Enerpac Integrated Solutions

ENERPAC
POWERFUL SOLUTIONS. GLOBAL FORCE.

With more than 50 years of experience, Enerpac has gained unique expertise which is acknowledged by industrial and construction professionals around the world. In addition to standard products and components, Enerpac specializes in the design, manufacture and supply (sale & rental) of high-force hydraulic systems required for the precise controlled movement of heavy structures.

Engineers and construction experts consult with Enerpac to develop integrated hydraulic solutions, which have included:

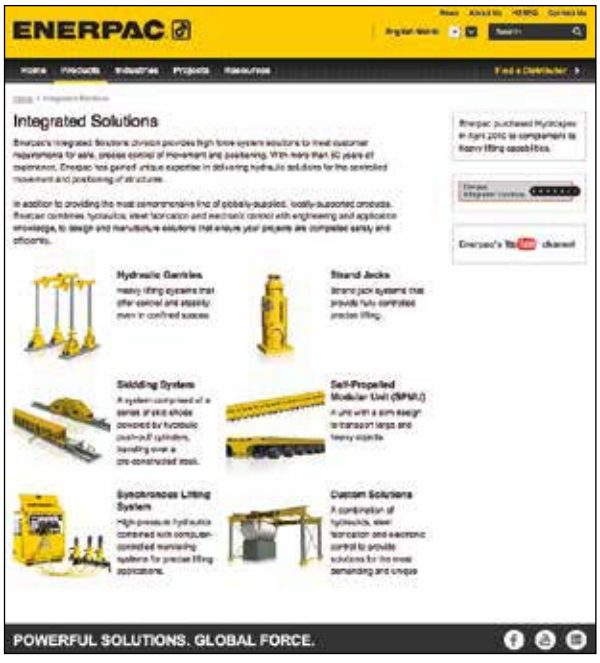
- The incremental launching equipment for the tallest bridge in the world – le Viaduct de Millau (France),
- Construction solutions for the China Olympics – Beijing's National Stadium, the world's largest steel structure and the retractable roof system for the Nantong Olympic Stadium.
- Automatic foundation leveling systems for offshore wind turbines,
- Strand jacking equipment for construction, oil & gas and industrial heavy lifting applications.

Across every continent Enerpac has presence through local offices, including application engineers, authorized distributors and service centers to deliver innovative solutions and technical assistance.

The deciding factor to choose for Enerpac resides on a history of supply of quality products & systems as well as a strong relationship with customers, Enerpac local representation and an excellent back-up in technical support on a global front.

Integrated Solutions Section Overview

Capacity ton (kN)	Capabilities	Series		Page
N/A	**Synchronous Lifting Systems** Standard 4 to 16 point lift system	**ESS**		**224** ▶
N/A	**Synchronous Lifting Systems** Premium 4 to 64 point lift system	**EPS**		**226** ▶
37 - 673 (360 - 6600)	**Heavy Lifting Strand Jack Systems** Accurate lifting, lowering or horizontal movements of heavy loads	**TT**		**228** ▶
5,5 - 37 kW	**Strand Jack Hydraulic Pumps** **Master PLC-Control Units** Control multiple strand jacks & pumps	**TTP**		**230** ▶ **231** ▶
50 - 200 (498 - 1995)	**Stage Lifting Systems** Incremental lifting	**BLS**		**232** ▶
60 - 110 (605 - 1110)	**Synchronous Hoisting Systems** SyncHoist – hydraulic precision positioning systems	**SHS**		**234** ▶
0,25 - 250 (2,2 - 2222)	**Uni-Lift® Actuators** Mechanical precision positioning	**M** **B**		**236** ▶



Contact Enerpac!

Contact the Enerpac office nearest to you for advice and technical assistance in the layout of your ideal Lifting System or visit us at: **www.enerpac.com**.

Or ask Enerpac for assistance by email: **integratedsolutions@enerpac.com**.

