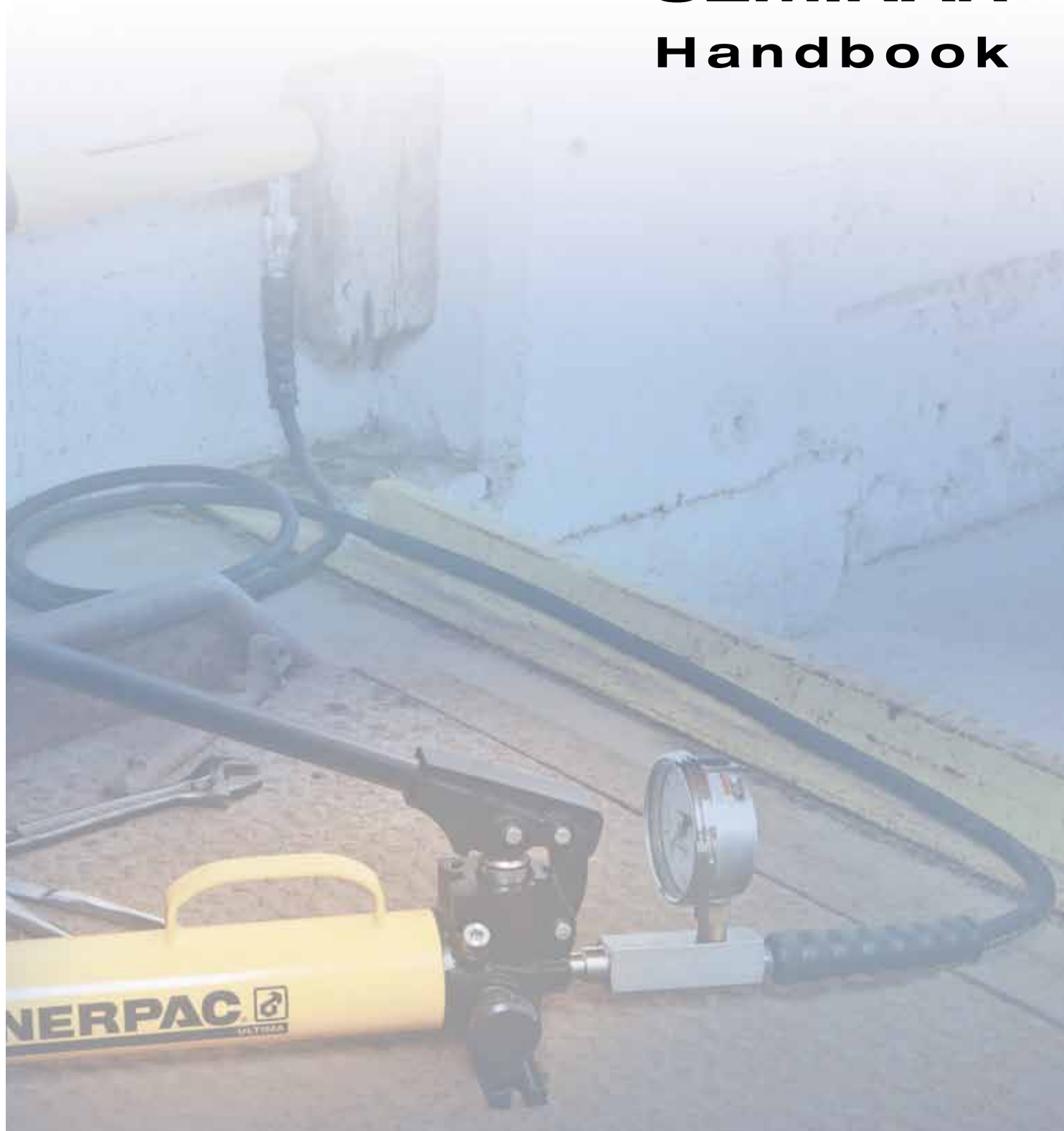


SEMINAR Handbook



THINK

SAFETY

THINK

ENERPAC 



TABLE OF CONTENTS

From Enerpac to YOU	4
High Pressure Hydraulic Tools	5
Lifting Forces	6
Components	7
Bottle Jacks	7
Cylinders	8-9
Hand Pumps	9
Hoses	10
Couplers	11
Oil	12
Gauges	13
Hydraulic Tools	14
STB-Series Pipe Benders	14-15
Heavy Duty Caterroller Load Skates	16-17
Machine Lifts	18-19
Pullers	20-21
Hydraulic Punches	22
Nut Splitters	23
Hydraulic Torque Wrenches	24-25
Hydraulic Systems.....	26
Basic Hydraulic System	26-27
Presses	28
Maintenance Set	29-30
Setup Considerations.....	31
Extensions	31
Work Area	31
Equipment Storage.....	31
Brief Summary	32
Questions	33
Answers	34

From Enerpac to YOU Thank you for using Enerpac hydraulic tools and welcome to the Hydraulic Tool *Safety Seminar Handbook*. This handbook is a companion to the Hydraulic Tool *Safety Seminar Video*, which is part of the *Enerpac Think Safety Kit*. The handbook contains an overview of the information that was presented in the video and questions to help you study what you learned in the video.

Promoting personal safety is the primary goal of the *Think Safety Kit*. Whether you work in maintenance or production; power plant, shipyard, mine, shop floor, or construction site; we hope you will learn to use your hydraulic tools safely. When you practice safety, you also benefit by being more efficient and by increasing the useful life of your tools.

This seminar presents real concerns that real people deal with on a day-to-day basis. It's not just an exercise to fulfill a safety training requirement. You must be diligent when it comes to safety. We can provide high quality tools and accessories, but it is up to you to be aware of the situations that you put yourself and others into.

If you have a situation that is not covered in this seminar, please call our Technical Services Department at **1-800-558-0530**. We are here to make even your toughest job easier.

We sincerely hope this seminar helps you get the most out of your Enerpac hydraulic tools.

Keep this handbook in your work area for ready reference.

High Pressure Hydraulic Tools High pressure hydraulic tools are designed to be operated up to 10,000 psi [700 bar] hydraulic pressure. Most fluid power systems operate at 3,000 psi [210 bar]; with some going up to 5,000 psi [350 bar]. The hydraulic pressure is the pressure that builds up inside the equipment (jacks, pumps, cylinders, hoses). Any components connected to a high pressure pump must also be rated to withstand 10,000 psi [700 bar] because the entire system becomes pressurized to 10,000 psi [700 bar].

Equipment Ratings Equipment ratings include many different specifications. The ratings that you need to be the most concerned with are hydraulic pressure or maximum rated pressure, capacity or tonnage, stroke, and oil capacity. These ratings are used to choose the correct equipment for your application. The ratings are explained in the table below.

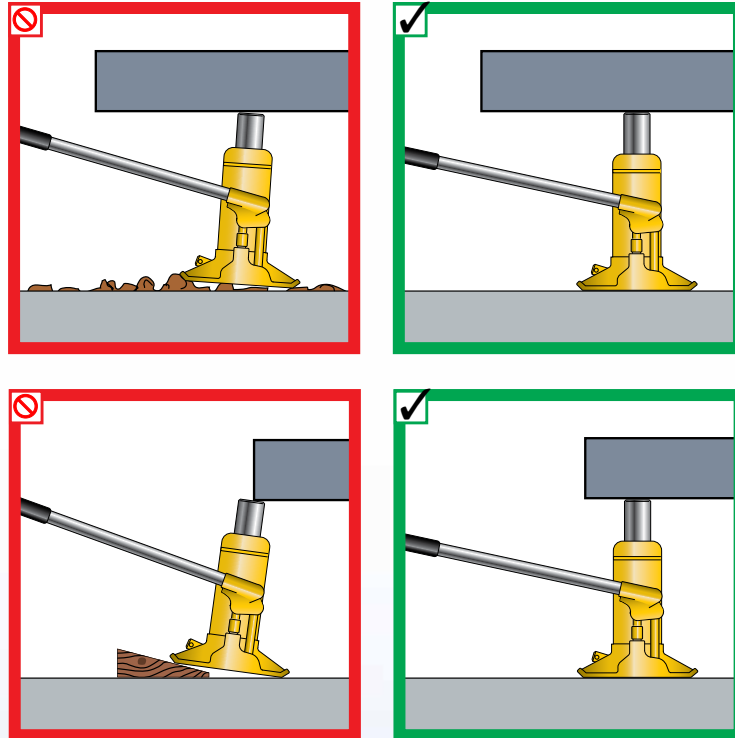
RATING	DESCRIPTION
High pressure or Maximum Rated Pressure	This is the maximum operating pressure. All components in a hydraulic system have a maximum pressure rating. The operating hydraulic pressure should never be higher than that of the lowest rated component in the system.
Capacity or Tonnage	This is the maximum amount of weight a tool can lift, push, pull, or squeeze. Jacks, cylinders, presses, spreaders, and other accessories have capacity or tonnage ratings.
Stroke	This is the distance that the plunger will extend out of a jack, cylinder, or press. The stroke rating must be longer than the distance that you are moving the load (except in staged lifting applications).
Oil Capacity	This is the amount of oil a component holds. The pump must hold enough oil to fill the hydraulic circuit.
NOTE: If you are sizing equipment for an application, choose the cylinder first and then the pump. The pump should have a big enough reservoir to fill the cylinder and hose(s). New hoses are not filled with oil.	

Safety Factors High pressure hydraulic tools are designed to be safely operated up to the manufacturer's ratings. They are not designed with an unspecified safety factor that allows you to exceed the equipment rating. In fact, it is safer to use high pressure tools at 80% of their maximum instead of 100%. The 80% rule is explained in greater detail under **Setup Considerations** on page 8.



