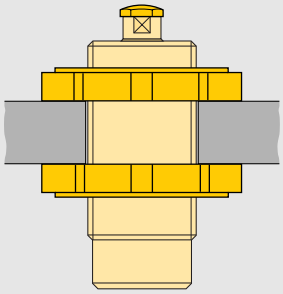
A mm	Model number	B	C	D	E
▼ **Spherical Contact Bolts**					
M4 x 0,7	**BS-42**	7,0	8,0	8,0	11,0
M6 x 1,0	**BS-62**	8,0	11,0	11,0	14,0
M8 x 1,25	**BS-82**	10,0	14,0	14,0	17,0
M10 x 1,5	**BS-102**	10,0	17,0	17,0	18,0
M16 x 2,0	**BS-162**	12,0	22,0	22,0	24,0

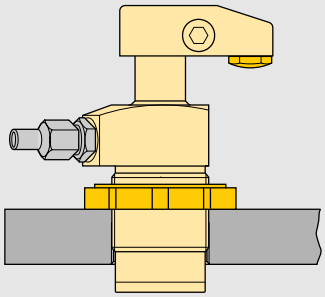
MF

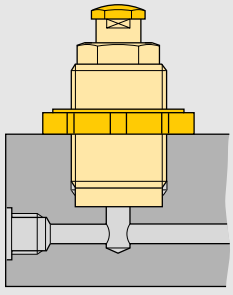


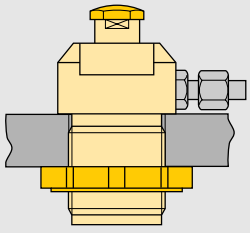
A mm	Model number	B	C	D	E	F	K	L
▼ **Mounting Flanges**								
M12 x 1,5	**MF-122**	39,9	24,9	6,3	24,9	M4 x 0,7	24,9	39,9
M20 x 1,5	**MF-202**	65,0	44,5	10,1	39,9	M4 x 0,7	45,0	65,0
M28 x 1,5	**MF-282**	74,9	50,8	10,1	39,9	M4 x 0,7	50,8	74,9
M35 x 1,5	**MF-352**	80,0	57,1	10,1	39,9	M6 x 1	57,1	80,0
M42 x 1,5	**MF-422**	89,9	63,5	10,1	39,9	M6 x 1	63,5	89,9
M48 x 1,5	**MF-482**	95,0	69,9	10,1	39,9	M6 x 1	69,9	95,0
M55 x 1,5	**MF-552**	110,0	82,5	11,2	44,5	M6 x 1	82,5	110,0
M65 x 1,5	**MF-652**	115,1	88,9	11,2	44,5	M6 x 1	88,9	115,1
M80 x 2	**MF-802**	134,9	108,0	11,2	44,5	M6 x 1	108,0	134,9











Installation information

Thread mm	Model number	Used with cylinder
▼ Flange Nuts – self-locking DIN 1804		
M12 x 1,5	**FN-122**	CST-272, CST-2102, CST-2132
M20 x 1,5	**FN-202**	CST-572, CST-5132, CST-5192, CST-5252, CST-5382
M28 x 1,5	**FN-282**	CST-10..., ST..-22, PT..-22
M35 x 1,5	**FN-352**	CST-18..., WFT-72, WFL-112, WST-72, WSL-112,
		ST..-52, PT..-52
M42 x 1,5	**FN-422**	CST-27..., BRD-41, BRD-43, BRD-46, BRD-256, BRD-2510
M48 x 1,5	**FN-482**	CST-40..., CDT-18..., ST..-92, PT..-92, MPTR-100, MPTC-210,
		LU..-32, MRH-20, MRS-2
M55 x 1,5	**FN-552**	CDT-27...
M65 x 1,5	**FN-652**	CDT-40..., ST..-202, HCS-50, MRS-1001, LU..-82
M80 x 2	**FN-802**	ST..-352, MPTR-300, MPTS-200, PT..-352, MRS-2001, LU..-122
▼ Spherical Contact Bolts		
M4 x 0,7	**BS-42**	CST-572, CST-5132, CST-5192, CST-5252, CST-5382,
		CSM-572, CSM-5132
M6 x 1	**BS-62**	CST-10..., CSM-10..., CAS-22, BS/BD/BMS/BMD-10...
M8 x 1,25	**BS-82**	CST-18..., CDT-18..., CDT-27..., CSM-18..., CSM-27...,
		CAS-52, MA-540, MPFS-100, MPTS-100,
		PU../PL../PT..-52, MRS-1, MPFC-110, MPTC-110, BS/BD/BMS/BMD-18...
M10 x 1,5	**BS-102**	CST-40..., CDT-40..., CAS-92, MA-1050, PU../PL../PT..-92, MPFC-210,
		WFM-72, WFT-72, WFC-72, WSM-72, WST-72, WSC-72,
		WFC-112, WFL-112, WSL-112, WSC-112, MPTC-210, MRS-2,
M16 x 2	**BS-162**	CAS-352, MA-3070, PU../PL../PT..-352, MPFC-410, MPTC-410,
		MRS-5, MRS-2001, BS/BD/BMS/BMD-40...
▼ Mounting flanges		
M12 x 1,5	**MF-122**	CST-272, CST-2102, CST-2132
M20 x 1,5	**MF-202**	CST-572, CST-5132, CST-5192, CST-5252, CST-5382
M28 x 1,5	**MF-282**	CST-10..., ST..-22, PT..22
M35 x 1,5	**MF-352**	CST-18.., WFT-72, WST-72, WFL-112, WSL-112,
		ST..-52, PT..-52
M42 x 1,5	**MF-422**	CST-27.., BRD-41, BRD-43, BRD-46, BRD-256, BRD-2510
M48 x 1,5	**MF-482**	CST-40..., CDT-18..., ST..-92, PT..-92, MPTR-100, MPTC-210,
		LU..-32, MRH-20, MRS-2
M55 x 1,5	**MF-552**	CDT-27...
M65 x 1,5	**MF-652**	CDT-40..., ST..-202, MRS-1001, HCS-50, LU..-52
M80 x 2	**MF-802**	ST..-352, MPTR-300, PT..-352, MPTS-200, MRS-2001, LU..-122

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 air operated pumps to fully customizable electric motor driven units.

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

Technical support

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

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

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Turbo II air-hydraulic pumps *Application & selection*

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

Turbo II air-hydraulic pumps generate the hydraulic pressure you need, using the air pressure you have available. The air saver piston reduces air consumption and operating costs.
They are ideal for providing the power and speed desired in simple clamping circuits. Turbo II air-hydraulic pumps are best suited to medium and lower cycle applications. At only 75 dBA, these new Turbo II series help to keep noise level to a minimum.

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

- On-demand stall-restart operation maintains system pressure, providing clamp security
- External adjustable pressure relief valve (behind sight glass)
- Internal pressure relief valve provides overload protection
- Reduced noise level to 75 dBA reduces operator fatique
- Operating air pressure: 1,7-8,6 bar – enables pump to start at low air pressure
- Reinforced heavy-duty lightweight reservoir for applications in tough environments
- 5 valve mounting options provide flexibility in setup and operation
- Composite air piston seal allows operation on completely dry air supply

Select the required operation

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

PACG series
- Momentary or continuous air inlet treadle
- Remote valve is required to operate single-acting cylinders
- Pressure gauge included

PASG series
- Momentary or continuous air inlet treadle
- Suitable for mounting any single or double acting valve with a CETOP 03 mounting configuration

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

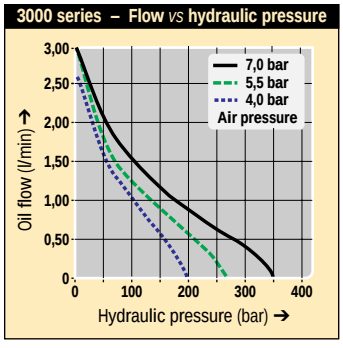
PARG series
- Includes 4,5 m air pendant for remote control of single-acting cylinders
- Provides advance, hold and retract functions

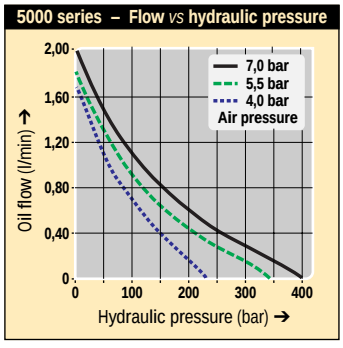
Select the required output

3000 series
- Hydraulic-air ratio 45:1 (350 bar hydraulic pressure at 8 bar air pressure)
- Hydraulic pressure range 85 - 350 bar (range of 35 - 85 bar available with diminished stall/restart performance)
- Maximum hydraulic oil flow 3,0 l/min

5000 series
- Hydraulic-air ratio 60:1 (350 bar hydraulic pressure at only 5,5 bar air pressure)
- Hydraulic pressure range 120 - 350 bar (range of 48 - 120 bar available with diminished stall/restart performance)
- Maximum hydraulic oil flow 2,0 l/min

Output Oil Flow versus pressure

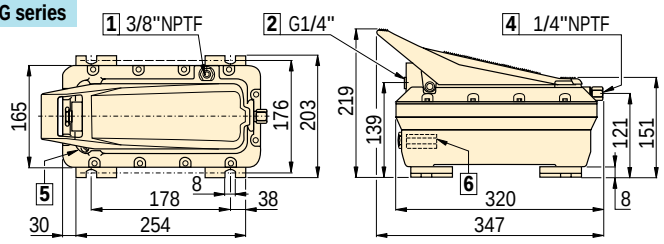


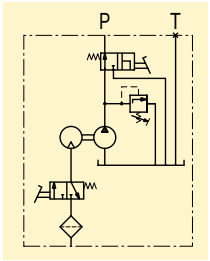


ENERPAC

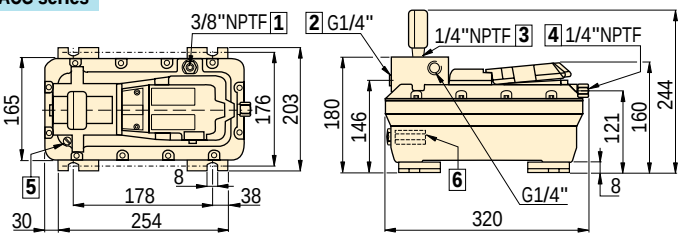
www.enerpac.com

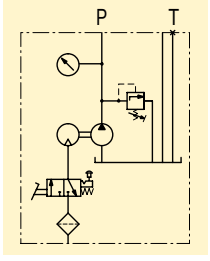
PATG series



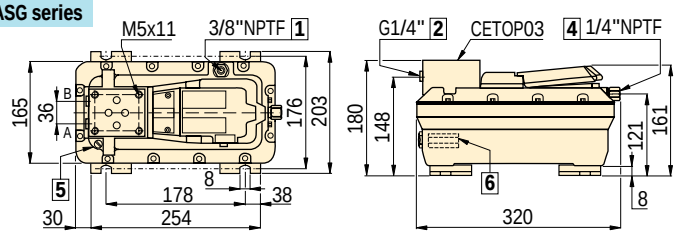


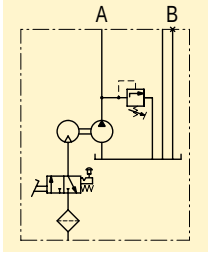
PACG series PACG series include pressure gauge G-2517L.



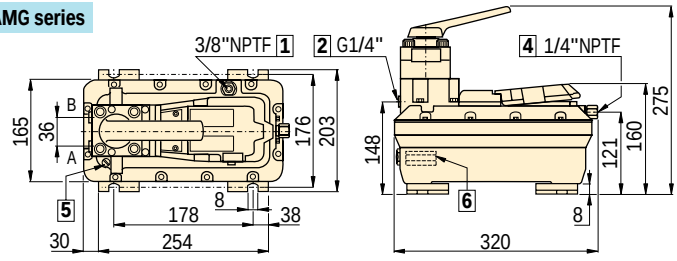


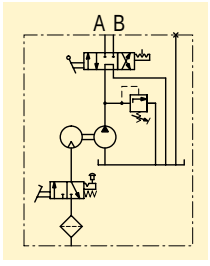
PASG series



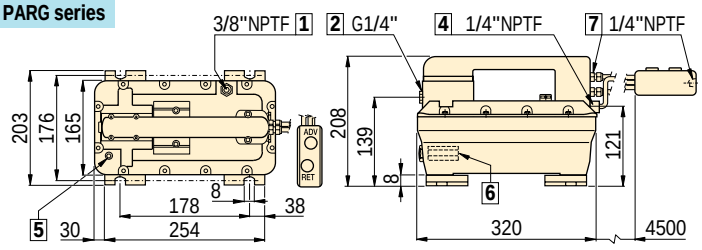


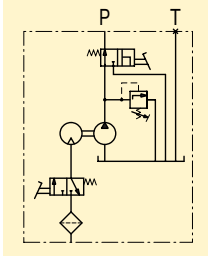
PAMG series





PARG series





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

Product Selection

Pump type	3000 series Model Number	Oil flow [1] 3000 series l/min	5000 series Model Number	Oil flow [1] 5000 series l/min	Max. hydraulic pressure bar	Reservoir size [2] litres	Usable oil capacity [2] litres hor. mount.	Usable oil capacity [2] litres vert. mount.	Air pressure range bar	Air consumption l/min	kg
PATG	**PATG-3102PB**	3,0	**PATG-5102PB**	2,0	350	2,4	2,1	1,1	1,7-8,6	340	8,6
PACG	**PACG-3002PB**	3,0	**PACG-5002PB**	2,0	350	2,4	2,1	1,1	1,7-8,6	340	8,6
PASG	**PASG-3002PB**	3,0	**PASG-5002PB**	2,0	350	2,4	2,1	1,1	1,7-8,6	340	8,6
PAMG	**PAMG-3402PB**	3,0	**PAMG-5402PB**	2,0	350	2,4	2,1	1,1	1,7-8,6	340	11,3
PARG	**PARG-3102PB**	3,0	**PARG-5102PB**	2,0	350	2,4	2,1	1,1	1,7-8,6	340	10,5

[1] At 0 bar hydraulic and 7 bar air pressure.

[2] Turbo II air-hydraulic pumps are also availble with 5 litres reservoir. To order replace **2** in model number with **5**.

Oil Flow:	**2,0-3,0 l/min**
Pressure:	**85 - 350 bar**
Air:	**340 l/min**
Reservoir:	**2,4 - 5,0 litres**

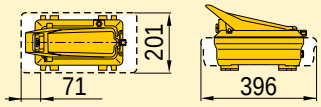
(E) **Bombas hidroneumáticas**
(F) **Pompes hydro-pneumatiques**
(D) **Lufthydraulische pumpen**

Options

Large reservoir models

Enerpac Turbo air-hydraulic pumps are also available with large reservoir.

Usable oil capacity
Hor. mounted: 3,7 litres
Vert. mounted: 2,9 litres



To order your Turbo II with a large reservoir, replace 2 in the model number with 5.

Gauges and accessories
106

Regulator-filter-lubricator
97

Important

For high cycle applications electric pumps are recommended.

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.

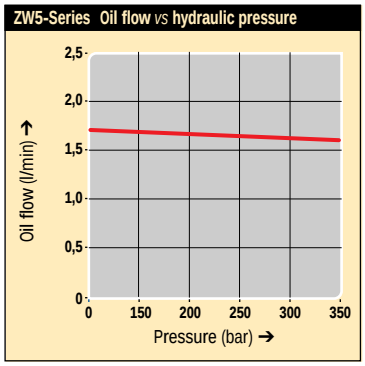
Application

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 isolating valves
- Stackable to 8 VP-series valve stations high
- Customer adjustable relief valve
- Glycerine dampened pressure gauge G-2517L on pumps with VP-series valves
- 230/400 Volt - 50Hz - 1,1 kW Motor



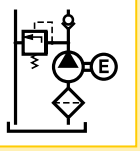
Product selection

Oil Flow rate	Pressure Range	Voltage and current 50Hz	Usable oil capa-city [2]	Valve models included	Model number	
l/min	bar	V @ A	litres			kg
▼ With manifold for VP-series modulair valves, no electric controls						
1,64	100-350	230 @ 3,3	10,0	–	**ZW5VPSEE100**	65
1,64	100-350	400 @ 1,9	10,0	–	**ZW5VPSWE100**	65
▼ With manifold for CETOP 03 valves, no electric controls						
1,64	100-350	230 @ 3,3	10,0	–	**ZW5C03SEE100**	65
1,64	100-350	400 @ 1,9	10,0	–	**ZW5C03SWE100**	65
▼ For 2x Single-Acting circuits						
1,64	100-350	230 @ 3,3	10,0	1x VP-41	**ZW5141SEE100**	77
1,64	100-350	400 @ 1,9	10,0	1x VP-41	**ZW5141SWE100**	77
▼ For 1x Double-Acting circuits + Isolating Valve [1] for A-port						
1,64	100-350	230 @ 3,3	10,0	1x VP-11	**ZW5111SEE100**	77
1,64	100-350	400 @ 1,9	10,0	1x VP-11	**ZW5111SWE100**	77
▼ For 2x Double-Acting circuits + Isolating Valves [1] for all A-ports						
1,64	100-350	230 @ 3,3	10,0	2x VP-11	**ZW5211SEE100**	80
1,64	100-350	400 @ 1,9	10,0	2x VP-11	**ZW5211SWE100**	80

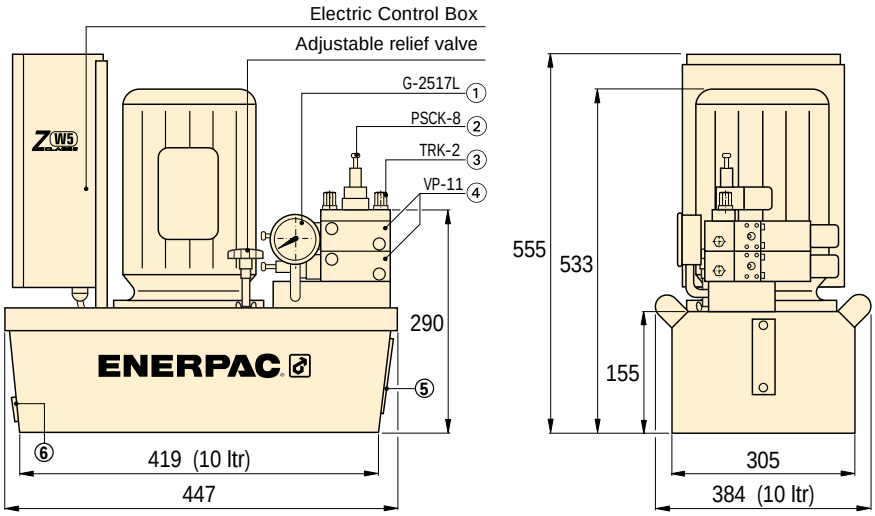
[1] Isolating Valve is Pressure Switch PSCK-8.
[2] ZW5-series pumps comes standard with 10 litres reservoir. (4, 8, 20 or 40 litres reservoir is optional).

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

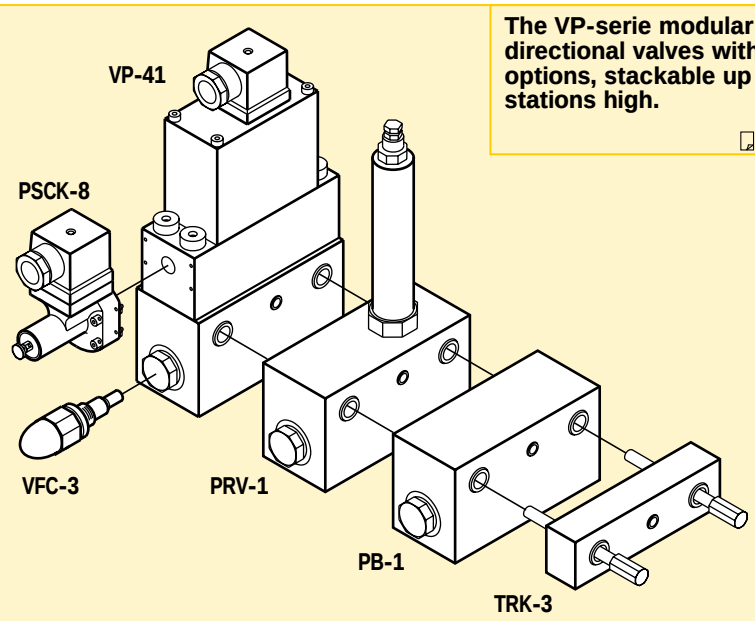


① Pressure gauge
② Pressure switch
③ Tie Rod Kit
④ Directional valve
⑤ Oil level glass
⑥ Oil drain

Product specifications

Pump series	Voltage	Phase	Continous 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



The VP-serie modular directional valves with all its options, stackable up to 8 stations high.