Standard 4 to 16 Point Lifting System

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▼ **ESS-Series 8-point Synchronous Lifting System** (shown without cylinders)

Controlled Hydraulic Movement for Positioning and Weighing

- **Stroke and load controlled movement for positioning and weighing**
- **Measurement accuracy better than 1,0 mm between leading and lagging cylinders**
- **Data storage and recording capabilities**
- **Load and stroke alarms for optimal safety**
- **For use with standard single or double-acting cylinders**
- **Integrated 700 bar hydraulic pump and controls.**

Typical Synchronous Lifting Applications

- Lifting, lowering, weighing of heavy structures
- Centre of gravity measurement
- Bridge maintentance
- Deck lifting & bearing replacement
- De-propping/load transfer from temporary steel work
- Heavy plant installation
- Incremental bridge launching & box jacking
- Pile testing
- Foundation shoring.

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▼ *Synchronous system lifted and monitored the load of the bridge as pier heads were rebuilt for wider traffic lanes, while highway below and the railway on top of this bridge were kept operational.*

Lifting Cylinders

For a complete line of Enerpac cylinders, see the Cylinder and Lifting Products Section of this catalogue.

Page: 5

Premium Synchronous Lifting Systems

For networking, data storage, preprogrammable and recording functions, graphical representation and up to 64 lifting points see the **EPS-Series** Synchronous Lifting System.

Page: 226

Standard 4 to 16 Point Synchronous Lifting System

Synchronous Lifting

The synchronous lift system uses feedback from multiple sensors to control the lifting, lowering and positioning of any large, heavy or complex structure, regardless of weight distribution.

Synchronous lifting reduces the risk of bending, twisting or tilting, due to uneven weight distribution or load-shifts between the lift points.

A PLC controller monitors each lift position stroke and optional load transducers located at each lift point. By varying the oil flow to each lift point, the system maintains very accurate positional control.

This control maintains structural integrity and can increase the productivity and safety of the lift, by eliminating manual intervention in the event of a load-shift or other problem.

Programmable and failsafe monitoring and safety alarms include operating parameters and hydraulic conditions, such as oillevel and over-temperature.

Programmable data recording and “differential-lift” options allow a load to be manipulated into a pre-set position.

ESS Series

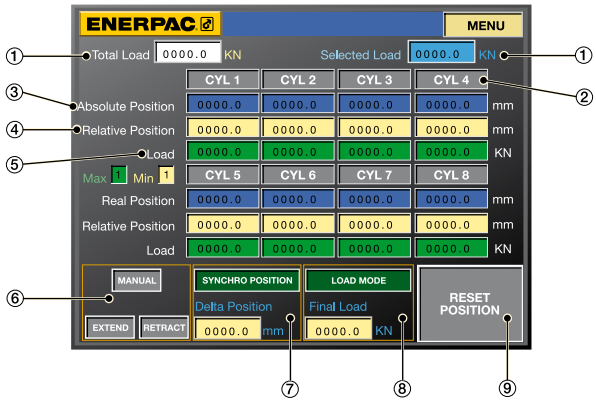
Number of Lifting Points:
4, 8, 12 or 16

Accuracy Over Full Stroke:
± 1,0 mm

Maximum Operating Pressure:
700 bar

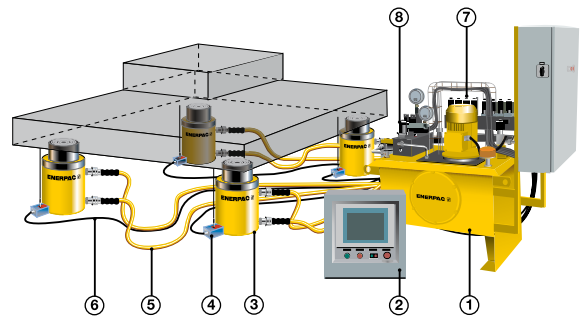
▲ *PLC-controller station for ESS-Series synchronous lifting system.*

▼ **Touch screen display of ESS-Series synchronous lifting PLC-controller**



① Load readings
② Cylinder On/Off
③ Absolute sensor position
④ Relative stroke sensor
⑤ Individual load readings
⑥ Manual controls
⑦ Stroke controls
⑧ Load controls
⑨ Relative position reset