REMEMBER: The 80% Rule – It is safer to use high pressure tools at 80% of their maximum rating instead of 100%.

Lifting Forces This section briefly explains some of the forces at work while you are lifting a load with a jack or cylinder. The main line of force is through the center of the plunger. The weight should be distributed as close to this center line as possible. The entire base of the jack or cylinder needs to be on a solid and level surface for a stable lift. Good and bad lifts are pictured below.



If the load is not centered or the entire face of the plunger saddle does not contact the load, side loading will occur. Side loading creates an unstable setup which may shift or fall. It also damages the jack or cylinder by distorting the wiper seal and bending the plunger. Side loading increases with distance. The further you extend the plunger, the more unstable it becomes.

Components

In this section you will find information about the basic components that make up a hydraulic system.

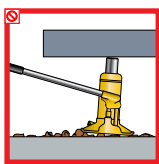
BOTTLE JACKS



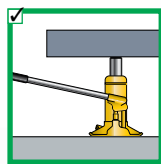
The bottle jack is one of the oldest and most familiar pieces of hydraulic equipment. This familiarity contributes to misuse which can lead to personal injury.

The bottle jack is a load lifting device and should never be used as a load holding device, especially when a person will be going underneath the supported load.

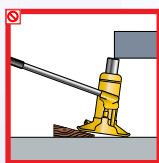
KEEP THE FOLLOWING IN MIND WHEN USING A BOTTLE JACK:



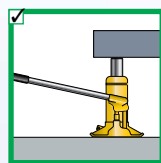
Provide a level and solid support for the entire jack base area.



◀ The base of the jack should be fully supported and as level as possible. When working on soft surfaces, put a sturdy metal plate under the base of the jack for stability.



The entire jack saddle must be in contact with the load. Movement of the load must be in the same direction as jack plunger.



◀ The saddle on the end of the plunger should make full contact with the load. Try to move the load on the centerline of force to prevent side loading.



Never place any part of your body under the load. Ensure the load is on a solid support before venturing under.



◀ Do not try to lift a load more than the rated stroke. If you need to lift the load further, block the load, raise the level of the jack with a sturdy support, and continue the lift.



REMEMBER: Do not go under a load supported by a jack. After the load has been raised, it should be blocked.

CYLINDERS



The cylinder (or ram) operates much the same as the jack, except that it is more versatile. Since the pump is separate, the cylinder can be used in several positions. By adding extensions and attachments to the cylinder, you can create a wide variety of hydraulic tools. The extensions and attachments are covered in the **Maintenance Set** section of this handbook on pages 29-30.

The saddle in the plunger serves two important purposes. It protects the plunger threads from damage and it keeps the end of the plunger from becoming deformed. Keep the saddle in place at all times. Do not thread attachments into the plunger and rely on the plunger threads for support. The load must be transferred to the face of the plunger. The threads in the plunger may be stripped if loaded.

As with the bottle jack, the cylinder is a load lifting device and should never be used as a load holding device, especially when a person will be going underneath the supported load.

KEEP THE FOLLOWING IN MIND WHEN USING A CYLINDER:



- The base of the cylinder should be fully supported. Where applicable, use a cylinder base plate for added stability. Do not weld or otherwise modify the cylinder to attach a base or other support.

- The saddle on the end of the plunger should make full contact with the load. Try to move the load on the centerline of force to prevent side loading. Be especially careful about side loading long-stroke cylinders.
- Do not try to lift a load more than the rated stroke. If you need to lift the load further, block the load, raise the level of the cylinder with a sturdy support, and continue the lift.

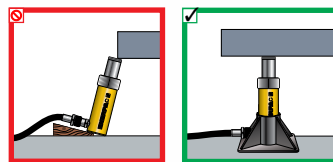


REMEMBER: Do not go under a load supported by a cylinder. After the load has been raised, it should be blocked.

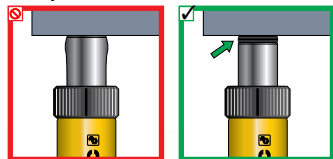
SETUP CONSIDERATIONS: THE 80% RULE

When you make hydraulic setups, you should always examine the setup before using it. You want to look for ways to protect yourself and others, and ways to protect your equipment and other property.

Try to create the ideal setup. Since few things in life are ideal, following the 80% rule will result in more stable setups and prolong



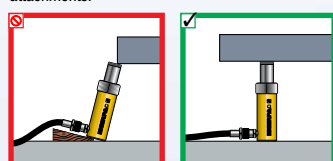
Provide a solid support for the entire cylinder base area. Use cylinder base attachment for more stability.



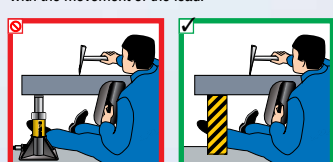
Do not use cylinder without saddle. This will cause plunger to "mushroom." Saddles distribute load evenly on the plunger.



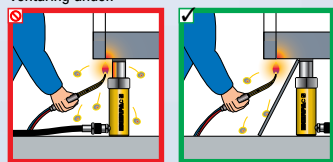
Always protect cylinder threads for use with attachments.



The entire cylinder saddle must be in contact with the load. Movement of the cylinder must be parallel with the movement of the load.



As with jacks, never place any part of the body under the load. Load must be on cribbing before venturing under.



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

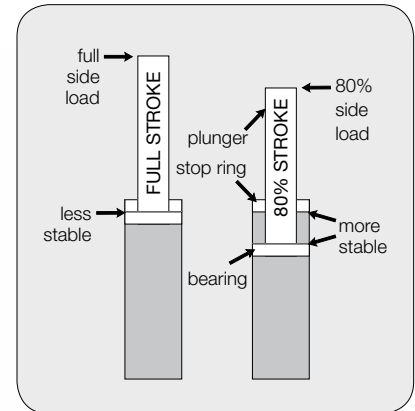
the life of your equipment. The 80% rule applies to cylinder stroke and cylinder capacity.

Cylinder Stroke

The illustration at right shows two benefits of applying the 80% rule to cylinder stroke. The first is that leaving distance between the stop ring and the bearing reduces side loading force resulting in a more stable cylinder. The second is that you avoid damaging the stop ring by running the plunger all the way up and hitting the stop ring with the bearing.

Cylinder Capacity

The reason for applying the 80% rule to cylinder capacity (tonnage) is that most loads are not lifted on their true center. This results in side loading of the cylinder. Allowing for a safety factor is the simplest way to compensate for the off-center characteristics of a one-point lift.



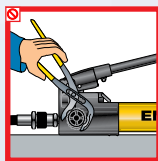
HAND PUMPS



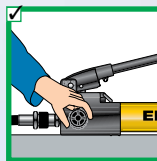
Hand pumps are a convenient, portable source of hydraulic power. They are designed to be stable during operation. For best performance, operate the pump handle at moderate speed. When the handle gets hard to push at high pressure, take short strokes. The maximum leverage is obtained in the last 5 degrees of stroke. Adding an extension to the pump handle is dangerous and is not recommended.

THINGS TO REMEMBER WHEN USING A HAND PUMP:

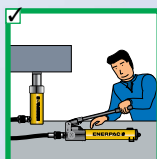
- Close the release valve finger tight only. Using tools on the release valve can damage it and cause the pump to malfunction.
- In certain situations the pump handle can “kick back.” Always keep your body to the side of the pump, away from the line of force of the handle.
- Many hand pumps can be operated in the horizontal or vertical position. However, *when using it in the vertical position, the hose end must be down or you will pump air instead of oil.* Check the pump instruction sheet to determine the correct operating position for your pump.



Close release valve finger tight. Using force will ruin the valve.



Don't use handle extenders. Hand pumps should be easy to operate when used correctly.



HOSES

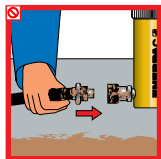
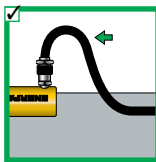


Rubber hoses are made in 4 layers: a rubber tube on the inside, 2 layers of wire braid, and a protective rubber layer on the outside. If the wire braid can be seen from the outside, it is time to replace the hose. Rubber hoses have a 2:1 safety factor. Thermoplastic hoses are frequently used with power-driven hydraulic pumps. Only 700 series thermoplastic hoses have a 4:1 safety factor.

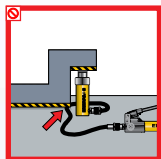
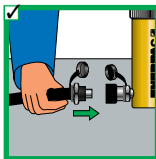
USE THE FOLLOWING INFORMATION TO AVOID PROBLEMS WITH HOSES:



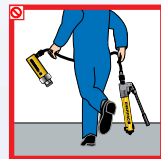
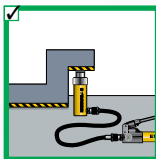
Don't kink hoses. Bending radius should be at least 4½ inch. Don't drive over or drop heavy objects on hose.



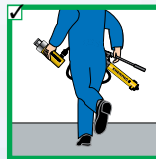
Clean both coupler parts before connecting. Use dust caps when coupler parts are not connected.



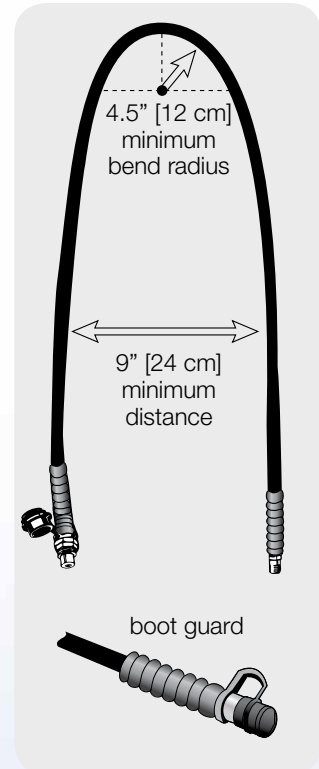
Keep hoses away from the area beneath loads.