88-91

Options

VP-series, modular valves 88

VFC-3 Inline Flow control valve 89

Pressure switches 89

Hoses and couplers 108

High pressure filters 109

Fittings 110

Important

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

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

Electric Driven Workholding Pumps *Applications & Options*

Shown: ZW5111SWE100

02_004

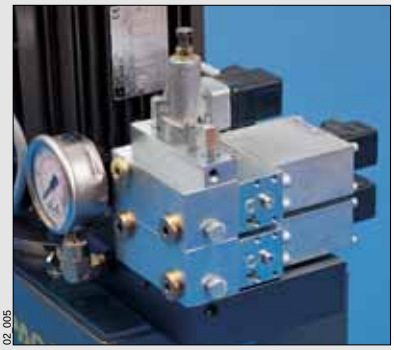
ZW5 series

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

Application

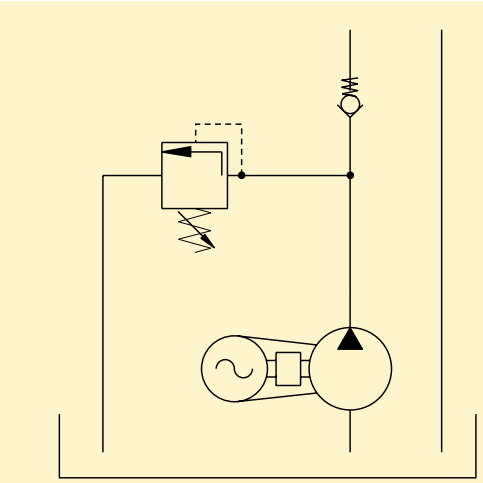
Enerpac electric pump used in conjunction with swing cylinders, work supports, directional valves, control valves and sequence valves can provide a complete clamping solution. The pressure switch allows the unit to be fully automated.

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

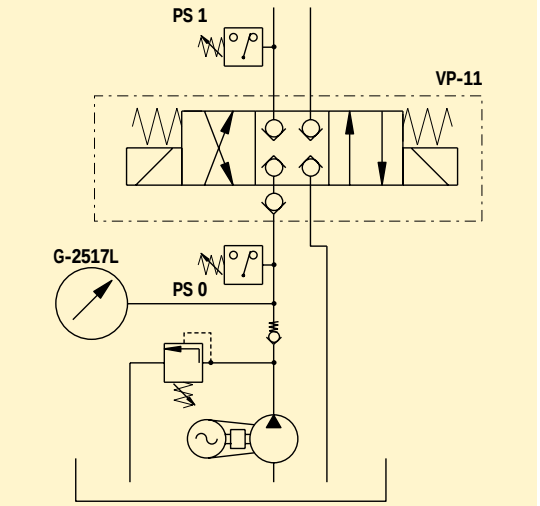


02_005

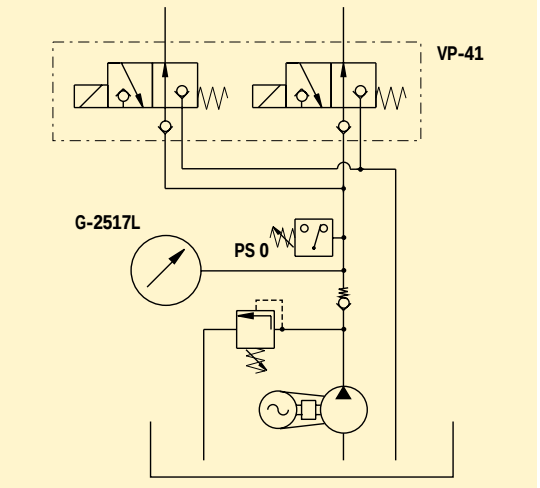
ZW5VPSEE100 with manifold for VP-series or CETOP 03 valves, without electric controls and gauge



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



ZW5141SEE100 For 2x Single-Acting circuits



Basic pumps

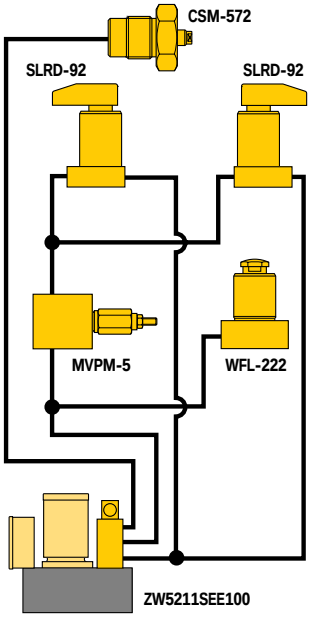
Customize to your needs with the Enerpac VP-series valves and options or choose your own CETOP 03 valve.

Isolating valves

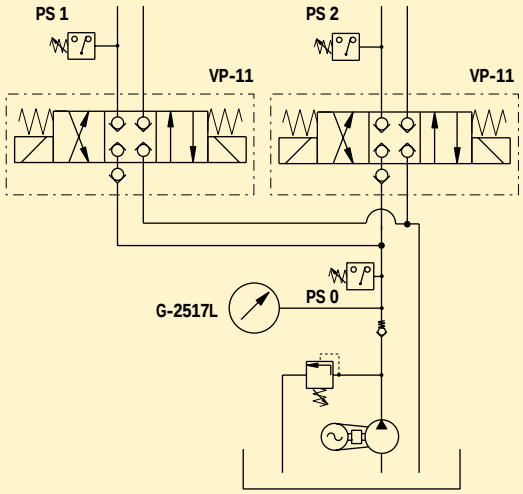
For applications where clamping pressure has to be maintained, isolating valves are an economic and safe solution.
The pressure switch (PS 1) switches in the hydraulic line to the cylinder actuates the valve with a closed center position and isolates the circuit when the preset pressure has been reached. In case of pressure drop the switch opens the valve to compensate.

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

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



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



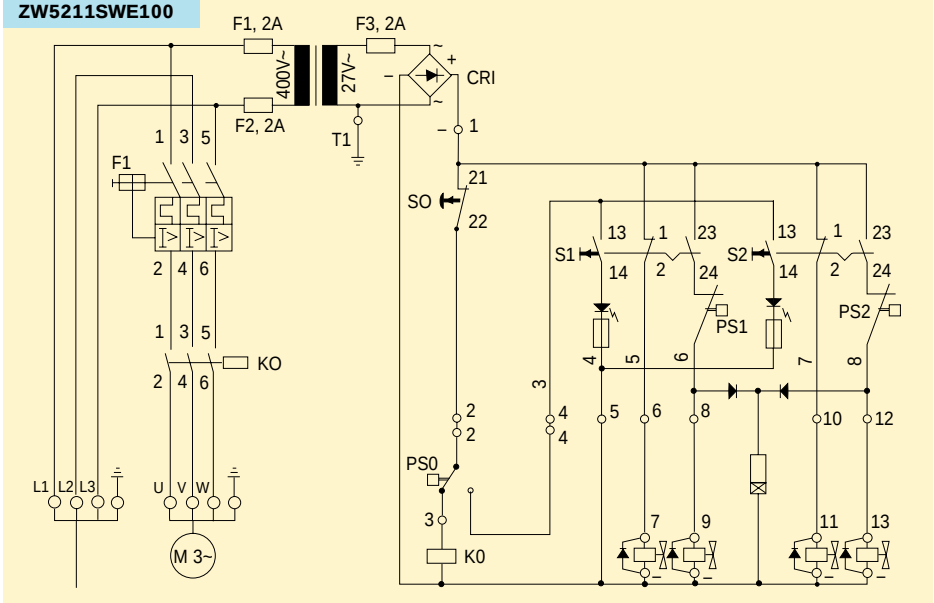
Application example

Building the right workholding system for a specific production tooling requirement is best achieved by observing the Basic System Set-up in our “Yellow Pages” (113).

Electric Scheme

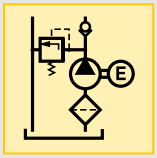
Shown the electric scheme of the ZW5211SWE100 (400 volt) for two double-acting circuits and isolating valves (pressure switches) in both A-lines.

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 92 ▸

Flow control valves 96 ▸

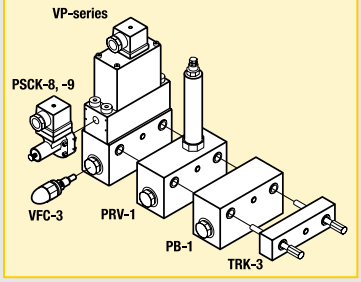
Hoses and couplers 108 ▸

High pressure filters 109 ▸

Hydraulic oil 109 ▸

Fittings 110 ▸

VP-series Valve options 88-91 ▸



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

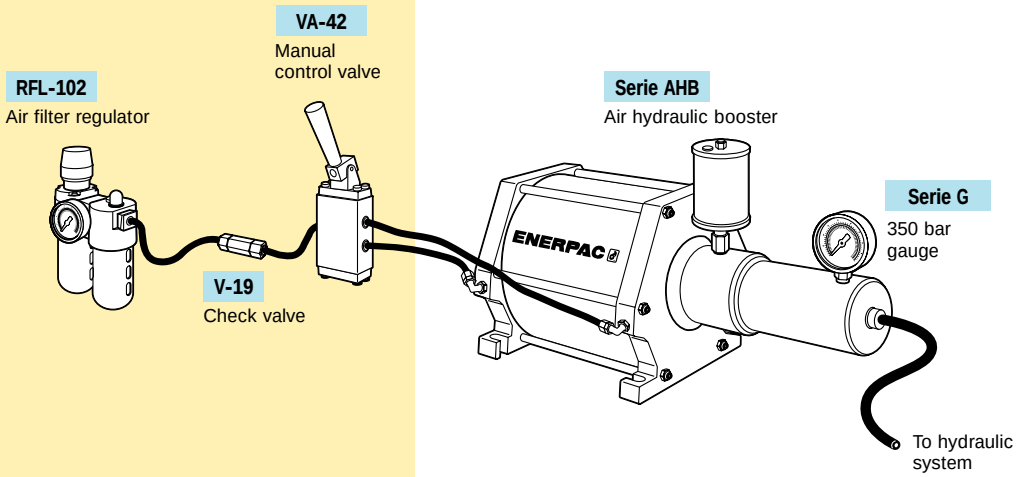
- High speed operation
- Extended service life
- Constant hydraulic output
- Large oil delivery per stroke allows quick filling of cylinders for clamping or punching

AHB series Boosters

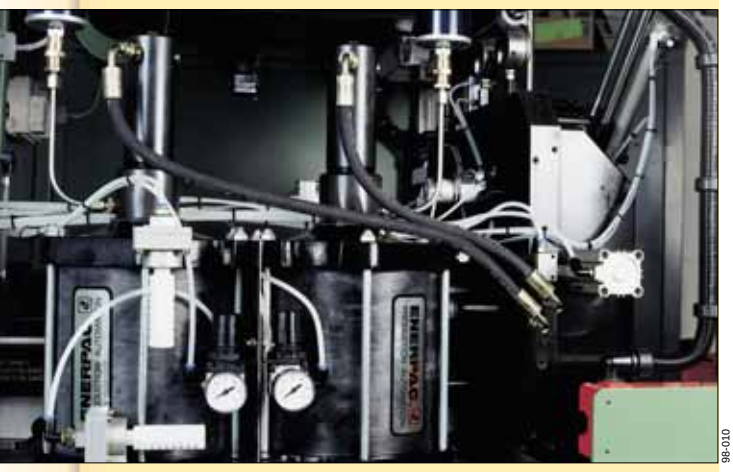
- Fiberglass wound air chamber eliminates possibility of rust due to moisture in air system
- Designed for fully automated production applications
- Double-acting, high speed operation of air piston

B series Boosters

- One-shot spring return
- Aluminium 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

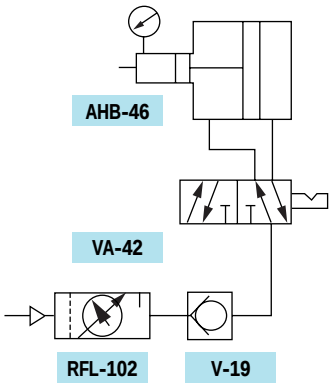


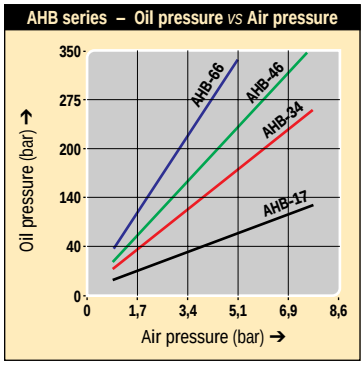
In an automated clamping set-up with both hydraulic and pneumatic components, AHB series boosters are used as a power source for the hydraulic system.

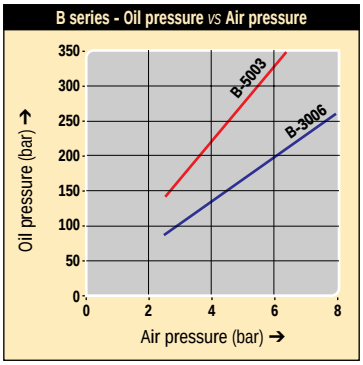


Hydraulic system schematics

Complete power systems eliminate 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: 110 - 350 bar

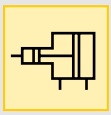
Oil flow: 60-295 cm³/stroke

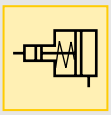
Air: 27-64,1 dm³/cycle

(E) Multiplicadores

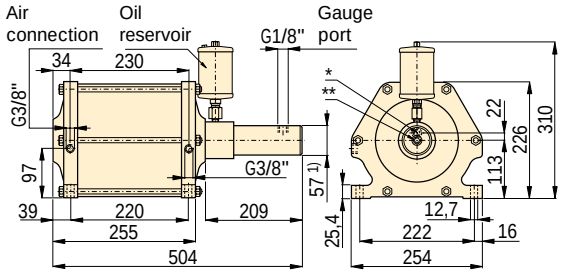
(F) Multiplicateurs

(D) Drucübersetzer





AHB series



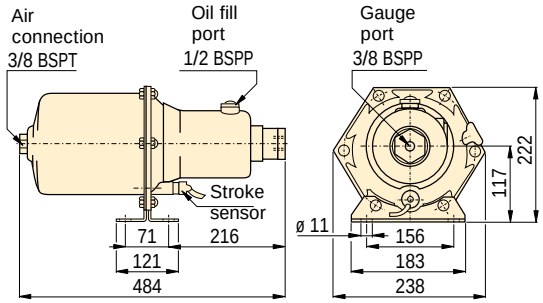
1) Ø 71,9 mm for model **AHB-17**

* Oil connection (G1/4") for model **AHB-17**

** Oil connection (G1/4") for model **AHB-34**, **-46**, **-66**

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

B series



Options

Air valves 97

HF-series Hydraulic oil 108

Fittings 110

Important

Boosters can provide high oil flow rates based on the volume of incoming 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.

Product selection

Oil pressure bar at 5 bar air pressure	Oil pressure bar at 7 bar air pressure	Oil volume per stroke cm³	Air to oil pressure ratio	Model number	Air consumption per cycle 1) dm³ at 6 bar air	Air piston diameter mm	Hydraulic piston diameter mm	Hydraulic stroke mm	Air operating pressure 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.

Oil/oil intensifiers

Shown: PID-402

99-055

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, eliminates the need for an external pilot check valve
- Select fit of all internal components provides long operating life

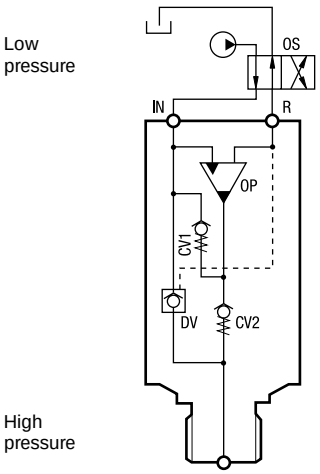
PID series

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 oscilating 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.
- A 10 micron filtration is essential in the supply circuit to ensure trouble free operation (see options).

PID series



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

98-021

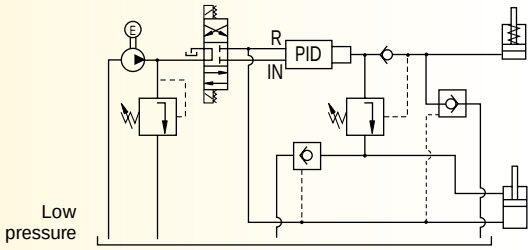
Product selection

Maximum output pressure bar	Pressure intensification ratio	Maximum input flow l/min	Maximum output flow l/min	Model number with dump valve	Inlet pressure range min. - max. bar	kg
640	1 : 3,2	15,0	2,5	**PID-322**	20 - 200	1,2
700	1 : 4,0	14,0	2,0	**PID-402**	20 - 175	1,2
700	1 : 5,0	14,0	1,6	**PID-502**	20 - 140	1,2
700	1 : 6,6	13,0	1,3	**PID-662**	20 - 106	1,2

System set-up information

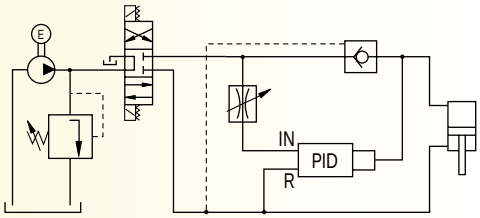
With dump valve (PID models)

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



With external dump valve

In a circulating system where the pump's oil flow is higher than the maximum inlet oil flow of the intensifier, an external check valve and flow control valve reduces the pump's oil flow.
This application can be set up when machines are equipped with low pressure hydraulics but the pressure to clamp the workpiece must be higher.



Ratio: 1 : 3,2 - 1 : 6,6

Flow: 1,3 - 2,5 l/min

Pressure: 65 - 700 bar

(E) **Multiplicadores**

(F) **Multiplicateurs**

(D) **Öl-Öl Druckübersetzer**

Options

FL-series, High pressure filters 109

Directional valves 88

FZ-series Fittings 110

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

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

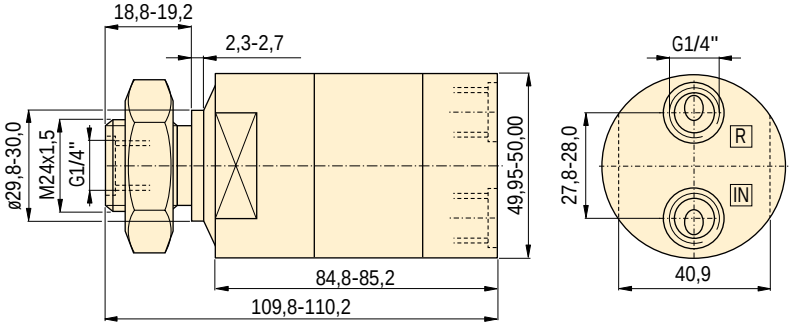
Important

Do not exceed maximum allowable inlet pressure.

