The World Class Brand

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

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

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

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

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

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

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

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

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

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

... helps you design more efficient workholding fixtures,

... is a global resource of workholding solutions.

This catalog is set-up in two main sections:

1 Imperial hydraulic product data section
   All Enerpac hydraulic workholding products shown with imperial based specifications and dimensions.

2 Yellow Pages section
   Your guide to safety, basic hydraulics and application suggestions.

Selecting the right product for your application:

1. Select your main product category from the main index on page 3. This index shows page numbers of product offerings in the catalog.

2. From here you go to the selected product range overview. For an example see pages 20 and 21 for the swing cylinders and work supports overview. On this page you will find the main groups with regard to functional and mounting style options.

3. Proceed to pages 22 and 23 to narrow down your selection with regard to function, mounting style and clamping capacity. These application & selection pages offer a brief overview of an entire range of products within one group. Note that these pages have yellow columns on both sides of the spread.

4. Once you have made your product selection you can proceed to the product data pages, 24 and onwards, of the specific product series of your choice. These pages have gray columns on both sides of the spread.
**Application & selection pages**

1. Product or range photo including basic description of the product's 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.

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

Swing Clamps
Enerpac Collet-Lok® Swing Clamps combine the rotational actuation and clamping force of a hydraulic Swing Clamp with an internal locking mechanism that maintains the applied clamping force without holding hydraulic pressure in the clamp. Ideal for use in large-scale fixtures, they are available in 1000-, 2000-, and 8500 lb. models. Standard models are available in either Threaded Body or Lower Flange configurations. Available modifications include flange top manifold porting, longer strokes, non-rotational versions and special design bodies. Viton seals are standard.

Work Supports
Enerpac Collet-Lok® Work Supports use internal spring force to lift the support rod into contact with the work piece and then maintain the support with an internal locking system. Cataloged in 2000-, 4500-, and 10,000 lb. capacities, these products are available in Threaded Body (2000 and 4,000 lb. only) and Lower Flange models (2000, 4,000, and 10,000). Available modifications include longer strokes, flange top manifold porting, and special design bodies. Viton seals are standard.

Push Cylinders
Enerpac Collet-Lok® Push Cylinders are designed for either clamping or supporting applications. The clamping or supporting force is maintained once the internal lock is engaged. Available in either 2500 or 5000 lb. capacities, these cylinders are available in both Threaded Body or Lower Flange models. Available modifications include flange top manifold porting, longer strokes, and special design bodies. Viton seals are standard.

Technical support
Refer to the “Yellow Pages” of this catalog for:
• Safety instructions
• Basic hydraulic information
• Advanced hydraulic technology
• FMS (Flexible Machining Systems) technology
• Conversion charts and hydraulic symbols
# Products

<table>
<thead>
<tr>
<th>Collet-Lok® swing cylinder range overview</th>
<th>10-11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collet-Lok® Swing clamps</td>
<td>WPFL, WPTL</td>
</tr>
<tr>
<td>Collet-Lok® Work supports</td>
<td>WPFS, WPTS</td>
</tr>
<tr>
<td>Collet-Lok® Push cylinders</td>
<td>WPFC, WPTC</td>
</tr>
</tbody>
</table>
Hydraulic actuation with mechanical lock

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

Collet-Lok® Designs:

Collet-Lok® Swing Clamps
- Available in 1000-, 2000-, and 8500 lb. models
- Available in Right Hand or Left Hand Swing and Straight (guided) models

Collet-Lok® Work Supports
- Available in 2,000-, 4,000- and 10,000 lb. models
- Spring advance design to maintain contact with the work piece

Collet-Lok® Push Cylinders
- Available in 2,500- and 5,000 lb. models
- Designed for Push only
- Can be used as a heavy-duty Work Support

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

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

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

Collet-Lok® Sequence:

Step 1 2-passage Auto coupler connects external power source with pallet receiver and the Collet-Lok® cylinder is activated for hydraulic clamping.

Step 2 After reaching maximum clamping pressure the sequence valve is opened and actuates the internal wedge hydraulically.

Step 3 The wedge system secures the plunger position mechanically and the hydraulic pressure is taken off, then the auto coupler retracts. The work piece on the pallet is now securely clamped, without being connected to a power source.

Step 4 After being in the machine the pallet returns to the loading and unloading position and the auto coupler is connected again to release the wedge.

Step 5 The hydraulic plunger is now retracted and the pallet is free for unloading and loading.

Collet-Lok® Clamping and Unclamping Cycle

WPTR-100 Collet-Lok® swing cylinder
1 = 90˚ Rotation + Clamp
2 = Lock
3 = Unlock
4 = Unclamp + 90˚ Rotation

WCA-62, WPA-62 Auto coupler
A = Pressure line from pump to swing cylinder
B = Pressure line from pump to swing cylinder
C = Auto coupler advance
D = Auto coupler retract

How Does Collet-Lok® Work?

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

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

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

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

### Selection chart

<table>
<thead>
<tr>
<th>Clamping force</th>
<th>Stroke</th>
<th>Left turning</th>
<th>Right turning</th>
<th>Cylinder effective area</th>
<th>Oil capacity</th>
<th>Max. oil flow</th>
<th>Standard clamp arm</th>
</tr>
</thead>
<tbody>
<tr>
<td>lbs</td>
<td>in</td>
<td>90°</td>
<td></td>
<td>in²</td>
<td>in³</td>
<td>in³/min</td>
<td>Sold separately</td>
</tr>
<tr>
<td>Lower flange</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1000</td>
<td>.32</td>
<td>.95</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td>.47</td>
<td>1.11</td>
<td></td>
<td>.25</td>
<td>.71</td>
<td>.24</td>
<td>.67</td>
</tr>
<tr>
<td>8500</td>
<td>.39</td>
<td>1.65</td>
<td></td>
<td>.50</td>
<td>1.11</td>
<td>.55</td>
<td>1.22</td>
</tr>
<tr>
<td>Threaded body</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td>.47</td>
<td>1.11</td>
<td></td>
<td>.50</td>
<td>1.11</td>
<td>.55</td>
<td>1.22</td>
</tr>
<tr>
<td>8500</td>
<td>.39</td>
<td>1.65</td>
<td></td>
<td>3.05</td>
<td>3.45</td>
<td>3.40</td>
<td>5.70</td>
</tr>
</tbody>
</table>

Note:
- Call Enerpac for models with metric thread and BSPP port connections.
- Minimum working pressure for Collet-Lok® system is 1400 psi.
- This product is made to order. Please contact Enerpac for delivery information before specifying in your design.

### Collet-Lok® sequence

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

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

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

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

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

### Product dimensions in inches [ inches ]

<table>
<thead>
<tr>
<th>Model</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>C1</th>
<th>D</th>
<th>D1</th>
<th>F</th>
<th>H1</th>
<th>H2</th>
<th>H3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower flange</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WPFL-50V</td>
<td>7.92</td>
<td>6.97</td>
<td>6.74</td>
<td>0.98</td>
<td>2.28</td>
<td>3.35</td>
<td>0.75</td>
<td>0.39</td>
<td>0.49</td>
<td>–</td>
</tr>
<tr>
<td>WPFL-100V</td>
<td>8.77</td>
<td>7.67</td>
<td>6.48</td>
<td>0.98</td>
<td>2.68</td>
<td>3.94</td>
<td>0.88</td>
<td>0.39</td>
<td>0.49</td>
<td>–</td>
</tr>
<tr>
<td>WPFL-300V</td>
<td>12.67</td>
<td>11.02</td>
<td>10.82</td>
<td>0.98</td>
<td>3.53</td>
<td>5.19</td>
<td>1.38</td>
<td>0.43</td>
<td>0.49</td>
<td>–</td>
</tr>
<tr>
<td>Threaded body</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WPTL-100V</td>
<td>8.39</td>
<td>7.28</td>
<td>4.78</td>
<td>3.56</td>
<td>1.875-16 UN</td>
<td>2.76</td>
<td>0.88</td>
<td>1.24</td>
<td>2.64</td>
<td>2.97</td>
</tr>
<tr>
<td>WPTL-300V</td>
<td>12.22</td>
<td>10.57</td>
<td>6.46</td>
<td>4.53</td>
<td>3.125-16 UN</td>
<td>3.66</td>
<td>1.38</td>
<td>1.5</td>
<td>3.62</td>
<td>3.96</td>
</tr>
</tbody>
</table>

Note:
- Dimensions shown with standard clamp arm.
- For nonrotational model replace “L” with “N”. Example: WPFFN-100V

[Image of Collet-Lok® swing cylinders mounted on a pallet.]

- **WP series**
  - Enerpac Collet-Lok® cylinders are designed to mechanically hold the workpiece after hydraulic pressure is removed. Clamping capacities range from 1000 lbs. to 8500 lbs.
  - SAE oil connection

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

- **Lower flange Collet-Lok® swing cylinder mounted on a pallet.**
Installation dimensions in inches

<table>
<thead>
<tr>
<th>Clamping force lbs</th>
<th>Fixture hole Ø D3</th>
<th>Mounting thread J</th>
<th>Minimum depth J2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000</td>
<td>2.301 ± 0.12</td>
<td>M6 x 1.00</td>
<td>.68</td>
</tr>
<tr>
<td>2000</td>
<td>2.701 ± 0.12</td>
<td>M8 x 1.25</td>
<td>.72</td>
</tr>
<tr>
<td>8500</td>
<td>3.565 ± 0.12</td>
<td>M10 x 1.50</td>
<td>.72</td>
</tr>
</tbody>
</table>

Threaded body

| Clamping force lbs | Fixture hole Ø D3 | Mounting flange Sold separately | 67 | Mounting nut Sold separately | 56 |
|--------------------|-------------------|----------------------------------|----|                            |    |
| 2000               | 1.875-16 un       | MF-481                           | FN-481 |                            |    |
| 8500               | 3.125-16 un       | MF-801                           | FN-801 |                            |    |

With standard clamp arm.

Oil port functions

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

WPF models

WPT models

<table>
<thead>
<tr>
<th>J</th>
<th>J1</th>
<th>K</th>
<th>L</th>
<th>P</th>
<th>Q</th>
<th>T</th>
<th>U</th>
<th>V</th>
<th>W</th>
<th>X</th>
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<tbody>
<tr>
<td>Ø</td>
<td>Ø</td>
<td>Ø</td>
<td>Ø</td>
<td>Ø</td>
<td>Ø</td>
<td>lbs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>.625-18 un</td>
<td>0.31</td>
<td>1.18</td>
<td>–</td>
<td>1.57</td>
<td>.313-24 un</td>
<td>2.13</td>
<td>2.76</td>
<td>0.35</td>
<td>0.55</td>
<td>1.89</td>
</tr>
<tr>
<td>.750-16 un</td>
<td>0.35</td>
<td>1.18</td>
<td>–</td>
<td>1.97</td>
<td>.375-24 un</td>
<td>2.52</td>
<td>3.31</td>
<td>0.35</td>
<td>0.56</td>
<td>2.13</td>
</tr>
<tr>
<td>1.250-12 un</td>
<td>0.39</td>
<td>1.85</td>
<td>–</td>
<td>2.76</td>
<td>.625-18 un</td>
<td>3.66</td>
<td>4.41</td>
<td>0.43</td>
<td>0.67</td>
<td>3.78</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>J</th>
<th>J1</th>
<th>K</th>
<th>L</th>
<th>P</th>
<th>Q</th>
<th>T</th>
<th>U</th>
<th>V</th>
<th>W</th>
<th>X</th>
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</thead>
<tbody>
<tr>
<td>Ø</td>
<td>Ø</td>
<td>Ø</td>
<td>Ø</td>
<td>Ø</td>
<td>Ø</td>
<td>lbs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>.750-16 un</td>
<td>0.35</td>
<td>1.18</td>
<td>1.63</td>
<td>1.97</td>
<td>.375-24 un</td>
<td>2.52</td>
<td>–</td>
<td>–</td>
<td>2.44</td>
<td>–</td>
</tr>
<tr>
<td>1.250-12 un</td>
<td>0.39</td>
<td>1.85</td>
<td>3.35</td>
<td>2.76</td>
<td>.625-18 un</td>
<td>3.66</td>
<td>–</td>
<td>–</td>
<td>3.92</td>
<td>–</td>
</tr>
</tbody>
</table>

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

Important

Minimum unlock pressure must be at least 1500 psi above lock pressure.

Check local regulations and standards before installing equipment.

For more information, see Yellow Pages (224)
Swing cylinders, CA Series  Dimensions & options

- **Force:** 1000 - 8500 lbs
- **Stroke:** 500 - 5000 psi

**Gauges**
- Ø 190

**Flow control valves**
- Ø 155

**Sequence valves**
- Ø 152

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**Options**

**Important**

Do not exceed maximum oil flow.

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

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

**Example:**

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

---

**Product dimensions in inches [ ]**

<table>
<thead>
<tr>
<th>Clamp force lbs</th>
<th>Model number</th>
<th>A</th>
<th>C</th>
<th>D1</th>
<th>D2</th>
<th>E</th>
<th>G</th>
<th>J</th>
<th>K1</th>
<th>K2</th>
<th>P</th>
<th>Q</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000</td>
<td>CA-540</td>
<td>.94</td>
<td>.71</td>
<td>.749-.750</td>
<td>.625-18</td>
<td>1.18</td>
<td>1.26</td>
<td>.313-24</td>
<td>.75</td>
<td>.39</td>
<td>1.57</td>
<td>.313-24</td>
</tr>
<tr>
<td>2000</td>
<td>CA-1050</td>
<td>3.27</td>
<td>.75</td>
<td>.875-879</td>
<td>.75-16</td>
<td>1.18</td>
<td>1.38</td>
<td>.313-24</td>
<td>.71</td>
<td>.39</td>
<td>1.97</td>
<td>.375-24</td>
</tr>
<tr>
<td>8500</td>
<td>CA-3070</td>
<td>5.04</td>
<td>1.38</td>
<td>1.377-1.378</td>
<td>1.25-12</td>
<td>1.85</td>
<td>2.32</td>
<td>.313-24</td>
<td>1.26</td>
<td>.67</td>
<td>2.76</td>
<td>.625-18</td>
</tr>
</tbody>
</table>
Special configurations are available

Model: MPFL100PE001-S

- **Body style:** Upper flange
- **Clamp capacity:** 2000 lbs (9 kN)
- **Clamping stroke:** 0.71 in. (18 mm)
- **Special feature:** Position sensing

Model: MPFN300VE002

- **Body style:** Lower flange
- **Clamp capacity:** 8800 lbs (39 kN)
- **Clamping stroke (straight):** 2.25 in. (57.4 mm)
- **Special feature:** Viton seals, Long stroke

Model: MPFL200VE100

- **Body style:** Mid-body flange
- **Clamp capacity:** 3900 lbs (20 kN)
- **Clamping stroke (left hand):** 2.50 in. (63.5 mm)
- **Special feature:** Viton seals, Long stroke, Mid-flange body

Special features for Swing Cylinders*

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

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

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

Hydraulically locked, mechanically maintained work support

- Collet-Lok® design allows the work support to maintain support position after the hydraulic pressure is removed
- Collet-Lok® maintains a higher level of safety, as it is not dependent on hydraulic supply pressure
- Low deflection: lowest deflection of any work support available
- Threaded or flanged body increases mounting flexibility
- Capacities up to 10,000 lbs available

Collet-Lok® sequence

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

Step 2
Pressurize oil port #1. The plunger will be locked in the supporting position.

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

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

Mounting style

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

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

WPF series,
Flange models
Mounts directly to fixture plate. Offers the flexibility of side ports or manifold ports on the underside of the flange.

Product selection

<table>
<thead>
<tr>
<th>Max. support force</th>
<th>Support plunger stroke</th>
<th>Flange models</th>
<th>Threaded models</th>
<th>Operating pressure</th>
<th>Locking system displacement</th>
<th>Plunger contact spring force</th>
<th>Max. oil flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>lbs</td>
<td>psi</td>
<td>min.</td>
<td>max.</td>
<td>in/min</td>
<td>max.</td>
<td>lock</td>
<td>min.</td>
</tr>
<tr>
<td>2000</td>
<td>0.39</td>
<td>WFPS-100V</td>
<td>-</td>
<td>-</td>
<td>1450</td>
<td>5000</td>
<td>0.24</td>
</tr>
<tr>
<td>4000</td>
<td>0.39</td>
<td>WFPS-200V</td>
<td>-</td>
<td>-</td>
<td>1450</td>
<td>5000</td>
<td>0.37</td>
</tr>
<tr>
<td>10,000</td>
<td>0.77</td>
<td>WFPS-450V</td>
<td>-</td>
<td>-</td>
<td>1450</td>
<td>5000</td>
<td>1.10</td>
</tr>
<tr>
<td>2000</td>
<td>0.39</td>
<td>WPTS-100V</td>
<td>-</td>
<td>-</td>
<td>1450</td>
<td>5000</td>
<td>0.24</td>
</tr>
<tr>
<td>4000</td>
<td>0.39</td>
<td>WPTS-200V</td>
<td>-</td>
<td>-</td>
<td>1450</td>
<td>5000</td>
<td>0.37</td>
</tr>
</tbody>
</table>

While pallet No. 1 is in the machine, a new work piece is loaded on to pallet No. 2.
### Deflection chart:
Elastic deformation of the work support resulting from the application of load.

**Support force vs pressure**

- WP-450V
- WP-200V
- WP-100V

**Elastic deflection vs load**

- WP-450V
- WP-200V
- WP-100V

### WP series

**Options**

- Collet-Lok® swing cylinders
- Auto couplers
- Positive clamping cylinders
- Sequence valves

#### Important

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

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

### Product dimensions in inches

<table>
<thead>
<tr>
<th>Model number</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>C1</th>
<th>D</th>
<th>D1</th>
<th>E</th>
<th>E1</th>
<th>F</th>
<th>H</th>
<th>K</th>
<th>L</th>
<th>M</th>
<th>P</th>
<th>S</th>
<th>U</th>
<th>V</th>
<th>W</th>
<th>X</th>
<th>lbs</th>
</tr>
</thead>
<tbody>
<tr>
<td>WPFS-100V</td>
<td>4.88</td>
<td>4.49</td>
<td>4.17</td>
<td>0.98</td>
<td>Ø 2.99</td>
<td>4.33</td>
<td>0.62</td>
<td>0.55</td>
<td>–</td>
<td>0.49</td>
<td>.313-24</td>
<td>0.59</td>
<td>–</td>
<td>0.2</td>
<td>Ø 11*</td>
<td>3.7</td>
<td>0.35</td>
<td>–</td>
<td>3.21</td>
<td>8.8</td>
</tr>
<tr>
<td>WPFS-200V</td>
<td>4.96</td>
<td>4.56</td>
<td>4.17</td>
<td>0.98</td>
<td>Ø 3.62</td>
<td>5.12</td>
<td>0.98</td>
<td>0.91</td>
<td>–</td>
<td>0.49</td>
<td>.500-20</td>
<td>0.79</td>
<td>–</td>
<td>0.2</td>
<td>Ø 11*</td>
<td>4.41</td>
<td>0.35</td>
<td>–</td>
<td>3.82</td>
<td>13.2</td>
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<tr>
<td>WPFS-450V</td>
<td>7.61</td>
<td>6.84</td>
<td>6.34</td>
<td>0.98</td>
<td>Ø 5.12</td>
<td>6.49</td>
<td>1.97</td>
<td>1.89</td>
<td>–</td>
<td>0.49</td>
<td>.750-16</td>
<td>1.18</td>
<td>–</td>
<td>0.39</td>
<td>1.18*</td>
<td>5.79</td>
<td>0.43</td>
<td>–</td>
<td>4.92</td>
<td>35.2</td>
</tr>
<tr>
<td>WPTS-100V</td>
<td>4.84</td>
<td>4.45</td>
<td>4.13</td>
<td>1.50</td>
<td>2.375-12</td>
<td>2.94</td>
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<td>0.55</td>
<td>2.17</td>
<td>0.61</td>
<td>.313-24</td>
<td>0.59</td>
<td>0.79</td>
<td>0.20</td>
<td>Ø 11*</td>
<td>–</td>
<td>–</td>
<td>2.64</td>
<td>6.6</td>
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<td>4.53</td>
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<td>2.76</td>
<td>0.61</td>
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<td>0.79</td>
<td>0.79</td>
<td>0.26</td>
<td>Ø 11*</td>
<td>–</td>
<td>–</td>
<td>2.64</td>
<td>8.8</td>
<td></td>
</tr>
</tbody>
</table>

* Spanner holes (x 2)
** Wrench Flats

www.enerpacwh.com
Push cylinders - Collet-Lok® design

Shown: WPTC-110, WPFC-210

Ideal when live hydraulics are not available

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

- Double-acting Collet-Lok® action allows fully automated operation
- Additional level of safety since live hydraulics are not required
- Collet-Lok® push cylinders can either be mounted by the flange, or threaded into the fixture
- The Collet-Lok® design is an industry exclusive
- Capacities up to 8800 lbs. available on request

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

<table>
<thead>
<tr>
<th>Max. push force</th>
<th>Hydr. plunger stroke</th>
<th>Operating pressure</th>
<th>Hydraulic effective area</th>
<th>Oil capacity</th>
<th>Max. oil flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>lbs</td>
<td>in</td>
<td>min.</td>
<td>max.</td>
<td>psi adv.</td>
<td>adv.</td>
</tr>
<tr>
<td>2500</td>
<td>.60</td>
<td>725</td>
<td>5000</td>
<td>.50</td>
<td>.30</td>
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<tr>
<td>5000</td>
<td>.99</td>
<td>725</td>
<td>5000</td>
<td>.99</td>
<td>.61</td>
</tr>
</tbody>
</table>

Maximum cycle rate: 8 cycles/min.

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

Capacities up to 8800 lbs. available on request.

Dimensions in inches [°]

<table>
<thead>
<tr>
<th>Model number</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>C1</th>
<th>D</th>
<th>D1</th>
<th>D2</th>
<th>E</th>
<th>E1</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

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

WP series

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

Push capacities range from 2500 lbs. to 5000 lbs.
**Installation dimensions** in inches

<table>
<thead>
<tr>
<th>Push force lbs</th>
<th>Fixture hole øD3</th>
<th>Mounting thread J</th>
<th>Minimum depth J2</th>
</tr>
</thead>
<tbody>
<tr>
<td>▼ Lower flange</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2500</td>
<td>2.79</td>
<td>M6</td>
<td>.68</td>
</tr>
<tr>
<td>5000</td>
<td>3.10</td>
<td>M8</td>
<td>.72</td>
</tr>
<tr>
<td>▼ Threaded body</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2500</td>
<td>2.375-12 UN</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>5000</td>
<td>2.750-16 UN</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

**Elastic deflection vs load**

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

**Deflection chart:**

<table>
<thead>
<tr>
<th>Applied load (lbs)</th>
<th>Elastic deformation (inch)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>.0004</td>
</tr>
<tr>
<td>2000</td>
<td>.0008</td>
</tr>
<tr>
<td>4000</td>
<td>.0012</td>
</tr>
<tr>
<td>6000</td>
<td>.0016</td>
</tr>
<tr>
<td>8000</td>
<td>.0020</td>
</tr>
<tr>
<td>10,000</td>
<td>.0024</td>
</tr>
</tbody>
</table>

**Options**

- **Auto couplers**
- **Sequence valves**
- **Accessories**
- **Collet-Lok® swing cylinders**

**Important**

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

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

Technical support

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

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

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<table>
<thead>
<tr>
<th>Swing cylinder range overview</th>
<th>▼ series</th>
<th>▼ page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper flange swing clamps</td>
<td>SU</td>
<td>24 - 25</td>
</tr>
<tr>
<td>Lower flange swing clamps</td>
<td>SL</td>
<td>26 - 27</td>
</tr>
<tr>
<td>Threaded body swing clamps</td>
<td>ST</td>
<td>28 - 29</td>
</tr>
<tr>
<td>Cartridge model swing clamps</td>
<td>SC</td>
<td>30 - 31</td>
</tr>
<tr>
<td>Clamp arms</td>
<td>CA</td>
<td>32 - 33</td>
</tr>
<tr>
<td>Pivoting T-arms</td>
<td>CAC, CAPT</td>
<td>34 - 35</td>
</tr>
<tr>
<td>Upreach clamp arms</td>
<td>CAU</td>
<td>36 - 37</td>
</tr>
<tr>
<td>Swing clamps</td>
<td>SC</td>
<td>38</td>
</tr>
<tr>
<td>Swing clamps</td>
<td>ASC</td>
<td>39</td>
</tr>
<tr>
<td>Three-position swing clamps</td>
<td>WTR</td>
<td>40 - 41</td>
</tr>
</tbody>
</table>
Swing clamps  Application & selection

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

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

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

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

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

Select your swing cylinder type:

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

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

For Collet-Lok® positive locking swing clamps, see 12
Select your mounting method:

**SU series, Upper flange mounting**
- 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**
- 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**
- 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**
- Minimal space required on fixture
- External plumbing not required
- Allows close positioning of adjoining units
- Cylinder can be completely recessed in fixture

---

**Product selection**

<table>
<thead>
<tr>
<th>Clamping force</th>
<th>Stroke</th>
<th>Upper flange</th>
<th>Lower flange</th>
<th>Threaded body</th>
<th>Cartridge</th>
</tr>
</thead>
<tbody>
<tr>
<td>lbs</td>
<td>in</td>
<td>lbs</td>
<td>in</td>
<td>lbs</td>
<td>in</td>
</tr>
<tr>
<td>475</td>
<td>(0.32)</td>
<td>SRS-21</td>
<td>SRS-21</td>
<td>SRS-21</td>
<td>SRS-21</td>
</tr>
<tr>
<td>1100</td>
<td>(0.39)</td>
<td>SRS-51</td>
<td>SRS-51</td>
<td>SRS-51</td>
<td>SRS-51</td>
</tr>
<tr>
<td>1800</td>
<td>(0.47)</td>
<td>SRS-92</td>
<td>SRS-92</td>
<td>SRS-92</td>
<td>SRS-92</td>
</tr>
<tr>
<td>2400</td>
<td>(0.50)</td>
<td>SRS-121</td>
<td>SRS-121</td>
<td>SRS-121</td>
<td>SRS-121</td>
</tr>
<tr>
<td>3900</td>
<td>(0.55)</td>
<td>SRS-201</td>
<td>SRS-201</td>
<td>SRS-201</td>
<td>SRS-201</td>
</tr>
<tr>
<td>7400</td>
<td>(0.63)</td>
<td>SRS-351</td>
<td>SRS-351</td>
<td>SRS-351</td>
<td>SRS-351</td>
</tr>
<tr>
<td>500</td>
<td>(0.32)</td>
<td>SRS-21</td>
<td>SRS-21</td>
<td>SRS-21</td>
<td>SRS-21</td>
</tr>
<tr>
<td>1250</td>
<td>(0.39)</td>
<td>SRS-51</td>
<td>SRS-51</td>
<td>SRS-51</td>
<td>SRS-51</td>
</tr>
<tr>
<td>2025</td>
<td>(0.47)</td>
<td>SRS-92</td>
<td>SRS-92</td>
<td>SRS-92</td>
<td>SRS-92</td>
</tr>
<tr>
<td>2025</td>
<td>(1.26)</td>
<td>SRS-121</td>
<td>SRS-121</td>
<td>SRS-121</td>
<td>SRS-121</td>
</tr>
<tr>
<td>2600</td>
<td>(0.50)</td>
<td>SRS-201</td>
<td>SRS-201</td>
<td>SRS-201</td>
<td>SRS-201</td>
</tr>
<tr>
<td>2600</td>
<td>(1.25)</td>
<td>SRS-351</td>
<td>SRS-351</td>
<td>SRS-351</td>
<td>SRS-351</td>
</tr>
</tbody>
</table>

- With standard clamp arm. Clamp arms are sold separately (32). Clamping forces for single-acting models are reduced in order to overcome return spring force. For left turning swing clamps replace the R in the model number for an L. Note: Call Enerpac to order models with metric thread and BSPP port connections.
- This product is made to order. Please contact Enerpac for delivery information before specifying in your design.

---

**Options**

Available as both left and right turning

<table>
<thead>
<tr>
<th>Clamp arms</th>
<th>Work supports</th>
<th>Accessories</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Important**

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

All swing clamps have swing angle repeatability of ± 1°.

Other swing angles available upon request. Contact Enerpac for info.
Swing clamps - Upper flange model

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

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

Product selection

<table>
<thead>
<tr>
<th>Clamping force ¹</th>
<th>Stroke</th>
<th>Left turning</th>
<th>Right turning</th>
<th>Cylinder effective area</th>
<th>Oil capacity</th>
<th>Max. oil flow ⁹</th>
<th>Standard clamp arm</th>
</tr>
</thead>
<tbody>
<tr>
<td>lbs</td>
<td>in</td>
<td>90°</td>
<td>90°</td>
<td>Clamp</td>
<td>Un-clamp</td>
<td>Clamp</td>
<td>Sold separately</td>
</tr>
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<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>▼ Single acting</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>475</td>
<td>.32</td>
<td>.65</td>
<td></td>
<td>.12</td>
<td>.08</td>
<td>.16</td>
<td>12</td>
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<tr>
<td>1100</td>
<td>.39</td>
<td>.89</td>
<td></td>
<td>.28</td>
<td>.25</td>
<td>.53</td>
<td>25</td>
</tr>
<tr>
<td>1800</td>
<td>.47</td>
<td>.90</td>
<td></td>
<td>.49</td>
<td>.42</td>
<td>.60</td>
<td>60</td>
</tr>
<tr>
<td>2400</td>
<td>.50</td>
<td>1.10</td>
<td></td>
<td>.63</td>
<td>.70</td>
<td>.100</td>
<td></td>
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<tr>
<td>3900</td>
<td>.55</td>
<td>1.16</td>
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<td>2.27</td>
<td>2.40</td>
<td>240</td>
</tr>
<tr>
<td>▼ Double acting</td>
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<td>.39</td>
<td>.89</td>
<td></td>
<td>.28</td>
<td>.59</td>
<td>.25</td>
<td>53</td>
</tr>
<tr>
<td>2025</td>
<td>.47</td>
<td>.90</td>
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<td>86</td>
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<td>1.69</td>
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<td>1.23</td>
<td>.70</td>
<td>140</td>
</tr>
<tr>
<td>2600</td>
<td>.50</td>
<td>1.10</td>
<td></td>
<td>.63</td>
<td>1.23</td>
<td>.97</td>
<td>100</td>
</tr>
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<td>2600</td>
<td>1.25</td>
<td>1.85</td>
<td></td>
<td>1.10</td>
<td>2.35</td>
<td>1.22</td>
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¹ With standard clamp arm. Clamp arms are sold separately. ³ For models with straight plunger movement, replace L or R with S.
² This product is made to order. Please contact Enerpac for delivery information before specifying in your design.

Dimensions in inches [ ]

<table>
<thead>
<tr>
<th>Left turning models</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>C1</th>
<th>D</th>
<th>D1</th>
<th>D2</th>
<th>F</th>
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</table>

¹ This product is made to order. Please contact Enerpac for delivery information before specifying in your design.

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

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

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

SULS-21 SULS-51 SULS-92 SULS-121 SULS-201 SULS-351
SULD-21 SULD-51 SULD-92 SULD-121 SULD-201 SULD-351

Integrated O-ring port

SAE oil connection
### Installation dimensions in inches

<table>
<thead>
<tr>
<th>Clamping force (lbs)</th>
<th>Fixture hole Ø D3</th>
<th>Mounting thread J unf</th>
<th>Min. depth J2</th>
<th>Manifold O-ring, ARP number or inside Ø x thickness</th>
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<td>7600</td>
<td>3.035</td>
<td>.375-24</td>
<td>.74</td>
<td>.17 x .139</td>
</tr>
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</table>

> *With standard clamp arm.

> *Polyurethane, 92 Durometer

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

### Options

- **Clamp arms**
- **Work supports**
- **Collet-Lok® swing cylinders**
- **Accessories**

### Important

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

- Custom cylinders including longer stroke lengths are available on request.

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

- Do not exceed maximum flow rates.

---

**Power sources** Work supports

**Pallet components** Swing clamps

**Swing clamps**

**Collet-Lok®**

**Valves**

**Linear cylinders**

**System components**

**Yellow pages**
Swing clamps - Lower flange models

No fixture hole required

...cylinder can be bolted directly to fixture

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

Product selection

<table>
<thead>
<tr>
<th>Clamping force</th>
<th>Stroke</th>
<th>Left turning effective area</th>
<th>Right turning effective area</th>
<th>Cylinder capacity</th>
<th>Oil flow</th>
<th>Max. oil flow</th>
<th>Standard clamp arm</th>
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<td>in²</td>
<td>in³</td>
<td>in³/min</td>
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<td></td>
<td></td>
<td>Clamp</td>
<td>Un-clamp</td>
<td>Clamp</td>
<td>Un-clamp</td>
<td>in³/min</td>
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</tr>
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<td>3.68</td>
<td>435</td>
<td>240</td>
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</table>

- With standard clamp arm. Clamp arms are sold separately (page 32). Clamping forces for single-acting models are reduced in order to overcome return spring force.

- For models with straight plunger movement, replace L or R with S.

Dimensions in inches

<table>
<thead>
<tr>
<th>Left turning models</th>
<th>A</th>
<th>C</th>
<th>C1</th>
<th>D</th>
<th>D1</th>
<th>D2</th>
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<th>G</th>
<th>H</th>
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<td>1.86</td>
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<td>3.94</td>
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<td>1.50</td>
<td>SAE #4</td>
<td>0.49</td>
<td>1.58</td>
<td>1.08</td>
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- Double acting

| SLLD-21             | 4.41| 3.13| 3.78| 1.10| 1.86| 1.77| 0.39| SAE #2 | 0.54| 0.63|   |
| SLLD-51             | 5.33| 3.68| 4.57| 1.37| 2.13| 2.25| 0.63| SAE #4 | 0.55| 0.76|   |
| SLLD-92             | 5.99| 4.10| 5.01| 1.88| 2.76| 2.13| 0.98| G1/4 | 0.49| 0.99| 0.59|
| SLLD-121            | 6.75| 4.46| 5.56| 1.87| 2.62| 2.88| 0.87| SAE #4 | 0.61| 1.2 |   |
| SLLD-201            | 6.89| 4.54| 5.70| 2.51| 3.35| 2.76| 1.26| SAE #4 | 0.49| 1.19|   |
| SLLD-351            | 7.77| 4.91| 6.19| 3.14| 3.94| 3.50| 1.50| SAE #4 | 0.49| 1.58|   |

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

Lower flange swing clamps mounted to the face of the fixture.
### Installation dimensions in inches

<table>
<thead>
<tr>
<th>Clamping force lbs</th>
<th>Mounting thread J</th>
<th>Minimum thread depth J2</th>
<th>Manifold O-ring (^a)</th>
<th>Note: Mounting bolts and O-rings included.</th>
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<td>.250-28</td>
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<td>568-011</td>
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<td>M6</td>
<td>.59</td>
<td>.17 x .139</td>
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<tr>
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<td>7600</td>
<td>.375-24</td>
<td>.74</td>
<td>.17 x .139</td>
<td></td>
</tr>
</tbody>
</table>

\(^a\) With standard clamp arm.

### Options

- **Clamp arms**
- **Work supports**
- **Collet-Lok\(^e\) swing cylinders**
- **Accessories**

### Important

- Custom cylinders including longer stroke lengths are available on request.
- In case there is a risk of machining coolants and debris being inhaled via the breather vent, it is recommended to pipe this port to an area outside the fixture that is protected from machining coolants and debris.
- Do not exceed maximum flow rates.

### Force: 475 - 7600 lbs

### Stroke: .65 - 1.28 inch

### Pressure: 500 - 5000 psi

---

**Note:**

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

---

### Dimensions & options

#### SL series

- **Force:** 475 - 7600 lbs
- **Stroke:** .65 - 1.28 inch
- **Pressure:** 500 - 5000 psi

---

**E** Cilindros giratorios

**F** Vérins de bridage pivotants

**D** Schwenkspannzylinder

---

**N P Q R S T U V X Y Z**

**Right turning models**

<table>
<thead>
<tr>
<th>N</th>
<th>P</th>
<th>Q</th>
<th>R</th>
<th>S</th>
<th>T</th>
<th>U</th>
<th>V</th>
<th>X</th>
<th>Y</th>
<th>Z</th>
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**Single acting**

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**Double acting**

---

www.enerpacwh.com
Swing clamps - Threaded body models

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

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

ST series

Enerpac threaded body swing clamps are threaded directly into the fixture. The cylinder height is adjusted to the appropriate height, and then locked in place using a jam nut (86).

SAE oil connection

Flange nut

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

Product selection

<table>
<thead>
<tr>
<th>Clamping force1)</th>
<th>Stroke</th>
<th>Left turning 90°</th>
<th>Right turning 90°</th>
<th>Cylinder effective area</th>
<th>Oil capacity</th>
<th>Max. oil flow3)</th>
<th>Standard clamp arm</th>
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</table>

1) With standard clamp arm. Clamp arms are sold separately (32). Clamping forces for single-acting models are reduced in order to overcome return spring force.
2) For models with straight plunger movement, replace L or R with S.

Dimensions in inches [ ]

<table>
<thead>
<tr>
<th>Left turning models</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>C1</th>
<th>C2</th>
<th>D</th>
<th>D1</th>
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</table>

Note: dimensions shown with standard clamp arm.

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

Model Nos. | Mounting flange | Flange nut
--- | --- | ---
Left turning | Right turning |
90° |

**Single acting**
- STLS-21 STRS-21 — MF-281 FN-281
- STLS-51 STRS-51 AW-5 MF-351 FN-351
- STLS-92 STRS-92 — MF-482 FN-482
- STLS-121 STRS-121 AW-89 MF-481 FN-481
- STLS-201 STRS-201 AW-19 MF-651 FN-651
- STLS-351 STRS-351 AW-90 MF-801 FN-801

**Double acting**
- STLD-21 STRD-21 — MF-281 FN-281
- STLD-51 STRD-51 AW-5 MF-351 FN-351
- STLD-92 STRD-92 — MF-482 FN-482
- STLD-121 STRD-121 AW-89 MF-481 FN-481
- STLD-201 STRD-201 AW-19 MF-651 FN-651
- STLD-351 STRD-351 AW-90 MF-801 FN-801

**Options**
- Clamp arms
- Work supports
- Collet-Lok® swing cylinders
- Accessories

**Important**
- Custom cylinders including longer stroke lengths are available on request.
- In case there is a risk of machining coolants and debris being inhaled via the breather vent, it is recommended to pipe this port to an area outside the fixture that is protected from machining coolants and debris.

**Force:** 475-7600 lbs

**Stroke:** 0.65 - 1.28 inch

**Pressure:** 500 - 5000 psi

**Dimensions & options**

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<th>Mounting Flange</th>
<th>Flange Nut</th>
<th>Single acting</th>
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<th>Flange Nut</th>
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<td>.625-11 UNC</td>
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</tbody>
</table>

www.enerpacwh.com
Swing clamps - Cartridge models

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

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

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

Cartridge swing clamps simplify mounting and optimize clamping effectiveness.

**Product selection**

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<thead>
<tr>
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<th>Stroke Right turning</th>
<th>Cylinder Oil Max.</th>
<th>Standard clamp arm</th>
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**Dimensions in inches**

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<th>C</th>
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<th>C2</th>
<th>D1</th>
<th>D2</th>
<th>E</th>
<th>F</th>
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<td>2.61</td>
<td>1.43</td>
<td>2.99</td>
<td>2.25</td>
<td>2.74</td>
<td>0.87</td>
</tr>
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</table>

**Double acting**

| Single acting      |   |   |   |   |   |    |    |   |   |
| SCLD-22            | 4.41 | 2.26 | 0.98 | 1.63 | 0.94 | 1.51 | 1.00 | 1.37 | 0.39 |
| SCLD-52            | 5.33 | 3.14 | 1.49 | 2.39 | 1.39 | 2.23 | 1.37 | 1.99 | 0.63 |
| SCLD-122           | 6.75 | 3.80 | 1.52 | 2.61 | 1.43 | 2.99 | 2.25 | 2.74 | 0.87 |

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

in inches

-22 models

-22, 52, 122 models

-52 models

-122 models

**Options**

- Clamp arms
- Work supports
- Collet-Lok® swing cylinders
- Accessories
- Sequence valves

**Important**

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

Custom cylinders including longer stroke lengths are available on request.

Do not exceed maximum flow rates.

<table>
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<tr>
<th>J</th>
<th>J1</th>
<th>K</th>
<th>P</th>
<th>Q</th>
<th>T</th>
<th>W</th>
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<td>5.5</td>
<td>SCRS-122</td>
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<td>1.58</td>
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<td>2.44</td>
<td>2.95</td>
<td>5.5</td>
<td>SCRD-122</td>
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</tbody>
</table>

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

---

**Power sources Work supports Pallet components Swing clamps Valves Linear cylinders System components Yellow pages Right turning models**

www.enerpacwh.com


**Clamp arms for swing clamps**

Shown: CAS-121, CAL-122

---

**Patented Design**

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

---

**Pressure vs clamping force**

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

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

---

Ordering rotation limiting spacers

**BUILD YOUR PART NUMBER:**

<table>
<thead>
<tr>
<th>SP</th>
<th>Clamp force</th>
<th>Angle</th>
<th>186</th>
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<td>20</td>
<td>4200 lbs</td>
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</tr>
<tr>
<td>35</td>
<td>7600 lbs</td>
<td></td>
<td></td>
</tr>
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</table>

**Example:**

SP-12 45-186 converts a 2600 lb. swing cylinder to 45 degree rotation.