Don't lift hydraulic equipment by the hoses.



- Do not kink or tightly bend hoses. This will damage the wire braid. The minimum bend radius is approximately 4.5 inches [12 cm]. This means there should be no less than 9 inches [24 cm] between the straight sections of the hose as pictured.
- The most sensitive part of the hose is at the fitting. To reduce damage, do not bend the hose at the fitting. Keep the strain relief (spring or boot) guard over the fitting as shown. It will help to support the hose.
- Make the layout of the hoses such that there is no risk of damage due to vehicles, trucks etc. Do not drop objects onto hose.
- Hoses are not designed to be used as a tow rope for your pump. Do not pull on the hose to move the pump.
- Never pressurize a hose which has a kink or sharp bend.
- Hydraulic pressure in a hose, cylinder or other component can increase due to heat. Never try to push check balls or pins in couplers to reduce the pressure. To avoid such problems, *never* store components in warm areas.



REMEMBER: Always discard damaged hoses to eliminate the risk of someone else using the hose. The next user might not notice the damage until the hose is pressurized. A leak in a hose can cause high pressure oil to penetrate your skin. IF YOU ARE EVER INJURED BY A SPRAY OF OIL, SEE A DOCTOR IMMEDIATELY.

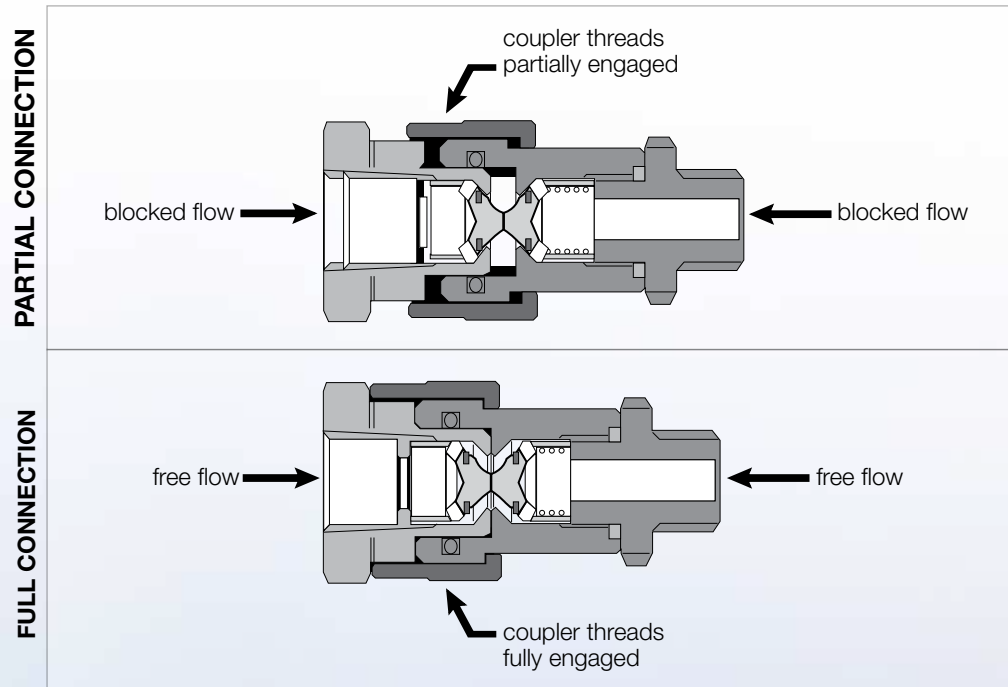
COUPLERS



The advantage of using couplers rather than threaded connections is that you can quickly make and break hydraulic connections. The disadvantage of using couplers is that they are frequently the point at which dirt enters a hydraulic system.

OBSERVE THE FOLLOWING WHEN USING COUPLERS:

- Make sure couplers are clean before making any connections. Use dust caps to keep couplers clean. If a dust cap was not used, clean the coupler by carefully blowing the dirt out with compressed air.
- Tighten couplers *hand tight only*; do not use wrenches. The threads must be fully engaged to allow for proper oil flow. A partially connected, checked-off, coupler is shown below along with a properly connected coupler.



- Couplers are designed to be pressurized only when they are connected together. *Never pressurize half couplers.*



CT-604 Safety Tool

Use the Enerpac CT-604 to relieve hydraulic back pressure by safely bleeding the hydraulic coupler. Minimize injuries from projectile parts and under-skin hydraulic fluid injections by eliminating unsafe coupler bleeding practices. The CT-604 is Enerpac-engineering safe for use at 10,000 psi (700 bar). NOTE: C-Series only.

OIL



All oils are not alike. The correct oil will protect moving parts and will not damage seals. Using the wrong oil will damage your equipment and lead to malfunctions. Use Enerpac premium hydraulic oil.

The most important oil characteristic is viscosity. Heat is also an important factor. See the chart below for details.

CHARACTERISTIC	ENERPAC SPECIFICATIONS	EFFECTS
Viscosity	42-45 SUS @ 210°F [5.3-5.4 cSt @ 100°C] 150-165 SUS @ 100°F [30-32 cSt @ 40°C]	Viscosity describes the ability of an oil to flow. If the oil is too thin, there is not enough lubrication. If the oil is too thick, it will not flow fast enough to perform as required.
Operating Temperature	150°F [65°C] maximum	High temperatures also cause seal damage. In general, if the system is too hot to touch, it is too hot to use.

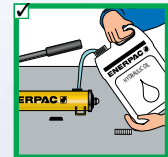
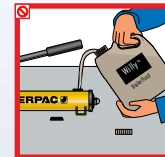


REMEMBER: Always dispose of used oil properly. Observe local ordinances. Do not mix used hydraulic oil with other fluids.

▼ Oil Specifications Chart

	LX Oil	HF Oil
ISO Grade	15	32
Viscosity Index	101 min	100 min
Viscosity at 210 °F	3.2/3.7 S.U.S.	42/45 S.U.S.
Viscosity at 100 °F	13.5/16.5 S.U.S.	150/165 S.U.S.
Viscosity at 0 °F	<2100 S.U.S.	<12000 S.U.S.
API Gravity	31.0/35.0	31.0/33.0
Flash, C.O.C. °F	370	375
Pour Point, °F	-30	-25
Paraffinic Base Color	Yellow	Blue

NOTE: SAE grades do not apply to hydraulic oil.



Use only genuine Enerpac hydraulic oil. The wrong fluid can destroy your seals and pump and will render your warranty null and void.

GAUGES



All hydraulic systems should have a gauge. The gauge is the window to the hydraulic system. In addition to indicating the operating pressure, the gauge can also warn you that something is going wrong.

IN A LIFTING SITUATION THE GAUGE WILL READ AS FOLLOWS:

- The gauge will not show much of a pressure rise until the cylinder contacts the load.
- The pressure will start to rise after the cylinder has contacted the load.
- The pressure continues to rise with each pump stroke.
- When the load starts to move, the pressure will remain constant. If you continue pumping and the load does not move, you may have reached the end of the cylinder stroke, or part of your setup may be yielding.



REMEMBER: The gauge shows more than maximum pressure. It can also alert you to what is happening throughout an operation.

Hydraulic Tools In this section you will find information about the basic tools that are used with a hydraulic system.

STB-SERIES PIPE BENDER SETS

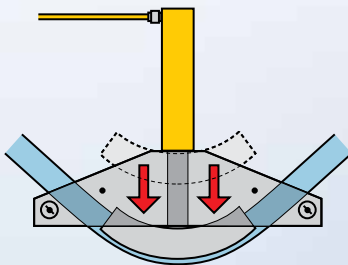


STB-Series hydraulic pipe bender sets are designed to provide quick, safe, and wrinkle-free bending of schedule 40, 80, 160, and DEH pipe in 1/2" through 4" sizes. STB-Series pipe bender sets include the Enerpac hydraulic cylinder, hose, and manual, air, or electric powered pump. Sets are also available without hydraulics. The bending frame and shoes are lightweight, heat-treated aluminum. Eject-O-Matic™ series benders have double-acting cylinders to eject pipe from the bending shoe.



IMPORTANT: No bender set is all-purpose, please refer to selection chart located in the Enerpac catalog or the instructions included with the bender when selecting the proper bender to suit the size and schedule of the material to be bent. If in doubt, call Enerpac.

ASSEMBLY:



1. Fully thread the hydraulic cylinder into the cylinder support block on the bending frame.
2. Make sure that the saddle is fully threaded into the plunger fully hand tight.
3. Make all hose connections between the cylinder and hydraulic pump. Make sure that the coupler(s) are fully hand tightened.
4. Select the appropriate bending shoe for the pipe size. Each shoe is marked for size. An arrow indicates the center of the bend to be made.
5. Insert and lock the bending shoe onto the cylinder plunger. Make sure to install the "U" shaped lock pin.

BENDING:

1. Place the pipe into the bender frame.
2. Attach the optic angle gauge to the top of the pivot shoe. The pin locator on the top of the pivot shoe locates the correct setting of zero before the bending cycle.
3. Mount the second pivot shoe. Both pivot shoes are marked for various pipe sizes.
The markings on the pivot shoes must match the pipe size being bent and face the pipe.
4. The angle gauge should now read zero when read along the line that is scribed on the bender frame.
5. Lock both of the pivot shoes into position with the push-button pivot pins. The pivot pins are operated by pushing down on the push-button while inserting the pin into the pivot hole. The pivot pins must be completely inserted through the hole that is marked with the corresponding pipe size.
6. Actuate the hydraulic pump and proceed with the bend.