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

Product dimensions in mm [⊳⊕]

PID Serie



Valves

Technical support

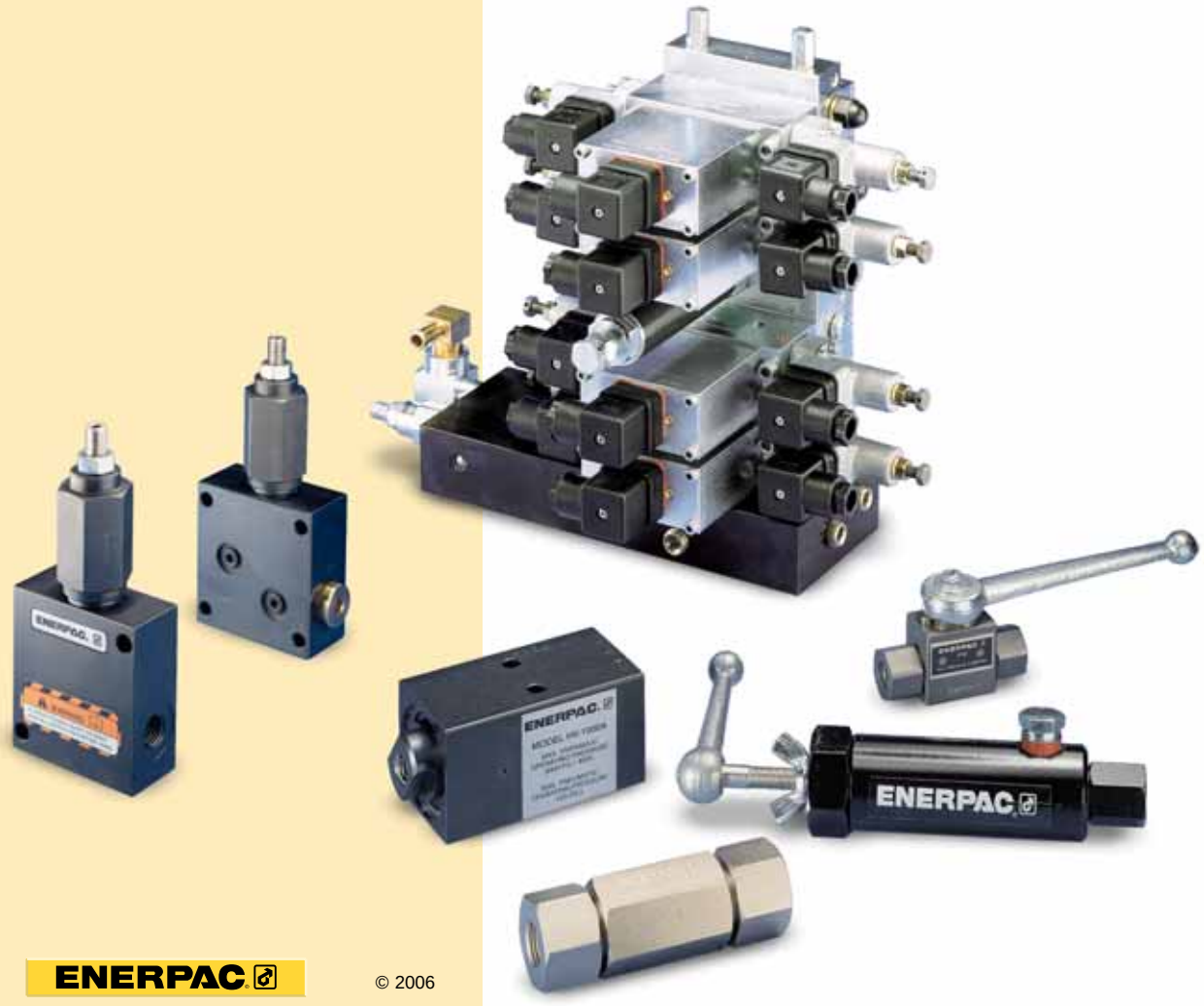
Refer to the “Yellow Pages” of this catalog for:

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

113

Valves

Valves – 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 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-11

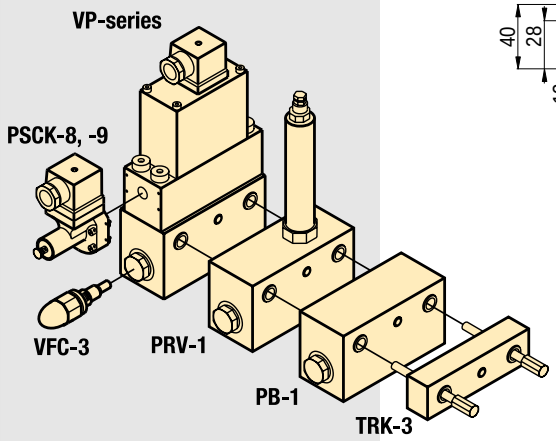
99-017

VP-series

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

Application

VP-valve in combination with all its options in the drawing and photo below. For remote mounting of these valves use WM-10 manifold (90).



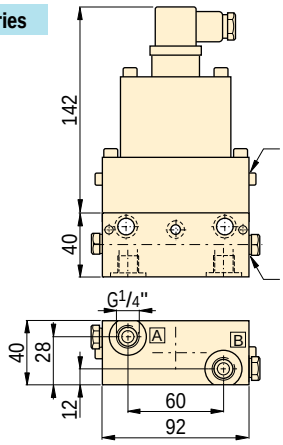
Enerpac VP-series valves stackbuilded on a workholding pump.

99-030

Solenoid directional valves

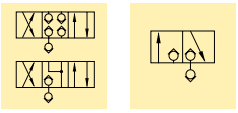
- Dual poppet valve design for zero internal leakage
- Inlet check-valve standard
- High cycle switching
- Stackable to 8 valve stations high
- 17 - 350 bar operational pressure
- Oil flow capacity 7 l/min @ 350 bar
- Oil flow capacity 15 l/min @ 0 bar
- G1/4" oil connections and integrated filtration

VP series



Pressure:	**350 bar**
Max. Flow:	**15 l/min @ 0 bar**
Voltage:	**24 VDC**

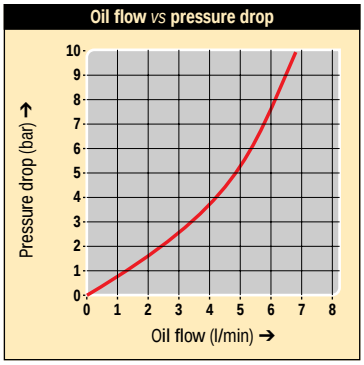
E **Válvulas de control**
F **Electrodistributeurs**
D **Wegesitzventile**



Options

PB-1 Auxiliary block 90

Tie Rod Kits 90



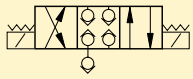
Product selection

Voltage @ current (at 50/60 Hz @ 1,13 Amps)	Model number	Used with cylinder(s)
▼ 4/3 Closed centre		
24 VDC @ 1,13 A	**VP-11**	1x DA / 2xSA
▼ 4/3 Float centre		
24 VDC @ 1,13 A	**VP-21**	1x DA / 2xSA
▼ 3/2 Normally closed		
24 VDC @ 1,13 A	**VP-31**	1x DA / 2xSA
▼ 3/2 Normally open		
24 VDC @ 1,13 A	**VP-41**	1x DA / 2xSA
▼ 3/2 one port normally open, one port normally closed		
24 VDC @ 1,13 A	**VP-51**	1x DA / 2xSA

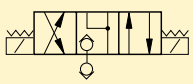
Note: DIN 43650 electrical connector included. Valve weight 3,0 kg.

Flow Path [1]

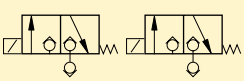
VP-11



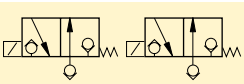
VP-21



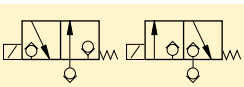
VP-31



VP-41



VP-51



[1] See page 129 for full hydraulic scheme.

Pressure: 350 bar

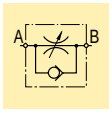
Flow: 7 l/min @ 350 bar

Voltage: 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

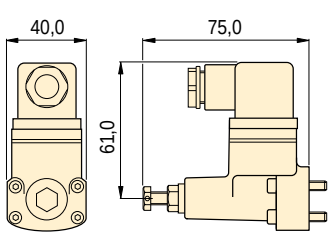
Shown: PSCK-8, VFC-3

Options

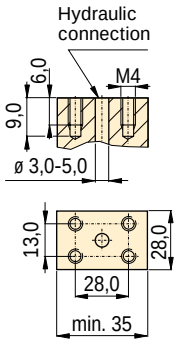
Flow control valves 96

Pressure reducing valves 91

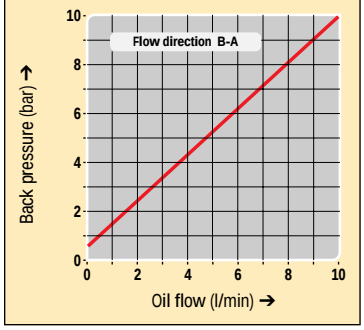
PSCK-8, 9



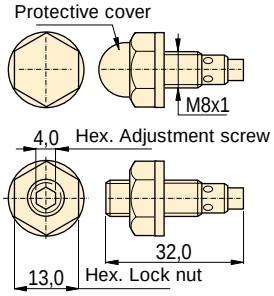
Mounting dim.



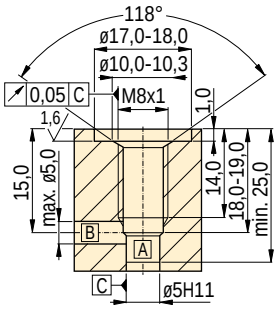
VFC-3 Back pressure vs flow return



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.

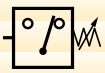
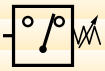
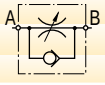
VFC-3

Screw-in throttle type valve to control the amount of oil flow to the hydraulic cylinder.

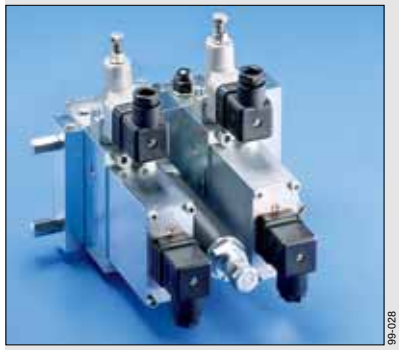
Application

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
▼ **Pressure switch**					
24 VDC @ 2 A	**PSCK-9**		20 - 210	6 - 15	7
▼ **Flow control valve**					
Screw-in throttle valve	**VFC-3**		0 - 350	–	7

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



Tie Rod Kits, Remote/Porting Manifolds TRK, WM, PB-series

Shown: WM-10, TRK-4, PB-1

99-005

TRK-series

Tie Rod Kits mount Enerpac VP-series modular valves to the WM-10 manifold or pump mounted manifold and can accommodate one to eight VP-valve stations.

WM-10

Remote manifold allows mounting of VP-series modular valves to a remote location from the pumping unit. This manifold has a built-in adjustable relief valve.

PB-1

Porting manifold provides three pressure ports for auxiliary lines or accessories, such as a pressure gauge. Mounts between VP-series modular valve stations using TRK-series tie rod kits.

Tie rods mount VP-series valves and accessories to manifold, providing leak-free sealing.

99-035

Simplifies valve and accessory mounting

TRK-series Tie Rods

- Connects 1 to 8 VP-series valves
- Provide leak-free sealing valves
- G1/4” oil connection

WM-10 Remote manifold

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

PB-1 Porting manifold

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

Mounting: 1-8 VP valve stations

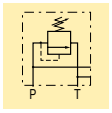
Pressure: 350 bar max.

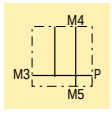
Flow: 15 l/min

(E) **Pernos de montaje de válv.**

(F) **Vis de montage de distrib.**

(D) **Zugstangen**



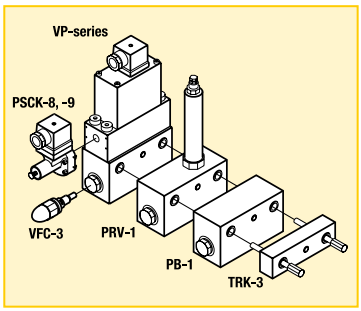


Options

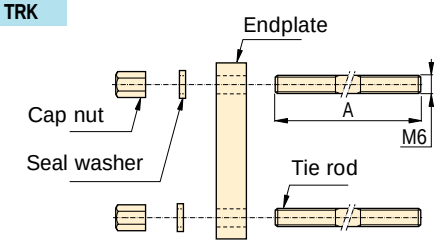
Pressure switches 89

VP-series directional valves 88

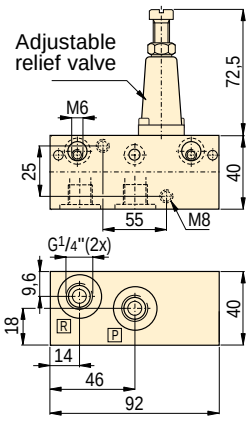
Gauges 106



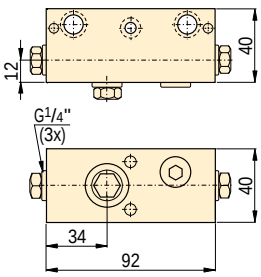
TRK



WM-10



PB-1



Product selection

Quantity of stackable VP-series directional valves	Model number	Tie rod length mm	Mounting thread 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 BSPP	Model number	Hydr. scheme	Maximum pressure bar
▼ Remote manifold with pressure relief			
2x G1/4”	WM-10		350
▼ Porting manifold (P port connection)			
3x G1/4”	PB-1		350

ENERPAC

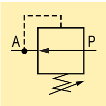
Pressure: 350 bar

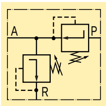
Flow: 7 l/min

E **Válv. reguladora de presión**

F **Valve de pression réglable**

D **Druckreduzierventil**





Precise control of hydraulic pressure

- Stackbuilding with VP series modular valves
- Stackable for multiple pressures on one valve stack assembly
- Tool adjustable knob can be locked
- Precise control of pressure
- G1/4" oil connection
- Remote mount PRV-3

Shown: PRV-1

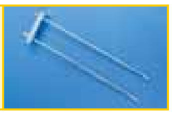
99-021

Options

VP-Modular valves
88

Pressure switches
89

Tie rod kits
90



Fittings
110

PRV-series

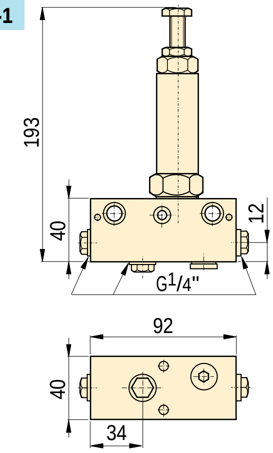
These valves regulates system pressure for all subsequent valves, according to the adjusted pressure. Maintains a constant pressure in a secondary circuit. Includes a check valve that prevents pressure drop on secondary side.

Application

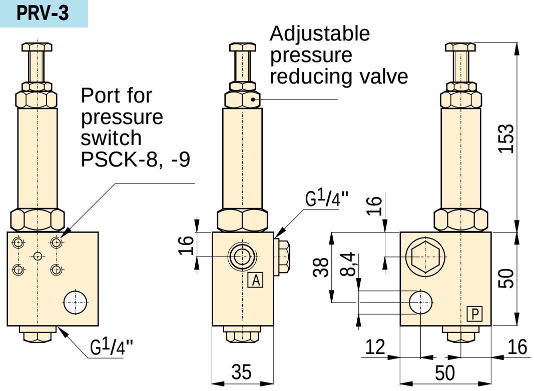
Used when a hydraulic supply with a higher pressure (primary side) must also be used for another circuit with a lower pressure (secondary circuit).

PRV-1 can be stack builded between VP-series valves. PRV-3 is for remote mounting. The cartridge from PRV-3 can be removed from manifold for direct integration into gundrilled fixture.

PRV-1



PRV-3



PRV-1 connected with remote manifold WM-10.

99-024

Product selection

Mounting style	Adjustable pressure range	Maximum pressure	Built-in adjustable pressure relief valve	Model number	Oil ports	Maximum oil flow	(weight)
	bar	bar	bar		BSPP	l/min	kg
VP-series	30 - 300	350	–	**PRV-1**	G1/4"	7	1,6
Remote	30 - 300	350	–	**PRV-3**	G1/4"	7	1,3

Valves
System components
Yellow pages

Shown: MVPM-5

Pressure dependent sequence control

MVPM-5

- Direct accurate pressure setting
- Pressure setting between 35 - 350 bar for secondary circuit is secured with lock nut

V-2000

- Direct accurate pressure setting
- Pressure setting betweeen 14 - 140 bar for secondary circuit
- Flag indicator appears every time the valve is operated

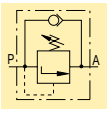
Pressure: 350 bar max.

Flow: 4,1 - 6,0 l/min max.

(E) **Válvulas de secuencia**

(F) **Valves de séquence**

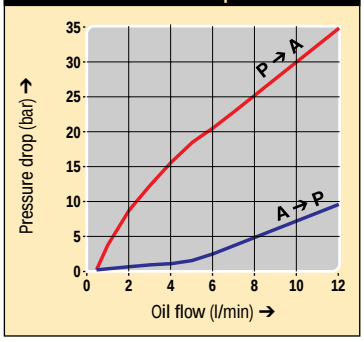
(D) **Folgeventile**



Options

Gauges 106

MVPM-5 Pressure drop *vs* oil flow



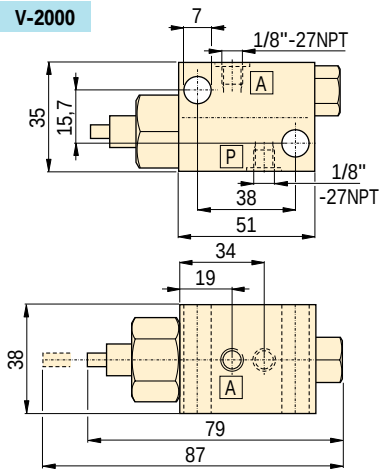
Sequence valves

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.

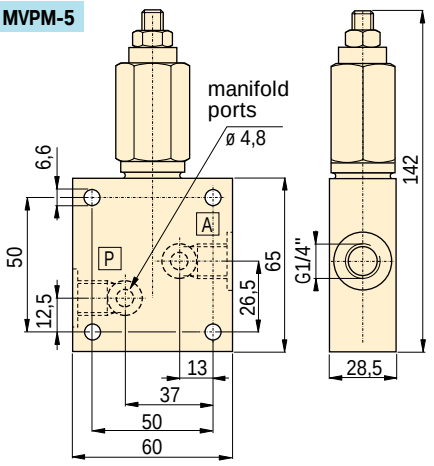
Application

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.

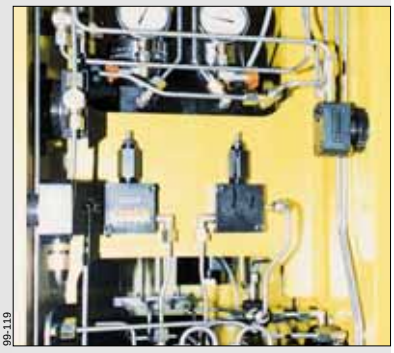
V-2000



MVPM-5



Two MVPM-5 sequence valves used in conjuction with Enerpac MCA-series Auto Coupler to provide system automation.



Product selection

Pressure adjustment range	Maximum pressure	Maximum oil flow	Model number	Oil ports	Opening pressure check valve	
bar	bar	l/min			bar	kg
14-140	350	4,1	**V-2000**	1/8”-27N P T	–	0,9
35-350	350	6,0	**MVPM-5**	G 1/4”	1,4	1,3

Seal material: Buna-N. Manifold O-rings included with MVPM-5. For manifold mounting installation information consult Enerpac for surface preparation.

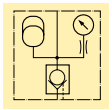
Pilot ratio: 7:1

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

Options

Fittings

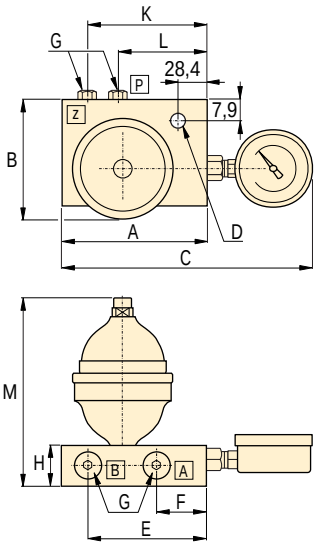
110

Product selection

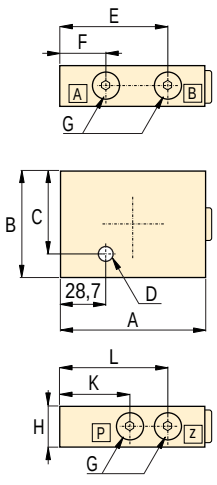
Pilot ratio	Accumulator included	Maximum oil flow l/min	Maximum pressure bar	Model number	Oil ports	Optional charging tool for ACL	kg
7 : 1	–	38	350	**MV-72**	G 1/4”	–	1,8
7 : 1	ACL-22	38	350	**MV-722B**	G 1/4”	**WAT-2**	2,7
7 : 1	ACL-202	38	350	**MV-7202B**	G 1/4”	**WAT-2**	3,4
7 : 1	–	38	350	**MVM-72**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

For more information on ACL-series Accumulators see page 104.

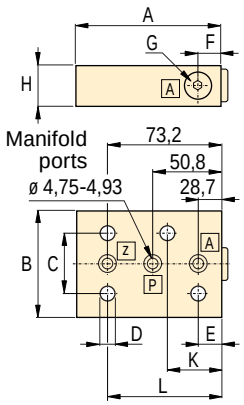
MV-722B, -7202B



MV-72



MVM-72



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.

Shown: MV-72, MVM-72

MV-series

Pilot operated check valves check the oil flow with a built-in pilot circuit providing fast, automatic check-off for your workholding applications.
The pilot operated check valves with built-in accumulator help to maintain system pressure due to minor oil loss.

Application

Added capability to open with pilot pressure to allow cylinders to retract. By using a pilot operated check valve, cylinder retraction can be accomplished automatically without operator activity.

Accessory valves *Application & selection*

Shown: HV-1000A, V-17, V-10, V-12, V-152

Accessory valves

Enerpac accessory valves, available in a wide variety and many configurations to control hydraulic pressure or oil flow. These valves are used in conjunction with other valves and system components to provide full automation and control.

Application

Accessory valves are used to automate clamp cycles, prevent pressure loss and provide additional operator and component safety.

