Instruction- and Maintenance Manual
Push-Up Systems

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(Untranslated)

JS125 (125 ton)
JS250 (250 ton)
JS500 (500 ton)

ENERPAC
HEAVY LIFTING TECHNOLOGY®

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Revisions

Rev	Description	Date	Author	Checked	Approved by
0	First release	15 June 2018	G. Kottier	R. Broenink	G. Rezette
1	Updated to include JS500 specific items	21 Aug 2018	F. Schiphorst	S. Huiskes	G. Rezette
2	Additional updates after training	9 March 2018	R. Broenink	F. Schiphorst	M. Ruijter
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4	- No shared oil circuits anumore - Dimensions of barrels corrected - More realistic example of ground pressure - Usage of button Set Expected Load - Timber gap width - Obligatory use of saddle	20 oct 2020	D. Rosier	M.Schreur	R. Broenink

Preface

Dear customer,

This is the manual for assembling, operating and maintaining your Push-Up System. In the rest of this manual, this machine is referred to by the term "**System**".

The manual is part of the handbook of the System, and is meant to be used by operators and by maintenance engineers.

It is essential that the user reads this manual completely before start working with the System.

- All information, illustrations and technical data in this manual are applicable to the System as it was at the time of issuing of this manual.
- We continuously improve our products and therefore reserve the right to implement improvements and changes whenever it is necessary and possible to do so, without any obligation to apply improvements or changes to models purchased previously. Nevertheless, when the system is improved due to serious safety issues, you as a customer will be informed.
- If this manual becomes unreadable, in whole or in part, you can order a copy by providing us the number given on the front cover.
- Despite the fact that this manual has been drafted with great care, we cannot guarantee that it does not contain any errors.
- The use and interpretation of all information in this manual and the possible consequences through improper use of the system are wholly the responsibility of the user. Enerpac shall under no circumstances accept any responsibility for such improper use.

Pictures and illustrations in this manual may differ from reality.

Within this document use is made of **structured text**. The following conventions are applied:

- Procedural steps are numbered. Execute the steps sequentially. Do not skip any step.
- Responses of the system are written on the next line in italic font.
- Choices are indicated with bullets

Example:

1.	Press the green button. *The motor starts running.*	
2.	Select one of the options: • Use the red button to stop the motor • Use the blue button to pause the machine.	

We hope this manual will help you to use the System properly.

Enerpac

Contents

1 Introduction

1.1 Manufacturer address

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1.2 Declaration

Declaration of Conformity according to Machine Directive 2006/42/EC.
For the EC Declaration of Conformity reference is made to ref [5] “EC Declaration of conformity” which is part of the product delivery.

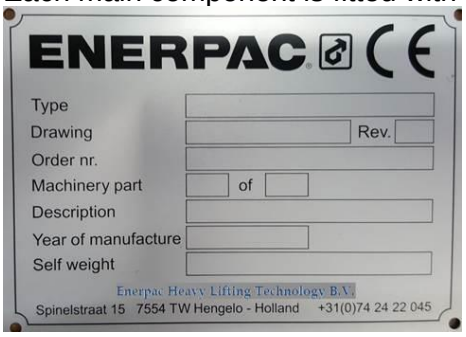
1.3 Referenced documents

The following documents are referred to in this manual:

Ref	Name	Identification	Manufacturer
1.	Operation of electrical installations - Low voltage	NEN 3140	NEN
2.	Operation of electrical installations	NEN-EN 50110-1	NEN
3.	General rules and safety requirements for systems and their components	NEN-EN-ISO 4413	NEN
4.	Technical handbook		Enerpac
5.	EC Declaration of conformity		Enerpac
6.	ASME B30.1-2015	Jacks, Industrial Rollers, Air Casters, and Hydraulic Gantries. (Safety Standard for Cableways, Cranes, Derricks, Hoists, Hooks, Jacks and Slings)	American Society of Mechanical Engineers

1.4 Identification

Each main component is fitted with a name plate as shown below.



Name plates are official documents. It is not permitted to alter them or render them illegible.

1.5 Liability

- Personnel as well as other people involved in the usage of the System are expected to have read and understood this manual.
- In cases of doubt about the use or application of this machine, always contact Enerpac for advice and recommendations.
- Unauthorised alterations to the machine may have a deleterious effect on the characteristics of the machine and may disrupt the control functions. Unauthorised alterations therefore annul any resultant damage claims against Enerpac.
- The risk analysis conducted by Enerpac, intended usage and reasonably foreseeable incorrect usage of the System were assessed. The instructions in this manual were drawn up based on this analysis.

1.6 Intended use

The definition of 'intended use' excludes any and all uses which do not meet the descriptions, including use that exceeds the machine's technical limitations. Enerpac shall not accept any liability for damage resulting from use that is not in accordance with the machine's intended use. The user shall bear any and all risks. The definition of 'intended use' also includes strict compliance with the instructions in the user manual and assumes that the equipment is inspected and maintained at the indicated times.

- The System should only be used in the intended manner as described in the instructions in this manual.
- The System should only be operated by operators with full knowledge of the applicable safety regulations and the hazards which may arise during use.
- The System was developed and built according to the officially recognized safety regulations. However, if the machine is not used as intended:
    - This may pose a risk to the health and lives of operators and bystanders.
    - The System may not function properly or may create hazardous situations.
- The System should only be used if the machine is in perfect technical condition.
- Faults which may result in hazardous situations must be resolved immediately.
- The machine must not be used in potentially explosive environments.

The intended use of the System is to push up a load.
Using the System on trolleys on tracks adds the intention to move the load in horizontal direction. This is optional.

1.7 Modifications

Never make any modifications or additions which could have an adverse impact on safety without prior approval from Enerpac. This also applies to the installation and adjustment of safety devices and valves and welding work on the System.

Spare parts should meet the technical specifications given by Enerpac.
Apply original spare parts as these parts are made according the technical specifications of Enerpac.
In cases of doubt, please contact Enerpac.

1.8 Personnel and responsibilities

- Only qualified personnel are allowed to operate the System.
  Qualified personnel are those who have certified skills to operate the System.
  They should preferably have received training from Enerpac, or else from the customer.
- Only qualified personnel are allowed to maintain the System.
  Qualified personnel are those who have certified main education for the jobs they have to perform, either mechanical, hydraulical or electrical.
  They should preferably have received training from Enerpac, or else from the customer.
- Qualification of the personnel is a responsibility of the customer.
- Always comply with legal minimum age stipulations.
- The System should only be used, maintained and repaired by properly instructed and trained personnel. Clearly describe the qualifications of the relevant employees with regard to use, commissioning, assembly, disassembly and all maintenance and repair work. If work must be performed by third parties, they must receive clear instructions so both the client and the contractor are up-to-date on the agreements reached.
- The supervisor and operator are authorized to refrain from following any instructions from third parties that may pose a risk to the machines or bystanders.
- Personnel who have not been fully trained and instructed in the use of the machine, or personnel who have only received general training, may only perform work on the System under continuous supervision of a qualified person.
- Work on the electrical and the hydraulic systems must be performed by competent, qualified personnel, or by trained personnel under the direct supervision of qualified personnel, in compliance with all applicable rules and regulations.
- Assembly and disassembly may only be performed by trained installers under the supervision of an authorized person who has adequate knowledge of the System.

The responsibilities listed the following sub-sections are in accordance with the standard as referred to in Ref [6] ASME B30.1-2015.
In some situations, the owner and the user may be the same entity and is therefore accountable for all of the following responsibilities listed in this chapter.In other cases, the user may lease or rent the system without supervisory, operational, maintenance, support personnel, or services from the system owner. In these situations, sections 1.8.1 “The owner of the system” and 1.8.2 “The user of the system” shall apply.

1.8.1 The owner of the system

The responsibilities of the owner of the system are:

a) to make sure the system meets the requirements as given in this manual as well as specific job requirements defined by the user,
b) to make sure the system and all necessary components, specified by the manufacturer, meet the user's requested configuration and capacity,
c) to provide the applicable capacity charts to the user,
d) to provide this manual to the user to enable correct assembly, disassembly, operation and maintenance information,
e) to make sure all inspections and maintenance activities are performed,
f) to designate personnel for maintenance, repair, transport, assembly, and disassembly,
g) and to designate personnel for inspections as required in the applicable chapters.

1.8.2 The user of the system

The responsibilities of the user of the system are:

a) to comply with the requirements of this manual and all regulations applicable at the work site,
b) to use supervisors for activities,
c) to ensure that the system is in proper operating condition, prior to initial use at the worksite by
   - verifying that the Owner has provided this manual,
   - and verifying that a frequent inspection has been performed,
d) to verify that the system has the necessary capacity to perform the proposed operations in the planned configuration,
e) to ensure the assigned operators have been notified of adjustments or repairs that have not yet been completed, prior to commencing operations,
f) to designate personnel for inspections as required in the applicable chapter,
g) to designate personnel for maintenance, repair, transport, assembly, and disassembly,
h) to ensure that all personnel involved in maintenance, repair, transport, assembly, disassembly, and inspection are aware of their responsibilities, assigned duties, and the associated hazards,
i) and to ensure that the inspection, testing, and maintenance programs specified by owner are followed.

1.8.3 The site supervisor

In some cases the site supervisor and the system director may be the same person.
The responsibilities of the site supervisor shall include the following:

a) ensuring that the system meets the requirements prior to initial site usage.
b) determining if additional regulations or requirements are applicable.
c) ensuring that a qualified person is designated as the system director.
d) ensuring that the operations are coordinated with other jobsite activities that will be affected by or will affect the operations.
e) ensuring that the area for the system is adequately prepared. The preparation includes, but is not limited to, the following:
   1. access for the system and associated equipment.
   2. sufficient room to assemble and disassemble the system.
   3. an operating area that is suitable for the system with respect to levelness, surface conditions, support capability, proximity to power lines, excavations, slopes, underground utilities, subsurface construction, and obstructions to operation.
   4. traffic control as necessary to restrict unauthorized access to the system's working area.
   5. ensuring that work involving the assembly and disassembly of system is supervised by a qualified person .
   6. ensuring that operators meet the physical, knowledge, and skill requirements as described in this manual.
   7. ensuring that conditions that may adversely affect the operations are addressed. Such conditions include, but are not limited to, the following:
      - poor soil or support conditions
      - wind velocity or gusting winds
      - weather conditions
      - extreme temperatures
      - inadequate lighting
      - operating surface conditions
      - excessive noise proximity to energized sources (e.g., power lines, pressurized lines)
      - ensuring that work performed by the rigging crew is supervised by a qualified person
      - ensuring that maintenance is performed by a designated person

1.8.4 The system director

The system Director's responsibilities shall include the following:

a) being present at the job site during the operations.
b) stopping the operations if alerted to an unsafe condition.
c) ensuring that the preparation of the area needed to support the operation has been completed before the operation starts.
d) ensuring necessary traffic controls are in place to restrict unauthorized access to the system's work area.
e) ensuring that personnel involved in the operations understand their responsibilities, assigned duties, and the associated hazards.
f) addressing safety concerns raised by the system operator or other personnel and being responsible if he decides to overrule those concerns and directs the operation to continue. In all cases the manufacturer's criteria for safe operation and the requirements of this manual shall be followed.
g) designating the signal person(s) and conveying that information to the system operator.
h) evaluating the operation in proximity to energized sources.
i) ensuring precautions are implemented when hazards associated with special load handling operations are present. Such operations may include, but are not limited to, the following:
    - multiple types of system used simultaneously
    - shifting centre(s) of gravity or lifting below the centre or gravity
    - shifting, inclined, or moving surfaces
    - operating barges
j) informing the system operator of the weight and planned movement of the loads to be handled.
k) obtaining the system operator's verification that this weight does not exceed the system's rated load.
l) ensuring that load rigging personnel have been designated for the system.
m) ensuring that the load is properly rigged and stable.

1.8.5 The operators

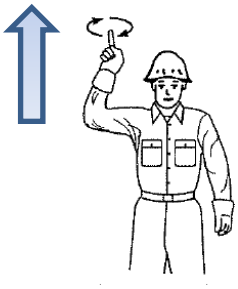
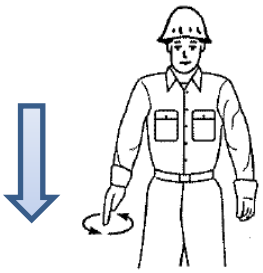
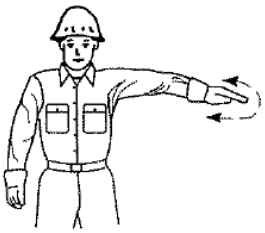
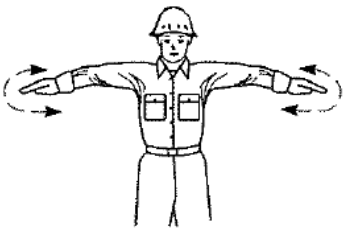
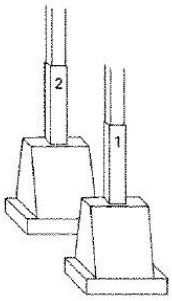
The system Operator shall be responsible for the following listed items.
The system Operator shall not be responsible for hazards or conditions that are not under his direct control and that adversely affect the system operations.
Whenever the system Operator has doubt as to the safety of operation, the system Operator shall stop the system functions in a controlled manner. System operations shall resume only after safety concerns have been addressed and the continuation of the operation is directed by the system Director.
The system Operator's responsibilities shall include the following:

a) reviewing the requirements for the system with the Director before the operations.
b) knowing what types of site conditions could adversely affect the operation of the system and consulting with the system Director concerning the possible presence of those conditions.
c) understanding and applying the information contained in this manual.
d) understanding the system's functions and limitations as well as its particular operating characteristics.
e) using the system's load/capacity chart(s) and diagrams and applying all notes and warnings related to the charts to confirm the correct system configuration to suit the load, site, and load handling conditions.

f) refusing to operate the system when any portion of the load or the system could be adversely affected by proximity to energized sources until evaluated and approved by a qualified person.
g) performing inspections as specified in the applicable chapter.
h) promptly reporting the need for any adjustments or repairs.
i) following applicable lock out/tag out procedures,
j) not operating the system when physically or mentally unfit.
k) ensuring that all controls are in the off or neutral position and that all personnel are in the clear before energizing the system.
l) not engaging in any practice that will divert his attention while actually operating the system controls.
m) testing the system function controls that will be used and operating the system only if those function controls respond properly.
n) operating the system's functions, under normal operating conditions, in a smooth and controlled manner.
o) knowing and following the procedures specified by the system manufacturer or approved by a qualified person for assembly, disassembly, and setting up the system.
p) knowing how to travel the system, if applicable.
q) ensuring that the load and rigging weight(s) have been provided.
r) calculating or determining the rated load for all configurations that will be used and verifying, using the capacity chart(s), that the system has sufficient capacity for the proposed operation.
s) considering all factors known that might affect the system capacity and informing the system Director of the need to make appropriate adjustments.
t) knowing the standard and special signals as specified in the applicable chapter and responding to such signals from the signalperson. When a signalperson is not required, the system Operator is then responsible for the movement of the system. However, the system Operator shall obey a stop signal at all times, no matter who gives it.
u) Understanding of rigging and basic rigging procedures. Ensuring that the load is properly secured and will be lifted safely.
v) if power fails during the operations
    - set all locking devices
    - move all power controls to the OFF or neutral position
    - secure and stabilize the load, if practical
w) before leaving the system unattended
    - secure and stabilize the load
    - set all locking devices
    - put the system controls in the OFF or neutral position
    - turn off the system power source
    - follow the recommendations as given in this manual or given by a qualified person for securing the system

1.9 Hand signals

The following hand signals are applicable when using the system:

RAISE. With forearm vertical, forefinger pointing up, move hand in small horizontal circle.		LOWER. With arm extended downward, forefinger pointing down, move hand in small horizontal circle.	
STOP. Arm extended, palm down, move arm back and forth horizontally.		EMERGENCY STOP. Both arms extended, palms down, move arms back and forth horizontally.	
END EVERYTHING. Clasp hands in front of body.		INDIVIDUAL UNITS. Hold up: one finger for the unit marked "1", two fingers for the unit marked "2". Etc. Regular signals follow.	 

1.10 Lifetime

No lifetime of the System is specified, since its safe and effective lifetime strongly depends on

- the intensity of use,
- the quality of the maintenance,
- the service conditions the system is exposed to, like wet or salty environments,
- and the load to which the system is exposed.

1.11 Warning symbols used within this document

In this manual warnings and symbols are used to draw your attention to important safety information.
The table below shows the applied warnings and symbols:

NB
'NB' is used to highlight important **work activities** and for **additional information**

Caution
'Caution' is used if failure to heed the given instructions may result in **damage to the system**.

Attention
General warning to the operator of potential damage to **equipment** and the **environment**.

Hazard
Draws the user's attention to potential **hazards to personnel** if work instructions are not followed precisely.

2 General safety aspects

This chapter contains general safety aspects.
Specific safety directions are mentioned in other chapters.

2.1 Mandatory protective gear

While using the System ensure that the locally applicable safety regulations are observed

Make sure that all people on the working place observe the following safety regulations:

Always wear • safety goggles
and a safety helmet

Always wear • safety footwear

Wear safety gloves.
But we strongly advise not to wear them when
operating handheld control consoles

Wear a safety harness when working at heights
more than 2 meters

2.2 General safety regulations

Special safety regulations are given in the relevant national legislations or company regulations for accident prevention. Compliance with these rules and regulations is a legal requirement and a condition of employment. In addition to the safety regulations set out under the law, also observe the following points:

- Keep the worksite clean.
- Before every start-up, always check that there are no persons in an unsafe situation or position with respect to the System. Stop working if, despite warnings, there are still employees in an unsafe situation.
- Only use the System on an adequately stable and robust subsurface.
- Keep all equipment out of the area of above-ground power lines.
- The coverings must be closed (this does not apply to the covering on control panels).
- The operator must switch off the System before leaving it unattended.
- Use all required Personal Protection Equipment (PPE).
- Do not wear any loose clothing or jewellery. Long hair must be tied back.
- Tools and equipment, necessary for (dis-)assembly of the System as well as for maintenance have to be in good condition. Badly maintained equipment can cause time wastage and lead to permanent damage to the equipment and/or it surroundings.
- Keep the hydraulic and moving equipment of the System clean to prevent it from jamming or causing damage to itself or other equipment.
- Do not use the System, whether loaded or not, while unauthorized people are in its vicinity. The System can be operated remotely.
- Maintain focus during the work. Carelessness may result in serious injuries.
- Additional lifting gear and accessories such as hawsers, shackles, lugs, slings etc. must comply with the legal requirements imposed in the country of use.
- Inspect the condition of the System before *every* individual start-up, given the fact that the slightest defect may have severe consequences.
- Personnel shall not place any part of their body under the load.
- Personnel shall remain clear of the system during operation.
- Personnel shall not ride on the system while it is moving or being moved.
- Remove loose tools or components from the load or the System if the load will be moved as they might fall down during moving, which can lead to fatal accidents.

Enerpac is not liable for improper use of accessories in combination with the System.

2.3 Symbols applied to the System

The System can be labelled with

- warning symbols,
- and mandatory signs.

The table below shows the most commonly used **warning symbols** in industrial environments:

Danger of contact with moving machine parts

Danger
Lethal voltage in the control panels

Danger of **parts of hands** getting trapped/caught

Danger of **parts of feet** getting trapped/caught

Danger of **falling**

Danger
Exercise extreme attention and caution when **under moving loads**.

Danger of getting **trapped**/caught between moving parts.

The table below shows the most common symbols of **mandatory signs** in industrial environments:

Read the instruction manual.

Wear **gloves** to prevent injury from and/or exposure to chemicals.

Wear safety **glasses** to prevent eye injuries.

Wear safety **shoes** to prevent injuries caused by falling objects and/or feet getting caught in machinery.

Wear **hearing** protection.

Wear a safety **helmet** to prevent injuries caused by falling objects.

Wear a safety **harness**

NB: The stickers on the machine are official documents and it is not permitted to alter them or render them illegible.

NB: It is strictly obligatory to observe the warning symbols and the mandatory signs applied to the machine.

2.4 Welding work

- Welding, cutting and grinding work on the System is only permitted with the prior written consent of Enerpac.
- Welders must be properly qualified and must have a valid welding certificate.
- If welding work needs to be performed on the System then
  - Switch the machine off
  - Disconnect all power cables and communications cables
  - Connect the system to a direct earth line.

NB: Welding, cutting, grinding or any other structural adjustment work on the System is not permitted without Enerpac's prior written permission.

2.5 Working on the electrical system

- In the event of an electrical fault in the electric control system, you must bring all connected devices into a safe condition. Switch off the System.
- Work on the electrical system must be performed by a competent, qualified electrician or by trained personnel under the direct supervision of a qualified electrician, in compliance with all applicable rules and regulations such as
  - Ref 1 "Operation of electrical installations - Low voltage"
  - Ref 2 "Operation of electrical installations".
- Switch the power off before inspection, maintenance or repair of the System.
  Make sure that there is no power on the relevant parts. If necessary, connect the machine to earth. Insulate any adjacent component that is still under voltage.
- Check and inspect the electrical system of the System at regular intervals.
  Problems, such as loose connections and damaged or stuck wiring, must be resolved immediately. Only use original fuses and circuit breakers with the correct current value.
- If work does need to be performed on components which are under voltage, then cordon off the work zone and only use certified and properly insulated tools.

2.6 Working on the hydraulic system

- Work on the hydraulics system or other components in a pressurized system must be performed by a competent, qualified installer or by trained personnel under the direct supervision of a qualified installer, in compliance with all applicable rules and regulations.
- Check all pipes, hoses, quick-release couplings and screw joints regularly for leaks and visible external damage. Repair damage immediately. Pressurized hydraulic fluid leaks may cause serious injury, and it may cause fire and damage to the environment.
- If parts need to be removed from the hydraulic system, the hydraulic pressure must be released according to the instructions in this manual before beginning work.
- Expand and install pressurized hydraulic pipes, tubes and lines in accordance with professional standards.
- Make sure that no parts have been switched during re-installation work. All parts and the length and quality of hoses meet the requirements of Ref 3 "General rules and safety requirements for systems and their components".

2.7 Fire

The course of action in the event of an emergency is determined by the rules and regulations applicable on the worksite. Every company has its own special rules. So make sure you are up-to-date on these rules.

In any case, the following actions are necessary in the event of a fire:

- Keep calm.
- Report the emergency to the employee responsible for in-house emergency services (IHES).Tell who you are, where you are located and describe the emergency situation. (The IHES employee will notify external emergency services.)
- Warn your colleagues.
- Extinguish the fire if it is still in its early stage, using the extinguishing means available onsite.
- If possible, switch off the electrical power supply.
- Leave the scene of the emergency situation and report to the rendez-vous point.

Caution
Never use water to put out an electrical fire or a fluid fire

2.8 Working with hazardous substances

It is thought that special first aid procedures are required in cases of accidents with chemicals. But in cases of small quantities, standard measures suffice:

1. rinse thoroughly with water
2. wash with soap
3. provide fresh air
4. remove any contaminated clothing

In common the following rules are applicable:

- Contact with skin:
  - rinse thoroughly with water
  - remove any contaminated clothing
  - wash the relevant body parts with soap.
- Contact with eyes:
  - rinse thoroughly with water (10 till 15 minutes) using eye wash fountain
  - consult a doctor.
- Ingestion:
  - rinse the mouth out with water.
  - If necessary, dilute the substance by drinking water.
  - If a corrosive substance has been ingested, do not induce vomiting. This is to prevent the substance coming into contact with the sensitive oesophagus again.
  - If the victim is unconscious, never attempt to induce vomiting or have the victim drink anything.