REMOVING THE PIPE:

1. On benders that are equipped with a single-acting cylinder, retract the plunger and remove the pipe from the shoe.
2. On benders with double-acting cylinders, partially retract the cylinder. This will take any remaining force off of the pivot shoes and pins. Remove either one or both pivot shoes and reposition one pivot pin in the proper size “eject hole” where the pin will restrain the pipe, not the shoe, as they retract. Four-inch capacity frames have two “eject holes”. Use both sides.
3. Now fully retract the cylinder plunger. The bending shoe and pipe will retract together until the pipe meets the pivot pin. On contact, the pipe will strip from the bending shoe.
4. Remove the other pivot pin and pivot shoe to remove the pipe from the bender.
 - If the measured pipe diameter is greater than the maximum allowable diameter, do not attempt to bend that pipe. *Attempting to bend oversized pipe could damage the bender and cause personal injury* and will result in an unacceptable bend.



CAUTION: When activating the hydraulic pump, the operator must be located on the cylinder side of the bender. It is important to stay out of the line of force of the equipment while operating.

- During the bending process, watch the optic gauge until the gauge indicating line for the designated angle is aligned with the mark on the frame. Because of pipespring back, it is usually necessary to bend slightly more than the desired angle.
- For complete bending instructions, refer to the instruction booklet included with every bender or call Enerpac.

HEAVY DUTY CATERROLLER™ LOAD SKATES



Load skates consist of a rigid steel frame with saw-toothed edges, a center guide plate and a set of rollers. The rollers are connected by link chain on either side with a master link for separating them. Each roller turns independently and the entire set rotates around the guide plate. Loads may be attached permanently by welding to the skate. Loads with wood bases will sink into the frame edges for better stability. Typically, a mobile force of 35 to 50 lbs per ton is required to move loads mounted on the skates. Refer to the specification chart in the Enerpac Catalog or the instructions included with the skates for capacities and dimensions.



Lubricate rollers, when needed, with molybdenum disulfide paste only (such as Dow Corning's Molykote #G-n paste, or equivalent.)

For heavy use, lubricate rollers weekly.

Note: Graphite formulations are not an equivalent lubrication.



CAUTION: Based on load size and weight, be sure the correct number of skates are used to support the load.

LOAD REQUIREMENTS:

1. Determine the number of skates needed by calculating the total weight including support timbers, beams or skids. **As a general rule, double the size requirements.**
2. Plan skate positions to equally distribute weight and to facilitate maneuvering. **Do not exceed skate capacity.**
3. Skate selection and accessories are determined by the weight of the load, the pathway surface, and the number and nature of turns required during movement. For straight-line moves, the standard rigid skate is adequate. For moves with turns and for positioning the load, swivel plates should be added to the skates.
4. Most moves will require some amount of lifting. Carefully select the lifting equipment. Consider the load weight, height of lift and location of lift devices to allow positioning of the skates.



CAUTION: Check all load routes to ensure ramps, floors and structures will support the weight and size of the load.



WARNING: To prevent the load from slipping, place wood skids or timbers between the load and the skates. Nail chocks into the wood for added security.



CAUTION: Swivel type skates must be checked during moves to ensure parallel alignment under the load.



WARNING: To prevent possible injury and equipment damage, do not exceed the rated capacities of the skates.

FLOOR CONDITION AND PATHWAY CLEARANCES:

1. Floors or other path surfaces must be clean and free of cracks or holes, which can hinder skate travel.
2. Check and verify all load-bearing capacities of all floors or pathway surfaces. Ramps or other structures should be reinforced to handle the load.
3. If ramps or other inclines are in the pathway, be sure that motive forces are powerful enough and if needed, provide restraining devices to hold the load.
4. For rough surfaces or unpaved areas, the use of steel channels will provide good skate paths.

LIFTING LOADS:

1. Use load-lifting devices with a capacity exceeding the load weight and with enough lift height to safely install skates under the load.
2. Refer to the selection chart in the Enerpac catalog or the instruction sheets included with the skates for dimensions and skate load capacities.
3. Loads should be supported with timbers, beams or skids placed between the load base and the skates.

STRAIGHT MOVES:

1. Position skates evenly around the load base. Rigid skates must be parallel to each other in order to provide straight travel in one direction.
2. Skates with swivel top plates will not maintain position on rough floors. If swivel skates are used, the floor must be clean and the skate position must be constantly watched to ensure smooth straight travel. If swivel plates are used, always use them in pairs, either front or rear.

STEERING OR MANEUVERING A LOAD:

1. Steering is accomplished using skates with swivel plates in all locations or in pairs at the front or rear.
2. The number and placement of the swivel plates will depend on the size, shape and total load weight. Also consider the path surface conditions.
3. Gradual turns are fairly easy to make while the load is moving. Sharp 90° degree turns may require lifting one end and pivoting around the outer.

STRAIGHT-LINE MOVES: Skates must remain parallel to each other to assure easiest motion in any one direction. Rigid-top skates will stay in position as placed, but swivel skates may be knocked out of alignment if the move is over a rough or dirty surface. Care should be taken, floors cleaned, and alignment progressively monitored during moves using swivel skates, especially over less than ideal surfaces.

STEERING AND SPOTTING LOADS: Maneuvering the load is made easier by using swivel skates or combinations of swivel skates with rigid-top skates. Size, configuration, and weight of loads determine models, quantity, and placement of required skates.

MACHINE LIFTS



Enerpac machine lifts are built from a steel housing and a single-acting, spring return hydraulic cylinder. Powered by an external hand or electric pump, the cylinder plunger moves and actuates the machine lift. The support feet on the

machine lift must be extended to provide maximum stability.

The lifting toe of the machine lift is adjustable to three positions using the slotted holes in the lifting plate. To use, lift the toe and pull it out of the slots in the lifting plate, then mount it in the slots at the required height.



WARNING: To avoid personal injury and possible equipment damage make sure that all hydraulic components withstand the maximum pressure of 10,000 psi or 700 bar.



WARNING: Do not exceed equipment ratings. Never attempt to lift a load weighing more than the capacity of the equipment. Overloading causes equipment failure and possible personal injury.



WARNING: Off center loads will produce unnecessary stress on the equipment. Avoid point loading. Distribute the load evenly across the entire surface of the lifting area.



WARNING: Always provide a flat, solid and firm foundation before attempting to lift any load.



WARNING: Serious equipment damage and personal injury can result, if the support feet are not fully extended and pinned into position.



WARNING: To avoid personal injury, keep hands and feet away from the lifting equipment and load during operation.



WARNING: Stay clear of loads supported by hydraulics. After the load has been raised, it must be blocked or cribbed mechanically.



WARNING: Never pressurize uncoupled couplers. Make sure that all couplers are reconnected and fully tightened before operating the system.



WARNING: Avoid sharp bends and kinks in the hose which will lead to hose failure.

OPERATION:

Before lifting a load, the cylinder must be securely attached to the toe lift base. Keep the contact surface between the toe lift and the load clean. The contact surface must be free of oil, grease, or dirt to avoid slippage. Before lifting a load make sure that the contact surface of the toe lift completely supports the load (**See Fig. 1**). *The lock pins must always be properly positioned in the support feet while lifting.*

Advancing and retracting the machine lift. For complete operating instructions refer to **HAND PUMPS** and **BASIC HYDRAULIC SYSTEMS** in this manual.



IMPORTANT: Always keep the guide paths of the lifting plate greased.

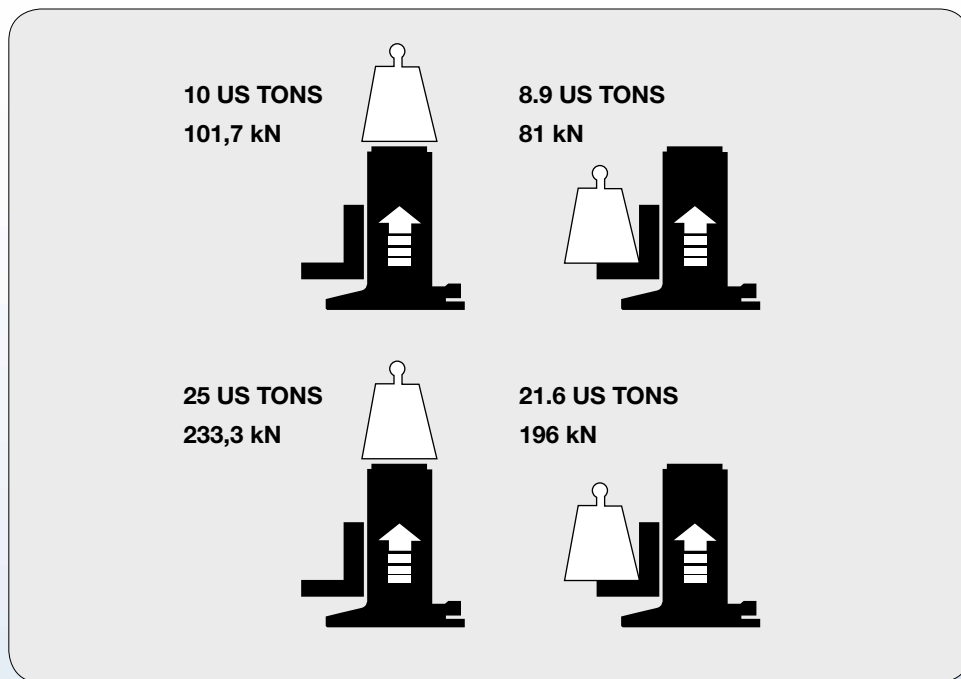


Figure 1



Machine Lifts

To place the load skates, the load must first be lifted. This can be accomplished easily and safely using enerpac SOH series Machine Lifts.