Your hydraulic control solution

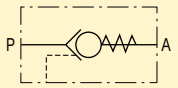
- Regulate oil flow or system pressure
- All valves feature NPT or SAE porting to insure against leakage at rated pressure
- Can easily be installed in any system
- All valves are painted, coated or plated for corrosion resistance

Product selection

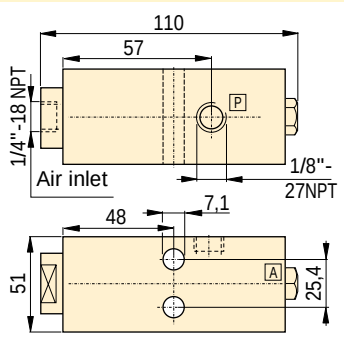
Valve type	Maximum pressure bar	Model number	Oil ports
Holding valve, air pilot	210	**HV-1000A**	1/8" N P T
Holding valve, modular	210	**MHV-1**	1/8" N P T
Presssure limiting valve	210	**PLV-40013B**	1/8" N P T
Manual shut-off valve	350	**V-12**	SAE #4
Auto-damper valve	700	**V-10**	1/2" N P T
Safety check valve	700	**V-17**	3/8" N P T
Presssure relief valve	700	**V-152**	1/8" N P T

Product specification

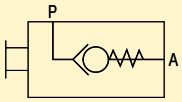
HV-1000A Air pilot holding valve



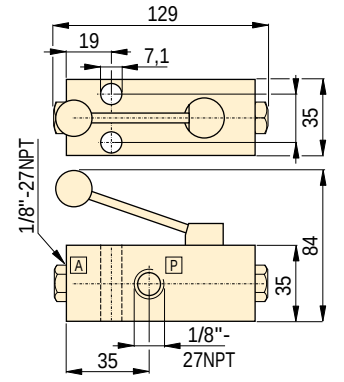
- Holds fluid under pressure offering independent control of different branches of the same fixture
- Valve can control the pilot air and the booster in sequence
- Max. oil flow 5 l/min
- Works with the VA-42 four-way air valve and a booster



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 presssure is interrupted, the MHV-1 will hold the pressure beyond the valve
- Max. oil flow 5 l/min
- To release system pressure, rotate valve handle in either direction 90˚ to release and retract system pressure



V-17 Safety check valve installed on a fixture.

ENERPAC

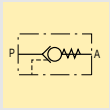
Pressure: 0 - 700 bar

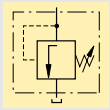
Flow max.: 5 - 30 l/min

E Válvulas de control

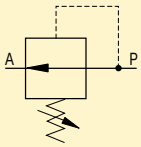
F Valves de contrôle

D Regelventile

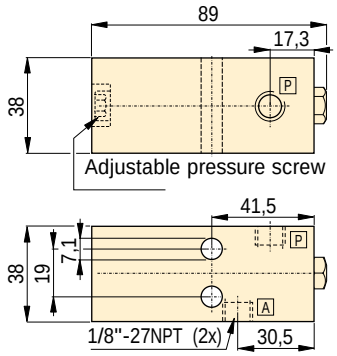




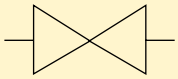
PLV-40013B
Pressure limiting valve



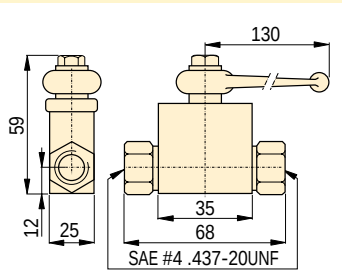
- Allows precise control of pressures reaching specific clamps
- When pressure build-up reaches a preset level, the valve closes, stabilizing pressure to that section of the fixture
- Pressure adjustment between 14 - 105 bar
- Max. oil flow 5 l/min



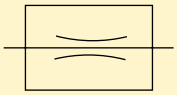
V-12 Manual shut-off valve



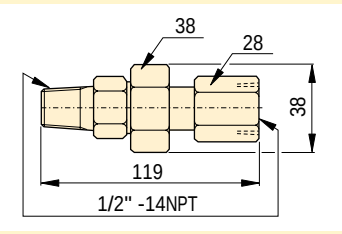
- Ball type valve can be used for the master system shut-off or for isolating separate circuits on a fixture
- Viton seals standard
- Straight through design for easy system plumbing and installation
- Fully open allows high flow return of oil
- Max. oil flow 12 l/min



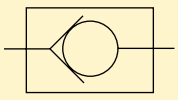
V-10 Auto-damper valve



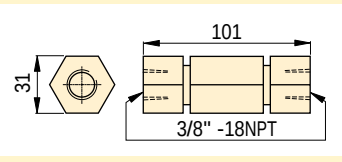
- To protect gauge during high cycle applications
- Creates a flow resistance when load is released suddenly. No adjustments are necessary
- Fits directly into GA-series gauge adaptor



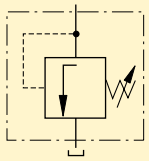
V-17 Safety check valve



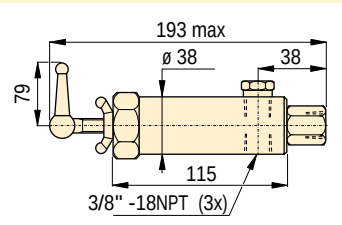
- Ruggedly built to resist shock and operate with low pressure drop
- Closes smoothly without pounding
- Max. oil flow 30 l/min



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 m return line hose kit



Options

VA-42 Air valve
97

Gauges and adaptors
106

Hoses and couplers
108

Fittings
110

Important

Valving help

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

113

Flow control valves VFC-series

Shown: VFC-1, VFC-2

99-025

Regulate the flow of oil

- Color coded flow indicator
- Free flow return
- Fine metering capability
- Lockable
- Standard Viton seals

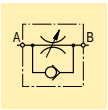
Max. Flow: 38 l/min

Pressure: 0 - 350 bar

(E) **Válv. reguladoras de caudal**

(F) **Valves de control débit**

(D) **Stromregelventile**



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

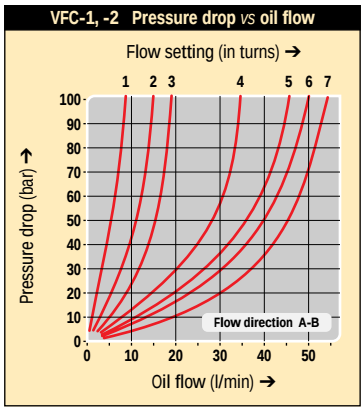
Use VFC-series flow control valves in-line with the Enerpac WE-series workholding pump to protect your components from damage due to high flow rates.

Options

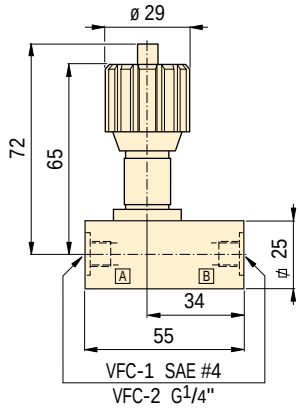
Fittings 110

High pressure filters 109

Inline Flow Control Valve 89



VFC-1, -2



In-line installation of a VFC-1 flow control valve.

99-041

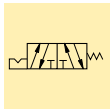
Product selection

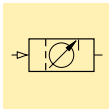
Maximum oil flow	Pressure range	Oil ports	Model number	Flow path	Maximum pressure drop	
l/min	bar				bar	kg
▼ **Flow control valves**						
38	0 - 350	SAE #4	**VFC-1**		105	0,8
38	0 - 350	G 1/4"	**VFC-2**		105	0,8

Seal material: Viton.

Air Pressure: 0 - 10 bar

(E) Válvulas de aire
(F) Valves à air
(D) Luftventile





Options

Gauges and adaptors 106 ▸

Hoses and couplers 108 ▸

Fittings 110 ▸

To control and regulate air supply

VA-42 Manual operated air valve, 5-way, 2-pos.
- For control of boosters
- Viton seals standard

VAS-42 Solenoid operated air valve 5-way, 2-pos.
- For control of pump and boosters air supply
- Viton seals standard
- Solenoid: 120 VAC, 50/60Hz
  Amperage: inrush 0,11 Amp, holding 0,07 Amp
- 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

QE-375 Air/Noise silencer
- Reduces noise level of exhaust air from pump to 45 dBa

Shown: VA-42, VAS-42

99_110

Air valves

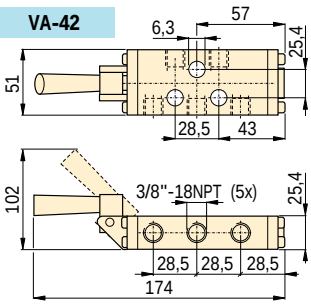
Enerpac's line of directional air valves and accessories complete your workholding system. Used to control air operated hydraulic units, they increase your productivity and efficiency.

Application

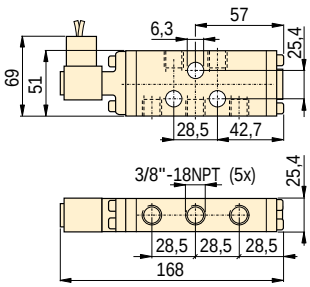
VA-series directional air valves provide either manual or electric control to air operated hydraulic units. Accessories such as rapid exhaust, check valves, silencers and regulators complete the air control system.

- 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

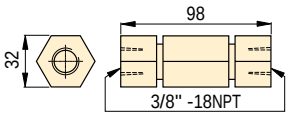
VA-42



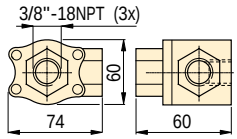
VAS-42



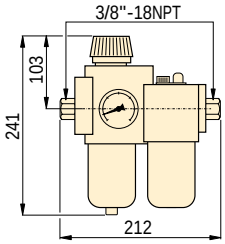
V-19



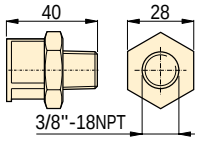
VR-3



RFL-102



QE-375



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

System

System components

From the simplest to the most complex hydraulic system, Enerpac's system components help you complete your design. Gauges, fittings, couplers and hoses are simple but necessary items for any hydraulic system, and Enerpac can provide the full range. And more specialized components such as accumulators and automatic coupler systems ensure that whatever your need, Enerpac can help.

Technical support

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

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

113

components

Auto-coupler systems *Application & selection*

Shown: MCA-62, MPA-62

98-064

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
- Adjustment stroke allows clearance for pallet indexing
- Coupler elements supplied with air blow-off nozzles to prevent damage from contamination

An auto-coupler is being connected to the receiver, mounted on the side of a palletized fixture.

98-095

Product selection

Station position	Model number [1]	Adjustable stroke	Oil capacity		Maximum oil flow [2]
			cm^3		
		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**	–	–	–	–

[1] For additional pallet clearance, WCA-82 long stroke model is available.
[2] Maximum oil flow of coupler elements is 17 l/min.

ENERPAC

Connection: 2 ports

Stroke: 5 - 113 mm

Pressure: 40 - 350 bar

(E) **Acopladores automáticos**

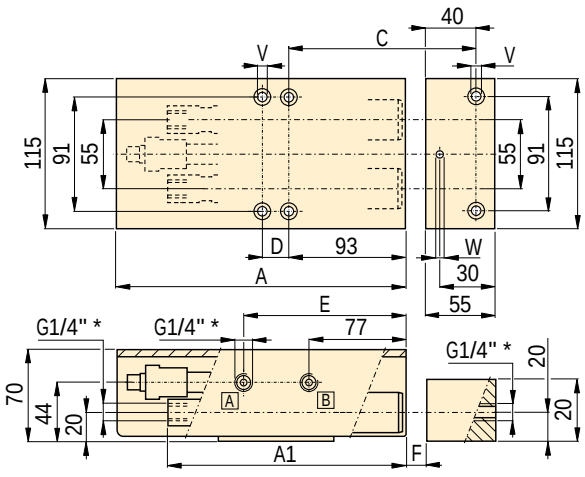
(F) **Coupleurs automatiques**

(D) **Automatische Kupplungen**

Product specifications

Model number	Required radial alignment accuracy mm	Operating pressure bar	Hydraulic nozzle model nr. (included)	Recommended alignment tool
▼ 2 port auto coupler				
MCA-62	± 0,5	40 - 350	**CDF-6**	**AT-1**
WCA-82	± 0,5	40 - 350	**CDF-6**	**AT-2**
MPA-62	± 0,5	40 - 350	**CDM-6**	**AT-1**

MCA-62, WCA-82 **MPA-62**



* Note: For WCA-82 oil ports are SAE #4 7/16-20 UNF

Product dimensions in mm [⊕]

Model number	A	A1	C	D	E	F max.	V [1] for mounting bolts DIN912 - 12.9	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

[1] Mounting bolts are not included. 2) Drill dowel pin holes after installing MPA..

Options

Hoses

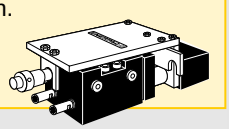
108

High pressure filters

109

AT series alignment tool

Use the AT series alignment tool to adjust the position of the pallet station in relation to the base station.



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

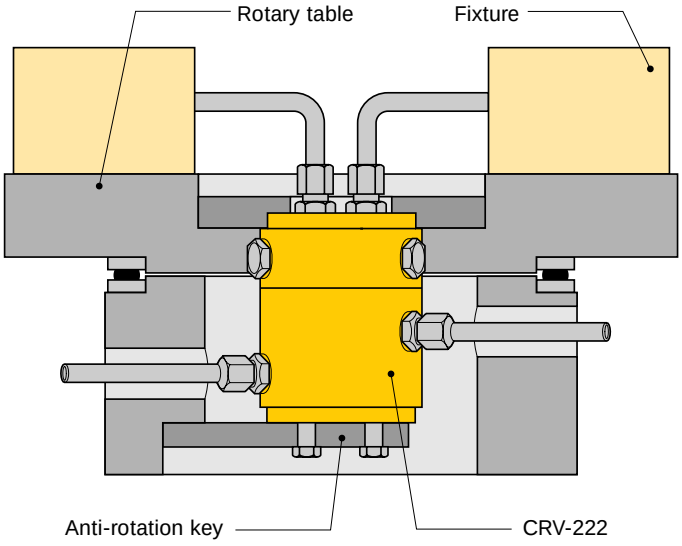
98-067

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.

Permanent hydraulic connection on indexing and rotating work stations

- High rotation per minute
- Low starting torque
- Internal oil bearings for increased lifetime
- Single, 2 or 4 passage coupler type

Rotary coupler operation



In this application 8 CRV-222 rotary couplers are installed to power the individual presses of an 8 station rotary press table.

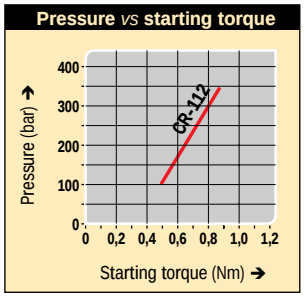
98-070

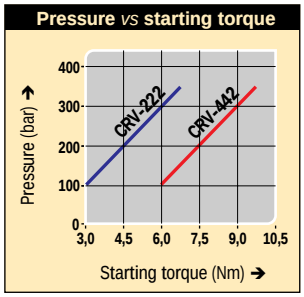
Product selection

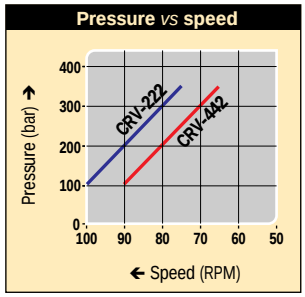
Number of radial passages	Model number [1]	Operating pressure range	Maximum speed		Starting torque	
			RPM		Nm	
		bar	100 bar	350 bar	100 bar	350 bar
1	CR-112	100-350	30	30	0,5	0,9
2	CRV-222	100-350	100	75	3,0	7,0
4	CRV-442	100-350	90	65	6,0	10,0

[1] Before selecting, note the starting torque and speed diagrams on the next page. Maximum oilflow 9 l/min.

Starting torque and speed diagrams







Max. operating speed = 30 RPM.
Max. oilflow 9 l/min.

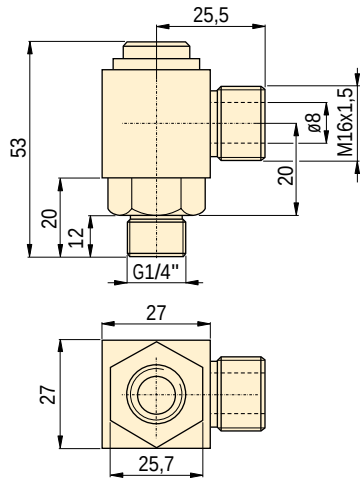
Oil loss CRV-222 = 20 cm³/h, CRV-442 = 40 cm³/h

Passages:	**1-4 lines**
Speed:	**30-100 RPM max**
Pressure:	**100 - 350 bar**

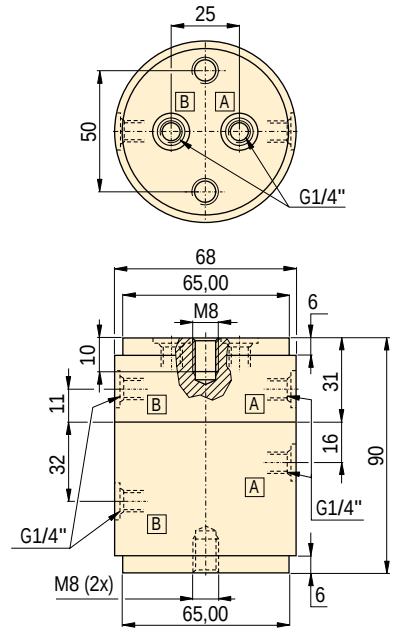
E Acoplamientos giratorios
F Joints tournants
D Drehdurchführungen

Product dimensions in mm [⊳⊕]

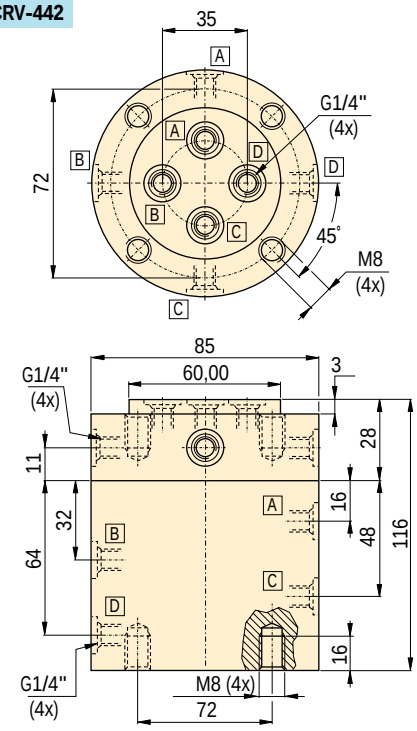
CR-112



CRV-222



CRV-442



Options

Fittings 110

Couplers 108

Hoses 108

Gauges 106

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.

Accumulators *Application & selection*

Shown: ACM-1, ACBS-202, ACL-202

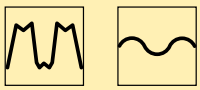
99-054

Enerpac accumulators supply auxiliary pressure to dampen shock loads or to compensate pressure drop in applications where system pressure needs to be maintained. Accumulator packages will help maintain system pressure to your fixture when separated from the hydraulic source. The gauge will display system pressure after the circuit is disconnected.

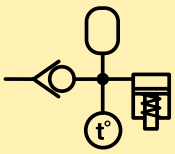
Accumulator applications:

- Energy storage
- Circuit pulsation dampening
- Thermal expansion compensation

Pulse dampening



Thermal expansion



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

99-056

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

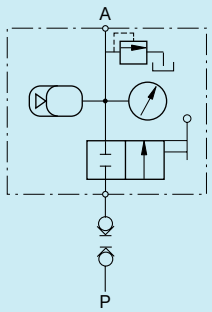
Accumulator coupler packages

...compact design for easy use of accumulators

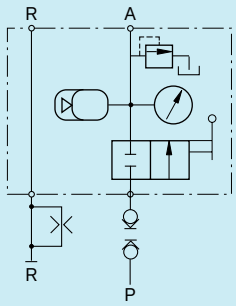
- Single design accommodates both single-acting or double-acting circuit
- Relief valve fitted and ball check shut-off
- Glycerin-filled gauge included
- Supplied standard with one male coupler (AH-652)
- Optional manifold mounting. O-ring seals located on bottom of block only for single-acting circuit

Accumulator coupler package circuits

Single-acting circuit



Double-acting circuit
with customer-supplied connections



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**					
0-120	**ACM-1**	1,6	–	–	–
100-350	**ACL-22**	14,7	20,0	100	8,7
100-350	**ACL-202**	126,2	169,9	100	73,9
100-350	**ACL-502**	337,6	450,0	100	196,6
▼ **Pre-charged accumulator coupler packages**					
100-350	**ACBS-22**	16,4	20,0	100	8,7
100-350	**ACBS-202**	163,9	169,9	100	73,9

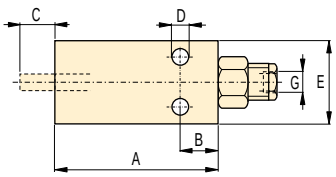
Pressure: 0 - 350 bar

Oil volume: 1,6 - 337,6 cm³

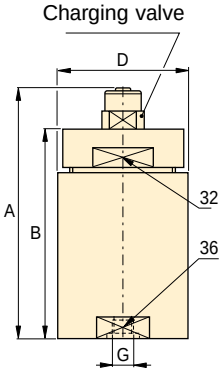
Gas volume: 20 - 450 cm³

(E) **Acumuladores**
(F) **Accumulateurs**
(D) **Druckspeicher**

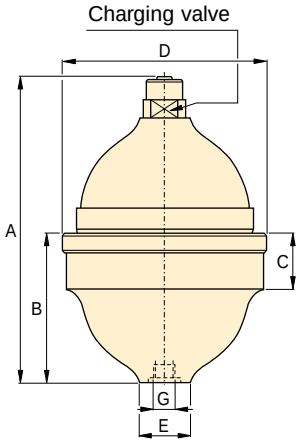
ACM-1



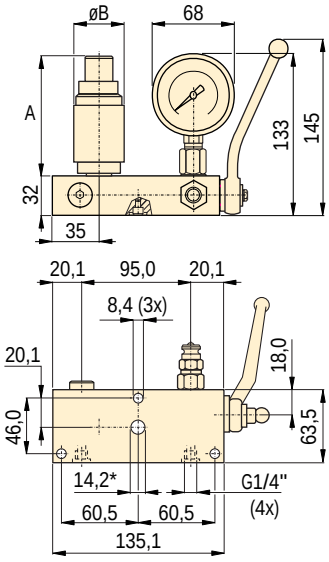
ACL-22



ACL-202, 502



ACBS



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

Product dimensions in mm [⊳⊕]

Model number	A	B	C	D	E	G	Recommended charging tool	kg
▼ **Pre-charged Accumulators**								
ACM-1	133	19	13	6,7	45	.125-27NPT	–	1,0
ACL-22	99	66	–	42,0	–	G1/4"	**WAT-2**	0,6
ACL-202	137	69	29	84,5	29	G1/4"	**WAT-2**	1,2
ACL-502	171	89	35	114,0	40	G3/8"	**WAT-2**	2,8
▼ **Pre-charged accumulator coupler packages**								
ACBS-22	68	42	–	–	–	G1/4"	**WAT-2**	4,6
ACBS-202	106	85	–	–	–	G1/4"	**WAT-2**	5,4

Options

Couplers 108

High pressure filters 109

Hydraulic oil 109

Fittings 110

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 (AH-652) for use in double-acting hydraulic circuits.