Using a ‘neutralizing solution’ (such as a base for an acid) can actually make the situation worse.

In addition to this, it is advisable to consult the safety information (TREMCARD book, safety information sheets and the catalogue) and report everything that is relevant to the accident to a doctor.

When work has to be done in confined spaces:

- Wear personal protection equipment
- ventilate according to the relevant regulations
- Ask a colleague to remain by the entrance in order to provide assistance in the event of an emergency.
- You are legally required to be familiar with the potential hazards of the product.
  The safety information sheets are intended to provide adequate, correct and up-to-date information on all substances used on the worksite.
- Relevant safety information sheets are given in Appendix E

During maintenance, you may work with substances fitted with **GHS symbols**.
These GHS symbols are explained in the next below.[1]

Symbol	General hazard indication	Possible precautionary measures
	May cause an allergic reaction on the skin.	Contaminated work clothing must not leave the workspace.
	Harmful to aquatic organisms, with long term effects	Do not discharge into the environment.
	Causes serious eye injury and/or damage to the skin.	Wear eye protection and skin protection (such as protective gloves).
	Fire hazard when heated and/or in presence of sparks.	Keep away from heat, sparks, open flames and/or hot surfaces. No smoking!
	May cause fire (oxidising agent).	Take the necessary precautionary measures to prevent mixture with flammable substances.
	Toxic in cases of ingestion and/or skin penetration	Do not eat, drink or smoke when using this product.

[1] *CLP is the Regulation on Classification, Labelling and Packaging of substances and mixtures (EC No 1272/2008). This regulation brings European legislation on the classification, labelling and packaging of chemical substances into accordance with the GHS (Global Harmonised System for classification and labelling of chemical substances).The GHS is a United Nations system used to identify chemical substances and inform users of their hazards using standard symbols and phrases on labels, packaging and Safety Information Sheets (SIS).*

Symbol	General hazard indication	Possible precautionary measures
	May cause hypersensitivity of the airways or heritable mutations in male reproductive cells, is a potential carcinogen and/or is toxic to human reproduction	Apply a strict hygiene/health policy and wear suitable personal protection equipment.
	Explosion hazard when heated and/or in presence of sparks	Keep away from heat, sparks, open flames and/or hot surfaces. No smoking!
	Contains a gas under pressure. May explode if heated	Keep out of sunlight. Store in a well-ventilated space.

2.9 Assembly and disassembly

- Assembly and disassembly of the System has to be performed by properly trained operators
- Only use certified lifting and hoisting equipment.
  Check the validity of these certificates and qualifications.
- Only use lifting and hoisting equipment with suitable capacity for the loads in question.
- Before commissioning, any parts that were disassembled for transport must be re-assembled, re-installed, checked and approved by qualified personnel.
- Make sure that the instructions in this manual have been followed precisely before commissioning the System.
- Lift loads as described in the user manual (connection points for lifting hooks) and observe the professional standards.

Hazard
Any components that are blocked or stuck in any way (and any parts connected to these components) will be under mechanical tension. If you release these parts, they could change position suddenly and seriously injure you.

2.10 Transport, loading and unloading of the System

- Loading and unloading has to be performed by properly trained operators
- Only use lifting and hoisting equipment with suitable capacity for the loads in question.
- Lift loads as described in the user manual (connection points for lifting hooks) and observe the professional standards.
- Only use suitable containers with adequate load-bearing capacity for transport purposes.
- Secure the load properly using suitable connection points and twist locks (for the containers). When using twist locks secure them properly and check that the locking mechanism is working correctly.
- Disconnect all electrical and hydraulic connections when the System has to be moved, even if it is for only a short distance.
- To avoid damage during transport use timbers, rubber pads and plastic for packaging.
- Containers may be used for transport, since they provide rigid protection against and avoid weather influences. Make sure that all parts are secured against sliding around.

2.11 Dealing with hoses

- Make sure the maximum permitted pressure is never exceeded:
  - Do not change any safety setting.
- Ensure that the accumulators and by-pass hoses are in good condition.
- Do not drive over or stand on the hoses:
  - Standing on and driving over the hoses causes' damage to the hose fabric, which causes leaks.
  - A sudden increase in pressure caused by squeezing the hose causes serious damage to other components.
- Do not pull on a hose that is connected:
  - If pulling forces are exerted on a hydraulic coupling the hose and coupling interface will weaken which may result in the hose bursting out of the coupling.
  - Always lift a hose by the hose itself, whilst supporting the coupling.
  - Stow hoses in such a way that no forces (gravitational force) are exerted on the coupling.
- While moving the hoses, prevent the couplings being dragged over the ground:
  - Prevent excessive wear on the couplings and hoses by transporting them on pallets, if possible.
  - During assembly the hose must be supported by necessary use bend guides to prevent twisting of the hose.
- Protect the hose sleeve in places where chafing etc. cannot be avoided:
  - Wear spots can be prevented by sliding protective sleeves over areas where wear is expected or by covering sharp edges.
- Change worn or damaged hoses immediately:
  - If a hose is pressurized continuously by more than 20% above working pressure it must be replaced.
- Do not use dirty or corroded couplings.
  - They are less reliable
  - They will cause leaks over time.
  - They pollute the hydraulic system
- Disconnecting hydraulic tubing and hoses shall be done with utmost care.
  - The system is designed in such a way that hydraulic pressure drops to zero when the system is switched off. Nevertheless, pressure can remain due to
    i. The presence of load on the system
    ii. Raise of temperature
  - But the hydraulic connections have been designed in such a way that either
    i. they cannot be uncoupled when they're under pressure, or
    ii. they can be uncoupled under pressure of only a few bars, but measures have been taken that no oil can come out
  - Always use the manometers of the System to verify that the pressure is zero.

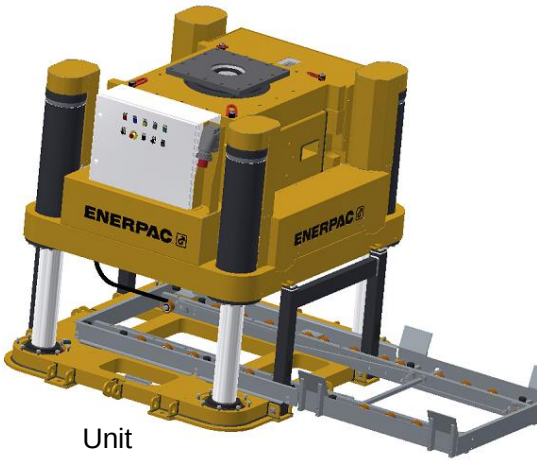
NB: Preferably do not uncouple the HPU when there is load on the System
Preferably store the System in lowest position

Hazard: Careless handling of hydraulics can cause serious injuries

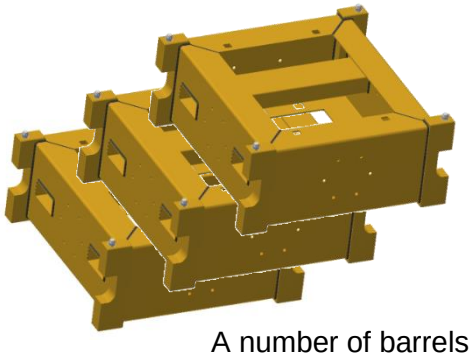
3 System Overview

This chapter describes the main functions and components of the System. Pictures may differ from reality depending on the type of machine (JS125, JS250 or JS500).

3.1 General



Unit



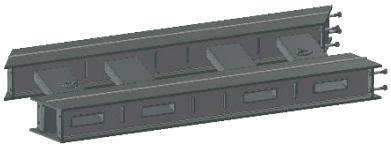
A number of barrels

Trolley JS125 (optional)

Trolley JS250 (optional)

Software applicaation

Smartbox



Skid tracks (optional)

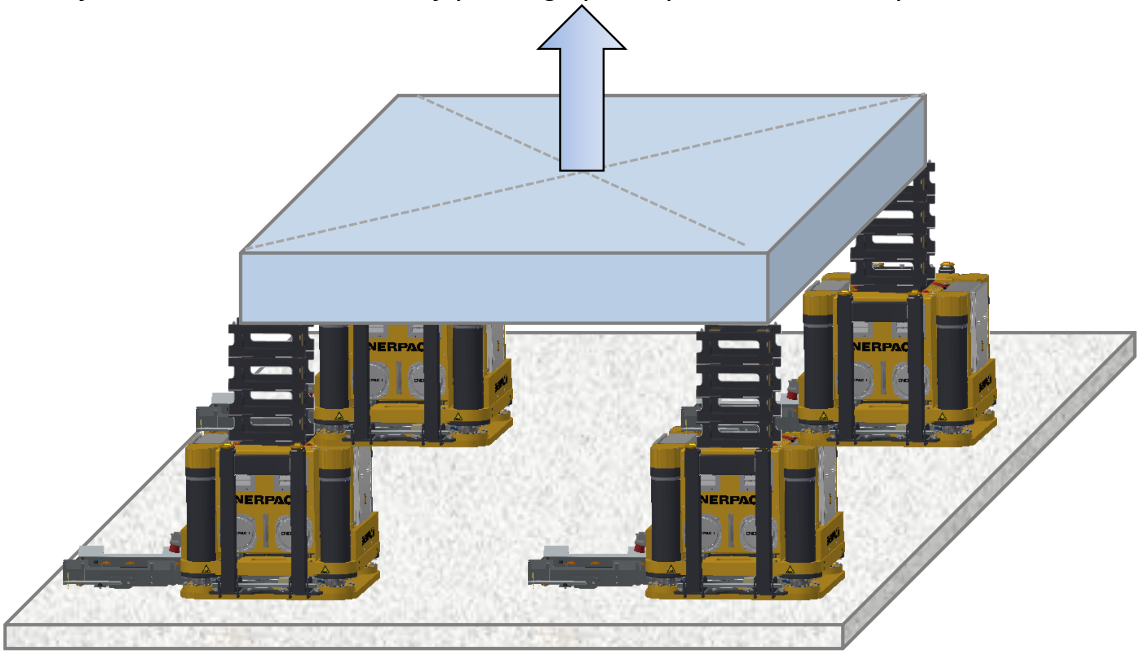
One complete system consists of

- four units
- one software application, running on a laptop
- one smartbox
- a number of barrels
- four trolleys (optional) including skid tracks

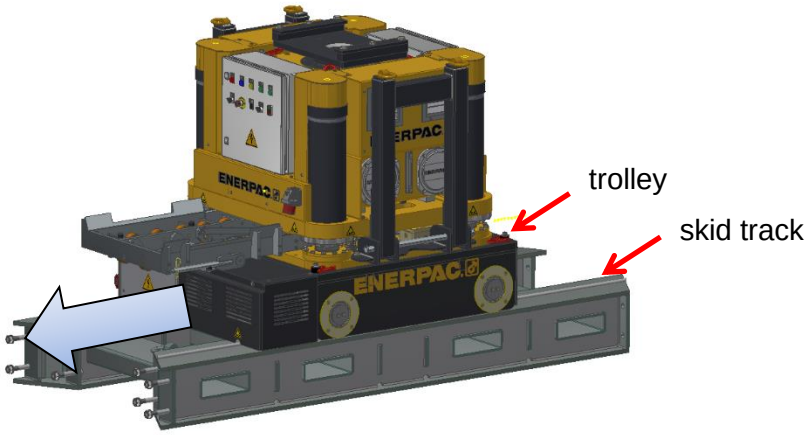
Properties of one unit:

- The load is put on top of the barrel
- Barrels are inserted into the unit one by one using the insertion system.
- Once inside, the barrel is fetched by mini-jacks inside the unit.
- The barrel is pushed upwards by the four main jacks. Every time a new barrel is inserted, the pile is pushed up one step.
- Only one unit can be operated by the controls on its control panel.
  Four units can be controlled simultaneously by the applying the application running on the laptop. The smartbox interfaces between the laptop and the unit.

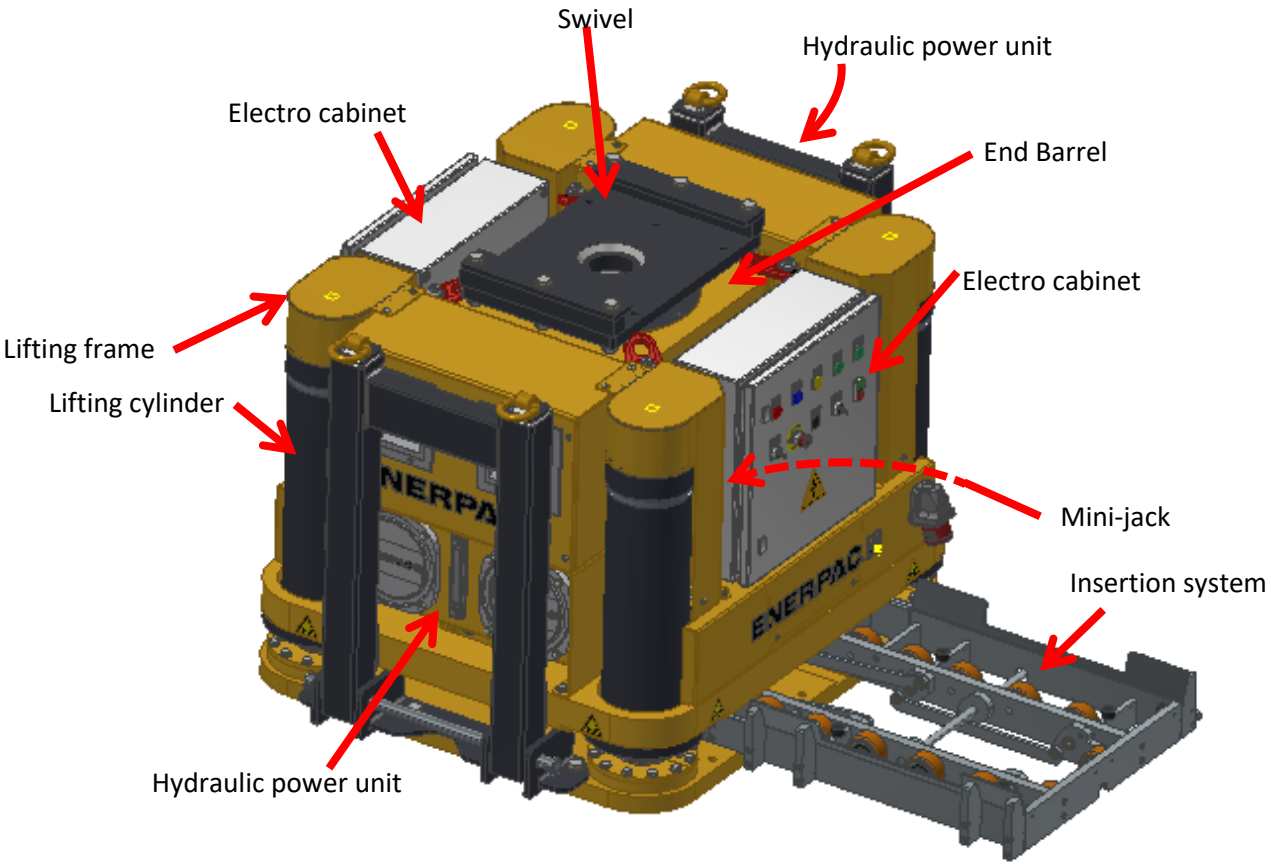
The system is able to lift a load by pushing up four piles of barrels in parallel.



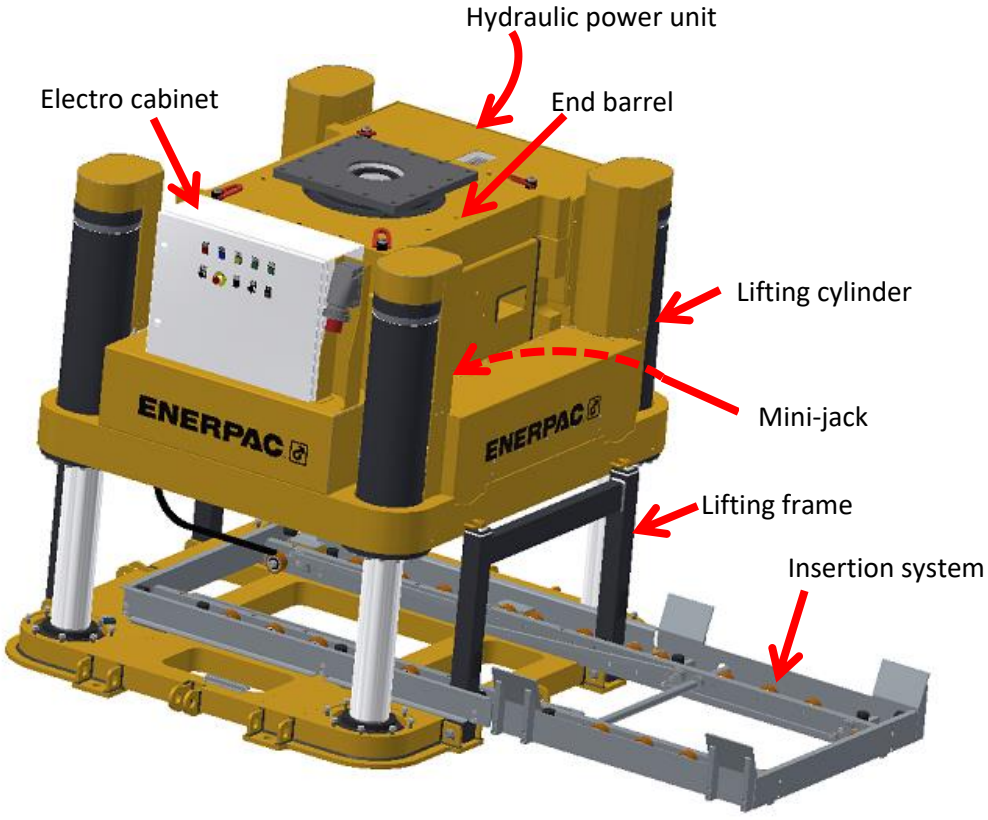
Optionally, the units can be put on trolleys which run on skid tracks. In such case, the load can be moved in a horizontal direction.



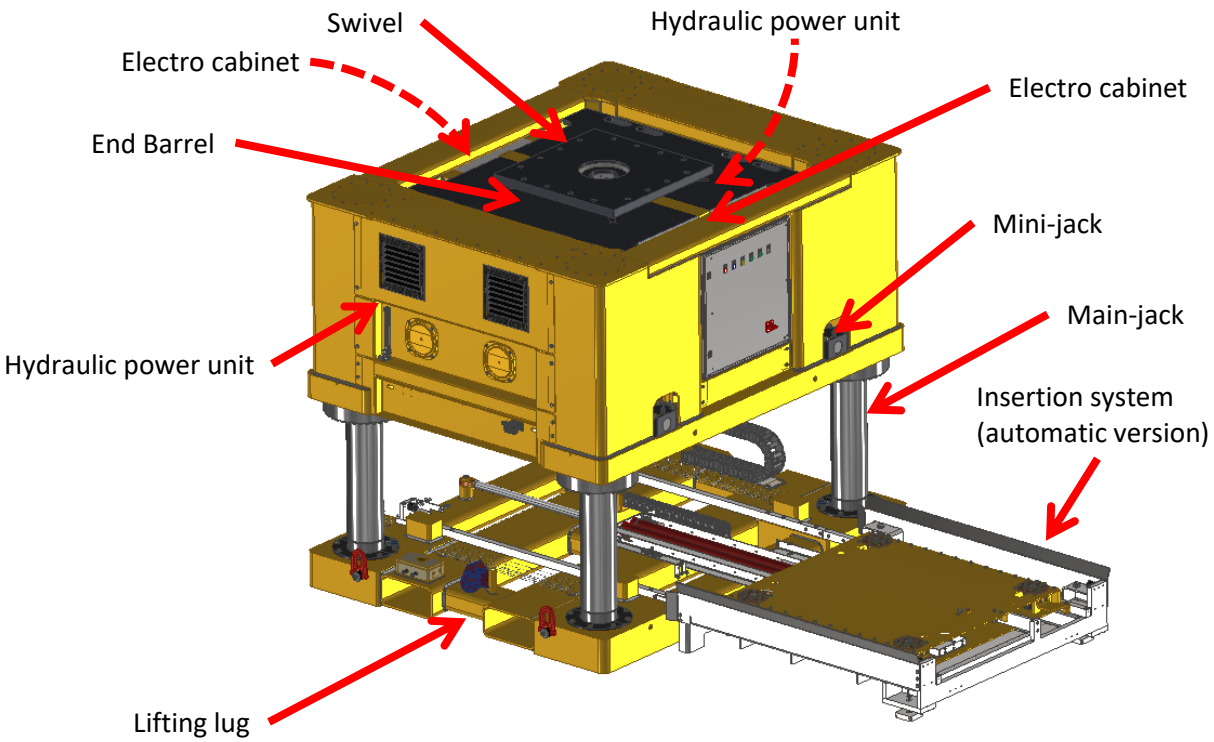
3.1.1 The Unit



JS125



JS250

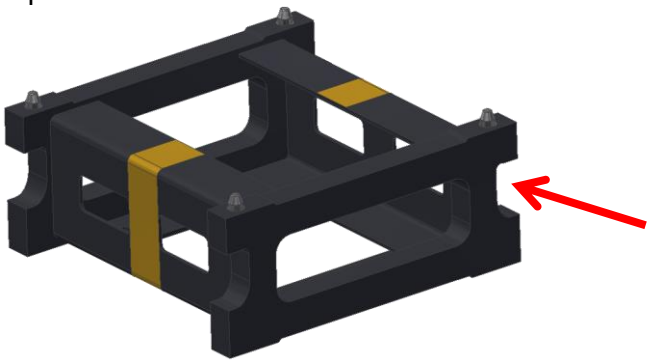


JS500

NB: The four cylinders of a unit ar not connected to each other hydraulically. All of them form separate oil circuits.

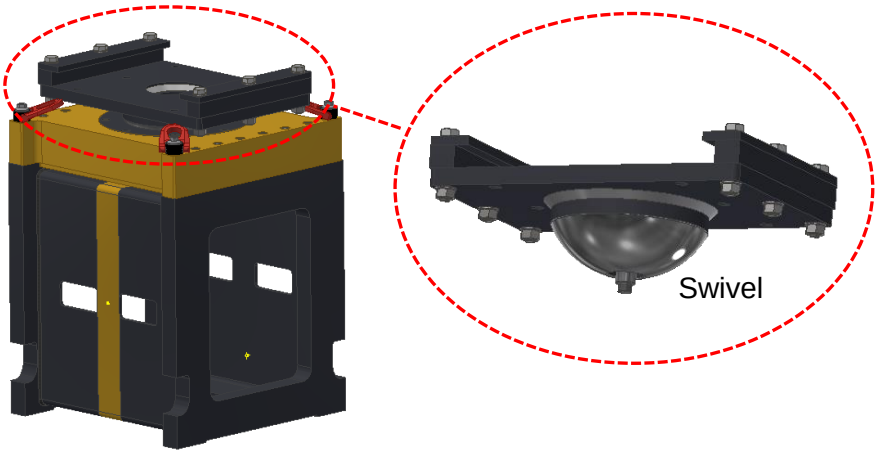
3.1.2 The barrel

A pile of barrels bears the load.