The addition of this spacer requires minor disassembly of the clamp. If you are uncomfortable doing this, please contact an authorized Enerpac Service Center.
**Dimensions in inches [†] ▼**

**Clamp force lbs** | **Model number** | **A** | **C** | **D** | **E** | **F** | **G** | **H** | **J** | **L** | **P** | **Q (UNC)** | **lbs**
--- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | ---
**Standard clamp arms**
500 | CAS-21 | 1.60 | 0.38 | .393-.395 | 0.63 | 0.4 | 0.76 | 0.5 | .250-28 | 1.22 | 0.97 | .250-20 | 0.1
1250 | CAS-51 | 2.39 | 0.50 | .630-.631 | 0.76 | 0.45 | 1.00 | 0.62 | .312-24 | 1.89 | 1.58 | .312-18 | 0.8
2025 | CAS-92 | 2.99 | 0.79 | .965-.986 | 0.99 | 0.62 | 1.58 | 0.86 | M10 X 1.25 | 2.21 | 1.78 | M10x1.5 | 0.7
2600 | CAS-121 | 3.13 | 0.70 | .876-.877 | 1.20 | 0.64 | 1.40 | 0.82 | .375-24 | 2.44 | 2.03 | .375-16 | 1.0
4200 | CAS-201 | 3.72 | 0.95 | 1.260-1.262 | 1.19 | 0.83 | 1.90 | 1.18 | .500-20 | 2.77 | 2.18 | .500-13 | 1.0
7600 | CAS-351 | 4.65 | 1.38 | 1.497-1.498 | 1.58 | 1.17 | 2.76 | 1.18 | .625-18 | 3.27 | 2.68 | .625-11 | 3.0
**Long clamp arms**
500 | CAL-22 | 3.63 | 0.38 | .393-.395 | 0.63 | 0.42 | 0.76 | 0.45 | M6x1.0 | 3.25 | – | – | 0.2
1250 | CAL-52 | 5.81 | 0.50 | .630-.631 | 0.76 | 0.45 | 1.00 | 0.56 | M8x1.0 | 5.31 | – | – | 1.0
2025 | CAL-92 | 7.09 | 0.79 | .965-.986 | 0.99 | 0.63 | 1.58 | 0.71 | M10x1.25 | 6.30 | – | – | 1.2
2600 | CAL-122 | 7.06 | 0.70 | .876-.877 | 1.20 | 0.63 | 1.40 | 0.73 | M10x1.5 | 6.36 | – | – | 1.5
4200 | CAL-202 | 7.95 | 0.95 | 1.260-1.262 | 1.19 | 0.83 | 1.90 | 1.00 | M12x1.25 | 7.00 | – | – | 1.5
7600 | CAL-352 | 8.47 | 1.38 | 1.497-1.498 | 1.58 | 1.33 | 2.76 | 1.19 | M16x1.50 | 7.09 | – | – | 4.2

**Custom design clamp arms**

**Clamp force lbs** | **Model number** | **C** | **D2** | **E** | **F** | **G** | **H** | **J** | **K1** | **K2** | **L** | **O** | **P** | **R**
--- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | ---
500 | .61 | .393-.394 | .495-.497 | .63 | .06-.12 | .79 | .37 | M5x0.8 | .122-.138 | .33 | .98-1.10 | .22 | .49 | .22
1250 | .79 | .623-.631 | .727-.729 | .75 | .06-.12 | 1.18 | .53 | M6x1.0 | .161-.177 | .39 | 1.38-1.57 | .26 | .43 | .26
2025 | 1.18 | .894-.895 | 1.096-1.100 | .98 | .06-.12 | 1.57 | .87 | M8x1.25 | .154-.165 | .49 | 2.17-2.36 | .35 | .55 | .35
2600 | 1.12 | .8756-.8766 | 1.002-1.006 | 1.18 | .06-.12 | 1.38 | .70 | .375-24 | .272-.287 | .50 | 2.05-2.25 | .39 | .63 | .31
4200 | 1.38 | 1.260-1.261 | 1.398-1.402 | 1.18 | .06-.12 | 2.36 | .98 | M10x1.5 | .201-.217 | .59 | 2.44-2.64 | .43 | .67 | .43
7600 | 1.57 | 1.496-1.497 | 1.634-1.638 | 1.57 | .06-.12 | 2.76 | 1.18 | M10x1.5 | .193-.209 | .79 | 3.15-3.35 | .43 | .67 | .43

**Important**

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

**Flow control valves**

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

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

**Gauges and accessories**

**Options**

- Brazos de amarre
- Bras de bridage
- Spannarme

CAS models
Standard clamp arms

CAL models
Long clamp arms

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

---

www.enerpacwh.com
**Pivoting T-Arms** for double-acting swing clamps

**Clamping two workpieces with one cylinder**

...quick and precise clamp arm positioning

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

**Allowable flow vs arm length**

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

![Diagram illustrating force distribution](image)

**Important**

- T-Arm Length \( L \) (in)
- \(-52,-92,-122\) models
  - Allowable Oil Flow
  - \(-122\):
  - \(-92\):
  - \(-52\):
- \(-202,-352\) models
  - Allowable Oil Flow
  - \(-352\):
  - \(-202\):

**Clamp arms are used to transmit the force generated by the swing cylinder to the workpiece. The T-arm clamps two workpieces simultaneously with one swing cylinder.**

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

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

**Shown:** CAC-202, CAPT-202; CAC-352, CAPT-352
**Dimensions & options**

**CAC, CAPT series**

**Collars - Dimensions** in inches [ ]

<table>
<thead>
<tr>
<th>Clamp force</th>
<th>Model number</th>
<th>Max. tilt angle</th>
<th>A (°)</th>
<th>B (°)</th>
<th>C (°)</th>
<th>D1 (°)</th>
<th>D2 (°)</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
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<td></td>
<td></td>
<td>max.</td>
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<td></td>
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<td>.95</td>
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**CA models**

**Collars for T-arms**

- **CA models**
- **Collars for T-arms**

**T-arms – Dimensions** in inches [ ]

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<th>Clamp force</th>
<th>Model number</th>
<th>A (°)</th>
<th>C (°)</th>
<th>D1 (°)</th>
<th>D2 (°)</th>
<th>G</th>
<th>H</th>
<th>J</th>
<th>K</th>
<th>L</th>
<th>L1</th>
<th>L2</th>
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<td>.59</td>
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*Note: D1 equals set screw thread size. Set screw must be long enough to secure the pivot pin.*

**Installation dimensions** in inches [ ]

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<th>T-arm model</th>
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<th>SU-L-series C</th>
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</table>

**Important**

- **For high cycle applications use double-acting cylinders.**
- **Do not exceed maximum oil flow.**
- If flow rates are exceeded, swing cylinder indexing mechanism may be permanently damaged.

**Options**

- **Gauges and accessories**
- **Flow control valves**
- **Download CAD files from www.enerpacwh.com**

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

**Power sources**

- Work supports
- Swing clamps
- Linear cylinders
- Sytems components
- Yellow pages

**Swing clamps**

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

** downloading CAD files from www.enerpacwh.com**

**Dimensions & options**

- **CAC, CAPT series**
- **Collars - Dimensions** in inches [ ]
- **T-arms – Dimensions** in inches [ ]
- **Installation dimensions** in inches [ ]

**www.enerpacwh.com**
Upright clamp arms for swing clamps

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

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

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

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

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

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

-22 models
-52 models
-92 models
-122 models
-202 models
-352 models

<table>
<thead>
<tr>
<th>Arm length (in)</th>
<th>Clamping force (lbs)</th>
<th>Pressure (psi)</th>
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<tr>
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<td>2000</td>
<td>810</td>
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<table>
<thead>
<tr>
<th>Arm length (in)</th>
<th>Clamping force (lbs)</th>
<th>Pressure (psi)</th>
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</thead>
<tbody>
<tr>
<td>0.38</td>
<td>5000</td>
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<th>Pressure (psi)</th>
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<table>
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<th>Arm length (in)</th>
<th>Clamping force (lbs)</th>
<th>Pressure (psi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.38</td>
<td>5000</td>
<td>1360</td>
</tr>
<tr>
<td>1.00</td>
<td>3850</td>
<td>1250</td>
</tr>
<tr>
<td>1.50</td>
<td>3100</td>
<td>1140</td>
</tr>
<tr>
<td>2.00</td>
<td>2625</td>
<td>1030</td>
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<tr>
<td>2.50</td>
<td>2285</td>
<td>920</td>
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<tr>
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<td>2000</td>
<td>810</td>
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<table>
<thead>
<tr>
<th>Arm length (in)</th>
<th>Clamping force (lbs)</th>
<th>Pressure (psi)</th>
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</thead>
<tbody>
<tr>
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<td>920</td>
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<tr>
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<table>
<thead>
<tr>
<th>Arm length (in)</th>
<th>Clamping force (lbs)</th>
<th>Pressure (psi)</th>
</tr>
</thead>
<tbody>
<tr>
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<td>920</td>
</tr>
<tr>
<td>3.00</td>
<td>2000</td>
<td>810</td>
</tr>
</tbody>
</table>
Angled arms use deflection to improve clamping

**Angled arms**
Tip engages part first and contact increases as clamping force is applied. Eliminates “push” effect caused by straight arms deflecting under load.

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

---

**Installation dimensions** in inches

<table>
<thead>
<tr>
<th>Model number</th>
<th>Clamp force</th>
<th>SU-Series C1</th>
<th>SL-Series C1</th>
<th>ST-Series C1</th>
<th>SC-Series C1</th>
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<td>CAU-22</td>
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<td>2.23</td>
<td>4.32</td>
<td>2.23</td>
</tr>
<tr>
<td>CAU-52</td>
<td>200</td>
<td>5.31</td>
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<tr>
<td>CAU-92</td>
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<td>6.30</td>
<td>2.90</td>
<td>5.89</td>
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<tr>
<td>CAU-122</td>
<td>500</td>
<td>6.36</td>
<td>3.29</td>
<td>6.67</td>
<td>3.29</td>
</tr>
<tr>
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<td>6.99</td>
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<td>6.90</td>
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<tr>
<td>CAU-352</td>
<td>1900</td>
<td>7.09</td>
<td>3.90</td>
<td>7.56</td>
<td>4.18</td>
</tr>
</tbody>
</table>

**Options**

- Sequence valves
- Flow control valves

**Download CAD files from**
www.enerpacwh.com

---

**CAU models**

**Uprach clamp arms**

**Dimensions** in inches

<table>
<thead>
<tr>
<th>Model number</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>F</th>
<th>G</th>
<th>H</th>
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<th>L</th>
<th>L</th>
<th>M</th>
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<tr>
<td></td>
<td>Std.</td>
<td>Min.</td>
<td>Std.</td>
<td>Min.</td>
<td>Std.</td>
<td>Min.</td>
<td>Std.</td>
<td>Min.</td>
<td>mm</td>
<td>Std.</td>
<td>Min.</td>
<td>lbs</td>
<td></td>
<td></td>
<td></td>
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<tr>
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<td>0.54</td>
<td>0.66</td>
<td>0.63</td>
<td>.393-.394</td>
<td>1.17</td>
<td>0.32</td>
<td>0.54</td>
<td>0.79</td>
<td>0.33</td>
<td>0.82</td>
<td>M6 x 1,0</td>
<td>0.64</td>
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<td>0.98</td>
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<tr>
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<td>6.10</td>
<td>0.85</td>
<td>1.05</td>
<td>0.79</td>
<td>.630-.631</td>
<td>1.65</td>
<td>0.26</td>
<td>0.57</td>
<td>1.18</td>
<td>0.47</td>
<td>1.25</td>
<td>M6 x 1,0</td>
<td>0.75</td>
<td>5.31</td>
<td>1.57</td>
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<tr>
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<td>0.93</td>
<td>1.17</td>
<td>1.18</td>
<td>.985-.986</td>
<td>1.89</td>
<td>0.43</td>
<td>0.76</td>
<td>1.57</td>
<td>0.57</td>
<td>1.61</td>
<td>M8 x 1,25</td>
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<td>1.77</td>
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<td>1.34</td>
<td>1.12</td>
<td>.876-.877</td>
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<td>0.50</td>
<td>1.15</td>
<td>1.50</td>
<td>0.65</td>
<td>1.56</td>
<td>M10 x 1,5</td>
<td>1.18</td>
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<td>2.00</td>
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<td>8.37</td>
<td>1.27</td>
<td>1.52</td>
<td>1.38</td>
<td>1.260-1.261</td>
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<td>0.52</td>
<td>0.96</td>
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<td>0.68</td>
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<td>1.497-1.498</td>
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<td>0.74</td>
<td>1.35</td>
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<td>0.62</td>
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<td>M10 x 1,5</td>
<td>1.58</td>
<td>7.09</td>
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</table>

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

...with 360° fully adjustable clamp arm

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

Selection chart

<table>
<thead>
<tr>
<th>Clamping force 1)</th>
<th>Stroke</th>
<th>Model number</th>
<th>Cylinder effective area in²</th>
<th>Oil capacity in³</th>
<th>Pressure psi</th>
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<tr>
<td>lbs</td>
<td>in</td>
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<td>Pull</td>
<td>Push</td>
<td>Pull</td>
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<td>2164</td>
<td>.50</td>
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<td>.98</td>
<td>1.767</td>
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<tr>
<td>500</td>
<td>.25</td>
<td>SC-3</td>
<td>.245</td>
<td>.442</td>
<td>.184</td>
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</tbody>
</table>

1) Standard clamp arm (included).

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

Product dimensions in inches

| Model number | A     | B     | C     | C1    | D     | D1    | D2    | F     | G     | G1    | H     | H1    | H1    | P     | Q     | U     | U1    | W     | lbs   |
|--------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| SC-1         | 8.88  | 7.37  | 5.87  | 5.74  | 1.875-16 UNF | 2.90  | 1.88  | 1.00  | 2.50-18 | .125-18 | 3.31  | .88  | 2.00  | .375-16 | 1.28  | 2.06  | 2.87  | 6     |
| SC-3         | 5.27  | 4.26  | 3.71  | 3.48  | 1.00-12 UNF  | 2.00  | 1.13  | .50   | .125-27 | .125-27 | 2.15  | .63  | 1.00  | .250-20 | .75   | 1.50  | 2.03  | 2     |
Swing clamps

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 series

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

Important

For high cycle applications use double-acting cylinders.

Selection chart

<table>
<thead>
<tr>
<th>Clamping force</th>
<th>Stroke</th>
<th>Model number</th>
<th>Operating pressure</th>
<th>Cylinder effective area</th>
<th>Oil capacity</th>
<th>Max. oil flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>lbs</td>
<td>in</td>
<td></td>
<td>psi</td>
<td>in²</td>
<td>in³</td>
<td>lbs</td>
</tr>
<tr>
<td>1375</td>
<td>.25</td>
<td>ASC-30</td>
<td>1200 - 2500</td>
<td>.55</td>
<td>.30</td>
<td>115</td>
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<tr>
<td>4375</td>
<td>.43</td>
<td>ASC-100</td>
<td>1200 - 2500</td>
<td>1.76</td>
<td>1.22</td>
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</table>

Product dimensions in inches [ in. ]

<table>
<thead>
<tr>
<th>Model number</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
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<th>N</th>
<th>U</th>
<th>V</th>
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<tr>
<td>ASC-30</td>
<td>5.00</td>
<td>3.38</td>
<td>.50</td>
<td>.25</td>
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<td>.75</td>
<td>.125-27</td>
<td>2.75</td>
<td>1.63</td>
<td>.500-13</td>
<td>2.75</td>
<td>2.50</td>
<td>2.50</td>
<td>.41</td>
</tr>
<tr>
<td>ASC-100</td>
<td>7.00</td>
<td>4.50</td>
<td>.53</td>
<td>.43</td>
<td>5.25</td>
<td>.73</td>
<td>.125-27</td>
<td>4.25</td>
<td>2.25</td>
<td>.500-13</td>
<td>4.00</td>
<td>3.50</td>
<td>3.50</td>
<td>.63</td>
</tr>
</tbody>
</table>
### Unobstructed part loading
- Plunger rotates only when cylinder is fully extended, to minimize obstructions
- Ideal for mounting beneath the fixture, as the clamp does not rotate until the workpiece has been cleared
- Stainless steel body for additional corrosion resistance
- Three port design for fewer hydraulic connections
- Fully threaded body for easy installation
- Standard two sided clamp arm included
- Clamp arm design makes mounting easy

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

1. **Step 1**
   - Pressurize port A.
   - Plunger extends through workpiece.

2. **Step 2**
   - Keep port A pressurized.
   - Pressurize port C.
   - Plunger makes 90° flat rotation.

3. **Step 3**
   - Keep port C pressurized.
   - Pressurize port B.
   - Plunger retracts: clamp force is applied.

4. **Step 4**
   - Keep port C pressurized.
   - Pressurize port A.
   - Plunger extends: clamp force is released.

5. **Step 5**
   - Keep port A pressurized.
   - Depressurize port C.
   - Plunger makes 90° flat rotation.

6. **Step 6**
   - Pressurize port B.
   - Plunger retracts through workpiece.

### Selection chart

<table>
<thead>
<tr>
<th>Clamping force</th>
<th>Stroke</th>
<th>Model number</th>
<th>Cylinder effective area</th>
<th>Oil capacity</th>
<th>Max. oil flow</th>
<th>Maximum cycle rate</th>
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<tbody>
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<td></td>
<td>in²</td>
<td>in³ Clamped</td>
<td>in³ Unclamped</td>
<td>cycles /min</td>
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<tr>
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<td>2.50</td>
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<td>0.98</td>
<td>1.77</td>
<td>2.5</td>
<td>4.4</td>
</tr>
</tbody>
</table>

1) When using optional CA-28 clamp arm, max. operating pressure is 2000 psi.
2) Standard clamp arm included.

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

- **High pressure filters**
- **Fittings**
- **Valves**

**Important**

- It is highly recommended that system filtration be used to ensure reliable operation.
- Do not exceed maximum pressure and flow rates.
- For recommended valving schemes, please refer to page 42.

**Clamp arm movement:**

90° ± 3° flat rotation.

---

**Optional CA-28 clamp arm**

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

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

Important

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

Work support range overview 44 - 45

Hydraulic advance work supports WF 46 - 47

Spring advance work supports WS 48 - 49

Work support mounting dimensions WF, WS 50 - 51

Work Supports

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

Technical support

Refer to the “Yellow Pages” of this catalog for:
- Safety instructions
- Basic hydraulic information
- Advanced hydraulic technology
- FMS (Flexible Machining Systems) technology
- Conversion charts and hydraulic symbols
**Work supports**

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.

**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.

**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.

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
## Work supports

### 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

<table>
<thead>
<tr>
<th>Maximum support force</th>
<th>Stroke</th>
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<th>Threaded body</th>
<th>Lower flange</th>
<th>Cartridge style</th>
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<td>Model number</td>
<td>Model number</td>
<td>Model number</td>
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<tr>
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<td>WFC-112</td>
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<td>.47</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>WSC-222</td>
</tr>
</tbody>
</table>

### 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.**
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 fixtureing that prevents coolants and debris from being ingested into the mechanism
- Minimized deflection increases machining accuracy
- Multiple mounting configurations for design flexibility
- Contact bolt included

Four mounting styles

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

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

### Four mounting styles

#### WFM series, Manifold models
Eliminates the need for fittings and tubing on the fixture.

#### WFT series, Threaded models
Offers the flexibility of side or bottom porting.

#### WFL series, Lower flange models
Plumbed directly – no fixture hole required.

#### WFC series, Cartridge models
Can be designed into narrow fixture plates as thru-hole mounting is fully functional.

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

**Product selection**

<table>
<thead>
<tr>
<th>Max. support force</th>
<th>Support plunger stroke</th>
<th>Manifold mount</th>
<th>Threaded body</th>
<th>Lower flange</th>
<th>Cartridge style</th>
<th>Operating pressure</th>
<th>Plunger contact spring force</th>
<th>Oil capacity</th>
<th>Oil flow</th>
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</thead>
<tbody>
<tr>
<td>lbs</td>
<td>in</td>
<td>psi max.</td>
<td>psi min.</td>
<td>lbs ext.</td>
<td>lbs retr.</td>
<td>in³/ min</td>
<td>lbs ext.</td>
<td>in³/ min</td>
<td>lbs ext.</td>
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<tr>
<td>1650</td>
<td>.39</td>
<td>WF-71</td>
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<td>2.0 5.8</td>
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* This product is made to order. Please contact Enerpac for delivery information before specifying in your design.
**WF series**

<table>
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<tr>
<th>WFM series</th>
<th>WFT series</th>
</tr>
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<tr>
<td><img src="image1.png" alt="Diagram" /></td>
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**WFL series**

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</table>

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**Options**

- **Accessories**
  - 86
- **In-line filters**
  - 193

---

**Important**

- **Important**
  - **WARNING!**
    - Support force and clamping force must be matched. Support force should be at least 150% of clamping force.
  - **Do not exceed maximum flow rates to avoid premature lockup.**
  - Custom cylinders including longer stroke lengths are available on request.

---

**Product dimensions in inches**

<table>
<thead>
<tr>
<th>Model number</th>
<th>Capacity</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>C1</th>
<th>D</th>
<th>D1</th>
<th>D2</th>
<th>E</th>
<th>F</th>
<th>H1</th>
<th>H2</th>
<th>K</th>
<th>L</th>
<th>M</th>
<th>N**</th>
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<th>U2</th>
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<td>-</td>
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<td>0.51</td>
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<td>3.53</td>
<td>3.13</td>
<td>-</td>
<td>1.03</td>
<td>1.375-18 UNEF</td>
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<td>-</td>
<td>0.591</td>
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<td>0.18</td>
<td>1.34</td>
<td>0.51</td>
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<td>3.54</td>
<td>3.10</td>
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<td>.70</td>
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<td>1.496</td>
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<td>M20x2.5</td>
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<td>2.75</td>
<td>0.92</td>
<td>-</td>
<td>2.72</td>
<td>4.0</td>
</tr>
</tbody>
</table>

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

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

*Note:* For manifold mounting dimensions 50.

**www.enerpacwh.com**
Spring advance work support contacts workpiece as it is loaded into fixture

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

### Mounting style

**WSM series, Manifold mount**
Eliminates the need for fittings and tubing on the fixture.

**WST series, Threaded body**
Offers the flexibility of side or bottom porting.

**WSL series, Lower flange**
Plumbed directly – no fixture hole required.

**WSC series, Cartridge mount style**
Can be designed into narrow fixture plates as thru-hole mounting is fully functional.

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

### Product selection

<table>
<thead>
<tr>
<th>Max. support force</th>
<th>Support plunger stroke</th>
<th>Manifold mount</th>
<th>Threaded body</th>
<th>Lower flange</th>
<th>Cartridge style</th>
<th>Operating pressure psi</th>
<th>Plunger contact spring force lbs</th>
<th>Oil capacity ext. in³</th>
<th>Oil flow in³/min</th>
</tr>
</thead>
<tbody>
<tr>
<td>1650</td>
<td>.38</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>700</td>
<td>2.0</td>
<td>5.8</td>
<td>.04</td>
</tr>
<tr>
<td>1650</td>
<td>.38</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>700</td>
<td>2.0</td>
<td>5.8</td>
<td>.04</td>
</tr>
<tr>
<td>2500</td>
<td>.38</td>
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<td>5.2</td>
<td>.06</td>
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<td>19.5</td>
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</tr>
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<td>WSC-72</td>
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<td>.04</td>
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<td>3.4</td>
<td>5.2</td>
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<td>-</td>
<td>WSC-222</td>
<td>700</td>
<td>2.1</td>
<td>19.5</td>
<td>.19</td>
</tr>
</tbody>
</table>

**Note:**
- 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.
**WSM series**

- **WSM-71**
  - Capacity: 1650 lbs
  - Stroke: 3.00 to 2.20 inches
  - Pressure: 1250 to 16 UN

- **WSM-111**
  - Capacity: 2500 lbs
  - Stroke: 3.36 to 2.54 inches

- **WSM-221**
  - Capacity: 3000 lbs

**WST series**

- **WST-71**
  - Capacity: 1650 lbs
  - Stroke: 3.51 to 2.82 inches

- **WST-111**
  - Capacity: 2500 lbs

**WSL series**

- **WSL-111**
  - Capacity: 2500 lbs

- **WSL-221**
  - Capacity: 5000 lbs

**WSC series**

- **WSC-72**
  - Capacity: 1650 lbs

- **WSC-112**
  - Capacity: 2500 lbs

- **WSC-222**
  - Capacity: 3000 lbs

**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 flow lockup.**

**Custom cylinders including longer stroke lengths are available on request.**

**Options**

- **Accessories**
  - In-line filters

**Dimensions & options**

- **Force:** 1650 - 10,000 lbs
- **Stroke:** .38 - .66 inch
- **Pressure:** 700 - 5000 psi
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.

Product dimensions in inches [\text{in}]

<table>
<thead>
<tr>
<th>Model number</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>R</th>
<th>Manifold O-ring</th>
<th>Flange nut</th>
</tr>
</thead>
<tbody>
<tr>
<td>WFM-71</td>
<td>1.250-16 UN 2B</td>
<td>.37-.39</td>
<td>.58-.60</td>
<td>.93-.95</td>
<td>.015</td>
<td>ARP-017</td>
<td>FN-301</td>
</tr>
<tr>
<td>WSM-71</td>
<td>1.250-16 UN 2B</td>
<td>.37-.39</td>
<td>.58-.60</td>
<td>.93-.95</td>
<td>.015</td>
<td>ARP-017</td>
<td>FN-301</td>
</tr>
</tbody>
</table>

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 page 47 (WFT) and page 49 (WST models). Use a flange nut to secure your threaded work support in the required position.

Lower flange work support mounting dimensions

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

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

Product dimensions in inches [\text{in}]

<table>
<thead>
<tr>
<th>Model numbers</th>
<th>D</th>
<th>Q</th>
<th>R</th>
<th>S</th>
<th>U1</th>
<th>U2</th>
<th>V</th>
<th>Manifold O-ring</th>
<th>Flange nut</th>
</tr>
</thead>
<tbody>
<tr>
<td>WFL-111</td>
<td>1.375-18UNEF</td>
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<td>.23</td>
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<td>.94</td>
<td>.284</td>
<td>ARP-010</td>
<td>FN-351</td>
</tr>
<tr>
<td>WFL-221</td>
<td>2.625-20UN 1.08</td>
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<td>.56</td>
<td>2.18</td>
<td>2.18</td>
<td>.284</td>
<td>ARP-110</td>
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<tr>
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<td>2.44</td>
<td>.284</td>
<td>ARP-110</td>
<td>—</td>
</tr>
<tr>
<td>WFL-441</td>
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<td>1.44</td>
<td>.34</td>
<td>.56</td>
<td>2.94</td>
<td>2.94</td>
<td>.284</td>
<td>ARP-110</td>
<td>—</td>
</tr>
<tr>
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<td>1.375-18UNEF</td>
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<td>.23</td>
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<td>.284</td>
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<td>FN-351</td>
</tr>
<tr>
<td>WSL-221</td>
<td>2.625-20UN 1.08</td>
<td>.34</td>
<td>.56</td>
<td>2.18</td>
<td>2.18</td>
<td>.284</td>
<td>ARP-110</td>
<td>—</td>
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</tr>
<tr>
<td>WSL-331</td>
<td>2.88</td>
<td>1.20</td>
<td>.34</td>
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<td>2.44</td>
<td>2.44</td>
<td>.284</td>
<td>ARP-110</td>
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<tr>
<td>WSL-441</td>
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<td>.34</td>
<td>.56</td>
<td>2.94</td>
<td>2.94</td>
<td>.284</td>
<td>ARP-110</td>
<td>—</td>
</tr>
</tbody>
</table>

\(^1\) Polyurethane 92 duro.
**Cartridge work support** mounting dimensions

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

---

**Dimensions in inches**

<table>
<thead>
<tr>
<th>Model numbers</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>Ventilation below force required</th>
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</thead>
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<tr>
<td></td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>min.</td>
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<td><strong>Spring advance</strong></td>
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<td>WSC-72</td>
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<td>2.38-2.40</td>
<td>.69-.72</td>
<td>2.20</td>
<td>Yes</td>
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</table>

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

---

<sup>3</sup>Cartridge work support

<sup>4</sup>Options

<sup>5</sup>Important

---

- **Force:** 1650 - 10,000 lbs
- **Stroke:** .36 - .66 inch
- **Pressure:** 700 - 5000 psi

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

---

**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

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
<table>
<thead>
<tr>
<th>Category</th>
<th>Model</th>
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<td>Link clamp / Link clamp arms</td>
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<td>54 - 55</td>
</tr>
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<td>LCA</td>
<td>56 - 57</td>
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<tr>
<td><strong>Pull cylinder range overview</strong></td>
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<td>58 - 59</td>
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<tr>
<td>Upper flange pull cylinders</td>
<td>PU</td>
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<tr>
<td>Lower flange pull cylinders</td>
<td>PL</td>
<td>62 - 63</td>
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<td>Threaded body pull cylinders</td>
<td>PT</td>
<td>64 - 65</td>
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<td>66 - 67</td>
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<td>Additional threaded cylinders</td>
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<td>WMT,</td>
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<td>WRT</td>
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<td>ECM</td>
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<td>Hollow plunger cylinders</td>
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<td>80 - 81</td>
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<td>Cylinder accessories</td>
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<td>Tie rod cylinder</td>
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<tr>
<td>Tie rod accessories</td>
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</table>
Quick and accurate clamping action

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

Product selection

<table>
<thead>
<tr>
<th>Clamping Stroke</th>
<th>Model Number</th>
<th>Cylinder Effective Area</th>
<th>Oil Capacity</th>
<th>Standard Clamp Arm (Sold Separately)</th>
<th>Long Clamp Arm</th>
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<td>0.14</td>
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<td>LCAS-32</td>
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<td>1.49</td>
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<td>LCAS-282</td>
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Contact Enerpac for models with metric threads and BSPP ports.

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

Dimensions in inches [ ]

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<tr>
<th>Model Number</th>
<th>Port Size</th>
<th>C1</th>
<th>C2</th>
<th>C3</th>
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<th>D2</th>
<th>E</th>
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<td>SAE#2</td>
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<td>1.44</td>
<td>2.17</td>
<td>1.875-16 UN</td>
<td>2.44</td>
<td>2.20</td>
<td>27.9*</td>
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<td>3.125-16 UN</td>
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Contact Enerpac for models with metric threads and BSPP ports.

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

<table>
<thead>
<tr>
<th>Clamp force lbs</th>
<th>Fixture hole Ø D3</th>
<th>Mounting thread J unit</th>
<th>Min. depth J2</th>
<th>Manifold O-ring ²</th>
<th>ARP No. or Inside Ø x thickness</th>
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<tr>
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<td>1.885</td>
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<td>1800</td>
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<td>0.75</td>
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<td>2700</td>
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<td>4300</td>
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<td>6300</td>
<td>4.140</td>
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<td>0.94</td>
<td>-010</td>
<td></td>
</tr>
</tbody>
</table>

² With standard clamp arm.
³ Polyurethane, 92 Durometer

Note: Mounting bolts and O-rings included.

**Options**

- **Clamp arms**
  - Single acting
  - Double acting

- **Work supports**

**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.

---

**Dimensions shown with standard clamp arm.**

Double acting:
- A = Clamp
- B = Unclamp

---

<table>
<thead>
<tr>
<th>Clamp force lbs</th>
<th>Fixture hole Ø D3</th>
<th>Mounting thread J unit</th>
<th>Min. depth J2</th>
<th>Manifold O-ring ²</th>
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² With standard clamp arm.
³ Polyurethane, 92 Durometer

**Single acting**

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<th>Clamp force lbs</th>
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<th>Mounting thread J unit</th>
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<th>Manifold O-ring ²</th>
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</table>

² With standard clamp arm.
³ Polyurethane, 92 Durometer

**Double acting**

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<th>Fixture hole Ø D3</th>
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<th>ARP No. or Inside Ø x thickness</th>
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<td>0.94</td>
<td>-010</td>
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</tbody>
</table>

² With standard clamp arm.
³ Polyurethane, 92 Durometer

---

**Clamp force:** 675-6300 lbs

**Stroke:** 0.73-1.76 inch

**Pressure:** 500-5000 psi

---

**www.enerpacwh.com**
Clamp arms for link clamps

Standard or custom built

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

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

Pressure vs clamping force

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

Important

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

**LCAS/LCAL series**

**Force:** 700-6300 lbs  
**Pressure:** 500-5000 psi

**Options**

**Work supports**

**Accessories**

**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.

**Dimensions in inches [尺寸]**

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<td>4.92</td>
<td>1.20</td>
<td>0.51</td>
<td>1.14</td>
<td>0.63</td>
<td>1.77</td>
<td>1.06</td>
<td>1.25</td>
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<table>
<thead>
<tr>
<th>Clamp capacity lbs</th>
<th>Model number</th>
<th>J1</th>
<th>J2</th>
<th>K</th>
<th>L1</th>
<th>L2</th>
<th>N</th>
<th>P</th>
<th>Q</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
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<td></td>
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<tr>
<td><strong>Standard clamp arms</strong></td>
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<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>700</td>
<td>LCAS-32</td>
<td>0.237-0.239</td>
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<td>0.51</td>
<td>0.93</td>
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<tr>
<td>1800</td>
<td>LCAS-82</td>
<td>0.396-0.398</td>
<td>0.317-0.319</td>
<td>0.63</td>
<td>1.26</td>
<td>0.96</td>
<td>0.20</td>
<td>0.87</td>
<td></td>
<td>M10 x 1,5</td>
</tr>
<tr>
<td>2700</td>
<td>LCAS-122</td>
<td>0.474-0.476</td>
<td>0.396-0.398</td>
<td>0.79</td>
<td>1.48</td>
<td>1.18</td>
<td>0.22</td>
<td>0.98</td>
<td></td>
<td>M12 x 1,75</td>
</tr>
<tr>
<td>4300</td>
<td>LCAS-192</td>
<td>0.593-0.595</td>
<td>0.474-0.476</td>
<td>0.94</td>
<td>1.63</td>
<td>1.42</td>
<td>0.26</td>
<td>1.22</td>
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<td>2.01</td>
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</table>

**LCAL models**

**Long Arm**

<table>
<thead>
<tr>
<th>Clamp capacity lbs</th>
<th>Model number</th>
<th>A</th>
<th>B</th>
<th>C1</th>
<th>C2</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>J1</th>
<th>J2</th>
<th>K</th>
<th>L2</th>
<th>N</th>
<th>P</th>
<th>Q</th>
<th>H</th>
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<tbody>
<tr>
<td></td>
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<td></td>
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<td></td>
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<td></td>
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<td></td>
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<tr>
<td><strong>Standard clamp arms</strong></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>800</td>
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<td>0.37</td>
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<td>0.47</td>
<td>0.237-0.239</td>
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<td>0.51</td>
<td>0.73</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td>0.31</td>
<td>0.61</td>
<td>0.39</td>
<td>0.98</td>
<td>0.74</td>
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<td>0.63</td>
<td>0.96</td>
<td>0.20</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2700</td>
<td>LCAL-122</td>
<td>4.33</td>
<td>0.87</td>
<td>0.39</td>
<td>0.77</td>
<td>0.43</td>
<td>1.26</td>
<td>0.86</td>
<td>0.474-0.476</td>
<td>0.396-0.398</td>
<td>0.79</td>
<td>1.18</td>
<td>0.22</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>4300</td>
<td>LCAL-192</td>
<td>6.30</td>
<td>1.02</td>
<td>0.43</td>
<td>0.94</td>
<td>0.51</td>
<td>1.50</td>
<td>0.98</td>
<td>0.593-0.595</td>
<td>0.474-0.476</td>
<td>0.94</td>
<td>1.42</td>
<td>0.26</td>
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<td></td>
</tr>
<tr>
<td>6300</td>
<td>LCAL-282</td>
<td>8.66</td>
<td>1.20</td>
<td>0.51</td>
<td>1.14</td>
<td>0.63</td>
<td>1.77</td>
<td>1.25</td>
<td>0.711-0.713</td>
<td>0.593-0.595</td>
<td>1.10</td>
<td>1.73</td>
<td>0.31</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**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.

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

---

www.enerpacwh.com
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 1250 to 9600 lbs. for pulling and 2950 to 18,400 lbs. for pushing applications.

Compact and full featured design

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

Select your pull cylinder type:

Single acting

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

Double acting

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

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

**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

**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

**Product selection**

<table>
<thead>
<tr>
<th>Cylinder capacity</th>
<th>Stroke</th>
<th>Upper flange</th>
<th>Lower flange</th>
<th>Threaded body</th>
</tr>
</thead>
<tbody>
<tr>
<td>lbs</td>
<td>Push</td>
<td>Pull</td>
<td>Push</td>
<td>in</td>
</tr>
<tr>
<td>1250</td>
<td>–</td>
<td>.89</td>
<td>PUSS-51</td>
<td>PLSS-51</td>
</tr>
<tr>
<td>2950</td>
<td>–</td>
<td>1.10</td>
<td>PUSS-121</td>
<td>PLSS-121</td>
</tr>
</tbody>
</table>

**Options**

- **Accessories**
- **Collet-Lok® push cylinders**
- **Work supports**
- **Swing cylinders**
- **Sequence valves**

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

www.enerpacwh.com
Pull cylinders - Upper flange models

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.

Product selection

<table>
<thead>
<tr>
<th>Cylinder number</th>
<th>Stroke</th>
<th>Model number</th>
<th>Cylinder effective area</th>
<th>Oil capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>lbs</td>
<td>in</td>
<td>Pull</td>
<td>Push</td>
</tr>
<tr>
<td></td>
<td>lbs</td>
<td>in</td>
<td>Pull</td>
<td>Push</td>
</tr>
<tr>
<td>Single acting</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1250</td>
<td>.89</td>
<td>PUSS-51</td>
<td>.28</td>
<td>.25</td>
</tr>
<tr>
<td>2950</td>
<td>1.10</td>
<td>PUSD-121</td>
<td>.63</td>
<td>.70</td>
</tr>
<tr>
<td>Double acting</td>
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<tr>
<td>1400 2950</td>
<td>.89</td>
<td>PUSD-51</td>
<td>.28</td>
<td>.25</td>
</tr>
<tr>
<td>2475 6300</td>
<td>.87</td>
<td>PUSD-92</td>
<td>.49</td>
<td>.42</td>
</tr>
<tr>
<td>3150 6150</td>
<td>1.10</td>
<td>PUSD-121</td>
<td>.63</td>
<td>.70</td>
</tr>
<tr>
<td>9600 18,400</td>
<td>1.20</td>
<td>PUSD-351</td>
<td>1.92</td>
<td>2.27</td>
</tr>
</tbody>
</table>

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

Dimensions in inches [\(\text{in} \times \text{in}\)]

<table>
<thead>
<tr>
<th>Model number</th>
<th>A</th>
<th>B</th>
<th>C1</th>
<th>D</th>
<th>D1</th>
<th>D2</th>
<th>E</th>
<th>E1</th>
<th>F</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(\text{in} \times \text{in})</td>
<td></td>
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<td></td>
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<td></td>
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</tr>
<tr>
<td>Single acting</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>PUSS-51</td>
<td>5.07</td>
<td>4.18</td>
<td>0.98</td>
<td>1.37</td>
<td>2.13</td>
<td>2.25</td>
<td>0.63</td>
<td>0.59</td>
<td>0.51</td>
<td>0.55</td>
</tr>
<tr>
<td>PUSS-121</td>
<td>6.31</td>
<td>5.21</td>
<td>1.00</td>
<td>1.87</td>
<td>2.62</td>
<td>2.88</td>
<td>0.87</td>
<td>0.82</td>
<td>0.68</td>
<td>0.61</td>
</tr>
<tr>
<td>Double acting</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>PUSD-51</td>
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<td>4.18</td>
<td>0.98</td>
<td>1.37</td>
<td>2.13</td>
<td>2.25</td>
<td>0.63</td>
<td>0.59</td>
<td>0.51</td>
<td>0.55</td>
</tr>
<tr>
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<td>2.13</td>
<td>0.98</td>
<td>0.93</td>
<td>0.70</td>
<td>0.49</td>
</tr>
<tr>
<td>PUSD-121</td>
<td>6.31</td>
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<td>1.00</td>
<td>1.87</td>
<td>2.62</td>
<td>2.88</td>
<td>0.87</td>
<td>0.82</td>
<td>0.68</td>
<td>0.61</td>
</tr>
<tr>
<td>PUSD-351</td>
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<td>0.98</td>
<td>3.14</td>
<td>3.94</td>
<td>3.50</td>
<td>1.50</td>
<td>1.42</td>
<td>1.13</td>
<td>0.49</td>
</tr>
</tbody>
</table>
**Installation dimensions** in inches

<table>
<thead>
<tr>
<th>Pull force lbs</th>
<th>Fixture hole Ø D3</th>
<th>Mounting thread J Unf</th>
<th>Min. depth J2</th>
<th>Manifold O-ring *</th>
<th>ARP numbers or Inside Ø x thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>1400</td>
<td>1.39</td>
<td>.250-28</td>
<td>.65</td>
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<td>568-011</td>
</tr>
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<td>2475</td>
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<td>M6</td>
<td>.59</td>
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<td>.17 x .139</td>
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<tr>
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<td>1.89</td>
<td>.312-24</td>
<td>.80</td>
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<td>9600</td>
<td>3.06</td>
<td>.375-24</td>
<td>.74</td>
<td></td>
<td>.17 x .139</td>
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</tbody>
</table>

*O-ring material: polyurethane, 92 Durometer

---

**Options**

- **Accessories**
  - 86

- **Collet-Lok® push cylinders**
  - 18

- **Swing cylinders**
  - 22

- **Sequence valves**
  - 152

---

**Important**

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

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

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

![Image](image_url)

**Minimal mounting height**

...when space is at a premium

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

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

**Product selection**

<table>
<thead>
<tr>
<th>Cylinder capacity</th>
<th>Stroke</th>
<th>Model number</th>
<th>Cylinder effective area</th>
<th>Oil capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>lbs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Push</td>
<td>in</td>
<td>Pull</td>
<td>Push</td>
<td>Pull</td>
</tr>
<tr>
<td>Single acting</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1250</td>
<td>–</td>
<td>.89</td>
<td>PLSS-51</td>
<td>.28</td>
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<tr>
<td>2950</td>
<td>–</td>
<td>1.10</td>
<td>PLSS-121</td>
<td>.63</td>
</tr>
<tr>
<td>Double acting</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1400</td>
<td>2950</td>
<td>.89</td>
<td>PLSD-51</td>
<td>.28</td>
</tr>
<tr>
<td>2475</td>
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<td>.87</td>
<td>PLSD-92</td>
<td>.49</td>
</tr>
<tr>
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<td>6150</td>
<td>1.10</td>
<td>PLSD-121</td>
<td>.63</td>
</tr>
<tr>
<td>9600</td>
<td>18,400</td>
<td>1.20</td>
<td>PLSD-351</td>
<td>1.92</td>
</tr>
</tbody>
</table>

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

**Dimensions in inches [inch]**

<table>
<thead>
<tr>
<th>Model number</th>
<th>A</th>
<th>B</th>
<th>C1</th>
<th>D</th>
<th>D1</th>
<th>D2</th>
<th>E</th>
<th>E1</th>
<th>F</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLSS-51</td>
<td>5.07</td>
<td>4.18</td>
<td>0.98</td>
<td>1.37</td>
<td>2.13</td>
<td>2.25</td>
<td>0.63</td>
<td>0.59</td>
<td>0.51</td>
<td>0.55</td>
</tr>
<tr>
<td>PLSS-121</td>
<td>6.31</td>
<td>5.21</td>
<td>1.00</td>
<td>1.87</td>
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<td>2.88</td>
<td>0.87</td>
<td>0.82</td>
<td>0.68</td>
<td>0.61</td>
</tr>
<tr>
<td>PLSD-51</td>
<td>5.07</td>
<td>4.18</td>
<td>0.98</td>
<td>1.37</td>
<td>2.13</td>
<td>2.25</td>
<td>0.63</td>
<td>0.59</td>
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<td>0.55</td>
</tr>
<tr>
<td>PLSD-92</td>
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<td>4.57</td>
<td>0.98</td>
<td>1.88</td>
<td>2.76</td>
<td>2.13</td>
<td>0.98</td>
<td>0.93</td>
<td>0.7</td>
<td>0.49</td>
</tr>
<tr>
<td>PLSD-121</td>
<td>6.31</td>
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<td>1</td>
<td>1.87</td>
<td>2.62</td>
<td>2.88</td>
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<td>0.68</td>
<td>0.61</td>
</tr>
<tr>
<td>PLSD-351</td>
<td>8.04</td>
<td>6.83</td>
<td>0.98</td>
<td>3.14</td>
<td>3.94</td>
<td>3.5</td>
<td>1.5</td>
<td>1.42</td>
<td>1.13</td>
<td>0.49</td>
</tr>
</tbody>
</table>
Installation dimensions in inches

<table>
<thead>
<tr>
<th>Pull force</th>
<th>Mounting thread J</th>
<th>Minimum depth J2</th>
<th>Manifold O-ring arp numbers or inside Ø x thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>1400</td>
<td>.250-28</td>
<td>.65</td>
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<td>.17 x .139</td>
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</table>

*O-ring material: polyurethane, 92 Durometer

### Options

- **Accessories**
- **Collet-Lok® push cylinders**
- **Swing cylinders**
- **Sequence valves**

**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.
Threaded directly into the fixture
...can be secured at any height

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

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

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

Product selection

<table>
<thead>
<tr>
<th>Cylinder capacity lbs</th>
<th>Stroke in</th>
<th>Model number</th>
<th>Cylinder effective area in²</th>
<th>Oil capacity in³</th>
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<tr>
<td></td>
<td>Pull</td>
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<td>PTSD-351</td>
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</table>

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

Dimensions in inches [ 1 ]

<table>
<thead>
<tr>
<th>Model number</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>D1</th>
<th>D2</th>
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<tr>
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<td>4.18</td>
<td>0.98</td>
<td>1.375-18 UNEF</td>
<td>1.88</td>
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<tr>
<td>PTSS-121</td>
<td>6.31</td>
<td>5.22</td>
<td>1.00</td>
<td>1.875-16 UN</td>
<td>2.38</td>
<td>2.00</td>
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**Installation dimensions** in inches