Pressure gauges and accessories *Application & selection*

Shown: V-91, GA-918, G-2535L, DGR-1

Enerpac digital pressure gauges offer greater accuracy and are easier to read than conventional dial gauges, greatly enhancing your ability to monitor and control hydraulic system pressure.

G series, glycerine filled pressure gauges allow the operator a visual representation of what is happening in the hydraulic circuit.

Enerpac gauges provide a safe and inexpensive monitoring system for your hydraulic circuit. These gauges deliver years of accurate service while withstanding vibration, corrosive media and atmospheric conditions.

Enerpac gauges used to monitor system pressure and maintain process accuracy.

Digital gauge

- ± 0,2 % accuracy of full scale
- Rated for system pressures up to 1000 bar
- Displays in bar, hPa, mbar, kPa, kg/cm², psi.
- Zero set – ensures that gauge reads actual system pressure
- Battery low indicator; 1400 hours continuous operation
- Automatic shut-off after 15 minutes

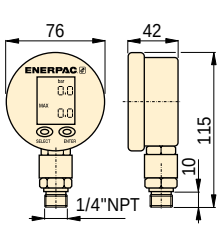
Highly reliable and accurate pressure sensing

- ± 1,5 % accuracy of full scale
- All pressure sensing parts sealed and dampened by glycerine for long life
- Includes safety blow-out disk and pressure equalizing membrane to prevent overpressurization
- Copper alloy, coiled safety Bourdon tube for 70 bar and higher
- Dual psi and bar scale readings, 63 mm gauge face

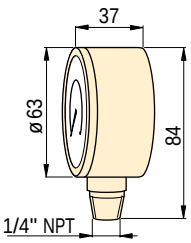
Gauge accessories for easy installation

- 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

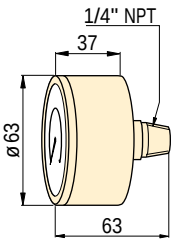
DGR-1 Digital gauge



Lower mount models



Rear mount models



Product selection

Accuracy % of full scale	Pressure range psi	Pressure range bar	Model number	PSI graduation Major psi	PSI graduation Minor psi	Bar graduation Major bar	Bar graduation Minor bar
▼ Digital pressure gauge							
0,2	0-15000	0-1000	**DGR-1**	–	–	–	–
▼ Pressure gauge – Lower mount							
1,5	0-600	0-40	**G-2513L**	100	10	10	1
1,5	0-1000	0-70	**G-2514L**	100	20	10	1
1,5	0-2000	0-140	**G-2515L**	500	50	10	2
1,5	0-3000	0-200	**G-2516L**	500	50	50	5
1,5	0-6000	0-400	**G-2517L**	1000	100	100	10
1,5	0-10000	0-700	**G-2535L**	2000	200	100	10
▼ Pressure gauge – Rear mount							
1,5	0-1000	0-70	**G-2531R**	100	20	10	1
1,5	0-6000	0-400	**G-2534R**	1000	100	100	10
1,5	0-10000	0-700	**G-2537R**	2000	200	100	10

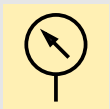
www.enerpac.com

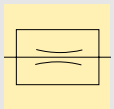
Pressure: 0-1000 bar

Accuracy: 0,2-1,5% /full scale

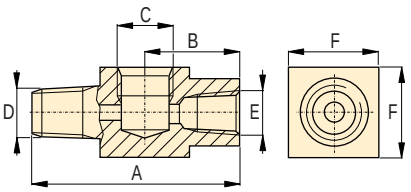
Gauge face: ø 63-76 mm

(E) Manómetros
(F) Manomètres
(D) Manometer

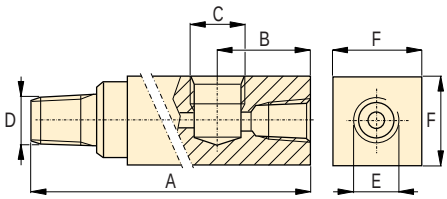




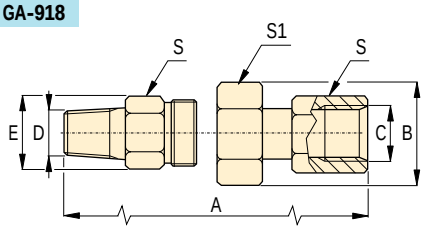
GA-1



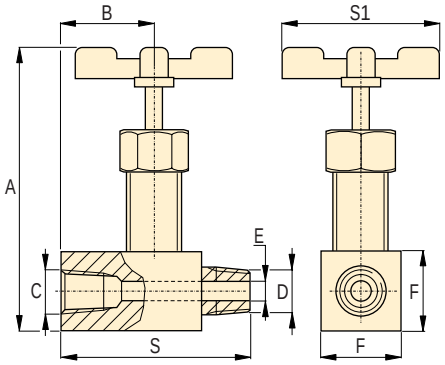
GA-2, -3, -4



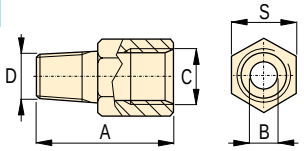
GA-918



NV-251, V-91



GS-2, -3



Product dimensions in mm [⊳⊕]

Gauge port NPT	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" NPT	3/8" NPT	3/8" NPT	32	–	–
1/2"	700	**GA-2**	155	35	1/2" NPT	3/8" NPT	3/8" NPT	32	–	–
1/4"	700	**GA-3**	133	35	1/4" NPT	3/8" NPT	3/8" NPT	32	–	–
1/2"	700	**GA-4**	111	35	1/2" NPT	1/4" NPT	3/8" NPT	32	–	–
▼ **Swivel gauge adaptor**										
1/2"	700	**GA-918**	57	44	1/2" NPT	1/2" NPT	33	–	29	38
▼ **Gauge shut-off valves**										
1/4"	700	**NV-251**	57	29	1/4" NPT	1/4" NPT	4,3	19	57	46
1/2"	700	**V-91**	89	32	1/2" NPT	1/2" NPT	4,8	37	64	64
▼ **Gauge snubber valves**										
1/4"	350	**GS-2**	41	0,46	1/4" NPT	SAE #4	–	–	19	–
1/4"	350	**GS-3**	41	0,46	1/4" NPT	G1/4"	–	–	19	–

Options

Hoses and couplers 108

Accessory valves 94

Fittings 110

700 bar Auto Damper® Valve V-10 94

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.

113

Manifolds, hoses and couplers Series A, C, H

Shown: H-7202, A-66, HF-95Y, CR-400, AH-650, A-64

99_105-1a

Use genuine Enerpac manifolds, couplers and hoses 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.

C series, High-Flow Couplers

High pressure coupler recommended for use on all Enerpac pumps and cylinders

AH, AR series, Couplers

Quick disconnect low leakage couplers for easy connection of hydraulic circuits.

H-700 series, Hoses

High pressure hydraulic hoses, for demanding applications, featuring a 4:1 design factor.

Options

Fittings
110

Gauges and accessories
106

Manifolds

- Easy to connect
- Mounting holes on all models

Couplers

- Spee-D-Coupler® design allows cylinder to be connected and disconnected in seconds
- For more safety: couplers cannot be connected or disconnected while under hydraulic pressure

Thermo-plastic safety hoses

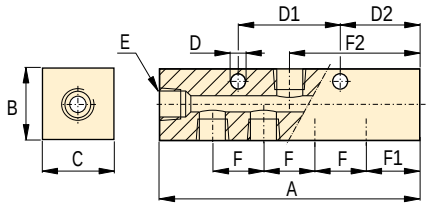
- Maximum working pressure of 700 bar
- Four layer design, including two high strength wire braids
- Outside jacket is polyurethane, to provide maximum abrasion resistance

Important

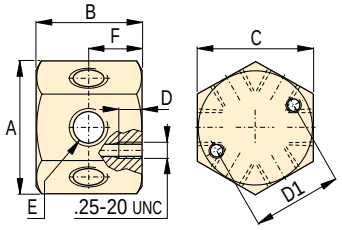
Do not exceed the maximum pressure.

Inspect hoses and hydraulic lines frequently and replace as required.

A-64, -65



A-66



Manifolds dimensions in mm [▱⊕]

Number of ports	Model number	A	B	C	D	D1	D2	E	F	F1	F2	kg
7	A-64 [1]	178	32	32	6,3	76	32	.375-18 N P T	38	32	89	1,5
7	A-65 [1]	368	32	32	6,3	203	32	.375-18 N P T	102	32	184	2,7
6	A-66 [1]	58	42	51	13,2	38	–	.375-18 N P T	–	–	–	0,9

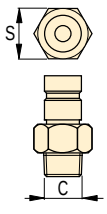
[1] Note: Maximum operating pressure of A-64, A-65 and A-66: 700 bar

Thermoplastic Safety Hoses

Hose length m	Hose End one	Hose End two	Internal diameter mm	Model number	Maximum pressure bar	kg
0,6	3/8" NPT	3/8" NPT	6,4	H-7202	700	0,5
0,9	3/8" NPT	3/8" NPT	6,4	H-7203	700	0,7
1,8	3/8" NPT	3/8" NPT	6,4	H-7206	700	0,9
3,0	3/8" NPT	3/8" NPT	6,4	H-7210	700	1,4

Couplers

Maximum pressure bar	Maximum oil flow l/min	Modelnr. Coupler complete	Modelnr. Female half	Modelnr. Male half	Thread size C	S mm
700	40	C-604	CR-400	CH-604	3/8" NPT	22
700	40	A-604	AR-400	AH-604	3/8" NPT	19
350	17	–	AR-650 [1]	AH-650	1/4" NPT	17,5
350	17	–	AR-650 [1]	AH-652	G1/4"	17,5
350	17	–	AR-650 [1]	AH-654	SAE #4	17,5



[1] Note: Thread size AR-650 is 1/4" NPT, dimension S is 20,6 mm. Use FZ-1055 Fitting to connect to 3/8" NPT Hose ends.

High pressure filters, hydraulic oil — Series FL, HF

High pressure filters

- Keep your hydraulic system clean
- Pleated stainless steel wire mesh screen construction provides large filter area in a compact size
- Rated for full system pressure up to 350 bar
- Bi-directional design allows filtration of oil in either flow direction
- Two piece body construction for easy replacement of filter elements
- High flow rates are obtainable with a minimum pressure drop
- Threaded port connections on each end simplify installation

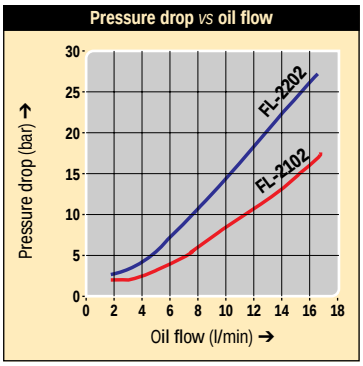
Hydraulic oil

- Ensures effective lubricity
- Protects essential parts

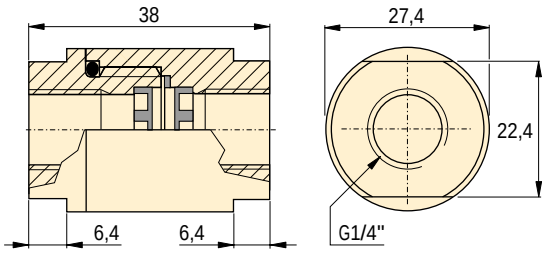
Filtration

20 micron filter provides the longest service life before element replacement.

10 micron filter recommended for more sensitive hydraulic components.



FL series



High pressure filters (350 bar)

Model number	Filtration micron		Model number Filter element set	kg
	Nominal	Absolute		
FL-2102	10	25	FL-2101K	0,2
FL-2202	20	40	FL-2201K	0,2

Hydraulic oil

Contents litres	Model number	Specifications genuine Enerpac hydraulic oil			
1,0	HF-95X	0 °C	< 1500 cSt	Flash, C.O.C.	210 °C
5,0	HF-95Y	37,8 °C	32 - 34 cSt	Pour point	-32 °C
60,0	HF-95Z	100 °C	5,0 - 6,1 cSt	Aniline point	99/104 °C

Note: Viscosity index: 100 min

(E) **Mangueras, Filtros Acoplamientos, Aceite**

(F) **Flexibles, Filtres Raccords, Huile**

(D) **Schläuche, Filter Kupplungen, Öl**

High pressure filters

Compact inline high pressure filters prevent chips and debris that have entered the hydraulic fluid system from damaging hydraulic system components.

Hydraulic oil

Use only genuine Enerpac hydraulic oil to guarantee optimal performance and long life of your hydraulic equipment.

Options

Fittings

110

Important

Do not exceed the maximum pressure.

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

High pressure fittings *Selection & dimensions*

Shown: FZ-2023, FZ-2054, FZ-2052

99-036

Fittings are used to connect all cylinders, components, power sources, tubes, gauges and hoses in a hydraulic system. Enerpac fittings provide flexible, safe and leak-free connections.

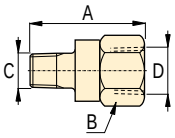
Multiple hydraulic line connections are easily installed with Enerpac fittings and manifolds.

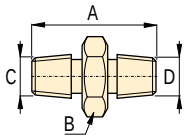
99-060

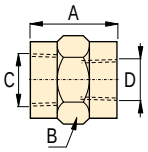
Proper connection for hydraulic components

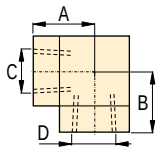
- Male and female BSPP, UNF, NPT threaded fittings in common sizes allow easy connection of all components
- BFZ and FZ-1000 models are 700 bar maximum pressure
- FZ-2000 models are 350 bar maximum pressure

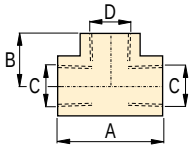
Product selection

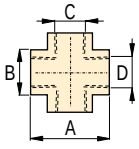












From	To	Max. pressure bar	Model number	Dimensions in millimetres A	B	C	D
▼ Adaptors							
1/4" NPT	1/8" NPT	700	**FZ-1642**	30	19	1/8" NPT	1/4" NPT
G1/4"	1/4" NPT	700	**BFZ-16411**	35	19	1/4" NPT	G1/4"
G1/4"	1/8" NPT	700	**BFZ-16421**	31	19	1/8" NPT	G1/4"
G3/8"	1/4" NPT	700	**BFZ-16323**	43	24	1/4" NPT	G3/8"
G3/8"	3/8" NPT	700	**BFZ-16324**	43	24	3/8" NPT	G3/8"
3/8" NPT	1/4" NPT	700	**FZ-1055**	45	24	1/4" NPT	3/8" NPT
SAE #4	1/4" NPT	350	**FZ-2007**	29	19	7/16" UN	1/4" NPT
SAE #4	1/8" NPT	350	**FZ-2008**	25	14	7/16" UN	1/8" NPT
SAE #4	SAE #2	350	**FZ-2022**	29	17	5/16" UN	7/16" UN
1/2" NPT	1/4" NPT	700	**FZ-1633**	43	29	1/4" NPT	1/2" NPT
1/2" NPT	3/8" NPT	700	**FZ-1634**	43	29	3/8" NPT	1/2" NPT
▼ Nipples							
1/4" NPT	1/4" NPT	700	**FZ-1608**	38	16	1/4" NPT	1/4" NPT
3/8" NPT	G1/4"	700	**BFZ-305**	36	19	3/8" NPT	G1/4"
3/8" NPT	3/8" NPT	700	**FZ-1617**	38	19	3/8" NPT	3/8" NPT
3/8" NPT	3/8" NPT	700	**FZ-1619**	51	19	3/8" NPT	3/8" NPT
▼ Connectors							
1/4" NPT	1/4" NPT	700	**FZ-1605**	28	19	1/4" NPT	1/4" NPT
3/8" NPT	1/4" NPT	700	**FZ-1615**	29	25	3/8" NPT	1/4" NPT
3/8" NPT	3/8" NPT	700	**FZ-1614**	37	24	3/8" NPT	3/8" NPT
1/2" NPT	3/8" NPT	700	**FZ-1625**	48	29	1/2" NPT	3/8" NPT
▼ Elbows							
1/4" NPT	1/4" NPT	700	**FZ-1638**	36	24	1/4" NPT	1/4" NPT
3/8" NPT	3/8" NPT	700	**FZ-1610**	33	20	3/8" NPT	3/8" NPT
▼ Tee							
1/4" NPT	1/4" NPT	700	**FZ-1637**	45	24	1/4" NPT	1/4" NPT
3/8" NPT	3/8" NPT	700	**FZ-1612**	45	25	3/8" NPT	3/8" NPT
▼ Cross							
3/8" NPT	3/8" NPT	700	**FZ-1613**	45	25	3/8" NPT	3/8" NPT

Pressure: 0-700 bar

Threads: NPT, UNF, BSPP

For tubing: 0,25 inch / 8 mm

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

Product selection

From	To	Max. pressure bar	Model number	Dimensions A	B	C	D
▼ Reducers							
3/8" NPT	1/4" NPT	700	**FZ-1630**	19	14	1/4" NPT	3/8" NPT
3/8" NPT	G1/4"	700	**BFZ-16301**	19	19	G1/4"	3/8" NPT
▼ Adaptors SAE to 37° Flared Tube							
SAE #4	ø 0,25"	350	**FZ-2019**	31	14	7/16" UN	ø 0,25"
SAE #4	ø 0,25"	350	**FZ-2039**	35	22	3/4" UN	ø 0,25"
▼ Adaptor SAE to 37° Flared End							
SAE #2	ø 0,25"	350	**FZ-2025**	32	14	5/16" UN	ø 0,25"
▼ Swivel banjo BSPP to tube							
G1/4"	ø 8 mm	700	**BFZ-307**	28	30	G1/4"	ø 8 mm
▼ Swivel T-banjo BSPP to tube							
G1/4"	ø 8 mm	700	**BFZ-309**	28	30	G1/4"	ø 8 mm
▼ Straight union							
SAE #4	SAE #4	350	**FZ-2005**	31	14	7/16" UN	7/16" UN
▼ SAE plug							
SAE #4	–	350	**FZ-2006**	2,5	14	7/16" UN	–
▼ Adaptor NPT to 37° Flared End Tube							
1/4" NPT	ø .25"	350	**FZ-2020**	36	14	1/4" NPT	ø 0,25"
▼ Adaptors							
G1/8"	1/8" NPT	350	**FZ-2055**	24	19	G1/8"	1/8" NPT
G1/4"	1/4" NPT	350	**FZ-2023**	32	22	G1/4"	1/4" NPT
1/4" NPT	SAE #4	350	**FZ-2042**	33	18	1/4" NPT	7/16" UN
G1/8"	1/4" NPT	350	**FZ-2060**	31	19	G1/8"	1/4" NPT

Options

Gauges and accessories
106

Manifolds, couplers, hoses, oil
108

Important

Do not exceed maximum pressure.

Use fittings and tubing in high cycle applications and areas having excessive heat or weld splatter.

To seal NPT threads use anaerobic thread sealers or Teflon paste.