▼ **Typical layout for a 4-point ESS-Series synchronous lifting system**



① Hydraulic pump
② PLC-control with touch screen
③ Hydraulic cylinders
④ Stroke sensors
⑤ Hydraulic hoses
⑥ Sensor cables
⑦ Solenoid control valves
⑧ Pressure transducer

▼ *Offshore wind turbines levelling in the North Sea, Germany: Enerpac's hydraulic synchronous lifting system provided the solution for levelling the supporting cross pieces for 80 wind turbines of 5 MW each.*

Premium 4 to 64 Point Lifting System

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▼ EPS-Series 4-point Premium Synchronous Lifting System

Ideal for lifting applications requiring customised control features

- **Controls up to 64 lifting points**
- **Networking available to connect multiple systems**
- **Stroke, load and tilt controlled movement**
- **Hydraulic weighing and centre of gravity functions**
- **Dynamic load or stroke compensation**
- **Load and stroke alarms for optimal safety**
- **Pre-programmable movement**
- **Measurement accuracy better than ± 0,25 mm between leading and lagging cylinders**
- **Data storage, recording capabilities and graphic representation available**
- **For use with standard single- or double-acting cylinders**
- **Integrated 700 bar hydraulic pump and controls.**

Lifting an Unbalanced Load

Visit **www.enerpac.com** to learn more about hydraulics and system set-ups.

Contact Enerpac!

Contact the Enerpac office nearest to you for advice and technical assistance in the layout of your ideal Lift System.
You can also ask Enerpac for assistance by email at:
integratedsolutions@enerpac.com.

EPS-Series Premium Synchronous Lifting Systems

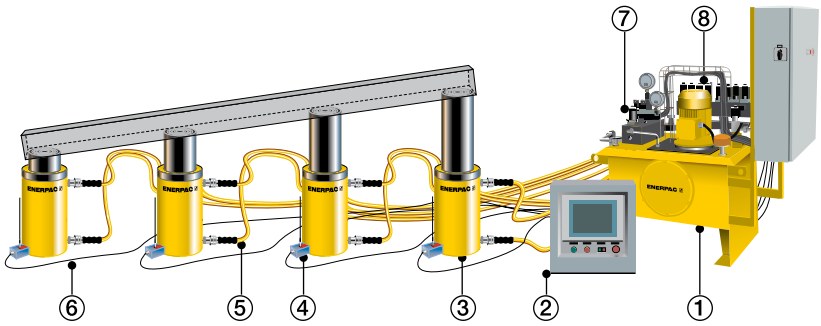
The potential applications of this system are numerous. Synchronised lifting, lowering, pushing, pulling and positioning using computer technology and high-pressure hydraulics has become popular in many industries around the world.

The lifting or lowering capacity of this system is unlimited. By adding more or larger hydraulic cylinders to the setup, the system will allow jobs of 50.000 ton and more to be lifted with a high-level of safety and accuracy.

◀ *Hydraulic lifting, weighing and manipulation system. During the lifting procedure the 16 point synchronous system operates within strict load and stroke constraints to ensure the desired load paths into the ship's hull structure are maintained. The various ship's hull segments up to 1300 tons are supported by the premium synchronous lifting system to confirm the design calculations.*

Premium 4 to 64 Point Synchronous Lifting System

▼ **In tilting mode, each cylinder can be programmed to achieve a different stroke at the same time.**



① Hydraulic pump
② PLC-control with touch screen
③ Hydraulic cylinders
④ Stroke sensors
⑤ Hydraulic hoses
⑥ Sensor cables
⑦ Solenoid control valves
⑧ Pressure transducer