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-51, 121

-92, -351

**Accessory chart**

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**Options**

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

**Important**

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

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

**Power sources**

**Pallet components**

**Valves**

**System components**

**Yellow pages**
High clamping forces in a compact body

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

Product selection

<table>
<thead>
<tr>
<th>Cylinder capacity at 5000 psi lbs push pull in</th>
<th>Stroke Model number</th>
<th>Effective area in² push pull</th>
<th>Oil capacity in³ push pull</th>
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<td>0.79 – 0.40</td>
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<td>CST-18501</td>
<td>0.79 – 1.56</td>
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<td>CST-27151</td>
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<td>3900 – 2330 0.51</td>
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<td>CDT-18251</td>
<td>0.77 – 0.46</td>
<td>0.78 – 0.46</td>
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<td>3900 – 2330 1.50</td>
<td>CDT-18381</td>
<td>0.77 – 0.46</td>
<td>1.18 – 0.70</td>
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<tr>
<td>3900 – 2330 1.97</td>
<td>CDT-18501</td>
<td>0.77 – 0.46</td>
<td>1.52 – 0.91</td>
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<td>1.22 – 0.82</td>
<td>0.72 – 0.48</td>
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<td>2.40 – 1.61</td>
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<td>CDT-40251</td>
<td>1.76 – 1.17</td>
<td>1.73 – 1.15</td>
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<td>CDT-40381</td>
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<td>2.63 – 1.75</td>
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<td>CDT-40501</td>
<td>1.76 – 1.17</td>
<td>3.46 – 2.30</td>
</tr>
</tbody>
</table>

Note: *Seal material: Buna-N, Polyurethane.  
- Minimum operating pressure for single-acting models (to overcome return spring force) is 580 psi.  
- Pressure losses for single-acting models (to overcome return spring force) are 580 psi.
## Product dimensions in inches [inch]

| Model number | Model | Ext. A | Retr. B | C | C1 D | D1 E | E1 F | K | L | M | P | S | T | lbs |
|-------------|-------|--------|--------|---|------|-----|-----|----|---|--|--|--|--|---|-----|
| CST-271     | Single acting | 1.89   | 1.65   | 1.61 | 0.59 | .500-20 | UNF | .019 | .063 | #6-32 UNC | – | – | – | – | .20 | 0.2 |
| CST-2101    | Single acting | 2.13   | 1.77   | 1.74 | 0.61 | .500-20 | UNF | .019 | .063 | #6-32 UNC | – | – | – | – | .20 | 0.3 |
| CST-2131    | Single acting | 2.55   | 2.03   | 2.03 | 0.61 | .500-20 | UNF | .019 | .063 | #6-32 UNC | – | – | – | – | .20 | 0.3 |
| CST-471     | Single acting | 2.14   | 1.87   | 1.71 | 0.37 | .750-16 | UNF | .069 | .027 | .062 | #8-32 UNC | – | 0.16 | 0.25 | 0.28 | 0.4 |
| CST-4131    | Single acting | 2.71   | 2.21   | 2.05 | 0.37 | .750-16 | UNF | .069 | .027 | .062 | #8-32 UNC | – | 0.16 | 0.25 | 0.28 | 0.3 |
| CST-4191    | Single acting | 3.38   | 2.62   | 2.46 | 0.37 | .750-16 | UNF | .069 | .027 | .062 | #8-32 UNC | – | 0.16 | 0.25 | 0.28 | 0.4 |
| CST-4251    | Single acting | 3.95   | 2.97   | 2.81 | 0.37 | .750-16 | UNF | .069 | .027 | .062 | #8-32 UNC | – | 0.16 | 0.25 | 0.28 | 0.5 |
| CST-4381    | Single acting | 5.76   | 4.27   | 4.11 | 0.37 | .750-16 | UNF | .069 | .027 | .062 | #8-32 UNC | – | 0.16 | 0.25 | 0.28 | 0.7 |
| CST-971     | Single acting | 2.54   | 2.26   | 2.03 | 0.32 | 1.000-12 | UNF | .088 | .039 | .079 | .250-28 UNC | – | 0.15 | 0.32 | 0.39 | 0.6 |
| CST-9131    | Single acting | 3.02   | 2.50   | 2.28 | 0.32 | 1.000-12 | UNF | .088 | .039 | .079 | .250-28 UNC | – | 0.15 | 0.32 | 0.39 | 0.7 |
| CST-9191    | Single acting | 3.67   | 3.11   | 2.89 | 0.32 | 1.000-12 | UNF | .088 | .039 | .079 | .250-28 UNC | – | 0.15 | 0.32 | 0.39 | 0.8 |
| CST-9251    | Single acting | 4.46   | 3.42   | 3.21 | 0.32 | 1.000-12 | UNF | .088 | .039 | .079 | .250-28 UNC | – | 0.15 | 0.32 | 0.39 | 0.9 |
| CST-9381    | Single acting | 5.63   | 4.11   | 3.91 | 0.32 | 1.000-12 | UNF | .088 | .039 | .079 | .250-28 UNC | – | 0.15 | 0.32 | 0.39 | 1.0 |
| CST-18131   | Double acting | 3.26   | 2.75   | 2.50 | 0.49 | 1.313-16 | UN | 1.22 | 0.63 | 0.59 | 1.06 | .313-24 UNC | – | 0.26 | 0.50 | 0.47 | 1.2 |
| CST-18251   | Double acting | 4.50   | 3.52   | 3.27 | 0.49 | 1.313-16 | UN | 1.22 | 0.63 | 0.59 | 1.06 | .313-24 UNC | – | 0.26 | 0.50 | 0.47 | 1.3 |
| CST-18381   | Double acting | 5.76   | 4.90   | 4.65 | 0.49 | 1.313-16 | UN | 1.22 | 0.63 | 0.59 | 1.06 | .313-24 UNC | – | 0.26 | 0.50 | 0.47 | 1.5 |
| CST-18501   | Double acting | 6.87   | 4.90   | 4.65 | 0.49 | 1.313-16 | UN | 1.22 | 0.63 | 0.59 | 1.06 | .313-24 UNC | – | 0.26 | 0.50 | 0.47 | 1.6 |
| CST-27151   | Double acting | 3.46   | 2.87   | 2.62 | 0.54 | 1.625-16 | UN | 1.52 | 0.71 | 0.67 | 1.38 | .375-16 UNC | – | 0.26 | 0.57 | 0.47 | 1.4 |
| CST-27251   | Double acting | 4.66   | 3.68   | 3.43 | 0.54 | 1.625-16 | UN | 1.52 | 0.71 | 0.67 | 1.38 | .375-16 UNC | – | 0.26 | 0.57 | 0.47 | 2.0 |
| CST-27501   | Double acting | 7.71   | 5.74   | 5.49 | 0.54 | 1.625-16 | UN | 1.52 | 0.71 | 0.67 | 1.38 | .375-16 UNC | – | 0.26 | 0.57 | 0.47 | 2.9 |
| CST-40131   | Double acting | 3.52   | 2.94   | 2.70 | 0.43 | 1.875-16 | UN | 1.79 | 0.78 | 0.75 | 1.63 | .500-13 UNC | – | 0.31 | 0.67 | 0.47 | 2.2 |
| CST-40251   | Double acting | 4.78   | 3.73   | 3.48 | 0.43 | 1.875-16 | UN | 1.79 | 0.78 | 0.75 | 1.63 | .500-13 UNC | – | 0.31 | 0.67 | 0.47 | 2.6 |
| CST-40381   | Double acting | 6.49   | 4.93   | 4.69 | 0.43 | 1.875-16 | UN | 1.79 | 0.78 | 0.75 | 1.63 | .500-13 UNC | – | 0.31 | 0.67 | 0.47 | 2.9 |
| CST-40501   | Double acting | 7.44   | 5.41   | 5.16 | 0.43 | 1.875-16 | UN | 1.79 | 0.78 | 0.75 | 1.63 | .500-13 UNC | – | 0.31 | 0.67 | 0.47 | 3.9 |

**CST, CDT series**

**Force:** 380-8800 lbs

**Stroke:** 0.24-2.03 inch

**Pressure:** 580-5000 psi

**C1** Cilindros rosados

**E** Vérins corps filetés

**F** Einschraubzylinder

**Options**

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

Fine positioning and convenient installation

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

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

Single or Double acting

Single acting

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

Double acting

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

Product selection

<table>
<thead>
<tr>
<th>Cylinder capacity at maximum pressure</th>
<th>Stroke</th>
<th>Model number</th>
<th>Effective area</th>
<th>Oil capacity</th>
<th>Operating pressure</th>
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<td>push</td>
<td>pull</td>
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<td>push</td>
<td>pull</td>
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<td>.79</td>
<td>–</td>
</tr>
<tr>
<td>Double acting</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>1200</td>
<td>600</td>
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<td>.41</td>
<td>.20</td>
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<td>.47</td>
<td>WMT-39</td>
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<tr>
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<td>2700</td>
<td>.98</td>
<td>WMT-40</td>
<td>.79</td>
<td>.54</td>
</tr>
</tbody>
</table>

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

**Power sources**
- Pallet components
- Valves
- Linear cylinders
- System components
- Yellow pages

**Options**
- Cylinder accessories
- "86"

**Important**
- Apply Loctite 222 or equivalent to threads and torque CYDA-15 in cavity to 72-96 in-lbs. Cavity must be designed to withstand hydraulic forces.

**Accessory chart**

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

**Product dimensions** in inches

| Model number | A   | B   | C   | C1  | D   | D1  | E   | F   | G   | H   | H1  | J   | K   | N   | S   | T   |  lbs |
|--------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|
| WRT-21       | 3.75| 3.25| 2.95| –   | 1.375-18 UNEF | 1.23 | .75 | 1.06 | .62 | –   | 2.0 | .250-28 | –   | .50 | .32 | 1.2 |
| WRT-22       | 4.75| 3.75| 3.45| –   | 1.375-18 UNEF | 1.23 | .75 | 1.06 | .62 | –   | 2.5 | .250-28 | –   | .50 | .32 | 1.4 |
| CYDA-15      | 5.98| 4.42| 3.15| 1.75| 1.000-12 UN   | 1.25 | .50 | .87  | .125-27 NPT | .38 | .20 | 1.00 | .313-24 | .31 | .50 | .41 | 1.2 |
| WMT-39       | 3.74| 3.27| 2.99| –   | 1.375-18 UNEF | 1.30 | .56 | 1.06 | .125-27 NPT | .73 | –   | 2.05 | .250-28 | –   | .47 | .39 | 1.0 |
| WMT-40       | 4.76| 3.78| 3.50| –   | 1.375-18 UNEF | 1.30 | .56 | 1.06 | .125-27 NPT | .73 | –   | 2.56 | .250-28 | –   | .47 | .39 | 1.2 |

**Important**
- Force: 1200-3900 lbs
- Stroke: .47-1.56 inch
- Pressure: 150-5000 psi

**Surface roughness must be 63 micro-inches**

**WRT CYDA WMT**
- CYDA
- WMT
- WRT

**Cylinder Capacity 1200 lbs**

**Dimensions & options**

**Product dimensions** in inches

**Important**
- Apply Loctite 222 or equivalent to threads and torque CYDA-15 in cavity to 72-96 in-lbs. Cavity must be designed to withstand hydraulic forces.

**Options**
- Cylinder accessories
- “86”

**Important**
- Apply Loctite 222 or equivalent to threads and torque CYDA-15 in cavity to 72-96 in-lbs. Cavity must be designed to withstand hydraulic forces.

**Options**
- Cylinder accessories
- “86”

**Important**
- Apply Loctite 222 or equivalent to threads and torque CYDA-15 in cavity to 72-96 in-lbs. Cavity must be designed to withstand hydraulic forces.

**Options**
- Cylinder accessories
- “86”

**Important**
- Apply Loctite 222 or equivalent to threads and torque CYDA-15 in cavity to 72-96 in-lbs. Cavity must be designed to withstand hydraulic forces.
**Compact, fixture-integrated positioning and holding**

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

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

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

**Product selection**

<table>
<thead>
<tr>
<th>Cylinder capacity at 5000 psi</th>
<th>Stroke</th>
<th>Model number</th>
<th>Effective area</th>
<th>Oil capacity</th>
</tr>
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<tbody>
<tr>
<td>lbs</td>
<td>in</td>
<td></td>
<td>in²</td>
<td>in³</td>
</tr>
<tr>
<td>380</td>
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<td>CSM-271</td>
<td>0.08</td>
<td>0.02</td>
</tr>
<tr>
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<td>0.04</td>
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<tr>
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<td>CSM-571</td>
<td>0.24</td>
<td>0.07</td>
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<tr>
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<td>CSM-5131</td>
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<td>0.12</td>
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<td>CSM-1071</td>
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<tr>
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<tr>
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<tr>
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<td>0.98</td>
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<td>1.22</td>
<td>1.20</td>
</tr>
</tbody>
</table>

**Note:** Seal material: Buna-N, Polyurethane.
### Installation dimensions in inches ['"]

<table>
<thead>
<tr>
<th>Model number</th>
<th>D Thread SAE</th>
<th>D2 min.</th>
<th>H max.</th>
<th>J1 min.</th>
<th>L min.</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSM-271</td>
<td>SAE#6 (9/16&quot;-18 un)</td>
<td>0.97</td>
<td>0.064</td>
<td>0.50</td>
<td>.96</td>
</tr>
<tr>
<td>CSM-2131</td>
<td>SAE#6 (9/16&quot;-18 un)</td>
<td>0.97</td>
<td>0.064</td>
<td>0.50</td>
<td>1.45</td>
</tr>
<tr>
<td>CSM-571</td>
<td>SAE#10 (7/8&quot;-14 un)</td>
<td>1.34</td>
<td>0.094</td>
<td>0.66</td>
<td>1.20</td>
</tr>
<tr>
<td>CSM-5131</td>
<td>SAE#10 (7/8&quot;-14 un)</td>
<td>1.34</td>
<td>0.094</td>
<td>0.66</td>
<td>1.53</td>
</tr>
<tr>
<td>CSM-1071</td>
<td>SAE#12 (1-1/16&quot;-12 un)</td>
<td>1.63</td>
<td>0.094</td>
<td>0.75</td>
<td>1.20</td>
</tr>
<tr>
<td>CSM-10131</td>
<td>SAE#12 (1-1/16&quot;-12 un)</td>
<td>1.63</td>
<td>0.094</td>
<td>0.75</td>
<td>2.05</td>
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<tr>
<td>CSM-18131</td>
<td>SAE#16 (1-5/16&quot;-12 un)</td>
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<td>0.75</td>
<td>1.57</td>
</tr>
<tr>
<td>CSM-18251</td>
<td>SAE#16 (1-5/16&quot;-12 un)</td>
<td>1.91</td>
<td>0.125</td>
<td>0.75</td>
<td>2.34</td>
</tr>
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<td>SAE#20 (1-5/8&quot;-12 un)</td>
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<td>SAE#20 (1-5/8&quot;-12 un)</td>
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<td>0.125</td>
<td>0.80</td>
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</tr>
</tbody>
</table>

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

### Important

Tighten manifold cylinders according to specifications in the instruction sheet.

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

### Accessory chart

<table>
<thead>
<tr>
<th>Plunger Contact Bolt</th>
<th>K</th>
<th>Thread</th>
</tr>
</thead>
<tbody>
<tr>
<td>#6-32 UN BS-21</td>
<td>86</td>
<td></td>
</tr>
<tr>
<td>#8-32 UN BS-41</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>0.313-24 UN BS-81</td>
<td>81</td>
<td></td>
</tr>
<tr>
<td>0.375-16 UN BS-91</td>
<td>89</td>
<td></td>
</tr>
</tbody>
</table>

![Accessory chart image]

### Product dimensions in inches ['"]

<table>
<thead>
<tr>
<th>Model number</th>
<th>A Ext. height</th>
<th>B Retr. height</th>
<th>C</th>
<th>C1</th>
<th>D</th>
<th>D1</th>
<th>E</th>
<th>E1</th>
<th>F</th>
<th>F1</th>
<th>J</th>
<th>K</th>
<th>P</th>
<th>T</th>
<th>lbs</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSM-271</td>
<td>1.61</td>
<td>1.33</td>
<td>–</td>
<td>0.91</td>
<td>.563-18 un</td>
<td>0.47</td>
<td>0.19</td>
<td>–</td>
<td>0.75</td>
<td>–</td>
<td>0.48</td>
<td>#6-32 UN</td>
<td>–</td>
<td>0.19</td>
<td>0.2</td>
</tr>
<tr>
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<td>2.22</td>
<td>1.71</td>
<td>–</td>
<td>1.40</td>
<td>.563-18 un</td>
<td>0.47</td>
<td>0.19</td>
<td>–</td>
<td>0.75</td>
<td>–</td>
<td>0.47</td>
<td>#6-32 UN</td>
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<td>.875-14 un</td>
<td>0.69</td>
<td>0.31</td>
<td>0.27</td>
<td>1.06</td>
<td>0.25</td>
<td>0.55</td>
<td>#8-32 UN</td>
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<td>1.87</td>
<td>1.65</td>
<td>1.14</td>
<td>1.062-12 un</td>
<td>0.94</td>
<td>0.47</td>
<td>0.43</td>
<td>1.25</td>
<td>0.35</td>
<td>0.59</td>
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<td>0.22</td>
<td>0.32</td>
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<td>1.89</td>
<td>1.38</td>
<td>1.062-12 un</td>
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<td>0.47</td>
<td>0.43</td>
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<td>0.35</td>
<td>0.59</td>
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<td>3.50</td>
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<td>0.47</td>
<td>0.43</td>
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<td>0.35</td>
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<td>.312-24 UN</td>
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<td>1.60</td>
<td>1.625-12 un</td>
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<td>0.71</td>
<td>0.67</td>
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<td>0.57</td>
<td>0.79</td>
<td>.375-16 UN</td>
<td>0.26</td>
<td>0.47</td>
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</tr>
</tbody>
</table>

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

Versatile, all purpose cylinder

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

Select your block cylinder type:

**CSB series, Single acting**
- Internal threaded plunger
- Manifold O-ring ports
- Black oxide base
- Hard chrome-plated plunger
- BSPP oil port
- Strong return spring
- Filtered vent plug

**CDB series, Double acting**
- Internal threaded plunger
- Manifold O-ring ports
- Black oxide base
- Hard chrome-plated plunger
- BSPP oil port
Application example

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

Product selection

<table>
<thead>
<tr>
<th>Piston Ø</th>
<th>Rod Ø</th>
<th>Clamping force at 5000 psi</th>
<th>Stroke</th>
<th>Model number</th>
<th>Cylinder effective area</th>
<th>Cylinder oil capacity</th>
<th>Minimum spring return force</th>
</tr>
</thead>
<tbody>
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<td></td>
<td></td>
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</tr>
<tr>
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<td>1.97</td>
<td>38,900</td>
<td>1.97</td>
<td>CDB-180502*</td>
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<td>4.74</td>
<td>15.33</td>
</tr>
<tr>
<td>3.93</td>
<td>2.48</td>
<td>60,850</td>
<td>2.20</td>
<td>CDB-280562*</td>
<td>12.17</td>
<td>7.33</td>
<td>26.83</td>
</tr>
</tbody>
</table>

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

Options

- Contact bolts
- Fittings
- Valves
- Pressure gauges
- Pressure switches
- High pressure filters

Accessory chart

<table>
<thead>
<tr>
<th>Plunger Thread</th>
<th>Contact Bolt</th>
</tr>
</thead>
<tbody>
<tr>
<td>K</td>
<td>86</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cylinder type</th>
<th>M6 X 1.0</th>
<th>M8 X 1.25</th>
<th>M16 X 2.0</th>
<th>M20 X 2.5</th>
<th>M30 X 3.5</th>
<th>M36 X 4.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Force</td>
<td>BS-62</td>
<td>BS-82</td>
<td>BS-16</td>
<td>BS-20</td>
<td>BS-30</td>
<td>BS-36</td>
</tr>
<tr>
<td>Pressure</td>
<td>580-5000 psi</td>
<td>580-5000 psi</td>
<td>580-5000 psi</td>
<td>580-5000 psi</td>
<td>580-5000 psi</td>
<td>580-5000 psi</td>
</tr>
</tbody>
</table>

**Certification**
- This product is CE certified.
**Block cylinders**  
*Application & selection*

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

**CDB, CSB series**

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

**Dimensions in inches**

<table>
<thead>
<tr>
<th>Model number</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>F</th>
<th>F1</th>
<th>G</th>
<th>H</th>
<th>J</th>
<th>K</th>
<th>L</th>
<th>M</th>
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</thead>
<tbody>
<tr>
<td>Single acting</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSB-10182</td>
<td>3.94</td>
<td>3.23</td>
<td>2.91</td>
<td>2.36</td>
<td>.47</td>
<td>.43</td>
<td>G1/8</td>
<td>.47</td>
<td>1.75</td>
<td>M6 x 1,0</td>
<td>1.77</td>
<td>.98</td>
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<tr>
<td>CSB-18252</td>
<td>4.92</td>
<td>3.94</td>
<td>3.62</td>
<td>2.56</td>
<td>.63</td>
<td>.59</td>
<td>G1/8 *</td>
<td>.47</td>
<td>2.24</td>
<td>M8 x 1,25</td>
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<td>1.18</td>
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<td>5.13</td>
<td>4.15</td>
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<td>.98</td>
<td>.94</td>
<td>G1/8 *</td>
<td>.39</td>
<td>2.26</td>
<td>M16 x 2,0</td>
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<td>1.38</td>
</tr>
<tr>
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<td>4.65</td>
<td>4.09</td>
<td>3.94</td>
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<td>1.22</td>
<td>G1/4 *</td>
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<td>M20 x 2,5</td>
<td>3.15</td>
<td>1.77</td>
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<tr>
<td>Double acting</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CDB-10162</td>
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<td>2.44</td>
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<td>.43</td>
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<td>.98</td>
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<td>M6 x 1,0</td>
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<td>.98</td>
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<tr>
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<td>2.76</td>
<td>2.44</td>
<td>2.56</td>
<td>.63</td>
<td>.59</td>
<td>G1/8 *</td>
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<td>1.06</td>
<td>M8 x 1,25</td>
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<td>1.18</td>
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<td>3.62</td>
<td>2.56</td>
<td>.63</td>
<td>.59</td>
<td>G1/8 *</td>
<td>.47</td>
<td>2.24</td>
<td>M8 x 1,25</td>
<td>1.97</td>
<td>1.18</td>
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<tr>
<td>CDB-40252</td>
<td>4.13</td>
<td>3.15</td>
<td>2.68</td>
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<td>.97</td>
<td>.94</td>
<td>G1/8 *</td>
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<td>M16 x 2,0</td>
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<td>1.38</td>
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<tr>
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<td>4.15</td>
<td>3.67</td>
<td>3.15</td>
<td>.97</td>
<td>.94</td>
<td>G1/8 *</td>
<td>.39</td>
<td>2.26</td>
<td>M16 x 2,0</td>
<td>2.36</td>
<td>1.38</td>
</tr>
<tr>
<td>CDB-70252</td>
<td>4.53</td>
<td>3.54</td>
<td>2.99</td>
<td>3.94</td>
<td>1.26</td>
<td>1.22</td>
<td>G1/4 *</td>
<td>.53</td>
<td>1.42</td>
<td>M20 x 2,5</td>
<td>3.15</td>
<td>1.77</td>
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<tr>
<td>CDB-70502</td>
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<td>4.65</td>
<td>4.09</td>
<td>3.94</td>
<td>1.26</td>
<td>1.22</td>
<td>G1/4 *</td>
<td>.54</td>
<td>2.52</td>
<td>M20 x 2,5</td>
<td>3.15</td>
<td>1.77</td>
</tr>
<tr>
<td>CDB-180252</td>
<td>5.16</td>
<td>4.17</td>
<td>3.50</td>
<td>5.51</td>
<td>1.97</td>
<td>1.93</td>
<td>G1/4 *</td>
<td>.59</td>
<td>1.63</td>
<td>M30 x 3,5</td>
<td>4.33</td>
<td>3.15</td>
</tr>
<tr>
<td>CDB-180502</td>
<td>7.28</td>
<td>5.31</td>
<td>4.65</td>
<td>5.51</td>
<td>1.97</td>
<td>1.93</td>
<td>G1/4 *</td>
<td>.47</td>
<td>2.78</td>
<td>M30 x 3,5</td>
<td>4.33</td>
<td>3.15</td>
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<td>CDB-280562</td>
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<td>2.44</td>
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<td>3.05</td>
<td>M36 x 4,0</td>
<td>5.31</td>
<td>3.54</td>
</tr>
</tbody>
</table>

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

Block cylinder used for punching applications.
**Installation instructions**

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

**Manifold mounting**

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

**Single-acting cylinders**

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

---

**Installation dimensions in inches**

<table>
<thead>
<tr>
<th>Clamping capacity</th>
<th>Oil channel diameter</th>
<th>Mounting thread</th>
<th>Min. thread length</th>
<th>Torque (bolt type 12.9 DIN 912)</th>
<th>Manifold O-ring</th>
</tr>
</thead>
<tbody>
<tr>
<td>lbs</td>
<td>A</td>
<td>C</td>
<td>D</td>
<td>Ft.lbs</td>
<td>Inside Ø x thickness</td>
</tr>
<tr>
<td>2400</td>
<td>.20</td>
<td>M6</td>
<td>.43</td>
<td>13</td>
<td>.31 x .06</td>
</tr>
<tr>
<td>3800</td>
<td>.20</td>
<td>M8</td>
<td>.51</td>
<td>30</td>
<td>.31 x .06</td>
</tr>
<tr>
<td>9750</td>
<td>.20</td>
<td>M10</td>
<td>.63</td>
<td>63</td>
<td>.31 x .06</td>
</tr>
<tr>
<td>15,200</td>
<td>.20</td>
<td>M12</td>
<td>.75</td>
<td>107</td>
<td>.31 x .06</td>
</tr>
<tr>
<td>38,900</td>
<td>.31</td>
<td>M16</td>
<td>.94</td>
<td>260</td>
<td>.38 x .09</td>
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<td>60,850</td>
<td>.31</td>
<td>M20</td>
<td>1.10</td>
<td>498</td>
<td>.38 x .09</td>
</tr>
</tbody>
</table>

1) Manifold O-rings included

---

**Important**

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

**Options**

- **Contact bolts**
  - [86](#)
- **Fittings**
  - [194](#)
- **Pressure gauges**
  - [190](#)
- **High pressure filters**
  - [193](#)

---

* This product is made to order. Please contact Enerpac for delivery information before specifying in your design.
Enerpac pull down clamps are designed to allow unobstructed top face machining. Independent horizontal and vertical movement achieves high lateral and pull down forces to hold the workpiece firmly down against the machine table or fixture. The pull down forces are approximately 33% of the clamping force.

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 BSP Porting
- Investment high-alloy cast, heat-treated clamping jaw and plunger
- Contamination resistant design for low maintenance, removable guard for chip removal
- Oil ports on both sides for mounting flexibility
- Optional mechanical counter hold provides pull down on end stop for large parts
- Mounting bolts included for ease of installation

**Pull down clamp operation**

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

**Product selection**

<table>
<thead>
<tr>
<th>Lateral clamping force at 5000 psi (lbs)</th>
<th>Pull down force at 5000 psi (lbs)</th>
<th>Stroke (in)</th>
<th>Model number</th>
<th>Effective area (in²)</th>
<th>Oil capacity (in³)</th>
<th>Mounting bolts (included)</th>
</tr>
</thead>
<tbody>
<tr>
<td>▼ Hydraulic pull down clamps</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>870</td>
<td>290</td>
<td>.20</td>
<td>ECH-52</td>
<td>.18</td>
<td>.03</td>
<td>M8 x 45</td>
</tr>
<tr>
<td>3900</td>
<td>1300</td>
<td>.31</td>
<td>ECH-202</td>
<td>.78</td>
<td>.24</td>
<td>M12 x 80</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Holding force (lbs)</th>
<th>For pull down clamp model number</th>
<th>Model number</th>
<th>Mounting bolts included (if number)</th>
<th>Replaceable ribbed jaws model</th>
</tr>
</thead>
<tbody>
<tr>
<td>▼ Mechanical counter holds</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>870</td>
<td>ECH-52</td>
<td>ECM-5</td>
<td>M8 x 35</td>
<td>ECJR-5</td>
</tr>
<tr>
<td>3900</td>
<td>ECH-202</td>
<td>ECM-20</td>
<td>M12 x 65</td>
<td>ECJR-20</td>
</tr>
</tbody>
</table>

1/ Torque M8 with 18 Ft.lbs, M12 with 63 Ft.lbs.

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.

The mounting surface must extend out under the jaw.

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

**Options**

- **Fittings**
- **Threaded cylinders**
- **Positive clamping cylinders**

**Important**

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

**Product dimensions** in inches

<table>
<thead>
<tr>
<th>Model number</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>H1</th>
<th>N</th>
<th>O</th>
<th>P</th>
<th>Q</th>
<th>R</th>
<th>S</th>
<th>T</th>
<th>U</th>
<th>V</th>
<th>W</th>
<th>( \text{mm} )</th>
<th>( \text{lbs} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECH-52</td>
<td>4.14</td>
<td>3.94</td>
<td>1.18</td>
<td>1.18</td>
<td>G1/8&quot;</td>
<td>.75</td>
<td>.74</td>
<td>.33</td>
<td>.46</td>
<td>2.09</td>
<td>.12</td>
<td>.08</td>
<td>2.32</td>
<td>–</td>
<td>.87</td>
<td>–</td>
<td>.24</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>ECH-202</td>
<td>5.62</td>
<td>5.31</td>
<td>1.97</td>
<td>1.97</td>
<td>G1/4&quot;</td>
<td>.98</td>
<td>.93</td>
<td>.49</td>
<td>.54</td>
<td>2.64</td>
<td>.55</td>
<td>.12</td>
<td>2.91</td>
<td>–</td>
<td>1.42</td>
<td>–</td>
<td>.47</td>
<td>5.5</td>
<td></td>
</tr>
<tr>
<td>ECM-5</td>
<td>3.11</td>
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<td>1.18</td>
<td>1.18</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>.33</td>
<td>1.65</td>
<td>1.02</td>
<td>.12</td>
<td>.08</td>
<td>–</td>
<td>1.61</td>
<td>–</td>
<td>–</td>
<td>.31</td>
<td>1.3</td>
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<tr>
<td>ECM-20</td>
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<td>–</td>
<td>1.97</td>
<td>1.97</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>.49</td>
<td>2.36</td>
<td>1.18</td>
<td>.55</td>
<td>.12</td>
<td>2.32</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>.51</td>
<td>4.1</td>
<td></td>
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</table>

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

**Pallet components**
- Linear cylinders
- System components
- Yellow pages
Hollow plunger cylinders  

Application & selection

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

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

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

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

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

---

**Product selection**

<table>
<thead>
<tr>
<th>Cylinder capacity lbs</th>
<th>Stroke in</th>
<th>Center hole diameter in</th>
<th>Model number</th>
<th>Effective area in²</th>
<th>Oil capacity in³</th>
<th>Operating pressure psi</th>
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<tr>
<td>2610</td>
<td>0.25</td>
<td>0.39</td>
<td>CY1254-25</td>
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<td>4000</td>
<td>0.33</td>
<td>0.53</td>
<td>MRH-20</td>
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<td>0.41</td>
<td>3000</td>
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<tr>
<td>4000</td>
<td>0.33</td>
<td>0.53</td>
<td>RWH-20</td>
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<td>0.41</td>
<td>3000</td>
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<td>4000</td>
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<td>0.53</td>
<td>RWH-20T</td>
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<td>3000</td>
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<td>4830</td>
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<td>HCS-20⁴</td>
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<td>5000</td>
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<td>7410</td>
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<td>0.77</td>
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<td>0.86</td>
<td>5000</td>
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<tr>
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<td>0.32</td>
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⁴ At maximum operating pressure. ⁵ This product is made to order. Please contact Enerpac for delivery information before specifying in your design.
**Optional Heat Treated Hollow Saddles**

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<th>Saddle type</th>
<th>Cylinder model number</th>
<th>Saddle model No.</th>
<th>Saddle Dimensions (in)</th>
<th>Saddle Dimensions (mm)</th>
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Smooth hollow saddles are standard on all RWH 20 and 30 ton models (12 ton models are not equipped with saddles).

**Options**

- **Flange nuts**
  - 86

**Important**

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

RWH cylinders can be used up to 10,000 psi maximum working pressure (except RWH-20 and RWH120).

---

**Product dimensions in inches [** ]**

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<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>D1</th>
<th>F</th>
<th>O</th>
<th>H</th>
<th>J</th>
<th>K</th>
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<th>T</th>
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"(1) For these models G1 = manifold and .125-27 NPTF"

www.enerpacw.com

**Force:** 2610-36,000 lbs

**Stroke:** .25-.249 inch

**Pressure:** 800-5000 inch

- **Cylindres de émbolo hueco**
- **Vérins a piston creux**
- **Hohlkolbenzylinder**
Positive clamping cylinder  

Application & selection

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.

Ideal for palletized applications

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

Positive clamping operation

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

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

Product selection

<table>
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<th>Effective clamping stroke</th>
<th>Model number</th>
<th>Required operating pressure</th>
<th>Max. tensioning stroke</th>
<th>Oil capacity</th>
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1) Minimum operating pressure to fully retract the plunger.

Note: Seal material Buna-N, Polyurethane.
**Dimensions & options**

**MRS series**

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

- Suggested Clamping Range

**Options**

- Contact bolts
- Flange nuts
- Collet-Lok® work supports

**Important**

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

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

**Product dimensions** in inches [ producto ]

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<td>2.36</td>
<td>3.15</td>
<td>1.81</td>
<td>.67</td>
<td>M20 x 2.5</td>
<td>.79</td>
<td>1.46</td>
<td>.83</td>
<td>6.6</td>
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<td>3.56</td>
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<td>3.15</td>
<td>1.81</td>
<td>.67</td>
<td>M20 x 2.5</td>
<td>.79</td>
<td>1.46</td>
<td>.83</td>
<td>7.7</td>
</tr>
</tbody>
</table>
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

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

Block and cylindrical models

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

Block models
- Easily mounted
- Compact design

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

Product selection

<table>
<thead>
<tr>
<th>Cylinder capacity at 5000 psi</th>
<th>Stroke</th>
<th>Model number</th>
<th>Effective area</th>
<th>Oil capacity</th>
<th>Operating pressure</th>
</tr>
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<tbody>
<tr>
<td>lbs</td>
<td>in</td>
<td>in²</td>
<td>in³</td>
<td>psi</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
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<tr>
<td>4970</td>
<td>0.62</td>
<td>RW-41</td>
<td>0.99</td>
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Note: Seal material Buna-N, Polyurethan.
### RW-41

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<th>G</th>
<th>H</th>
<th>J</th>
<th>K</th>
<th>L</th>
<th>T</th>
<th>U</th>
<th>V</th>
<th>Z</th>
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<td>1.62</td>
<td>1.00</td>
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### RW-50

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<th>H</th>
<th>J</th>
<th>K</th>
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<th>T</th>
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<td>-</td>
<td>1.62</td>
<td>2.32</td>
<td>1.00</td>
<td>.375-18</td>
<td>0.75</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1.50</td>
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### MRW-50F

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<th>F</th>
<th>G</th>
<th>H</th>
<th>J</th>
<th>K</th>
<th>L</th>
<th>T</th>
<th>U</th>
<th>V</th>
<th>Z</th>
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</thead>
<tbody>
<tr>
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<td>1.61</td>
<td>1.62</td>
<td>2.56</td>
<td>1.00</td>
<td>.375-18</td>
<td>0.81</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1.75</td>
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<td>0.22</td>
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### MRW-50M

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<th>G</th>
<th>H</th>
<th>J</th>
<th>K</th>
<th>L</th>
<th>T</th>
<th>U</th>
<th>V</th>
<th>Z</th>
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<tr>
<td>2.60</td>
<td>2.01</td>
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<td>-</td>
<td>-</td>
<td>M8x1,25</td>
<td>1.75</td>
<td>0.24</td>
<td>1.12</td>
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</tbody>
</table>

### RW-series 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.

### Options

| Cylinder accessories | 86 |

### Product dimensions

**Model dimensions in inches**

<table>
<thead>
<tr>
<th>Model number</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>D1</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>J</th>
<th>K</th>
<th>L</th>
<th>T</th>
<th>U</th>
<th>V</th>
<th>Z</th>
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<tbody>
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<td>1.62</td>
<td>2.32</td>
<td>1.00</td>
<td>.375-18</td>
<td>0.75</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<td>1.12</td>
<td>0.22</td>
<td>-</td>
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<td>1.62</td>
<td>2.56</td>
<td>1.00</td>
<td>.375-18</td>
<td>0.81</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1.75</td>
<td>1.12</td>
<td>0.22</td>
<td>-</td>
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<tr>
<td>MRW-50M</td>
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<td>2.56</td>
<td>1.00</td>
<td>.375-18</td>
<td>0.81</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>M8x1,25</td>
<td>1.75</td>
<td>0.24</td>
<td>1.12</td>
</tr>
</tbody>
</table>
Heavy-duty cylinders
...provide push as well as pull forces

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

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

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

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

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

Clevis eye
Threads onto plunger or base.

Product selection

<table>
<thead>
<tr>
<th>Cylinder capacity at 5000 psi</th>
<th>Stroke push pull in</th>
<th>Cylinders Model number</th>
<th>Effective area push in² pull in²</th>
<th>Oil capacity push pull in³ pull in³</th>
</tr>
</thead>
<tbody>
<tr>
<td>3900 push 1720 pull 3.11</td>
<td>1.11</td>
<td>RD-41</td>
<td>.79 .34</td>
<td>.89 .40</td>
</tr>
<tr>
<td>3900 push 1720 pull 6.11</td>
<td>3.11</td>
<td>RD-43</td>
<td>.79 .34</td>
<td>2.47 1.10</td>
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<td>6.11</td>
<td>RD-46</td>
<td>.79 .34</td>
<td>4.84 2.10</td>
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<tr>
<td>9000 push 4910 pull 1.15</td>
<td>1.15</td>
<td>RD-91</td>
<td>1.77 .98</td>
<td>2.00 1.10</td>
</tr>
<tr>
<td>9000 push 4910 pull 3.15</td>
<td>3.15</td>
<td>RD-93</td>
<td>1.77 .98</td>
<td>5.54 3.00</td>
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<tr>
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<td>6.15</td>
<td>RD-96</td>
<td>1.77 .98</td>
<td>10.88 6.00</td>
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<td>10.15</td>
<td>RD-910</td>
<td>1.77 .98</td>
<td>17.94 9.90</td>
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<td>6.24</td>
<td>RD-166</td>
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<td>19.67 10.40</td>
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<tr>
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<td>RD-1610</td>
<td>3.15 1.66</td>
<td>32.62 17.00</td>
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<tr>
<td>24,500 push 10,750 pull 6.30</td>
<td>6.30</td>
<td>RD-256</td>
<td>4.92 2.15</td>
<td>30.73 13.40</td>
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<tr>
<td>24,500 push 10,750 pull 10.28</td>
<td>10.28</td>
<td>RD-2510</td>
<td>4.92 2.15</td>
<td>50.40 22.00</td>
</tr>
</tbody>
</table>

Clamping application using Enerpac RD cylinders (with clevis eye attachments on both ends) for their high pressure capability and mounting flexibility.
### Cylinder attachments in inches [单位]

<table>
<thead>
<tr>
<th>Cylinder capacity at Model</th>
<th>B</th>
<th>C</th>
<th>E</th>
<th>F</th>
<th>H</th>
<th>V</th>
<th>ø</th>
<th>lbs</th>
</tr>
</thead>
<tbody>
<tr>
<td>5000 psi</td>
<td>AD-141</td>
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<td>2.00</td>
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<td>2.25</td>
<td>1.25</td>
<td>0.41</td>
<td>0.9</td>
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<td>10,000 psi</td>
<td>AD-171</td>
<td>4.00</td>
<td>2.88</td>
<td>1.00</td>
<td>3.25</td>
<td>1.75</td>
<td>0.53</td>
<td>2.6</td>
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<td>3.75</td>
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<td>4.00</td>
<td>2.06</td>
<td>0.78</td>
<td>6.4</td>
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<tr>
<td>24,500 psi</td>
<td>AD-191</td>
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<td>4.62</td>
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<td>4.88</td>
<td>2.50</td>
<td>1.03</td>
<td>9.9</td>
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</table>

#### Foot mounting with retainer nut
- 3900 7800 1.38
- 9000 18,000 2.00
- 15,500 31,000 2.63
- 24,500 49,000 3.25

#### Flange mounting with retainer nut
- 3900 7800 1.38
- 9000 18,000 2.00
- 15,500 31,000 2.63
- 24,500 49,000 3.25

#### Retainer nut
- 3900 7800 1.375-12 UNF
- 9000 18,000 2.000-12 UNF
- 15,500 31,000 1.125-12 UNF
- 24,500 49,000 1.500-12 UNF

#### Clevis eye
- 3900 7800 .500-20 UNF
- 9000 18,000 .750-16 UNF
- 15,500 31,000 1.125-12 UNF
- 24,500 49,000 1.500-12 UNF

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

### RD series cylinders are designed for a maximum operating pressure of 10,000 psi.
- When applying 10,000 psi cylinder capacities double as well.

### Product dimensions in inches [单位]
Cylinder accessories

For optimum mounting and fixture flexibility

…to match specific applications

- **Contact bolts**
  Allow cylinders to act as a datum point in your clamping applications, and protect the piston when cylinders are used for pushing applications

- **Cylindrical flange nuts**
  For mounting threaded body cylinders in any position

- **Mounting brackets**
  For bolting cylinders to suit the application

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

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

Enerpac product line
Swing clamps
Linear clamps
Work supports
Cylinder accessories

Shown: Cylinder accessories

Product dimensions in inches [in]

<table>
<thead>
<tr>
<th>A thread</th>
<th>Model number</th>
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<th>C</th>
<th>D</th>
<th>E</th>
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<td>.25</td>
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<td>.44</td>
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<td>.63</td>
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<td>.71</td>
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<td>.24</td>
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<td>FN-201</td>
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<td>.42</td>
</tr>
<tr>
<td>M20 x 1.5</td>
<td>FN-202</td>
<td>1.12</td>
<td>.31</td>
</tr>
<tr>
<td>1.000-12 UNF</td>
<td>FN-251</td>
<td>1.50</td>
<td>.55</td>
</tr>
<tr>
<td>1.125-16 UNF</td>
<td>FN-281</td>
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<td>.39</td>
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Product dimensions in inches [in]

Product dimensions in inches [in]
### Product dimensions in inches [šířku]

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### Product dimensions in inches [šířku]

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Enerpac 5000 psi Tie Rod cylinders provide a variety of mounting options for pushing and positioning workpieces and fixtures on a machine. Enerpac tie rod cylinders are designed to the highest industry standards to provide long life and worry-free performance in the most demanding applications.

**Performance tested design features at 5000 psi**

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

**Tie Rod cylinder construction**

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**Tie Rod cylinder mounting styles**

- **Clevis Mount – TCRM Series**
  - NFPA style MP1
  - Allows cylinder to pivot
  - Requires provision for pivoting on rod end

- **Foot mount – TRFM series**
  - NFPA style MS2
  - Allows easy mounting with only four bolts
  - Backup key included in design to ensure long life

- **Flange mount – TRFL series**
  - NFPA style ME5
  - Allows cylinder length to be buried in machine
  - Strongest, most rigid mount

**Standard bore sizes**

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<th>Bore diameter (in)</th>
<th>Rod diameter (in)</th>
<th>Capacity at 5000 psi Push lbs</th>
<th>Pull lbs</th>
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**Additional bore sizes**

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Contact Enerpac for ordering information on additional bore sizes.
### Product selection

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<tr>
<td>TRCM-4012</td>
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<td>TRFL-4012</td>
</tr>
</tbody>
</table>

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

* These models are only rated to 4000 psi due to constraints on the mechanical properties of the rod.