Apply Teflon tape one thread from the end of the fitting, to prevent it from winding up in the hydraulic system.

Multiple line connections are easily installed with Enerpac fittings.

High pressure fittings *Selection & dimensions* BFZ, FZ series

Pressure: 0-350 bar
Threads: NPT, UNF, BSPP
For tubing: 0,25 inch / 8 mm

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

Options

Manifolds, couplers, hoses, oil
108

Gauges and accessories
106

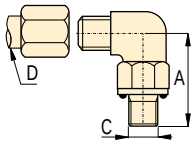
Important

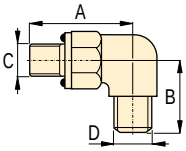
Do not exceed maximum pressure.

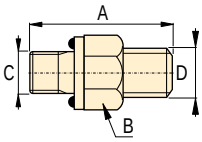
Use fittings and tubing in high cycle applications and areas having excessive heat or weld splatter.

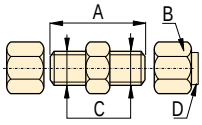
High pressure fittings enable the design of hydraulic systems to meet a variety of applications.

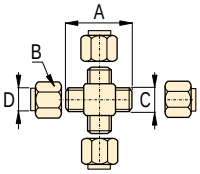
99-060

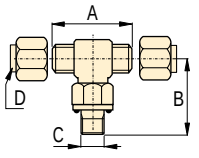


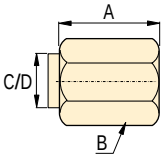


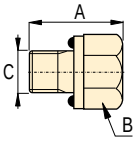












Product selection

From	To	Max. pressure bar	Model number	Dimensions A	B	C	D
▼ Elbow SAE to 37° Flared End							
5/16”-24	ø 0,25”	350	**FZ-2024**	26	19	5/16”UN	ø 0,25”
7/16”-20	ø 0,25”	350	**FZ-2035**	26	19	7/16”UN	ø 0,25”
▼ Elbow BSPP to 37° Flared End							
G1/8”	7/16”-20	350	**FZ-2051**	26	23	G1/8”	7/16”UN
G1/4”	7/16”-20	350	**FZ-2052**	32	27	G1/4”	7/16”UN
▼ Straight union BSPP to 37° Flared End							
G1/8”	7/16”-20	350	**FZ-2053**	29	23	G1/8”	7/16”UN
G1/4”	7/16”-20	350	**FZ-2054**	32	27	G1/4”	7/16”UN
▼ Straight union 37° Flared Tube Ends							
1/4”	ø 0,25”	350	**FZ-2033**	35	13	1/4”	ø 0,25”
▼ Cross Flared 37° Tube Ends							
1/4”	ø 0,25”	350	**FZ-2034**	45	13	1/4”	ø 0,25”
▼ Tee SAE to Flared Tube							
SAE #4	ø 0,25”	350	**FZ-2036**	45	26	7/16”UN	ø 0,25”
▼ 37° Flared nut and sleeve for 1/4” tubing							
1/4”	ø 0,25”	350	**FZ-2037**	15	14	37°	ø 0,25”
▼ 37° Flared cap for 1/4” tubing							
1/4”	ø 0,25”	350	**FZ-2038**	15	14	37°	ø 0,25”
▼ SAE Plug							
SAE #8	–	350	**FZ-2041**	19	18	3/4”UN	–

Enerpac “Yellow Pages”

stand for

Hydraulic Information!

If selecting hydraulic equipment is not your daily routine, then you will appreciate these pages. The “Yellow Pages” are designed to help you work with hydraulics. They will help you to better understand the basics of hydraulics of system set-ups and the most commonly used hydraulic techniques. The better your choice of equipment, the better you will appreciate hydraulics.

Take the time to go through these “Yellow Pages” and you will benefit even more from Enerpac hydraulic and mechanical workholding.

Global Warranty

See page 126 in this catalogue or Visit **www.enerpac.com** for the complete Global Lifetime Warranty.

Enerpac is certified for several quality standards. These standards require compliance with standards for management, administration, product development and manufacturing.

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

UL approved

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

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.

World Standard Guarantee

All Enerpac products are guaranteed against defects in workmanship and materials for as long as you own them. Replace worn or damaged parts with genuine Enerpac parts. These are designed to fit properly and withstand rated loads.

CE Marking & Conformity

Enerpac provides a Declaration of Conformity and CE marking for products that conform with the European Community Directives.

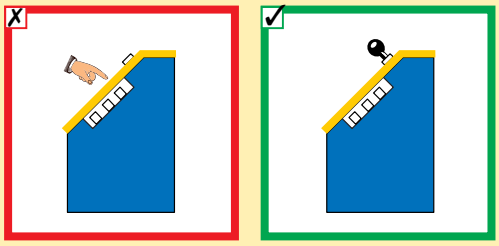
Safety instructions *Correct use of hydraulic power*

Hydraulic clamping can increase your machine shop's efficiency by reducing setup time. Power clamping can also maximize output in another way–by reducing employee lost time due to the injuries that can occur with manual clamping.

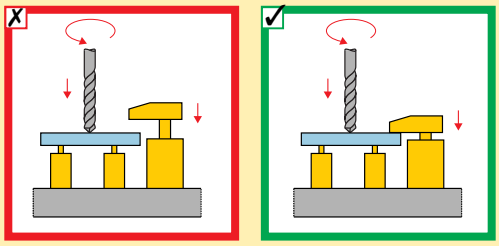
Although hydraulic operation moves the control of the clamping fixture to an area of greater safety, operators must still be alert to several common sense practices. And to that end we offer some DOs and DON'Ts, simple common sense points which apply to practically all Enerpac hydraulic products.

The line drawings and application photos of Enerpac products throughout this catalog are used to portray how some of our customers have used hydraulics in industry. In designing similar systems, care must be taken to select the proper components that provide safe operation and fit your needs.

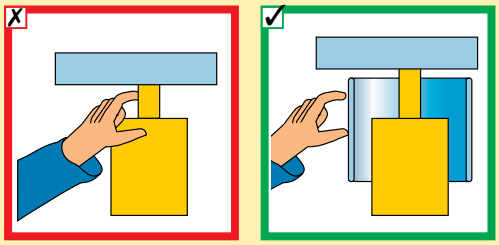
Check to see if all safety measures have been taken to avoid the risk of injury and property damage from your application or system.
Enerpac can not be held responsible for damage or injury, caused by unsafe use, maintenance or application of its products. Please contact the Enerpac office or a representative for guidance when you are in doubt as to the proper safety precautions to be taken in designing and setting up your particular system.
In addition to these tips, every Enerpac product comes with instructions spelling out specific safety information. Please read them carefully.



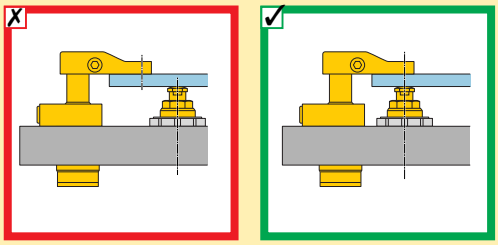
Prevent inadvertent activation of the control units of power operated clamping systems.



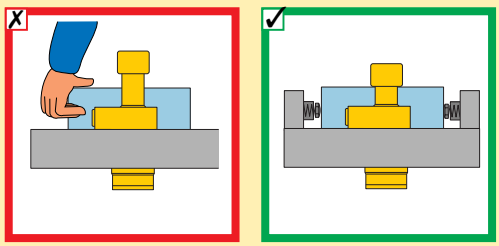
Clamping devices must be activated before main spindle can be started.



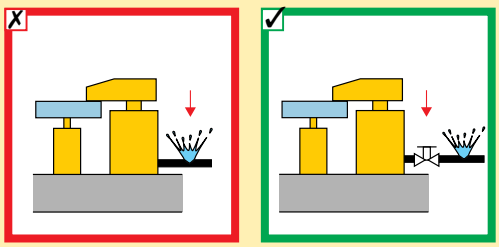
Obey the safe distance between clamping elements and workpiece to avoid personal injury.



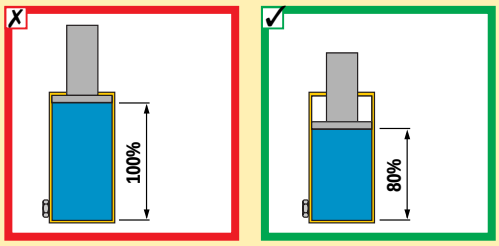
Do not apply off-center load. Clamping force must be directly over the support point.



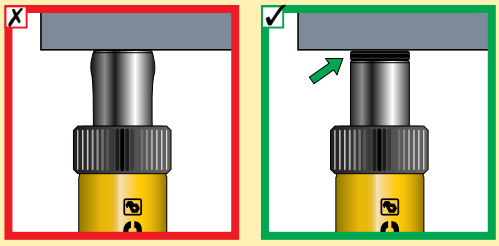
Use mechanical devices and not fingers to hold part until the hydraulics are activated.



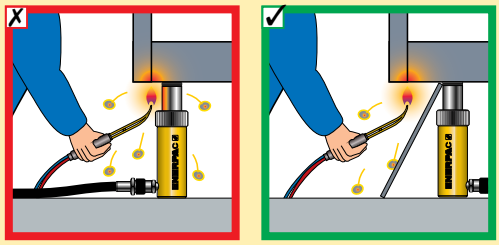
Use check-valves to maintain hydraulic pressure to clamping devices in the event of a hydraulic line failure



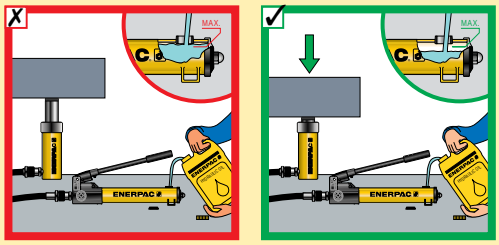
Do not operate cylinders beyond limits of rated stroke or pressure. Use only 80% of usable stroke.



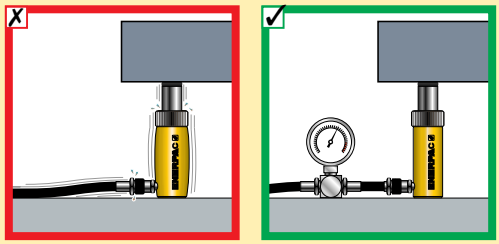
Use saddles or buttons to prevent mushrooming of plungers. Saddles distribute load evenly on the plunger.



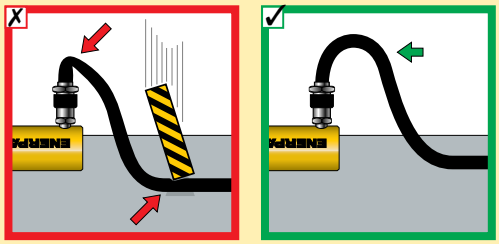
Keep hydraulic equipment away from open fire and temperatures above 65 °C (150 °F).



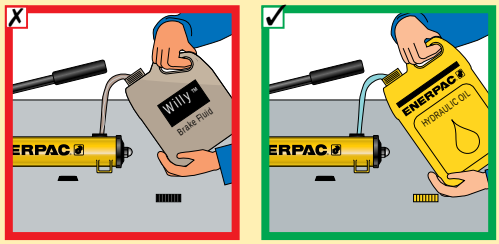
Fill pump only to recommended level. Fill only when connected cylinders are fully retracted.



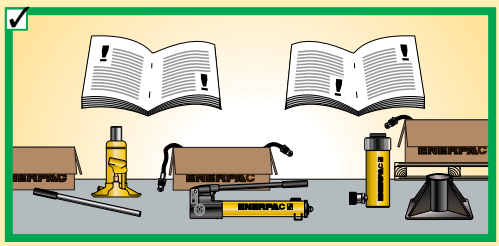
Do not override the factory setting of pressure relief valves. Always use a gauge to check system pressure.



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.



Use genuine Enerpac hydraulic oil. Wrong fluid destroys seals and pump, will render your warranty null and void your guarantee.



Always read instructions and safety warnings that come with your Enerpac hydraulic equipment.

www.enerpac.com

Visit our web site to learn more about hydraulics and system set ups.

Basic hydraulics *Things to know*

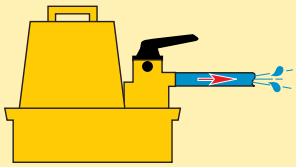
Oil Flow

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

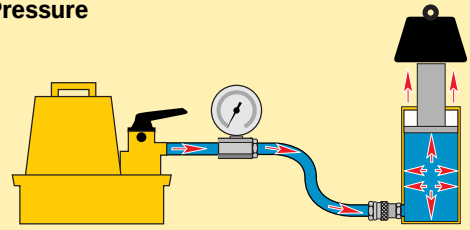
Pressure

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).

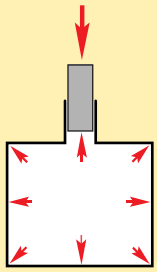


Figure 1

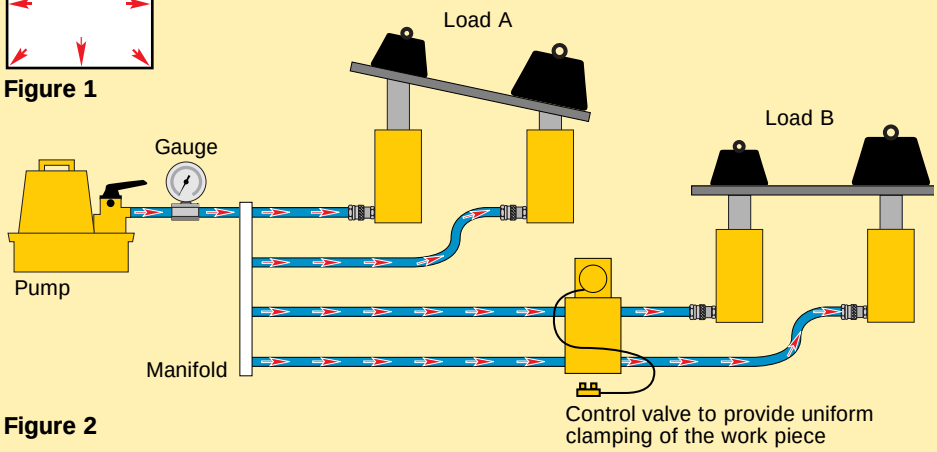
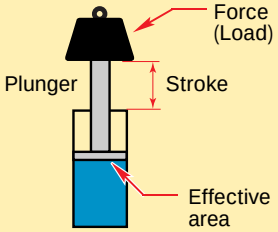


Figure 2

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.

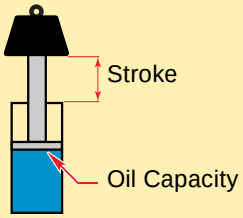


Force	=	Hydraulic Working Pressure	x	Cylinder Effective Area
F	=	P	x	A

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.

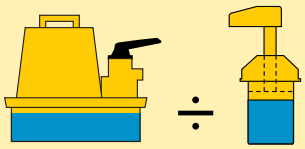
Cylinder Oil Capacity (cm^3) = **Cylinder Effective Area** (cm^2) x **Cylinder Stroke** (cm)



Usable Oil Capacity

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

Pump Usable Oil Capacity (cm^3) = **Cylinder Oil Capacity** (cm^3) x **Total Number of Cylinders**



Cylinder Speed

Cylinder speed is determined by dividing the pump flow rate by the cylinder effective area.

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

Seals

Various seal types are used in our hydraulic equipment: O-rings, U-cups, Quad-rings and T-rings for static and dynamic applications such as rod-seal, piston-seal and wipers. Buna-N (nitrile rubber) and Polyurethane basic compounds are most frequently used - they offer the best performance and durability for most applications.

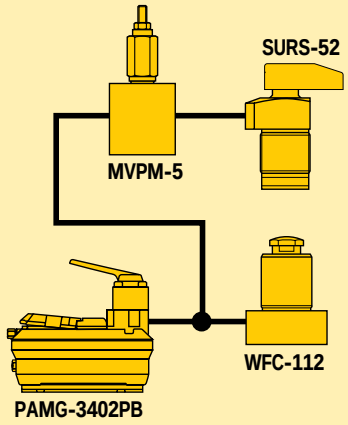
Heat is a crucial factor in seal life. Maximum temperature for good seal life is 65°C. This is also the maximum temperature of Enerpac hydraulic oil. Above 65°C, the use of Viton and high temperture oil seals is necessary. Viton has a maximum temperature which is much higher. Viton is however an extremely 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 compatibilty with any seal material. Cutting fluid suppliers will provide an application book on the compatibility of their fluids. If problems arise after previously successfull 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 dealing with equipment selection, one with system connection.



Step 1

Selecting the type of cylinders by choosing the right 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 – to match in terms of type, stroke and force rating

Positioning and push cylinders to position the workpiece and to push-clamp it securely in that position.

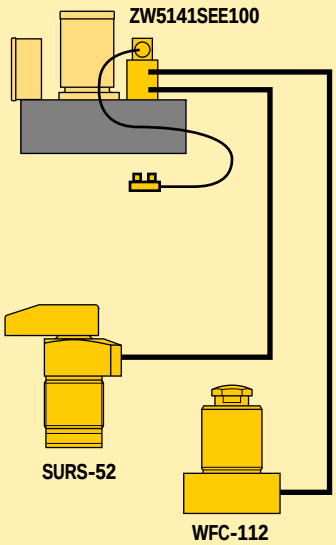
Down-Holding cylinders to clamp the positioned workpiece firmly to the fixture or worktable. The range of Enerpac swing cylinders and edge-clamps meet virtually any down-holding requirement.

Pull cylinders 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 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, 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

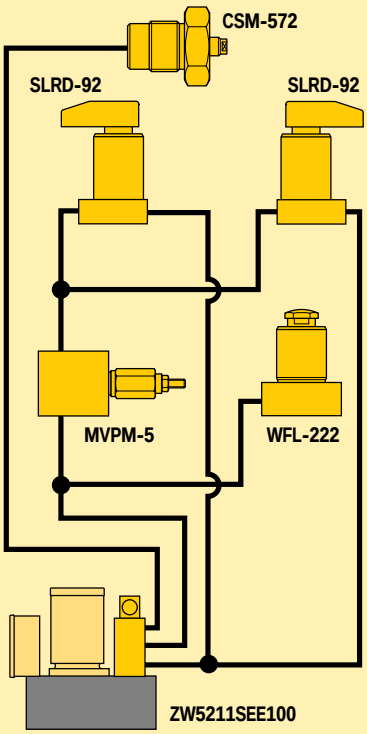
Selecting the power source. The power source for an automatic workholding system can accurately be matched to the requirements. Enerpac pumps span a wide range of sizes and capacities – in compressed air or electric-driven configurations.

Step 4

Connecting 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. ZW5 Workholding pump
2. GA Gauge Adaptor
3. G Pressure gauge
4. H Hoses
5. FZ Fittings
6. SU Swing cylinders
7. WFC Work Support cylinders
8. MVPM-5 Sequence valve

Select all these components from their respective catalog sections.



Swing Cylinders and Worksupports

The combined use of clamping cylinders and work supports in fixturing has become indispensable.

Swing cylinders have become important clamping components for fixturing applications where unrestricted loading and unloading of the workpiece is required. Enerpac offers the most complete, comprehensively featured and compact swing cylinder line.

Work supports are widely used to support critical workpiece areas to prevent them from bending and/or vibrating during the machining process. Thus minimizing the deflection of the workpiece, improving it's quality and assuring a high degree of repeatability.

The combination of swing cylinders and work supports provides substansial time savings and quality improvements in the machine tool industry.

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

Maximum clamp arm length
The maximum clamp arm length of a given size of swing clamp is limited. This limitation is due to the bending moment on the plunger. The bending moment applied to the plunger is a function of the real clamping force and length of the clamp arm. Never exceed the maximum pressure or flow for any given clamp arm length. Excessive weight will limit flow.

Actual Clamping Forces
The actual clamping force is important to know. Frictional losses will reduce the actual clamping force to between 40% and 95% of theoretical values. The unique Enerpac swing clamp and patented clamp arm guarantee the lowest frictional losses and most efficient clamp design available on the market today.

The length of a standard single clamp arm, together with the clamping force, creates a bending moment on the plunger. This bending moment will result in increased friction.

The higher the theoretical clamping force, the higher the friction and hence loss in actual clamping force. Actual force is not a product of just pressure and cylinder effective area.

For actual clamping force at reduced pressures, we invite you to download our “Swing Clamp Selection Tool” through the Internet at **www.enerpac.com**.

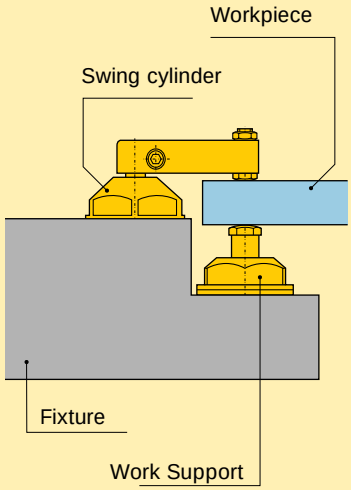


Figure 1
The combined use of clamping cylinders and work supports.