PULLERS



To avoid personal injury during system operation, read and follow all CAUTIONS, WARNINGS, and INSTRUCTIONS included with or attached to each product. Enerpac cannot be responsible for damage resulting from unsafe use of product, lack of maintenance, or incorrect product and system application.



WARNING: Always wear proper personal protective gear (i.e. gloves, safety glasses).



WARNING: Never use a tool to strike the puller. Hitting the puller may cause it to break.



WARNING: Make sure that the items to be pulled are supported by a means other than the puller.



WARNING: Applying heat to the puller may damage it, causing the puller to fail at lower than rated load.



WARNING: Before each use, lubricate the center bolt threads with a graphite-based lubricant.



WARNING: Use puller only with recommended attachments or damage to the puller may occur.



WARNING: Use a puller capable of pulling the load. Overloading the puller may cause it to break.



WARNING: NEVER use standard grade bolts or parts to repair pullers. Standard grade parts may break when the puller is used, causing personal injury and/or property damage.

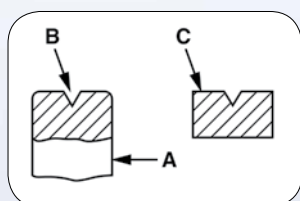


Figure 1

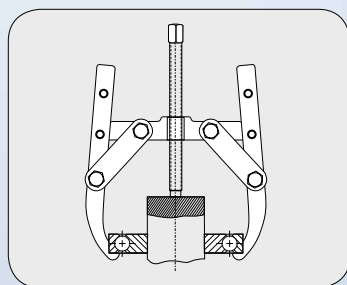


Figure 2

MECHANICAL PULLER OPERATION:

1. Make sure that the spindle is clean and greased before use.
2. The shaft (A) must have a center hole (B) as shown. If it does not, use a shaft protector (C). (See Fig. 1)
3. Tighten strap bolts to hold jaws *lightly* in place.
4. Position the puller as shown in Fig 2.
5. Tighten the spindle slightly by turning the spindle nut.
6. Check that the jaws are fully contacting the part to be pulled.
7. Tighten the strap bolts.
8. Apply pulling force by turning the spindle.



IMPORTANT: Always keep the guide paths of the lifting plate greased.

POSI LOCK PULLER OPERATION FOR MANUAL PULLERS:

1. Make sure that all items being pulled are supported by a means other than the puller. **NO LOOSE PIECES!!!**
2. Before each use, lubricate the center bolt of the puller with a graphite-based lubricant.
3. To operate the puller, grasp the puller with one hand and turn the T-handle counter-clockwise with the other hand until the jaw opening is big enough to fit over the component to be pulled.
4. Turn the T-Handle clockwise to tighten the jaw firmly onto the component. *(Fig. 3A)*
5. Make sure that the center of the puller is aligned with the center of the component to be pulled. Using hand tools only, tighten the center bolt to pull the component off of its shaft. **Never exceed the maximum torque ratings of the puller's drive bolt.** *(Fig. 3B)*
6. Turn the T-handle counter-clockwise to remove the puller from the component. *(Fig. 3C)*

HYDRAULIC PULLER OPERATION:

1. Make sure that all items being pulled are supported by a means other than the puller. **NO LOOSE PIECES!!!**
2. Install the cylinder into the puller by threading collar threads clock-wise into the jawhead assembly. Make sure that the puller collar threads are fully engaged in the puller. Attach lift plate to the coupler end of the cylinder. Remove the saddle from the cylinder and insert the ram point into the plunger. **Select the ram point that will provide the maximum contact with the shaft.**
3. To operate the puller, grasp the puller with one hand and turn the T-handle counter-clockwise with the other hand until the jaw opening is big enough to fit over the component to be pulled.
4. Turn the T-Handle clockwise to tighten the jaw firmly onto the component.
5. Make sure that the puller is square with the component to be pulled. Advance the plunger until the ram point contacts the shaft to insure correct alignment. The center point of the puller must be aligned with the center point of the shaft. Continue to advance the plunger slowly to pull the component off of the shaft. **Never try to retighten the T-handle during the pulling operation.** **For 100-ton hydraulic pullers refer to the puller instruction sheet.**

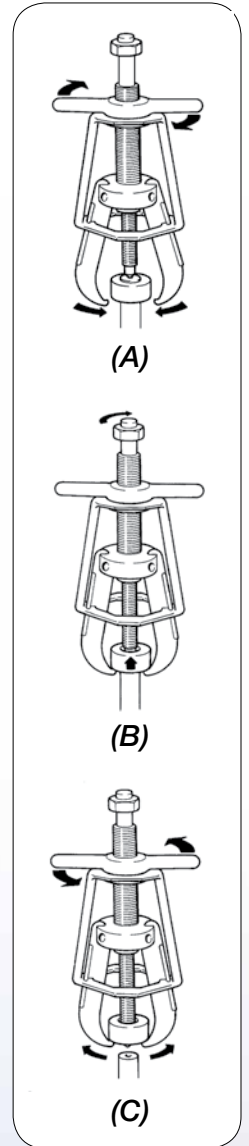


Figure 3



Enerpac's Bearing puller attachment can be used with grip, bearing, and bearing cup pullers to solve many difficult pulling applications where pulling surfaces are limited.

For more information on pullers, see the tool section of your Enerpac Industrial Tool catalog.

HYDRAULIC PUNCHES



Hydraulic punches are designed to perforate metal with round, square or oblong holes. They are designed to work on mild steel, non-ferrous metals and some plastics (non-shattering). Hydraulic punches may be powered by hand pumps, air/hydraulic, gas, or electric driven pumps which develop up to 10,000 psi (700 bar).



WARNING: Do not exceed the maximum punch limits as shown on the tool decal, instruction sheets or catalog.



WARNING: Protect punch and die sets. Return to storage case after use.



WARNING: Keep punch and dies clean. Lubrication is not required, but will extend punch and die life.



WARNING: Use only Enerpac oil in punch and pump.



WARNING: Always match punch and die correctly. Install dies with larger opening facing down.



WARNING: Cracked, chipped, or worn punches and dies should be replaced immediately.

PUNCH AND DIE REPLACEMENT:



1. Remove the punch by using the pin tool or spanner wrench to loosen the punch retainer.
2. Use an allen wrench to remove the set screw in the lower jaw of the punch frame. Remove the die from the frame.



3. Install dies with larger openings facing down or away from the punch.
4. Tighten the set screw.
5. **CAUTION:** Indexing slots are used with square and oblong dies to keep them aligned with the matching punch.



6. **IMPORTANT:** Square or oblong punches must be installed using the square key provided with the punch. The square key must engage the slot of the punch plunger. **Do not use the square key with round punches.**



7. Install the punch with the long stem facing downward.
8. Before using the punch make sure that the set screw and cap nut are tightened securely.
9. Advance the punch through the die and check for proper alignment. The punch must pass freely through the die. Minor adjustments to the die are possible by loosening the set screw and repositioning the die, then re-tightening the set screw.



IMPORTANT: During punching operation, periodically check the cap nut to ensure that the punch remains tight. Remove the slugs from the punch to prevent damage.



Dry stripping is a principal cause of punch failure.

Lubrication will facilitate easy punching and will significantly prolong the life of the punch.

For more information on pullers, see the tool section of your Enerpac Industrial Tool catalog.

NUT SPLITTERS



To avoid personal injury during system operation, read and follow all CAUTIONS, WARNINGS, and INSTRUCTIONS included with or attached to each product. **Enerpac cannot be responsible for damage resulting from unsafe use of product, lack of maintenance, or incorrect product and system application.**



WARNING: Always wear proper personal protective gear (i.e. gloves, safety glasses).



WARNING: The system operating pressure must not exceed the pressure rating of the lowest rated component in the system.



WARNING: Make sure that all system components are protected from external sources of damage, such as excessive heat, flame, moving machine parts, sharp edges, and corrosive chemicals.



WARNING: To prevent injury, do not place fingers on or near the cutting blade while the nut splitter is operating.



WARNING: To prevent injury and to avoid damage, do not use the nut splitter on glass, plastic, wood, or any material which could shatter.



WARNING: To avoid damage to the nut splitter blade, housing, plunger and seals:

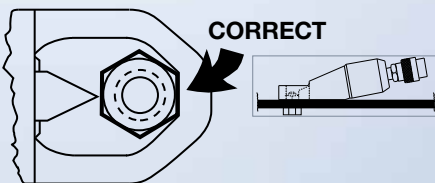
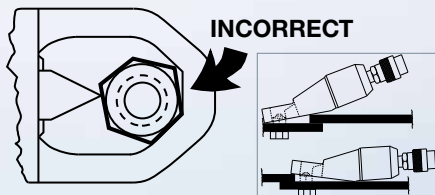
- A. Do not cut chains or bolts.
- B. Do not use the nut splitter to rotate nuts.
- C. Do not move the nut splitter during the cutting operation.
- D. Do not heat up nuts while the nut splitter is in position.



WARNING: Enerpac Nut Splitters are designed specifically for metal nuts that match the sizes as listed in the selection charts in the Enerpac catalog and nut splitter instruction sheets.



WARNING: Maximum allowable hardness of the nuts to be split is HRC-44.



NUT SPLITTER OPERATION:

1. Make all appropriate hydraulic connections.
2. Place the nut splitter head over the nut.
IMPORTANT: the flat surface of the cutter must rest flat on one of the nut flats, and the head must rest on a flat surface.
3. Hold the nut splitter in the proper position.
4. Operate the pump until the cutter blade cuts through the nut.
5. To avoid damage to the bolt thread, de-energize the pump as soon as the nut is split.
6. Retract the blade.
7. Repeat the cutting process on the other side of the nut. (Must be 180 degrees opposed).
8. Retract the cutter blade and remove both nut halves.