### Custom build your Tie Rod cylinder

<table>
<thead>
<tr>
<th>TR</th>
<th>CM</th>
<th>15</th>
<th>12</th>
<th>C</th>
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</tr>
<tr>
<td>2</td>
<td>Mounting</td>
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<td></td>
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<td>25 = 2.5&quot;</td>
<td></td>
</tr>
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<td></td>
<td>FM = Foot Mount</td>
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<td>32 = 3.25&quot;</td>
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<td></td>
<td>FL = Flange Mount</td>
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<td>40 = 4.0&quot;</td>
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### Seal and repair kits

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

<table>
<thead>
<tr>
<th>Bore diameter in</th>
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<th>Seal kit</th>
<th>Repair kit</th>
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<td>TR15RK</td>
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<td>1.38</td>
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<td>TR20RK</td>
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<td>1.75</td>
<td>TR25SK</td>
<td>TR25RK</td>
</tr>
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<td>2.00</td>
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<td>TR32RK</td>
</tr>
<tr>
<td>4.00</td>
<td>2.50</td>
<td>TR40SK</td>
<td>TR40RK</td>
</tr>
</tbody>
</table>

### Product dimensions in inches

- Stroke: 2–12 inches
- Pressure: 500–5000 psi

### Important

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

Enerpac can provide many other tie rod cylinders in a wide variety of mounting styles, bore and stroke sizes. Contact Enerpac directly and talk to our Custom Products group for a quotation.
5000 psi Tie Rod cylinders

TR series clevis mount
Enerpac clevis mount 5000 psi Tie Rod cylinders provide for motion in two axis, increasing the range of motion on your machine with only one cylinder.

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

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

Options

**Accessories**

- E Cilindros Atirantados
- F Vérins à tirants
- D Zugankerzyllinder

**ZW Series Pumps**

**VP Series Valves**

**Fittings**

<table>
<thead>
<tr>
<th>Bore diameter</th>
<th>Rod diameter</th>
<th>Model number</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>CB</th>
<th>CD</th>
<th>CW</th>
<th>D*</th>
<th>E</th>
<th>EE</th>
<th>F</th>
<th>G</th>
<th>J</th>
<th>K</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.50</td>
<td>1.00</td>
<td>TRCM-15xx**</td>
<td>1.13</td>
<td>1.50</td>
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<td>1.75</td>
<td>0.75</td>
</tr>
</tbody>
</table>

* D = Distance across plunger wrench flats.
** 10 and 12 inch models are rated at only 4000 psi.

**Dimensions**

- Force: 8850-62,850 lbs.
- Stroke: 2-12 inches
- Pressure: 500-5000 psi

For product weights, please reference the price list or contact Enerpac customer service for more information.
Ease of installation

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

Important

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

Special rod ends

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

Dimensions in inches

<table>
<thead>
<tr>
<th>Bore diameter</th>
<th>Rod diameter</th>
<th>Model number</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>C*</th>
<th>E</th>
<th>EE</th>
<th>F</th>
<th>FA</th>
<th>G</th>
<th>J</th>
<th>K</th>
<th>KK2</th>
<th>LB</th>
<th>MM</th>
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<td>2.50</td>
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</table>

* D = Distance across plunger wrench flats.
5000 psi Tie rod cylinders

**TR series flange mount**
Enerpac flange mount 5000 psi

Tie Rod cylinders provide the most rigid mounting ensuring long life and high accuracy on your machine.

**Special rod ends**

**Rod boots**
- Rod boots are made from neoprene coated fabric
- Impervious to oil grease and water
- Rated for temperatures from 0° F to 200° F

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

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

---

### TRFL models Flange Mount

---

### Dimensions in inches

<table>
<thead>
<tr>
<th>Bore diameter</th>
<th>Rod diameter</th>
<th>Model number</th>
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<th>B</th>
<th>C</th>
<th>D*</th>
<th>E</th>
<th>EE</th>
<th>F</th>
<th>FB</th>
<th>G</th>
<th>J</th>
<th>K</th>
<th>KK2</th>
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<td>0.63</td>
<td>1-1/4&quot;-12</td>
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<td>0.75</td>
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</table>

* D = Distance across plunger wrench flats.

---

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<th>P</th>
<th>R</th>
<th>RD</th>
<th>TF</th>
<th>UF</th>
<th>V</th>
<th>W</th>
<th>WF</th>
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</table>

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

---

**Accessories**

- **ZW Series Pumps**
- **VP Series Valves**

---

**Fittings**

---

**Options**

---

---
For high production applications

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

**Fittings dimensions in inches [ ]**

<table>
<thead>
<tr>
<th>From</th>
<th>To</th>
<th>Model number</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
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<tbody>
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**Rod Clevis and Rod Eye dimensions in inches [ ]**

<table>
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<th>Rod eye model number</th>
<th>Maximum tension load lbs</th>
<th>KK</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>CD</th>
<th>CE</th>
<th>CR</th>
<th>CW</th>
<th>ER</th>
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<td>2.00</td>
<td>TRPP-40</td>
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</table>

**Linear Alignment Coupler in inches [ ]**

<table>
<thead>
<tr>
<th>Model number</th>
<th>Maximum tension load lbs</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
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<tbody>
<tr>
<td>TRAC-15</td>
<td>8500</td>
<td>3/4&quot;-16</td>
<td>1.75</td>
<td>2.31</td>
<td>0.50</td>
<td>1.13</td>
<td>0.97</td>
<td>0.88</td>
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<tr>
<td>TRAC-20</td>
<td>16,000</td>
<td>1&quot;-14</td>
<td>2.50</td>
<td>2.94</td>
<td>0.50</td>
<td>1.63</td>
<td>1.38</td>
<td>1.16</td>
<td>2.25</td>
</tr>
<tr>
<td>TRAC-25</td>
<td>19,500</td>
<td>1-1/4&quot;-12</td>
<td>2.50</td>
<td>2.94</td>
<td>0.50</td>
<td>1.63</td>
<td>1.38</td>
<td>1.16</td>
<td>2.25</td>
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<tr>
<td>TRAC-32</td>
<td>33,500</td>
<td>1-1/2&quot;-12</td>
<td>3.25</td>
<td>4.38</td>
<td>0.81</td>
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<td>1.75</td>
<td>1.50</td>
<td>3.00</td>
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<tr>
<td>TRAC-40</td>
<td>60,000</td>
<td>1-7/8&quot;-12</td>
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<td>3.00</td>
<td>2.00</td>
<td>1.88</td>
<td>3.50</td>
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</table>

Power sources

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

With a wide variety of accessories to choose from, Enerpac power units are easily the most versatile and reliable in the industry.
<table>
<thead>
<tr>
<th>Topic</th>
<th>Series</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Choosing a Pump</td>
<td></td>
<td>96 - 97</td>
</tr>
<tr>
<td>Turbo II air-hydraulic pumps</td>
<td>PA</td>
<td>98 - 101</td>
</tr>
<tr>
<td>Air-hydraulic pumps</td>
<td>ZAJ</td>
<td>102</td>
</tr>
<tr>
<td>Air-hydraulic pumps</td>
<td>PA</td>
<td>103</td>
</tr>
<tr>
<td>Air-hydraulic boosters</td>
<td>AHB, B</td>
<td>104 - 105</td>
</tr>
<tr>
<td>Air valves and accessories</td>
<td>VA, VR RFL</td>
<td>106 - 107</td>
</tr>
<tr>
<td>Economy electric pumps</td>
<td>WU</td>
<td>108 - 109</td>
</tr>
<tr>
<td>Electric submerged pumps and ordering matrix</td>
<td>WE</td>
<td>110 - 113</td>
</tr>
<tr>
<td>Electric pumps and ordering matrix</td>
<td>ZW</td>
<td>114 - 117</td>
</tr>
<tr>
<td>Return line filter kit and heat exchanger kits</td>
<td>ZPF, ZHE</td>
<td>118 - 119</td>
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<tr>
<td>Level/ temp switch and pressure transducer</td>
<td>ZLS ZPT, ZPS</td>
<td>120</td>
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<tr>
<td>Valve manifold</td>
<td>ZW</td>
<td>121</td>
</tr>
<tr>
<td>Pallet coupling pumps</td>
<td>ZW</td>
<td>122 - 123</td>
</tr>
<tr>
<td>Continuous connection pumps</td>
<td>ZW</td>
<td>124 - 125</td>
</tr>
<tr>
<td>Single station D03 pumps</td>
<td>ZW</td>
<td>126 - 127</td>
</tr>
<tr>
<td>Electric driven workholding pump</td>
<td>ZW5</td>
<td>128 - 131</td>
</tr>
<tr>
<td>Hand pumps</td>
<td>P, SP</td>
<td>132</td>
</tr>
<tr>
<td>Enerpac system solutions</td>
<td></td>
<td>133</td>
</tr>
</tbody>
</table>
Choosing a pump

Select your pump type

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

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

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

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

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

Options

**Manual valves**

**Electric valves**

**Air operated valves**

Important

231 cubic inches = 1 US gal.
61 cubic inches = 1 liter
1 US gallon = 3.785 liters

Select your pump options

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

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

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

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

ENERPAC Workholding Pump Comparison Chart

What flow is right for you?

Flow: 40-640 in³/min
Pressure: 5000 psi max
Reservoir: up to 10 gallons
Quick and powerful hydraulic supply in an economical air-powered unit

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

Select the required output

**NOTE:** From 50-125 psi air inlet pressure. Performance is significantly diminished below 50 psi. Performance may vary compared to listed values due to seal friction, internal pressure drops and manufacturing tolerances. Be sure to allow some flexibility on air inlet pressure.
Select the required output:

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

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

**PASG series**
- Momentary or continuous air inlet treadle
- Suitable for mounting any single- or double-acting valve with a DO3 mounting configuration
- Available with multiple valve manifold (2-gallon only)

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

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

---

**Options**

- Gauges and accessories
- Regulator-filter-lubricator

---

**Important**

For high cycle applications electric pumps are recommended.

---

**Specifications**

- **Oil Flow**: 180 in³/min
- **Pressure**: 5000 psi max
- **Sound level**: 75 dBA
- **Air**: 12 scfm
- **Reservoir**: 70-462 in³

---

**Translated**

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

---

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2 Gallon Turbo Pump

The 2 gallon Turbo pump models feature a drawn steel reservoir with an oil level sight glass. Choose from models with a P & T manifold for use with remote mount valves, a single station D03 manifold, the standard treadle or manual 4 way valve models. The PARG series uses an air operated pendant to control the pump functions. Or build a system pump with multiple Enerpac VP valve series, VP03 series or VSS/VST series D03 mount valves. The VMMD series D03 Manual valves can also be used.

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

Product selection

<table>
<thead>
<tr>
<th>Description</th>
<th>Model numbers 3000 series</th>
<th>Model numbers 5000 series</th>
<th>Usable oil capacity¹ horizontal mount in³</th>
<th>Usable oil capacity⁵ vertical mount in³</th>
<th>Air pressure range psi</th>
<th>Air consumption scfm</th>
<th>Air consumption lbs</th>
</tr>
</thead>
<tbody>
<tr>
<td>▼ Factory supplied valves</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hand/foot 3-way</td>
<td>PATG-3102NB</td>
<td>PATG-5102NB</td>
<td>127</td>
<td>70</td>
<td>50-125</td>
<td>12</td>
<td>19</td>
</tr>
<tr>
<td>Hand 4-way</td>
<td>PAMG-3402NB</td>
<td>PAMG-5402NB</td>
<td>127</td>
<td>70</td>
<td>50-125</td>
<td>12</td>
<td>25</td>
</tr>
<tr>
<td>Remote 3-way pendant</td>
<td>PARG-3102NB</td>
<td>PARG-5102NB</td>
<td>127</td>
<td>70</td>
<td>50-125</td>
<td>12</td>
<td>23</td>
</tr>
<tr>
<td>▼ User supplied valves</td>
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<td></td>
<td></td>
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<td></td>
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<tr>
<td>Remote mount</td>
<td>PACG-3002SB</td>
<td>PACG-5002SB</td>
<td>127</td>
<td>70</td>
<td>50-125</td>
<td>12</td>
<td>19</td>
</tr>
<tr>
<td>Pump mount, single D03 Valve</td>
<td>PASG-3002SB</td>
<td>PASG-5002SB</td>
<td>127</td>
<td>70</td>
<td>50-125</td>
<td>12</td>
<td>19</td>
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</tbody>
</table>

¹) At 0 psi hydraulic and 100 psi air pressure.
²) Turbo air-hydraulic pumps are also available with 305 in³ reservoir. To order replace 2 in model number with 5.
2-Gallon reservoir

All models

PACG with MB2 or MB4

8.75 (MB-4)

9.96

PAMG series

PASG series

PARG series

PATG series

Options

Gauges and accessories

Regulator-filter-lubricator

Product selection

<table>
<thead>
<tr>
<th>Description</th>
<th>Model numbers 3000 series</th>
<th>Model numbers 5000 series</th>
<th>Usable oil capacity in³</th>
<th>Air pressure range psi</th>
<th>Air consumption scfm</th>
<th>lbs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factory supplied valves</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hand/foot 3-way</td>
<td>PATG-31S8N</td>
<td>PATG-51S8N</td>
<td>462</td>
<td>50-125</td>
<td>12</td>
<td>54</td>
</tr>
<tr>
<td>Hand 4-way</td>
<td>PATG-34S8N</td>
<td>PATG-54S8N</td>
<td>462</td>
<td>50-125</td>
<td>12</td>
<td>60</td>
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<tr>
<td>Remote 3-way pendant</td>
<td>PARG-31S8N</td>
<td>PARG-51S8N</td>
<td>462</td>
<td>50-125</td>
<td>12</td>
<td>58</td>
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<tr>
<td>User supplied valves</td>
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<td></td>
</tr>
<tr>
<td>Remote mount</td>
<td>PACG-30S8S</td>
<td>PACG-50S8S</td>
<td>462</td>
<td>50-125</td>
<td>12</td>
<td>54</td>
</tr>
<tr>
<td>Pump mount, Single DO3 Valve</td>
<td>PACG-30S8S</td>
<td>PACG-50S8S</td>
<td>462</td>
<td>50-125</td>
<td>12</td>
<td>54</td>
</tr>
<tr>
<td>Pump mount, Two DO3 Valves</td>
<td>PACG-30S8S-MB2</td>
<td>PACG-50S8S-MB2</td>
<td>462</td>
<td>50-125</td>
<td>12</td>
<td>58</td>
</tr>
<tr>
<td>Pump mount, Four DO3 Valves</td>
<td>PACG-30S8S-MB4</td>
<td>PACG-50S8S-MB4</td>
<td>462</td>
<td>50-125</td>
<td>12</td>
<td>61</td>
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<tr>
<td>Pump mount, (1-8) VP Valves</td>
<td>PACG-30S8S-WM10</td>
<td>PACG-50S8S-WM10</td>
<td>462</td>
<td>50-125</td>
<td>12</td>
<td>56</td>
</tr>
</tbody>
</table>

1) At 0 psi hydraulic and 100 psi air pressure.

Dimensions & options

PA series

Oil Flow: 180 in³/min
Pressure: 5000 psi max
Sound level: 75 dBA
Air: 12 scfm
Reservoir: 70-462 in³

E Bombas hidroneumáticas
F Pompes hydro-pneumatiques
D Lufthydraulische pumpen

www.enerpacwh.com
Air Pump

ZAJ-065 series

Heavy-duty Air Powered Pump
- Suited for use in production applications
- 1-gallon steel reservoir with sight glass, mounting flange

ZAJ-065 series air driven pump
These heavy-duty air driven pumps are well suited for use in production applications.

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

ZAJ-06505M1
Pressure and tank manifold for use with remote mounted valves.

ZAJ-06505S2C
Dual 2 position/3 way normally closed solenoid valves for use with double-acting circuits.

ZAJ-06505S2C
Dual 2 position/3 way normally closed solenoid valves for use with two independent single-acting circuits.

Flow: 124 in³/min at 100 psi
62 in³/min at 2000 psi

Pressure: 5000 psi max

<table>
<thead>
<tr>
<th>Supplied Valving</th>
<th>Valve Solenoid Voltage</th>
<th>Model Number</th>
<th>Air Pressure Range</th>
<th>Oil Ports</th>
<th>Oil Consumption</th>
<th>Air Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure and tank manifold</td>
<td>-</td>
<td>ZAJ-06505M1</td>
<td>15-100</td>
<td>3/8&quot; NPT</td>
<td>18</td>
<td>49</td>
</tr>
<tr>
<td>Single 2 pos./3 way solenoid valve</td>
<td>24 VDC</td>
<td>ZAJ-06505S1C</td>
<td>15-100</td>
<td>3/8&quot; NPT</td>
<td>18</td>
<td>49</td>
</tr>
<tr>
<td>Dual 2 pos./3 way solenoid valve</td>
<td>24 VDC</td>
<td>ZAJ-06505S2C</td>
<td>15-100</td>
<td>3/8&quot; NPT</td>
<td>18</td>
<td>49</td>
</tr>
</tbody>
</table>
Portable air hydraulic power

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

PA series

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

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

![PA-135, PA-136](image)

**Options**

- Regulator-filter-lubricator
- Fittings

**Fittings**

- 1/2"-20 UNF
- 1/4"-18 NPT
- External adjustable relief valve

**Product selection**

<table>
<thead>
<tr>
<th>Usable oil capacity</th>
<th>Max. oil flow</th>
<th>Max. hydraulic pressure</th>
<th>Model number</th>
<th>Valve function</th>
<th>Air pressure range</th>
<th>Air consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>in³</td>
<td>in³/min</td>
<td>psi</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>36.6</td>
<td>60</td>
<td>5000</td>
<td>PA-135</td>
<td>Advance/Retract</td>
<td>60-100</td>
<td>12</td>
</tr>
<tr>
<td>36.6</td>
<td>120</td>
<td>3000</td>
<td>PA-136</td>
<td>Advance/Retract</td>
<td>60-100</td>
<td>12</td>
</tr>
</tbody>
</table>

*At 0 psi hydraulic pressure.

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

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Air hydraulic boosters

For high production applications

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

AHB series boosters

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

B series boosters

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

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

Hydraulic system schematics

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

- **Air connection**: 3/8 BSPP
- **Oil reservoir**: 1/2 BSPP
- **Gauge port**: G1/4

**B series**

- **Air connection**: 3/8 BSPP
- **Oil fill port**: 1/2 BSPP
- **Gauge port**: 3/8 BSPP

---

**Selection chart**

<table>
<thead>
<tr>
<th>Oil pressure (psi)</th>
<th>Oil volume per stroke (in³)</th>
<th>Air to oil pressure ratio</th>
<th>Model number</th>
<th>Air consumption per cycle (ft³ at 85 psi)</th>
<th>Air piston diameter (in)</th>
<th>Hydraulic piston diameter (in)</th>
<th>Hydraulic stroke (in)</th>
<th>Air operating pressure (psi)</th>
<th>Air operating pressure (lbs)</th>
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<tbody>
<tr>
<td><strong>AHB series</strong></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1200</td>
<td>1600</td>
<td>18.0</td>
<td>1:16</td>
<td>AHB-17</td>
<td>2.2</td>
<td>8.00</td>
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<td>5.71</td>
<td>15-115</td>
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<td>2550</td>
<td>3460</td>
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<td>1:34</td>
<td>AHB-34</td>
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<td>8.00</td>
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<td>5.71</td>
<td>15-115</td>
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<td>3450</td>
<td>4600</td>
<td>6.1</td>
<td>1:46</td>
<td>AHB-46</td>
<td>2.2</td>
<td>8.00</td>
<td>1.18</td>
<td>5.71</td>
<td>15-115</td>
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<tr>
<td>4800</td>
<td>–</td>
<td>4.5</td>
<td>1:64</td>
<td>AHB-66</td>
<td>2.2</td>
<td>8.00</td>
<td>1.00</td>
<td>5.71</td>
<td>15-75</td>
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<tr>
<td><strong>B series</strong></td>
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<tr>
<td>2250</td>
<td>3000</td>
<td>6.2</td>
<td>1:30</td>
<td>B-3006</td>
<td>.95</td>
<td>7.10</td>
<td>1.22</td>
<td>5.20</td>
<td>40-125</td>
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<td>3750</td>
<td>5000</td>
<td>3.7</td>
<td>1:50</td>
<td>B-5003</td>
<td>.95</td>
<td>7.10</td>
<td>.94</td>
<td>5.20</td>
<td>40-125</td>
</tr>
</tbody>
</table>

---

1) One cycle = advance + retract stroke.

Note: Seal material: Buna-N, Polyurethane.
Air valves and accessories V, VA, VR, HV, RFL-series

To control and regulate air supply

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

VAS-42 Solenoid operated air valve 5-way, 2-position
- For control of pump and boosters air supply
- Viton seals standard
- Solenoid: 120 VAC, 50/60Hz
  Amperage: inrush .11 Amps, holding .07 Amps
- Maximum cycle rate: 600 cycles per minute

VR-3 Rapid exhaust valve
- Enables booster to advance and retract faster
- Instantly exhaust air supply from booster to atmosphere

V-19 Air check valve
- Prevent rapid drop of air pressure to the booster in the event of sudden loss of input air

RFL-102 Regulator-Filter-Lubricator
- Regulates air pressure
- Filter air input
- Lubricates air motors with a fine oil vapor mist
- Maximum air flow 48 scfm

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 305 in³/min
- Works with the VA-42 four-way air valve and a booster

QE-375 Muffler
- Use with VR-3 or VAS/VA-42
- Reduces noise level of exhaust air from pump

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

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

- Accessory valves provide greater safety and more efficient clamping cycles
- Recommended for use with all air powered units
- Directional valves to control booster and pump air supply
- Remote air valve permits either hand or foot operation

Important

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

Product selection

<table>
<thead>
<tr>
<th>Maximum pressure psi</th>
<th>Model number</th>
</tr>
</thead>
<tbody>
<tr>
<td>▼ Air valves</td>
<td></td>
</tr>
<tr>
<td>30-150</td>
<td>VA-42</td>
</tr>
<tr>
<td>30-150</td>
<td>VAS-42</td>
</tr>
<tr>
<td>0-100</td>
<td>VR-3</td>
</tr>
<tr>
<td>0-100</td>
<td>V-19</td>
</tr>
<tr>
<td>▼ Holding Valve</td>
<td></td>
</tr>
<tr>
<td>0-100</td>
<td>HV-1000A*</td>
</tr>
<tr>
<td>▼ Accessories</td>
<td></td>
</tr>
<tr>
<td>0-125</td>
<td>RFL-102</td>
</tr>
<tr>
<td>0-125</td>
<td>QE-375</td>
</tr>
</tbody>
</table>

* Maximum hydraulic pressure: 3000 psi.
Dimensions & options V, VA, VR, HV, RFL-series

**Options**

- Gauges and adaptors
- Hoses
- Fittings

---

**Important**

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

---

**Air Pressure:** 0-150 psi

**E** Válvulas de aire

**F** Valves à air

**D** Luftventile

---

**Dimensions & options**

**V, VA, VR, HV, RFL-series**

- **AHB Series Booster**
- **B Series Booster**
- **G-2517L Gauge**
- **FZ-2060 Adapter**
- **VFC-1 Flow control**
- **FZ-1608 Nipple**
- **FZ-2007 Adapter**
- **VA-42**
- **V-19 Check valve**
- **VR-3 Rapid exhaust valve**
- **QE-375 Muffler**
- **GA-3 Gauge adapter**
- **VFC-1 Flow control**
- **FZ-1608 Nipple**
- **FZ-2007 Adapter**

---

**Power Sources**

**Pallet Components**

**System Components**

**Yellow pages**

---

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

Heavy on performance, light on weight

- Lightweight and compact design, 26 lbs
- Large easy-carry handle for maximum portability
- Two-speed operation reduces cycle times for improved productivity
- 115 VAC 50/60- or 220 VAC 50/60-cycle universal motor will operate on voltage as low as 60 volts
- 24 VDC remote motor control, 10-ft length for operator safety
- Starts under full load
- High strength molded shroud with integral handle, protects motor from contamination and damage
- Designed for intermittent duty cycle

WUD-1100 series

- Provides advance/auto-retract of single-acting cylinders
- 10-foot pendant controls motor and valve operation
- Use with AP500

WUD-1300 series

- Provides advance/hold/retract of single-acting cylinders
- 10-foot pendant controls motor and valve operation
- Ideal for applications requiring remote valve operation
- Use with ACBS22 or ACBS202

Product selection

<table>
<thead>
<tr>
<th>Model number</th>
<th>Used with cylinder</th>
<th>Pressure rating (psi)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1st stage</td>
</tr>
<tr>
<td>WUD-1100B</td>
<td>single-acting</td>
<td>200</td>
</tr>
<tr>
<td>WUD-1101B</td>
<td>single-acting</td>
<td>200</td>
</tr>
<tr>
<td>WUD-1100E</td>
<td>single-acting</td>
<td>200</td>
</tr>
<tr>
<td>WUD-1101E</td>
<td>single-acting</td>
<td>200</td>
</tr>
<tr>
<td>WUD-1300B</td>
<td>single-acting</td>
<td>200</td>
</tr>
<tr>
<td>WUD-1301B</td>
<td>single-acting</td>
<td>200</td>
</tr>
<tr>
<td>WUD-1300E</td>
<td>single-acting</td>
<td>200</td>
</tr>
<tr>
<td>WUD-1301E</td>
<td>single-acting</td>
<td>200</td>
</tr>
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</table>
Economy WU series

**Product dimensions** in inches [inches]

<table>
<thead>
<tr>
<th>Usable oil capacity</th>
<th>Model number</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>H</th>
<th>J</th>
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<tr>
<td>gal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>.50</td>
<td>WUD-1100B</td>
<td>9.62</td>
<td>9.62</td>
<td>14.25</td>
<td>4.00</td>
<td>4.72</td>
<td>8.00</td>
<td>.40</td>
<td>5.25</td>
</tr>
<tr>
<td>1.0</td>
<td>WUD-1101B</td>
<td>14.50</td>
<td>12.18</td>
<td>14.72</td>
<td>4.15</td>
<td>5.12</td>
<td>12.74</td>
<td>.40</td>
<td>5.62</td>
</tr>
<tr>
<td>.50</td>
<td>WUD-1100E</td>
<td>9.62</td>
<td>9.62</td>
<td>14.25</td>
<td>4.00</td>
<td>4.72</td>
<td>8.00</td>
<td>.40</td>
<td>5.25</td>
</tr>
<tr>
<td>1.0</td>
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<td>14.50</td>
<td>12.18</td>
<td>14.72</td>
<td>4.15</td>
<td>5.12</td>
<td>12.74</td>
<td>.40</td>
<td>5.62</td>
</tr>
<tr>
<td>.50</td>
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<td>4.72</td>
<td>8.00</td>
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<tr>
<td>1.0</td>
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<td>12.18</td>
<td>14.72</td>
<td>4.15</td>
<td>5.12</td>
<td>12.74</td>
<td>.40</td>
<td>5.62</td>
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<tr>
<td>.50</td>
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<td>4.00</td>
<td>4.72</td>
<td>8.00</td>
<td>.40</td>
<td>5.25</td>
</tr>
<tr>
<td>1.0</td>
<td>WUD-1301E</td>
<td>14.50</td>
<td>12.18</td>
<td>14.72</td>
<td>4.15</td>
<td>5.12</td>
<td>12.74</td>
<td>.40</td>
<td>5.62</td>
</tr>
</tbody>
</table>

**Output flow rate** in^3/min

<table>
<thead>
<tr>
<th>1st stage</th>
<th>2nd stage</th>
<th>Valve type</th>
<th>Current draw</th>
<th>Motor voltage</th>
<th>Sound level</th>
<th>Model number</th>
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</thead>
<tbody>
<tr>
<td>200</td>
<td>25</td>
<td>Dump*</td>
<td>9.5</td>
<td>115</td>
<td>85</td>
<td>WUD-1100B</td>
</tr>
<tr>
<td>200</td>
<td>25</td>
<td>Dump*</td>
<td>9.5</td>
<td>115</td>
<td>85</td>
<td>WUD-1101B</td>
</tr>
<tr>
<td>200</td>
<td>25</td>
<td>Dump*</td>
<td>9.5</td>
<td>220</td>
<td>85</td>
<td>WUD-1100E</td>
</tr>
<tr>
<td>200</td>
<td>25</td>
<td>Dump*</td>
<td>9.5</td>
<td>220</td>
<td>85</td>
<td>WUD-1101E</td>
</tr>
<tr>
<td>200</td>
<td>25</td>
<td>Dump and Hold</td>
<td>9.5</td>
<td>115</td>
<td>85</td>
<td>WUD-1300B</td>
</tr>
<tr>
<td>200</td>
<td>25</td>
<td>Dump and Hold</td>
<td>9.5</td>
<td>115</td>
<td>85</td>
<td>WUD-1301B</td>
</tr>
<tr>
<td>200</td>
<td>25</td>
<td>Dump and Hold</td>
<td>9.5</td>
<td>220</td>
<td>85</td>
<td>WUD-1300E</td>
</tr>
<tr>
<td>200</td>
<td>25</td>
<td>Dump and Hold</td>
<td>9.5</td>
<td>220</td>
<td>85</td>
<td>WUD-1301E</td>
</tr>
</tbody>
</table>

* Electric dump valve for auto-retract of cylinders.

**Flow:** 25 in^3/min  
**Pressure:** 5000 psi max  
**Motor:** .5 hp  
**Reservoir:** 0.5-1 gallon

E Bombas eléctricas  
F Centrale hydraulique  
D Tauchpumpe

**Standard equipment**

**Gauge, filter and pressure switch**

Pumps are supplied with a manifold mounted 6000 psi gauge for convenient reading of pump pressure.

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

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

www.enerpacwh.com
Electric submerged pumps

Best performance for mid-range cylinders

- Reduce cycle times for improved productivity
- Two-speed pump unit provides rapid cylinder advance
- Submerged dual voltage induction motor, runs cooler and quieter (60-70 dBA)
- Available with heat exchanger for higher duty cycle applications
- Externally adjustable relief valve – no need to open pump when reducing pressure
- Reservoir mounting holes for easy mounting to fixed surface
- Full length side tube for easy monitoring of oil level
- Auxiliary return port, eliminates the need for a separate adapter

WE series

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

Select your pump type

WED-series with dump valve
- For use when load holding is not required
- Ideal for palletized workholding for single acting circuits
- Motor is on only during work cycle

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

WEM-series with manual valve
- Manual valve control
- Manual motor control
- Simple and economical solution to your workholding power source needs

WER-series with remote actuated solenoid
- Solenoid directional with shear seal design
- Remote valve operation

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

Pressure switch specifications:
- Classification NEMA 1
- Pressure range:
  - IC-51: 3000-7500 psi
  - IC-31: 500-3500 psi
Used with cylinder | Valve function | Valve type | Model number | Motor voltage | Heat exchanger
---|---|---|---|---|---
Single-Acting | Advance / Retract | Dump | WED-1101B | 115V | Heat exchanger cools oil in pumps used in higher duty cycle applications.
Single-Acting | Advance / Retract | Dump | WED-1101E | 230V |

Single-Acting | Advance / Retract | Jog | WEJ-1201B | 115V |

Single-Acting | Advance / Retract | Manual 3/2 | WEM-1201B | 115V | Oil should be replaced every 500 working hours to ensure long life. Change filters when changing oil or 4 times a year whichever comes first.
Double-Acting | Adv. / Hold / Retr. | Solenoid | WER-1401B | 115V |
Double-Acting | Adv. / Hold / Retr. | Solenoid | WER-1401D | 115V |
Double-Acting | Adv. / Hold / Retr. | Solenoid | WER-1401F | 230V |
Double-Acting | Adv. / Hold / Retr. | Manual 4/3 | WES-1401E | 230V | Output flow rate should be matched to hydraulic components used in the system.
Enerpac submerged motor pumps are available in a wide range of configurations to fit any requirement.

For full features see page 110.

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

Product selection

<table>
<thead>
<tr>
<th>Motor voltage</th>
<th>Motor capacity</th>
<th>Amperage draw</th>
<th>Maximum oil flow**</th>
<th>Pressure rating</th>
<th>Usable oil capacity</th>
<th>Adjustable relief valve</th>
</tr>
</thead>
<tbody>
<tr>
<td>50/60 Hz 1 ph</td>
<td>.50</td>
<td>13.5</td>
<td>150</td>
<td>40</td>
<td>1000</td>
<td>1.5</td>
</tr>
<tr>
<td>115V-1ph</td>
<td>.75</td>
<td>6.75</td>
<td>150</td>
<td>40</td>
<td>1000</td>
<td>1.5</td>
</tr>
</tbody>
</table>

** Weight for WES and WET models is 83 lbs.
** All flow data at 60 Hz, 50 Hz data will be 5/6 th this number.
Custom build your submerged pump

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

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

```
<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>W</td>
<td>E</td>
<td>M</td>
<td>1</td>
<td>3</td>
<td>01</td>
<td>B</td>
</tr>
</tbody>
</table>
```

**1 Product Type**
- **W** = Workholding Pump

**2 Motor Type**
- **E** = Electric motor

**3 Pump Type**
- **D** = Dump
- **J** = Jog
- **M** = Manual
- **R** = Remote (solenoid)
- **S** = Pressure switch (IC-51)
- **T** = Pressure switch (IC-31)

**4 Pump Series**
- **1** = .5 hp 10,000 psi

**5 Valve Type**
- **0** = No valve (WER only)
- **1** = Dump
- **2** = 3-way, 2-position, normally open
- **3** = 3-way, 3-position, tandem center
- **4** = 4-way, 3-position, tandem center
- **5** = Custom VE-series valve (WER only)
  - See example 2 below.

**6 Reservoir Capacity**
- **01** = 1.5 gallon

**7 Motor Voltage and Heat Exchanger**
- **B** = 115 V, 1 Ph, 50/60 Hz
- **D** = 115 V, 1 Ph, 50/60 Hz with heat exchanger
- **E** = 230 V, 1 Ph, 50/60 Hz
- **F** = 230 V, 1 Ph, 50/60 Hz with heat exchanger
- **I** = 230 V, 1 Ph, 60 Hz

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

---

**Examples**

**Ordering example 1**

**Ordering example 2**

---

**Important**

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

WES series pumps use IC-51 pressure switch, adjustable from 3000-7500 psi.

WET series pumps use IC-31 pressure switch, adjustable from 500-3500 psi.

---

**Model number:**

**WER-1301B**

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

**Model number:**

**WER-1501B- VED15000D**

The WER-1501B is a .5 hp, 5,000 psi, submerged electric pump, with 1.5 gallon usable oil capacity. The valve, model VED15000D is a 115 V, 60 Hz solenoid valve. (For details and options for all VE-series valves see pages 146-147.)
Z-Class electric pumps are designed for use in the harshest manufacturing environments. The pumps provide reliable and durable performance in a wide variety of configurations.

## Electric pumps

### Application & selection

**Shown: ZW5020HB-FT21**

*Z-Class* high-efficiency pump design; higher oil flow and by-pass pressure, cooler running and requires 18% less current than comparable pumps.

- Totally enclosed, fan cooled industrial electric motors supply extended life and stand up to harsh industrial environments.
- Multiple valve and reservoir configurations provide application specific models to match the most demanding workholding applications.
- High-strength, molded electrical enclosure protects electronics, power supplies and LCD readout from coolant and contamination.

### The standard for workholding applications

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

---

### Basic configurations

All pumps listed in this chart include LCD electrical box, 5 gallon reservoir, return line filter and either 0-6000 psi pressure gauge or pressure transducer (solenoid valve models). For additional options, see the complete pump matrix on page 117.

<table>
<thead>
<tr>
<th>Pump type</th>
<th>Valve/manifold type</th>
<th>Motor voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZW-Series with manifold</td>
<td>Pressure and tank ports</td>
<td>50/60 Hz</td>
</tr>
<tr>
<td></td>
<td>Single station DO3</td>
<td>230 VAC, 3 ph</td>
</tr>
<tr>
<td></td>
<td>Enerpac VP-series</td>
<td>230 VAC, 3 ph</td>
</tr>
<tr>
<td></td>
<td>Two station DO3</td>
<td>230 VAC, 3 ph</td>
</tr>
<tr>
<td></td>
<td>Four station DO3</td>
<td>230 VAC, 3 ph</td>
</tr>
</tbody>
</table>

- **ZW-Series with manifold**
  - Used when supplying pressure to multiple valve circuits
  - Valves must be supplied separately

- **ZW-Series with pallet coupling valve**
  - Provides momentary pressure and flow to fixture
  - Ideal for pallet disconnect systems

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

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

---

### Electric pumps

### Pressure and tank ports

- **Single station DO3**
  - 230 VAC, 3 ph
- **Enerpac VP-series**
  - 230 VAC, 3 ph
- **Two station DO3**
  - 230 VAC, 3 ph
- **Four station DO3**
  - 230 VAC, 3 ph

### ZW-Series with pallet coupling valve

- **4-way, 3-pos. solenoid operated**
  - 115 VAC, 1 ph
- **4-way, 3-pos. solenoid operated**
  - 230 VAC, 3 ph
- **4-way, 3-pos. solenoid operated**
  - 460 VAC, 3 ph

### ZW-Series with continuous connection valve

- **4-way, 3-pos. solenoid operated**
  - 115 VAC, 1 ph
- **4-way, 3-pos. solenoid operated**
  - 230 VAC, 3 ph
- **4-way, 3-pos. solenoid operated**
  - 460 VAC, 3 ph

### ZW-Series with manual valve

- **4-way, 3-pos. manually operated**
  - 115 VAC, 1 ph
- **4-way, 3-pos. manually operated**
  - 230 VAC, 3 ph
- **4-way, 3-pos. manually operated**
  - 460 VAC, 3 ph
### ZW series

#### Output oil flow and current draw

<table>
<thead>
<tr>
<th>ZW3 Series</th>
<th>ZW4 Series</th>
<th>ZW5 Series</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output oil flow at 5000 psi 40 in³/min</td>
<td>Output oil flow at 5000 psi 60 in³/min</td>
<td>Output oil flow at 5000 psi 120 in³/min</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LCD Electric Model Number</th>
<th>LCD Electric Model Number</th>
<th>LCD Electric Model Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZW3020HG-FG01</td>
<td>ZW4020HG-FG01</td>
<td>ZW5020HG-FG01</td>
</tr>
<tr>
<td>ZW3020HG-FG11</td>
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<td>ZW5020HG-FG11</td>
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<tr>
<td>ZW3020HG-FG12</td>
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<td>ZW5020HG-FG12</td>
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<td>ZW4420DB-FT</td>
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<tr>
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<td>ZW5420FJ-FT</td>
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<td>ZW5420LB-FG</td>
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<td>ZW3420LG-FG</td>
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<td>ZW5420LG-FG</td>
</tr>
<tr>
<td>ZW3420LJ-FG</td>
<td>ZW4420LJ-FG</td>
<td>ZW5420LJ-FG</td>
</tr>
</tbody>
</table>

**Flow rate:** 40-120 in³/min  
**Pressure:** 5000 psi max  
**Motor:** 1.0 & 1.5 hp  
**Reservoir:** 2-10 gal

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

**Important**

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

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

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

Dimensions & options

Shown: ZWS020HB-FT21

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

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

2.5, 5, 10 gallon

2 gallon

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

Options

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

Product dimensions in inches [ ]

Table: Usable oil capacity

<table>
<thead>
<tr>
<th>gal</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>D1</th>
<th>E</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.0</td>
<td>8.1</td>
<td>11.3</td>
<td>6.6</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>22.6</td>
</tr>
<tr>
<td>2.5</td>
<td>6.1</td>
<td>16.5</td>
<td>12.0</td>
<td>15.1</td>
<td>14.6</td>
<td>11.0</td>
<td>23.6</td>
</tr>
<tr>
<td>5.0</td>
<td>7.1</td>
<td>16.5</td>
<td>16.6</td>
<td>19.7</td>
<td>19.2</td>
<td>15.6</td>
<td>24.6</td>
</tr>
<tr>
<td>10.0</td>
<td>10.6</td>
<td>15.7</td>
<td>19.9</td>
<td>22.7</td>
<td>22.5</td>
<td>18.9</td>
<td>28.1</td>
</tr>
</tbody>
</table>

Table: ZW Series pump dimensions (in)

<table>
<thead>
<tr>
<th>Output flow rate in³/min</th>
<th>ZW3*</th>
<th>1.0</th>
<th>1,000-5,000</th>
<th>75</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 psi</td>
<td>203</td>
<td>196</td>
<td>170</td>
<td>40</td>
</tr>
<tr>
<td>350</td>
<td>305</td>
<td>-</td>
<td>83</td>
<td>60</td>
</tr>
<tr>
<td>650</td>
<td>602</td>
<td>-</td>
<td>123</td>
<td>120</td>
</tr>
</tbody>
</table>

* Constant flow rate for single-stage models.
This is how a ZW series Model number is built:

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product Type</td>
<td>Motor Type</td>
<td>Flow Group</td>
<td>Valve Type</td>
<td>Usable Oil Capacity</td>
<td>Valve Operation</td>
<td>Voltage</td>
<td>Options</td>
<td>Manifold Options</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>Z</td>
<td>W</td>
<td>4</td>
<td>0</td>
<td>20</td>
<td>H</td>
<td>G</td>
<td>-</td>
<td>FG</td>
</tr>
</tbody>
</table>

1 Product type
- Z = Z-Class Pump

2 Motor type
- W = Workholding Electric

3 Flow group
- 3 = 40 in³/min
- 4 = 60 in³/min
- 5 = 120 in³/min

4 Valve type
- 0 = No valve or valve manifold
- 2 = 3-way, 2-position, manual valve
- 3 = 3-way, 3-position, manual valve
- 4 = 4-way, 3-position, manual or solenoid valve
- 6 = 3-way, 3-position, tandem center w/P.O. check (manual only)
- 8 = 4-way, 3-position, tandem center w/P.O. check (manual only)

5 Usable oil capacity
- 8 = 8 Liters (2 gallon)
- 10 = 10 Liters (2.5 gallon)
- 20 = 20 Liters (5 gallon)
- 40 = 40 Liters (10 gallon)

6 Valve operation
- D = Solenoid valve (pallet coupling) with pendant and LCD (valve type 4)
- F = Solenoid valve (continuous connection) with pendant and LCD (valve type 4)
- G = Valve manifold without LCD (valve type 0)
- H = Valve manifold with LCD (valve type 0)
- L = Manual valve with LCD (without pendant, valve type 2, 3, 4, 6 or 8)
- M = Manual valve without LCD (valve type 2, 3, 4, 6 or 8)
- N = No valve, without LCD (valve type 0)
- W = No valve with LCD (valve type 0)

7 Power supply
- Single Phase
  - B = 115V, 1 ph, 50-60 Hz
  - E = 208-240V, 1 ph, 50-60 Hz
- European plug
- I = 208-240V, 1 ph, 50-60 Hz
- USA plug
- Three Phase
  - M = 190-200V, 3 ph, 50/60 Hz
  - G = 208-240V, 3 ph, 50/60 Hz
  - W = 380-415V, 3 ph, 50/60 Hz
  - K = 440V, 3 ph, 50/60 Hz
  - J = 460-480V, 3 ph, 50/60 Hz
  - R = 575V, 3 ph, 50/60 Hz

8 Options
- F = Return line filter, 25 micron
- G = 0-6000 psi pressure gauge, 21/2"
- H = Heat exchanger
- L = Level/temperature switch
- N = No handles (lifting eyes only)
- P = Pressure switch
- R = Roll bars
- S = Single stage
- T = Pressure transducer
- U = Foot switch

9 Manifold options
- 01 = Pressure & tank porting manifold
- 11 = Single station D03
- 12 = VP series manifold
- 13 = Single station CETOP
- 21 = 2 station D03
- 22 = 2 station CETOP
- 41 = 4 station D03
- 42 = 4 station CETOP

Example

The ZW5810LG-FT is a 120 in³/min, 2-stage pump with a manual 4-way, 3 position tandem center valve, integrated P.O. check, LCD electrical box, 2.5 gallon reservoir, 208-240 volt 3-phase motor, return line filter and pressure transducer.