3.1.3 The top barrel

The top barrel is provided with a swivel. On top of two swivels, a header beam can be fitted.

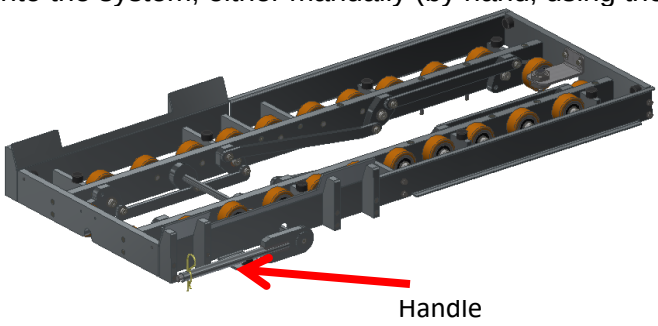


3.1.4 The mini-jacks

The mini-jacks fetch the barrels.

3.1.5 The insertion system

The insertion system is used to move a barrel into the system.
Barrels are put one by one on top of the insertion system by a forklift. Then the barrel is moved into the system, either manually (by hand, using the handle) or automatically.



3.1.6 The electro cabinet

The electro cabinet contains the electrical systems. The number of cabinets differs per system. Controls and indicators are mounted at the frontside of one electro cabinet. Using the controls, the main jacks and the mini jacks of the unit can be controlled.
No other units can be controlled. The panel is intended to be used for setting-to-work and maintenance purposes, not to perform a lifting operation.

3.1.7 The hydraulic power unit (HPU)

The HPU provides the System with hydraulic power. The number of HPUs differs per system.

3.1.8 The laptop and the smartbox

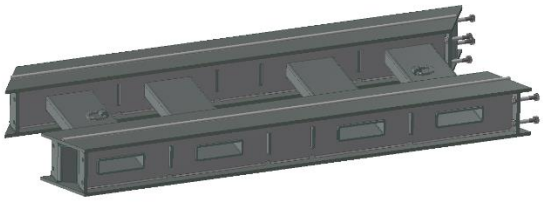
The laptop together with the Smartbox enables the operator to control the system.

(The laptop is not part of the delivery, just the application running on it.)

- The laptop presents the HMI (Human Machine Interface).
- The Smartbox is the interface cabinet between the laptop and the units.

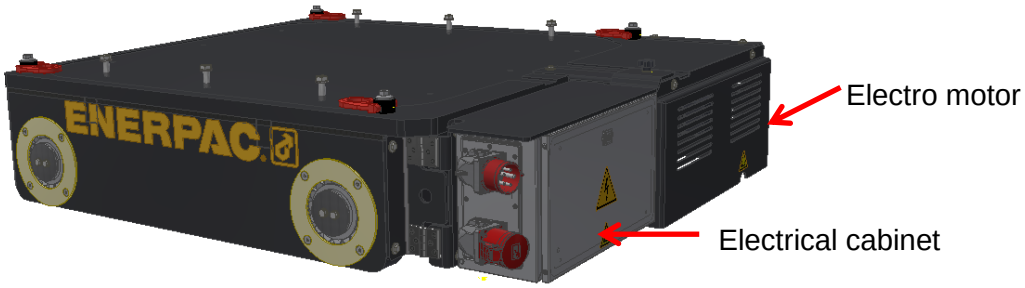
3.1.9 The trolley (optional)

- One trolley bears one unit.
- The trolley is self-propelling and is provided with an electro motor
- The trolley has to be provided with electric power.
- Two trolleys run on the same skid track.
  For a four-unit configuration, two skid tracks have to be built.
- Skid tracks consist of skid track elements, which are mounted together.



Two types of trolleys are available:

3.1.9.1 JS125



- A remote control console can control up to four trolleys simultaneously.

NB: The controlling of the trolleys including the emergency stop circuit is complete separated from the control of the JS125 units as the trolleys is not integrated within the System and is therefore a separate optional system.

- One single trolley can be operated by the controls on the electrical cabinet.

- Each trolley is provided with a sensor which measures the travelled distance. This enables synchronised travelling of all trolleys.

3.1.9.2 JS250

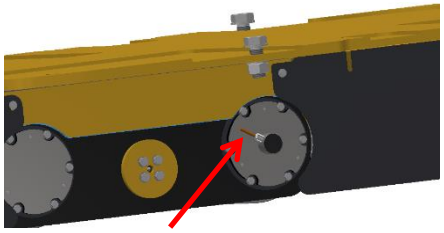
- A remote control console can control up to four trolleys simultaneously.

NB: The controlling of the trolleys including the emergency stop circuit is complete separated from the control of the units as the trolleys is not integrated within the System and is therefore a separate optional system.

- One single trolley can be operated by the controls on the local control dongle:
  - low speed / high speed
  - travel forward / reverse
  - emergency stop

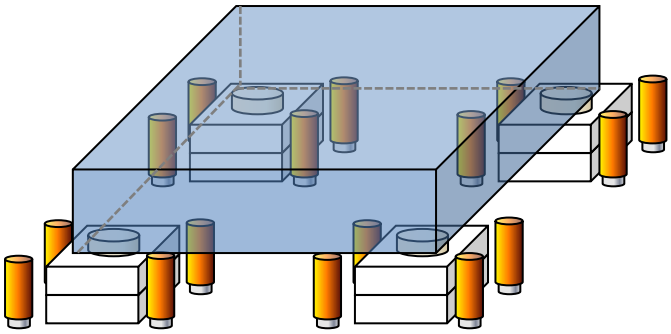
NB: No other units can be controlled. The Local Control dongle is intended to be used for setting-to-work and positioning of one unit, not to perform a lifting operation.

- Each trolley is provided with a sensor which measures the travelled distance. This enables synchronised travelling of all trolleys.

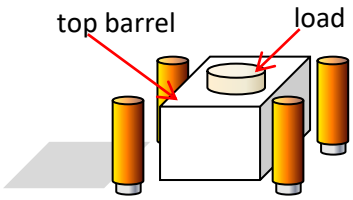
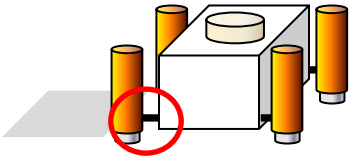
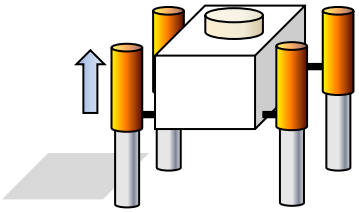
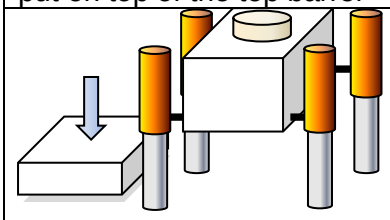
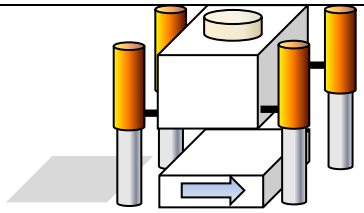
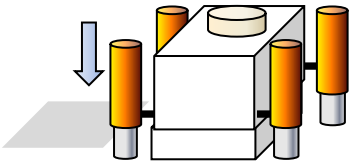
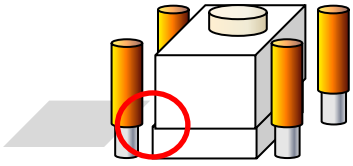
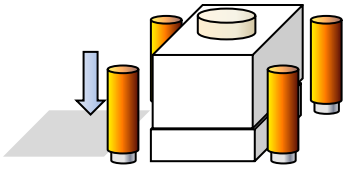
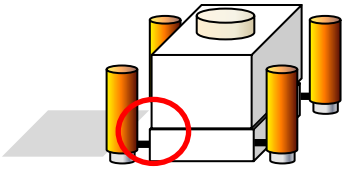
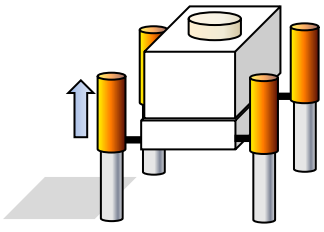
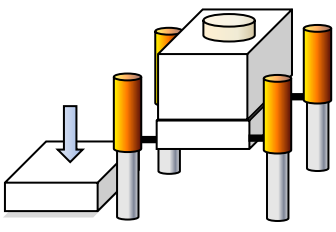


3.2 The lifting principle of the system

Four units, put in a square formation, lift the load:



The principle of lifting is depicted below for just one unit.

 Initially the system is loaded with the top barrel. The load is put on top of the top barrel	 The mini-jacks fetch the barrel	 The main jacks extend. The barrel is lifted, together with the top barrel and the load
 A new barrel is put upon the insertion system	 The new barrel is shifted into the system	 The main jacks retract until the load rests on the just inserted barrel.
 The mini-jacks retract.	 The main jacks lower to their lowest position.	 The mini-jacks fetch the lowest barrel
 The main jacks extend; the pile of barrels is lifted	 A new barrel is put on the insertion system.	 The cycle starts from step 5

3.3 System specifications

3.3.1 Main specifications

JS125 unit	
Power	10 kW per unit
Current	20 A
Voltage	380 to 480 V AC/ 3-phase
Frequency	50-60 Hz
Power connector	32 A per unit
JS125 Trolley	
Power	0.75 kW per unit
Current	3 A per unit
Voltage	380 to 480 V AC/ 3-phase
Frequency	50-60 Hz
Power connector:	32 A per unit
JS250 Trolley	
Power	1.1 kW per unit
Current	5 A per unit
Voltage	380 to 480 V AC/ 3-phase
Frequency	50-60 Hz
Power connector:	32 A per unit
JS250	
Power	16 kW per unit
Current	32 A per unit
Voltage	360 to 480 V AC/ 3-phase
Frequency	50-60 Hz
Power connector:	32 A per unit
JS500	
Power	30 kW per unit
Current	54 A per unit
Voltage	360 to 480 V AC/ 3-phase
Frequency	50-60 Hz
Power connector:	63 A per unit

Temperatures, both for units and trolleys		
Operating temperature of the machine	Min	-20°C
	Max	+50°C
Temperature of the hydraulic oil	Min at start up	-20°C
	Min operation	-20°C
	Max in operation	+70°C
Storage temperature of the machine	Min	-25°C
	Max	+60°C
Storage temperature of the smartbox	Min	-25°C
	Max	+60°C

Hydraulic oil	
Type	Shell Tellus S4 VE 46
Purity	class 10 of NAS 1638 class 21/19/16 of ISO DIS 4406

Noise pressure, both for units and trolleys	
Measured at ear height at nominal loading one metre away from any Unit's electric motor. (The C-weighted instantaneous sound pressure of 130 dB is never exceeded)	72 dB(A)

Caution
There is a risk of ice accretion at temperatures below 0ºC.
If ice has accreted on machine components, they cannot be used since they may lock up.

Consult Enerpac if you want to apply the system by other temperatures.

3.3.2 Functional specifications

Tower height	Sideload				
[m]	1%	2%	3%	4%	5%
1.0	1250	1250	1250	1250	1250
1.5	1250	1250	1250	1250	1250
2.0	1250	1250	1250	1250	1250
2.5	1250	1250	1250	1250	1250
3.0	1250	1250	1250	1250	1250 (1229)
3.5	1250	1250	1250	1250	1250 (1132)
4.0	1250	1250	1250	1250 (1170)	1246 (1047)
4.5	1250	1250	1250 (1249)	1250 (1093)	0
5.0	1250	1250	1250 (1179)	1221 (1022)	0
5.5	1250	1250	1250 (1112)	0	0
6.0	1250	1250	1250 (1051)	0	0
6.5	1250	1250 (1210)	1191 (993)	0	0
7.0	1250	1250 (1154)	0	0	0
7.5	1250	1250 (1101)	0	0	0
8.0	1250	1248 (1050)	0	0	0
8.5	1250	1199 (1000)	0	0	0
9.0	1250	0	0	0	0
9.5	1250	0	0	0	0
10.0	1250 (1219)	0	0	0	0
10.5	1250 (1176)	0	0	0	0
11.0	1250 (1133)	0	0	0	0
11.5	1250 (1091)	0	0	0	0
12.0	1249 (1051)	0	0	0	0
12.5	1209 (1010)	0	0	0	0

Note: Load capacity in [kN]

Note: Limiting values for tilting of the system are calculated according ASME B30.1 (2015)

Note: Loadchart is based on zero inclination at the baseframe

Note: System load capacity is based on a sideload acting perpendicular to a side of the barrel stack. In case side load is acting allong the diagonal of the barrels a reduced load capacity is given between brackets (xxxx). For intermediate directions linear interpolation is allowed.

Legend	
xxx	Full system capacity
xxx	Reduced system capacity
xxx	Tilting limit exceeded

JS125

Tower height	Sideload				
[m]	1%	2%	3%	4%	5%
2.0	2500	2500	2500	2500	2500
3.0	2500	2500	2500	2500	2500
4.0	2500	2500	2500	2500	2500
5.0	2500	2500	2500	2500	2500 (2454)
6.0	2500	2500	2500	2500 (2471)	2500 (2251)
7.0	2500	2500	2500	2500 (2296)	2432 (2073)
8.0	2500	2500	2500 (2419)	2493 (2138)	2276 (1916)
9.0	2500	2500	2500 (2278)	2354 (1995)	2133 (1774)
10.0	2500	2500	2500 (2146)	2223 (1864)	0
11.0	2500	2500 (2411)	2381 (2023)	0	0
12.0	2500	2500 (2298)	2267 (1908)	0	0
13.0	2500	2500 (2189)	2157 (1800)	0	0
14.0	2500	2439 (2085)	0	0	0
15.0	2500	2341 (1985)	0	0	0
16.0	2500	2245 (1888)	0	0	0
17.0	2500 (2430)	2152 (1796)	0	0	0
18.0	2500 (2343)	0	0	0	0
19.0	2500 (2257)	0	0	0	0
20.0	2500 (2173)	0	0	0	0

Note: Load capacity in [kN]

Note: Limiting values for tilting of the system are calculated according ASME B30.1 (2015)

Note: Loadchart is based on zero inclination at the baseframe

Note: System load capacity is based on a sideload acting perpendicular to a side of the barrel stack. In case side load is acting allong the diagonal of the barrels a reduced load capacity is given between brackets (xxxx). For intermediate directions linear interpolation is allowed.

Legend	
xxx	Full system capacity
xxx	Reduced system capacity
xxx	Tilting limit exceeded

JS250

Tower height	Sideload				
[m]	1%	2%	3%	4%	5%
2	5000	5000	5000	5000	5000
3	5000	5000	5000	5000	5000
4	5000	5000	5000	5000	5000
5	5000	5000	5000	5000	5000
6	5000	5000	5000	5000	5000
7	5000	5000	5000	5000	5000
8	5000	5000	5000	5000	5000
9	5000	5000	5000	5000	5000
10	5000	5000	5000	5000	5000 (4763)
11	5000	5000	5000	5000	5000 (4516)
12	5000	5000	5000	5000 (4792)	5000 (4294)
13	5000	5000	5000	5000 (4579)	4888 (4083)
14	5000	5000	5000	5000 (4384)	0
15	5000	5000	5000 (4828)	5000 (4195)	0
16	5000	5000	5000 (4653)	4825 (4023)	0
17	5000	5000	5000 (4486)	0	0
18	5000	5000	5000 (4322)	0	0
19	5000	5000	4971 (4169)	0	0
20	5000	5000 (4887)	4818 (4018)	0	0
21	5000	5000 (4744)	0	0	0
22	5000	5000 (4600)	0	0	0
23	5000	5000 (4466)	0	0	0
24	5000	5000 (4335)	0	0	0
25	5000	5000 (4202)	0	0	0

Note: Load capacity in [kN]

Note: Limiting values for tilting of the system are calculated according ASME B30.1 (2015)

Note: Loadchart is based on zero inclination at the baseframe

Note: System load capacity is based on a sideload acting perpendicular to a side of the barrel stack. In case side load is acting allong the diagonal of the barrels a reduced load capacity is given between brackets (xxxx). For intermediate directions linear interpolation is allowed.

Legend	
xxx	Full system capacity
xxx	Reduced system capacity
xxx	Tilting limit exceeded

JS500

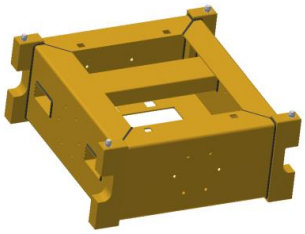
Hazard

Never exceed the maximum lifting height as indicated in the loadcharts. Using the system for **other purposes** than the intended use may cause hazards to personnel and may cause damage to the equipment.

JS125 Trolley		
Driving speed	Fast (only available in local control)	0,0128 m/s (It takes 79 sec to travel 1 m)
	Slow	0,0064 m/s (It takes 158 sec to travel 1 m)
Capacity		125 Te

JS250 Trolley		
Driving speed	Fast (only available in local control)	0,0088 m/s (It takes 144 sec to travel 1 m)
	Slow	0,0063 m/s
Capacity		250 Te

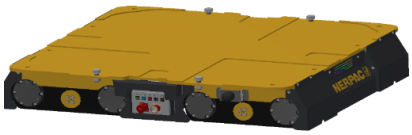
3.3.3 Dimensions

Barrel	System	Length [mm]	Width [mm]	Height [mm]	weight [kg]
	JS125 JS250 JS500	600 1150 1700	600 1150 1700	300 500 700	105 359 950

Top Barrel	System	Length [mm]	Width [mm]	Height [mm]	weight [kg]
	JS125 JS250 JS500	600 1150 1700	600 1150 1700	913 1265 1368	620 - 670 (depending on chosen cylinder) 2416 3850

Unit (without barrels)	System	Length [mm]	Width [mm]	Height [mm]	weight [kg]
	JS125 JS250 JS500	1850 3450 4500	1200 2250 2800	950 1455 1675	2200 7500 13000

Trolley 125	System	Length [mm]	Width [mm]	Height [mm]	weight [kg]
	JS125	1590	1309	359	1750

Trolley 250	System	Length [mm]	Width [mm]	Height [mm]	weight [kg]
	JS250	2150	2150	410	5500

3.4 Service conditions

- The system is intended to push up a **load**
- The system placed on a trolley is intended to move the **load** horizontally
- The system is intended to be used in a **four-units-in-a-square** configuration
- Do not use the system for **any other purpose** than the intended.
  If you would want such, contact Enerpac.
- No **alterations** may be made to the system. Only use the system as it was delivered.

NB: When you want to use other than **4 units** for a lifting operation, contact Enerpac.
The system is explicitly **not intended** for lifting people

Hazard
Using the system for **other purposes** than the intended use may cause hazards to personnel and may cause damage to the equipment.

4 Plan an operation

In this chapter, all planning activities for a lifting operation are described.

NB: It is of the utmost importance to read this whole chapter carefully before start the lifting operation.

4.1 Properties of the operation

1. Populate the checklist given in Appendix A “Checklist for planning” while you’re planning
2. Make sure the following information is available:
   - Mass of the load.
   - Centre of gravity of the load.
   - Dimensions of the load.
3. Determine the position of the load’s centre of gravity within the units
4. Determine the maximum lifting height
5. Consider the following subjects:
   - Bearing capacity of the subsoil.
   - The wind load

NB

- It is of the utmost importance to read this whole chapter carefully before start the lifting operation.
- It is the responsibility of the customer that the foundation of the system is according the specifications.

Hazard
failure to prepare correctly for a lifting operation may result in loss of system stability during use.

4.2 Ground bearing pressure and foundation

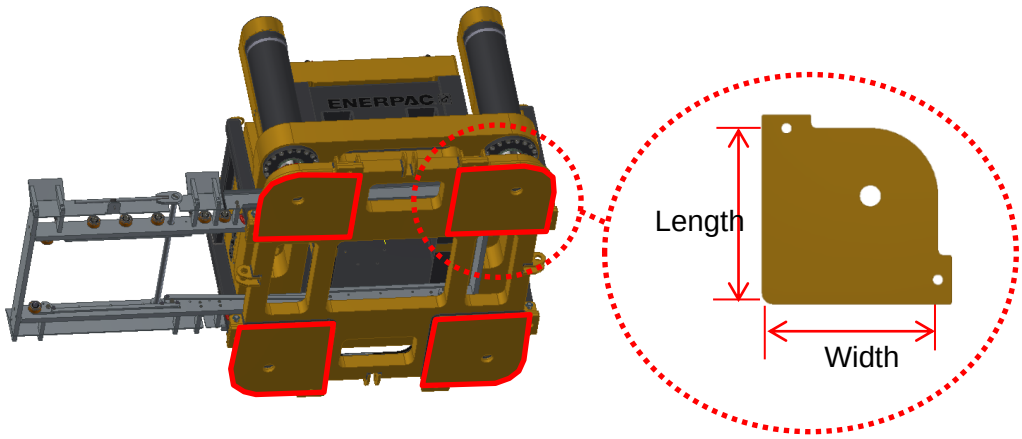
This chapter describes

- how to calculate the ground bearing pressure

The ground bearing pressure is calculated in relation to

- the mass of the load
- the maximum swivel height
- the side load

The system consists of four units. Each unit rests on four plates:



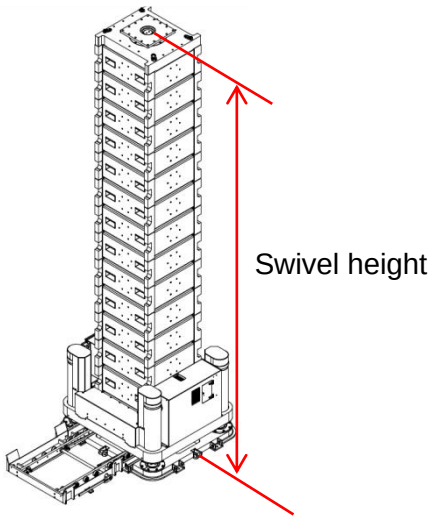
The foundation, if applied, has to support the indicated bearing areas.

The ground bearing pressure will be highest below the barrel resting point areas, as that is the smallest area.