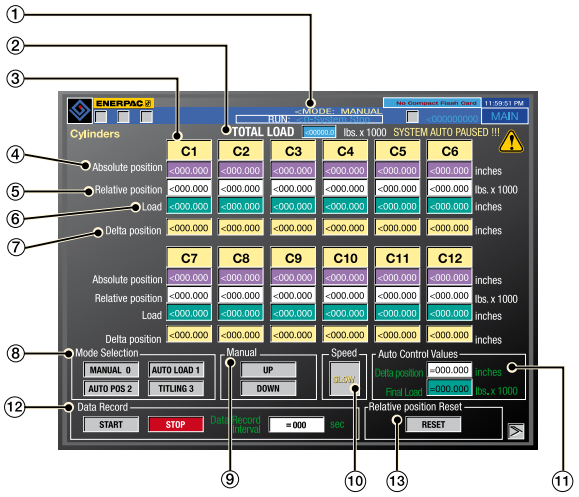
EPS Series

Number of Lifting Points:
4 to 64

Accuracy Over Full Stroke:
± 0,25 mm

Maximum Operating Pressure:
700 bar

▼ **Touch screen display of EPS Synchronous Lift Controller.**



① Operating Mode
② Load Reading
③ Cylinder On/Off
④ Absolute Sensor Position
⑤ Relative Sensor Position
⑥ Individual Load Readings
⑦ Tilting Control Values
⑧ Operating Mode Selection
⑨ Manual Controls
⑩ Speed Control
⑪ Auto Control Values
⑫ Recording Controls
⑬ Relative Position Reset

▲ *PLC-controller station of the EPS-Series premium synchronous lifting system.*

▼ *One of the world's first and largest lifting jobs for maintenance of a 3500 ton mining dragline was successfully done with an Enerpac synchronous hydraulic system: exact aligning of bearings on the rail on which this dragline rotates.*

▼ *Millau Viaduct, France: Bridge lifting and launching system. The load is balanced on groups of CLL-Series lock nut cylinders. The hydraulic lifting, launching and balancing movements are synchronised with PLC-control.*

TT-Series, Heavy Lifting Strand Jacks

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▼ Shown: **TT-84SJ706, 86 ton Strand Jack**

- **Hydraulic wedge setting and wedge release for positive load control**
- **Individual strand guidance through jack**
- **Multi functional treatment for corrosion protection and trouble-free wedge release**
- **Jacks designed to be operated in all positions: vertical, horizontal or inclined**
- **Strand jack designed according to the highest safety standards with a minimum of 2,5:1 of strand breaking load**
- **Built-in sensors for closed-loop control.**

Lifting, lowering or horizontal movements of heavy loads

Lifting in Unusual Situations

When loads need to be lifted or lowered in tight areas or in situations where overhead clearance is limited, Enerpac offers this economical alternative to traditional rigging equipment. Contact Enerpac: **integratedsolutions@enerpac.com.**

Pre-stress Cap

Included with all strand jacks. Used for tensioning strand prior to operation.

Strand Wedges

Specially designed wedges for use with Enerpac strand jacks are included and available to purchase separately.

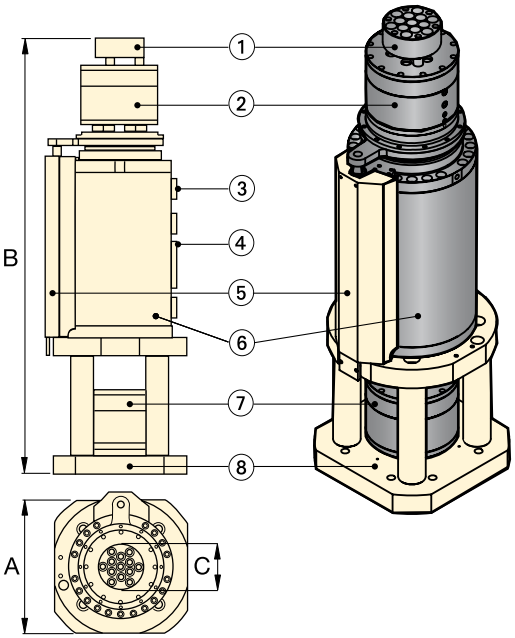
Heavy Lifting Accessories

- Lifting attachments
- Palm trees
- Strand recoilers
- Strand dispenser.