Example

ZW4020GB-FGS21 is a 60 in³/min, single-stage pump with a 2 station D03 manifold, standard electric without LCD, 5 gallon reservoir, 115 volt, 50/60 Hz motor, return line filter and 0-6000 psi pressure gauge.

ZW4410DJ-T is a 60 in³/min, 2-stage pump with a pallet de-coupling valve, LCD electrical box, 2.5 gallon reservoir, 460-480 volt 3-phase motor and pressure transducer.

ZW5040HJ-FGL01 is a 120 in³/min, 2-stage pump with a pressure and tank manifold, LCD electrical box, 10 gallon reservoir, 460-480 volt 3-phase motor, return line filter, 0-6000 psi pressure gauge and level and temperature shutdown switch.

www.enerpacwh.com

ZW Electric Pump ordering matrix

<table>
<thead>
<tr>
<th>Flow: 40-120 in³/min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure: 5000 psi max</td>
</tr>
<tr>
<td>Motor: 1.0 &amp; 1.5 hp</td>
</tr>
<tr>
<td>Reservoir: 2.0-10 gal.</td>
</tr>
</tbody>
</table>

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

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

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

Extend life of hydraulic components

...increase system reliability

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

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

### Product selection

<table>
<thead>
<tr>
<th>Nominal filtration</th>
<th>Model number</th>
<th>Maximum pressure</th>
<th>Maximum oil flow</th>
<th>Bypass pressure setting</th>
<th>Filter gauge service indicator</th>
<th>lbs</th>
</tr>
</thead>
<tbody>
<tr>
<td>micron</td>
<td>ZPF</td>
<td>psi</td>
<td>gpm</td>
<td>psi</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td></td>
<td>200</td>
<td>12.0</td>
<td>25</td>
<td>✓</td>
<td>3.2</td>
</tr>
</tbody>
</table>
Extends system life

- Electrical connector factory installed
- All installation components included
- Stabilizes oil temperature at a maximum of 130°F at 70°F ambient temperature
- Stabilizes oil viscosity, increasing oil life and reduces wear of pump and other hydraulic components

Voltage: 24V
Pressure: max. 300 psi

<table>
<thead>
<tr>
<th>Transfer: 900 Btu/h</th>
<th>Voltage: 24V</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Model number</th>
<th>Thermal transfer*</th>
<th>Amperage draw</th>
<th>Maximum pressure</th>
<th>Maximum oil flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 VDC</td>
<td>ZHE-E10</td>
<td>900 Btu/h</td>
<td>950 kJoule</td>
<td>300 psi</td>
<td>7.0 gpm</td>
</tr>
</tbody>
</table>

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

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

Important

ZHE- Series Heat Exchangers
Heat exchanger stabilizes oil temperature at 130°F at 70°F ambient temperature. Thermal transfer at 5 GPM and 70°F ambient temperature: 900 Btu/hour. Do not exceed maximum oil flow of 7.0 GPM and maximum pressure of 300 psi. Not suitable for water-glycol or high water based fluids.
Electronic level/temp switch for feedback on pump oil level

- Drop-in design allows for easy installation to pump reservoir
- Electrical connector included
- Built-in thermal sensing provides feedback on oil temperature
- Senses low oil level in pump reservoir

ZLS series

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

Shown: ZLS-U4

ZPT/ZPS series

ZPT pressure transducer provides constant pressure monitoring for automated pump control. ZPS can be used to provide a pressure signal to an external control.

Shown: ZPT-U4, ZPS-W4

**Important**

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

Control your pump, monitor pressure

ZPT pressure transducer

- More durable than analog gauges (against mechanical and hydraulic shock)
- More accurate than analog gauges (0.5% full scale)
- Calibration can be fine tuned for certification
- “Auto-mode” provides automatic pressure make-up
- Display pressure in psi, bar or MPa

ZPS-E3 pressure switch

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

**Product Selection**

<table>
<thead>
<tr>
<th>Fixed temperature signal</th>
<th>Model number</th>
<th>Voltage</th>
<th>Thermostat rating setting</th>
<th>Maximum pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>°F</td>
<td>ZLS-U4</td>
<td>24 VDC</td>
<td>2.6</td>
<td>150</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Adjustable pressure range</th>
<th>Electrical specification</th>
<th>Model number</th>
<th>Accuracy (full scale)</th>
<th>Deadband</th>
</tr>
</thead>
<tbody>
<tr>
<td>psi</td>
<td></td>
<td>ZPT-U4</td>
<td>0.5%</td>
<td>50</td>
</tr>
<tr>
<td>50-10,000</td>
<td>4-20 mA</td>
<td>ZPS-W4</td>
<td>2%</td>
<td>115-550</td>
</tr>
</tbody>
</table>

Note: Electrical harness included with kit. ZPS-W4 includes 0-6000 psi pressure gauge.
**Valve manifold**

**Pressure: 5000 psi**

**Stations: 1-4 valves horizontal**

**Stations: 1-8 valves vertical**

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

**Increased flexibility for complex systems**

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

**Options**

- **Pressure transducer**
- **Level switch**

**Product Selection**

<table>
<thead>
<tr>
<th>Valve mounting pattern</th>
<th>Option code</th>
<th>Number of stations</th>
<th>Coverplate model number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Porting manifold, SAE ports</td>
<td>01</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Enerpac VP Series</td>
<td>12</td>
<td>1-8</td>
<td>–</td>
</tr>
<tr>
<td>2 station D03</td>
<td>21</td>
<td>2</td>
<td>MC-1</td>
</tr>
<tr>
<td>4 station D03</td>
<td>41</td>
<td>4</td>
<td>MC-1</td>
</tr>
<tr>
<td>2 station CETOP3</td>
<td>22</td>
<td>2</td>
<td>MC-3</td>
</tr>
<tr>
<td>4 station CETOP3</td>
<td>42</td>
<td>4</td>
<td>MC-3</td>
</tr>
</tbody>
</table>

- Enerpac porting manifold provides pressure and tank line to remote mounted valve stack on a machining center.
The new Enerpac Pallet Coupling Pump provides three modes of operation:

**Manual mode**
Pump runs as long as operator holds down pendant button.

**AUTO mode without timer**
Pump runs until user-adjustable pressure setting is reached.

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

**Product selection**

<table>
<thead>
<tr>
<th>Output flow rate</th>
<th>Motor size</th>
<th>Motor voltage</th>
<th>Model number</th>
<th>Pressure range</th>
<th>Sound level</th>
<th>Usable oil capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>@ max. pressure</td>
<td>in³/min</td>
<td>psi</td>
<td>dBA</td>
<td>gal</td>
<td>lbs</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>1.0</td>
<td>115-1-60</td>
<td>ZW3406DB-FT</td>
<td>75</td>
<td>2</td>
<td>115</td>
</tr>
<tr>
<td></td>
<td></td>
<td>115-1-60</td>
<td>ZW3410DB-FT</td>
<td>75</td>
<td>2.5</td>
<td>134</td>
</tr>
<tr>
<td></td>
<td></td>
<td>230-1-60</td>
<td>ZW3406DI-FT</td>
<td>75</td>
<td>2</td>
<td>115</td>
</tr>
<tr>
<td></td>
<td></td>
<td>230-1-60</td>
<td>ZW3410DI-FT</td>
<td>75</td>
<td>2.5</td>
<td>134</td>
</tr>
<tr>
<td>60</td>
<td>1.0</td>
<td>115-1-60</td>
<td>ZW4406DB-FT</td>
<td>1000-5000</td>
<td>75</td>
<td>2.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>115-1-60</td>
<td>ZW4410DB-FT</td>
<td>1000-5000</td>
<td>75</td>
<td>2.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>230-3-60</td>
<td>ZW4406DG-FT</td>
<td>1000-5000</td>
<td>75</td>
<td>2.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>230-3-60</td>
<td>ZW4410DG-FT</td>
<td>1000-5000</td>
<td>75</td>
<td>2.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>460-3-60</td>
<td>ZW4406DJ-FT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>460-3-60</td>
<td>ZW4410DJ-FT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>120</td>
<td>1.5</td>
<td>115-1-60</td>
<td>ZW5406DB-FT</td>
<td>1000-5000</td>
<td>75</td>
<td>2.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>115-1-60</td>
<td>ZW5410DB-FT</td>
<td>1000-5000</td>
<td>75</td>
<td>2.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>230-3-60</td>
<td>ZW5406DG-FT</td>
<td></td>
<td></td>
<td></td>
</tr>
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<td></td>
<td></td>
<td>230-3-60</td>
<td>ZW5410DG-FT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>460-3-60</td>
<td>ZW5406DJ-FT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>460-3-60</td>
<td>ZW5410DJ-FT</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Automatic pressure control for palletized fixtures**

- Programmable clamp and unclamp pressure settings increase automation capability
- Programmable dwell settings ensure desired pressure level is maintained on large circuits or circuits with accumulators
- Low-voltage pendant features sealed switches and operates at 15 VDC for improved operator safety
- Backlit LCD provides pump usage information, hour and cycle counts

**Example Circuits**

- Double-acting circuit

**Single-acting circuit**

ZW5410DB-FT used to connect and disconnect a palletized fixture.
**Operation – pallet coupling pump**

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

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

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

**Output oil flow and current draw**

**Product dimensions** in inches [ **]**

<table>
<thead>
<tr>
<th>Usable oil capacity</th>
<th>Modelo number</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>D1</th>
<th>E</th>
<th>H</th>
<th>lbs</th>
</tr>
</thead>
<tbody>
<tr>
<td>gal</td>
<td>ZWxx08xx</td>
<td></td>
<td></td>
<td>8.1</td>
<td>11.0</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>22.6</td>
</tr>
<tr>
<td>2.0</td>
<td>ZWxx10xx</td>
<td>6.1</td>
<td>16.5</td>
<td>12.0</td>
<td>15.1</td>
<td>14.6</td>
<td>11.0</td>
<td>23.6</td>
<td>107</td>
</tr>
<tr>
<td>2.5</td>
<td>ZWxx20xx</td>
<td>7.1</td>
<td>16.5</td>
<td>16.6</td>
<td>19.7</td>
<td>19.2</td>
<td>15.6</td>
<td>24.6</td>
<td>134</td>
</tr>
<tr>
<td>5.0</td>
<td>ZWxx40xx</td>
<td>10.6</td>
<td>15.7</td>
<td>19.9</td>
<td>22.7</td>
<td>22.5</td>
<td>18.9</td>
<td>28.1</td>
<td>184</td>
</tr>
<tr>
<td>10.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Important**
Enerpac recommends a pressure differential of no less than 200 psi for most applications. If you believe your application requires a tighter differential, please contact us directly.

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

**Options**
- Heat exchanger
- Level switch
- Pressure transducer
- Return line filter

**Power Sources**
Pressure: 5000 psi max
Motor: 1.0 or 1.5 hp
Reservoir: 2.0-10.0 gal
**Continuous connection pumps Application & selection**

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

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

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

**Automatic pressure control for continuous connection fixtures**

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

**Example Circuits**

- **Double-acting circuit**

  ![Double-acting circuit diagram](ZW4410FB-FT)

- **Single-acting circuit**

  ![Single-acting circuit diagram](ZW4410FB-FT)

**Product selection**

<table>
<thead>
<tr>
<th>Output flow rate @ max. pressure</th>
<th>Motor size</th>
<th>Motor voltage</th>
<th>Model number</th>
<th>Pressure range</th>
<th>Sound level</th>
<th>Usable oil capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>in³/min</td>
<td>hp</td>
<td>volts</td>
<td></td>
<td>psi</td>
<td>dBA</td>
<td>gal</td>
</tr>
<tr>
<td>40</td>
<td>1.0</td>
<td>115-1-60</td>
<td>ZW4408FB-FT</td>
<td>75</td>
<td>2</td>
<td>115</td>
</tr>
<tr>
<td></td>
<td></td>
<td>115-1-60</td>
<td>ZW4410FB-FT</td>
<td>1000-5000</td>
<td>75</td>
<td>134</td>
</tr>
<tr>
<td></td>
<td></td>
<td>230-1-60</td>
<td>ZW4408FI-FT</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>230-1-60</td>
<td>ZW4410FI-FT</td>
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<td>75</td>
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</tr>
<tr>
<td>60</td>
<td>1.0</td>
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<td>ZW4410FB-FT</td>
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<td>75</td>
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<td>230-3-60</td>
<td>ZW4410FG-FT</td>
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<td>75</td>
<td>2.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>460-3-60</td>
<td>ZW4410FJ-FT</td>
<td></td>
<td>75</td>
<td>2.5</td>
</tr>
<tr>
<td>120</td>
<td>1.5</td>
<td>115-1-60</td>
<td>ZW5410FB-FT</td>
<td>1000-5000</td>
<td>75</td>
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<td>230-3-60</td>
<td>ZW5410FG-FT</td>
<td></td>
<td>75</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>460-3-60</td>
<td>ZW5410FJ-FT</td>
<td></td>
<td>75</td>
<td>2.5</td>
</tr>
</tbody>
</table>

ZW5410FB-FT used to control clamping cycle on a horizontal machining center.
Operation – continuous connection pump

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

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

Output oil flow and current draw

Important
Enerpac recommends a pressure differential of no less than 200 psi for most applications. If you believe your application requires a tighter differential, please contact us directly.

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

Options
Heat exchanger
Level switch
Pressure transducer
Return line filter

Product dimensions

<table>
<thead>
<tr>
<th>Usable oil capacity</th>
<th>Modelo number</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>D1</th>
<th>E</th>
<th>H</th>
<th>lbs</th>
</tr>
</thead>
<tbody>
<tr>
<td>gal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.0</td>
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<td>11.0</td>
<td>8.1</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>22.6</td>
<td>93</td>
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<tr>
<td>2.5</td>
<td>ZWx10xx</td>
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<td>12.0</td>
<td>15.1</td>
<td>14.6</td>
<td>11.0</td>
<td>23.6</td>
<td>107</td>
</tr>
<tr>
<td>5.0</td>
<td>ZWx20xx</td>
<td>7.1</td>
<td>16.5</td>
<td>16.6</td>
<td>19.7</td>
<td>19.2</td>
<td>15.6</td>
<td>24.6</td>
<td>134</td>
</tr>
<tr>
<td>10.0</td>
<td>ZWx40xx</td>
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<td>15.7</td>
<td>19.9</td>
<td>22.7</td>
<td>22.5</td>
<td>18.9</td>
<td>28.1</td>
<td>184</td>
</tr>
</tbody>
</table>

www.enerpacwh.com
Industry standard mounting for electric or manual valves

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

Important

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

ZW5020HB-F11 with customer installed valve used to provide pressure to a clamping fixture.

Product selection

<table>
<thead>
<tr>
<th>Output flow rate @ max. pressure</th>
<th>Motor size</th>
<th>Motor size</th>
<th>Model number</th>
<th>Pressure range</th>
<th>Sound level</th>
<th>Usable oil capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>in³/min</td>
<td>hp</td>
<td>psi</td>
<td>dBA</td>
<td>gal</td>
<td>lbs</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>1.0</td>
<td>115-1-60</td>
<td>ZW3008GB-11</td>
<td>1000-5000</td>
<td>75</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>115-1-60</td>
<td>ZW3010GB-11</td>
<td>1000-5000</td>
<td>75</td>
<td>2.5</td>
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<td>ZW3010GI-11</td>
<td>1000-5000</td>
<td>75</td>
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</tr>
<tr>
<td>60</td>
<td>1.0</td>
<td>115-1-60</td>
<td>ZW4010GB-11</td>
<td>1000-5000</td>
<td>75</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>230-3-60</td>
<td>ZW4010GG-11</td>
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</tr>
<tr>
<td></td>
<td></td>
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<td>ZW4010GJ-11</td>
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<tr>
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<tr>
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<td></td>
<td>460-3-60</td>
<td>ZW5010GJ-11</td>
<td>1000-5000</td>
<td>75</td>
<td>2.5</td>
</tr>
</tbody>
</table>
Operation – single station D03 pumps

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

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

Output oil flow and current draw

<table>
<thead>
<tr>
<th>ZW3 Oil flow &amp; current vs hydraulic pressure</th>
<th>ZW4 Oil flow &amp; current vs hydraulic pressure</th>
<th>ZW5 Oil flow &amp; current vs hydraulic pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Graph" /></td>
<td><img src="image2.png" alt="Graph" /></td>
<td><img src="image3.png" alt="Graph" /></td>
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</tbody>
</table>

Important

Enerpac recommends a pressure differential of no less than 200 psi for most applications. If you believe your application requires a tighter differential, please contact us directly.

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

Options

- Heat exchanger
- Level switch
- Pressure transducer
- Return-line filter
- VP03 solenoid valves
- VMM series manual valves

Dimensions & options

ZW series

Product dimensions in inches [ \(\text{inches}\) ]

<table>
<thead>
<tr>
<th>Usable oil capacity</th>
<th>Modelo number</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>D1</th>
<th>E</th>
<th>H</th>
<th>lbs</th>
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<td>ZWxx08xx</td>
<td>8.1</td>
<td>11.0</td>
<td>8.1</td>
<td>—</td>
<td>—</td>
<td>22.6</td>
<td>93</td>
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<tr>
<td>2.5</td>
<td>ZWxx10xx</td>
<td>6.1</td>
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<td>15.1</td>
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<td>11.0</td>
<td>23.6</td>
<td>107</td>
</tr>
<tr>
<td>5.0</td>
<td>ZWxx20xx</td>
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<td>16.6</td>
<td>19.7</td>
<td>19.2</td>
<td>15.6</td>
<td>24.6</td>
<td>134</td>
</tr>
<tr>
<td>10.0</td>
<td>ZWxx40xx</td>
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<td>22.7</td>
<td>22.5</td>
<td>18.9</td>
<td>28.1</td>
<td>184</td>
</tr>
</tbody>
</table>

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

www.enerpacwh.com
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 5000 psi hydraulic pressure, are highly suitable for production tooling applications – offering the optimum in terms of compact size for required oil flow and pressure rating and customization to your specific needs.

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

Customize to your needs
- Various models including electric controls and pressure switch
- Stackable to 8 VP-series valve stations high
- Customer adjustable relief valve
- Glycerine dampened pressure gauge G-2517L on pumps with VP-series valves
- 230/460/3/50/60 Hz 1.5 hp motor

**Product selection**

<table>
<thead>
<tr>
<th>Oil flow rate</th>
<th>Pressure range</th>
<th>Voltage and current 60Hz</th>
<th>Usable oil capacity</th>
<th>Valve models included</th>
<th>Model number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>in³/min</td>
<td>psi</td>
<td>V</td>
<td>@</td>
<td>A</td>
<td>gal.</td>
</tr>
<tr>
<td>120</td>
<td>1450-5000</td>
<td>230</td>
<td>@</td>
<td>4.8</td>
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</tr>
<tr>
<td>120</td>
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<td>460</td>
<td>@</td>
<td>2.4</td>
<td>2.5</td>
</tr>
<tr>
<td>120</td>
<td>1450-5000</td>
<td>230</td>
<td>@</td>
<td>4.8</td>
<td>2.5</td>
</tr>
<tr>
<td>120</td>
<td>1450-5000</td>
<td>460</td>
<td>@</td>
<td>2.4</td>
<td>2.5</td>
</tr>
<tr>
<td>120</td>
<td>1450-5000</td>
<td>230</td>
<td>@</td>
<td>4.8</td>
<td>2.5</td>
</tr>
<tr>
<td>120</td>
<td>1450-5000</td>
<td>460</td>
<td>@</td>
<td>2.4</td>
<td>2.5</td>
</tr>
<tr>
<td>120</td>
<td>1450-5000</td>
<td>230</td>
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<td>4.8</td>
<td>2.5</td>
</tr>
<tr>
<td>120</td>
<td>1450-5000</td>
<td>460</td>
<td>@</td>
<td>2.4</td>
<td>2.5</td>
</tr>
</tbody>
</table>

▼ Isolating valve is pressure switch PSCK-8.
* ZWS-series pumps comes standard with 2 gallon reservoir. (1, 2, 5 or 10 gallon reservoir is optional).
**Dimensions & options**

**ZW5-series**

Shown: ZWS211SEE100 with standard 10 litres reservoir

---

**Product selection**

<table>
<thead>
<tr>
<th>Pump series</th>
<th>Voltage</th>
<th>Phase</th>
<th>Continuous operation at 5000 psi</th>
<th>Motor capacity</th>
<th>Motor speed</th>
<th>Motor protection class</th>
<th>Sound Level</th>
</tr>
</thead>
<tbody>
<tr>
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<td>1725</td>
<td>IP54</td>
<td>75</td>
</tr>
<tr>
<td>ZWS......</td>
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<td>3</td>
<td>50%</td>
<td>1.5</td>
<td>1725</td>
<td>IP54</td>
<td>75</td>
</tr>
</tbody>
</table>

**Options**

- **VP-series, modular valves**
- **VFC-3 flow control valve (VP series)**
- **Pressure switches**
- **Hoses and couplers**
- **High-pressure filters**
- **Fittings**

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**Valve options**

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

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See page 141 for VP03-series valves and available options.
ZW5 series
These advanced workholding pumps, operating at maximum 5000 psi 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.

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

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

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

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

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

ZW5111SEE100 For 1x Double-Acting circuit and Isolating Valve for A-port
ZW5141SEE100 For 2x Single-Acting circuits
ZW5VPSEE100 with manifold for VP-series or CETOP 03 valves, without electric controls and gauge
Application example
Building the right workholding system for a specific production tooling requirement is best achieved by observing the Basic System Set-up in our “Yellow Pages” (202).
**Hand pumps**

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

**P series**

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

**SP-621 Screw pump**

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

**Product selection**

<table>
<thead>
<tr>
<th>Maximum pressure</th>
<th>Usable oil capacity</th>
<th>Model number</th>
<th>Pressure rating</th>
<th>Oil volume per stroke</th>
<th>Piston stroke</th>
<th>Maximum handle effort</th>
<th>Dimensions (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>psi</td>
<td>in³</td>
<td></td>
<td>1st stage</td>
<td>2nd stage</td>
<td>1st stage</td>
<td>2nd stage</td>
<td>A</td>
</tr>
<tr>
<td>3000</td>
<td>6.2</td>
<td>SP-621</td>
<td>–</td>
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<td>–</td>
<td>.25</td>
<td>1.00</td>
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<tr>
<td>3000</td>
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<td>P-51</td>
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<td>10,000</td>
<td>–</td>
<td>.055</td>
<td>.50</td>
</tr>
<tr>
<td>10,000</td>
<td>20</td>
<td>P-141</td>
<td>–</td>
<td>10,000</td>
<td>–</td>
<td>.055</td>
<td>.50</td>
</tr>
</tbody>
</table>

**Flow:** .055–.25 in³/stroke

**Pressure:** 3000–10,000 psi

**Reservoir:** 6.2–55 in³

**Important**

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

1) Handle travel of SP-621 is 2.50 inches; 25 handle rotations displace 6.2 in³ of oil.

2) Handle effort on SP-621 is 60 ft.lbs at 3000 psi.
Air Powered Pump with Manual Valve

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

Air Powered Pump with Dual Solenoid Valves

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

Electric Pump with Dual Solenoid Valves

This system uses a ZW3020HB-FT12 electric pump and two VP-11 solenoid valves to control two independent fixture circuits with double acting swing clamps and work supports. Flow controls mounted in the valves provide control of the cylinder actuation speed. Pressure switches on the “clamp” circuit can provide confirmation of clamping pressure. Sequence valves delay the actuation of the work supports until the swing clamps are clamped.
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

Controlling the operation of your clamping system requires the use of many specialized directional, pressure and flow control valves. Enerpac has the complete line of valving components to complement any hydraulic system. Choose from either manual or electric directional valves, and a wide variety of pressure control, flow control and specialty valves to provide the control and automation that your application needs.
<table>
<thead>
<tr>
<th>Topic</th>
<th>Code</th>
<th>Page(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solenoid modular poppet valve</td>
<td>VP</td>
<td>136</td>
</tr>
<tr>
<td>Pressure switches, Flow control valve</td>
<td>PSCK VFC</td>
<td>137</td>
</tr>
<tr>
<td>Pressure reducing valve</td>
<td>PRV</td>
<td>138, 154</td>
</tr>
<tr>
<td>Tie rod kits, Remote/porting manifolds</td>
<td>TRK WM/PB</td>
<td>139</td>
</tr>
<tr>
<td>Solenoid/Air operated 2-position poppet valves</td>
<td>VA, VS, VD</td>
<td>140</td>
</tr>
<tr>
<td>Solenoid poppet, D03/CETOP3</td>
<td>VP03</td>
<td>141</td>
</tr>
<tr>
<td>Solenoid D03 spool valves and accessories</td>
<td>VE</td>
<td>142</td>
</tr>
<tr>
<td>Manual, D03/CETOP3 valves</td>
<td>VMM VMT</td>
<td>143</td>
</tr>
<tr>
<td>Valve manifolds</td>
<td>MB</td>
<td>144</td>
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<tr>
<td>Solenoid modular valves</td>
<td>VE</td>
<td>146 - 147</td>
</tr>
<tr>
<td>3-Way directional manual control valves</td>
<td>V</td>
<td>148 - 149</td>
</tr>
<tr>
<td>4-Way directional manual control valves</td>
<td>V</td>
<td>150 - 151</td>
</tr>
<tr>
<td>Sequence valves</td>
<td>MVP WVP, V</td>
<td>152</td>
</tr>
<tr>
<td>Pilot operated check valves</td>
<td>MV, V</td>
<td>153</td>
</tr>
<tr>
<td>Flow control valves</td>
<td>VFC</td>
<td>155</td>
</tr>
<tr>
<td>Accessory valves</td>
<td>MH, HV PLV, V</td>
<td>156 - 157</td>
</tr>
<tr>
<td>Air valves and accessories</td>
<td>V, VA, VAS, VR, RFL, QE</td>
<td>158 - 159</td>
</tr>
</tbody>
</table>
Solenoid modular poppet valves

Solenoid directional valves
- Dual poppet valve design for zero internal leakage
- Inlet check-valve standard
- High cycle switching
- Stackable to 8 valve stations high
- 250-5000 psi operational pressure
- Oil flow capacity 427 in³/min @ 5000 psi
- Oil flow capacity 915 in³/min @ 0 psi
- G1/4" oil connections and integrated filtration
- 24 VDC and 110 VAC available

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

Options
- WM-10 series manifolds
- Tie rod kits

Product selection

<table>
<thead>
<tr>
<th>Voltage @ current</th>
<th>Model number</th>
<th>Flow path</th>
<th>Used with cylinder(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>at 50/60 Hz</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- 4/3 Closed center
  - 24 VDC @ 1.13 A
    - VP-11: 1x Dbl-act.
    - VP-12: 1x Dbl-act.
  - 110 VAC @ 500 mA
    - VP-11: 1x Dbl-act.
    - VP-12: 1x Dbl-act.

- 4/3 Float center
  - 24 VDC @ 1.13 A
    - VP-21: 1x Dbl-act.
    - VP-22: 1x Dbl-act.
  - 110 VAC @ 500 mA
    - VP-21: 1x Dbl-act.
    - VP-22: 1x Dbl-act.

- 3/2 Normally closed
  - 24 VDC @ 1.13 A
    - VP-31: 1x Dbl-act. / 2x Sgl-act.
    - VP-32: 1x Dbl-act. / 2x Sgl-act.
  - 110 VAC @ 500 mA
    - VP-31: 1x Dbl-act. / 2x Sgl-act.
    - VP-32: 1x Dbl-act. / 2x Sgl-act.

- 3/2 Normally open
  - 24 VDC @ 1.13 A
    - VP-41: 1x Dbl-act. / 2x Sgl-act.
    - VP-42: 1x Dbl-act. / 2x Sgl-act.
  - 110 VAC @ 500 mA
    - VP-41: 1x Dbl-act. / 2x Sgl-act.
    - VP-42: 1x Dbl-act. / 2x Sgl-act.

- 3/2 1 port normally closed, 1 port normally open
  - 24 VDC @ 1.13 A
    - VP-51: 1x Dbl-act. / 2x Sgl-act.
    - VP-52: 1x Dbl-act. / 2x Sgl-act.
  - 110 VAC @ 500 mA
    - VP-51: 1x Dbl-act. / 2x Sgl-act.
    - VP-52: 1x Dbl-act. / 2x Sgl-act.

Note: DIN 43650 electrical connector included. Valve weight 6.5 lbs (3.0 kg.).
PSCK, VFC-series  Pressure switches, Flow control valve

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

Options

PB-1 Auxiliary block

Pressure reducing valves

Pressure: 5000 psi
Flow: 427 in³/min @ 5000 psi
Voltage: 115 VAC, 24 VDC

PSCK-8, 9

PSCK-8, 9 mounting dimensions

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

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

<table>
<thead>
<tr>
<th>Solenoid voltage @ current</th>
<th>Model number</th>
<th>Hydraulic scheme</th>
<th>Pressure range</th>
<th>Deadband</th>
<th>Maximum oil flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>at 50/60 Hz</td>
<td></td>
<td></td>
<td>psi</td>
<td>psi</td>
<td>in³/min</td>
</tr>
</tbody>
</table>

Pressure switch

- 24 VDC @ 2 A: PSCK-8
  - 1450 - 5000 psi
  - 261 - 501 psi
  - 427 in³/min

Pressure switch

- 24 VDC @ 2 A: PSCK-9
  - 290 - 3045 psi
  - 87 - 218 psi
  - 427 in³/min

Flow control valve

- Screw-in throttle valve: VFC-3
  - 0-5000 psi
  - – psi
  - 427 in³/min

www.enerpacwh.com
Pressure reducing valves

Precise control of hydraulic pressure

- Stackbuilding with VP series modular valves
- Stackable for multiple pressures on one valve stack assembly
- Tool adjustable knob can be locked
- Precise control of pressure

**PRV series**

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

**Application**

Used when a hydraulic supply with a higher pressure (primary side) must also be used for another circuit with a lower pressure (secondary circuit). PRV-1 can be stack built between VP-series valves.

**Product selection**

<table>
<thead>
<tr>
<th>Mounting style</th>
<th>Adjustable pressure range</th>
<th>Maximum pressure</th>
<th>Model number</th>
<th>Oil ports</th>
<th>Maximum oil flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>VP-series</td>
<td>435 - 4350 psi</td>
<td>5000 psi</td>
<td>PRV-1</td>
<td>G1/4&quot;</td>
<td>427 in³/min</td>
</tr>
<tr>
<td>VP-series</td>
<td>75 - 2000 psi</td>
<td>5000 psi</td>
<td>PRV-5</td>
<td>G1/4&quot;</td>
<td>427 in³/min</td>
</tr>
</tbody>
</table>

**Options**

- **VP-Modular valves**
- **Pressure switches**
- **Tie rod kits**

**Valve stacking example**

PRV-1 connected with remote manifold WM-10.
TRK, WM/PB-series Tie rod kits, Remote/porting manifolds

**Simplifies valve and accessory mounting**

**TRK-series tie rods**
- Connects 1 to 8 VP-series valves station high
- Provide leak-free sealing valves
- G1/4" oil connection

**WM-10 remote manifold**
- Allows remote VP-series valve mounting
- Adjustable relief valve incorporated
- G1/4" oil connection

**PB-1 porting manifold**
- Provide 3 auxiliary pressure lines
- G1/4" oil connection

---

**Options**

**Pressure switches**

- TRK-series

**VP-series directional valves**

- WM-10
- PB-1

---

**Gauges**

- TRK-series

---

**Product selection**

<table>
<thead>
<tr>
<th>Quantity of stackable VP-series directional valves</th>
<th>Model number</th>
<th>Tie rod length</th>
<th>Mounting thread</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1</strong></td>
<td>TRK-1</td>
<td>3.45 inch</td>
<td>M6</td>
</tr>
<tr>
<td>2</td>
<td>TRK-2</td>
<td>4.92 inch</td>
<td>M6</td>
</tr>
<tr>
<td>3</td>
<td>TRK-3</td>
<td>6.50 inch</td>
<td>M6</td>
</tr>
<tr>
<td>4</td>
<td>TRK-4</td>
<td>8.07 inch</td>
<td>M6</td>
</tr>
<tr>
<td>5</td>
<td>TRK-5</td>
<td>9.65 inch</td>
<td>M6</td>
</tr>
<tr>
<td>6</td>
<td>TRK-6</td>
<td>11.22 inch</td>
<td>M6</td>
</tr>
<tr>
<td>7</td>
<td>TRK-7</td>
<td>12.80 inch</td>
<td>M6</td>
</tr>
<tr>
<td>8</td>
<td>TRK-8</td>
<td>14.37 inch</td>
<td>M6</td>
</tr>
</tbody>
</table>

---

**Product selection**

<table>
<thead>
<tr>
<th>Oil ports</th>
<th>Model number</th>
<th>Hydraulic schematic</th>
<th>Maximum pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>BSPP</td>
<td>WM-10</td>
<td></td>
<td>5000 psi</td>
</tr>
<tr>
<td>3x G1/4&quot;</td>
<td>PB-1</td>
<td></td>
<td>5000 psi</td>
</tr>
</tbody>
</table>

---

**TRK-series**

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

---

**WM-10**

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

---

**PB-1**

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

---

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

---

www.enerpacwh.com
Zero leakage poppet valves increase efficiency

- Poppet valve design for zero leakage
- 4-way, 2-position float offset or normally open
- D03 or CETOP3 mounting pattern
- DIN-standard rectifier plugs for easy connection to power source
- Air operated models eliminate need for electricity
- Including O-rings and mounting bolts
- SAE manifold ports simplify plumbing
- Inline check valve provides positive load holding

**Application**

Advance and retract for single- and double-acting cylinders. The valves require check valves for positive load holding and can be installed for the same independent operation with single-acting cylinders by blocking the B port.

**Solenoid and air piloted directional control valves.** Poppet design for zero leakage promote system efficiency. Increases the life of your workholding pump by decreasing internal valve leakage.

**Options**

- **D03 Manifolds**
- **MB-series**
- **Fittings**

**Important**

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

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

**Product selection**

| Valve flow path | Solenoid voltage @ current | Model number | Pressure range | Pressure drop 0 | Max. flow
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Solenoid poppet valves – Normally open</td>
<td></td>
<td></td>
<td>psi</td>
<td>psi</td>
<td>in³/min</td>
</tr>
<tr>
<td>4-way, 2 position</td>
<td>60-100 psi max.</td>
<td>VAS-0710D</td>
<td>0-5000</td>
<td>180</td>
<td>690</td>
</tr>
<tr>
<td>4-way, 2 position</td>
<td>24VDC @ 1.60 A</td>
<td>VSS-1410D</td>
<td>0-5000</td>
<td>180</td>
<td>690</td>
</tr>
<tr>
<td>4-way, 2 position</td>
<td>115VAC @ .40 A</td>
<td>VSS-2210D</td>
<td>0-5000</td>
<td>180</td>
<td>690</td>
</tr>
<tr>
<td>Solenoid poppet valves – Normally closed</td>
<td></td>
<td></td>
<td>psi</td>
<td>psi</td>
<td>in³/min</td>
</tr>
<tr>
<td>4-way, 2 position</td>
<td>60-100 psi max.</td>
<td>VAT-0710D</td>
<td>0-5000</td>
<td>180</td>
<td>690</td>
</tr>
<tr>
<td>4-way, 2 position</td>
<td>24VDC @ 1.60 A</td>
<td>VST-1410D</td>
<td>0-5000</td>
<td>180</td>
<td>690</td>
</tr>
<tr>
<td>4-way, 2 position</td>
<td>115VAC @ .40 A</td>
<td>VST-2210D</td>
<td>0-5000</td>
<td>180</td>
<td>690</td>
</tr>
<tr>
<td>Inline check valve</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1) Pressure drop from P-A or P-B at maximum oil flow of 690 in³/min.
VP03-series

Solenoid poppet valves

VP03 Directional Valves and accessories
- D03/CETOP 3 mounting pattern
- Directional valves
- Pilot operated check valve
- Dual flow control
- Pressure reducing valve

Options

D03 Manifolds MB-series

Fittings

VP03-series

VP03 valves are zero leakage, solenoid operated poppet valves.

Application

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

Important

VP03 series valves are zero leakage and can be used with pressure shut down electric pumps and air driven Turbo II pumps.

VP03-11 valve on PASG-3002SB Turbo pump.

Product selection

<table>
<thead>
<tr>
<th>Valve flow path</th>
<th>Solenoid voltage 50/60 hz</th>
<th>Model number</th>
<th>Hydraulic symbol</th>
<th>Pressure range</th>
<th>Maximum oil flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-position/4 way, Closed center</td>
<td>24 VDC</td>
<td>VP03-11</td>
<td>0-5000</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>3-position/4 way, Float center</td>
<td>110 VAC</td>
<td>VP03-12</td>
<td>0-5000</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>3-position/4 way, Closed center</td>
<td>24 VDC</td>
<td>VP03-21</td>
<td>0-5000</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>3-position/4 way, Float center</td>
<td>110 VAC</td>
<td>VP03-22</td>
<td>0-5000</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>2-position/4 way</td>
<td>24 VDC</td>
<td>VP03-51</td>
<td>0-3626</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>2-position/4 way</td>
<td>110 VAC</td>
<td>VP03-52</td>
<td>0-3626</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Dual flow control</td>
<td>-</td>
<td>VFC-4</td>
<td>0-5000</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Dual pilot operated check valve</td>
<td>-</td>
<td>VD2P</td>
<td>0-5000</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Pressure reducing valve</td>
<td>-</td>
<td>PRV-6</td>
<td>435-4350</td>
<td>3.2</td>
<td></td>
</tr>
<tr>
<td>Pressure reducing valve</td>
<td>-</td>
<td>PRV-7</td>
<td>75-2000</td>
<td>1.6</td>
<td></td>
</tr>
</tbody>
</table>
Solenoid spool valves, D03/CETOP3

D03 Direction Valve and accessories
- D03 mounting pattern
- Directional valves
- Pilot operated check valve
- Dual flow control
- Pressure reducing valve

Important

To hold the pressure in a clamping circuit, use the VEX11 valve with the VD2P check module. Do not use D03 spool valves with pressure shutdown pumps.

Product selection

<table>
<thead>
<tr>
<th>Valve flow path</th>
<th>Solenoid voltage 50/60 hz</th>
<th>Model number</th>
<th>Hydraulic symbol</th>
<th>Pressure range psi</th>
<th>Pressure drop psi</th>
<th>Maximum oil flow gpm</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-position/4 way</td>
<td>24 VDC</td>
<td>VEW-11</td>
<td></td>
<td>0-5000</td>
<td>125</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>1.32 Amps</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-position/4 way,</td>
<td>24 VDC</td>
<td>VET-11</td>
<td></td>
<td>0-5000</td>
<td>150</td>
<td>8</td>
</tr>
<tr>
<td>Closed center</td>
<td>1.32 Amps</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-position/4 way,</td>
<td>24 VDC</td>
<td>VEX-11</td>
<td></td>
<td>0-5000</td>
<td>165</td>
<td>8</td>
</tr>
<tr>
<td>Float center</td>
<td>1.32 Amps</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dual flow control</td>
<td>–</td>
<td>VFC-4</td>
<td></td>
<td>0-5000</td>
<td>–</td>
<td>10</td>
</tr>
<tr>
<td>Dual pilot operated check valve</td>
<td>–</td>
<td>VD2P</td>
<td></td>
<td>0-5000</td>
<td>200</td>
<td>15</td>
</tr>
<tr>
<td>Pressure reducing valve</td>
<td>–</td>
<td>PRV-6, PRV-7</td>
<td></td>
<td>435-4350</td>
<td>–</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>75-2000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

VE-series

Spool style solenoid valves and control modules are used in circuits that do not require zero leakage.

Application

Used to control the advance and retract of single acting and double acting cylinders. The dual check valve can be used to lock pressure in a group of cylinders. The dual flow control offers independent control of cylinder advance and retract speeds. The pressure reducing valve sets a circuit pressure lower than the main pump pressure.
VMM, VMT-serie

Manual Control of Single and Double-Acting Cylinders

- Near zero leakage pressure seal design
- 4-way, 3-position
- Detented handle positions
- Low handle effort 12 lbs, even at full pressure
- Handle can be repositioned for side by side valve mounting
- Compact size for directly mounting on fixture for individual circuit control
- D03/CETOP 3 mounting pattern

Options

VD1P, Inline check valve

D03 Manifolds

Hoses and couplers

Fittings

Important

For multiple circuit applications, the VD1P inline check valve is recommended to prevent pressure drop on the holding circuit. See page 145 for mounting bolt information.

Pressure on return side (tank) should not exceed 250 psi.

Product selection

<table>
<thead>
<tr>
<th>Valve mounting pattern</th>
<th>Mounting bolts included</th>
<th>Oil ports</th>
<th>Model number</th>
<th>Hydraulic symbol</th>
<th>Pressure range</th>
<th>Pressure drop</th>
<th>Max. oil flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panel mtg.</td>
<td>–</td>
<td>SAE #4</td>
<td>VMTD-001</td>
<td>4-way, 3-position</td>
<td>0-5000</td>
<td>70</td>
<td>1040</td>
</tr>
<tr>
<td>D03/CETOP 3</td>
<td>#10-24UN</td>
<td>–</td>
<td>VMMD-001</td>
<td></td>
<td>0-5000</td>
<td>70</td>
<td>1040</td>
</tr>
<tr>
<td>Panel mtg.</td>
<td>–</td>
<td>SAE #4</td>
<td>VMTD-003</td>
<td></td>
<td>0-5000</td>
<td>70</td>
<td>1040</td>
</tr>
<tr>
<td>D03/CETOP 3</td>
<td>#10-24UN</td>
<td>–</td>
<td>VMMD-003</td>
<td></td>
<td>0-5000</td>
<td>70</td>
<td>1040</td>
</tr>
</tbody>
</table>

Pressure drop from P-A or P-B at maximum oil flow of 1040 in³/min.

Seal material: Buna-N, Polyurethane.

Enerpac WH

www.enerpacwh.com
When independent control of multiple cylinders is required

- Multi-station manifolds with SAE or CETOP 3 porting – minimizes plumbing
- Mounting patterns for: VSS/VST Valves (D03 or CETOP 3); VE Valves (D03 or CETOP 3); VP03 Valves (D03 or CETOP 3); VMMD Valves (D03 or CETOP 3)
- Manifolds allow use of accessories, such as pressure switches and gauges

**Important**

Use MC-1 (D03) / MC-3 (CETOP 3) cover plates to seal non-used manifold stations.

Each non-used valve station on manifolds must be sealed with MC-1 cover plate.

**Product selection**

<table>
<thead>
<tr>
<th>Valve mounting pattern</th>
<th>Number of valve stations</th>
<th>Model number</th>
<th>Oil ports cover plate</th>
<th>Coverplate model number</th>
<th>Manifold in lbs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Single station manifold</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D03</td>
<td>1</td>
<td>MB-1</td>
<td>SAE #4</td>
<td>-</td>
<td>1.0</td>
</tr>
<tr>
<td>CETOP 3</td>
<td>1</td>
<td>MB-12</td>
<td>G1/4*</td>
<td>-</td>
<td>1.0</td>
</tr>
<tr>
<td><strong>Multiple station manifolds</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D03</td>
<td>2</td>
<td>MB-2</td>
<td>SAE #8</td>
<td>MC-1</td>
<td>4.75</td>
</tr>
<tr>
<td>CETOP 3</td>
<td>2</td>
<td>MB-22</td>
<td>G3/8*</td>
<td>MC-3</td>
<td>4.75</td>
</tr>
<tr>
<td>D03</td>
<td>4</td>
<td>MB-4</td>
<td>SAE #8</td>
<td>MC-1</td>
<td>8.75</td>
</tr>
<tr>
<td>CETOP 3</td>
<td>4</td>
<td>MB-42</td>
<td>G3/8*</td>
<td>MC-3</td>
<td>8.75</td>
</tr>
</tbody>
</table>

*Note: - MC-1 manifold cover plate must be ordered separately. Includes gasket and mounting bolts.
Use Stud Bolt Kits to assure the correct bolt length
- Studs are easily cut to length
- Stud nuts make installation easier
- Pre-mount the studs into the manifold to help guide the valve components into place

**Important**

The mounting stud must project into the manifold a minimum of .375” (9,5 mm). After installation, torque the stud nuts to 45 in-lbs (5 Nm).