The following dimensions are applicable for load transfer through the barrel resting point area:

System	Bearing length [m] $L_{jack\text{-}up}$	Bearing width [m] $B_{jack\text{-}up}$	Reaction width [mm]
JS125	0.17	0.12	520
JS250	0.37	0.27	1070
JS500	0.47	0.41	1510

In the calculations the maximum height of the swivel is taken into account.
The height of the swivel is defined as follows:



4.2.1 Calculate the ground bearing pressure without foundation

For calculating the **ground bearing pressure** of **one barrel resting point area** of **a unit** without applying a foundation, the following formulas apply:

Data depending on the operation	force on one unit		F_{unit}	kN
	number of applied barrels		Nr_barrels	
	percentage of side load		P	%
	height of the base plate of the swivel		$Swivel_{height}$	mm
Fixed data	own mass	one barrel	$Barrel_{mass}$	kN
		top barrel	Top_barrel_{mass}	
		the unit	$Unit_{mass}$	
	measures of the plate		$L_{jack-up}$, $B_{jack-up}$	m
	safety factor		S	
	reaction_width (related to the width of a barrel)		Reaction_width	mm

1. The force on one plate caused by the **load** and the **side load** is:

   $F_{load\ and\ side\ load} = F_{unit} (^1/_4 + {}^1/_2\ p * Swivel_{height} / Reaction\_width)$

2. The additional force on one plate caused by the **own mass** of the system:

   $F_{own\ mass} = (Unit_{mass} + Top\_barrel_{mass} + Nr\_barrels * Barrel_{mass}) / 4$

3. Total total force on one plate is

   $F_{total} = F_{load\ and\ side\ load} + F_{own\ mass}$

4. Take the safety factor into account:

   $F_{total\ safe} = F_{total} * S$

5. The ground bearing pressure is:

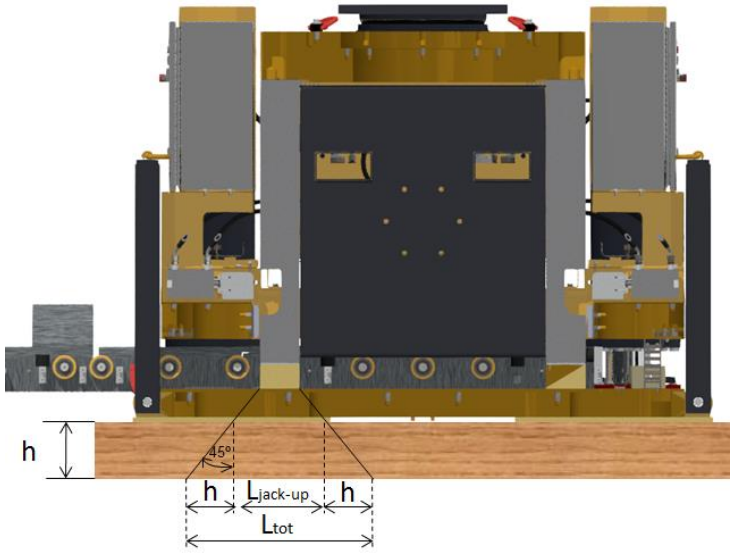
   $\sigma = F_{total\ safe} / (L_{jack-up} * B_{jack-up})$

4.2.2 Calculate the ground bearing pressure with foundation

This section describes how to calculate the ground bearing pressure, depending on

- the load
- the maximum swivel height
- the side load

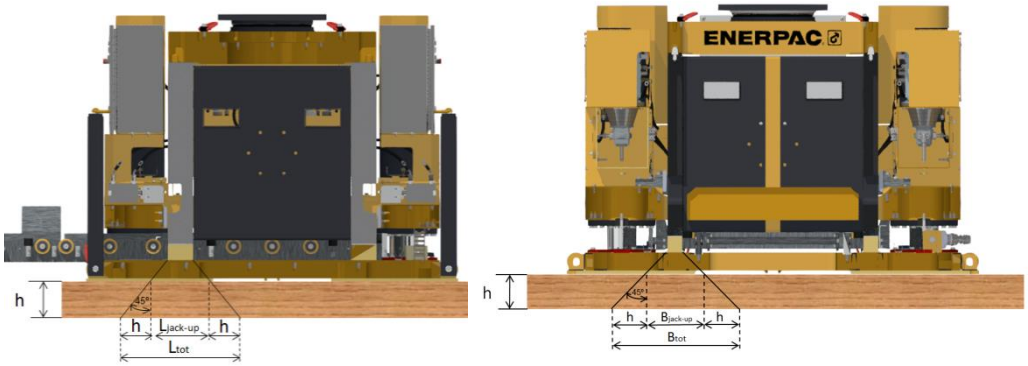
When a foundation is used then the force spreads down in an angle of 45^0. As an effect both the length and the width of the effective bearingsurface are extended with 2h:



The effective bearing surface of one plate will be $(L_{jack\text{-}up} + 2h) * (B_{jack\text{-}up} + 2h)$.

NB
The ground bearing pressure can be reduced by applying a foundation.

Attention
Construct the foundation in such a way that the force can spread down over 45^0 **in all directions** as within the illustrations.



Attention
Fully support the bearing area with timbers. Do not allow gaps between the timbers below each bearing area!

Example how to calculate the ground bearing pressure of the foundation (JS250):

Data depending on the operation	force on one unit		F_{unit}	1000	kN
	number of applied barrels		Nr_barrels	17	
	side_load		p	1.5	%
	swivel_height		$Swivel_{height}$	8000	mm
	Height of foundation		h	0.25	m
Fixed data	own mass	one unit	$Unit_{mass}$	75	kN
		one barrel	$Barrel_{mass}$	4	
		top barrel	Top_barrel_{mass}	24	
	measures of the bearing area		$L_{jack-up}$ $B_{jack-up}$	0.37 0.27	m m
	safety factor s		S	1.65	
	reaction-width of the barrel		Reaction_width	1070	mm

1. The force on one bearing area caused by the **load** and the **side load** is:
   $F_{load\ and\ side\ load} = F_{unit} (^1/_4 + {}^1/_2\ p * Swivel_{height} / Reaction\_width)$
   $F_{load\ and\ side\ load} = 1000 (^1/_4 + {}^1/_2\ 0.015 * 8000 / 1070) = 306$ kN

2. The force on one bearing area caused by the **own mass** of the system:
   $F_{own\ mass} = (Unit_{mass} + Top\_barrel_{mass} + Nr\_barrels * Barrel_{mass}) / 4$
   $F_{own\ mass} = (75 + 24 + 17 * 4) / 4 = 42$ kN

3. Total force on one bearing area is
   $F_{total} = F_{load\ and\ side\ load} + F_{own\ mass}$
   $F_{total} = 306 + 42 = 348$ kN

4. Take the safety factor into account:
   $F_{total\ safe} = F_{total} * S$
   $F_{total\ safe} = 348 * 1.65 = 574$ kN

5. The ground bearing pressure **without foundation** on one bearing area would be:
   $\sigma_{no\ foundation} = F_{total\ safe} / (L_{jack-up} * B_{jack-up})$
   $\sigma_{no\ foundation} = 574 / (0.37 * 0.27) = 5748$ kN / m^2

6. The ground bearing pressure **with foundation** on one bearing area would be:
   $\sigma_{foundation} = F_{total\ safe} / (L_{tot} * B_{tot})$
   $\sigma_{foundation} = F_{total\ safe} / ((L_{jack-up} + 2*h) * (B_{jack-up} + 2*h)$
   $\sigma_{foundation} = 574 / ((0.37 + 2*0.25) * (0.27 + 2*0.25)) = 857$ kN / m^2

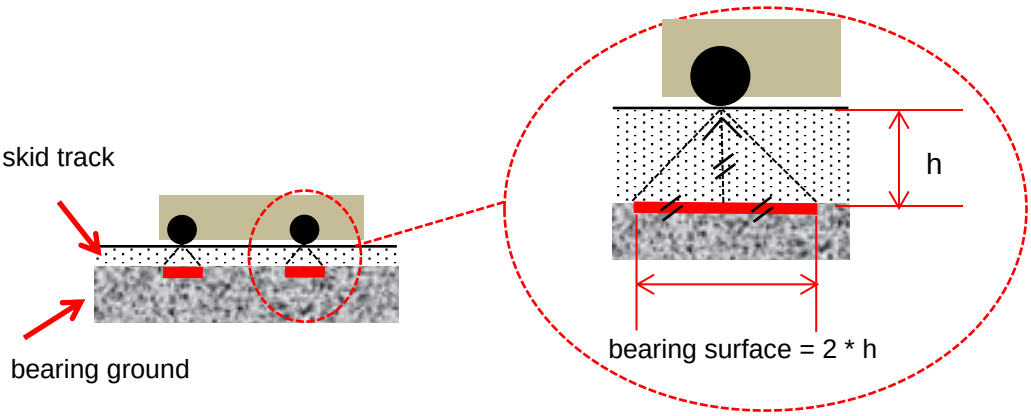
NB

- The actual ground bearing pressure shall not exceed the allowable ground bearing pressure.
- Complete the checklist of Appendix A with the calculated maximum ground bearing pressure as well as the height of the foundation

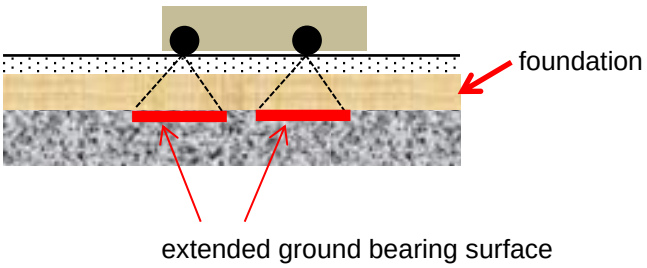
4.2.3 Calculate the ground bearing pressure with trolleys and tracks

Skid tracks enlarge the ground bearing surface. Use is made of the effect that pressure spreads down in an angle of 45°, as shown below. Skid tracks can be put

- Directly on the ground, if the bearing capacity of the ground is sufficient.



- on a foundation
  - to compensate unevenness in the ground.
  - to extend the ground bearing surface and therefore to lower the GBP.



NB
The higher the foundation, the lower the ground bearing pressure.

The following sections describe how the ground bearing pressure can be calculated.

NB
Feel free to apply your own calculation methods for ground bearing pressure.

4.2.3.1 Calculation of GBP skid track

Example of calculating ground bearing pressure

Data depending on the operation	force on one unit		F_{unit}	1250	kN
	number of applied barrels		Nr_barrels	20	
	side_load		p	3	%
	swivel_height		$Swivel_{height}$	6000	mm
Fixed data	own mass	one unit	$Unit_{mass}$	22	kN
		one barrel	$Barrel_{mass}$	1	
		top barrel	Top_barrel_{mass}	6	
	measures of the bearing area		Footprint bearing area	0.08	m^2
	safety factor s		S	1.65	
	reaction-width of the trolley		Reaction_width Trolley	914	mm

1. The force on **one area** caused by the **load** and the **side load** is:
   $F_{load\ and\ side\ load} = F_{unit} (^1/_4 + {}^1/_2\ p * Swivel_{height} / Reaction\_width\ Trolley)$
   $F_{load\ and\ side\ load} = 1250 (^1/_4 + {}^1/_2 * 0.03 * 6000 / 914) = 436$ kN

2. The force on one area caused by the **own mass** of the system:
   $F_{own\ mass} = (Unit_{mass} + Top\_barrel_{mass} + Nr\_barrels * Barrel_{mass}) / 4$
   $F_{own\ mass} = (22 + 6 + 20 * 1) / 4 = 12$ kN

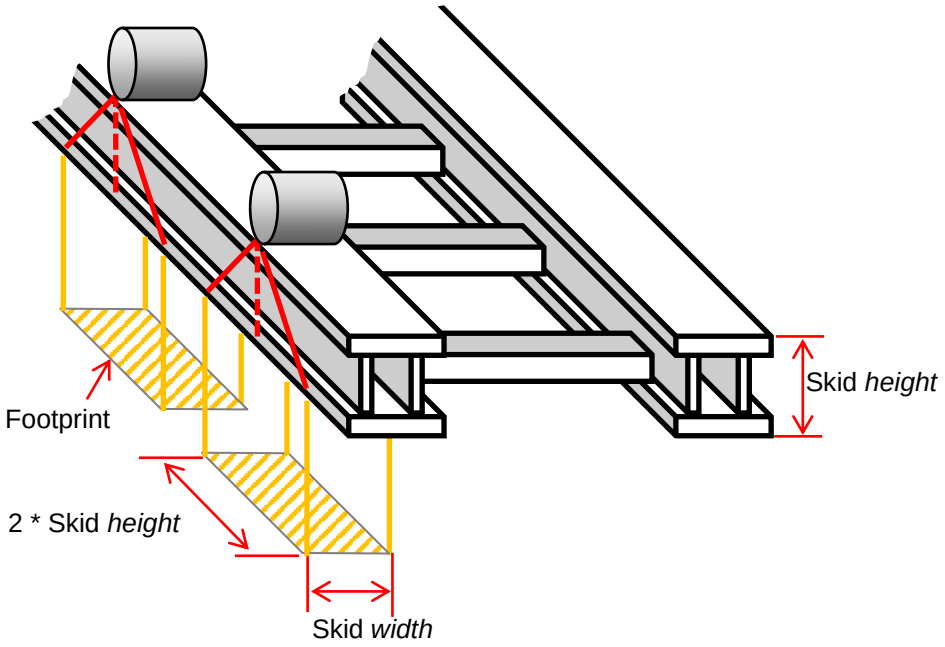
3. Total total force on **one area** is
   $F_{total} = F_{load\ and\ side\ load} + F_{own\ mass}$
   $F_{total} = 436 + 12 = 448$kN

4. Take the **safety factor** into account:
   $F_{total\ safe} = F_{total} * S$
   $F_{total\ safe} = 448 * 1.65 = 739$ kN

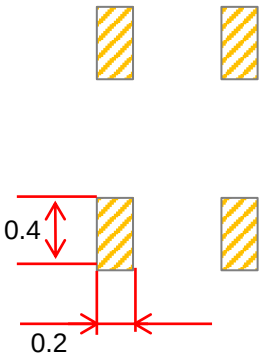
5. Dimensions of the skid tracks.
   The dimensions of the bearing surface are as follows:

Parameter		**Abbrev**	**Value**
Skid track	height	Skid *height*	0.2 [m]
	width	Skid *width*	0.2 [m]

6. Foot print bearing area



7. Calculation of the footprint bearing area:



0.2 * 0.4 = 0.08 m^2

8. Calculation of GBP:

$F_{total\ safe}$ = 739 kN per wheel.

Ground Bearing Pressure $\sigma = \frac{739}{0.08}$ = **9238** kN / m^2

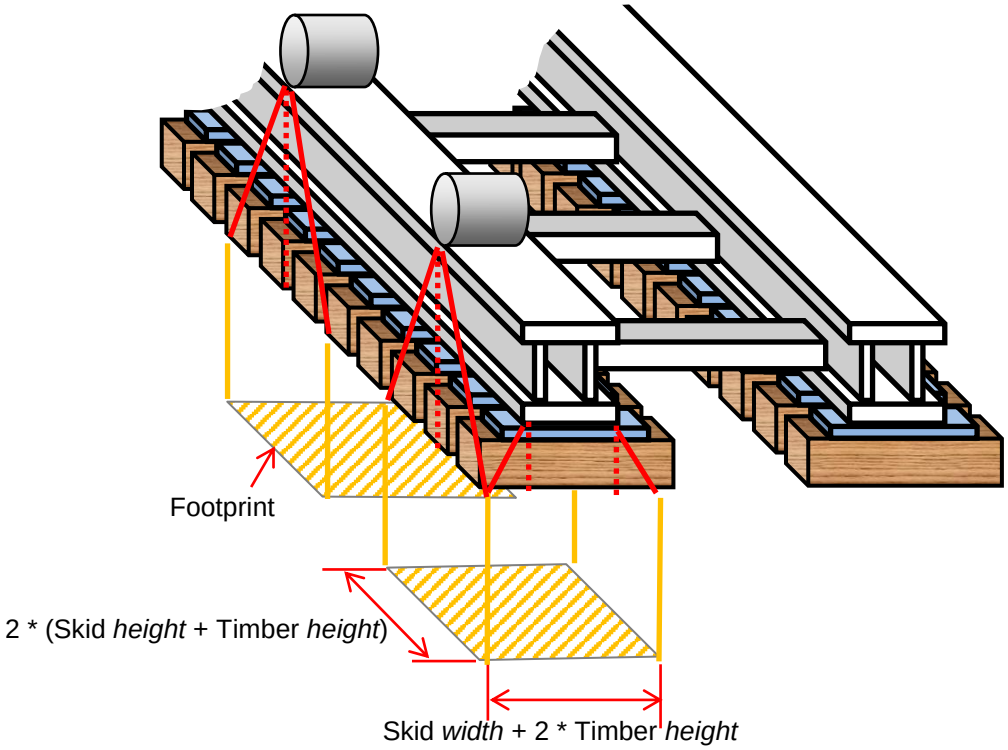
NB
Complete the checklist in appendix A “Checklist for planning” with the calculated bearing pressure.

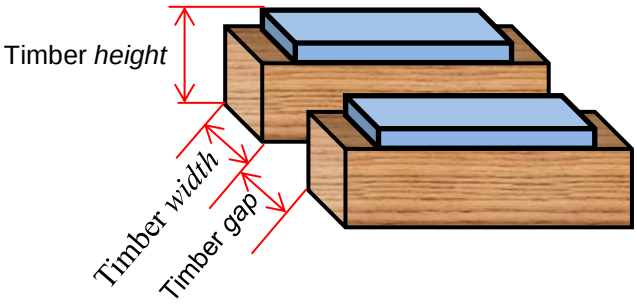
Attention
Never exceed the maximum allowed ground bearing pressure.

4.2.3.2 Calculation: foundation height JS125 on trolleys and tracks

In order to reduce the bearing ground pressure, timbers of hard wood can be applied as foundation material. Steel plates have to be mounted on top of the timbers.

The dimensions of the bearing surface are as follows:





To calculate the bearing pressure, Enerpac recommends the following procedure:

Parameter		**Abbrev**	**Value**
Skid track	height	Skid *height*	0.2 [m]
	width	Skid *width*	0.2 [m]
Timber	height	Timber *height*	Depends on the operation
	width	Timber *width*	
	gap	Timber *gap*	≤50 mm

1.	Surface of one footprint = width * length	(Skid *width* + 2 * Timber *height*) * [2 * (Skid *height* + Timber *height*)]
2.	Support ratio, to correct for the gaps between the timbers	Support_Ratio = Timber *width* / (Timber *width* + Timber *gap*)
3.	Pressure on the ground [metric tonnes / m^2]	$\sigma = \frac{Ftotalsafe\_per\_wheel}{one\_footprint * Support\_Ratio}$

Example of maximum load:
$F_{\text{total safe}}$ per wheel = 739 kN

Timbers for example:
Width 0.30 m
Height 0.30 m
Gap 0.05 m

Measures of one footprint:

Width: Skid *width* + 2 * Timber *height* = 0.2 + 2 * 0.3 = 0.8 m

Length: 2 * (Skid *height* + Timber *height*) = 2 * (0.2 + 0.3) = 1.0 m

Surface: 0.8 * 1.0 = 1.0 m^2

Support ratio 0.30 / (0.30 + 0.05) = 0, 86

Ground Bearing Pressure $\sigma = \frac{739}{1.0*0.86}$ = **859** kN / m^2

NB
Complete the checklist in appendix A “Checklist for planning” with the calculated bearing pressure.

Attention
Never exceed the maximum Ground Bearing Pressure of the ground.

4.2.4 Requirements for foundation material

Permitted filler material for the foundation material is hard wood with a mechanical compressive strength of at least 25 N/mm² without any occurrence of deflection.

However, Enerpac strongly recommends adhering to 30N/mm²; preferably Azobé.
The minimum hard wood thickness is 50 mm and the maximum thickness is 150 mm.

Wood is a product of nature, which means its quality is not standardly assured. In order to guarantee quality an **appropriate test** has to be conducted before use to verify that the material meets the set requirements.

NB

- Wood is a natural product: its quality is not assured. In order to guarantee quality, test the timber on 125% of the expected load.
- For your planning keep in mind that suitable wood may not always be available immediately.

Hazard
Use of other wood types such as plywood, multiply, pine and compressed wood is **explicitly prohibited**.

In case of doubt, consult Enerpac.

Hazard
Minor deformations in filler material or subsoil may result in strong internal transverse forces or diagonal or longitudinal movements of the load or masts.

Use of other wood types such as plywood, multiply, pine and compressed wood is expressly prohibited will endanger the stability of the system. Therefore, use of other types is strictly forbidden.

NB

- For your planning, please bear in mind that the ideal wood is not only hard to the touch; it is also hard to acquire.
- It is the responsibility of the customer that the foundation of the system is sufficient and according to the specifications.

5 How to install the system

This chapter describes

- how to hoist put the several parts of the system,
- and how to assemble the system.

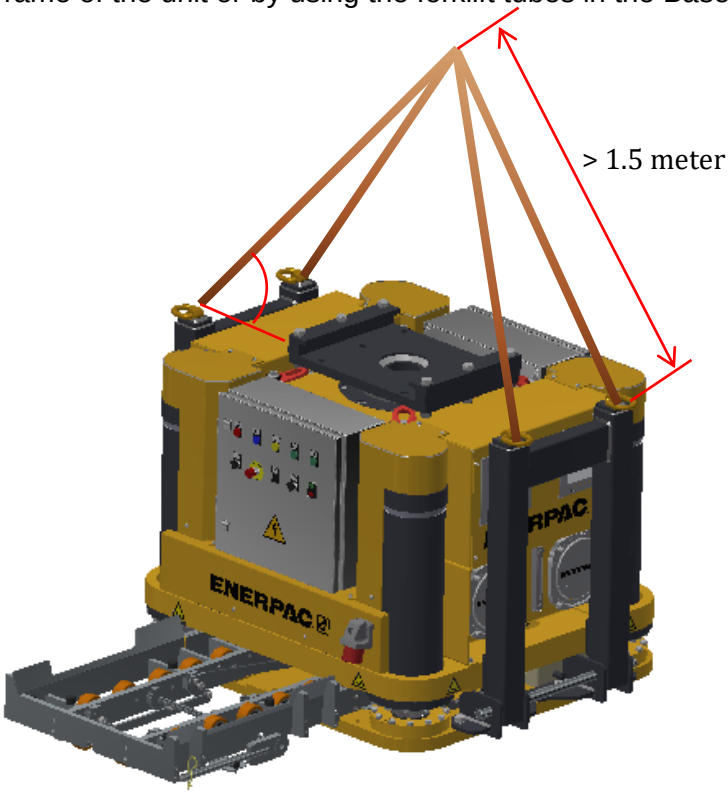
Fully complete the checklist as given in Appendix B “Checklist for installing the system”.

5.1 How to hoist the parts of the system

NB
Verify the lifting capacity of your hoisting equipment w.r.t. the weight of the parts.

5.1.1 Unit

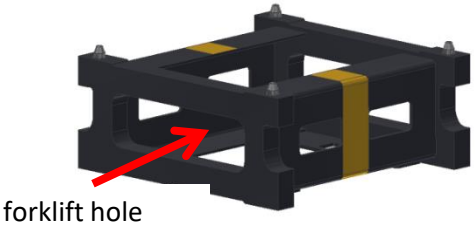
At the front and one at the rear of each unit hoisting lugs are mounted on a lifting frame. Use them to hoist the unit. The JS500 can be hoisted using the hoisting points in the Base Frame of the unit or by using the forklift tubes in the Base Frame.



The length of the applied slings or chains has to be larger than 1.5 meter.

5.1.2 Barrel

Use a forklift to hoist a barrel.



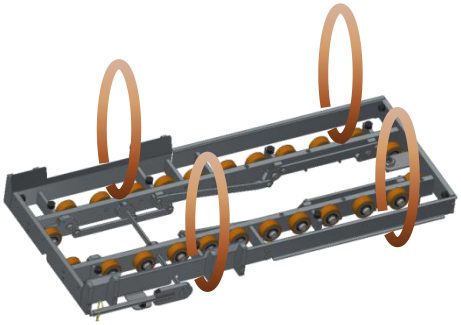
5.1.3 Top barrel

Use a crane to hoist the top barrel. Use the lugs.

5.1.4 Insertion system

Dependent on the system, the insertion system might be supplied with lifting lugs.
If so, use the lifting lugs to hoist the insertion system.

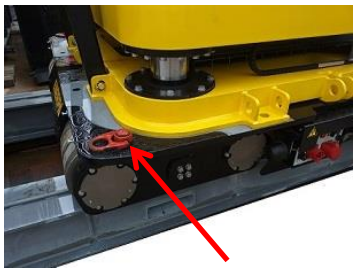
The JS125 system is delivered with the insertion system already mounted.
If you nevertheless want to handle the insertion system then use slings to hoist.