▼ *Heavy lifting system with 11 x 3720 kN Strand Jacks, 6 pumps, a master PLC-control system and network, for lifting roofs during the construction of a new triple bay aircraft maintenance hangar at Abu Dhabi International Airport.*

▼ *Eight 444 ton strand jacks including palm trees, lifting attachments, strand recoilers and lifting wedge consumables will lift twelve ball mills weighing 1500 ton to a height of 20 metres onto their bearing housings at an Australia mining facility.*

Heavy Lifting Strand Jacks



① Pre-Stress Cap
② Moving Lock Device
③ Pilot-Operated Check Valve
④ Electrical Connections
⑤ Stroke Sensor
Anti Rotation Device
⑥ Lifting Cylinder
⑦ Static Lock Device
⑧ Chair

TT Series

Rated Capacity per Jack:
37 - 673 ton

Effective Stroke:
500 mm

Working Pressure:
300 bar

PLC-Control Unit and Strand Jack Pumps

Using a network cable to interconnect each strand jack pump to the master control enables the use of an unlimited number of jacks.

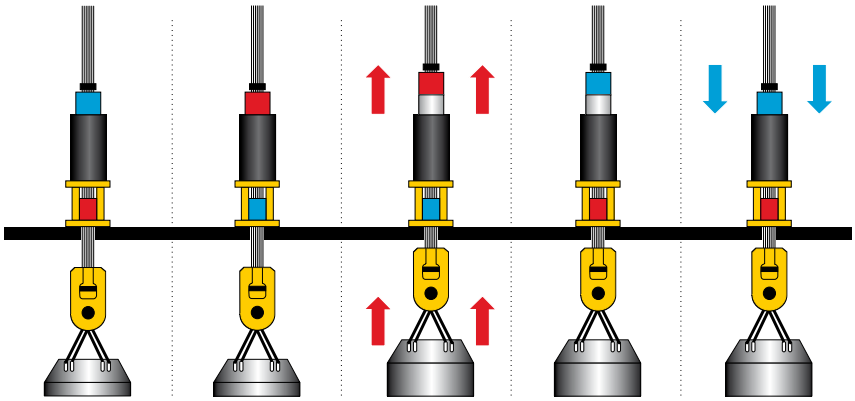
Page: 231

Mono Strand Lifting Jack

For heavy-lifting applications where a crane or hoist will not fit, the **ST-120M06** may be the only solution. Contact Enerpac for more details on this unique lifting solution.

Strand Jacking Lifting Sequence

The sequence of operation is illustrated with the lock devices shown in red when the wedges are closed. The lock devices are shown in blue when the wedges are open.



Bottom Wedges Closed | **Top Wedges Closed** | **Lifting Load** | **Bottom Wedges Closed** | **Top Wedges Open and Reset**

▼ SELECTION CHART

Strand Jack Capacity [1] ton (kN)	Model Number Strand Jack	Strand Diameter [2] inch (mm)	Number of Strands	Effective Stroke (mm)	Effective Area (cm^2)	Nominal Working Pressure (bar)	Dimensions (mm) A	B (extended)	C
37 (360)	**TT-36SJ306**	0.60 (15,2)	3	500	123	300	300	2270	60
86 (840)	**TT-84SJ706**	0.60 (15,2)	7	500	287	300	430	2290	93
147 (1440)	**TT-144SJ1206**	0.60 (15,2)	12	500	466	300	490	2298	133
232 (2280)	**TT-228SJ1906**	0.60 (15,2)	19	500	754	300	600	2330	169
330 (3240)	**TT-324SJ2706**	0.60 (15,2)	27	500	1089	300	650	2330	208
453 (4440)	**TT-444SJ3706**	0.60 (15,2)	37	500	1486	300	700	2652	246
587 (5760)	**TT-576SJ4806**	0.60 (15,2)	48	500	1865	300	760	2693	284
673 (6600)	**TT-660SJ5506**	0.60 (15,2)	55	500	2199	300	900	2775	291

[1] When used with compacted heavy lifting strand. Additional capacities and strokes are available.
[2] Strand jacks are also available for 18,0 mm (0.70 inch) strand. Contact Enerpac for further information.