Download the **Swing Clamp Selection Tool.** The size of the swing cylinder you can use is depending 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.

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 by this 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 it's capacity at a given operating pressure. For many applications this is sufficient to absorb additional forces like machining forces. This 2 to 1 safety facctor may need to be increased to 4 to 1 if extreme vibration or an interrupted cut is used.

The pressure/force diagrams, provided in the product selection pages of this catalog, allow for quick selection of the right combination of swing cylinder and work support.

The recommended ratio between clamping force and support force can be achieved by selecting the right sizes of the clamping components and/or by operating the swing cylinder and the work support with different operating pressures, e.g. the work support will be operated at maximum pressure while the swing cylinder operates at a reduced pressure.

Point of contact

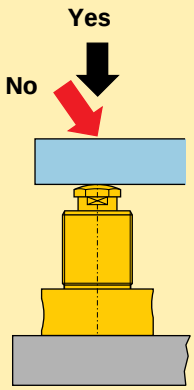


Figure 2

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 worksupport must be avoided in order to ensure a reliable and safe function (Figure 2).

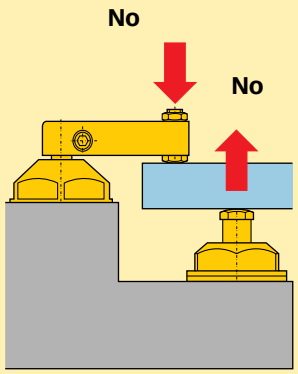


Figure 3

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

Hydraulic requirements

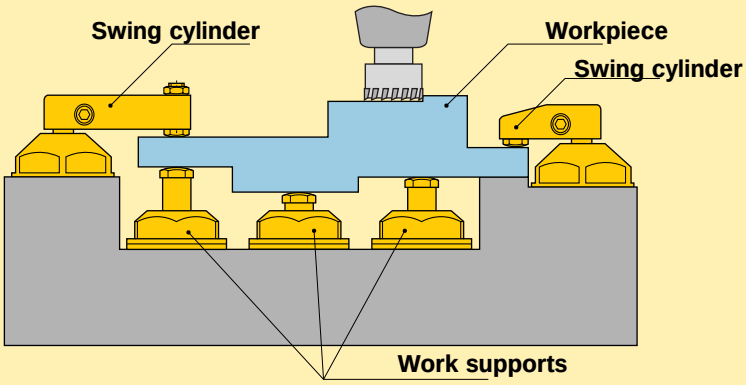
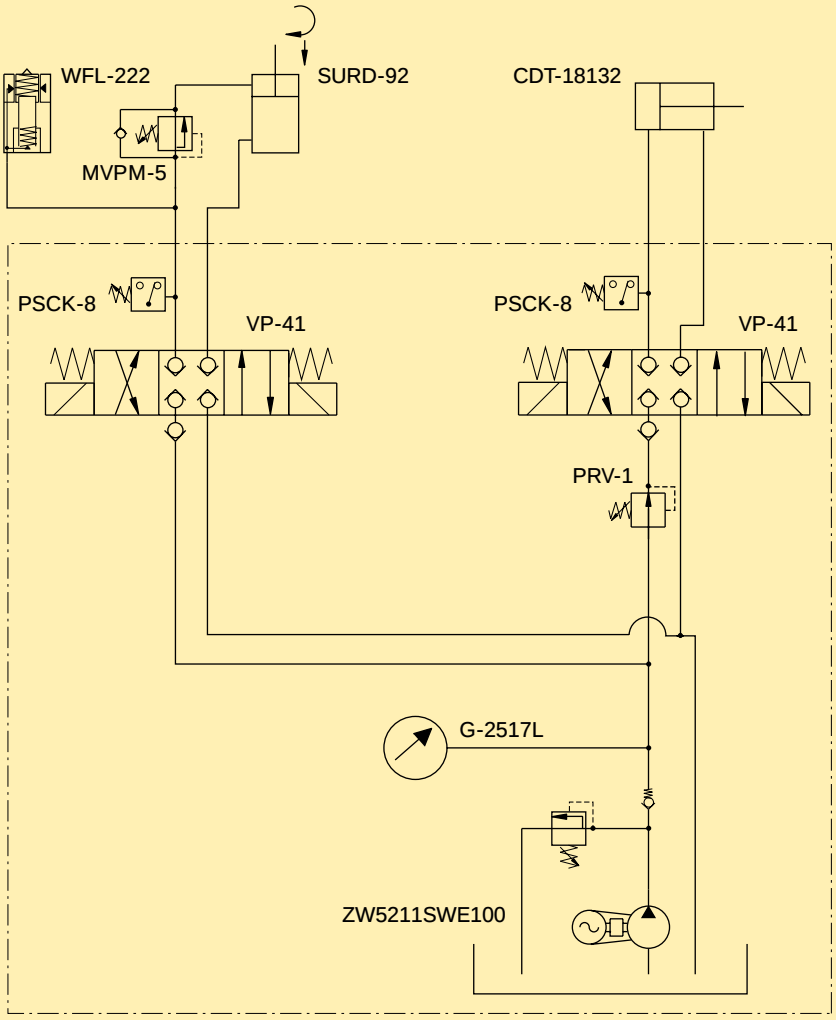


Figure 4

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 to be ensured that work supports will be operated only after the workpiece is firmly positioned and held against locators and datum's. 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)



WFL-222	Work Support
SURD-92	Swing cylinder
CDT-18132	Threaded cylinder
MVPM-5	Sequence Valve
ZW5211SWE	Workholding pump with:
VP-41	modular directional valve
PSCK-8	pressure switch
G-2517L	pressure gauge
PRV-1	pressure reducing valve

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.

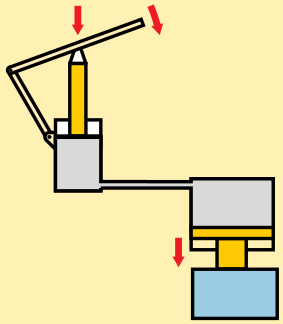


Figure 1: Operating principle of a hydraulic clamping device

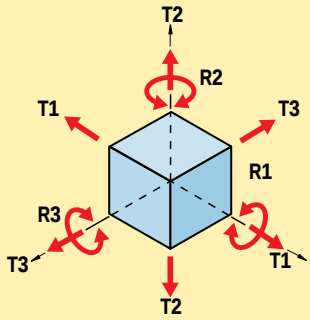


Figure 2: Three-dimensional Body

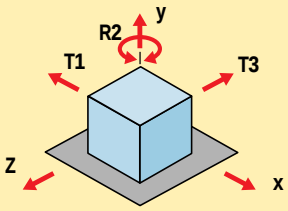


Figure 3a: Three degrees of freedom.

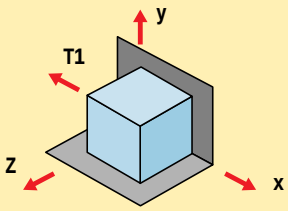


Figure 3b: One degree of freedom.

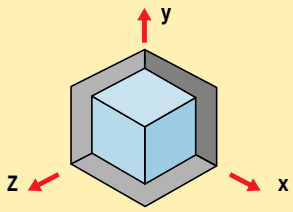


Figure 3c: Zero degree of freedom

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 illustration ”a” in Figures 2 and 3. 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.

a. Level 1: Three degrees of freedom
b. Level 2: One degree of freedom
c. Level 3: Zero degree of freedom

The degrees of freedom that a given workpiece or body possesses may be reduced by introducing reference planes that pass through any two axes.

For example, the plane in Figure 3a limits movement to travel in X and Z directions and rotation about the Y-axis. By defining this fixed plane, the workpiece can thus be limited or constrained to three degrees of freedom.

Another two degrees of freedom may be constrained by introducing a second reference plane, as shown in Figure 3b. This reference plane limits movement to translational motion in the X direction.

Constraining the last degree of freedom can be accomplished by defining a third reference plane as shown in Figure 3c.

2.1.3 Locating a Workpiece

Since locating a workpiece does not necessarily require the elimination of movement in all six degrees of freedom, the following three locating techniques are used in actual practice.

Figure 4a: Semi-constrained Workpiece. The workpiece is held in one plane only (elimination of three degrees of freedom).

Figure 4b: Constrained Workpiece. The workpiece is held by two planes (elimination of five degrees of freedom)

Figure 4c: Fully-constrained Workpiece. The workpiece is held by three planes (elimination of six degrees of freedom)

2.1.4 Avoiding Over-location

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.

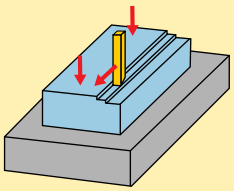


Figure 4a: Semi-constrained Workpiece.

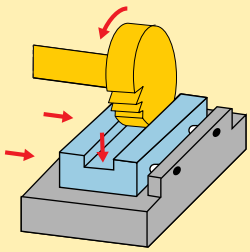


Figure 4b: Constrained Workpiece.

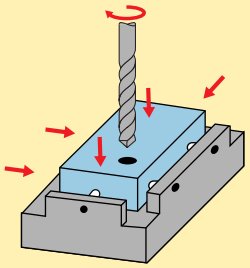


Figure 4c: Fully-constrained Workpiece.

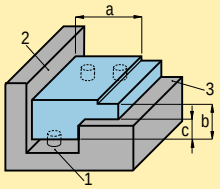


Figure 5a: Workpiece with locating planes.

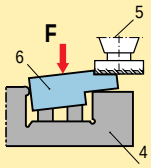


Figure 5b: Incorrectly located workpiece.

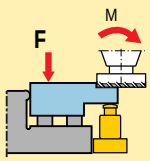


Figure 5c: Correctly located workpiece.

Clamping technology

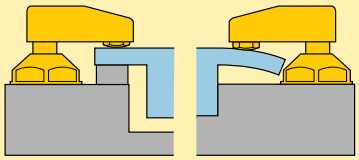


Figure 6: Design guidelines for clamping.

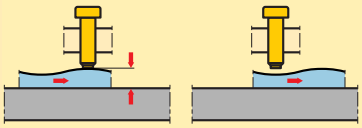


Figure 7: Mechanical clamping.

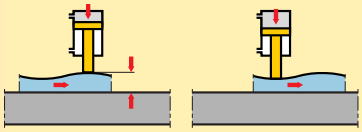


Figure 8: Hydraulic clamping.

As with clamping, locating is subject to a number of design guidelines, although exceptions are possible:

- Keep the clamping force vector away from the critical tolerance zones on the workpiece.
- Workpiece deformation and marking due to clamping forces should be avoided or minimized.
- The clamping points on the workpiece should be selected so that the piece can be machined without reclamping or, if this is not feasible, with a minimum of reclamping.
- The required clamping forces should be approximated by rough estimations.
- The clamping dimensions of the workpiece may change due to thermal expansion and vibration resulting from machining.
- The workpiece should only be exposed to a clamping force if it is appropriately supported by a solid bearing point, as illustrated in Figure 6.

The dimensions of clamped workpieces may change due to vibrations and the effects of thermal expansion. Two types of clamping may compensate for these changes.

- Mechanical Clamping
- Hydraulic Clamping

The illustration in Figure 7 (mechanical clamping) demonstrates that tension is relieved as the dimensions of the workpiece in the clamping area change.

In hydraulic clamping, the clamping elements gripping the workpiece adjust to changes while maintaining a constant clamping force. This is illustrated in Figure 8, where the workpiece is elongated due to temperature increases during machining.

Mechanical clamping is accomplished by using the following mechanical clamping elements:
- Clamping Bars
- Clamping Springs
- Clamping Nuts
- Clamping Bolts (Figure 7)

Hydraulic clamping is achieved by:
- Elastomeric Media
- Clamping with air (pneumatic clamping)
- Clamping with liquids (hydraulic clamping).

Mechanical clamping elements are usually used for simple clamping devices. However, mechanical clamping elements may be converted to hydraulic ones by inserting cylinders between the clamping element and the workpiece. In addition, mechanical elements may also be combined with hydraulic clamping elements.

Clamping may be subject to errors that cause deformation of the clamped workpiece. Since such deformations must not affect the function of the workpiece, all conceivable locating and supporting techniques, as well as the best possible directed transmission of the clamping force through the workpiece, should be considered.

It is recommended that clamping forces be estimated to prevent excessively high clamping forces and possible deformation of the workpiece. Deformation of the workpiece may also be avoided by selecting a suitable shape (for example, a sphere) for the clamping points and the locating points.

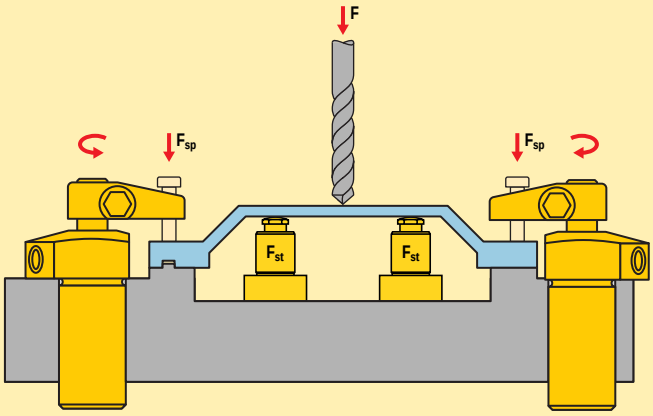


Figure 9: Supported workpieces.

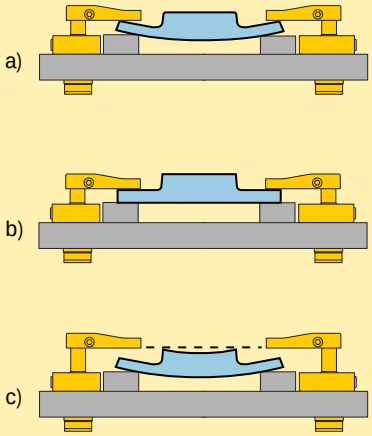


Figure 10a: Deformation caused by conventional clamping.

4 Supporting the workpiece

4.1 Supported workpiece

The workpiece requires support to ensure functional force transmission between the tool, the workpiece, and the clamping device, and / or to protect the workpiece from deformation (such as deflection at points with a thin cross-section) due to machining forces, gravitational forces, and clamping forces. Workpiece support also acts to eliminate the resulting machining errors (Figure 9).

In addition, surface quality may be improved and the service life of the tool prolonged with the use of an optimum supporting mechanism. The three-dimensional position of a workpiece, however, should not be defined by its support. It is preceded sequentially by the locating process and also has a lower priority.

4.2 Supporting Options for Bent Workpieces

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.

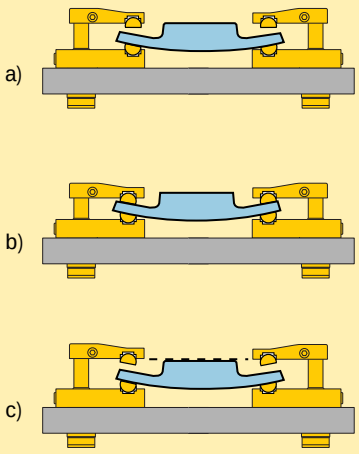


Figure 10b: Eliminate deformation using spherical ball supports.

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 is applied to the solid bearing surfaces of the device (Figure 11).

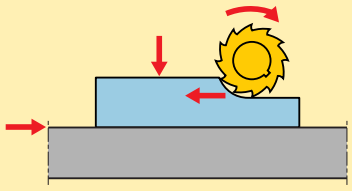


Figure 11: Approximation of the clamping force.

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All illustrations and calculations are for reference only. Enerpac does not take responsability for calculations given in these Yellow Pages.

ENERPAC products are warranted to be free of defects in materials and workmanship under normal use for as long as they are owned by the original purchaser, subject to the exclusions and limitations described below. This warranty does not cover ordinary wear and tear, overloading, alterations, (including repairs or attempted repairs by parties other than ENERPAC or its authorized service representatives), improper fluid, use in a manner for which they are not intended or use which is contrary to instructions for the products.
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If the customer believes a product is defective, the product must be delivered, or shipped freight prepaid, to the nearest ENERPAC Authorized Service Center. The customer should contact ENERPAC to locate an Authorized Service Center in the customer's area. Products that do not conform to this warranty will be repaired or replaced at ENERPAC's expense and returned by ground transportation, freight prepaid.

THE FOREGOING WARRANTY IS EXCLUSIVE AND IS IN LIEU OF ALL OTHER EXPRESS AND IMPLIED WARRANTIES, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

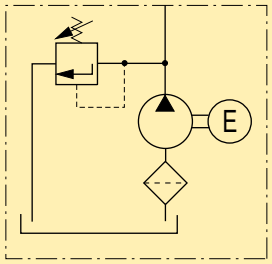
The remedy of repair, replacement or refund is customer's exclusive remedy in the event of breach of this warranty.

SELLER SHALL NOT BE SUBJECT TO AND DISCLAIMS:
(a) ANY OTHER OBLIGATIONS OR LIABILITIES ARISING OUT OF BREACH OF CONTRACT OR OF WARRANTY,
(b) ANY OBLIGATIONS WHATSOEVER ARISING FROM TORT CLAIMS (INCLUDING NEGLIGENCE AND STRICT LIABILITY) OR ARISING UNDER THEORIES OF LAW WITH RESPECT TO PRODUCTS SOLD OR SERVICES RENDERED BY SELLER OR ANY UNDERTAKINGS, ACTS OR OMISSIONS RELATING THERETO, AND
(c) ALL CONSEQUENTIAL, INCIDENTAL AND CONTINGENT DAMAGES WHATSOEVER.

ENERPAC's liability in all cases is limited to, and shall not exceed, the purchase price paid.

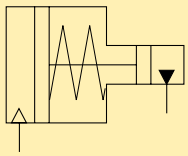
Effective June 1, 1997

Power Sources



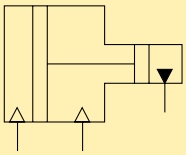
Single-stage electric pump

Example
ZW5-series



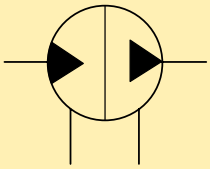
Single-acting booster

Example
B-3006



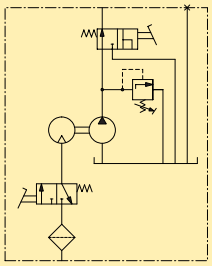
Double-acting booster

Example
AHB-34



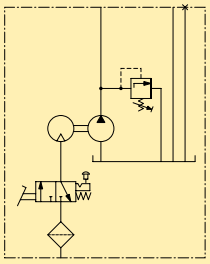
Hydraulic intensifier

Example
PID-322



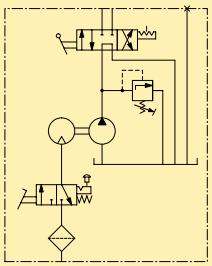
Turbo air pump

Example
PATG-3102PB



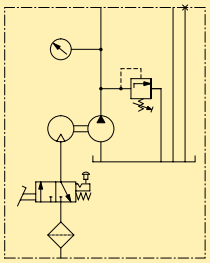
Turbo air pump

Example
PASG-3002PB



Turbo air pump

Example
PAMG-3402PB



Turbo air pump

Example
PACG-3002PB

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

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

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

Volume:

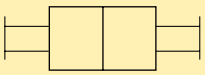
1 in^3	= 16,387 cm^3
1 cm^3	= 0,061 in^3
1 liter	= 61,02 in^3
	= 0,264 gal
1 USgal	= 3,785 cm^3
	= 3,785 l
	= 231 in^3

Other measurements:

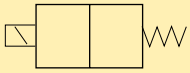
1 in	= 25,4 mm
1 mm	= 0,039 in
1 in^2	= 6,452 cm^2
1 cm^2	= 0,155 in^2
1 hp	= 0,746 kW
1 kW	= 1,340 hp
1 Nm	= 0,738 Ft.lbs
1 Ft.lbs	= 1,356 Nm
1 kN	= 224,82 lbs
1 lb	= 4,448 N