HYDRAULIC TORQUE WRENCHES



S-Series



W-Series

To avoid personal injury during system operation, read and follow all CAUTIONS, WARNINGS, and INSTRUCTIONS included with or attached to each product. Enerpac cannot be responsible for damage resulting from unsafe use of product, lack of maintenance, or incorrect product and system application.

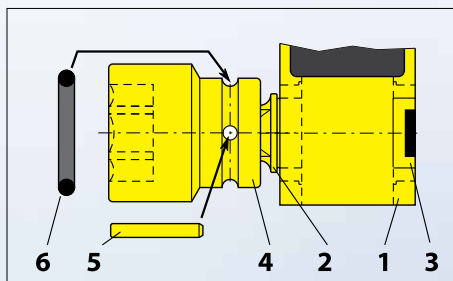
PRODUCT DESCRIPTION:

Enerpac hydraulic torque wrenches are double acting hand-controlled tools designed to tighten and loosen bolted connections. Any unauthorized change in design, construction or usage of the torque wrench is forbidden for safety reasons and will void the warranty. Hydraulic flow and pressure that is supplied to the wrench is converted to a rotary motion by means of a hydraulic cylinder and drive lever. Advancing and retracting oil flow from the pump is controlled by a remote operated valve with pendant control. The advance pressure supplied from the pump must be limited to 10,000 psi (700 bar) for S & W Series wrenches and 11,600 psi (800 bar) for SQD & HXD wrenches.

WARNING: Use only heavy-duty impact sockets for power driven machine wrenches, according to ISO-2725 and ISO-1174; DIN 3129 and DIN 3121, or ASME-B107.2/1995. Do not use worn or damaged sockets drives. They must fit precisely on the nut or bolt being tightened. Do not use metric size sockets or Allen-Key drives on imperial nuts or bolts or the reverse. Always secure the socket to the square drive to prevent the socket from slipping off.

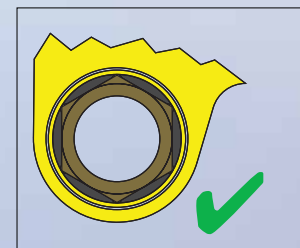
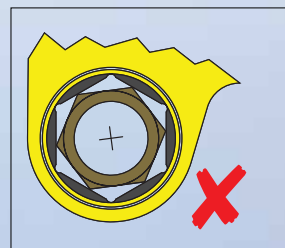


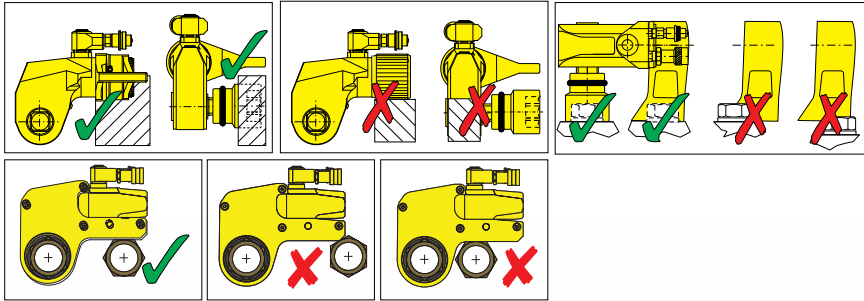
Always secure the socket to the square drive to prevent the socket from slipping off.



1. Drive Unit
2. Square Drive
3. Quick-Release
4. Socket
5. Retainer Pin
6. O-Ring Pin Retainer

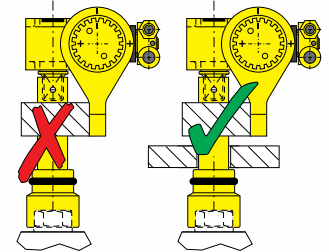
Use the proper sized socket (S-wrench) or cassette (W-wrench) on the nut.





The torque wrench must be properly positioned manually to make sure that the reaction force is safely transmitted via the reaction arm and not via other torque wrench parts. Never use the torque wrench without the reaction arm.

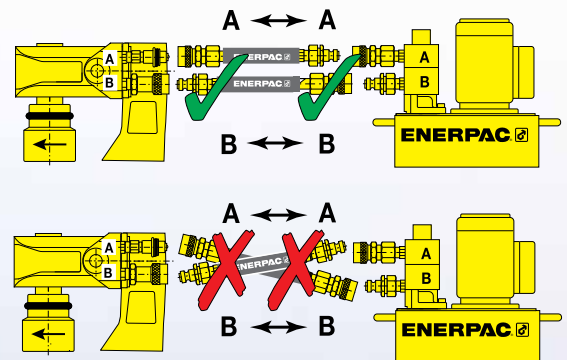
Avoid tilting the wrench. Do not use extensions. If this is unavoidable due to the reaction point, the torque must be reduced. An extra support must be used to minimize tilting and friction. When in doubt, contact Enerpac.



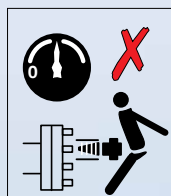
Make sure all couplers and hoses are fully connected and that oil can flow freely from (A to A) and (B to B). Incorrectly mounted couplers can still be closed, with the result that oil on the wrenches' retract side (B) can be pressurized by the pumps' advance side (A). The safety relief valve on the wrenches retract side will open and prevent over pressurization.

BLEEDING AIR FROM THE SYSTEM

During first-time operation, the hydraulic hoses and wrench can be full of air. Air must be removed from the system for safe and proper operation. Remove the air by connecting the hose set to the valve on the hydraulic pump. Connect the couplers on the other end of the hose together completing the hydraulic circuit. Cycle the pump and valve several times by using the remote control pendant. This will force any air into the reservoir and out to the atmosphere. Next, connect the torque wrench to the hose set. As before, cycle the pump and valve several times by using the remote control pendant. This will force any air into the reservoir and out to the atmosphere.



OPERATION Refer to the instruction booklet supplied with torque wrench system for proper operating instructions and procedures.



Be careful not to work in-line with the nuts and bolts you are tightening.



Be careful to avoid pinch points between the reaction arm and the nuts and bolts you are tightening.

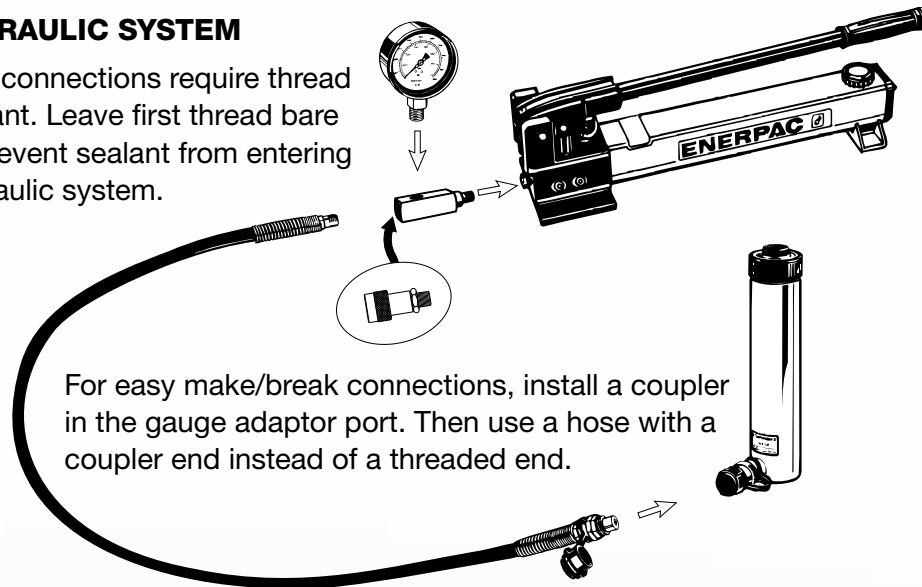


Enerpac recommends the use of special loosening liquids or sprays. Enerpac offers hydraulic nut splitters to remove rusted or frozen nuts.

Hydraulic Systems The components described in the first section of this handbook are connected together to form a basic hydraulic system as shown below.

BASIC HYDRAULIC SYSTEM

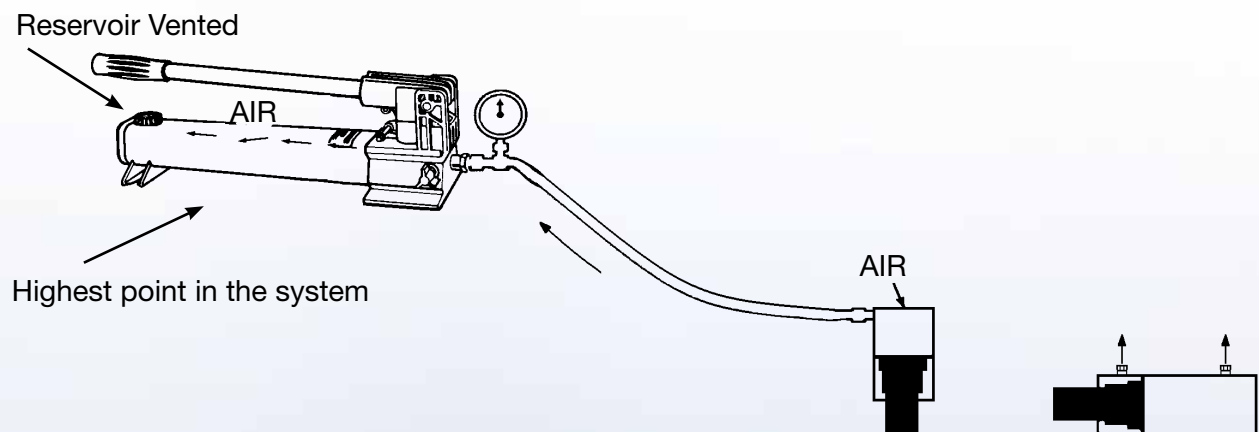
NPT connections require thread sealant. Leave first thread bare to prevent sealant from entering hydraulic system.