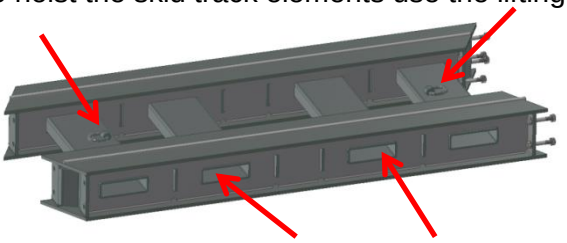
5.1.5 The trolley and the skid tracks

- To hoist the JS125 trolley use the lifting lugs.

- To hoist the JS250 trolley, mount hoisting eyes in the indicated holes. Then use your own method of hoisting.



- To hoist the skid track elements use the lifting lugs or use the forklift openings.



5.2 How to assemble the system

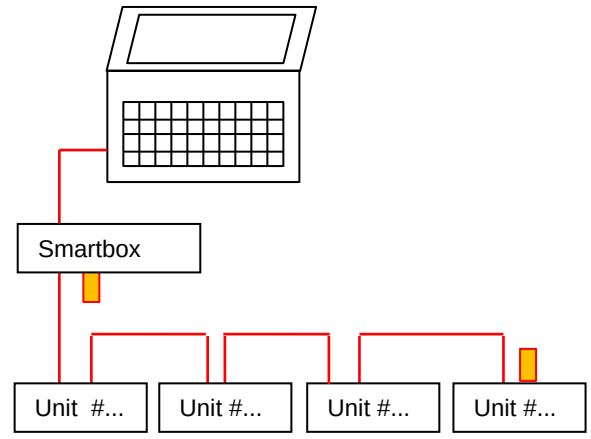
This chapter describes how to assemble the system:

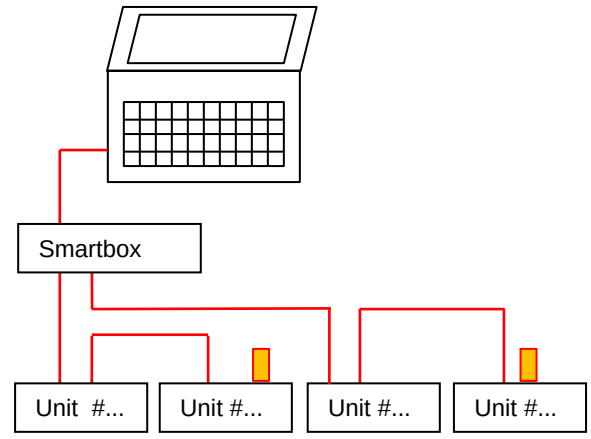
- Electrically
- Mechanically

No hydraulic connections have to be assembled; all hydraulics are integrated in the units.

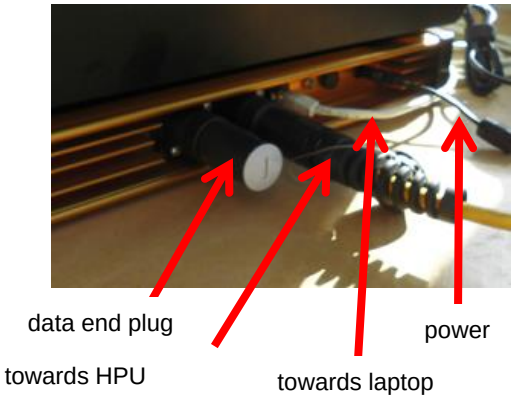
5.2.1 Electrically

The units, the smartbox and the laptop have to be connected to each other as one of the two configurations as shown below, depending on your own preferences:





Proceed as follows:

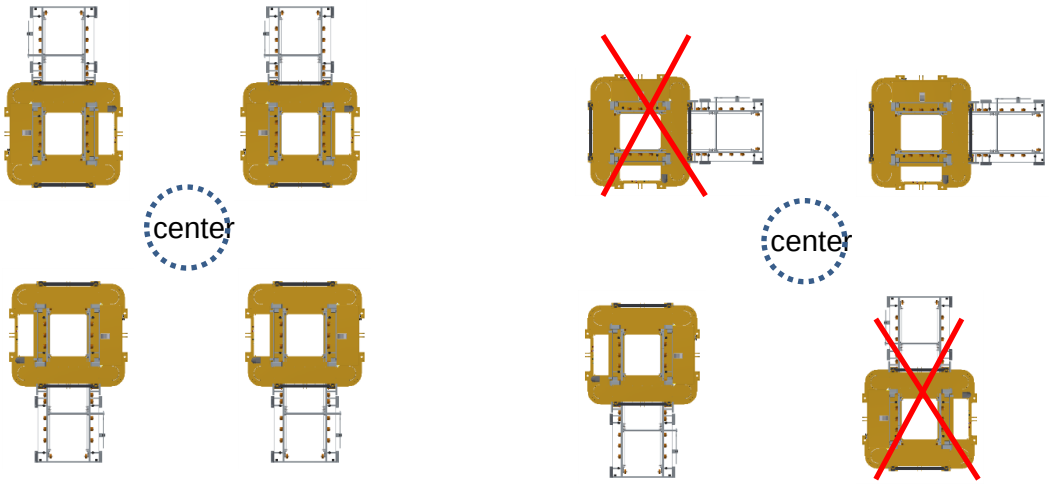
1.	Connect the smartbox with: • the laptop • power and mount the Data end plug	

2.	Connect the smartbox with one of the units. You can pick a unit at random since there is no prescribed sequence of connecting. The units will identify themselves electronically. The sockets on the connection box are equivalent; pick one of them at random. Use the provided data cables. Remove the lifting bracket in front of the connection box if necessary.	
3.	Connect all units to each other, according to the scheme.	
4.	Provide the unused socket of the last unit(s) with the data end plug.	 
5.	Connect all units with the main power.	

5.2.2 Mechanically

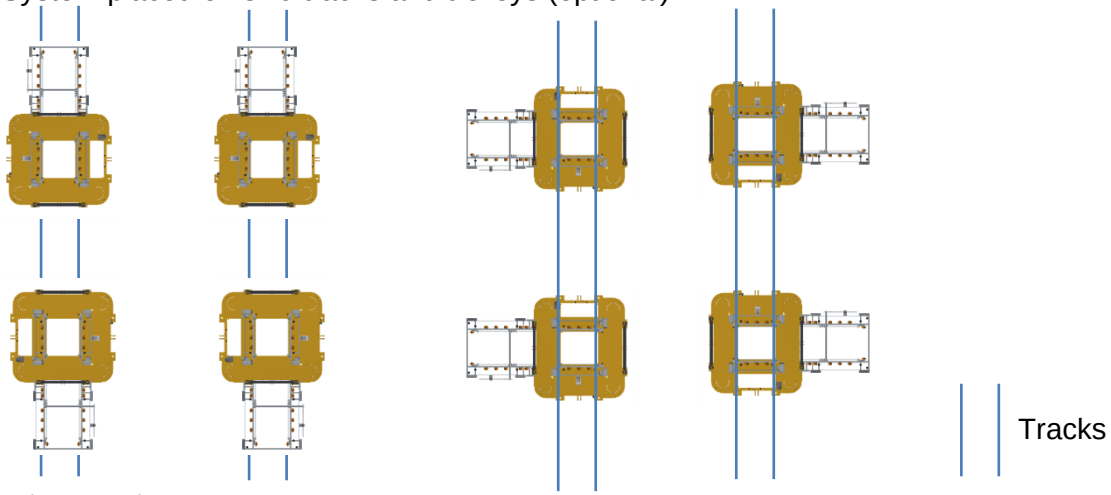
Put the units in a square formation, according to the scheme below.

- System not put on trolleys:
  Let all insertion systems face outwards, seen from the center of the four assembled units, not inwards.



(top view: without trolleys on tracks)

- System placed on skid tracks and trolleys (optional):



(top view)

5.2.3 Alignment requirements

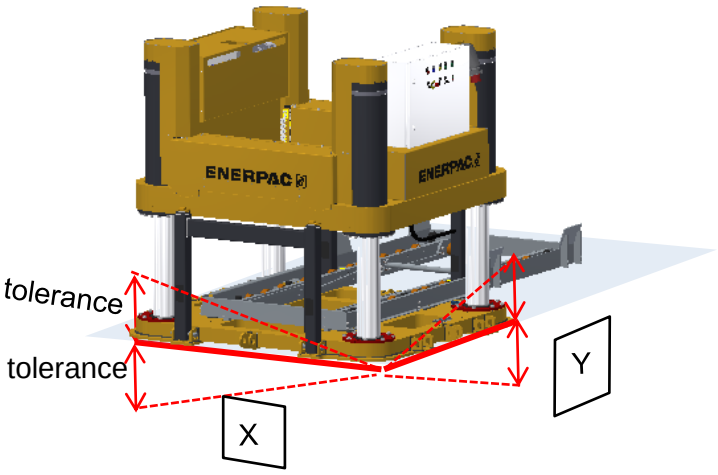
The complete System as well as the individual units have to be positioned plumb and level, according to alignment requirements.
This chapter gives those requirements as well as how align the units.

NB
Correct alignment is crucial for the stability of the system.

Hazard
Faults in alignment may injure people and may lead to the total loss of the system.

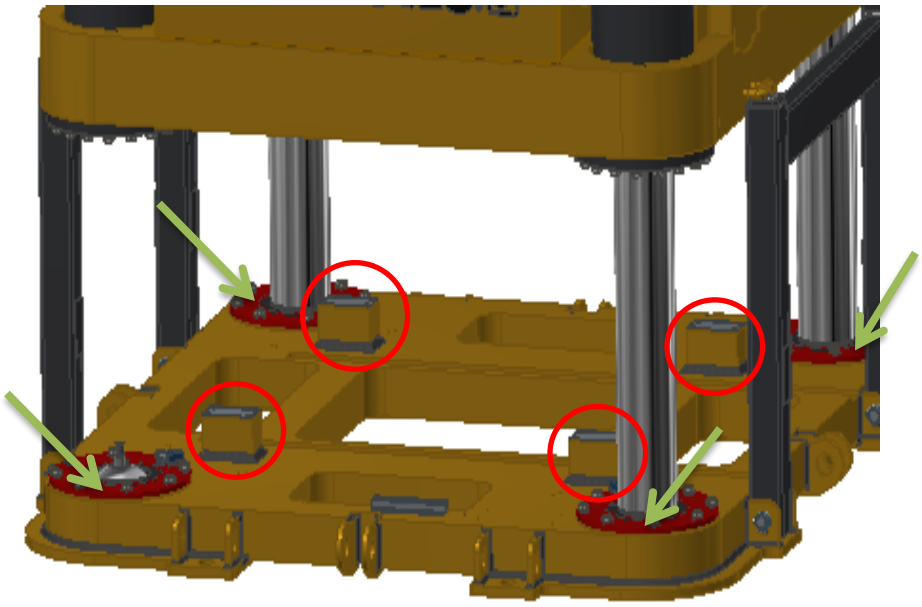
Level:
Each unit shall be positioned level on the ground with a tolerance in the X and Y direction.

System	Tolerance [mm]
JS125	0.5
JS250	1.0
JS500	1.0

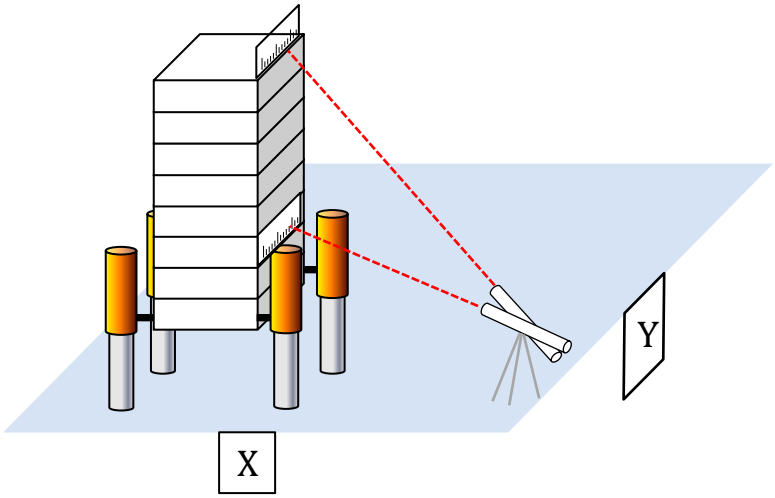


In order to eliminate the effect of possible distortion of the base of the unit, Enerpac advises to take one the following machined surfaces as a reference:

- resting points of the barrels (indicated with the red circle):
- Top of the cylinder mounting plates (indicated with the green arrow).

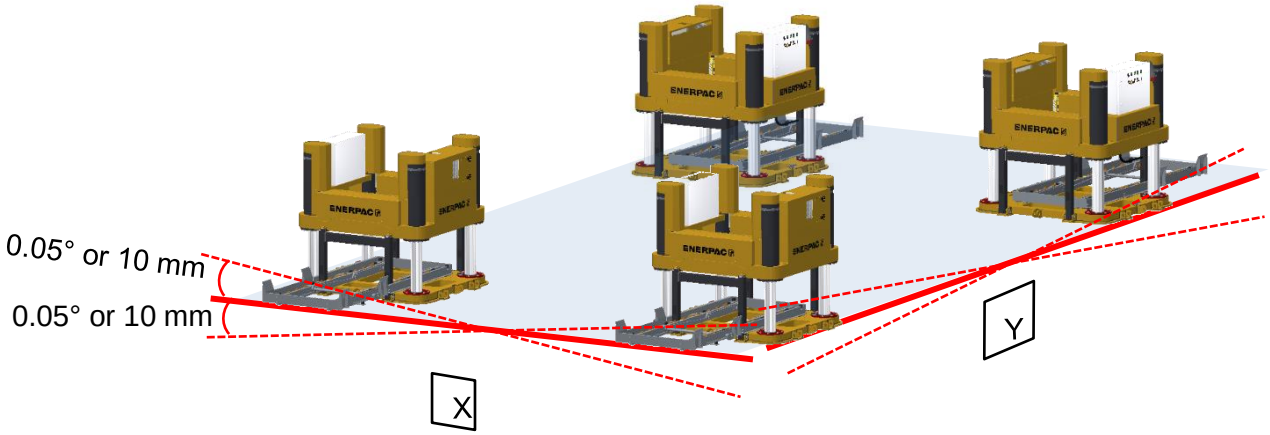


You might apply a theodolite to verify the alignment in vertical direction.
Perform measurements both in X and Y direction, for all units:

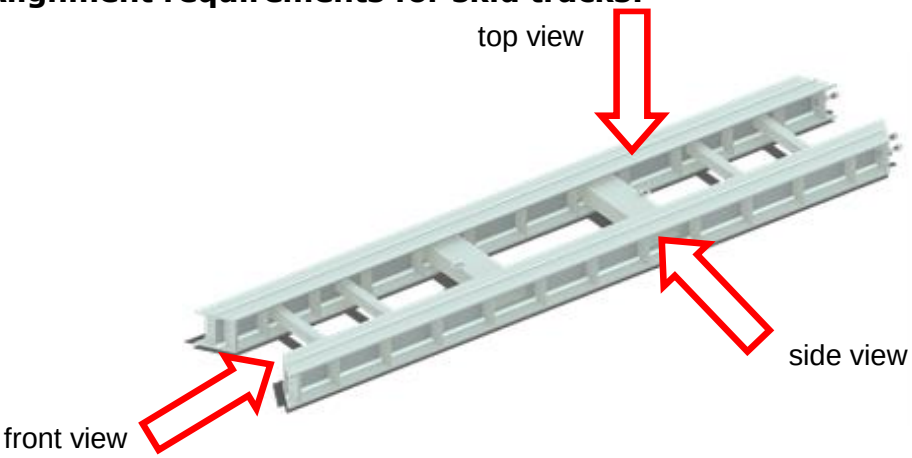


You might use a plummets to monitor the vertical alignment during operation.

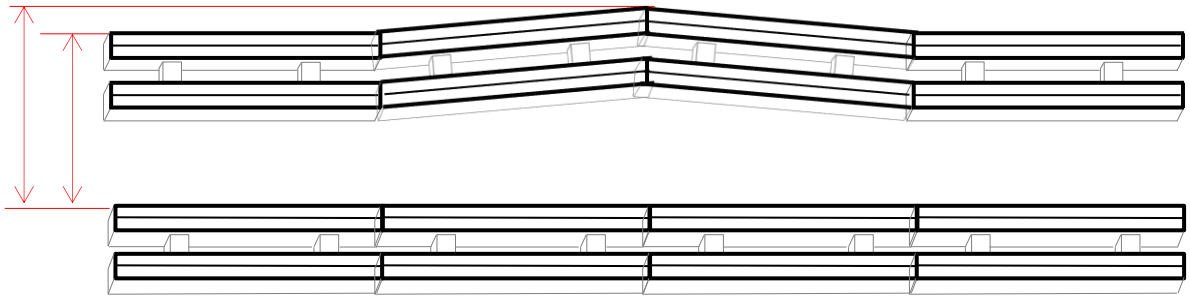
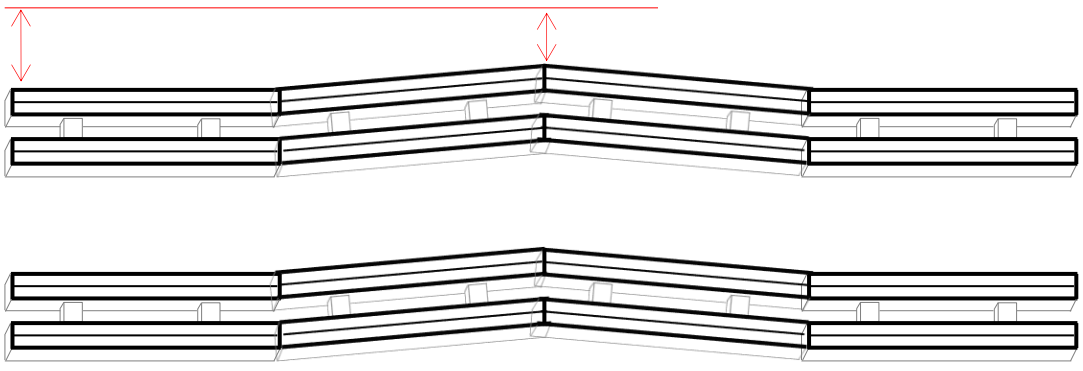
Horizontal plane:
The units shall be aligned to each other in the horizontal plane with a tolerance of 0.05^0 in X and Y direction or maximal 1 cm whichever is worse.

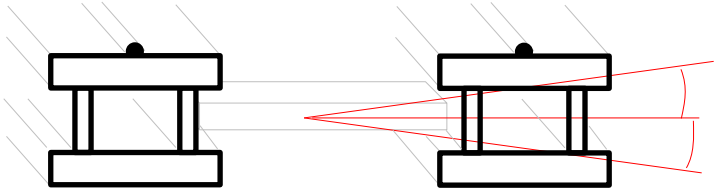
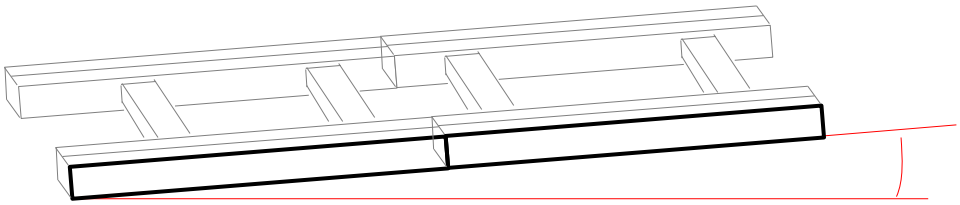
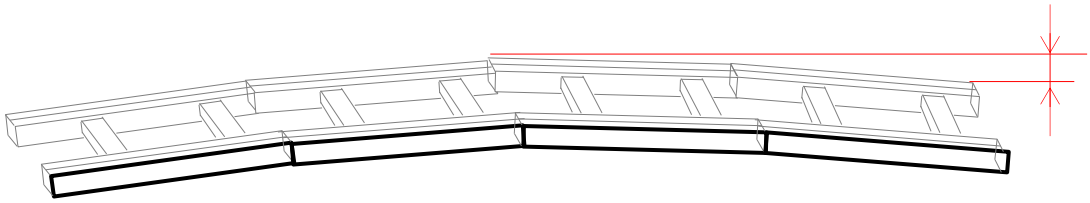
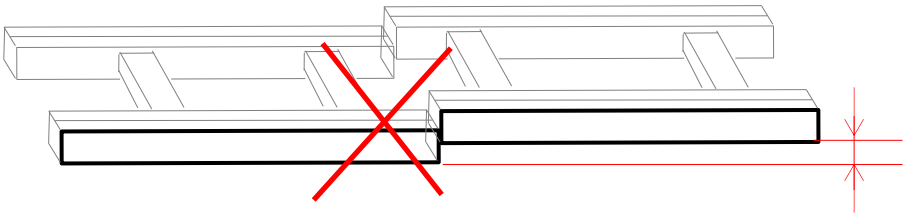


Alignment requirements for skid tracks:



Align the Skid tracks according to the followaligning requirements:

No	Alignment requirement	Tolerance
1	The Skid tracks shall be in parallel	12 mm
	 *(top view)*	
2	The Skid tracks shall be aligned from the start to the end	12 mm
	 *(top view)*	
3	The skew of the Skid tracks shall be zero	0.2°

	 *(front view of one skid track)*	
4	The inclination of the Skid tracks shall be zero	0.2°
	 *(side view)*	
5	The Skid tracks shall be flat	5 mm over 3 meter
	 *(side view)*	
6	The surfaces of the segments of the Skid tracks shall be well aligned. *Use shims if necessary*	-
	 *(side view)*	

Recommended tools:

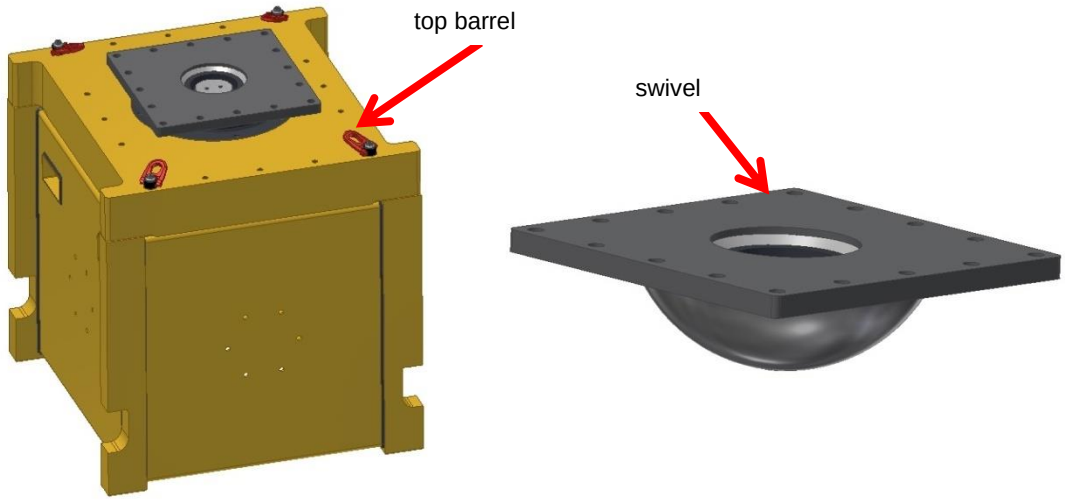
For alligning the system, enerpac recommends to use the following tools:

- Rotary Laser level
- Digital spirit level(degrees and mm)
- Selfleveling Multi-line laser
- Theodolite

Make sure the tools are calibrated/checked by a certified company.