TTP-Series, Strand Jack Hydraulic Pumps

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▼ Shown: **TTP-Series, Strand Jack Hydraulic Pump**

Hydraulic Power for Demanding Strand Jacking Applications

Motor Size:
5,5 - 37 kW

Lifting Speed:
1 - 29 m/hr

Working Pressure:
300 bar

- **Multiple pump and reservoir options**
- **PLC-controlled operation**
- **Steel frame and lifting eyes**
- **One pump per strand jack allows for short connections and flexible jack positions**
- **Pumps can be interconnected with a network cable.**

Premium Options:

- **Variable frequency drive for flow control and accurate synchronization between multiple lifting points**
- **One pump to operate multiple jacks**
- **Fully enclosed cabinet**
- **Oil cooler for operation in high temperature environments or continuous operation**
- **Reinforced cabinet with steel frame and lifting lugs**
- **Oil pre-heater in low temperature applications**
- **Biodegradable oil.**

Hand Pendant
Allows individual control of strand jacks for set-up and manual operation. Included with each pump unit.

Contact Enerpac!
Contact the Enerpac office nearest to you for advice and technical assistance in the layout of your ideal Lifting System: **integratedsolutions@enerpac.com**. or visit: **www.enerpac.com**.

TT-Series Strand Jacks
Multi Strand Jacks for accurate lifting, lowering or horizontal movements of heavy loads.

Page: 228

▼ *Two concrete arches of this viaduct in Silleda, Spain are rotated and lowered by Enerpac Heavy Lifting Strand Jacking Systems.*

▼ Shown: **Master PLC-Control Unit**

Control Multiple Strand Jacks from One Master Controller

- **Modular based system**
- **Control up to 32 strand jacks with one master controller**
- **Multiple controllers can be networked**
- **Individual or synchronous control**
- **Individual and accumulative stroke and load display**
- **Stroke and load alarms for safety**
- **Data logging capabilities.**

▼ *Strand jack pumps and eight strand jacks are networked to the master PLC-controller to lift twelve ball mills, weighing 1500 ton each, at a mining facility in Australia. By using a network cable to interconnect each strand jack pump, multiple strand jacks can be operated from one master controller.*

▼ *Bridge launching with Enerpac Heavy Lifting Strand Jacks.*

▼ *Bridge launching with Enerpac Heavy Lifting Strand Jacks.*

BLS-Series, Stage-Lift Cylinders

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▼ Shown: **BLS-506 in three lifting positions.**

A Simple Solution to Incremental Lifting

- **Double-acting cylinder with solid plunger design**
- **Simple three-stage operation**
- **Swivel saddle and large support attachments for stability**
- **Anti-rotation device**
- **Built-in overload protection.**
- **Option: stroke sensors for use with Enerpac synchronous lifting systems**
- **Capacity per lifting point 50 - 200 ton. Other capacities and strokes available, please contact Enerpac.**

Lifting Height

Stage-lift cylinders overcome the usual limitation of lift height imposed by the cylinder's plunger stroke length. Large objects, such as oil tanks, can be lifted, held and lowered for maintenance without sending for a crane.

Synchronous Lift System

Multi-cylinder arrangements can be powered and fully synchronized by Enerpac's Synchronous Lift System.

Page: 224

▼ *PLC-controlled hydraulic movement: Enerpac stage lift systems lift and lower the umbrella deck on the world's largest concrete block builder with 1,0 mm accuracy, provided by 30 hydraulic climbing units in an integrated hydraulic system. Each climbing unit consists of two 70 ton double-acting cylinders and two 20 ton locking cylinders.*

▼ *Typical stage-lift application using a custom built Enerpac system to lift the 360 ton Akkerwinde wooden bridge in the Netherlands.*

Double-Acting Stage-Lift Cylinders

Stage Lifting Application

For many lifting applications, the cylinder stroke can not be made long enough to lift the load to the required height. There is a direct relationship between the stroke length and the collapsed height of a cylinder. This relationship many times prevents a cylinder with the proper stroke length from also fitting in the required position to lift the load correctly. When these limitations are experienced, sometimes Stage-Lifting is the only solution.