Hydraulic symbols *Most common system elements*

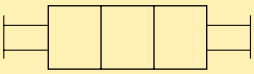
Valves



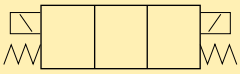
2-position, manual



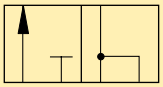
2-position, solenoid



3 position manual

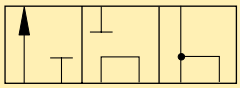


3 position solenoid



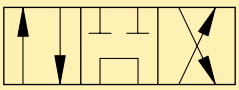
3-way, 2-position,
Normally open

Series	Example
V	**VM-2**



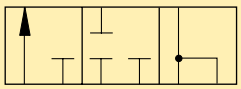
3-way, 3-position, Tandem center

Series	Example
V	**VM-3, VC-3**



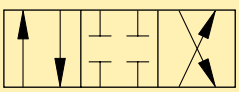
4-way, 3-position, Tandem center

Series	Example
V	**VM-4, VC-4**



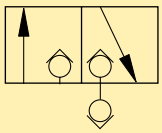
3-way, 3-position, Closed center

Series	Example
V	**VC-15**



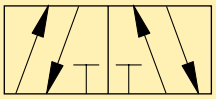
4-way, 3-position, Closed center

Series	Example
V	**VC-20**



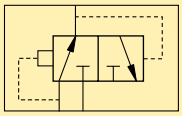
3-way, 2-position, Normally closed

Series	Example
VP	**VP-31**



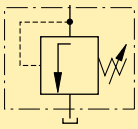
4-way, 2-position, Air valve

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



Rapid air exhaust valve

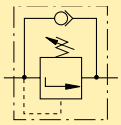
Series	Example
VR	**VR-3**



Pressure relief valve

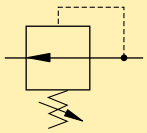
Series	Example
V	**V-152**

Valves



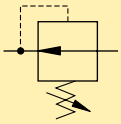
Sequence valve

Series	Example
MVPM	**MVPM-5**
V	**V-2000**



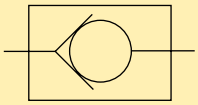
Pressure limiting valve

Series	Example
PLV	**PLV-40013B**



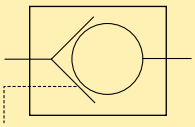
Pressure reducing valve

Series	Example
PRV	**PRV-1**



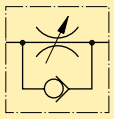
Check valve

Series	Example
V	**V-17**



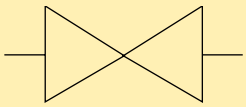
Check valve, pilot operated

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



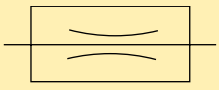
Flow control valve, free flow check

Series	Example
VFC	**VFC-1**



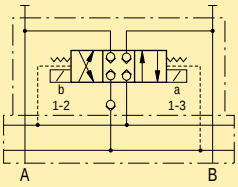
Shut-off valve

Series	Example
V	**V-12**



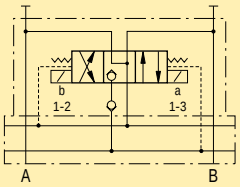
Auto-damper valve

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



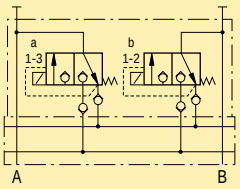
4-way, 3-position, Closed center

Example
VP-11



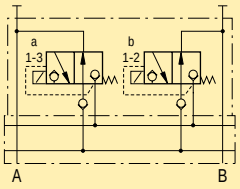
4-way, 3-position, Float center

Example
VP-21



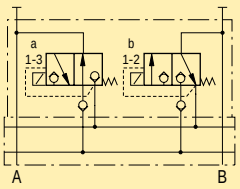
3-way, 2-position, normally closed

Example
VP-31



3-way, 2-position, normally open

Example
VP-41

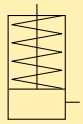


3-way, 2-position,
one port normally open and one port normally closed

Example
VP-51

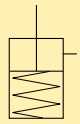
Hydraulic symbols *Most common system elements*

Cylinders



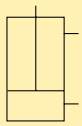
Single-acting cylinder, push

Example
BMS-18252
CST-5132
CSM-5132



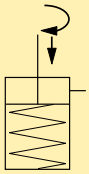
Single-acting cylinder, pull

Example
PLSS-52
PTSS-52
PUSS-52



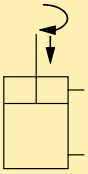
Double-acting cylinder

Example
BD-18252
BRD-96
CDT-18132



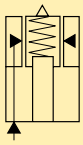
Single-acting swing cylinder

Example
SLRS-92
STRS-92
SURS-92



Double-acting swing cylinder

Example
SLRD-92
STRD-92
SURD-92

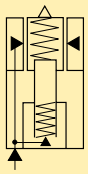


Spring advance work support

Example
WSL-112

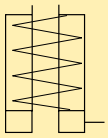
Positive clamping cylinder

Example
MRS-5
MRS-1001

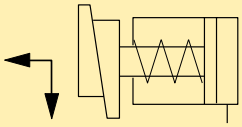


Fluid advance work support

Example
WFL-112

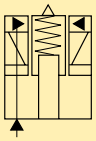


Single-acting hollow plunger cylinder
Example
HCS-80
MRH-20

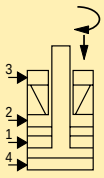


Pull down clamp

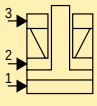
Example
ECH-202



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

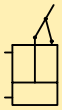


Collet-Lok® swing cylinder positive locking
Example
MPFR-100
MPTR-100



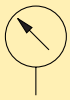
Collet-Lok® push cylinder positive locking
Example
MPFC-110
MPTC-110

Link clamp, single-acting
Example
LUCS-32



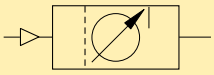
Link clamp, double--acting
Example
LUCD-82

System Components



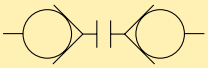
Pressure gauges

Example
DGR-1
G-2535L



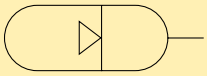
Air regulator

Example
RFL-102



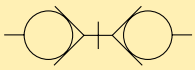
Hydraulic couplers, uncoupled

Example
AH-650
AH-652
AH-654



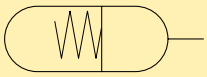
Accumulator, gas charged

Example
ACL-202



Hydraulic couplers, coupled

Example
AH-650
AH-652
AH-654

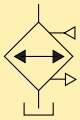


Accumulator, spring loaded

Example
ACM-1

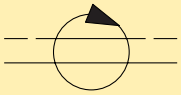
Rotary coupler, single passage

Example
CRV-112



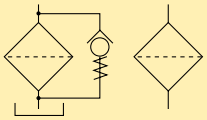
Heat exchanger

Example
ZHE-E04
ZHE-E10



Rotary coupler, double passage

Example
CRV-222

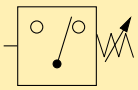


Return Line Filter,
High Pressure Filter, in line

Example
FL-2101

Rotary coupler, four passage

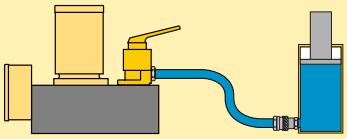
Example
CRV-442



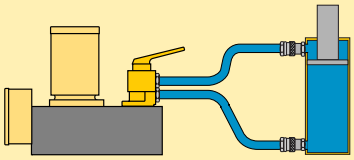
Pressure switch

Example
PSCK-8

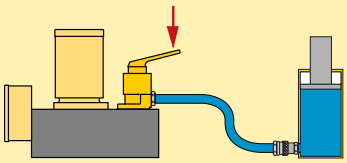
Valving Technology *How and when to use hydraulic valves*



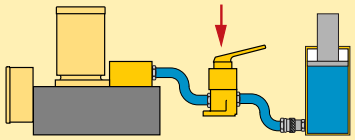
3-way valve used with single-acting cylinder



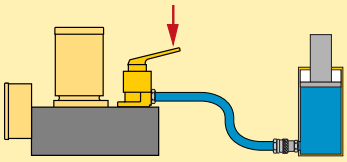
4-way valve used with double-acting cylinder



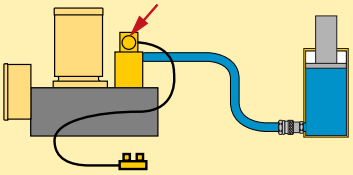
Valves can be **pump mounted**



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**
2. **Pressure Control**
3. **Flow Control**

1 Directional Control Valves

Ways – the (oil) ports on a valve.

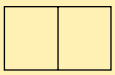
A 3-way valve has 3 ports: pressure (P), tank (T), and cylinder (A).

A 4-way valve has 4 ports: pressure (P), tank (T), advance (A) and retract (B).

Single-acting cylinders require at least a 3-way valve, and can, under certain instances, be operated with a 4-way valve.

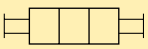
Double-acting cylinders require a 4-way valve, providing control of the flow to each cylinder port.

Positions – the number of control points a valve can provide.

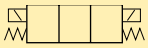


A **2-position valve** has the ability to control only the advance or retraction of the cylinder. To be able to control the cylinder with a hold position, the valve requires a 3rd position.

Operation – the way to shift the valve into position



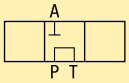
The valve position can be **manually operated** with the use of the handle.



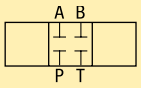
The valves position can be **solenoid operated** using power supply.

Center Configuration

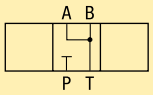
The center position of a valve is the position at which there is no movement required of the hydraulic component, whether a tool or cylinder.



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



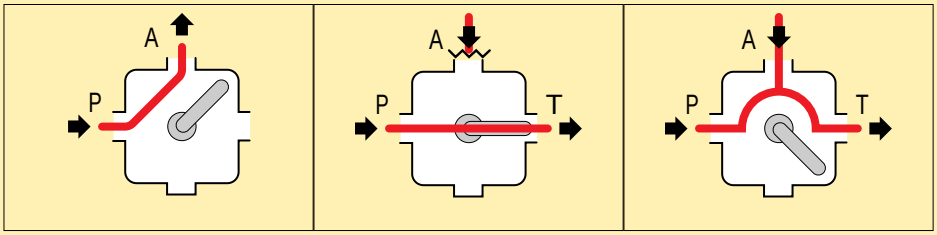
Another commonly used valve configuration is **Float Center**. This type of valve allows the cylinder ports to drain pressure back to tank. Used with a pallet mounted pilot operated check, it allows the hydraulics to be disconnected from the pallet.

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

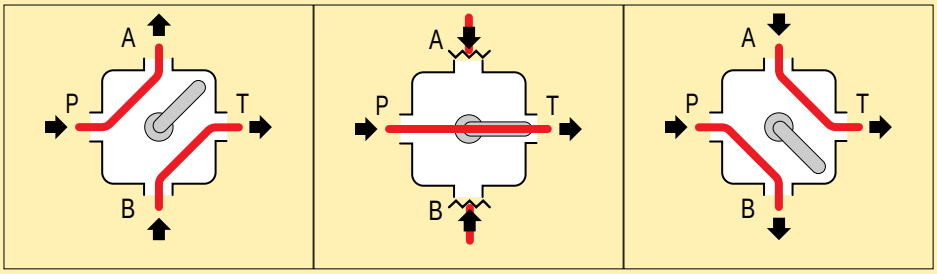
The oil flows from the pump pressure port P to the tank T. The cylinder port A is closed: the cylinder plunger will maintain its position.

Retract

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

Double-acting cylinder

Controlled by a 4-way, 3-position valve.



Advance

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

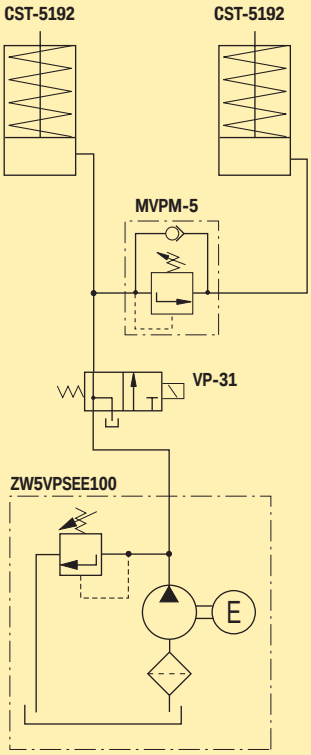
Hold

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

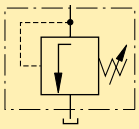
Retract

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

2 Pressure Control

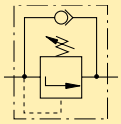


Relief Valve

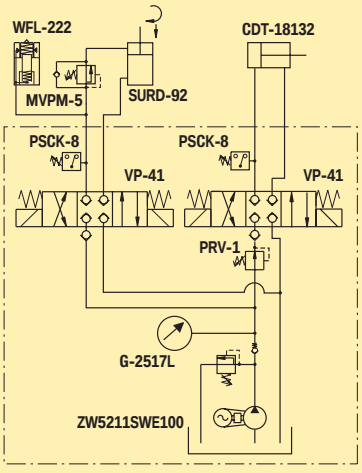


The most common type of pressure control valve is the pressure relief valve. This valve is used to limit the maximum pressure in the hydraulic circuit. This valve should always be included in any hydraulic system to limit that circuit to a maximum safe pressure. When used in a system, design considerations should be made since the valve does not act instantly. As the pressure approaches the set point the valve will at first only permit a very small amount of oil to pass. It is only when the valve opens farther that the full flow will pass through the valve.
From a practical standpoint, don't set the relief valve with a hand pump and then use it with a power pump and vice versa. The point of operation will vary. Also because of this action, when used in application with a pressure switch, the pressure setting on the pressure switch should be set at least 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.

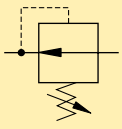
Sequence Valve (MVPM-series)



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 bar = 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 (PRV-series)



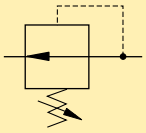
As the name implies, this valve will reduce the pressure to a lower value for a secondary part of the circuit. This is useful for example when you must reduce the capacity of a swing cylinder that might be clamping over a work support. The pressure reducing valve will automatically make-up pressure loss 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, [210 x 0,05 = 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.

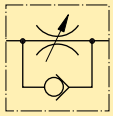
Pressure Limiting Valve (V-152)

This valve, like the pressure-reducing valve, will limit the pressure in a secondary part of the circuit to a preset lower setting than the system pressure. This valve functions differently in that once the valve closes, the secondary part of the circuit will not receive any make-up oil for any pressure loss. The system pressure must drop to zero pressure before the valve will open and permit oil to flow to the secondary part of the circuit. There is no pressure make-up capability with a pressure-limiting valve.



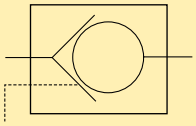
3 Flow Control

Flow Control Valves (VFC-series)

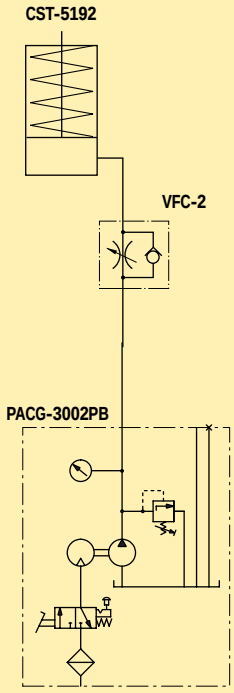


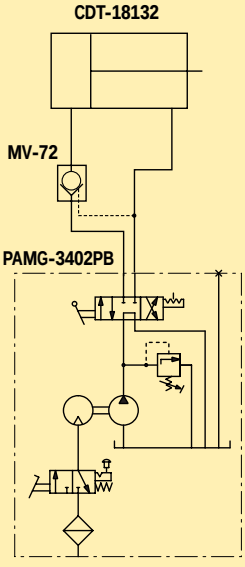
Flow controls permit the change of speed of a hydraulic component through the use of an adjustable orifice. Unlike a regular flow control that provides the same flow restriction in both directions, these flow controls provide a free flow reverse check. This allows restricted flow in one direction and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

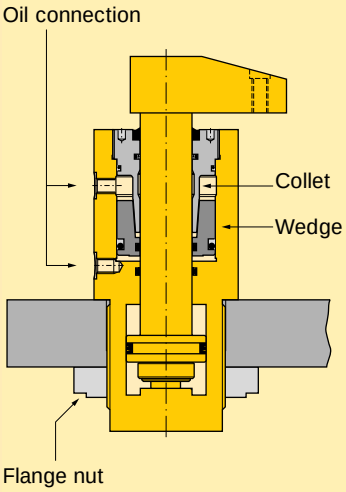


A check valve only permits the flow of oil in one direction. The pilot operated check valve works the same as a regular check valve but also has an additional port for a pressure signal. Pressure to this extra port will mechanically open the check valve to permit the oil to flow in both directions. The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

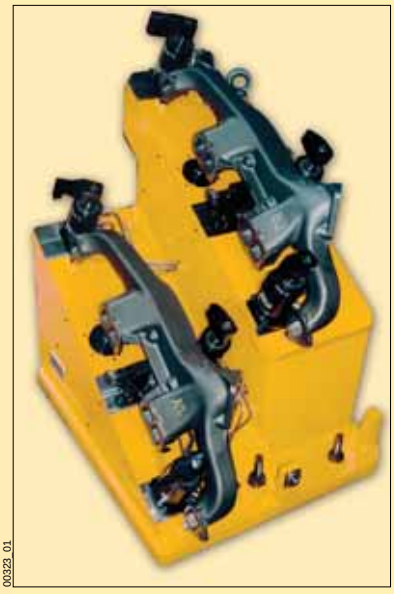
On the next page is an example of how this technology works. The Collet-Lok® swing cylinder has four ports.

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 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.



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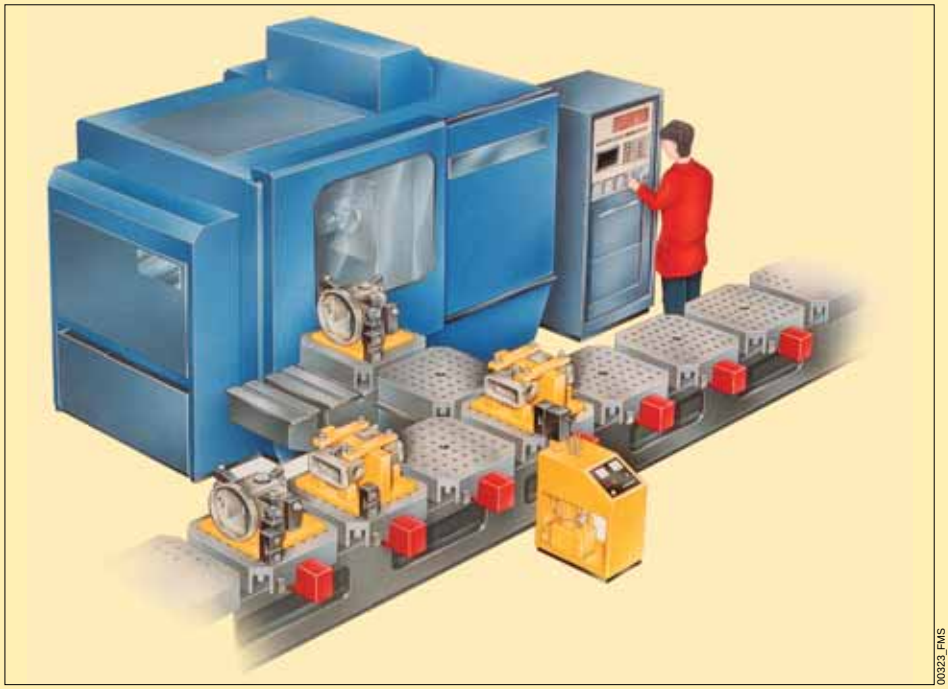
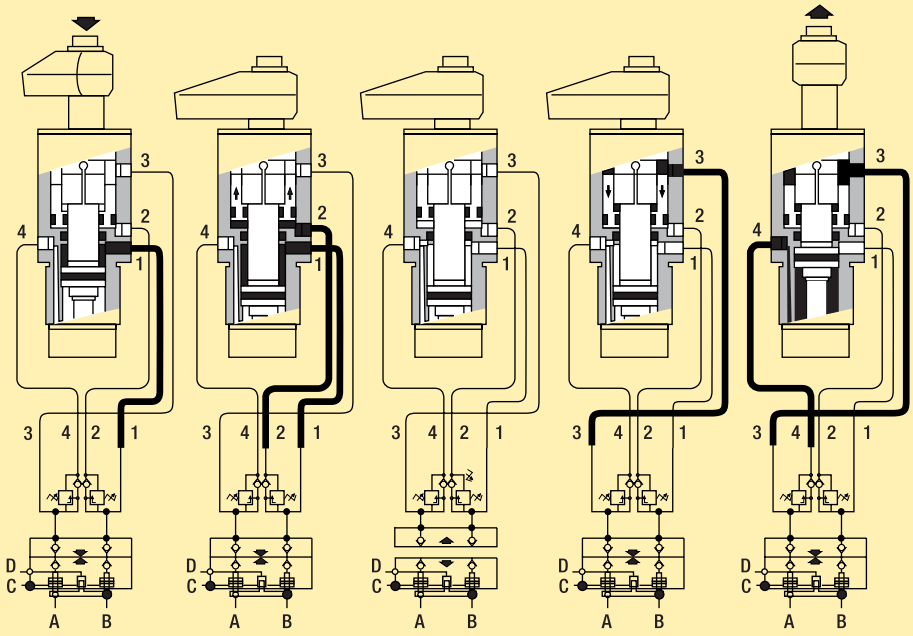
Palletized machining



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 centre 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.

Section Index

Model Number Index Index

Product Index

Yellow Pages

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

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

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ENERPAC
Hydraulic Technology Worldwide

Section Index

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