5.2.4 Mount the load

The load has to be mounted on the top barrel, which is provided with a swivel:



NB
Fix the load to the swivel. Use bolts.

Hazard
If the load is not fixated to the swivel then the stability of the system is in danger.
Do not use machine without swivel since the swivel distributes the load evenly on the machine.

Make sure not to leave any loose parts, e.g. tools, on the system.

Hazard
Keep the worksite clean. Loose materials that are left on the system or load might fall down when the load is lifted.

5.2.5 The trolleys

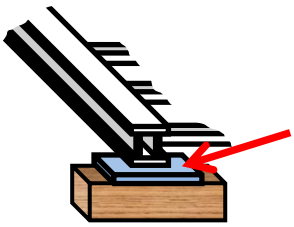
When trolleys are applied then proceed as follows for installing:

5.2.5.1 The skid tracks

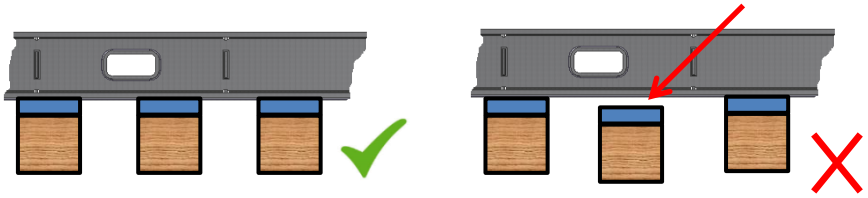
To put the skid tracks on top of the foundation proceed as follows:

1. Build the skid track.
   Regard the following aspects:

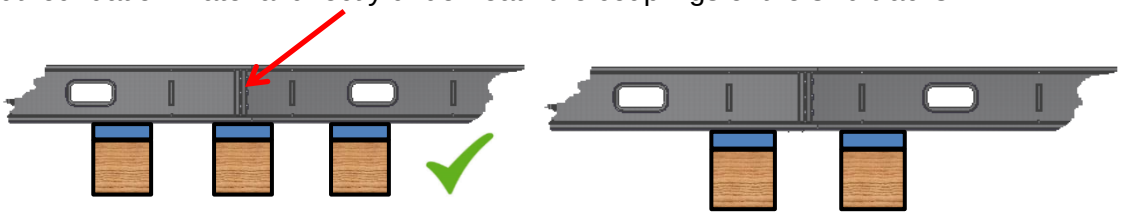
   - Put steel plates between the timbers and the skid tracks



- Make sure no slack is left between the foundation and the skid tracks.
  Eventually use shims.



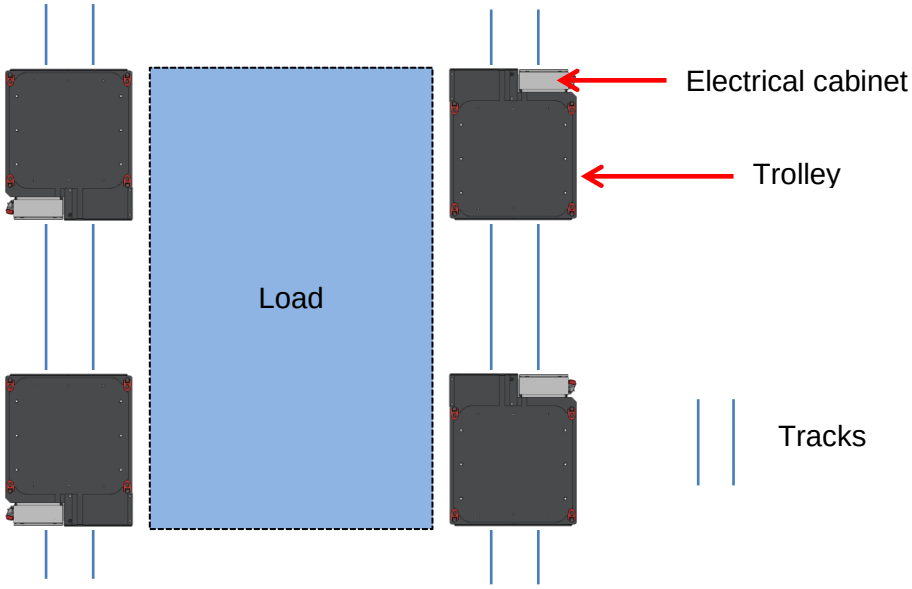
- Put foundation material directly underneath the couplings of the skid tracks:



2. Align the skid tracks according to the requirements as listed in section 5.2.3 “Alignment requirements”.

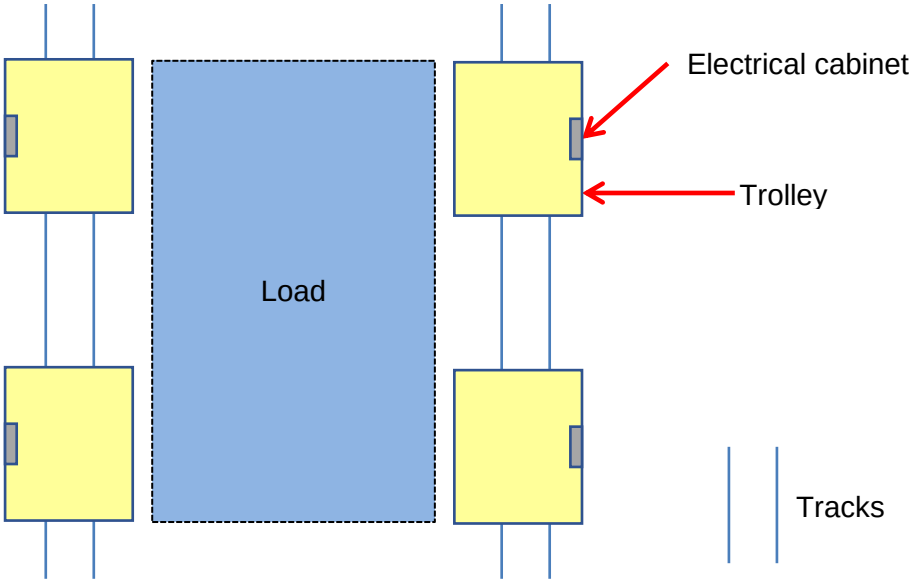
3. Put the trolleys on top of the skid tracks.
   The trolleys should be positioned as illustrated below.

   JS125:
   Position the trolleys on the tracks as shown below.



(top view)

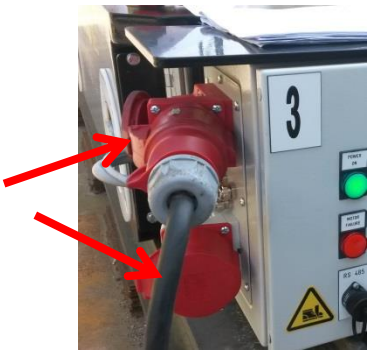
JS250:
Position the trolleys in such way that the electrical cabinets are on the outer side of the tracks



(top view)

5.2.5.2 Power cables

For connecting the power cables use the sockets of the trolleys.



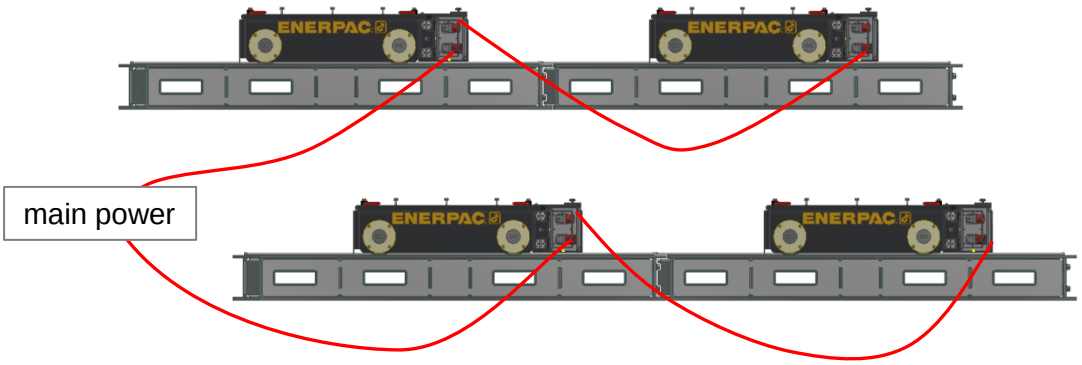
JS125

JS250

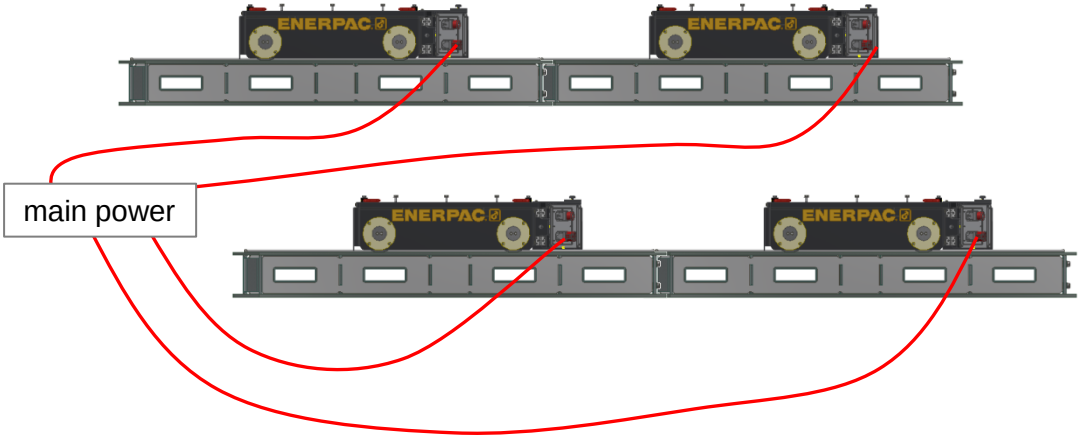
<u>standalone operation of trolleys without Push Up System</u>
The power cables of the trolleys can be connected in two different ways in case of a standalone operation without Push Up System.

NB
The procedures and pictures are valid for both the JS125 and the JS250 trolley type.

- Two by two.
  This configuration saves cable length.

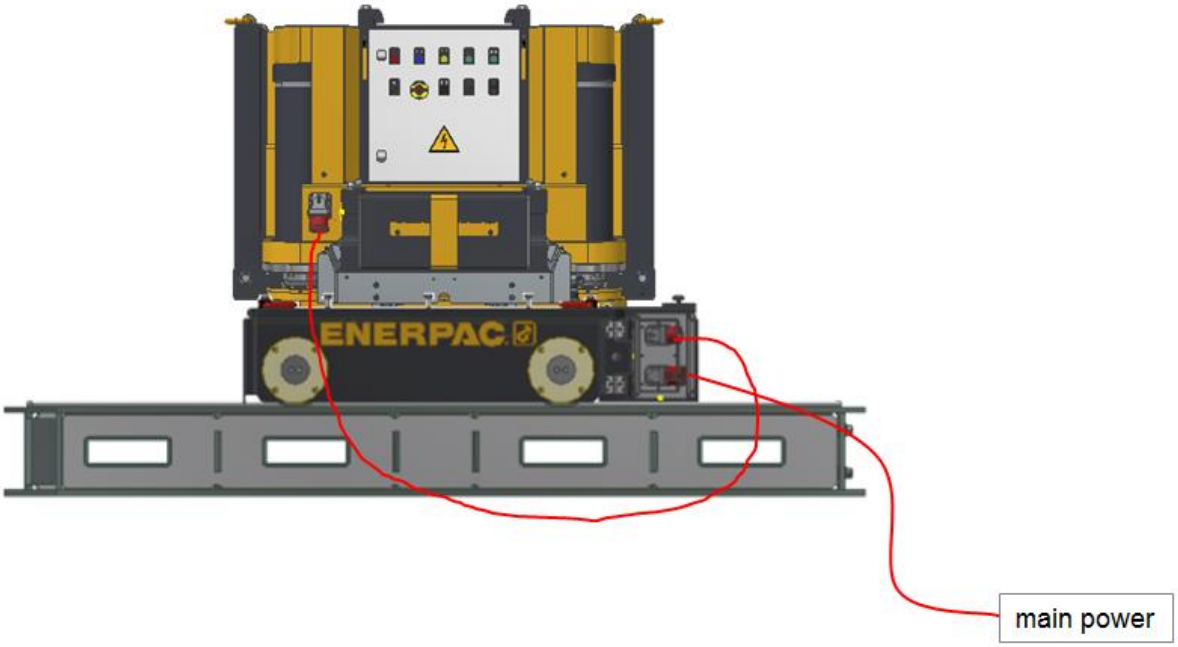


- One by one:



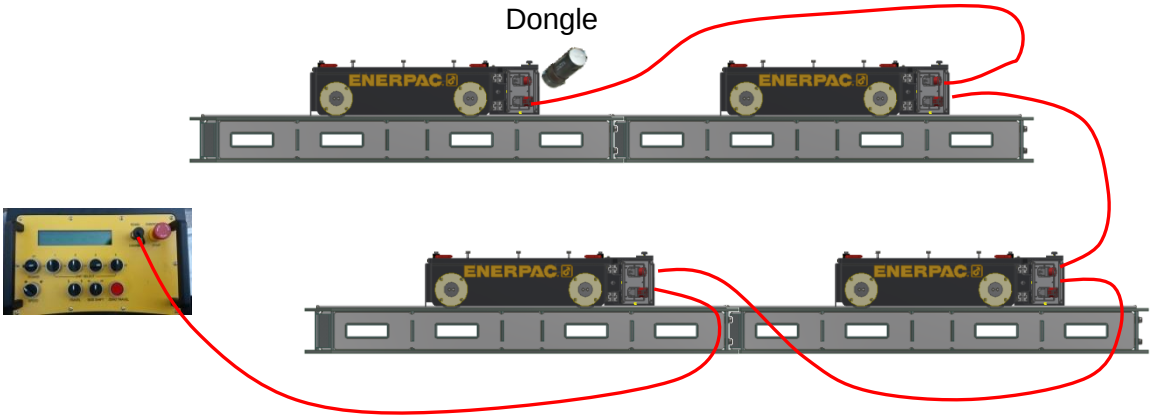
operation units placed on trolleys (Note only applicable to the JS125+trolley)

In case of an operation with units on trolleys, connect the main power from the trolley to the Push up Unit on top of it.



5.2.5.3 Data cables

If you want to apply cables for controlling the trolleys then connect the trolleys as follows:



To build the network proceed as follows:

1.	Switch the remote control off	
2.	Switch all trolleys off. Use the main switches.	
3.	Connect the data cable to the remote control. Use the RS-485 connection	
4.	Connect the data cable to one of the trolleys.	JS125:  JS250: 
5.	Interconnect all trolleys with data cables. The sequence is at random; the trolleys will identify themselves automatically.	

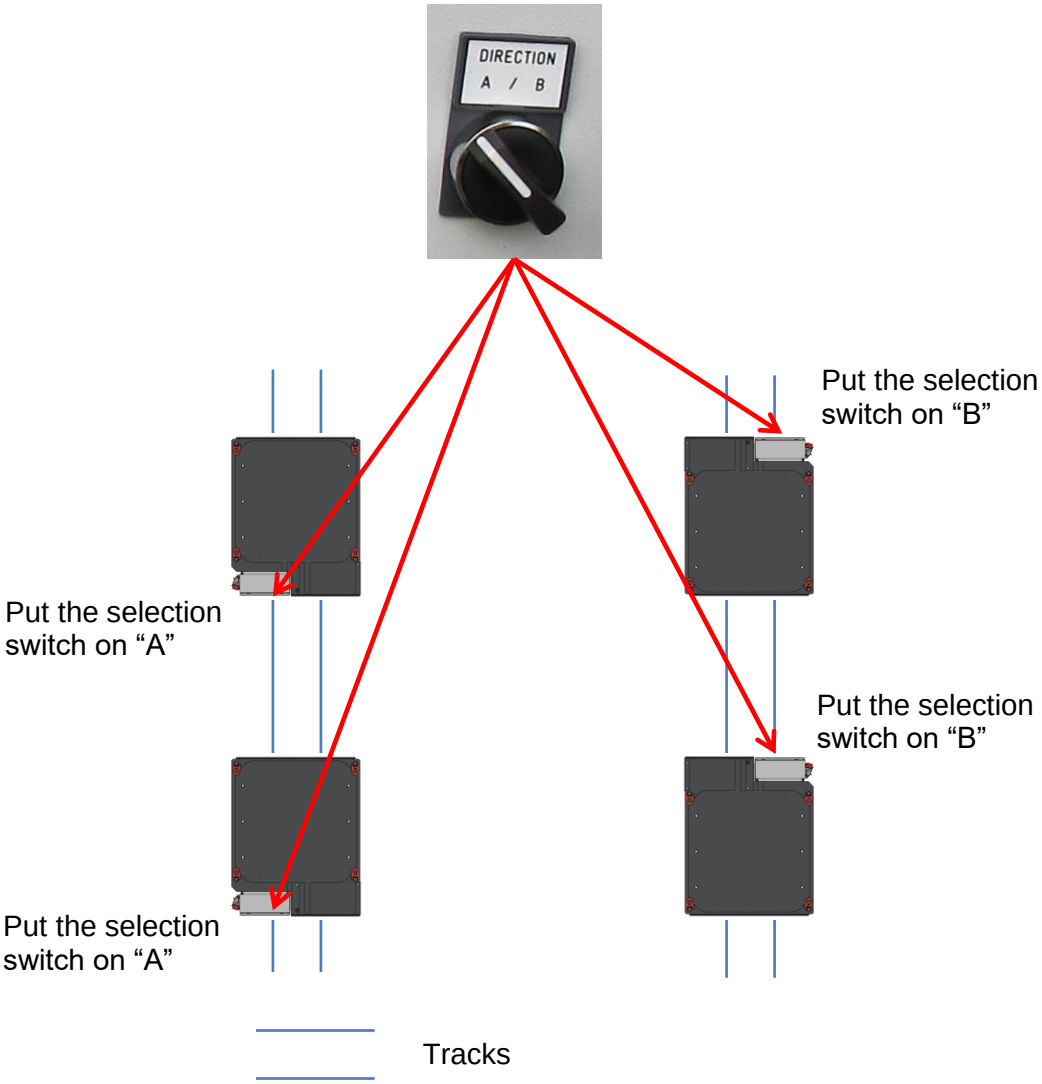
6.	Provide the last trolley with the dongle	
7.	For the JS250: Connect the local control dongle if you want to operate the trolley manually.	 

5.2.5.4 Travel direction

Adjust the positive travel direction on the electrical cabinet of all trolleys.

- The trolleys, which are positioned on one track, must be switched to “A” .
- The trolleys on the other track must be switched to “B” .

Now, the trolleys will travel in equal directions.



Hazard
Adjust the travel direction on the electrical cabinet of the trolleys according the schedule above.
Neglecting this instruction can lead to fatal accidents.

6 How to control the system

This chapter describes how to control the system, as well as some hydraulic principles.

6.1 The Emergency buttons

Hazard
When operating the system in combination with trolleys, realise that pushing an emergency stop of the system will not stop the trolleys. Furthermore pushing an emergency stop on one of the trolleys or on the remote control will not stop the system! The emergency circuits of the two systems are separated!

6.1.1 System

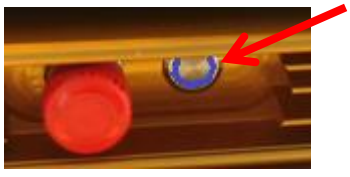
In case of an emergency, all movements of the System can be stopped by pressing an Emergency button.

Such buttons are provided:

On the control panel of each unit (JS125)	
On the wired remote control (JS500)	
As a separate wired emergency stop (JS500)	
On the smartbox	

To recover from an Emergency situation:

1. Solve the reason why the button was pressed
2. Turn the Emergency stop button which was pressed to release it
3. If any HPU was in Remote, then the blue Reset button on the smartbox is lit. Press that button to reset the smartbox



4. Restart the system

6.1.2 Trolleys (optional)

In case of an emergency, all movements of the trolleys can be stopped by pressing an Emergency button.

JS125 trolley	
JS250 trolley	
On the remote control	

To recover from an emergency situation:

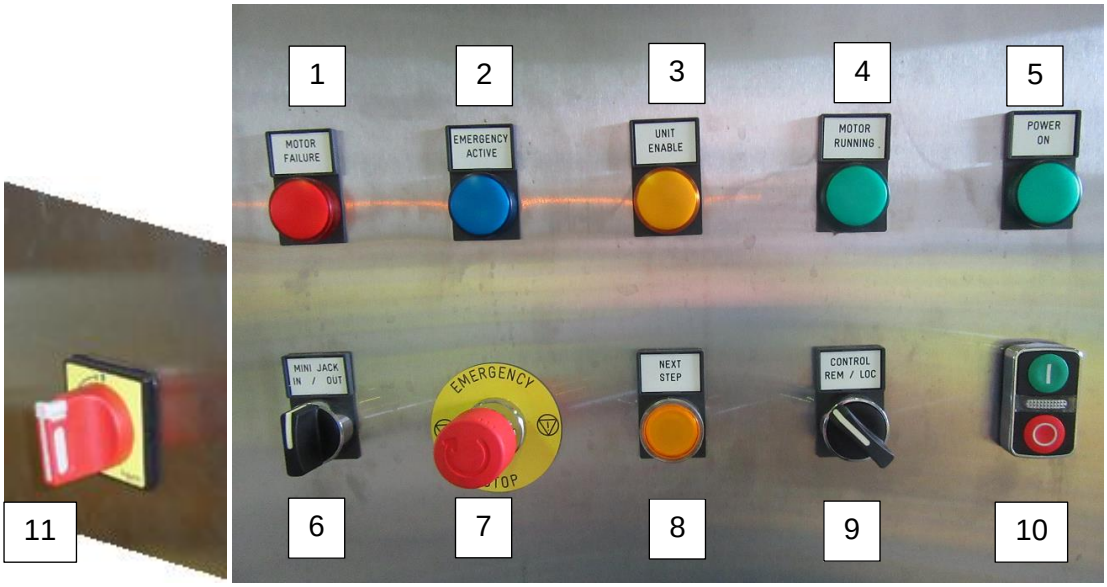
1. Solve the reason why the button was pressed
2. Turn the Emergency stop button which was pressed to release it
3. Press the blue Reset button. Both the JS125 and the JS250 trolleys are provided with the blue reset button.
4. Restart the system

6.2 The control panel on the electro cabinet (JS125 and JS250)

Each unit is provided with an electro cabinet. At the front of it is a controlpanel.
The control panel is intended for

- controlling the unit locally
- showing errors and statuses of the unit.

Hazard
Operating the system locally may causes potential **hazards to personnel** and **damage to the system**, due to the fact that all safety precautions are switched off.