Stage-Lifting is the process of lifting the load to the maximum stroke of the cylinder and then "cribbing" or holding, the load at this point. Once this is done and the load is secure, the cylinder is retracted, cribbing is then placed under the cylinder and then the cycle is repeated. This stage-lifting cycle allows the load to be lifted many times the stroke of the cylinder and total height is only limited by the strength and stability of the cribbing system.

The BLS-Series of cylinders feature attachments that facilitate the cribbing application, by providing reaction points for both the load and the piston cribbing reaction points.

BLS Series

Capacity per Lifting Point:
50 - 200 ton

Stroke per Stage:
150 mm

Maximum Operating Pressure:
700 bar

Think Safety

Manufacturer's rating of load and stroke are maximum safe limits.

Good practice encourages using only 80% of these ratings!

Lifting an Unbalanced Load?

See our "Yellow Pages" for multi-cylinder set-ups.

Page: 245

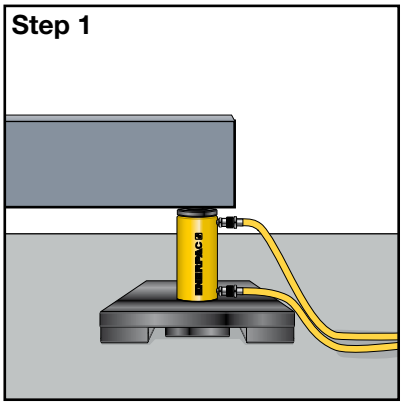
▼ **Stage Lifting Sequence**

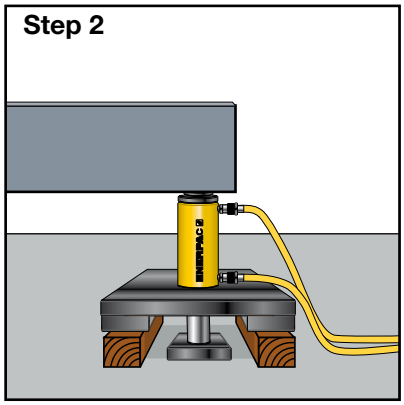
Step 1: The Stage Lift cylinder is placed on a solid support under the load (retracted plunger).

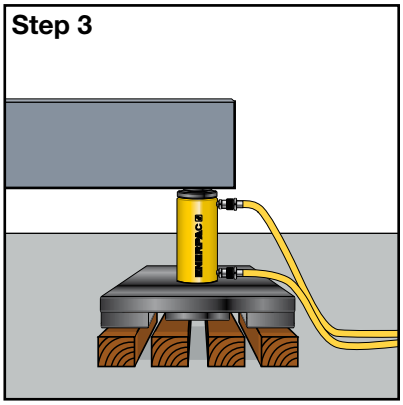
Step 2: Plunger extends, lifting the load and giving clearance to insert two outer blocks under the spreading plate.

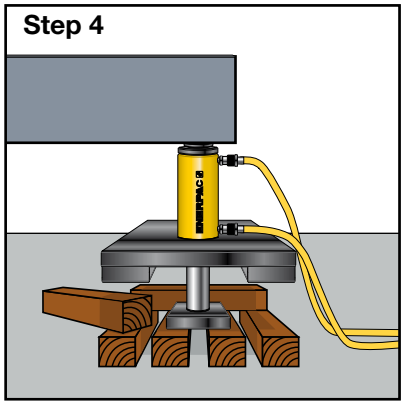
Step 3: Plunger retracts, giving clearance to position the central blocks which will support the plunger plate for the next extension.

Step 4: Plunger extends, lifting the load, giving clearance to insert two new blocks, placed crosswise under the spreading plate.