To calculate the required stud length, add the stud length for the directional valve and each accessory module used in the valve stack. Add .78” (19,81 mm) to this length. The mounting studs should be cut to this total length.

**Example**

<table>
<thead>
<tr>
<th>Description</th>
<th>Model number</th>
<th>Stud Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Directional valve</td>
<td>VP03-11</td>
<td>1.87 in 47,49 mm</td>
</tr>
<tr>
<td>Dual flow control</td>
<td>VFC-4</td>
<td>1.57 in 39,88 mm</td>
</tr>
<tr>
<td>Dual P.O. check</td>
<td>VD2P</td>
<td>1.57 in 39,88 mm</td>
</tr>
<tr>
<td>Stud nut</td>
<td>VD2P</td>
<td>0.40 in 10,16 mm</td>
</tr>
<tr>
<td>Manifold</td>
<td>V-19</td>
<td>0.38 in 9,65 mm</td>
</tr>
<tr>
<td>Total length:</td>
<td></td>
<td>5.79 in 147,06 mm</td>
</tr>
</tbody>
</table>

**Product selection**

<table>
<thead>
<tr>
<th>Description</th>
<th>Model number</th>
<th>Stud Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Imperial stud kit (#10-24)*</td>
<td>B KD71</td>
<td>7.00 in 177,80 mm</td>
</tr>
<tr>
<td>Metric stud kit (M5)*</td>
<td>B KD72</td>
<td>—</td>
</tr>
<tr>
<td>Stud Nut</td>
<td>B KD71, B KD72</td>
<td>0.40 in 10,16 mm</td>
</tr>
<tr>
<td>Manifold</td>
<td>MB1, MB2, MB3</td>
<td>0.38 in 9,65 mm</td>
</tr>
<tr>
<td>Solenoid valve</td>
<td>VAS/VSS/VST</td>
<td>1.63 in 41,40 mm</td>
</tr>
<tr>
<td>Solenoid valve</td>
<td>VEW/VET/VEX</td>
<td>1.25 in 31,75 mm</td>
</tr>
<tr>
<td>Solenoid valve</td>
<td>VP03</td>
<td>1.87 in 47,49 mm</td>
</tr>
<tr>
<td>Manual valve</td>
<td>VMMD001/VMMD003</td>
<td>1.13 in 28,70 mm</td>
</tr>
<tr>
<td>Pressure Reducing Valve</td>
<td>PRV6/PRV7</td>
<td>1.57 in 39,88 mm</td>
</tr>
<tr>
<td>Check valve, on “P”</td>
<td>VD1P</td>
<td>1.57 in 39,88 mm</td>
</tr>
<tr>
<td>Dual P.O. check valve</td>
<td>VD2P</td>
<td>1.57 in 39,88 mm</td>
</tr>
<tr>
<td>Dual flow control</td>
<td>VFC-4</td>
<td>1.57 in 39,88 mm</td>
</tr>
</tbody>
</table>

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

www.enerpacwh.com
Unmatched combination of possibilities

- Relief valve and pilot-operated check accessory valves are stackable eliminating external plumbing
- Remote and pump mounting
- Mounting bolts included with each modular valve

Select the required valve flow path

**VE-series**

Solenoid modular valves are especially well suited for workholding and production applications. With 11 possible flowpaths and 2 manifolds, for either Enerpac’s submerged pump or a remote NPT mount, you can “custom build” a valve for almost any application.

**Application**

Ideal when mounted on remote manifold for applications where independent control of multiple cylinders is required.

<table>
<thead>
<tr>
<th>Valve flow path</th>
<th>For cylinder</th>
<th>Valve code</th>
<th>Hydraulic symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>▼ 2-way, 2-position (2/2)</td>
<td>Normally closed</td>
<td>Unloading</td>
<td>VEH</td>
</tr>
<tr>
<td></td>
<td>Normally open</td>
<td>Unloading</td>
<td>VEK</td>
</tr>
<tr>
<td>▼ 3-way, 2-position (3/2)</td>
<td>Normally open</td>
<td>Single-acting</td>
<td>VEP</td>
</tr>
<tr>
<td>▼ 3-way, 3-position (3/3)</td>
<td>Tandem center</td>
<td>Single-acting</td>
<td>VEF</td>
</tr>
<tr>
<td></td>
<td>Closed center</td>
<td>Single-acting</td>
<td>VEG</td>
</tr>
<tr>
<td>▼ 4-way, 2-position (4/2)</td>
<td>Crossover offset</td>
<td>Double-acting</td>
<td>VEE</td>
</tr>
<tr>
<td></td>
<td>Float offset</td>
<td>Double-acting</td>
<td>VEM</td>
</tr>
<tr>
<td>▼ 4-way, 3-position (4/3)</td>
<td>Open center</td>
<td>Double-acting</td>
<td>VEA</td>
</tr>
<tr>
<td></td>
<td>Closed center</td>
<td>Double-acting</td>
<td>VEB</td>
</tr>
<tr>
<td></td>
<td>Tandem center</td>
<td>Double-acting</td>
<td>VEC</td>
</tr>
<tr>
<td></td>
<td>Float center</td>
<td>Double-acting</td>
<td>VED</td>
</tr>
</tbody>
</table>

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

Product specfications

<table>
<thead>
<tr>
<th>Pressure range</th>
<th>Maximum oil flow</th>
<th>Voltage @ Hz</th>
<th>Amperage draw</th>
</tr>
</thead>
<tbody>
<tr>
<td>psi</td>
<td>in³/min</td>
<td></td>
<td>Amps</td>
</tr>
<tr>
<td>0-10,000</td>
<td>920</td>
<td>24 VDC @ 50/60 Hz</td>
<td>2.5</td>
</tr>
<tr>
<td>0-10,000</td>
<td>920</td>
<td>115 VAC @ 60 Hz</td>
<td>3.6</td>
</tr>
<tr>
<td>0-10,000</td>
<td>920</td>
<td>220/240 VAC @ 50 Hz</td>
<td>1.3/1.4</td>
</tr>
<tr>
<td>0-10,000</td>
<td>920</td>
<td>230 VAC @ 50 Hz</td>
<td>1.8</td>
</tr>
</tbody>
</table>

Note: Seal material: Buna-N, Polyurethane. DIN43650 Valve plug included on remote mounted valves.
**Custom build your modular valves**

**This is how a Solenoid Modular Valve Model Number is built up:**

**VEA - 1 5 600 - D**

1 **Modular valve code**
   
   A = 4/3 Open center  
   B = 4/3 Closed center  
   C = 4/3 Tandem center  
   D = 4/3 Float center  
   E = 4/2 Crossover offset  
   F = 3/3 Tandem center  
   G = 3/3 Closed center  
   H = 2/2 Normally closed  
   K = 2/2 Normally open  
   M = 4/2 Float offset  
   P = 3/2 Normally open

2 **Oil flow capacity**
   
   1 = 920 in³ per minute

3 **Solenoid voltage**
   
   1 = 24 VDC, 50 / 60 Hz  
   2 = 230 V, 1 ph, 50 Hz  
   5 = 115 V, 1 ph, 60 Hz  
   6 = 230 V, 1 ph, 60 Hz

4 **Accessory valves**
   
   000 = No accessory valves  
   100 = VS-11 Relief valve only  
   150 = VS-11 Relief valve and check valve VEF/VEG only  
   160 = VS-11 Relief valve and VS-61 4-way pilot operated check valve VEA/VEB/VEC/VED only  
   500 = VS-51 3-way pilot operated check valve VEF/VEG only  
   600 = VS-61 4-way pilot operated check valve VEA/VEB/VEC/VED only

5 **Manifold**
   
   A = No manifold  
   B = Remote mounted manifold  
   D = Pump mounted manifold VEA/VRC/VEC only

**Example**

The VEA-15600-D is a modular valve with a 4-way, 3-position open center flowpath, 115 VAC, and an integrated pilot-operated check valve, for mounting on an Enerpac pump. Bolt Kit BK-2 is included.

---

**Dimensions & options VE-series**

- Pressure: 0–10,000 psi
- Flow max.: 920 in³/min
- Voltage: 24, 115, 230 V

**Options**

- Gauges and accessories
- Fittings

**Accessory Valves and Bolt Kits**

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

Use VS-51 3-way pilot operated check valve to convert 3-way VE-valve into load-holding valve.

Use VS-61 4-way pilot operated check valve to convert 4-way VE-valve into load-holding valve.

To install accessory valves to stack build modular valves use bolt kits:  

- BK-2 for 1 VS valve;  
- BK-3 for 2 VS valves.
3-way directional manual control valves

Reliable control of single-acting cylinders

- Directional control valves provide advance/hold/retract operation for use with single-acting cylinders
- Remote or pump mounting on most Enerpac pumps
- Return line kit included with remote valves
- Available “locking” option on VC and VM-series valves for load-holding applications

Select the required center position

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

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

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

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

Product selection

<table>
<thead>
<tr>
<th>Valve type</th>
<th>Valve mounting location</th>
<th>Model number</th>
<th>Hydraulic symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manual 3-way, 2-position (3/2)</td>
<td>- Pump</td>
<td>VM-2</td>
<td></td>
</tr>
<tr>
<td>Manual 3-way, 3-position (3/3)</td>
<td>Tandem center</td>
<td>Pump</td>
<td>VM-3</td>
</tr>
<tr>
<td></td>
<td>Tandem center</td>
<td>Remote</td>
<td>VC-3</td>
</tr>
<tr>
<td>Manual 3-way, 3-position (3/3)</td>
<td>Tandem center, locking</td>
<td>Pump</td>
<td>VM-3L</td>
</tr>
<tr>
<td></td>
<td>Tandem center, locking</td>
<td>Remote</td>
<td>VC-3L</td>
</tr>
<tr>
<td></td>
<td>Closed center, Remote</td>
<td>Remote</td>
<td>VC-15</td>
</tr>
<tr>
<td></td>
<td>Closed center, locking</td>
<td>Remote</td>
<td>VC-15L</td>
</tr>
</tbody>
</table>

V-series
Manual operated 3-way, 2-position and 3-way, 3-position directional control valves for operation of single-acting cylinders. Remote mount valves include return line kit for connecting the valves to pump reservoir.

Application
Pump mounted valves provide centralized control of pump output for cylinder cycling. Remote mounted at any convenient point along the system where control of cylinders is needed.

Shown: VM-2, VM-3

Four VC-15 Enerpac manual valves mounted on fixture to give independent control of several hydraulic circuits.
### Product specifications

<table>
<thead>
<tr>
<th>Model number</th>
<th>Pressure range</th>
<th>Used for cylinder</th>
<th>Schematic flowpath</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>psi</td>
<td>lbs</td>
<td>Advance</td>
</tr>
<tr>
<td>VM-2</td>
<td>0-10,000</td>
<td>Single-acting</td>
<td>A</td>
</tr>
<tr>
<td>VM-3</td>
<td>0-10,000</td>
<td>Single-acting</td>
<td>A</td>
</tr>
<tr>
<td>VC-3</td>
<td>0-10,000</td>
<td>Single-acting</td>
<td>A</td>
</tr>
<tr>
<td>VM-3L</td>
<td>0-10,000</td>
<td>Single-acting</td>
<td>A</td>
</tr>
<tr>
<td>VC-3L</td>
<td>0-10,000</td>
<td>Single-acting</td>
<td>A</td>
</tr>
<tr>
<td>VC-15</td>
<td>0-10,000</td>
<td>Single-acting</td>
<td>A</td>
</tr>
<tr>
<td>VC-15L</td>
<td>0-10,000</td>
<td>Single-acting</td>
<td>A</td>
</tr>
</tbody>
</table>

**Options**

- Gauges and accessories
  - VM-2: 1.44
  - VM-3: 1.88
  - VC-3: 5.12
  - VC-3L: 5.25
  - VC-15: 1.12
  - VC-15L: 5.75
- Hoses and couplers
  - 3/8"-18NPT: 7.25
  - 1/4"-20UN: 5.69
- Fittings
  - 3/8"-18NPT: 5.75
  - 1/4"-20UN: 7.19

**Important**

For applications that require positive load holding, most VM and VC valves are available with pilot operated check valve. This option provides hydraulic locking of the load until valve is shifted into retract position.

To order this feature, place an “L” at the end of the model number.

---

**Locking Valves**

**Fitting help**

See Basic System Set-up and Valve information in our “Yellow Pages”.
4-way directional manual control valves

Reliable control of double-acting cylinders

- Directional control valves provide advance/hold/retract operation for use with double-acting or two single-acting cylinders
- Remote or pump mounting on most Enerpac pumps
- Return line kit included with remote valves
- Available “locking” option on VC and VM-series valves for load-holding applications

Select the required center position

**Non-locking**

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

**Closed center**

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

**Locking center**

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

**Tandem center**

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

Product selection

<table>
<thead>
<tr>
<th>Valve type</th>
<th>Valve mounting location</th>
<th>Model number</th>
<th>Hydraulic symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>▼ Manual 4-way, 3-position (4/3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tandem center</td>
<td>Pump</td>
<td>VM-4</td>
<td>![VM-4 Symbol]</td>
</tr>
<tr>
<td>Tandem center</td>
<td>Remote</td>
<td>VC-4</td>
<td>![VC-4 Symbol]</td>
</tr>
<tr>
<td>Tandem center, locking</td>
<td>Pump</td>
<td>VM-4L</td>
<td>![VM-4L Symbol]</td>
</tr>
<tr>
<td>Tandem center, locking</td>
<td>Remote</td>
<td>VC-4L</td>
<td>![VC-4L Symbol]</td>
</tr>
<tr>
<td>Closed center</td>
<td>Remote</td>
<td>VC-20</td>
<td>![VC-20 Symbol]</td>
</tr>
<tr>
<td>Closed center, locking</td>
<td>Remote</td>
<td>VC-20L</td>
<td>![VC-20L Symbol]</td>
</tr>
</tbody>
</table>
### Dimensions & options  

**V-series**  

- **Pressure:** 0-10,000 psi  
- **Flow max.:** 1040 in³/min  

#### Options

**Gauges and accessories**  

**Hoses and couplers**  

**Fittings**  

---

### Important

**Locking Valves**  

For applications that require positive load holding, most VM and VC valves are available with pilot operated check valve. This option provides hydraulic locking of the load until valve is shifted into retract position. To order this feature, place an “L” at the end of the model number.

---

### Product specifications

<table>
<thead>
<tr>
<th>Model number</th>
<th>Pressure range</th>
<th>Used for cylinder</th>
<th>Schematic flowpath</th>
<th>▶ Manual 4-way, 3-position (4/3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>VM-4</td>
<td>0-10,000</td>
<td>Double-acting</td>
<td>![VM-4 Diagram]</td>
<td>4.6</td>
</tr>
<tr>
<td>VC-4</td>
<td>0-10,000</td>
<td>Double-acting</td>
<td>![VC-4 Diagram]</td>
<td>6.4</td>
</tr>
<tr>
<td>VM-4L</td>
<td>0-10,000</td>
<td>Double-acting</td>
<td>![VM-4L Diagram]</td>
<td>8.6</td>
</tr>
<tr>
<td>VC-4L</td>
<td>0-10,000</td>
<td>Double-acting</td>
<td>![VC-4L Diagram]</td>
<td>10.3</td>
</tr>
<tr>
<td>VC-20</td>
<td>0-10,000</td>
<td>Double-acting</td>
<td>![VC-20 Diagram]</td>
<td>6.4</td>
</tr>
<tr>
<td>VC-20L</td>
<td>0-10,000</td>
<td>Double-acting</td>
<td>![VC-20L Diagram]</td>
<td>10.3</td>
</tr>
</tbody>
</table>

---

### Valves

**See Basic System Set-up and Valve information in our “Yellow Pages”.”**
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 slopped pin in or out. The pressure settings for the other models is adjusted by loosening the jam nut and turn the set screw to reach your setting.

Application

The sequence valves can be mounted in-line or fixture mounted using mounting bolts.

A typical application for the sequence valve would be to build pressure within work supports before the swing cylinders are applied to the supported part, to prevent deflection in the part.

Two WVP-5 sequence valves used in conjunction with Enerpac WCA-series Auto Coupler to provide system automation.

Pressure dependent sequence control

**MVPM-5, WVP-5, MVP-5**

- Direct accurate pressure setting
- Pressure setting between 500-5000 psi for secondary circuit is secured with lock nut
- Mounting holes on WVP-5, manifold mounting ports on MVPM-5
- MVP-5 features cartridge body

**V-2000**

- Direct accurate pressure setting
- Pressure setting between 200-2000 psi for secondary circuit
- Flag indicator appears everytime the valve is operated

Options

Gauges and accessories

<table>
<thead>
<tr>
<th>MVPM-5, WVP-5</th>
<th>Pressure drop vs oil flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil flow (in³/min)</td>
<td>Pressure drop (psi)</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>30</td>
<td>72</td>
</tr>
<tr>
<td>60</td>
<td>147</td>
</tr>
<tr>
<td>90</td>
<td>220</td>
</tr>
<tr>
<td>120</td>
<td>290</td>
</tr>
<tr>
<td>150</td>
<td>360</td>
</tr>
<tr>
<td>180</td>
<td>430</td>
</tr>
<tr>
<td>210</td>
<td>500</td>
</tr>
<tr>
<td>240</td>
<td>570</td>
</tr>
<tr>
<td>270</td>
<td>640</td>
</tr>
<tr>
<td>300</td>
<td>710</td>
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<tr>
<td>330</td>
<td>780</td>
</tr>
<tr>
<td>360</td>
<td>850</td>
</tr>
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<td>390</td>
<td>920</td>
</tr>
<tr>
<td>420</td>
<td>990</td>
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<tr>
<td>450</td>
<td>1060</td>
</tr>
<tr>
<td>480</td>
<td>1130</td>
</tr>
<tr>
<td>510</td>
<td>1200</td>
</tr>
<tr>
<td>540</td>
<td>1270</td>
</tr>
<tr>
<td>570</td>
<td>1340</td>
</tr>
<tr>
<td>600</td>
<td>1410</td>
</tr>
<tr>
<td>630</td>
<td>1480</td>
</tr>
<tr>
<td>660</td>
<td>1550</td>
</tr>
</tbody>
</table>

**MVPM-5/WVP-5**

- Pressure drop vs oil flow
- Holes #2 and #3 are for model WVP-5
- Holes #1 through #4 are for model MVPM-5

Product selection

<table>
<thead>
<tr>
<th>Pressure adjustment range psi</th>
<th>Maximum pressure psi</th>
<th>Maximum oil flow in³/min</th>
<th>Model number</th>
<th>Oil ports</th>
<th>Opening pressure check valve A psi</th>
</tr>
</thead>
<tbody>
<tr>
<td>200-2000</td>
<td>5000</td>
<td>250</td>
<td>V-2000</td>
<td>1/8”-27 NPT</td>
<td>—</td>
</tr>
<tr>
<td>500-5000</td>
<td>5000</td>
<td>620</td>
<td>MVP-5</td>
<td>—</td>
<td>10</td>
</tr>
<tr>
<td>500-5000</td>
<td>5000</td>
<td>366</td>
<td>MVPM-5</td>
<td>G 1/4”</td>
<td>20</td>
</tr>
<tr>
<td>500-5000</td>
<td>5000</td>
<td>366</td>
<td>WVP-5</td>
<td>SAE #4</td>
<td>20</td>
</tr>
</tbody>
</table>

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

**Pilot operated check valves**

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

### MV and V-series

Pilot operated check valves check the oil flow with a built-in pilot circuit providing fast, automatic check-off for your workholding applications.

The pilot operated check valves with built-in accumulator help to maintain system pressure due to minor oil loss.

#### Application

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

### Options

**Fittings**

To order valve:

<table>
<thead>
<tr>
<th>Material</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>194</td>
<td></td>
</tr>
</tbody>
</table>

### Product selection

| Pilot ratio | Accumulator included | Maximum oil flow | Maximum pressure | Model number | Oil ports | Optional charging tool for ACL | Oil charging tool for ACL ||
|-------------|----------------------|------------------|------------------|--------------|----------|--------------------------------|--------------------------|
| 7:1         | –                    | 10 GPM           | 5000 psi         | V-72         | SAE #4   | –                              | –                        |
| 7:1         | ACL-22               | 10 GPM           | 5000 psi         | MV-722B      | G 1/4”   | WAT-2                           | 6.0                      |
| 7:1         | ACL-202              | 10 GPM           | 5000 psi         | MV-7202B     | G 1/4”   | WAT-2                           | 7.5                      |
| 7:1         | –                    | 10 GPM           | 5000 psi         | MVM-72       | G 1/4”   | –                              | 3.0                      |

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

### Product dimensions

**in inches**

<table>
<thead>
<tr>
<th>Model number</th>
<th>A (inch)</th>
<th>B (inch)</th>
<th>C (inch)</th>
<th>D (inch)</th>
<th>E (inch)</th>
<th>F (inch)</th>
<th>G (inch)</th>
<th>H (inch)</th>
<th>K (inch)</th>
<th>L (inch)</th>
<th>M (inch)</th>
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<tbody>
<tr>
<td>V-72</td>
<td>3.50</td>
<td>2.50</td>
<td>2.19</td>
<td>.28</td>
<td>2.88</td>
<td>1.13</td>
<td>SAE #4</td>
<td>1.25</td>
<td>2.00</td>
<td>2.88</td>
<td>–</td>
</tr>
<tr>
<td>MV-722B</td>
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<td>2.80</td>
<td>2.75</td>
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<td>2.88</td>
<td>1.12</td>
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<td>1.25</td>
<td>2.88</td>
<td>2.00</td>
<td>5.71</td>
</tr>
<tr>
<td>MV-7202B</td>
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<td>3.64</td>
<td>7.13</td>
<td>.28</td>
<td>2.88</td>
<td>1.12</td>
<td>G1/4&quot;</td>
<td>1.25</td>
<td>2.88</td>
<td>2.00</td>
<td>7.28</td>
</tr>
<tr>
<td>MVM-72</td>
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<td>2.50</td>
<td>1.50</td>
<td>.28</td>
<td>1.13</td>
<td>1.12</td>
<td>G1/4&quot;</td>
<td>1.25</td>
<td>1.75</td>
<td>2.88</td>
<td>–</td>
</tr>
</tbody>
</table>

Seal material: Buna-N.

Manifold O-rings included with MVM-72. For manifold mounting installation information consult Enerpac for surface preparation.

www.enerpacwh.com
Pressure reducing valves

**PRV-series**

Shown: PRV-3

**Precise control of hydraulic pressure**
- Tool adjustable knob can be locked
- Precise control of pressure
- G1/4" oil connection
- Remote mount
- PRVM-2 manifold has both ½" BSPP and manifold ports
  - Gauge port- 1/8" NPT

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

The PRVM-2 manifold can be manifold mounted or plumbed with tubing. The PRV-8 and PRV-9 use this manifold to provide a pre-assembled valve. PRV-3 and 4 are for remote mounting. The cartridge from PRV-3 and 4 can be removed from manifold for direct integration into gundrilled fixture. Order the cartridge separately as PRV-3T or PRV-4T.

**Option**

**Gauges**
- 190

**Fittings**
- 194

**Product selection**

<table>
<thead>
<tr>
<th>Mounting style</th>
<th>Adjustable pressure range</th>
<th>Maximum pressure</th>
<th>Model number</th>
<th>Oil ports</th>
<th>Maximum oil flow</th>
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</thead>
<tbody>
<tr>
<td>Remote</td>
<td>435 - 4350</td>
<td>5000</td>
<td>PRV-3</td>
<td>G1/4&quot;</td>
<td>427</td>
</tr>
<tr>
<td>Cartridge</td>
<td>435 - 4350</td>
<td>5000</td>
<td>PRV-3T</td>
<td>–</td>
<td>427</td>
</tr>
<tr>
<td>Remote</td>
<td>75 - 2000</td>
<td>5000</td>
<td>PRV-4</td>
<td>G1/4&quot;</td>
<td>427</td>
</tr>
<tr>
<td>Cartridge</td>
<td>75 - 2000</td>
<td>5000</td>
<td>PRV-4T</td>
<td>–</td>
<td>427</td>
</tr>
<tr>
<td>Remote</td>
<td>435 - 4350</td>
<td>5000</td>
<td>PRV-8</td>
<td>G1/4&quot;</td>
<td>427</td>
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<tr>
<td>Remote</td>
<td>72 - 2000</td>
<td>5000</td>
<td>PRV-9</td>
<td>G1/4&quot;</td>
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<tr>
<td>Remote</td>
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<td>5000</td>
<td>PRVM-2</td>
<td>G1/4&quot;</td>
<td>427</td>
</tr>
</tbody>
</table>

**Pressures and flows**
- Pressure: 5000 psi
- Flow: 427 in³/min

**Language options**
- E Válv. reguladora de presión
- F Valve de pression réglable
- D Druckreduzierventil

**Diagram**

[Diagram of PRV-series valves with various views and dimensions]
**Flow control valves**

Shown: VFC-1

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

**Application**

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

**Product selection**

<table>
<thead>
<tr>
<th>Maximum oil flow</th>
<th>Pressure range</th>
<th>Oil ports</th>
<th>Model number</th>
<th>Flow path</th>
<th>Maximum pressure drop</th>
</tr>
</thead>
<tbody>
<tr>
<td>gpm</td>
<td>psi</td>
<td>ports</td>
<td>number</td>
<td>path</td>
<td>psi</td>
</tr>
<tr>
<td>10</td>
<td>0-5000</td>
<td>SAE #4</td>
<td>VFC-1</td>
<td>1500</td>
<td>1.8</td>
</tr>
<tr>
<td>10</td>
<td>0-5000</td>
<td>G 1/4*</td>
<td>VFC-2</td>
<td>1500</td>
<td>1.8</td>
</tr>
</tbody>
</table>

Seal material: Viton

www.enerpacwh.com
Accessory valves

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

Application

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

Your hydraulic control solution

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

Product selection

<table>
<thead>
<tr>
<th>Valve type</th>
<th>Maximum pressure</th>
<th>Model number</th>
<th>Oil ports</th>
</tr>
</thead>
<tbody>
<tr>
<td>Holding valve, air pilot</td>
<td>3000</td>
<td>HV-1000A</td>
<td>1/8&quot; NPT</td>
</tr>
<tr>
<td>Holding valve, modular</td>
<td>3000</td>
<td>MHV-1</td>
<td>1/8&quot; NPT</td>
</tr>
<tr>
<td>Pressure limiting valve</td>
<td>3000</td>
<td>PLV-40013B</td>
<td>1/8&quot; NPT</td>
</tr>
<tr>
<td>Manual shut-off valve</td>
<td>5000</td>
<td>V-12</td>
<td>SAE #4</td>
</tr>
<tr>
<td>Auto-damper valve</td>
<td>10,000</td>
<td>V-10</td>
<td>1/2&quot; NPT</td>
</tr>
<tr>
<td>Safety check valve</td>
<td>10,000</td>
<td>V-17</td>
<td>3/8&quot; NPT</td>
</tr>
<tr>
<td>Pressure relief valve</td>
<td>10,000</td>
<td>V-152</td>
<td>3/8&quot; NPT</td>
</tr>
</tbody>
</table>

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 305 in³/min
- Works with the VA-42 four-way air valve and a booster

MHV-1

Modular holding valve

- Allows separate operation of clamping fixtures with a single power source
- Ideal for applications when fluid feed lines are impractical. If system pressure is interrupted, the MHV-1 will hold the pressure beyond the valve
- Max. oil flow 305 in³/min
- To release system pressure, rotate valve handle in either direction 90° to release and retract system pressure
### PLV-40013B
**Pressure limiting valve**

- Allows precise control of pressures reaching specific clamps
- When pressure build-up reaches a preset level, the valve closes, stabilizing pressure to that section of the fixture
- Pressure adjustment between 200 to 1500 psi
- Max. oil flow 305 in³/min

![Pressure limiting valve diagram](attachment:image1.png)

### V-12
**Manual shut-off valve**

- Ball type valve can be used for the master system shut-off or for isolating separate circuits on a fixture
- Viton seals standard
- Straight through design for easy system plumbing and installation
- Fully open allows high flow return of oil
- Max. oil flow 732 in³/min

![Manual shut-off valve diagram](attachment:image2.png)

### 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

![Auto-damper valve diagram](attachment:image3.png)

### V-17
**Safety check valve**

- Ruggedly built to resist shock and operate with low pressure drop
- Closes smoothly without pounding
- Max. oil flow 1830 in³/min

![Safety check valve diagram](attachment:image4.png)

### V-152
**Pressure relief valve**

- Limits pressure developed by the pump in hydraulic circuit, thus limiting the force imposed on other components
- 800-10,000 psi adjustment range; ± 3% repeatability
- Valve opens whenever preset pressure is reached. To increase pressure setting, turn handle clockwise
- Max. oil flow 1830 in³/min
- Includes 3 ft. return line hose kit

![Pressure relief valve diagram](attachment:image5.png)

---

**Options**

- **VA-42** Air valve
- **Gauges and adaptors**
- **Hoses and couplers**

**Fittings**

**Important**

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

---

www.enerpacwh.com
Air valves and accessories

To control and regulate air supply

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

**VAS-42 Solenoid operated air valve**
- 5-way, 2-position
- For control of pump and boosters air supply
- Viton seals standard
- Solenoid: 120 VAC, 50/60Hz
  Amperage: inrush .11 Amps, holding .07 Amps
- Maximum cycle rate: 600 cycles per minute

**VR-3 Rapid exhaust valve**
- Enables booster to advance and retract faster
- Instantly exhausts air supply from booster to atmosphere

**V-19 Air check valve**
- Prevent rapid drop of air pressure to the booster in the event of sudden loss of input air

**RFL-102 Regulator-Filter-Lubricator**
- Regulates air pressure
- Filter air input
- Lubricates air motors with a fine oil vapor mist
- Maximum air flow 48 scfm

**QE-375 Muffler**
- Use with VR-3 or VAS/VA-42
- Reduces noise level of exhaust air from pump

---

### Options

**Gauges and adaptors**

**Hoses and couplers**

**Fittings**

---

### Important

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

### Product selection

<table>
<thead>
<tr>
<th>Maximum pressure psi</th>
<th>Model number</th>
</tr>
</thead>
<tbody>
<tr>
<td>▼ Air valves</td>
<td></td>
</tr>
<tr>
<td>30-150</td>
<td>VA-42</td>
</tr>
<tr>
<td>30-150</td>
<td>VAS-42</td>
</tr>
<tr>
<td>0-100</td>
<td>VR-3</td>
</tr>
<tr>
<td>0-100</td>
<td>V-19</td>
</tr>
<tr>
<td>▼ Accessories</td>
<td></td>
</tr>
<tr>
<td>0-125</td>
<td>RFL-102</td>
</tr>
<tr>
<td>0-125</td>
<td>QE-375</td>
</tr>
</tbody>
</table>
**WVP-5**

The opening point is set by the adjustment spring. Incoming pressure is blocked by the valve spindle in the orifice plate. When opening pressure is reached, the spindle is pushed up until fluid will pass. The system pressure level is maintained as pressure builds in the downstream circuit. Reverse flow is through a reverse check valve.

**V-72**

System pressure enters through the "Pump" port, flows through the check seat and past the check valve into the cylinder circuit. When system pressure drops, the check ball closes off the seat, blocking flow. To release the cylinder pressure, the "Pilot" port is pressurized, and the pilot piston pushes the check ball off of the seat, allowing reverse flow.

**PRV-3**

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

- Manual and Automated Coupler Systems for connecting/disconnecting to the fixture
- Rotary couplers for use with continuous connection systems
- Pressure intensifiers to provide increased pressure for clamping when used with machine hydraulics
- Safe Link for remote wireless monitoring of fixture pressure or clamp position
<table>
<thead>
<tr>
<th>Product Category</th>
<th>Series</th>
<th>Page Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accumulators</td>
<td>AC WA</td>
<td>162 - 163</td>
</tr>
<tr>
<td>Coupler Packages</td>
<td>AC, AP MHV</td>
<td>164 - 165</td>
</tr>
<tr>
<td>Manual couplers</td>
<td>MCR MCH</td>
<td>166 - 171</td>
</tr>
<tr>
<td>Activator wand &amp; boosters</td>
<td>B, RA</td>
<td>172 - 173</td>
</tr>
<tr>
<td>Auto-coupler systems</td>
<td>WCA, WPA ACCB</td>
<td>174 - 175</td>
</tr>
<tr>
<td>Rotary couplers</td>
<td>AMP, CR CRV</td>
<td>176 - 177</td>
</tr>
<tr>
<td>Pressure intensifiers</td>
<td>PID</td>
<td>178 - 179</td>
</tr>
<tr>
<td>SafeLink</td>
<td>SL</td>
<td>180 - 185</td>
</tr>
</tbody>
</table>
Accumulators

Application & selection

Accumulators
• Ideal for high frequency and rapid discharge applications
• ACL series are pre-charged to 1450 psi
• Corrosion resistant bodies on ACL series
• Spring actuated accumulator for ACM-1
• High energy storage capacity in a compact package
• WA accumulators are piston type
• ACL accumulators are diaphragm type
• ACM accumulators use internal spring

Enerpac accumulators supply auxiliary pressure to dampen shock loads or to compensate pressure drop in applications where system pressure needs to be maintained.

Accumulator applications:
- Energy storage
- Circuit pulsation dampening
- Thermal expansion compensation

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

Product selection

<table>
<thead>
<tr>
<th>Operating pressure</th>
<th>Model number</th>
<th>Max. rated oil volume</th>
<th>Gas volume</th>
<th>Pre-charged nitrogen pressure</th>
<th>Usable oil capacity at 5000 psi</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-3000</td>
<td>ACM-1</td>
<td>.10</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>1500-5000</td>
<td>ACL-21A</td>
<td>.90</td>
<td>1.22</td>
<td>1450</td>
<td>.53</td>
</tr>
<tr>
<td>1500-5000</td>
<td>ACL-201A</td>
<td>7.70</td>
<td>10.37</td>
<td>1450</td>
<td>4.51</td>
</tr>
<tr>
<td>1500-5000</td>
<td>ACL-502A</td>
<td>20.60</td>
<td>27.46</td>
<td>1450</td>
<td>12.0</td>
</tr>
</tbody>
</table>

- Pre-charged accumulators

- Uncharged accumulators

* See pre-charge chart on page 163 for hydraulic operating pressures.
### Dimensions & options

#### WA, AC-series

**Pallet components**

**System components**

**Yellow pages**

---

### Hydraulic oil

- Pressure: 0-5000 psi
- Oil volume: .10-20.60 in³
- Gas volume: 1.22-27.46 in³

**E** - Acumuladores
**F** - Accumulateurs
**D** - Druckspeicher

---

### Options

**AW-50 Mounting block**

For WA series accumulators.

---

### Fittings

---

### Recommended pre-charge

<table>
<thead>
<tr>
<th>Operating pressure psi</th>
<th>Model number</th>
<th>Nitrogen pressure psi</th>
<th>Usable oil capacity in³</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1000</td>
<td>WA-502</td>
<td>500</td>
<td>1.50</td>
</tr>
<tr>
<td>1000-3000</td>
<td>WA-502</td>
<td>1000</td>
<td>2.00</td>
</tr>
<tr>
<td>3000-5000</td>
<td>WA-502</td>
<td>1200</td>
<td>2.50</td>
</tr>
<tr>
<td>0-1000</td>
<td>WA-5010</td>
<td>500</td>
<td>5.50</td>
</tr>
<tr>
<td>1000-3000</td>
<td>WA-5010</td>
<td>1000</td>
<td>6.50</td>
</tr>
<tr>
<td>3000-5000</td>
<td>WA-5010</td>
<td>1200</td>
<td>7.50</td>
</tr>
</tbody>
</table>

*At maximum operating pressure.*

---

### Product dimensions in inches

<table>
<thead>
<tr>
<th>Model number</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>Recommended charging tool</th>
<th>lbs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pre-charged accumulators</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ACM-1</td>
<td>5.25</td>
<td>.75</td>
<td>.50</td>
<td>.265</td>
<td>1.75</td>
<td>–</td>
<td>.125-27 NPT</td>
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</tr>
<tr>
<td>ACL-21A</td>
<td>4.14</td>
<td>1.46</td>
<td>.71</td>
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<td>–</td>
<td>–</td>
<td>SAE #4</td>
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<tr>
<td>ACL-201A</td>
<td>5.39</td>
<td>2.72</td>
<td>1.14</td>
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<td>SAE #6</td>
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<td>ACL-502A</td>
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<td>G3/8&quot;</td>
<td>6.2</td>
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<tr>
<td><strong>Uncharged accumulators</strong></td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>WA-502</td>
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<td>1.19</td>
<td>–</td>
<td>2.75-16 UN</td>
<td>2.75</td>
<td>–</td>
<td>SAE #8</td>
<td>7.0</td>
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<tr>
<td>WA-5010</td>
<td>7.13</td>
<td>1.19</td>
<td>–</td>
<td>2.75-16 UN</td>
<td>2.75</td>
<td>–</td>
<td>SAE #8</td>
<td>11.5</td>
<td></td>
</tr>
</tbody>
</table>

---

**ACM-1**

**ACL-21A**

**ACL-201A, 502A**

---

[www.enerpacwh.com](http://www.enerpacwh.com)
Accumulator packages will help maintain system pressure to your fixture when separated from the hydraulic source. The gauge will display system pressure after the circuit is disconnected.

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

Coupler packages

...compact design for easy use of accumulators

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

MHV-1 Modular holding valve

- Allows separate operation of clamping fixtures with a single power source
- Ideal for applications when fluid feed lines are impractical. If system pressure is interrupted, the MHV-1 will hold the pressure beyond the valve
- Max. oil flow 305 in³/min
- To release system pressure, rotate valve handle in either direction 90° to release and retract system pressure

Coupler package circuits

ACBS series

<table>
<thead>
<tr>
<th>Single-acting circuit</th>
<th>Double-acting circuit</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="#" alt="Circuit Diagram" /></td>
<td><img src="#" alt="Circuit Diagram" /></td>
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</tbody>
</table>

AP-500

<table>
<thead>
<tr>
<th>Single-acting circuit</th>
<th>Double-acting circuit</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="#" alt="Circuit Diagram" /></td>
<td><img src="#" alt="Circuit Diagram" /></td>
</tr>
</tbody>
</table>

MHV-1

<table>
<thead>
<tr>
<th>Single-acting circuit</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="#" alt="Circuit Diagram" /></td>
</tr>
</tbody>
</table>

Product selection

<table>
<thead>
<tr>
<th>Operating pressure</th>
<th>Model number</th>
<th>Max. rated oil volume</th>
<th>Gas volume</th>
<th>Pre-charged nitrogen pressure</th>
<th>Usable oil capacity at 5000 psi</th>
</tr>
</thead>
<tbody>
<tr>
<td>psi</td>
<td></td>
<td>in³</td>
<td>in³</td>
<td>psi</td>
<td>in³</td>
</tr>
<tr>
<td>0-5000</td>
<td>AP-500</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>0-3000</td>
<td>MHV-1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1500-5000</td>
<td>ACBS-22A</td>
<td>0.90</td>
<td>1.22</td>
<td>1450</td>
<td>.53</td>
</tr>
<tr>
<td>1500-5000</td>
<td>ACBS-202A</td>
<td>7.70</td>
<td>10.37</td>
<td>1450</td>
<td>4.51</td>
</tr>
</tbody>
</table>

Accumulator coupler packages

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


Options

Couplers

High pressure filters

Hydraulic oil

Fittings

Product dimensions in inches [  ▶️ ▶️ ]

<table>
<thead>
<tr>
<th>Model number</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>Recommended charging tool</th>
<th>lbs</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACBS-22A</td>
<td>2.69</td>
<td>1.65</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>G1/4”</td>
<td>WAT-2</td>
<td>10.1</td>
</tr>
<tr>
<td>ACBS-202A</td>
<td>4.18</td>
<td>3.33</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>G1/4”</td>
<td>WAT-2</td>
<td>11.8</td>
</tr>
<tr>
<td>AP-500</td>
<td>6.44</td>
<td>2.50</td>
<td>3.50</td>
<td>3.84</td>
<td>1.75</td>
<td>0.38</td>
<td>SAE #4</td>
<td>–</td>
<td>11.8</td>
</tr>
<tr>
<td>MHV-1</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>1/8” NPT</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

Pre-charged accumulator coupler packages

ACBS-22A 2.69 1.65 – – – – G1/4” WAT-2 10.1
ACBS-202A 4.18 3.33 – – – – G1/4” WAT-2 11.8
AP-500 6.44 2.50 3.50 3.84 1.75 0.38 SAE #4 – 11.8
MHV-1 – – – – – – 1/8” NPT – –
The Enerpac manual coupler is available as a dual connection model or dual connection with optional air circuit for part present sensing. The fixture side receiver is available with or without an internal pilot operated check valve. Filtration provides protection from contamination.

Manual coupler applications:
- **With P.O. check**
  - Use MCRC-21 for a complete, unitized coupler receiver solution
- **Without P.O. check**:
  - Use MCR-21 when using a remote mounted Pilot Operated Check Valve

Manual Coupler Circuits

<table>
<thead>
<tr>
<th>Model number</th>
<th>Basic configurations</th>
<th>Circuits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MCRC-21</td>
<td>Pallet receiver with P.O. check</td>
<td>Two Hydraulic</td>
</tr>
<tr>
<td>MCR-21</td>
<td>Pallet receiver without P.O. check</td>
<td>Two Hydraulic</td>
</tr>
<tr>
<td>MCRA-11</td>
<td>Auxiliary air circuit receiver block</td>
<td>One Air</td>
</tr>
<tr>
<td>MCH-21</td>
<td>Operator handle</td>
<td>Two Hydraulic</td>
</tr>
<tr>
<td>MCH-31</td>
<td>Operator handle</td>
<td>Two Hydraulic, One Air</td>
</tr>
<tr>
<td>MCSB-21</td>
<td>Storage block</td>
<td>N/A</td>
</tr>
<tr>
<td>MCPS-21</td>
<td>Proximity switch kit</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Enerpac manual couplers simplify the process of connecting and disconnecting to a palletized fixture.
Select your components

**MCRC-21 Pallet Receiver with P.O. Check**
An internal pilot operated check valve and multiple ports to accommodate a gauge or accumulator make the MCRC-21 a great choice of coupler receiver for use in a palletized fixture. Internal filtration protects the check from contamination. Use with the MCH-21 operator handle.

**MCR-21 Pallet Receiver**
For applications where the pilot operated check valve is remote mounted in the fixture circuit, use the MCR-1. Internal filtration protects the circuit from outside contamination.

**MCRA-11 Auxiliary air circuit receiver**
The MCRA-11 is used to provide an additional connection for use with air part sensing circuits. Use with either the MCRC-21 or the MCR-21. Use with the MCH-31 operator handle.

**MCSB-21 Operator Handle Storage Block**
Proper storage of the MCH-21 or MCH-31 handle prevents contamination of the couplers, and makes sure that the handle is disconnected from the fixture. Use the MCPS-21 proximity switch to confirm proper storage as an input to the machine control.