Nr	Type	Name	Description
1.	indicator	Motor failure	Is lit when motor failure. The motor has stopped.
2.	Indicator / button	Emergency active	Is lit when the emergency button [7] or the emergency button on the Smartbox has been pressed. Press the button to recover from an emergency stop.
3.	indicator	Unit enable	Is lit when the unit was enabled by the HMI. When enabled, the unit takes part in the lifting process.
4.		Motor running	The motor of the hydraulic system is running
5.		Power on	The power was switched on by button [10]
6.	switch	Mini jack in / out	All four mini jacks are extended / retracted
7.	button	Emergency stop	Press in case of emergency. The unit will stop moving. When the unit is switched in remote by [6] then other units which are switched in remote are switched off as well. Turn the button to recover from an emergency stop.
8.	Indicator / button	Next step	Only applicable for automatic mode: To be pressed by the operator to continue the lifting / lowering procedure after a barrel has been put in / removed.
9.	switch	Control rem/loc	1. When in remote then the unit is controlled by

			the laptop. Buttons [6] and [10] do not apply. 2. When in local, the unit cannot be controlled by the laptop. Buttons [6] and [10] do apply.
10.	button	On/off	Only applicable if [9] is switched to local: switches the pump of the unit on/off
11.	switch	Main switch	Switches the whole unit on/off

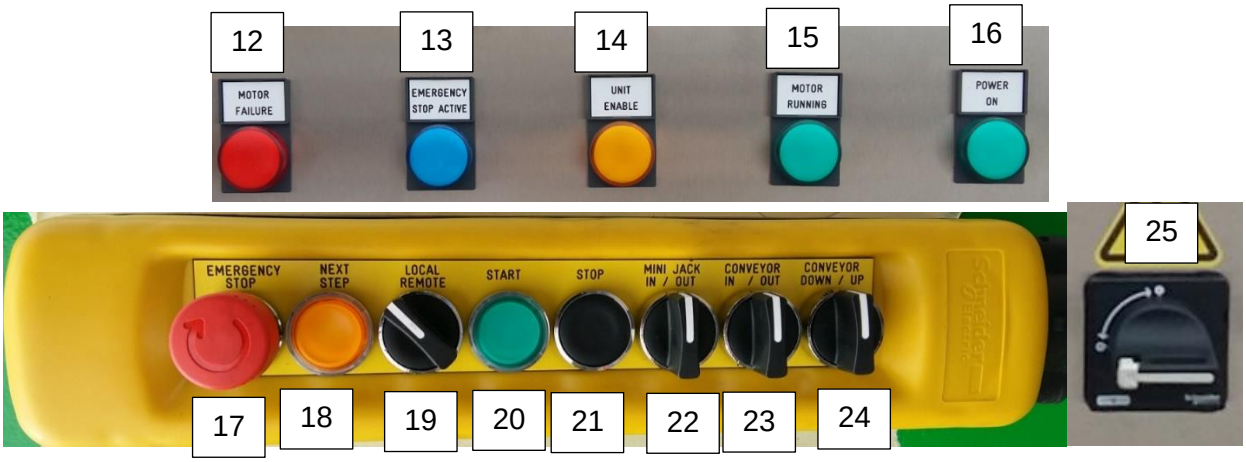
6.3 The control panel on the electro cabinet/remote control (JS500)

Each unit is provided with an electro cabinet. At the front of it is a controlpanel.
The control panel is intended for

- controlling the unit locally
- showing errors and statuses of the unit.

Hazard
Operating the system locally may causes potential **hazards to personnel** and **damage to the system**, due to the fact that all safety precautions are switched off.

Caution
When operating the automatic insert table locally, the table is not automatically aligned with the holes in the barrel. This should be done visually.



Nr	Type	Name	Description
12.	indicator	Motor failure	Is lit when motor failure. The motor has stopped.
13.	Indicator / button	Emergency active	Is lit when the emergency button [7] or the emergency button on the Smartbox has been pressed. Press the button to recover from an emergency stop.
14.	indicator	Unit enable	Is lit when the unit was enabled by the HMI. When enabled, the unit takes part in the lifting process.
15.		Motor running	The motor of the hydraulic system is running
16.		Power on	The power was switched on by button [10]
17.	button	Emergency stop	Press in case of emergency. The unit will stop moving. When the unit is switched in remote by [6] then other units which are switched in remote are switched off as well. Turn the button to recover from an emergency stop.

18.	Indicator / button	Next step	Only applicable for automatic mode: To be pressed by the operator to continue the lifting / lowering procedure after a barrel has been put in / removed.
19.	switch	Local / remote	1. When in remote then the unit is controlled by the laptop. Buttons [6] and [10] do not apply. 2. When in local, the unit cannot be controlled by the laptop. Buttons [6] and [10] do apply.
20.	button	Start	Only applicable if [19] is switched to local: switches the pump of the unit on
21.	button	Stop	Only applicable if [19] is switched to local: switches the pump of the unit off
22.	switch	Mini jack in / out	All four mini jacks are extended / retracted
23.	switch	Conveyor in / out	Conveyor is moving in / out
24.	switch	Conveyor up / down	Barrel lifting cylinders in the conveyor are moving up / down
25.	switch	Main switch	Switches the whole unit on/off

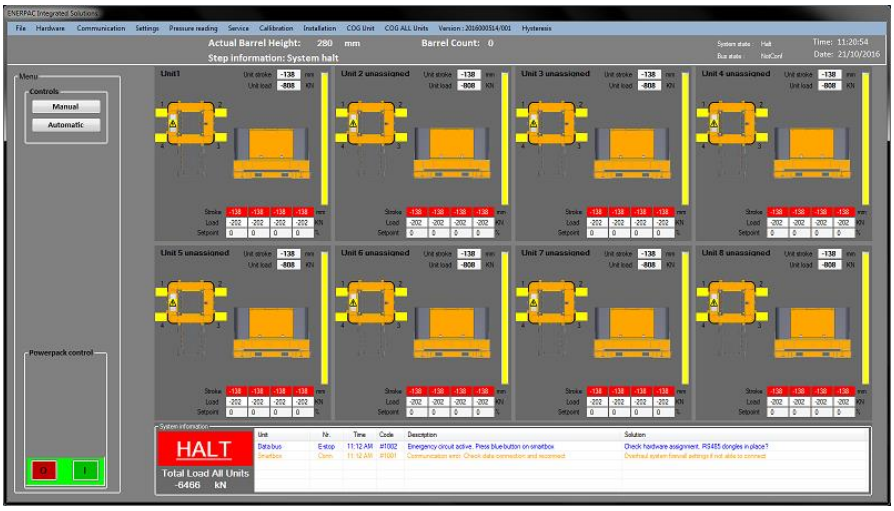
6.4 The human machine interface (HMI) on the laptop

The main functionality on the HMI comprises:

- controlling of **lifting a load**:
  - in **automatic** mode: the sequence of lifting/ lowering the barrels as well as fetching/releasing the barrels is completed automatically
  - **manual** mode: all movements of the system as well as moving of the mini-jacks are controlled by the operator
- **monitoring** the strokes and pressures of the cylinders of the units
- display of the **measured COG**
  - of the individual units
  - of the system as a whole
- configuring the **oil circuits** (“pools”).
- unguarded operation:
  - all safety measures can be switched off
  - automatic levelling (“hysteresis”) can be switched off
- technical stuff:
  - assignment of the MAC addresses of the units
  - display of digital input and output values
  - calibration of the stroke measurement

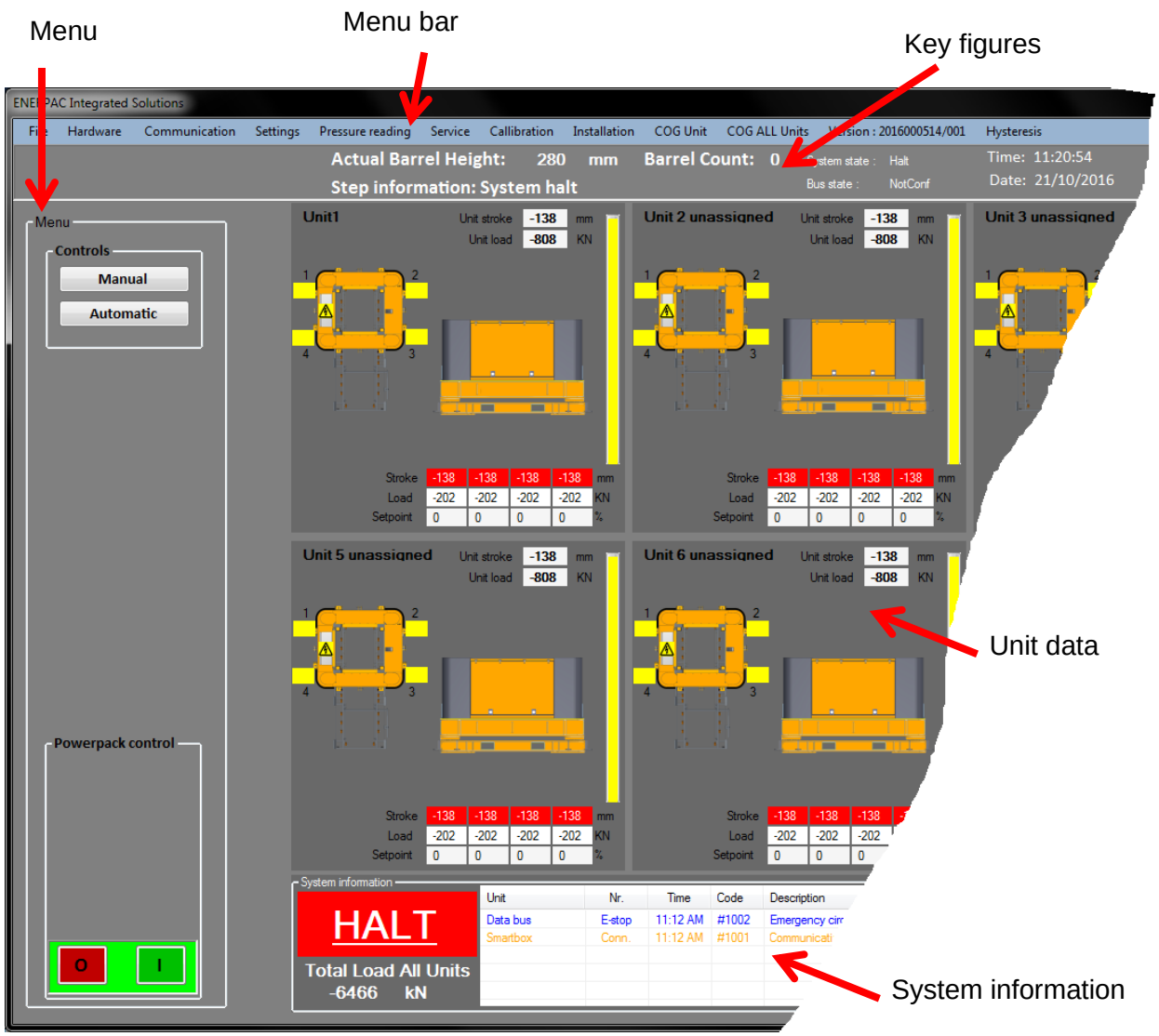
A start-up window is shown for a few seconds:

Then the Main window is shown:



6.4.1 The main window

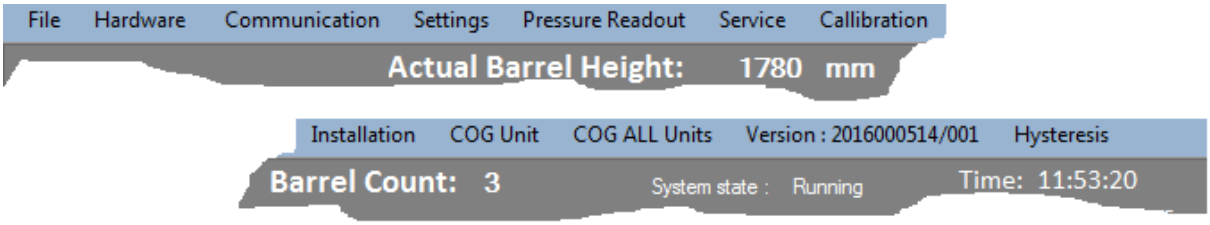
The following areas in the main window are defined:



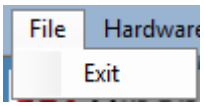
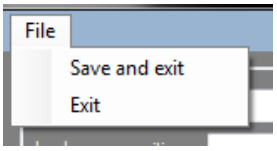
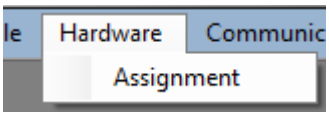
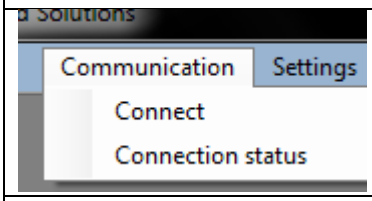
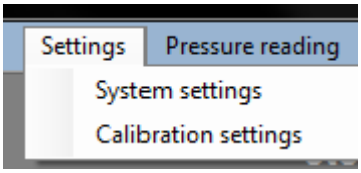
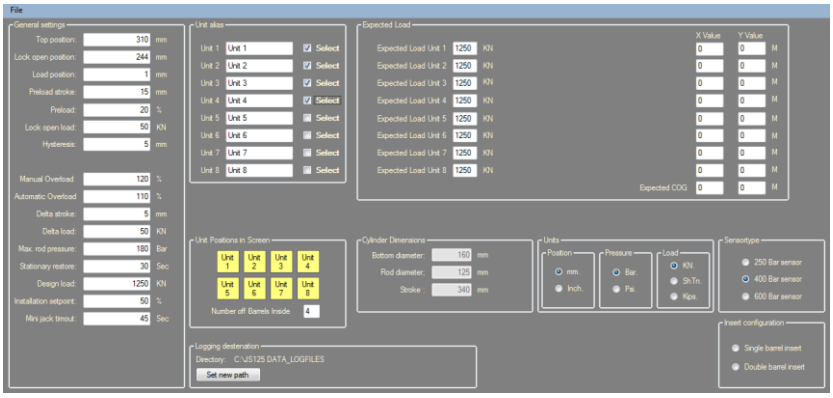
The areas are described in more detail below.

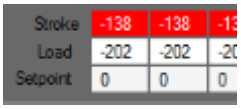
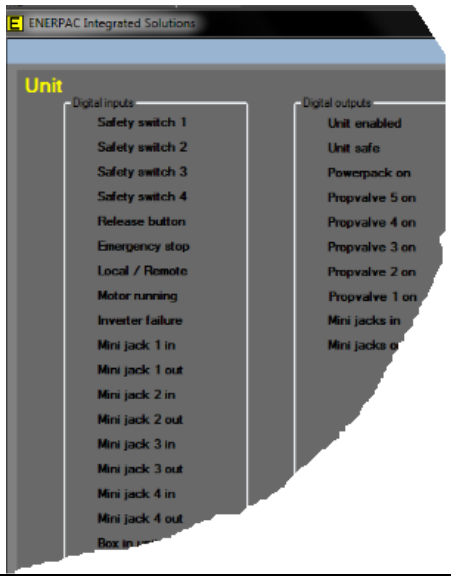
6.4.1.1 Menu bar

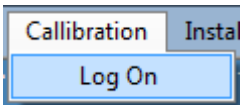
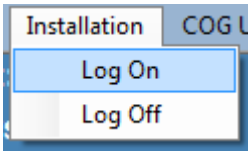
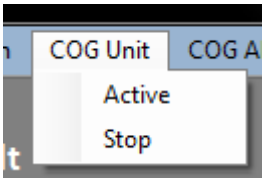
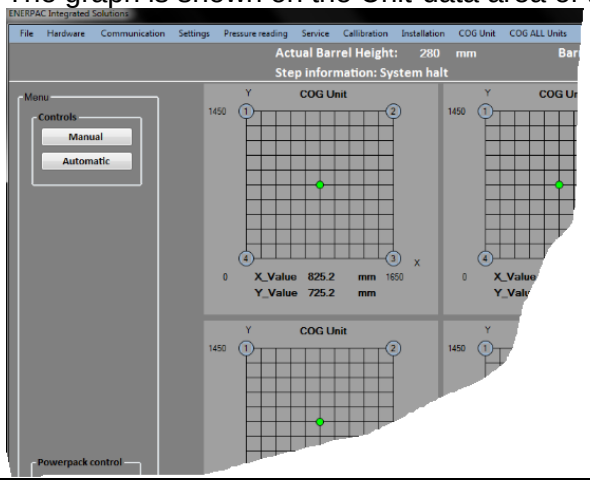
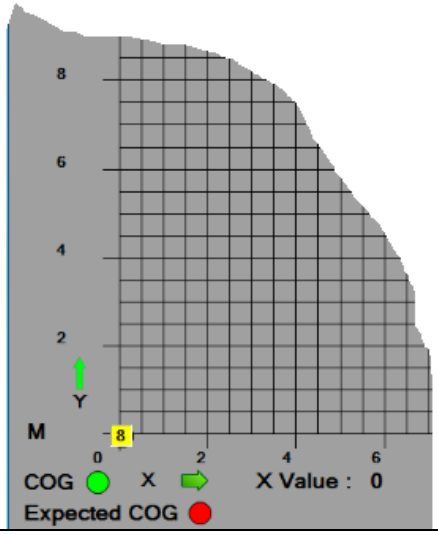
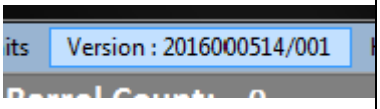
The menu bar is used to navigate to a number of functions and to switch on/off features.

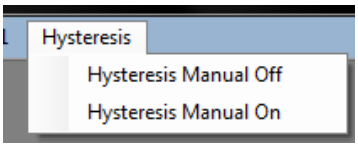


This chapter lists what functions you can invocate by using the menu bar.
(The functions themselves are described in full detail in par 6.4.2 “The functions on the Menu bar”.)

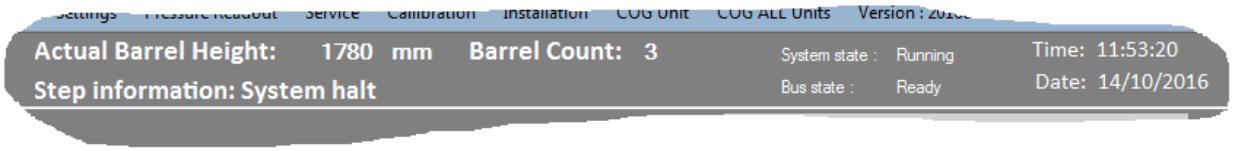
Field	Function
	Exit: to leave the program
	Save and exit: save the settings you modified.
	To assign the MAC addresses of the units. The password is 1234. 
	Connect: To restore the connection of the laptop with the system
	Connection status: To show the status of the connection
	To modify system settings: - General settings - Unit aliases - Expected load - Oil circuit configurations - Cylinder dimensions - Display units - Sensor types - Insert configuration - Logging destination The password is 1234. 

	To modify Calibration settings. To make the analog input values match with the real strokes of the main jacks. 
Pressure reading	To toggle between display on the main window of - Rod pressure, Bottom pressure  - Load, Setpoint 
Service	Shows a screen with all technical data of a specific unit: - digital inputs - digital outputs - analog in - analog out 

	To activate the Calibration mode. The password is 5678. The Calibration mode is logged out automatically when you end calibration.
	To switch off all safety measures of the system. All other functionality in this mode is equal to normal operation. The password is 5678
	To show a graph on which the COG of all certain unit are presented. The graph is shown on the Unit-data area of the main screen. 
	To show a graph on which the COG of the complete system is presented, together with the positions of the units. 
	The version of the application software

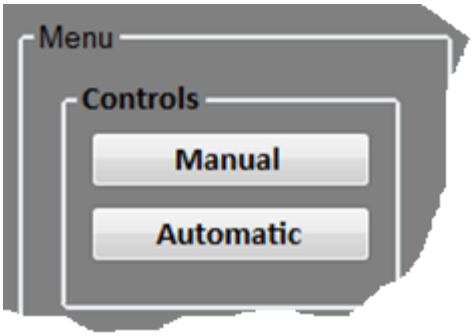
	To switch “hysteresis” (automatic levelling, height regulation) off and on. When switched on, extending and retracking of the main jacks is synchronised. Non-synchronous lifting can cause severe safety issues. Therefore it is required that the levelness of the load is checked continuously, e.g. using a theodolite.  **Hazard** The levelness of the load must be checked continuously. Neglecting this instruction can lead to fatal accidents.

6.4.1.2 Key figures



Actual barrel height	Height of the whole pile of barrels, measured from bottom level until the top of the top barrel
Barrel count	Current number of barrels in the pile
System state	Status of the system
Bus state	Status of the communication between the laptop and the Smartbox
Step information	Internal state; valid both for Manual and Automatic mode.

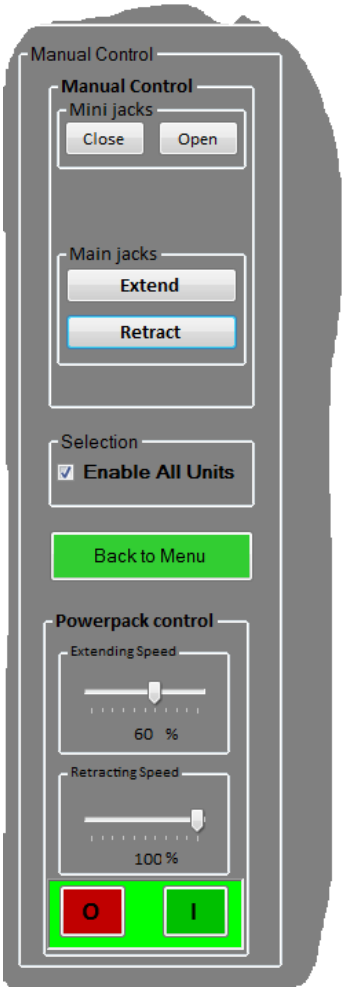
6.4.1.3 Menu



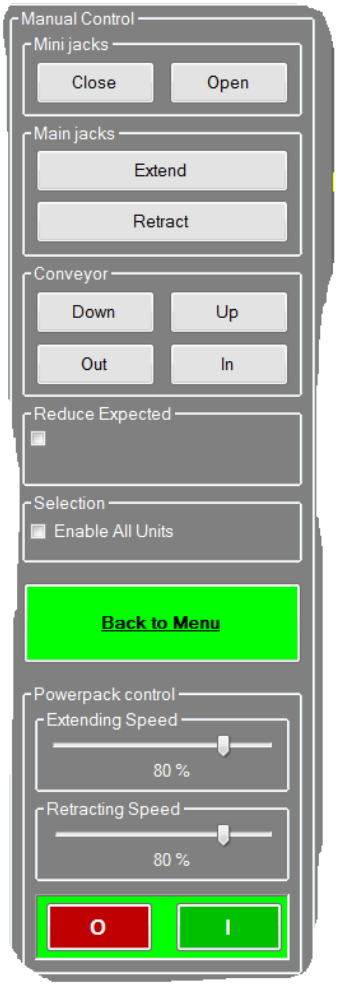
Manual	The main jacks of the units as well as the mini-jacks are operated manually.
Automatic	The sequence of lifting (lowering) and the control of the mini-jacks is completed automatically.