▼ *Bridge maintenance with synchronous stage lifting systems. Two systems are networked to a PLC-controlled 8-point lift and crib system.*

▼ SHS-Series 4-Point SyncHoist System

Accurate Hoisting and Load Positioning Enhancing a Crane's Capability

- **High precision load manoeuvering, vertically and horizontally – using one crane**
- **Reduces the risk of damage from oscillations of wire rope due to sudden crane starts/stops**
- **Vastly improving operating speed and worker safety**
- **Weather conditions play less critical role**
- **Intelligent hydraulics turn lifting into high accuracy hoisting and load positioning system**
- **High accuracy (± 1,0 mm)**
- **700 bar double-acting push/pull cylinders with parachute valves for added safety in case of hose rupture or coupler damage**
- **Cost reduction when compared to conventional load positioning methods.**

Options for system management & control:

- **Manual control: stroke control and system warning functions**
- **Extended manual control: stroke control, load and stroke display and system warning functions**
- **PLC-control: fully monitorized system with programmable functions using touch screen and wireless remote control and system warning functions**
- **Contact Enerpac for stroke, capacity or control options.**

Typical SyncHoist Functions and Applications

Functions

- High precision load positioning
- Pre-programmed positioning, tilting and aligning
- Counterweighing – determining centre of gravity.

Applications

- Positioning of roof sections, concrete elements, steel structures
- Positioning of turbines, transformers, fuel rods
- Precise machinery loading, mill rod changes, bearing changes
- Precise positioning of pipe lines, blow out valves
- Positioning and aligning of ship segments prior to assembly.

Visit **www.enerpac.com** to learn more about SyncHoist and download the animation.

▼ *Bridge segments are hoisted from the ground, being positioned with a 4-point SyncHoist system with fully monitorized cylinders.*

SyncHoist - High Precision Load Positioning

SHS-Series, Enerpac SyncHoist Systems

System Load Capacity	240 ton (2350 kN)	320 ton (3125 kN)	440 ton (4310 kN)
Max. handling load [1]	4x60 ton	4x80 ton	4x110 ton
Number of lifting points [2]	4	4	4
System reach	1500 mm	1500 mm	1500 mm
Cylinder configuration			
Push force @ 90 bar	10,5 ton	14,0 ton	22,0 ton
Pull force @ 700 bar	60,0 ton	80,0 ton	110,0 ton
Plunger stroke [2]	1500 mm	1500 mm	1500 mm
Pump single-stage			
Oil flow at 700 bar	4,0 l/min	4,0 l/min	4,0 l/min
Control options & system management [3]			
Manual control	Manual directional control valves		
Extended manual control	Joystick controls with position display		
PLC-control [4]	Fully closed-loop control system		

1) Subject to angle and position of lifting cylinders.
2) Each cylinder equiped with parachute valve for added safety in event of hose/coupler damage.
Note: Enerpac SyncHoist have standard 4 lifting points. In the event that more or less lifting points are required, contact your local Enerpac representative.
3) See chart below for detailed control features.
4) Required for counterweighing (centre of gravity).

Three options for system management and control

Contact Enerpac for the following options, or other customised stroke, capacity and control configurations.

1. Manual control

- Plunger stroke control
- System warnings for:
  – oil level, filter indication, thermal motor protection.

2. Extended manual control

- Plunger stroke control
- Load & stroke display
- System warnings for:
  – maximum cylinder load control setting
  – oil level, filter indication, thermal motor protection.

3. PLC-control

- Touch screen
- Remote wireless radio control
- Load and stroke monitoring
- Load calculations (centre of gravity)
- Pre-programmable motions and data recording
- System warnings for:
  – maximum cylinder load control setting
  – stroke and position control
  – oil level, filter indication, thermal motor protection.

SHS Series

Capacity Per Lifting Point:
60 - 110 ton

Maximum Stroke:
1500 mm

Accuracy Over Full Stroke:
± 1,0 mm

Maximum Operating Pressure:
700 bar

▲ *Perfectly synchronised balance: Naval ship superstructure weighing over 600 tons placed on the hull using Enerpac's hydraulic SyncHoist.*

▼ *Designs of Santiago Calatrava (architect) often require creative technological solutions. Enerpac SyncHoist System is one of them and was used for roof positioning of the Palace of the Arts in Valencia (Spain). Segments are hoisted from the ground, being positioned with four fully monitorized cylinders.*