BEFORE USING THE HYDRAULIC SYSTEM

- Check that all connections are tight and leak free. It is especially important to check all coupler connections because, after the system has been pressurized, you will not be able to tighten the couplers by hand and using tools will damage the couplers.
- Remove air from system.
- Check oil level in pump reservoir. Fill only to level indicated on the pump. Over-filling the reservoir may cause the pump to malfunction. Fill the reservoir only when all cylinders have been retracted. If you add oil when the cylinder is extended, the reservoir will overflow or be pressurized when you retract the cylinder.
- When using an electric, air, or gas powered hydraulic pump, energize the pump only when the directional control valve is in the neutral position.
- In lifting systems, use lifting bases that spread out the load. This reduces the contact pressure between the cylinder and the floor and avoids sinking or punching of the floor. Most working floors cannot withstand high loads.
- Use shut-off valves for temporary load holding. Never hold a load on a coupler or directional control valve.
- Never get under a load.
- Use cribbing for load holding for long periods.
- Do not use hose to lift or pull equipment.

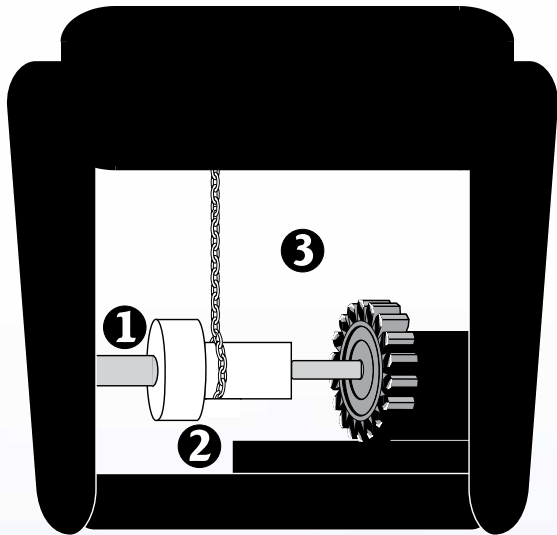
Removing Air from the Hydraulic System	
How to tell if there is air in the system	Hydraulic system operation should be instant and smooth. For every pump stroke, the cylinder should rise evenly. If the cylinder movement is erratic or jerky, there may be air in the system.
How to remove air from the system	<p>Air will always go to the highest point in the system. This includes the inside of the cylinder plunger. That is why the cylinder must be turned upside down (single-acting) or laid on its side (double-acting) to get the air out. To remove air from the system, position setup as illustrated below.</p> <p>NOTE: double-acting cylinders must have the couplers facing up.</p> <p>Fully advance and retract the cylinder 2 or 3 times. You can usually hear the air escaping through the reservoir.</p>



PRESSES

When using a press, have no loose pieces in the setup. If you need to use spacers to get to your workpiece, the spacers should be constructed in one solid piece. Spacers can be tackwelded together for increased stability.

When using horizontal presses, tie all pieces. Do not rely on friction to hold the pieces up; if one piece falls or breaks, the whole setup will fall.



ELEMENTS OF A SAFE HORIZONTAL PRESS SETUP

- 1** – The ram and all parts of the setup are centered on the line of force.
- 2** – Blocks have been tack welded together so that there are no loose pieces in the setup.
- 3** – Block assembly is suspended by a chain and gear is supported from below.

Depending upon your individual application, guards and/or additional controls may be required. It is the responsibility of the user to provide these devices if required.



REMEMBER: Keep your hands out of the working area and stand clear of the press when pressure is applied.

MAINTENANCE SET



The Enerpac maintenance set includes a pump, hose, cylinder, gauge, and several extensions and attachments. The maintenance set is designed so that you can create setups for use in a variety of situations.

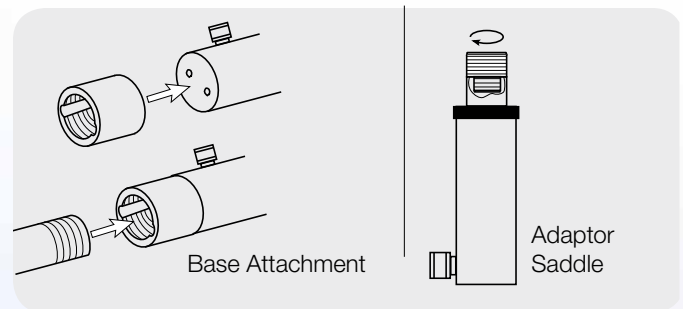


REMEMBER: Never exceed 5,000 psi [350 bar] when using cylinder attachments. Always use a gauge to verify the operating pressure. Gauge response in a lifting situation is described under GAUGES on page 13.

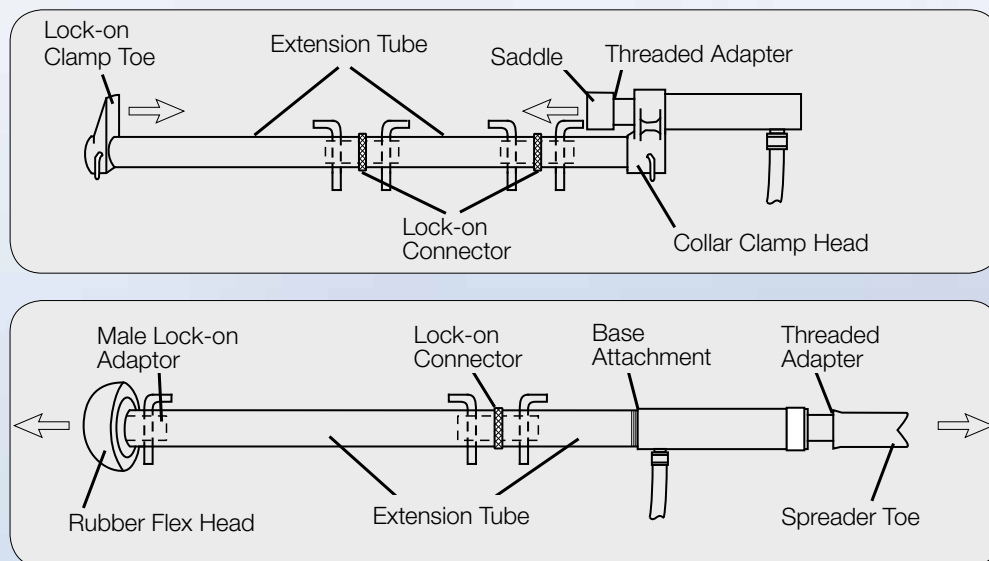
The first step in adding attachments to the cylinder is to mount the base attachment or

adaptor saddle as shown below. Snug the bolts on the base attachment with a wrench. When using threaded attachments, be sure all threads are fully engaged. Tighten by hand; no tools are required. When using lock-on attachments, always secure connection with a lock pin.

The maintenance set extensions and attachments are not made of standard pipe materials. They are designed to be much stronger. Standard grade parts will bend or break with much less load than the maintenance set components. See **SETUP CONSIDERATIONS** on page 8 and **EXTENSIONS** on page 30 for guidelines on using your own cylinder extensions.



Two examples of maintenance set setups are shown below. Note that all pieces are securely fastened together.



APPLICATION EXAMPLES OF THE MAINTENANCE SET

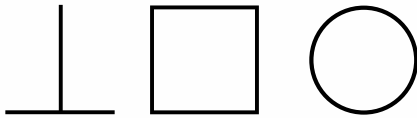


Setup Considerations

EXTENSIONS

In many situations, you will need to use extensions in your setup. The extension should be one rigid piece. When selecting extension material, keep in mind that hollow shapes are stronger than solid pieces.

SUITABLE CROSS SECTIONS



REMEMBER: Never have any loose pieces in your setup. Loose pieces may shift and fly out when pressure is applied. Use one-piece extensions or tack weld the pieces together.

WORK AREA

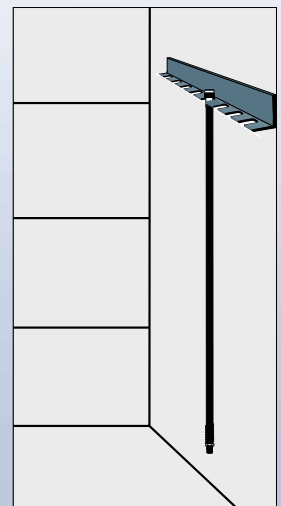
Examine your work area before pressurizing the hydraulic system. Again, you will be looking for ways to protect yourself and others, and ways to protect your equipment and other property.

OBSERVE THE FOLLOWING

- Check hoses and couplers. Hoses should have straight runs and be free of tangles or kinks. Coupler connections must be fully tightened.
- Protect your equipment from the work you are doing. For example, try to locate the equipment away from weld spatter and paint over-spray. Use protective covers when necessary.
- Have adequate operator space and clear aisle ways. For instance, do not box yourself in between the setup and a wall.

Equipment Storage Increase efficiency and protect your equipment by using good storage techniques.

Hydraulic equipment should be stored in a dry environment at temperatures above freezing. Store pumps and cylinders on a sturdy shelf and hoses in a rack. The hose rack shown keeps hoses from becoming tangled and kinked. The rack can be made by cutting notches in a section of angle iron.