**MCH-21 Two Coupler Operator Handle**
Use the MCH-21 with either the MCRC-21 or the MCR-21 pallet receiver.

**MCH-31**
Use the MCH-31 when using the MCRA-11 with either the MCRC-21 or MCR-21 receivers.

<table>
<thead>
<tr>
<th>Operating pressure psi</th>
<th>Replacement hydraulic nozzle</th>
<th>Replacement filter kit</th>
<th>Voltage</th>
<th>Model number</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 - 5000</td>
<td>AH654</td>
<td>Fl2201K</td>
<td>–</td>
<td>MCRC-21</td>
</tr>
<tr>
<td>100 - 5000</td>
<td>AH654</td>
<td>Fl2201K</td>
<td>–</td>
<td>MCR-21</td>
</tr>
<tr>
<td>10 - 100*</td>
<td>AH654</td>
<td>Fl2201K</td>
<td>–</td>
<td>MCRA-11</td>
</tr>
<tr>
<td>100 - 5000</td>
<td>AR650</td>
<td>–</td>
<td>–</td>
<td>MCH-21</td>
</tr>
<tr>
<td>100 - 5000</td>
<td>AR650</td>
<td>–</td>
<td>–</td>
<td>MCH-31</td>
</tr>
<tr>
<td>-</td>
<td>AH654</td>
<td>–</td>
<td>–</td>
<td>MCSB-21</td>
</tr>
<tr>
<td>-</td>
<td>–</td>
<td>–</td>
<td>24 VDC</td>
<td>MCPS-21</td>
</tr>
</tbody>
</table>

* Air pressure

---

**Options**

- **FZ Series fittings**
- **Hoses and couplers**
- **Pilot operated check valves**
- **Accumulators**

---

**Important**

Do not couple or uncouple with the hydraulic nozzles under pressure. This can damage the couplers.

Do not exceed maximum flow and pressure.
**Serie MCR e MCH**

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

**Shown: MCH-21, MCR-21**

### MCRC-21 Receiver with P.O. check

- (3) 5/16–18 x 1.50" Lg. SHCS (provided)

### MCR-21 Receiver without P.O. check

- Ø.188 x .62" Lg. spring roll pin (provided)
- 5/16–18 x 1.50" Lg. SHCS (provided)

### MCRA-11 Auxiliary air circuit receiver

- (2) #10-24 x 1.50" Lg. SHCS (provided)

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

- (2) #10–24 x 1.50" Lg. SHCS (provided)
- Ø.188 x .62" Lg. spring roll pin (provided)

Can mount air passage on either side
Dimensions & options

**MCR and MCH-series**

<table>
<thead>
<tr>
<th>Options</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FZ Series fittings</td>
<td>![Image]</td>
</tr>
<tr>
<td>Hoses and couplers</td>
<td>![Image]</td>
</tr>
<tr>
<td>Pilot operated check valves</td>
<td>![Image]</td>
</tr>
<tr>
<td>Accumulators</td>
<td>![Image]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Important</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Do not couple or uncouple with the hydraulic nozzles under pressure. This can damage the couplers.</strong></td>
</tr>
<tr>
<td><strong>Do not exceed maximum flow and pressure.</strong></td>
</tr>
</tbody>
</table>

**Max. Flow:** 4 GPM
**Pressure:** 0-5000 psi

**Options**

- E Acopladores manuales
- F Manuel coupleur
- D Manuelle Kupplung

**Dimensions & Options**

### MCRC-21 with MCRA-11

- (2) #10–24 x 1.50" Lg. SHCS (provided)
- (3) 5/16–18 x 1.50" Lg. SHCS (provided)

### MCSB-21 Storage block

- (2) 1/4–20 x .50" Lg. SHCS (provided)
- (2) M5–4.8 x 20mm Lg. SHCS with jam nuts (provided)

### MCPS-21 Optional proximity switch

- Optional proximity switch is available. See MCPS-21

### MCH-21 Operator handle

- Knurled gripping area 3.62
- Knurled gripping area 3.62

### MCH-31 Operator handle

- Knurled gripping area 3.62
- Knurled gripping area 3.62

**Notes:**

- Can mount air passage on either side
- Optional proximity switch is available. See MCPS-21
- Do not couple or uncouple with the hydraulic nozzles under pressure. This can damage the couplers.
- Do not exceed maximum flow and pressure.

**Specifications:**

- **Max. Flow:** 4 GPM
- **Pressure:** 0-5000 psi

**Accessories:**

- **FZ Series fittings**
- **Hoses and couplers**
- **Pilot operated check valves**
- **Accumulators**

**Important Notes:**

- Do not couple or uncouple with the hydraulic nozzles under pressure. This can damage the couplers.
- Do not exceed maximum flow and pressure.

**Dimensions:**

- 12.00
- 5.00
- 2.00
- 4.50
- 2.00
- 2.00
**MCR series**

The MCR-21 two passage receiver features multiple SAE #4 ports as well as manifold mount ports for easy plumbing to a fixture. Internal filtration in all receiver models protects the circuit from external contamination.

**MCR-21**

Receiver with P.O. check – Mtg. hole pattern

* Minimum from edge of tool plate

**MCR-21**

Receiver without P.O. check – Mtg. hole pattern

Can mount air passage on either side.
MCSB-21  Storage Block – Mounting Hole Pattern

Manifold and Port Dimensions

(2) 1/16-27 NPTF dry seal taper pipe plugs (provided). Remove when manifold mounting.

(2) O-rings (provided). Use when manifold mounting.

(2) Ø.25 feed holes

(2) Ø.19 feed holes

Rear view

Accumulator or gauge port only

SAE #4 plug (provided)

Bleeder port only

SAE #2 plug (provided)

(6) Port passages

SAE #4 plugs (provided)

(4) Port passages

SAE #2 plugs (provided)

Top view

Max. Flow: 4 GPM
Pressure: 0-5000 psi

E Acopladores manuales
F Manuel coupleur
D Manuelle kupplung

Options

FZ Series fittings

Hoses and couplers

Pilot operated check valves

Accumulators

Important

Do not couple or uncouple with the hydraulic nozzles under pressure. This can damage the couplers.

Do not exceed maximum flow and pressure.
Contamination resistant closed hydraulic system

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

Hydraulic system schematics

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

Product selection

<table>
<thead>
<tr>
<th>Pressure ratio</th>
<th>Oil flow ratio</th>
<th>Oil volume per stroke</th>
<th>Stroke</th>
<th>Model number</th>
<th>Effective area</th>
<th>Operating pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>in³</td>
<td>in</td>
<td></td>
<td>in²</td>
<td>psi</td>
</tr>
<tr>
<td>▼ Receiver booster</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2:1</td>
<td>1.75:1</td>
<td>8.10</td>
<td>0.04</td>
<td>B-81</td>
<td>3.98</td>
<td>400-5000</td>
</tr>
<tr>
<td>2:1</td>
<td>1.75:1</td>
<td>17.10</td>
<td>0.30</td>
<td>B-171</td>
<td>3.98</td>
<td>400-5000</td>
</tr>
<tr>
<td>▼ Activator wand</td>
<td></td>
<td></td>
<td></td>
<td>RA-1061</td>
<td>2.23</td>
<td>800-10,000</td>
</tr>
</tbody>
</table>
**Product dimensions** in inches [\(\text{inches}\)]

<table>
<thead>
<tr>
<th>Model number</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>D1</th>
<th>E</th>
<th>F</th>
<th>H</th>
<th>J</th>
<th>J1</th>
<th>K</th>
<th>K1</th>
<th>L</th>
<th>L1</th>
<th>L2</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-81</td>
<td>6.86</td>
<td>2.74</td>
<td>1.74</td>
<td>3.00</td>
<td>–</td>
<td>4.00</td>
<td>3.25</td>
<td>1.12</td>
<td>–</td>
<td>–</td>
<td>.41</td>
<td>.26</td>
<td>.41</td>
<td>.62</td>
<td>.42</td>
<td>–</td>
</tr>
<tr>
<td>B-171</td>
<td>9.12</td>
<td>2.74</td>
<td>1.74</td>
<td>3.00</td>
<td>–</td>
<td>4.00</td>
<td>3.25</td>
<td>1.12</td>
<td>–</td>
<td>–</td>
<td>.41</td>
<td>.26</td>
<td>.41</td>
<td>.62</td>
<td>.42</td>
<td>–</td>
</tr>
<tr>
<td>RA-1061</td>
<td>11.62</td>
<td>4.63</td>
<td>.19</td>
<td>2.25</td>
<td>3.00</td>
<td>.75</td>
<td>2.32</td>
<td>.75</td>
<td>3.02</td>
<td>1.53</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>2.75</td>
<td>–</td>
</tr>
</tbody>
</table>

**Options**

**Fittings**

**Hoses and couplers**

For 10,000 psi pumps, refer to the Enerpac Industrial Tools Catalog E327.

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

**Important**

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

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

**Dimensions & Options**

- **Ratio:** 2:1
- **Stroke:** 2.04-4.44 inch
- **Pressure:** 400-5000 psi
- **E**: Multiplicadores
- **F**: Multiplicateur
- **D**: Betätigungszylinder und Druckverstärker

**Important**

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

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

**Important**

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

The booster output flow is 1.75 times the wand input flow.
The automatic coupler system allows connection and disconnection of palletized hydraulic circuits. This system eliminates the direct intervention of an operator, allowing hands free, safe functioning of the process. Typical systems include one base station located at the load/unload station operating one or more pallet receivers.

For automated coupling of hydraulic circuits on palletized systems

- Sensing feedback of coupler position allows for fully automated applications
- Horizontal or vertical mounting for flexible installation on machine tools
- Available as 2 or 4 port model to provide a solution to various hydraulic circuit needs
- Adjustment stroke allows clearance for pallet indexing
- Coupler elements supplied with air blow-off nozzles to prevent damage from contamination
- Automatic coupler control box provides pre-programmed safety features to insure proper sequencing of automatic coupler and fixture operations

The automatic coupler system allows connection and disconnection of palletized hydraulic circuits. This system eliminates the direct intervention of an operator, allowing hands free, safe functioning of the process. Typical systems include one base station located at the load/unload station operating one or more pallet receivers.

A 4-way auto coupler is connected to the receiver, mounted on the side of a palletized fixture.

ACCB-2, Automatic coupler control box

- Provides automatic or manual control of your 2 or 4 port auto coupler station.
- Panel view informs when auto coupler is retracted or advanced and whether fixture is unclamped or clamped.
- Includes 2 pressure switches, 3 proximity switches.
- Pressure switches monitor clamping and unclamping system pressure.
- Proximity switches inform PLC when auto coupler is advanced or retracted and when pallet is in position for the auto coupling.
- Integrates with ZW4020HJ-FHLT12U300 and ZW5020HJ-FHLT12U300 pumps.

Product selection

<table>
<thead>
<tr>
<th>Station position</th>
<th>Model number</th>
<th>Adjustable stroke</th>
<th>Oil capacity</th>
<th>Maximum oil flow</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>in</td>
<td>in³/min</td>
<td></td>
</tr>
<tr>
<td>2 port auto coupler</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Base</td>
<td>WCA-62</td>
<td>.20 - .59</td>
<td>.66</td>
<td>.66</td>
</tr>
<tr>
<td>Base</td>
<td>WCA-82*</td>
<td>4.10 - 4.48</td>
<td>.66</td>
<td>.66</td>
</tr>
<tr>
<td>Pallet</td>
<td>WPA-62</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4 port auto coupler</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Base</td>
<td>WCA-64*</td>
<td>.20 - .59</td>
<td>.66</td>
<td>.66</td>
</tr>
<tr>
<td>Pallet</td>
<td>WPA-64*</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

* For additional pallet clearance, WCA-62 long stroke model are available.
* Maximum oil flow of coupler elements is 4.3 GPM.
* This product is made to order. Please contact Enerpac for delivery information before specifying in your design.
### Product specifications

<table>
<thead>
<tr>
<th>Model number</th>
<th>Required radial alignment accuracy in</th>
<th>Operating pressure psi</th>
<th>Hydraulic nozzle model number (included)</th>
<th>Air blow-off fitting model No. (included)</th>
<th>Recommended alignment tool</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 port auto coupler</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WCA-62</td>
<td>± .02</td>
<td>580 - 5000</td>
<td>CDF-6</td>
<td>FZ-2050</td>
<td>AT-1</td>
</tr>
<tr>
<td>WCA-82</td>
<td>± .02</td>
<td>580 - 5000</td>
<td>CDF-6</td>
<td>FZ-2050</td>
<td>AT-2</td>
</tr>
<tr>
<td>WPA-62</td>
<td>± .02</td>
<td>580 - 5000</td>
<td>CDM-6</td>
<td>FZ-2050</td>
<td>AT-1</td>
</tr>
<tr>
<td>4 port auto coupler</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WCA-64</td>
<td>± .02</td>
<td>580 - 5000</td>
<td>CDF-6</td>
<td>FZ-2050</td>
<td>AT-1</td>
</tr>
<tr>
<td>WPA-64</td>
<td>± .02</td>
<td>580 - 5000</td>
<td>CDM-6</td>
<td>FZ-2050</td>
<td>AT-1</td>
</tr>
</tbody>
</table>

### Options

**High pressure filters**
Use high pressure filters on pallet station outlet ports, to avoid contamination of pallet mounted valves and cylinders.

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

**Hoses and couplers**

**Important**
Use high pressure filters on pallet station outlet ports, to avoid contamination of pallet mounted valves and cylinders.

To guarantee leakage free connections, accurate positioning of the pallet and base stations is crucial. Carefully read the instruction manual included with the product.

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

Do not exceed maximum flow and pressure.

**Product dimensions** in inches

<table>
<thead>
<tr>
<th>Model number</th>
<th>A</th>
<th>A1</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F max.</th>
<th>V</th>
<th>W</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 port auto couplers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WCA-62</td>
<td>8.86</td>
<td>7.48</td>
<td>–</td>
<td>5.42</td>
<td>.83</td>
<td>5.09</td>
<td>.394-.413</td>
<td>.312-18UN x 3.00</td>
<td>–</td>
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<tr>
<td>WCA-82*</td>
<td>15.67</td>
<td>14.03</td>
<td>–</td>
<td>9.36</td>
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<td>.375-16UN x 2.00</td>
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<td>WCA-64*</td>
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<td>.394-.413</td>
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<td>–</td>
<td>.375-16UN x 2.00</td>
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<td>Automatic coupler control box</td>
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<td>ACCB-2</td>
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<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>30.0</td>
</tr>
</tbody>
</table>

1) Mounting bolts are not included.
2) Drill dowel pin holes after installing WPA.

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

Permanent hydraulic connection on indexing and rotating work stations

- High rotation per minute
- Low starting torque
- Internal oil bearings for increased lifetime
- Manifold mounting adaptors available to reduce fixture plumbing

Starting torque and speed diagrams

Product selection

In this application eight CRV-221 rotary couplers are installed to power the individual presses of an eight station rotary press table.

Manifold mounting adaptor

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

Product selection
**Product dimensions** in inches [_inches]

**AMP-2**
- Diameter: 2.94 in
- Diameter: 3.35 in
- Diameter: 0.35 in
- Length: 1.00 in

**AMP-4**
- Diameter: 4.72 in
- Diameter: 3.94 in
- Diameter: 1.38 in
- Length: 1.00 in

**CRV-221**
- Diameter: 9.8 in
- Diameter: 1.97 in
- Length: 2.68 in

**CRV-441**
- Diameter: 3.45 in
- Diameter: 2.36 in
- Length: 1.2 in

**Options**

- **Fittings**
  - SAE #4
  - .312-18UN (4x)
  - .312-18UN (2x)

- **Couplers**
  - SAE #4
  - .312-18UN

- **Hoses and couplers**
  - SAE #4
  - .312-18UN

**Important**

- Before selecting, note the pressure versus starting torque diagrams.
- Rotary couplers must be mounted in the center of rotation of the installation.
- Anti-rotation keys should be utilized.

For proper application, clamp force, pressures and timing, consult Enerpac for support.
Oil/oil intensifiers

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

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

Intensifier principle

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

Product selection

<table>
<thead>
<tr>
<th>Maximum pressure (psi)</th>
<th>Pressure intensification ratio</th>
<th>Maximum input flow (in³/min)</th>
<th>Maximum output flow (in³/min)</th>
<th>Model number with dump valve</th>
<th>Inlet pressure range (psi)</th>
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<tbody>
<tr>
<td>10,000</td>
<td>1 : 3.2</td>
<td>610</td>
<td>150</td>
<td>PID-321F</td>
<td>300 - 1560</td>
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<tr>
<td>10,000</td>
<td>1 : 4.0</td>
<td>580</td>
<td>120</td>
<td>PID-401F</td>
<td>300 - 1250</td>
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<tr>
<td>10,000</td>
<td>1 : 5.0</td>
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<td>95</td>
<td>PID-501F</td>
<td>300 - 1000</td>
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<tr>
<td>10,000</td>
<td>1 : 6.6</td>
<td>530</td>
<td>75</td>
<td>PID-661F</td>
<td>300 - 750</td>
</tr>
</tbody>
</table>

* Operating pressures above 5000 psi require high pressure fittings or intensifier models with BSPP ports. Contact Enerpac for details.
System set-up information:

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

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

Options

- FL-series, high-pressure filters
- Directional valves
- FZ-series fittings

Important

- Do not exceed maximum allowable inlet pressure.
- 10 micron filtration is included to ensure trouble-free operation.
- Applications above 5000 psi require high pressure fittings or intensifier models with BSPP ports. Contact Enerpac for details.
- PID models with dump valve provide an economical means of relieving pressure from the system.
- Can be panel mounted into machine (M24x1.5 thread).

Product dimensions in inches [‡‡‡]
SafeLink provides wireless communication between the fixture mounted SEND unit and the machine control interfaced RECEIVE unit.

A pressure switch is used on the fixture to monitor the circuit pressure. If the pressure switch on the fixture goes open, the RECEIVE unit communicates the changed status to the machine control through either 24 VDC, Modbus RTU RS485 or Ethernet IP protocol or Modbus TCP/IP.

The machine control would interrupt the machining process. The SEND unit can also be used with limit switch based position sensing clamps to verify clamped or unclamped status for robotically loaded systems.

### Product specifications

<table>
<thead>
<tr>
<th>Model Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLS-1</td>
<td>&quot;SEND&quot; Unit with Internal Antenna</td>
</tr>
<tr>
<td>SLS-2</td>
<td>&quot;SEND&quot; Unit with External Antenna</td>
</tr>
<tr>
<td>SLS-3</td>
<td>&quot;SEND&quot; Unit with External Antenna, 3 Inputs</td>
</tr>
<tr>
<td>SLR-1</td>
<td>&quot;RECEIVE&quot; Unit with External Antenna</td>
</tr>
<tr>
<td>SLR-2</td>
<td>&quot;RECEIVE&quot; Unit with External Antenna, 3 Inputs</td>
</tr>
<tr>
<td>SLS-2AC</td>
<td>.2m Antenna Cable</td>
</tr>
<tr>
<td>SLEM-1</td>
<td>Expansion Module for SLR</td>
</tr>
<tr>
<td>SLEB-1</td>
<td>Ethernet Bridge for SLR-1</td>
</tr>
<tr>
<td>SLSC-1</td>
<td>Power and Communication Splitter Cable for SLEB-1</td>
</tr>
<tr>
<td>SLDB-1</td>
<td>DIN Rail Mounting Bracket</td>
</tr>
</tbody>
</table>

### Model Number | Description
<table>
<thead>
<tr>
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</tbody>
</table>

### SafeLink Application & selection

- **Model Number**
- **Description**

<table>
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<tr>
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<td>DIN Rail Mounting Bracket</td>
</tr>
</tbody>
</table>

### WIRELESS communication between a fixture circuit and the machine control

- Fixture mounted “SEND” unit uses radio communication to monitor pressure and/or clamp position
- 2.4 GHz Frequency Band for global acceptance
- “Frequency Hopping” used to for signal stability, even in busy production environments
- “SEND” units are easily reassigned to a different “RECEIVE” unit so fixtures can be moved between machines
- No limit to the number of systems used in a production area
- “SEND” units are internally powered by a replaceable 3.6 VDC Lithium battery – provides up to 3-year battery life
- “SEND” units are sealed to IP-67 for protection from contamination and coolant
- LED lights for visual status indication
- LCD Display window for set-up and status display

### Model Number | Description
<table>
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</tr>
<tr>
<td>SLDB-1</td>
<td>DIN Rail Mounting Bracket</td>
</tr>
</tbody>
</table>
Important

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

Manifold Mount Pressure Switch
IP Rating: 65 (Dust and Water Jet)
PSCK-8: Range 1450–5000 psi (100-345 bar)
PSCK-9: Range 290-3045 psi (20-210 bar)
SafeLink can provide a discrete 24VDC output signal for systems of up to 4 fixtures. Each SEND unit can provide up to three outputs to the RECEIVE unit. The RECEIVE unit has 6 terminal stations, which are assigned to SEND units in groups of 3. So each RECEIVE unit can be paired with 2 SEND units when using the 24VDC output. For extra capacity, an EXPANSION MODULE provides an additional terminal strip, adding 2 more sets of three terminal stations.

**Basic System with I/O Machine Interface**

- **PALLETS #1**: Correct pressure, cylinder retracted. SLS-2 “SEND” unit.
- **PALLETS #2**: Correct pressure, cylinder retracted. SLS-2 “SEND” unit.
- **PALLETS #3**: Correct pressure, cylinder retracted. SLS-2 “SEND” unit.
- **PALLETS #4**: Correct pressure, cylinder retracted. SLS-2 “SEND” unit.

**Larger System with I/O Machine Interface**

- **PALLETS #1**: Correct pressure, cylinder retracted. SLS-2 “SEND” unit.
- **PALLETS #2**: Correct pressure, cylinder retracted. SLS-2 “SEND” unit.
- **PALLETS #3**: Correct pressure, cylinder retracted. SLS-2 “SEND” unit.
- **PALLETS #4**: Correct pressure, cylinder retracted. SLS-2 “SEND” unit.

**SLSC-1 Splitter Cable**
The SLSC-1 Splitter Cable is used with the SLEM-1 Expansion Module and the SLEB-1 Ethernet Bridge to connect to the SLR-1 RECEIVE unit and the machine control circuit.

**SLR-1 “RECEIVE” unit**
Output to machine controller: 24 VDC from RECEIVE unit.

**SLEM-1 “EXPANSION MODULE”**
Output to machine controller: 24 VDC from RECEIVE unit and EXPANSION MODULE.
Larger System with Modbus RTU Machine Interface

<table>
<thead>
<tr>
<th>PALLET #1</th>
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</thead>
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<table>
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<table>
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<td>SLS-1 “SEND” unit</td>
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</table>

SafeLink RECEIVE units can supply the outputs by using the standard Modbus RTU RS-485 protocol. This output uses the 5 pin connector on the RECEIVE unit. If Ethernet protocol is preferred, an ETHERNET BRIDGE is available to convert the Modbus RTU R-485 to ETHERNET IP or Modbus TCP/IP.

Larger System with Ethernet IP Machine Interface

<table>
<thead>
<tr>
<th>PALLET #1</th>
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<th>cylinder retracted</th>
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<table>
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</table>

The SLEB-1 Ethernet Bridge is used with the SLR-1 Receiver when Ethernet connection is available in the machine control. Use of the SLEB-1 will allow the monitoring of more fixtures in a large pallet pool system.
SafeLink FAQ

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

Why use SafeLink?
SafeLink can monitor the fixture pressure and clamp position in real time—even when parts are being machined. The system can also be used to verify that the operator has properly pressurized the fixture before it is sent in to be machined. If there is a pressure deficiency, the signal between the Send and Receive units is interrupted, and the machine control can respond before expensive damage occurs.

How does SafeLink work?
SafeLink uses 2.4 GHz radios to allow the SEND unit on the fixture to communicate with the RECEIVE unit that is interfaced with the machine control. The RECEIVE unit provides both 24 VDC outputs and a standard Modbus RTU RS485 communication protocol. An optional Ethernet Bridge will convert this to an Ethernet TCP IP protocol. The machine control must be set up to respond to this protocol to initiate a Feed Hold command, turn on a warning light, or even activate a Machine Stop command.

A pressure switch for pressure monitoring or a limit switch for position sensing is used with the SEND unit. If the pressure or position is lost, the switch goes open and the signal to the RECEIVE unit is interrupted.

What powers the SEND unit?
The SEND unit uses a 3.6 VDC size D Lithium battery that is supplied with the unit.
Projected battery life is 3 years.

What powers the RECEIVE unit?
The receive unit requires 24 VDC power, usually from the power supply in the machine control.

Will the machine fault if the pallet is in the loading station and the clamps are unclamped?
The Receive unit is just an input source for the machine control. The machine control must be able to identify which fixture is in the machine being run and which one is in the loading station. When in the loading station, the machine control must be able to ignore the signal loss when the clamps are unclamped to remove the completed parts.

How many fixtures can be monitored by one RECEIVE unit?
By using either Modbus RTU RS485 or Ethernet TCP IP, up to 56 SLS-1 or SLS-2 Send Units on fixtures can be monitored by a single SLR-1 Receive Unit.

Is installation available from Enerpac?
Enerpac has partnered with a CNC control specialist that can quote custom installation services. Contact your Enerpac Territory Manager for details.
**SAFE LINK PALLET MONITORING SYSTEM**

For customers who require custom installation of the Enerpac SafeLink pallet monitoring system, please provide the following information for each machine tool to be evaluated:

- **Company:** __________________________  **City, State, Zip:** __________________________
- **Contact:** ____________________________  **Contact Phone (ext):** __________________________
- **Address:** ____________________________  **Contact Email:** __________________________

### BUDGET

**Budget for custom installation of SafeLink system on this machine tool:**

- $500
- $1000
- $2500
- $5000+

### MACHINE INFORMATION

<table>
<thead>
<tr>
<th>Machine Make</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Machine Model</td>
<td></td>
</tr>
<tr>
<td>Machine Serial Number</td>
<td></td>
</tr>
<tr>
<td>Machine Type</td>
<td></td>
</tr>
<tr>
<td>Single Bed Horizontal Machining Center</td>
<td></td>
</tr>
<tr>
<td>Pallet Pool Cell with Horizontal Machining Centers</td>
<td></td>
</tr>
<tr>
<td>Number of Machines in Cell</td>
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</tr>
<tr>
<td>Single Bed Vertical Machining Center</td>
<td></td>
</tr>
<tr>
<td>Two Pallet Vertical Machining Center</td>
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<tr>
<td>Slide By</td>
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<tr>
<td>Vertical Turret Lathe (VTL)</td>
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<tr>
<td>Other/Describe</td>
<td></td>
</tr>
<tr>
<td>Number of Fixtures Associated with This Machine</td>
<td></td>
</tr>
<tr>
<td>Total Number of Circuits in Fixture Group</td>
<td></td>
</tr>
</tbody>
</table>

### MACHINE CONTROL INFORMATION

| Machine Control/Make          |  |
| Machine Control/Model Number  |  |
| Machine Control/Serial Number |  |
| Machine Control Interface Available | Modbus | Ethernet | DeviceNet | Relay |
| Serial RS-232 | Other/Describe |  |
| Machine Control IP Address    |  |
| Action if Fault is Detected  | Feedhold | Activate a Light |
| Machine Stop                  | Other/Describe |  |

**Contact Enerpac:** info@enerpac.com  •  Phone 414-747-8315  •  Fax 414-769-9247
System Components

From the simplest to the most complex hydraulic system, Enerpac's system components help you complete your design. Gauges, pressure switches, couplers and hoses are simple but necessary items for any hydraulic system, and Enerpac can provide the full range.

Technical support

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

<table>
<thead>
<tr>
<th>Category</th>
<th>Series</th>
<th>Page</th>
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<tbody>
<tr>
<td>Pressure switches</td>
<td>IC, PB</td>
<td>188</td>
</tr>
<tr>
<td>Digital pressure gauges</td>
<td>DG</td>
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<tr>
<td>Pressure gauges</td>
<td>G</td>
<td>190</td>
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<td>GA, GS</td>
<td>191</td>
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<tr>
<td>Manifolds, couplers, hoses, tubing</td>
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<td></td>
<td>HLS, H, T</td>
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<td>High pressure filters, hydraulic oil</td>
<td>FL, HF</td>
<td>193</td>
</tr>
<tr>
<td>High pressure fittings</td>
<td>BFZ, FZ</td>
<td>194-196</td>
</tr>
</tbody>
</table>
Pressure switches

Reliable electrical control of hydraulic power

- Compact design minimizes space requirements on fixture
- Switch is easily adjustable to meet system requirements

IC-series

The IC-series electrical pressure switches provide pressure readings for monitoring and/or control of hydraulic system pressure in workholding systems.

Shown: PSCK-8, IC-51

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

IC series

Electrical pressure switches

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<thead>
<tr>
<th>Adjustable pressure range</th>
<th>Electrical specifications</th>
<th>Model number</th>
<th>Deadband</th>
<th>Switch point repeatability</th>
<th>Oil port</th>
</tr>
</thead>
<tbody>
<tr>
<td>psi</td>
<td>at 50/60 Hz</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>500-3500</td>
<td>125 VAC @ 5 A</td>
<td>IC-30</td>
<td>100 - 500</td>
<td>+ /-2</td>
<td>SAE #4</td>
</tr>
<tr>
<td>500-3500</td>
<td>125 VAC @ 5 A</td>
<td>IC-31</td>
<td>100 - 500</td>
<td>+ /-2</td>
<td>250-18 NPT</td>
</tr>
<tr>
<td>3000-7500</td>
<td>125 VAC @ 5 A</td>
<td>IC-50</td>
<td>250 - 800</td>
<td>+ /-2</td>
<td>SAE #4</td>
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<td>IC-51</td>
<td>250 - 800</td>
<td>+ /-2</td>
<td>250-18 NPT</td>
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<tr>
<td>1450-5000</td>
<td>115 VAC @ 2 A</td>
<td>PSCK-8</td>
<td>250 - 800</td>
<td>+ /-2</td>
<td>Manifold mount</td>
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<td>PSCK-9</td>
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<td>-</td>
<td>-</td>
<td>PB-4</td>
<td>-</td>
<td>-</td>
<td>G 1/4</td>
</tr>
</tbody>
</table>

Options

Fittings

Gauges

Important

Do not exceed the maximum pressure.

Product selection

- Integrated in your hydraulic system, the pressure switch can be used to automate your clamping cycles.
# DGR-series

## Digital hydraulic pressure gauge

**Easy and precise pressure monitoring**

**DGR-2**
- Rated for system pressure up to 20,000 psi
- Displays in multiple units: psi, bar, mPa, kg/cm² (user selectable)
- Zero reset – ensures that gauge reads actual system pressure
- Batteries included, condition indicator on readout
- IP65 rated case design
- Shut off selectable – menu driven
- UL listed, CE and RoHS compliant

### Important

**Do not exceed the maximum pressure.**

Gauges can be easily installed into the hydraulic system using GA-3 gauge adaptor.

**Protective cover included**
Fits over face of gauge for protection in harsh environments.

### Options

**Fittings**

**Gauge adaptors**

### Product selection

<table>
<thead>
<tr>
<th>Pressure rating</th>
<th>Model</th>
<th>Pressure rating</th>
<th>Pressure rating</th>
<th>Pressure rating</th>
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<tr>
<td>psi</td>
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<tr>
<td>Range</td>
<td>Resolution</td>
<td>Range</td>
<td>Resolution</td>
<td>Range</td>
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<td>1</td>
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<td>0-140</td>
<td>0-1400</td>
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</table>

Shown: DGR-2

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

**DGR-2 Remote Operation**

Battery operated for additional flexibility. Includes maximum and minimum pressure capture.

**Back-lit Readout**

Back-lit readout allows easy reading in less than ideal lighting.

[www.enerpacwh.com](http://www.enerpacwh.com)
Enerpac gauges provide a safe and inexpensive monitoring system for your hydraulic circuit

Highly reliable and accurate pressure sensing

- ± 1.5% accuracy of full scale
- All pressure sensing parts sealed and dampened by glycerine for long life
- Includes safety blow-out disk and pressure equalizing membrane to prevent overpressurization
- Copper alloy, coiled safety Bourdon tube for 1000 psi and higher
- Dual psi and bar scale readings, 2.5 inch gauge face

Gauge accessories for easy installation

- Needle valves providing positive shut-off
- 303 stainless steel stem (NV-251)
- Snubber valves to control pressure surges between gauge and hydraulic system
- Gauge adaptors – male end screws into pump or cylinder, female port accepts hose or coupler, the third port is for gauge connection
- FM-25NG for panel mounting of 2.50 inch diameter gauges

Product selection

<table>
<thead>
<tr>
<th>Pressure gauge mounting style</th>
<th>Pressure range</th>
<th>Model number</th>
<th>PSI graduation</th>
<th>Bar graduation</th>
<th>A</th>
<th>B</th>
<th>D</th>
<th>G</th>
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<tbody>
<tr>
<td></td>
<td>psi</td>
<td>bar</td>
<td></td>
<td>psi</td>
<td>bar</td>
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<td>▼ Pressure gauge – Lower mount</td>
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<tr>
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<td>▼ Pressure gauge – Rear mount</td>
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<td>0-70</td>
<td>G-2531SR</td>
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<td>1000</td>
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<td>1.99</td>
<td>0.98</td>
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<td>G-2537SR</td>
<td>2000</td>
<td>200</td>
<td>100</td>
<td>10</td>
<td>1.99</td>
<td>0.98</td>
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Shown: G-2, G-2512L, GS-3
### Product dimensions in inches

<table>
<thead>
<tr>
<th>Gauge port number</th>
<th>Max. pressure psi</th>
<th>Model number</th>
<th>Dimensions</th>
</tr>
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<tbody>
<tr>
<td></td>
<td></td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td><strong>Gauge adaptors</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>10,000</td>
<td>GA-1</td>
<td>2.81</td>
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<tr>
<td>1/2&quot;</td>
<td>10,000</td>
<td>GA-2</td>
<td>6.10</td>
</tr>
<tr>
<td>1/4&quot;</td>
<td>10,000</td>
<td>GA-3</td>
<td>5.25</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>10,000</td>
<td>GA-4</td>
<td>4.38</td>
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<td></td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>10,000</td>
<td>GA-918</td>
<td>2.25</td>
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<td><strong>Gauge shut-off valves</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
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<td>10,000</td>
<td>NV-251</td>
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</tr>
<tr>
<td>1/2&quot;</td>
<td>10,000</td>
<td>V-91</td>
<td>3.50</td>
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<tr>
<td><strong>Gauge snubber valves</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>1/4&quot;</td>
<td>5000</td>
<td>GS-2</td>
<td>1.63</td>
</tr>
<tr>
<td>1/4&quot;</td>
<td>5000</td>
<td>GS-3</td>
<td>1.63</td>
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<tr>
<td><strong>Flange mounting for panel mounting of G series gauges</strong></td>
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<tr>
<td>–</td>
<td>–</td>
<td>FM-25NG</td>
<td>2.95</td>
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</tbody>
</table>

**Options**

- Hoses and couplers
- Digital gauges
- Pressure switches
- V-10 Auto Damper® valve

**Important**

- Do not exceed maximum pressure.
- 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.

---

www.enerpacwh.com
Manifolds, couplers, hoses, tubing

Use genuine Enerpac manifolds, couplers, hoses and tubings to connect your workholding cylinders or fixtures to the hydraulic power source.

A series, Manifolds
For multiple hydraulic line connections at one central location directing oil to or from a pressure source.

AH/AR series, Couplers
Quick disconnect low leakage couplers for easy connection of hydraulic circuits.

HLS series, Hoses
High pressure hydraulic hoses, featuring a heavy-duty protective plastic coating.

T-series, Tubing
High pressure steel tubing, available in 5 ft. lengths.

Important
Do not exceed the maximum pressure.

Inspect hoses and tubing frequently and replace as required.

Manifolds
- Easy to connect
- Mounting holes on all models

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

Hydraulic hoses and tubings
- Heavy-duty coating for abrasion resistance
- Resistant against mineral based hydraulic oil as well as water glycols
- High pressure steel tubing for permanent installations

Manifolds dimensions in inches [ ]

<table>
<thead>
<tr>
<th>Number of ports</th>
<th>Model number</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>D1</th>
<th>D2</th>
<th>E</th>
<th>F</th>
<th>F1</th>
<th>F2</th>
<th>lbs</th>
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<tbody>
<tr>
<td>2 x 4</td>
<td>A-63</td>
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<td>.28</td>
<td>1.50</td>
<td>1.00</td>
<td>SAE #4</td>
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<td>1.00</td>
<td>1.75</td>
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<td>7</td>
<td>A-61</td>
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<td>1.25</td>
<td>1.25</td>
<td>.28</td>
<td>1.50</td>
<td>1.25</td>
<td>SAE #4</td>
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<td>3.25</td>
<td>1.4</td>
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<td>A-64</td>
<td>7.00</td>
<td>1.25</td>
<td>1.25</td>
<td>.25</td>
<td>3.00</td>
<td>1.25</td>
<td>.375-18 NPT</td>
<td>1.50</td>
<td>1.25</td>
<td>3.50</td>
<td>3.3</td>
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<tr>
<td>7</td>
<td>A-65</td>
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<td>1.25</td>
<td>.25</td>
<td>8.00</td>
<td>1.25</td>
<td>.375-18 NPT</td>
<td>4.00</td>
<td>1.25</td>
<td>7.25</td>
<td>6.1</td>
</tr>
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<td>A-66</td>
<td>2.30</td>
<td>1.63</td>
<td>2.00</td>
<td>.52</td>
<td>1.50</td>
<td>–</td>
<td>.375-18 NPT</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>1.8</td>
</tr>
</tbody>
</table>

Couplers

AH-650
- Male coupler half
  250-18 NPT

AH-652
- Male coupler half
  G1/4” BSPP

AH-654
- Male coupler half
  SAE #4-437-20 UNF

AR-650
- Female coupler half
  250-18 NPT

Hoses

<table>
<thead>
<tr>
<th>Length ft</th>
<th>Model number</th>
<th>Internal diameter in</th>
<th>Maximum pressure psi</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>HLS-512</td>
<td>.19</td>
<td>5000</td>
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<tr>
<td>2</td>
<td>HLS-524</td>
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<td>3</td>
<td>HLS-536</td>
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<td>4</td>
<td>HLS-548</td>
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<td>5</td>
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<td>HLS-5120</td>
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<td>3</td>
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<td>6</td>
<td>H-9206</td>
<td>.25</td>
<td>10,000</td>
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<tr>
<td>10</td>
<td>H-9210</td>
<td>.25</td>
<td>10,000</td>
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Tubing

<table>
<thead>
<tr>
<th>Length ft</th>
<th>Model number</th>
<th>Internal diameter in</th>
<th>External diameter in</th>
<th>Max. pressure psi</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>T-2560</td>
<td>.152</td>
<td>.25</td>
<td>5000</td>
</tr>
</tbody>
</table>
High-pressure filters
- Keep your hydraulic system clean
- Pleated stainless steel wire mesh screen construction provides large filter area in a compact size
- Rated for full system pressure up to 5000 psi
- Bi-directional design allows filtration of oil in either flow direction
- Two piece body construction for easy replacement of filter elements
- High flow rates are obtainable with a minimum pressure drop
- Threaded port connections on each end simplify installation

Hydraulic oil
- Ensures effective lubricity
- Protects essential parts

Filtration
20 micron filter provides the longest service life before element replacement
10 micron filter recommended for more sensitive hydraulic components

High in line pressure filters

<table>
<thead>
<tr>
<th>Model number</th>
<th>Filtration micron</th>
<th>Filter element set</th>
<th>Pressure drop vs oil flow</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Absolute</td>
<td>Pressure drop (psi)</td>
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<tr>
<td>FL-2101</td>
<td>10</td>
<td>25</td>
<td>FL-2101K (.4)</td>
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<td>FL-2201</td>
<td>20</td>
<td>40</td>
<td>FL-2201K (.4)</td>
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</table>

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

<table>
<thead>
<tr>
<th>Contents</th>
<th>Model number</th>
<th>Specifications genuine Enerpac hydraulic oil</th>
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</thead>
<tbody>
<tr>
<td>.25 Gal</td>
<td>HF-100</td>
<td>0 °F &lt;12,000 S.U.S</td>
</tr>
<tr>
<td>1 Gal</td>
<td>HF-101</td>
<td>100 °F 150/165 S.U.S</td>
</tr>
<tr>
<td>5 Gal</td>
<td>HF-102</td>
<td>210 °F 42/45 S.U.S</td>
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<tr>
<td>55 Gal</td>
<td>HF-104</td>
<td>Flash, C.O.C. 400°F</td>
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</tbody>
</table>

Note: Viscosity index: 100 min

Do not exceed the maximum pressure.

Hydraulic power is distributed by manifolds and transported by hoses and tubing.
High Pressure Fittings  Selection & dimensions

Proper connection for hydraulic components

- Male and female NPT, SAE, BSPP threaded fittings in common sizes allow easy connection of all components.
- BFZ and FZ-1000 models are 10,000 psi maximum pressure
- FZ-2000 models are 5000 psi maximum pressure

Product selection

<table>
<thead>
<tr>
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<td>FZ-2053</td>
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| Adapters
Female Male
1/4" NPT 1/8" NPT 10,000 FZ-1642 1.21 3/4" 1/8"-27 NPT 1/4"-18 NPT
3/8" NPT 1/4" NPT 10,000 FZ-1055 1.44 7/8" 1/4"-18 NPT 3/8"-18 NPT
1/2" NPT 1/4" NPT 10,000 FZ-1633 1.69 1-1/8" 1/4"-18 NPT 1/2"-14 NPT
1/2" NPT 3/8" NPT 10,000 FZ-1634 1.89 1-1/8" 3/8"-18 NPT 1/2"-14 NPT

Reducers
Female Male
1/4" NPT 3/8" NPT 10,000 FZ-1630 .86 3/4" 1/4"-18 NPT 3/8"-18 NPT
1/4" NPT 1/2" NPT 10,000 FZ-1661 1.11 7/8" 1/4"-18 NPT 1/2"-14 NPT
SAE #6 SAE #8 5000 FZ-2029 1.38 1-1/16" 9/16"-18 3/4"-16

NPT Male Nipples
1/4" NPT 1/4" NPT 10,000 FZ-1608 1.45 5/8" 1/4"-18 NPT 1/4"-18 NPT
3/8" NPT 3/8" NPT 10,000 FZ-1617 1.45 3/4" 3/8"-18 NPT 3/8"-18 NPT
3/8" NPT 3/8" NPT 10,000 FZ-1619 2.00 3/4" 3/8"-18 NPT 3/8"-18 NPT
3/8" NPT G1/4" 10,000 BFZ-305 1.42 3/4" 3/8"-18 NPT G1/4"-19

NPT Female Connectors
1/4" NPT 1/4" NPT 10,000 FZ-1605 1.13 3/4" 1/4"-18 NPT 1/4"-18 NPT
3/8" NPT 1/4" NPT 10,000 FZ-1615 1.13 7/8" 3/8"-18 NPT 1/4"-18 NPT
3/8" NPT 3/8" NPT 10,000 FZ-1614 1.13 7/8" 3/8"-18 NPT 3/8"-18 NPT
1/2" NPT 3/8" NPT 10,000 FZ-1625 1.50 1-1/8" 1/2"-14 NPT 3/8"-18 NPT

NPT Elbows
1/4" NPT 1/4" NPT 10,000 FZ-1638 .88 3/4" 1/4"-18 NPT 1/4"-18 NPT
3/8" NPT 3/8" NPT 10,000 FZ-1610 1.02 7/8" 3/8"-18 NPT 3/8"-18 NPT

NPT Tee
1/4" NPT 1/4" NPT 10,000 FZ-1637 1.76 3/4" 1/4"-18 NPT 1/4"-18 NPT
3/8" NPT 3/8" NPT 10,000 FZ-1612 2.04 7/8" 3/8"-18 NPT 3/8"-18 NPT

NPT Cross
3/8" NPT 3/8" NPT 10,000 FZ-1613 2.04 7/8" 3/8"-18 NPT 3/8"-18 NPT

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

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

<table>
<thead>
<tr>
<th>From</th>
<th>To</th>
<th>Max. pressure psi</th>
<th>Model number</th>
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<td>FZ-2013**</td>
<td>2.03 1/2&quot; 7/16&quot;-20 ø.25</td>
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*Flared  **Flareless

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**Important**

- Use fittings and tubing in high cycle applications and areas having excessive heat or weld splatter.
- Do not exceed the maximum pressure.
- 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.