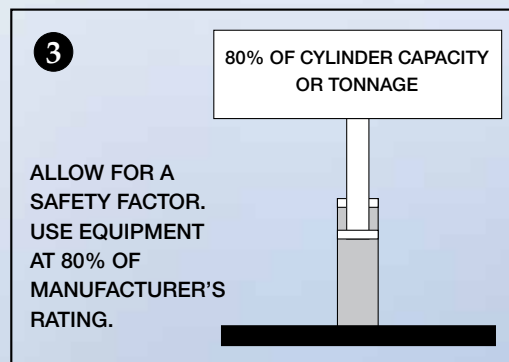
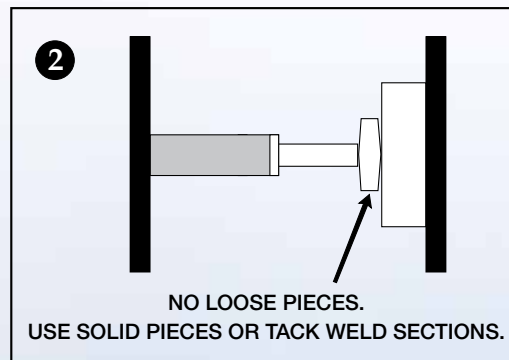
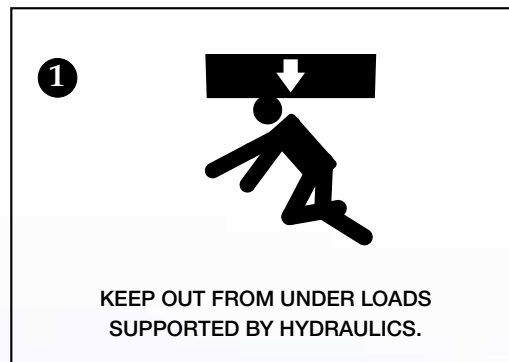


BRIEF SUMMARY

You should be familiar with all of the information presented in the Hydraulic Safety Seminar. However, the three practices shown below are essential to promoting personal safety and will help you to protect yourself and others.

You must be diligent when it comes to safety. We can provide high quality tools and accessories, but it is up to you to be aware of the situation that you put yourself and others into.

When you practice safety, you also benefit by being more efficient and by increasing the useful life of your tools.



QUESTIONS

1. Which hydraulic components are rated in terms of capacity or tonnage?
2. True or False?
Side loading can damage a jack or cylinder by distorting the wiper seal and bending the plunger.
3. What should you do if you have to lift a load further than the rated stroke of the jack or cylinder?
4. True or False?
It is OK to work under a load that is held up by a jack or cylinder as long as the load doesn't exceed the capacity or tonnage rating.
5. True or False?
You should never weld or otherwise modify a cylinder to attach a base or other support.
6. True or False?
Adding an extension to a pump handle will give you more leverage when pumping.
7. True or False?
You should tighten coupler connections with a wrench to be sure they are tight.
8. If cylinder movement is jerky, what may be wrong?
9. When you add extensions to a cylinder, how does it affect the maximum operating pressure?
10. True or False?
The 80% rule applies to cylinder stroke and cylinder capacity.

ANSWERS

1. Jacks, cylinders, presses, spreaders, and other accessories have capacity or tonnage ratings. *(See page 5)* **NOTE:** Pumps are rated for maximum operating pressure in psi [bar].
2. True.
Side loading can damage a jack or cylinder by distorting the wiper seal and bending the plunger. Side loading also creates an unstable setup which may shift or fall. *(See page 6)*
3. If you need to lift a load further than the rated stroke, block the load, raise the level of the cylinder with a sturdy support, and continue the lift. You could also switch to a jack or cylinder with a longer stroke. *(See page 7)*
4. False.
Never work under a load that is held up by a jack or cylinder. The load must be securely blocked before anyone goes under it. *(See pages 7-9)*
5. True.
You should never weld or otherwise modify a cylinder to attach a base or other support. *(See pages 8-9)*
6. False.
Adding an extension to a pump handle will not give you more leverage, but it will make the pump unstable. *(See page 9)*
7. False.
You should tighten coupler connections hand tight only, but do be sure that all threads are fully engaged. *(See page 11)*
8. If cylinder movement is jerky, air may be trapped in the hydraulic system. *(See page 15)*
9. When you add extensions to a cylinder, the maximum operating pressure must be cut in half, to 5,000 psi [350 bar]. Always use a gauge to verify the operating pressure. *(See pages 16-17)*
10. True.
The 80% rule applies to cylinder stroke and cylinder capacity. Following the 80% rule will result in more stable setups and prolong the life of your equipment. *(See pages 8-9)*



Lined area for notes, consisting of 28 horizontal lines.

Enerpac Worldwide Locations

Australia and New Zealand

Actuant Australia Ltd.
Block V Unit 3
Regents Park Estate
391 Park Road
Regents Park NSW 2143
(P.O. Box 261) Australia
T +61 297 438 988
F +61 297 438 648
sales-au@enerpac.com

Brazil

Power Packer do Brasil Ltda.
Rua dos Inocentes, 587
04764-050 - Sao Paulo (SP)
T +55 11 5687 2211
F +55 11 5686 5583
Toll Free: 0800 891 5770
vendabrasil@enerpac.com

Canada

Actuant Canada Corporation
6615 Ordan Drive, Unit 14-15
Mississauga, Ontario L5T 1X2
T +1 905 564 5749
F +1 905 564 0305
Toll Free:
T +1 800 268 4987
F +1 800 461 2456
customer.service@actuant.com

China

Actuant (China) Industries Co. Ltd.
No. 6 Nanjing East Road
Taicang Economic Dep Zone
Jiangsu, China
T +86 0512 5328 7500
F +86 0512 5335 9690
Toll Free: +86 400 885 0369
sales-cn@enerpac.com

France, Switzerland, North Africa and French speaking African countries

ENERPAC
Une division d'ACTUANT France S.A.S.
ZA de Courtaboeuf
32, avenue de la Baltique
91140 VILLEBON /YVETTE
France
T +33 1 60 13 68 68
F +33 1 69 20 37 50
sales-fr@enerpac.com

Germany and Austria

ENERPAC GmbH
P.O. Box 300113
D-40401 Düsseldorf
Willstätterstrasse 13
D-40549 Düsseldorf, Germany
T +49 211 471 490
F +49 211 471 49 28
sales-de@enerpac.com

India

ENERPAC Hydraulics Pvt. Ltd.
No. 1A, Peenya Industrial Area
IIInd Phase, Bangalore, 560 058, India
T +91 80 40 792 777
F +91 80 40 792 792
sales-in@enerpac.com

Italy

ENERPAC S.p.A.
Via Canova 4
20094 Corsico (Milano)
T +39 02 4861 111
F +39 02 4860 1288
sales-it@enerpac.com

Japan

Applied Power Japan LTD KK
Besshocho 85-7
Kita-ku, Saitama-shi 331-0821,
Japan
T +81 48 662 4911
F +81 48 662 4955
sales-jp@enerpac.com

Middle East, Egypt and Libya

ENERPAC Middle East FZE
Office 423, LOB 15
P.O. Box 18004, Jebel Ali, Dubai
United Arab Emirates
T +971 (0)4 8872686
F +971 (0)4 8872687
sales-ua@enerpac.com

Russia

Rep. office Enerpac
Russian Federation
Admiral Makarova Street 8
125212 Moscow, Russia
T +7 495 98090 91
F +7 495 98090 92
sales-ru@enerpac.com

Singapore

Actuant Asia Pte Ltd.
83 Joo Koon Circle
Singapore 629109
T +65 68 63 0611
F +65 64 84 5669
Toll Free: +1800 363 7722
sales-sg@enerpac.com

South Korea

Actuant Korea Ltd.
3Ba 717, Shihwa Industrial Complex
Jungwang-Dong, Shihung-Shi,
Kyunggi-Do
Republic of Korea 429-450
T +82 31 434 4506
F +82 31 434 4507
sales-kr@enerpac.com

Spain and Portugal

ENERPAC SPAIN, S.L.
Avda. Los Frailes, 40 - Nave C & D
Pol. Ind. Los Frailes
28814 Daganzo de Arriba
(Madrid) Spain
T +34 91 884 86 06
F +34 91 884 86 11
sales-es@enerpac.com

Sweden, Denmark, Norway, Finland and Iceland

Enerpac Scandinavia AB
Fabriksgatan 7
412 50 Gothenburg
Sweden
T +46 (0) 31 799 0281
F +46 (0) 31 799 0010
scandinavianinquiries@enerpac.com

The Netherlands, Belgium, Luxembourg, Central and Eastern Europe, Baltic States, Greece, Turkey and CIS countries

ENERPAC B.V.
Galvanistraat 115
6716 AE Ede
P.O. Box 8097
6710 AB Ede
The Netherlands
T +31 318 535 911
F +31 318 535 848
sales-nl@enerpac.com

Enerpac Integrated Solutions B.V.

Opaalstraat 44
7554 TS Hengelo
P.O. Box 421
7550 AK Hengelo
The Netherlands
T +31 74 242 20 45
F +31 74 243 03 38
integratedsolutions@enerpac.com

South Africa and other English speaking African countries

Enerpac Africa Pty Ltd
No5 Bauhinia Avenue
Cambridge Office Park
Block E
Highveld techno Park
Centurion 0157
South Africa
T: +27 12 940 0656
sales-za@enerpac.com

United Kingdom and Ireland

ENERPAC Ltd.,
Bentley Road South
Darlaston, West Midlands
WS10 8LQ
England
T +44 (0)121 50 50 787
F +44 (0)121 50 50 799
sales-uk@enerpac.com

USA, Latin America and Caribbean

ENERPAC
P.O. Box 3241
Milwaukee, WI 53201 USA
T +1 262 293 1600
F +1 262 293 7036
User inquiries:
+1 800 433 2766
Distributor inquiries/orders:
T +1 800 558 0530
F +1 800 628 0490
Technical inquiries:
techservices@enerpac.com
sales-us@enerpac.com

101311