---

**Options**

- Gauges
- Manifolds, couplers, hoses, tubing

---

**Gauges**

- 190

---

**Important**

- Do not exceed the maximum pressure.
### High pressure fittings Selection & dimensions

**BFZ, FZ-series**

<table>
<thead>
<tr>
<th>Options</th>
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<tbody>
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<td><strong>From</strong></td>
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<tr>
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<tr>
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<td>▼ Cap for Tubing</td>
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<td>ø.25</td>
<td>5000</td>
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<td>ø.375</td>
<td>5000</td>
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**Flareless

- **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.**
Enerpac “Yellow Pages” stand for Hydraulic Information!

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

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

Index

<table>
<thead>
<tr>
<th>Topic</th>
<th>Page Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety instructions</td>
<td>198 - 199</td>
</tr>
<tr>
<td>Basic hydraulics</td>
<td>200 - 201</td>
</tr>
<tr>
<td>Basic system set-up</td>
<td>202 - 205</td>
</tr>
<tr>
<td>Clamping technology</td>
<td>206 - 209</td>
</tr>
<tr>
<td>Cutting tool technology</td>
<td>210 - 212</td>
</tr>
<tr>
<td>Conversion factors and hydraulic symbols</td>
<td>213 - 219</td>
</tr>
<tr>
<td>Valving technology</td>
<td>220 - 223</td>
</tr>
<tr>
<td>Flexible machining systems</td>
<td>224 - 225</td>
</tr>
<tr>
<td>Converting from mechanical clamping to hydraulic clamping</td>
<td>226 - 228</td>
</tr>
</tbody>
</table>

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

www.enerpac.com
Visit our website for the complete Enerpac Global Warranty or call your Enerpac representative or Enerpac Authorized Service Center.

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

<table>
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<td>ISO 9001 REGISTERED</td>
<td>Enerpac worked hard to earn the quality rating ISO 9001, in its ongoing pursuit of excellence.</td>
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<tr>
<td>UL approved</td>
<td>All electrical components used on Enerpac products carry the UL rating when possible.</td>
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<td>Canadian Standards Association</td>
<td>Where specified, Enerpac electric pump assemblies meet the design, assembly and test requirements of the Canadian Standards Association.</td>
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<tr>
<td>Product Design Criteria</td>
<td>All hydraulic components are designed and tested to be safe for use at maximum 350 bar/5,000 psi pressure unless otherwise specifically noted.</td>
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<td>EMC Directive 89/336/EEC</td>
<td>Where specified, Enerpac electric power pumps meet the requirements for Electromagnetic Compatibility per EMC Directive 89/336/EEC.</td>
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<td>CE Marking &amp; Conformity</td>
<td>Enerpac provides a Declaration of Conformity and CE marking for products that conform with the European Community Directives.</td>
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</table>

www.enerpacwh.com
Hydraulic clamping can increase your machine shop’s efficiency by reducing setup time. Power clamping can also maximize output by reducing employee lost time due to the injuries that can occur with manual clamping.

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

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

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

Enerpac cannot be held responsible for damage or injury, caused by unsafe use, maintenance or application of its products. Please contact the Enerpac office or a representative for guidance when you are in doubt as to the proper safety precautions to be taken in designing and setting up your particular system.

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

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

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

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

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

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

- **Use check valves to maintain hydraulic pressure to clamping devices in the event of a hydraulic line failure.**
Correct use of hydraulic power  Safety instructions

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

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

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

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

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

**Do not kink hoses. Bending radius must be at least 4.5 inch (115 mm). Do not drive over or drop heavy objects on hoses. Use high pressure tubing in high cycle applications.**

**Always use genuine Enerpac hydraulic oil.**

**Always read instructions and safety warnings that come with your Enerpac hydraulic equipment.**
**Oil Flow**
A hydraulic pump produces flow. Flow is the amount of fluid coming out of the pump.

**Pressure**
Pressure occurs when there is resistance to flow.

**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).

**Force**
The amount of force a hydraulic cylinder can generate is equal to the hydraulic pressure times the “effective area” of the cylinder (see cylinder selection charts).

Use the formula $F = P \times A$ to determine either force, pressure or effective area if two of the variables are known.
**Cylinder Oil Capacity**
The volume of oil required for a cylinder (cylinder oil capacity) is equal to the effective area of the cylinder times the stroke.

\[
\text{Cylinder}
\]
\[
\text{Oil}
\]
\[
\text{Capacity}
\]
\[
\text{=} \times
\]
\[
\text{Cylinder}
\]
\[
\text{Effective}
\]
\[
\text{Area}
\]
\[
\text{=} \div
\]
\[
\text{Cylinder}
\]
\[
\text{Stroke}
\]

**Usable Oil Capacity**
The amount of hydraulic oil in the pump’s reservoir which can be used to activate one or more cylinders.

\[
\text{Pump Usable}
\]
\[
\text{Oil}
\]
\[
\text{Capacity}
\]
\[
\div
\]
\[
\text{Pump Flow Rate}
\]
\[
\text{in}^3/\text{min (cm}^3/\text{min)}
\]
\[
\times
\]
\[
\text{Cylinder Effective Area}
\]
\[
\text{=} \times
\]
\[
\text{Number}
\]
\[
\text{of Cylinders}
\]

**Cylinder Speed**
Pressure applied at any point Cylinder speed is determined by dividing the pump flow rate by the cylinder effective area.

\[
\text{Cylinder Speed}
\]
\[
\text{in}/\text{min (mm/sec)}
\]
\[
\div
\]
\[
\text{Pump Flow Rate}
\]
\[
\text{in}^3/\text{min (cm}^3/\text{min)}
\]
\[
\times
\]
\[
\text{Cylinder Effective Area}
\]
\[
\text{=} \times
\]
\[
10
\]
\[
60
\]

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

Heat is a crucial factor in seal life. Maximum temperature for good seal life is 150°F (65°C). This is also the maximum temperature of Enerpac hydraulic oil. Above 150°F, the use of Viton and high temperature oil is necessary. Viton has a maximum temperature which is much higher than nitrate or polyurethane. Viton is however an extremely quick wearing material. In many cases Viton seals will have a short working life due to abrasive wear.

Not all machine tool coolants are compatible with standard Enerpac seals. While most are, there are coolants that can harden or soften seals, which may result in free entry of contamination into the hydraulic cylinder. Using a high water based coolant may cause severe corrosive damage. This will often occur on fixtures where coolant has been allowed to pool for an extended period of time and evaporation has allowed it to concentrate. Drain and clean fixtures after use.

Often Viton seals are an immediate cure for coolant attack on standard Enerpac seals. When using Viton seals in cylinders, seals in the power source must also be replaced by Viton because inevitably some coolant will enter the hydraulic system. Consult the coolant manufacturer to verify compatibility with any seal material. Cutting fluid suppliers will provide an application book on the compatibility of their fluids. If problems arise after previous successful use, or if problems persist, contact Enerpac.
Building the right workholding system for a specific production tooling requirement is best achieved by observing the following basic steps – three steps deal with equipment selection, one with system connection.

**Step 1**
Selecting the type of cylinders, determined by shape and size of workpiece and the machining process involved, is the critical factor in any workholding system. For that reason, Enerpac offers an exceptionally broad range of production tooling cylinders – in terms of type, stroke and force rating.

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

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

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

**Work support cylinders** are designed to maintain the workpiece accurately on the prescribed plane throughout the machining operation. These support cylinders preclude both vibration and distortion problems.

**Step 2**
Select cylinder force and stroke, and choose single- or double-acting operation. The choice of force and stroke is largely dependent on size and shape of the workpiece and machining operation involved. Another factor to be considered is working space or clearance around the job, fixture or worktable.

Where a machining operation requires positive hydraulic return action, double-acting cylinders should be specified. Where spring-return action is sufficient, single-acting cylinders or a combination of the two can be used.

**Step 3**
Select the power source. The power source for an automatic workholding system can accurately be matched to the requirements. Enerpac pumps span a wide range of sizes and capacities – in compressed air or electric-driven configurations.

**Step 4**
Connect the system. Getting your workholding system together for operation means connecting the pump to the various control valves and cylinders through a circuit of hoses and/or piping, fittings, gauges and other accessories.

For example, two swing cylinders and work support cylinders working in sequence, powered by an electric-drive hydraulic pump unit would require the following components:

1. ZW Workholding pump
2. GA Gauge adaptor
3. G Pressure gauge
4. H Hoses
5. FZ Fittings
6. SU Swing cylinders
7. WFL Work support cylinders
8. WVP-5 Sequence valve

Select all these components from their respective catalog sections.
Swing cylinders and work supports
The combined use of clamping cylinders and work supports in fixturing has become indispensable.

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

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

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

Support forces
When designing a fixture, several products features of swing cylinders and work supports have to be considered. The determination of the necessary support force and the size of the work support is very critical. In principle the work support has to overcome two forces:

- clamping forces
- machining forces (including forces that may be generated by vibrations)

Clamping forces
In practice, as a rule of thumb, the clamping force applied to the work support should not exceed 50% of its capacity at a given operating pressure. For many applications this is sufficient to absorb additional forces like machining forces. This 2 to 1 safety factor may need to be increased to 4 to 1 if extreme vibration or an interrupted cut is used.

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

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

Workpiece

Swing cylinder

Work Support

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

Figure 2
The direction of the clamping force must be axial at the centerline of the work support’s plunger for best results in clamping and repeatability of quality. Side loading of the work support must be avoided in order to ensure reliable and safe function (Figure 2).

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

Hydraulic requirements

Figure 4
Swing cylinders and hydraulically advancing work supports are very sensitive regarding the oil flow rate applied.
To ensure safe and reliable function of these elements the maximum oil flow rate indicated in the catalog pages and in the instruction literature must not be exceeded. If there is the risk of high oil flow rates it is recommended to use flow control valves to adjust the flow rate.

During the clamping sequence it must be ensured that work supports will be operated only after the workpiece is firmly positioned and held against locators and datums. However, if the cylinder is clamping directly over the work support, the work support should be brought to full pressure before the cylinders clamp. This can be done by using a sequence valve.
Hydraulic requirements (continued)

For overhanging areas of the workpiece which have to be supported, the recommended sequence should be as follows (Figure 5):
1. Positioning of the workpiece
2. Actuate work supports
3. Clamp the overhanging area against work support.

The hydraulic sequence can be controlled either by independently controlled hydraulic circuits (Figure 6) or by sequence valves (Figure 7).
1 Basic principles
1.1 A simple hydraulic clamping mechanism (Figure 1).

1.2 Terms and definitions
1.2.1 Clamping Plunger
A device that applies clamping force to the workpiece.

1.2.2 Workpiece
The part or material that is to be held in place.

1.2.3 Pressure Piston
A device used to apply pressure to a hydraulic medium.

1.2.4 Hydraulic Medium
A fluid used to transmit the pressure created by applying a force to the pressure piston.

1.3 Hydraulic clamping process
The hydraulic clamping process consists of properly applying the forces created by a hydraulic clamping system to secure a workpiece. A hydraulic clamping system consists of the components illustrated in Figure 1, which shows the basic arrangement and operating principle of the use of hydraulic media.

Any such process using hydraulic fluids for clamping purposes may be referred to as a hydraulic clamping system. The operating pressure provided by hydraulic fluids in clamping systems can reach a maximum of 5000 psi (350 bar), allowing the application of considerable clamping forces even when using compact clamping cylinders.

When properly designed and controlled, the hydraulic clamping mechanism will prevent the workpiece from moving (sliding, twisting, etc.) when machining or other forces are applied, yet will not cause an unexpected permanent distortion to occur in the workpiece.

2 Assembly of hydraulic clamping devices
2.1 Locating, clamping, and supporting workpieces
2.1.1 Locating a Body
The term “locating” refers to the process of positioning the workpiece inside the clamping device, and holding it in position for the necessary machining. Only workpieces that are correctly held can be consistently machined within specified tolerances.

2.1.2 Limiting the degrees of freedom
The process of locating and holding a workpiece may be referred to as “limiting the degrees of freedom.” Any motion of a workpiece in any possible direction is considered to represent one degree of freedom.

A three-dimensional workpiece therefore possesses six degrees of freedom, as shown in Figure 2. These six degrees of freedom consist of the translational motions “T” in x, y, and z direction, and the rotational motions “R” turning about the x, y, and z axes.

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

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

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

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

The process of locating and holding a workpiece 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.
As with clamping, locating is subject to a number of design guidelines, although exceptions are possible:

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

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

- Mechanical Clamping
- Hydraulic Clamping

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

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

Mechanical clamping is accomplished by using the following mechanical clamping elements:

- Clamping Bars
- Clamping Springs
- Clamping Nuts
- Clamping Bolts (Figure 7)

Hydraulic clamping is achieved by:

- Elastometric media
- Clamping with air (pneumatic clamping)
- Clamping with liquids (hydraulic clamping)
4 Supporting the workpiece

4.1 Supported workpiece

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

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

4.2 Supporting options for bent workpieces

a. Unclamped workpiece
b. Clamped workpiece
c. Machined workpiece

A workpiece is considered to be supported even if it must be supported by frequently mobile and variable elements surpassing the theoretical maximum number of locating points. An example of this would be an unstable workpiece that easily vibrates.

When a deformed workpiece must be held and clamped in all three planes without altering its shape, it is possible to use a technique involving self-adjusting spherical surfaces. In this case the bearing surfaces, the close-tolerance bolts, the limit stops, and the vertically adjustable supporting and clamping elements must be equipped with spherical surfaces.

The illustrations in Figure 10 illustrate two different clamping methods. It shows deformation of a workpiece caused by conventional clamping (Figure 10a). As a result of this deformation, the surface area of the workpiece exhibits a greater degree of deformation when unclamped.

This deformation, which is convex in shape, may be attributed to the fact that the workpiece assumes its original, deformed shape (c), as soon as the clamping pressure is released.

The clamping points illustrated in Figure 10b are spherically shaped, and can therefore largely adapt to the workpiece curvatures (b). The machined surface is therefore flat, and the workpiece is only exposed to possible internal stresses that may be released by machining.

4.3 Determination of the clamping force

It is important to ensure that a workpiece that is clamped inside a device is not moved from its position by the clamping force and the subsequent action of the cutting force. This risk of movement may be minimized by applying the clamping force to the solid bearing surfaces of the device (Figure 11).
Introduction
This introduction will help you use information provided by tool manufacturers in the application of their tools. Estimating cutting forces being transferred into the workpiece is just one tool to use in a competitive workholding environment.

The information presented here is only to be a guideline and not the final decision. Use this information with a cutting tool brochure you get from your cutting tool supplier as an aid in determining your cutting forces. Much of the calculations presented here are readily available from many sources. Your cutting supplier may even have a slide chart you can obtain to do equations for you.

The operations described here include boring, drilling, end milling and face milling. Drilling involves using a multi-fluted tool with a helix spiral. The tool is driven in as it is rotated to create a round hole. End Milling uses a multi-fluted rotary tool with or without removable (inserts) teeth to remove material along the edge of the workpiece. The cut is usually very shallow and the depth is many times the thickness of the cut. Face Milling involves a very shallow depth, but a very wide cut. Cutters can range up 12 inches (300 mm) or more in diameter and can have many replaceable teeth (inserts).

These examples are only a very small sample of operations that can use hydraulic workholding.

Cutting force determinations
These cutting force examples involve face milling. The largest use of hydraulic workholding is by far for some sort of milling operations.

1 Imperial system
Cutting Force (Pounds) = Spindle Horsepower x 26400 (Horsepower to foot pounds per minute at 80% efficiency)/ Cutting Speed (In tool surface feet per minute) Spindle Horsepower = Unit Power (Horsepower per cubic inches of material removed per minute) x Material removal rate (Cubic Inches per Minute)
Material removal rate (Cubic inches per minute) = Width of the cut (Inches) x Depth of the Cut (Inches) x Feed per cutter tooth (Inches) x Number of cutter teeth x Spindle RPM

Example
An 8-inch diameter cutter with 10 teeth (inserts) is machining low silicon aluminum at 3000 SFM (surface feet per minute).

First, you must convert surface feet/minute into tool RPM/Solving Tool RPM= SFM
Diameter (Inch) x .2618 = 1432 Tool RPM

Now you can determine your material removal rate. An independent tool catalog lists a feed per tooth of 0.008" maximum at 3000 SFM at cut depth of 0.1":
This gives 8" (diameter cutter) x 0.100" (cut depth) x 0.008" (feed per tooth) x 10 (number of teeth) x 1432 (spindle RPM) = 91.6 cubic inches per minute material removal rate.

Next, spindle horsepower is found using unit HP from the table Spindle Horsepower = 91.6 x 0.4 (Unit Horsepower for Aluminum with a dull tool) = 36.6 HP.

Note this Horsepower is for fixture design and not for machine tool horsepower requirements.

For example a true 40 HP machine can remove aluminum well over 200 cubic inches per minute.
Using the original formula:

\[ 36.6 \text{ hp} \times 26,400/3000 \text{ SFM} = 322 \text{ lbs.} \]

3000 SFM of force being transmitted into the work.

Force is transmitted in the same direction as the cutter movement. In other words, if the cutter moves right to left in the diagram below, the cutter force is transmitted right to left.

Using a safety factor of 2 for rigid clamping gives 644 pounds in line parallel to the line force and 483 pounds using an elastic medium such as hydraulics with a safety factor of 1.5. Note this force does not take into account any sort of friction factors if you plan on relying on friction force between a swing cylinder and the workpiece.

For example:
The coefficient of friction for lubricated aluminum is .12 (flooded with coolant) this same 483 pounds of force becomes 483/.12 = 4025 pounds. This uses clamp force only and does not take into account any direct forces that may be developed by the cylinders that located the workpiece against fixed locators.

For example:
The coefficient of friction for lubricated aluminum is .12 (flooded with coolant) this same 483 pounds of force becomes 4025 pounds. This uses clamp force only and does not take into account any direct forces that may be developed by the cylinders that located the workpiece against fixed locators.

### Unit Power for dull tools [imperial system]

<table>
<thead>
<tr>
<th>Material</th>
<th>Hardness</th>
<th>Turning HSS &amp; Carbide Tools</th>
<th>Drilling HSS Drills</th>
<th>Milling HSS &amp; Carbide Tools</th>
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</thead>
<tbody>
<tr>
<td>STEELS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plain carbon</td>
<td>85-200 Bhn</td>
<td>1.4</td>
<td>1.3</td>
<td>1.4</td>
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<tr>
<td>and malleable</td>
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<td></td>
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<tr>
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<td>1.4</td>
<td>1.4</td>
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<td>2.2</td>
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<tr>
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<td>1.0</td>
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</table>
### Cutting technology

**Metric System**

Cutting Force (Newtons) = Spindle Power (kW) x 48000 (80% efficiency) / Cutting Speed (Meters per minute).

Spindle Power = Unit Power (kilowatts per cubic centimeters of material remove per minute) x Material removal rate (cubic centimeters per minute).

Material removal rate (Cubic centimeters per minute) = Width of cut (mm) x depth of cut (mm) x feed per tooth (mm) x number of teeth x spindle RPM/1000.

**Example:**

A 200 mm cutter with 10 teeth is machining low silicon aluminum at 1000 MPM (meters per minute).

Solving Tool RPM = MPM x 1000 Diameter (mm) x π (= 1592 Tool RPM)

The same tool catalog lists a feed per tooth of 0.2 mm at 1000 MPM and a cutting depth of 2.5 mm. This gives an 200 mm cutter x 2.5 mm depth x 0.2 mm feed x 10 teeth x 1592 Tool RPM/1000 = 1592 cm³/min.

Spindle power = 1592 x 0.018 = 28.7 kW

This too is power from a fixture design standpoint; the actual operation will use less power than indicated here.

Using the original formula transposed is:

Cutting Force = Spindle kW x 48000 / Cutting Speed (Meters per minute).

Multiply by a safety factor of 2 for rigid clamping and by 1.5 for elastic clamping (hydraulic).

This calculation does not take into account coefficients of friction when using clamp cylinders. For example, if the aluminum has a coefficient of .12 (flooded with coolant), the clamping force becomes 1378/0.12 = 11483 Newtons of force. This calculation does not take into account forces being generated by the fixture positioning cylinders.

Use these numbers and set up your hydraulic system to run at about 50 to 75% of its rated pressure. This leaves some reserve for a later date when the process is optimized and you need more holding/clamp force for higher speeds and feeds. If you design to the maximum now, you have nothing in reserve.

### Unit Power for dull tools [metric system]

<table>
<thead>
<tr>
<th>Material</th>
<th>Hardness</th>
<th>TURNING P1 HSS AND CARBIDE TOOLS feed</th>
<th>DRILLING P HSS DRILLS feed</th>
<th>MILLING P HSS AND CARBIDE TOOLS feed</th>
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<tr>
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<td>Alloy Steels</td>
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<td>.086</td>
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<td>Tool Steels</td>
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<td>.086</td>
<td>.096</td>
<td>.100</td>
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<tr>
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<td>.118</td>
<td>.118</td>
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<tr>
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<td>.036</td>
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<td>Ferritic, austenitic and martensitic 30-45 Rc</td>
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<td>.068</td>
<td>.086</td>
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<td>TITANIUM</td>
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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:

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<tr>
<th>Pressure</th>
<th>Equivalent</th>
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<td>.069 bar</td>
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<tr>
<td>1 bar</td>
<td>14.50 psi</td>
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<tr>
<td>1 MPa</td>
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Volume:

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<tbody>
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<td>1 liter</td>
<td>61.02 in³</td>
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<td></td>
<td>.264 gal</td>
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<td>1 US gal</td>
<td>3.785 cm³</td>
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<tr>
<td></td>
<td>3.785 l</td>
</tr>
<tr>
<td></td>
<td>231 in³</td>
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Weight:

<table>
<thead>
<tr>
<th>Weight</th>
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<tr>
<td>1 metric ton</td>
<td>2205 lbs</td>
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<tr>
<td></td>
<td>1000 kg</td>
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<tr>
<td>1 ton (short)</td>
<td>2000 lbs</td>
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<tr>
<td></td>
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</table>

Temperature:

To Convert °C to °F:

\[ T °F = (T °C \times 1.8) + 32 \]

To Convert °F to °C:

\[ T °C = (T °F - 32) \div 1.8 \]

Other measurements:

<table>
<thead>
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Imperial to metric

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Metric to imperial

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<th>Inches</th>
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Best practices in hydraulic system design

The following information consists of recommendations, advice and general rules regarding the design of hydraulic workholding systems. These tips apply to just about any system, and are a good starting point if you have questions about what products to use and how to apply them properly.

General design
Double-acting cylinders should always be used in applications where cycle time is critical. While the cylinders are designed with strong return springs, they may not consistently overcome the effects of long runs of tubing, orifices, and other restrictions. Double-acting cylinders help eliminate these effects.

Many hydraulic pumps are rated for substantial flow rates (10 gpm or more) that are far beyond the requirements of a hydraulic workholding system. While these pumps can be used, it is not recommended in general practice. Workholding cylinders are typically very small in comparison to the types of cylinders that these pumps were designed to operate. You will spend a great deal of time and money reducing the flow through the use of valving and still may not have an ideal system. Consider a separate hydraulic pump rated for less flow whenever possible.

Spool valves are very common and inexpensive, but also have their share of issues regarding use in hydraulic workholding systems. Spool valves are designed for use at much higher flow rates than those typically seen in workholding circuits. In fact the acceptable internal leakage in these valves is typically equal to the total amount of flow required for a small workholding circuit. And, the leakage will result in improper function and possible damage to many pumps designed for workholding systems.

Breather vents on cylinders are often overlooked. When you put oil into a single-acting cylinder and it begins to advance, the opposite side of the cylinder is filled with air. This air has to go somewhere. The breather vent provides this path. In turn, when the cylinder is retracting, and oil is leaving the cylinder, a vacuum is created and air needs to re-fill that opposite side of the cylinder. If the breather vent is located in an area that is subject to contamination from coolant, and chips, these items will also get pulled into the cylinder. Make sure the breather vent is plumbed to a clean location at all times.

Swing cylinders
The swing cylinders turn on a mechanical concept of a ball or a pin riding in a hardened groove. Trying to turn this too fast with a large heavy arm will result in enormous pressure on the ball or the pin, causing damage and eventually failure. A large arm also increases the amount of side load introduced into the cylinder. As the length of the arm increases, the allowable clamp load has to decrease accordingly. Follow the one-second rule: it should take at least one full second for the clamp arm to rotate and engage the part. Anything faster can result in damage.

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

Manifold mounting
Manifold mounting of cylinders significantly decreases the amount of space required on a fixture. It also makes installation and service much simpler. Be sure to clean and de-burr all passages in the fixture manifold. Burrs can break loose over time and be ingested into the hydraulic cylinders, causing severe damage. If you have a long line of cylinders all in the same manifold, route the passages from the center out and use large diameters for the main feed line. The use of small passages everywhere in the manifold will cause drastic backpressures on single-acting circuits.

Be sure to include a passage for the breather vents where necessary. This passage should be routed to a large open area, not an enclosed cavity. Eventually, an enclosed cavity may fill up with chips and coolant and begin to work into the cylinders.
Power sources

Single-stage electric pump
Example
ZW4010NB-S

Two-stage electric pump
Example
ZW5020NG

Reciprocating air pump
Example
PA-136

Single-acting booster
Example
B-3006

Double-acting booster
Example
AHB-34

Activator wand and booster
Example
B-171
RA-1061

Turbo air pump
Example
PATG-3102NB

Turbo air pump
Example
PASG-3002SB

Turbo air pump
Example
PAMG-3402NB

Turbo air pump
Example
PACG-3002NB

Hydraulic intensifier
Example
PID-321

Hand pump
Example
P-142
## Valves

### 2-position manual

- Series: V
- Example: VM-2

### 2-position solenoid

- Series: VE
- Example: VED-15000A

### 3-position manual

- Series: VE
- Example: VEE-15000A

### 3-position solenoid

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

### 3-way, 2-position, Normally open

- Series: V
- Example: VM-2

### 3-way, 3-position, Tandem center

- Series: VM-3, VC-3
- Example: VEF-15000D

### 3-way, 2-position, Normally closed

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

### 3-way, 2-position, Crossover offset

- Series: V
- Example: VM-2

### 4-way, 3-position, Tandem center

- Series: VM-4, VC-4
- Example: VEC-15000D

### 4-way, 2-position, Normally open

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

### 4-way, 3-position, Closed center

- Series: VC-15
- Example: VEG-15000A

### 4-way, 2-position, Air valve

- Series: VA
- Example: VA-42

### 4-way, 3-position, Closed center

- Series: VC-20
- Example: VEB-15000A

### Rapid air exhaust valve

- Series: VR
- Example: VR-3

### Pressure relief valve

- Series: V
- Example: V-152
Valves

Sequence valve
- **Series**: MVP, WVP
- **Example**: MVPM-5, WVP-5

Pressure limiting valve
- **Series**: PLV
- **Example**: PLV-40013B

Pressure reducing valve
- **Series**: PRV
- **Example**: PRV-3

Check valve
- **Series**: V
- **Example**: V-17

Check valve, Pilot operated
- **Series**: MV, V
- **Example**: MV-72, V-72

Flow control valve, Free flow check
- **Series**: VFC
- **Example**: VFC-1

Shut-off valve
- **Series**: V
- **Example**: V-12

Auto-damper valve
- **Series**: GS, V
- **Example**: GS-2, V-10
Cylinders

Single-acting cylinder, Push
Example
CSB-18252
CST-5131
CSM-18131

Single-acting cylinder, Pull
Example
PLSS-51
PTSS-51
PUSS-51

Double-acting cylinder
Example
CDB-18252
RD-96
CDT-18131

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-111

Fluid advance work support
Example
WFL-111

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

Pull down clamp
Example
ECH-202

Collet-Lok® work support
Example
WPFS-200
WPTS-200

Collet-Lok® swing cylinder
Example
WPFR-100
WPTR-100

Collet-Lock® push cylinder
Example
WPFS-100
WPTS-100
System components

Pressure gauges
Example
DGR-1
G-2534R

Air regulator
Example
RFL-102

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

Accumulator, Gas charged
Example
ACL-201
WA-502

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

Accumulator, Spring loaded
Example
ACM-1

Rotary coupler, Single passage
Example
CR-111

Heat exchanger
Example
ZHE-1

Rotary coupler, Double passage
Example
CRV-221

Return line filter, high pressure filter, in line
Example
PFK-25
FL-2101

Rotary coupler, Four passage
Example
CRV-441

Pressure switch
Example
IC-50
Valving Technology  How and when to use hydraulic valves

Valve types and functions

Hydraulic valves can be divided into 3 groups:

1. Directional Control
2. Pressure Control
3. Flow Control

1  Directional control valves

Ways – the (oil) ports on a valve

A 3-way valve has 3 ports: pressure (P), tank (T), and cylinder (A).
A 4-way valve has 4 ports: pressure (P), tank (T), advance (A) and retract (B).

Single-acting cylinders require at least a 3-way valve, and can, under certain instances, be operated with a 4-way valve.
Double-acting cylinders require a 4-way valve, providing control of the flow to each cylinder port.

Positions – the number of control points a valve can provide

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

Operation – the way to shift the valve into position

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

The valve position can be solenoid operated using power supply.

Center configuration

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

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

The next most common is the Closed Center configuration, which is used mostly for independent control of multi-cylinder applications. This configuration again provides for no movement of the cylinder, but also dead-heads the pump, isolating it from the circuit.

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

Another commonly used valve configuration is Float Center. This type of valve allows the cylinder ports to drain pressure back to tank. Used with a pallet mounted pilot operated check, it allows the hydraulics to be disconnected from the pallet.
Advance, hold and retract
The direction of the oil flow can be controlled depending on valve type, valve positions and port functions.

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

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

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

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

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

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

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

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

Relief valve

The most common type of pressure control valve is the pressure relief valve. This valve is used to limit the maximum pressure in the hydraulic circuit. This valve should always be included in any hydraulic system to limit the circuit to a maximum safe pressure. When used in a system, design considerations should be made since the valve does not act instantly. As the pressure approaches the set point the valve will at first only permit a very small amount of oil to pass. It is only when the valve opens farther that the full flow will pass through the valve.

From a practical standpoint, don't set the relief valve with a hand pump and then use it with a power pump and vice versa. The point of operation will vary. Also because of this action, when used in application with a pressure switch, the pressure setting on the pressure switch should be set at least 500 psi (35 bar) lower than the point at which the relief valve opens. This will prevent rapid cycling of the motor on the pump because of the slight pressure loss 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.

Enerpac sequence valves have a free flow return check meaning that there is no sequence action when the circuit is unclamping. There is however a small bias spring that will open at about 30 psi (2 bar). This will ensure a positive seal when the valve must provide sequence action in the forward direction. When multiple sequence valves are used they should be used in parallel and not in series. If used in series, these 30 psi (2 bar) bias springs will restrict the flow in an accumulative effect.

For example, if three valves are used, there would be about 3 x 30 psi = 90 psi (6 bar) of backpressure on components after the sequence valve in the system. While on a 5000 psi (350 bar) system this pressure may not seem like much, it is enough to prevent a single-acting swing from unclamping all the way or possibly cause a work support to not fully release and not properly readjust for the next part.

Pressure reducing valve

As the name implies, this valve will reduce the pressure to a lower value for a secondary part of the circuit. This is useful, for example, when you must reduce the capacity of a swing cylinder that might be clamping over a work support. The pressure reducing valve will automatically make-up pressure loss after the valve by permitting a very small amount of oil to the secondary circuit.

This pressure difference from when the valve first closes to the point it re-opens for pressure make-up is referred as the “deadband” of the valve. For example, on the Enerpac pressure reducing valve, this deadband is about 5% of the system pressure. If your system pressure is 3000 psi (210 bar) and the reduced pressure is 2000 psi (140 bar), the pressure in the secondary part of the circuit would need to drop 5% of the system pressure, [3000 x .05 = 150 psi (10 bar)] before the valve would open.

In this case the secondary part of the circuit would drop to 1850 psi (127.5 bar), before the valve would open and permit oil to flow to the secondary part of the circuit to return the pressure to 2000 psi (140 bar). This valve provides this function in only one direction with free flow in the reverse direction to allow cylinders to unclamp or work supports to unlock.

Sequence valve

This valve controls the order in which various branches of the hydraulic circuit operate. It sequences the order of the actions. In practice, one part of the circuit will reach a preset pressure at which point the sequence valve will open and permit oil to flow to the secondary part of the circuit. When the flow to the secondary part of the circuit begins, the pressure in the first part of the circuit will remain at the set point permitting for example a work support to stay at its rated pressure as the swing cylinder clamps.
How and when to use hydraulic valves

Valving Technology

Pressure limiting valve

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

3 Flow control

Flow control valves

Flow controls permit the change of speed of a hydraulic component through the use of an adjustable orifice. Unlike a regular flow control that provides the same flow restriction in both directions, these flow controls provide a free flow reverse check. This allows restricted flow in one direction and unrestricted flow in the other. This is a very important feature when using a flow control to regulate the speed of a single-acting swing cylinder or work support. The cylinder requires the clamping speed be regulated to a safe value through the use of a flow control to prevent damage to the cylinder. When unclamping, the spring in the cylinder will develop only a small amount of pressure. To ensure rapid unclamp time, back pressure, or resistance, must be minimized. Free flow reverse checks allow you to minimize this resistance.

Pilot operated check valves

A check valve only permits the flow of oil in one direction. The pilot operated check valve works the same as a regular check valve but also has an additional port for a pressure signal. Pressure to this extra port will mechanically open the check valve to permit the oil to flow in both directions. The pilot operated check is useful in holding pressure over a period of time in a remote part of a circuit, but allowing the pressure to be released using a pressure signal to the extra port on the valve. Usually this pressure is much lower than the system pressure you are holding back. Enerpac pilot operated check valves only require 15% of the system pressure you are clamping with to open the check valve, permitting the oil to return from the fixture and unclamp the part.
One of the most important aspects of machining cycle times is the speed and precision of the workpiece positioning, clamping and release.

The speed of these actions is greatly improved through the use of hydraulic workholding components, leading to increased efficiencies and cost savings.

Use of palletized fixtures

Being able to load many parts onto palletized fixtures also greatly increases the productivity and efficiency of the machining cycle. The use of palletized fixtures poses several problems however. The clamping cylinders must be repeatedly connected and disconnected from the hydraulic power source to make use of the flexibility of the pallets.

With conventional hydraulic cylinders, this also requires the use of load holding valves and accumulators to maintain pressure. With proper maintenance, this system of hydraulic workholding is very effective. This type of clamping is also very susceptible to contamination, and additional care must be taken to maintain the filtration and preventive maintenance schedules required.

Enerpac’s exclusive Collet-Lok® technology

There is another solution to palletized clamping. Enerpac’s exclusive Collet-Lok® technology eliminates the need for live hydraulics to be maintained on the pallet during the machining cycle. Once the part is hydraulically clamped in position for machining, the cylinders are mechanically locked in place. This mechanical lock replaces the accumulators, load holding valves and other requirements of live hydraulic palletized circuits. Once the machining cycle is complete, the mechanical lock is released, and the cylinders can be retracted to allow for the next piece to be loaded.

Enerpac offers swing cylinders, work supports and push cylinders with Collet-Lok® technology incorporated. Used in conjunction with an automatic coupler, pressure switches and proximity sensors, this technology can provide a totally automated and accurate clamping cycle.

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

Port #1 is first pressurized to apply the appropriate clamping force. Once this pressure is reached, a sequence valve opens, sending pressure to Port #2, which mechanically locks a wedge into place. This wedge locks the plunger in place, preventing movement, and maintaining the clamping force on the workpiece. The pressure should now be removed and machining can be performed at any time. This lock can be maintained for minutes, hours, even days, without the need for hydraulic pressure.

Once the machining cycle is complete, and the workpiece needs to be changed, the lock can be very easily removed. Pressure should be applied to Port #3 to unlock the wedge system. Once the wedge is unlocked, and the plunger is free, pressure can be applied to Port #4 to allow the plunger to retract. With this complete, the machined workpiece can be removed and a new piece can be loaded into the fixture to continue the process.

This system is the ultimate in system automation and positive control in clamping technology. For more information, be sure to consult Enerpac to receive additional literature and installation instructions.
Hydraulic Clamping and Hydraulic Mechanical Locking

Step 1 2-way Auto coupler connects external power source with pallet part and the Collet-Lok® cylinder is activated for hydraulic clamping.

Step 2 After reaching maximum clamping pressure the sequence valve is opened and actuates the internal wedge hydraulically.

Step 3 The wedge system secures the plunger position mechanically and the hydraulic pressure is taken off, then the auto coupler retracts. The product on the pallet is now securely clamped, without being connected to a power source.

Step 4 After being in the center of the machine the pallet returns to the loading and unloading position and the auto coupler is connected again to release the wedge.

Step 5 The hydraulic plunger is now retracted and the pallet is free for unloading and loading.

WPTR-100 Collet-Lok® swing cylinder
1 = 90° Rotation + Clamp
2 = Lock
3 = Unlock
4 = Unclamp + 90° Rotation

WCA-62, WPA-62 Auto coupler
A = Pressure line from pump to swing cylinder
B = Pressure line from pump to swing cylinder
C = Auto coupler advance
D = Auto coupler retract

www.enerpacwh.com
Mechanical clamping versus hydraulic clamping

Many factors should be taken into account when deciding whether to use mechanical or hydraulic workholding products for clamping your parts. In general, hydraulic clamping should be used in high volume applications, or when critical tolerances need to be held. Mechanical clamping products can be used in shorter production runs, or on rougher procedures where surface finishes and tight tolerances are optional.

For example, using hydraulic workholding products will allow you to maintain within a 1% accuracy on your clamping force. This is through the use of digital pressure switches, electric powered pumps and hydraulic clamping and support cylinders. This type of accuracy may be necessary when machining a surface requiring tight tolerances, less than .001 inch (0.025 mm). The slightest variation in clamping force could result in part movement or deflection greater than the required overall tolerance (Figure 1). In situations like this, the investment in hydraulic clamping is undeniable.

Mechanical clamping products are sufficient when tight tolerances are not required, or when the part is a large casting for example, and no amount of clamping force will distort the part. A typical operator, for example, can tighten a stud over a clamp to a specific torque value with possibly only 10% accuracy using a manual wrench. This could result in significant differences in part height and position on a fixture (Figure 2). However with a rough casting where the required finish is not critical, this may be acceptable. And, for the cost of mechanical clamping compared to hydraulic clamping, the choice is easy.

There are also situations where hydraulic clamping is not only not necessary for accuracy, but also, potentially dangerous. A perfect example of this is a die casting machine. Heat is an enemy of hydraulic components, and die casting obviously generates an enormous amount of heat. Mechanical clamping is an excellent and safe solution to the problem.

Production quantity runs should also be taken into account along with time savings and cost of materials when choosing between hydraulic and mechanical clamping.

Mechanical clamping is typically less expensive but more time consuming compared to hydraulic clamping.

See the examples below for ideal situations in which to use hydraulic or mechanical clamping:

**Example 1**
- Production quantity: 60,000 pieces
- Part material cost: $25
- Machine time cost: $150 p/h
- Hydraulic fixture and component cost: $30,000
- Parts per fixture: 4
- Load/unload time: 20 seconds
- Run time: 720 seconds

The run time and the load/unload time equate to 185 seconds of machine time per part. The machine costs money no matter whether you are actually cutting chips or waiting to cut chips while you are loading the parts. This is why you must take both the load and the run time into account.

This 185 seconds per part equates to being able to run 155 parts per 8 hour day, at an additional cost of $7.71 per part due to machine time cost of $150.00 per hour.

The hydraulic fixture cost of $30,000 divided over 60,000 parts equates to an additional $0.50 per part. All together, in this very simple example, you have added only $8.21 to the cost of the part. This $8.21 equates to only about a 33% increase in cost. Granted, there are more aspects which could be factored in, but you can see the minimal cost added by hydraulics in this example.

Assume that you were only running 3000 parts on a small run. The machine time is the same, but now, the hydraulic fixture and components adds an additional $10 to the cost of the part (30,000/3000 parts). This is a total of $17.71 additional cost, or a 71% increase. Hydraulic clamping is much too expensive for such a short run.
Example 2
Production quantity: 3000 pieces
Part material cost: $25
Machine time cost: $150 p/h
Mechanical fixture and component cost: $5000
Parts per fixture: 4
Load/unload time: 240 seconds
Run time: 720 seconds

In this example, the production quantity is much lower, and mechanical clamping is being used. The same part is being machined, on the same machine process. The mechanical clamping fixture is much less expensive, only adding $1.67 to the cost of each part. However, the load/unload time has increased significantly since the operator has to manually clamp each part. The machine is now only able to produce 120 parts per 8 hour day. This adds $10 to the cost of each part in machine time cost. All together, $11.67 has been added to the cost of each part, a 47% increase. While this may seem significant, remember that the cost increase using hydraulic clamping was 71%. Mechanical clamping is a much better choice in the lower production runs, even though it may be slower.

Many factors must be taken into account to decide on either mechanical clamping or hydraulic clamping. For example, taking labor into account can significantly add to the cost of mechanical clamping, since it is a much slower process. These examples are very simple and do not include all of the variable details that could affect your decision. Be sure to account for every situation in making your choice.

Replacing mechanical clamping with hydraulic clamping

In order to properly replace a mechanical clamping set-up with hydraulic cylinders, the most important thing to understand is the amount of clamping force being applied to the part. Figure 3 is an example of a typical mechanical clamping set-up for either one part or two parts. In this situation, the operator tightens the nut on the clamping stud, which in turn applies a holding force to the work piece. In order to convert this set-up to hydraulic clamping, you will need to know some values from Figure 3.

You will also need to know whether the clamping stud and nut are lubricated or dry. This makes a difference in how much clamping force is generated.

The first thing to know is how tight that nut is being applied to the clamping stud. This is best measured using a torque wrench. Even though the operator may not use a torque wrench in the everyday use of the fixture, it is critical to be able to provide a torque reading when converting to hydraulic clamping.

It may be necessary to use a torque wrench on the part a few times in order to get a good consistent value to be used in calculating the clamping force.
Once you have determined the amount of torque being applied to the clamping stud, and you have measured the diameter of the stud, and the distances \( L_1 \) and \( L_2 \), the clamping forces can be calculated. It is important to understand that the amount of clamping force being put into the clamping stud is not the same amount of force being applied to the part. In this setup, much less force gets applied to the part. You can calculate the force applied to the stud using the table. The force applied to the part is based on the formula.

\[
F_1 = \frac{L_2}{L_1 + L_2} \cdot F_T \\
F_2 = \frac{L_1}{L_1 + L_2} \cdot F_T
\]

When \( L_1 = L_2 \) (when the clamping stud is exactly halfway between the clamping points), \( F_1 = F_2 = \frac{1}{2} F_T \)

### SAE stud sizes

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Note: Values in the charts above are based on theoretical values. The chart values are meant to be guidelines in determining equivalent hydraulic cylinders for an application, but are by no means exact.

Factors such as lubrication, material, plating and method or torque application can affect the actual clamping force. Please use proper engineering practices when designing a fixture.
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• IGES
• STEP
Section index

Collet Lok® Products
8-19

Swing Clamps
20-42

Work Supports
43-51

Linear Cylinders
52-93

Power Sources
94-133

Valves
134-159

Pallet Components
160-185

System Components
186-196

Yellow Pages
197-228

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