6.4.1.4 Manual control

Without automatic insert table



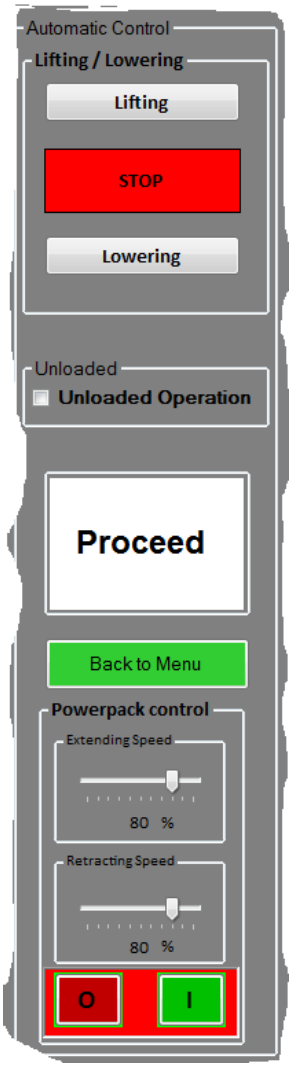
With automatic insert table



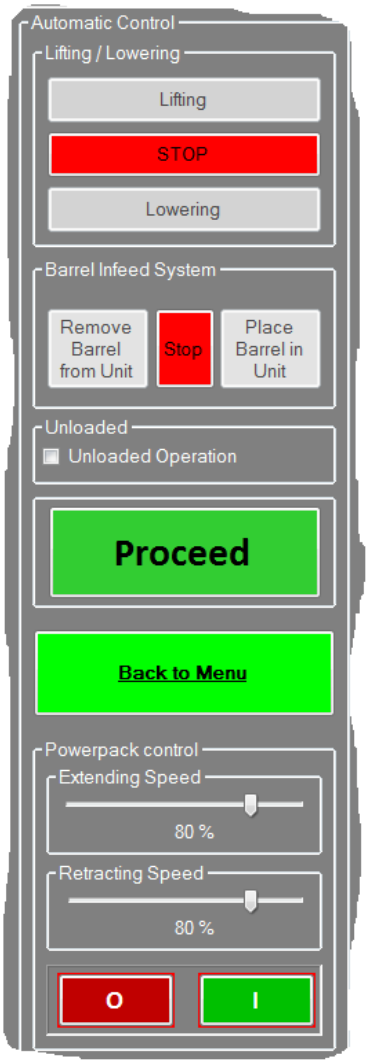
Mini jacks	Close	Manually extend and retract all four mini-jacks of the selected units. All mini-jacks are operated simultaneously.
	Open	
Main jacks	Extend	Manually extend and retract the main jacks of the selected units. Movements of the main jacks are synchronized. In this system the word “hysteresis” is used for this.
	Retract	
Conveyor (only with automatic insert table)	Down	Manually move the barrel lifting cylinders in the conveyor down
	Up	Manually move the barrel lifting cylinders in the conveyor up
	Out	Manually move the conveyor out
	In	Manually move the conveyor in
Reduce expected	Click to enable the reduce expected load functionality, see par 7.3.2.1 “Reduce expected load functionality”	
Selection	Click to enable all units. Commands will be applied to all units which do have hardware assignments.	
Back to menu	Return to the main window	
Powerpack control *(Powerpack is a synonym of HPU)*	Extending speed	Setting the speed of extending / retracting of the main jacks
	Retrackting speed	
On / off	To switch the pump of the selected units.	

6.4.1.5 Automatic control

Without automatic insert table



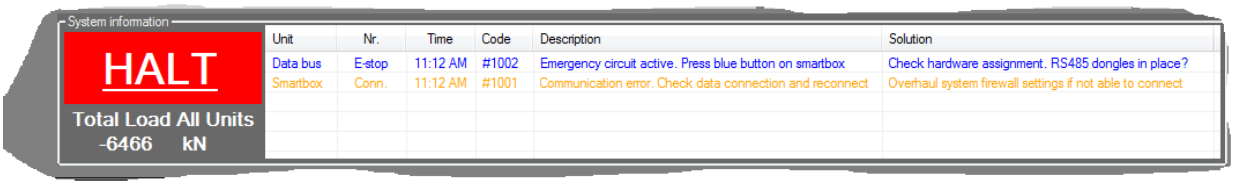
With automatic insert table



Lifting	Start the lifting sequence. Once pressed, the text changes to “Hold lifting” which enables you to temporize the movement.
Stop	To stop all movements.
Lowering	Start the lowering sequence. Once pressed, the text changes to “Hold lowering” which enables you to temporize the movement.
Remove Barrel from Unit (only with automatic insert table)	The Barrel is automatically removed from the unit
Stop (only with automatic insert table)	To stop all movements
Place barrel in Unit (only with automatic insert table)	The Barrel is automatically placed in the unit
Unloaded operation	No real load is lifted. The system will not perform a preload measurement.
Proceed	- When lifting a load, click after a new barrel was inserted - When lowering a load, click after a barrel was removed
Back to menu	Return to main menu

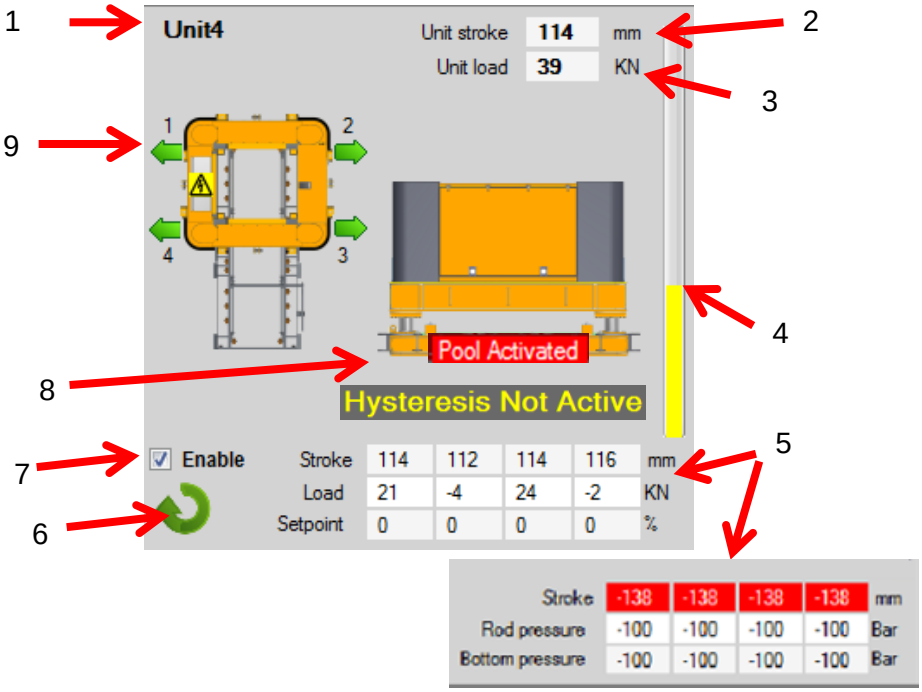
Powerpack control	See Manual control

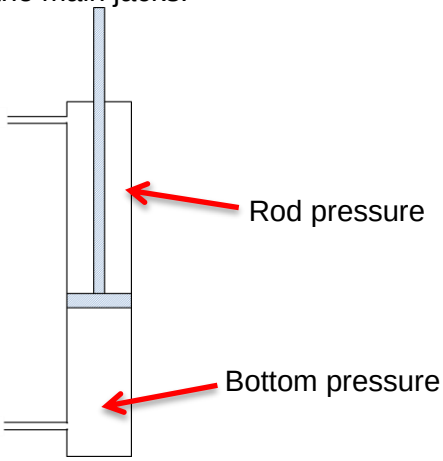
6.4.1.6 System information



Total Load All Units	The integrated current load on all units	
HALT	"HALT" is shown when an emergency button was pressed.	
Information area	System reports, displayed in combination with possible solutions. Double-click on a row to delete	
	Unit	Part of the system for which the report is applicable: PushUp unit | Data bus | Smartbox
	Nr.	Number of the PushUp unit for which the report is applicable.
	Time	Time on which the message was reported
	Code	Description and internal code of the error; see par 8.2.2 "Error reports of the units". Use the report when you communicate with Enerpac
	Description	
	Solution	

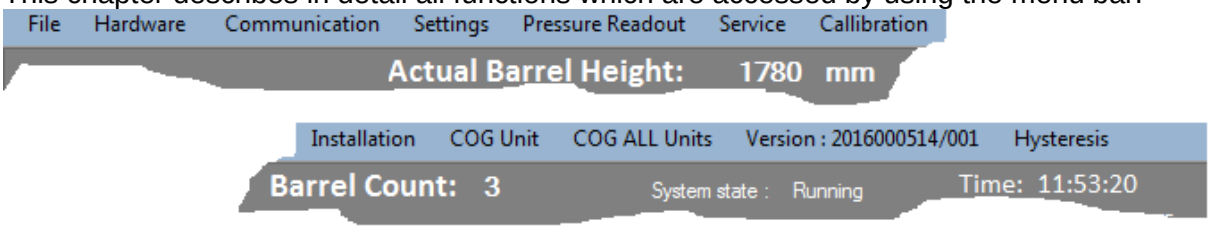
6.4.1.7 Unit data



<table>
<tr><td>1.</td><td colspan="3">The Unit name, as set in the window Settings</td></tr>
<tr><td>2.</td><td colspan="3">The mean actual stroke of main jacks</td></tr>
<tr><td>3.</td><td colspan="3">The load on the unit, as calculated from the pressure sensors of the cylinders</td></tr>
<tr><td>4.</td><td colspan="3">Indicator of the total load on the unit.
- yellow = preload
- green = expected load
- red = overload</td></tr>
<tr><td rowspan="5">5.</td><td rowspan="5">(Click “Pressure reading” on the menu bar to toggle between the screens; see section 6.4.2.6 “Pressure reading”)</td><td>Stroke</td><td>The measured stroke of main jacks 1,2,3,4
If text box turns red, the safety switch in the foot of the main jacks was activated.</td></tr>
<tr><td>Load</td><td>The calculated load per cylinder.</td></tr>
<tr><td>Setpoint</td><td>The strokes of the main jacks are kept equal automatically by regulating the pressures of the individual main jacks. The setpoint fields show the relative differences of those pressures.</td></tr>
<tr><td>Rod pressure</td><td rowspan="2">Pressures on the rod side and on the bottom side of the main jacks:
 
</td></tr>
<tr><td>Bottom pressure</td></tr>
<tr><td>6.</td><td colspan="3">Pump running indicator ; green when the pump is running</td></tr>
<tr><td>7.</td><td colspan="3">Enable checkbox, to make the unit controllable by the laptop. The unit has to be in remote.</td></tr>
<tr><td rowspan="3">8.</td><td rowspan="3">Warnings</td><td>  </td><td>A problem appeared; check the System information field for the description of the error.</td></tr>
<tr><td>Hysteresis Not Active</td><td>No automatic levelling of the main jacks of this specific unit is performed.
(It was switched off using the menu bar option “Hysteresis”, or calibration is active.)</td></tr>
<tr><td>Pool Activated</td><td>A non-default oil circuit has been configured.</td></tr>
<tr><td>9.</td><td colspan="3">Shows the positions of the mini jacks: extended or retracted.
- Green arrow: the mini jack is retracted
- Red arrow: the mini jack is extended; the barrel is fetched.</td></tr>
</table>

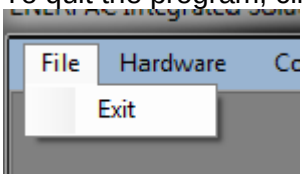
6.4.2 The functions on the Menu bar

This chapter describes in detail all functions which are accessed by using the menu bar.

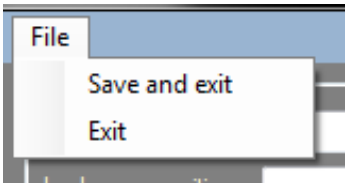


6.4.2.1 File

To quit the program, click in the menu bar on File; then click Exit.

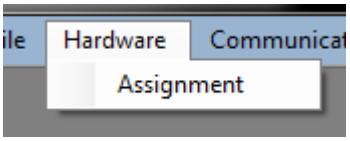


If modifications are made in system settings or calibrations then the menu shows “Save and exit”. Use it to save the modified settings.

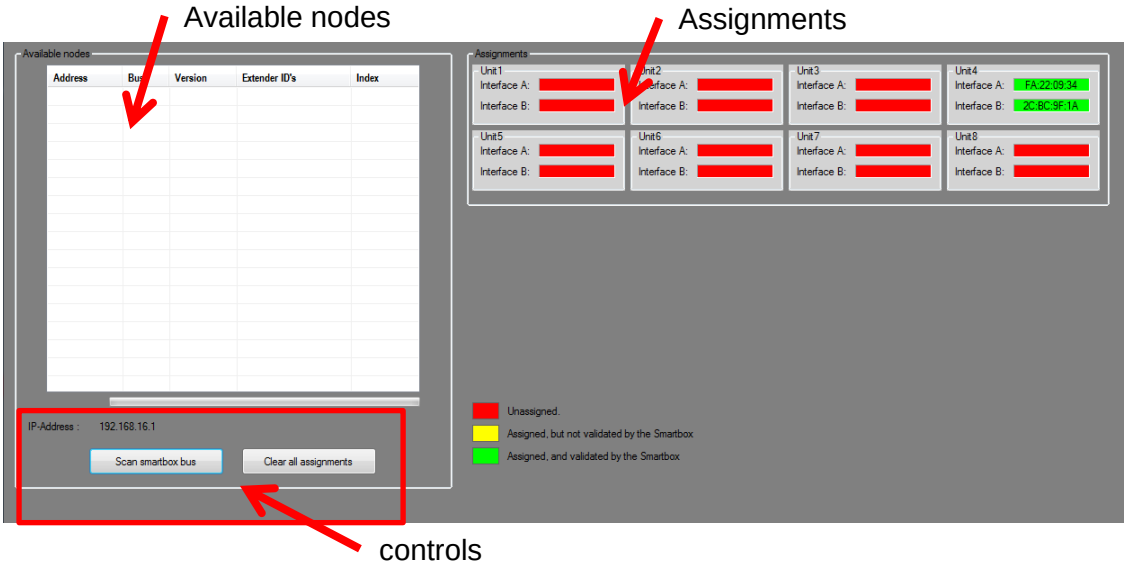


6.4.2.2 Hardware

To enter the hardware assignment function, click in the menu bar on the main screen on Hardware and then on Assignment.



Each unit is identified by a unique MAC address. Use this function to assign those MAC addresses to the system.



Each unit is provided with two interface boards: Interface A and interface B. Both are assigned simultaneously.

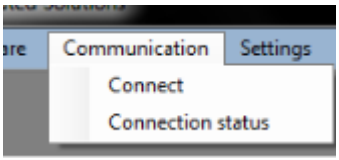
To assign the MAC addresses of the units to the system, proceed as follows:

- Click on the “Scan Smartbox bus” button.
- The system searches for available hardware
- All available hardware will become visible in field Available nodes field.
- Drag and drop a node from in the Available nodes towards a specific Unit in the Assignments field.
  The assigned unit turns green
- Use File / save & exit button in the menu bar to save the assignments

To wipe all assignment, click on “Clear all assignments”.

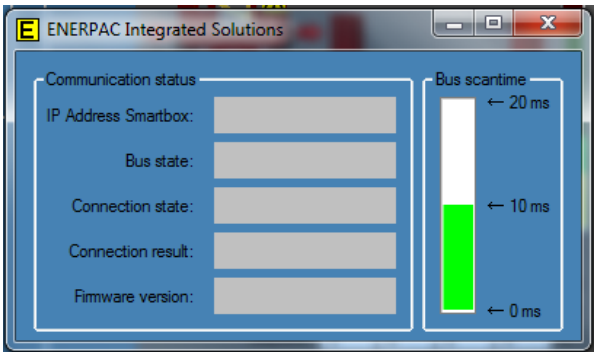
6.4.2.3 Communications

To use the Communications functions, click on Communication in the menu bar:



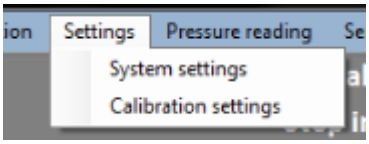
Connect:
Establish communication between the laptop and the system

Connection status:
Technical information about the connection status between the laptop and the smartbox is shown:



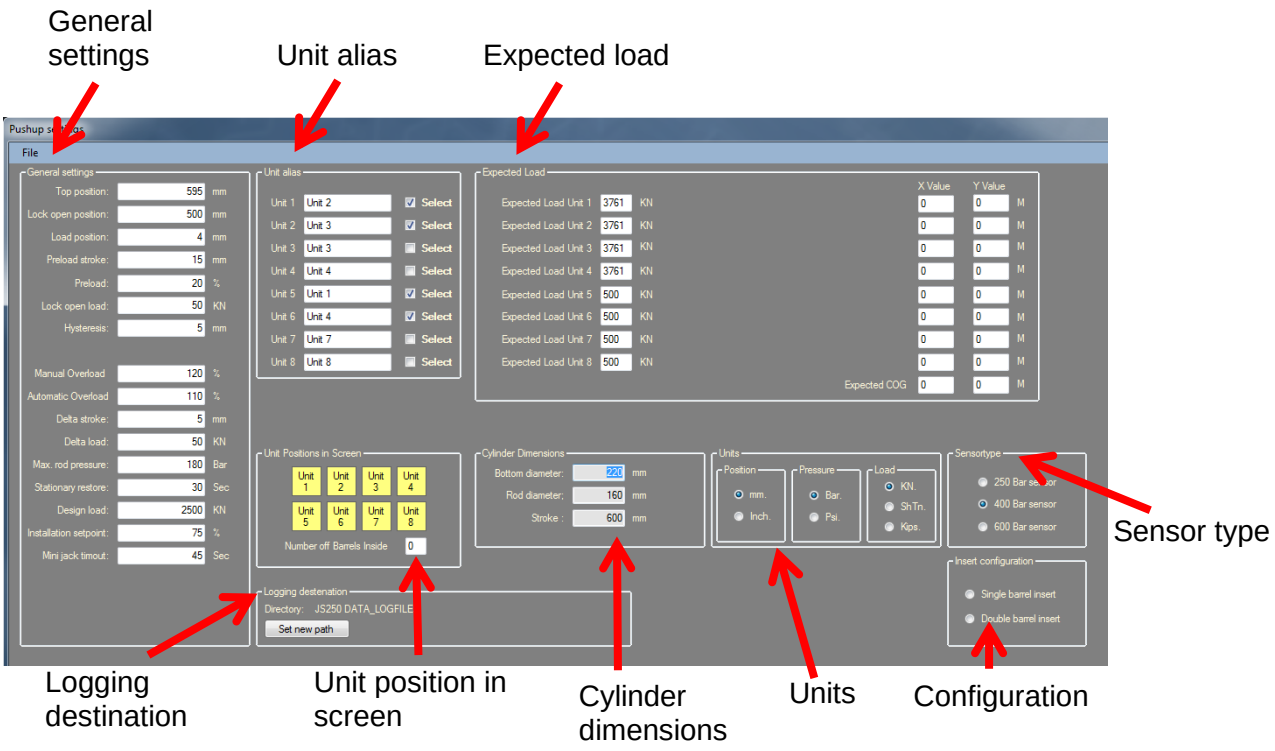
6.4.2.4 Settings / System settings

To use the Settings function click on Settings in the menu bar. Then click System settings.

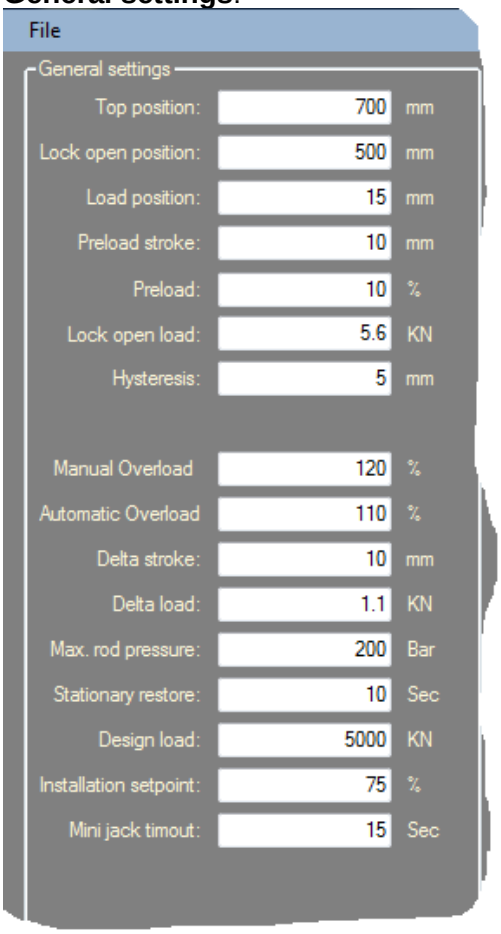


The Settings window enables the operator to set a number of system parameters.

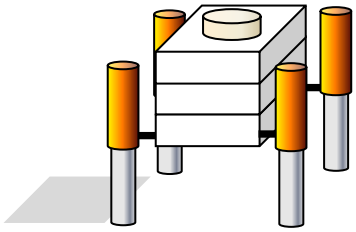
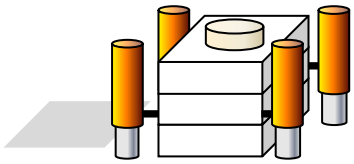
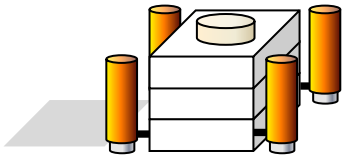
NB:
- Adjustments should only be done by trained and authorized personal.
- Most settings are specific for the system and should not be changed.


General settings
Unit alias
Expected load
Sensor type
Logging destination
Unit position in screen
Cylinder dimensions
Units
Configuration

General settings:

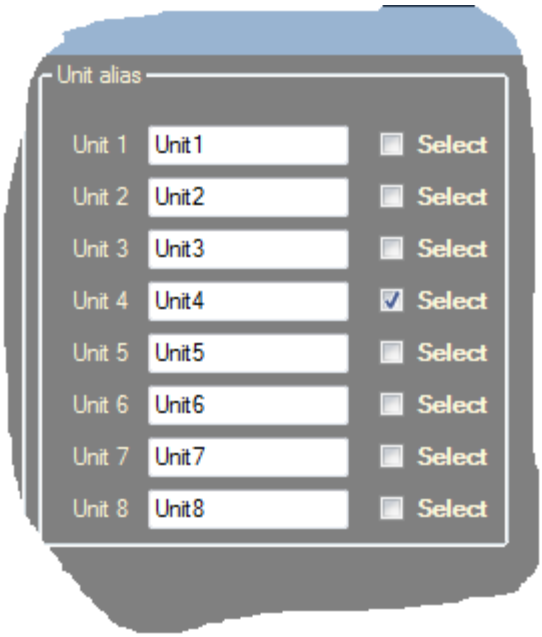


For the default values reference is made to the delivered application.

Field	Description
Top position	Maximum height of the system. It depends on the length of the cylinder. 
Lock open position	Stroke on which the mini-jacks can be retracted 
Load position	Stroke position of the main jacks on which the mini-jacks can fetch a new barrel 
Preload stroke	The preload stroke is the first small stroke during lifting in automatic mode. During this stroke the system check whether the load is being picked.
Preload	In automatic mode: during the preload stroke the system checks whether the load is being picked up, by comparing the measured load with the preload percentage of the expected load
Lock open load	In automatic mode: the maximum load at which the mini jacks can be safely retracted. Before retracting the system checks if the measured load does not exceed this value
Hysteresis	While moving the load up or down, the strokes of the main jacks are automatically kept equal within a certain bandwidth. This bandwidth we call “hysteresis”. If the stroke of a cylinder exceeds the bandwidth, its moving is stopped until the stroke gets within the bandwidth again.
Manual overload	The allowed overload in manual mode. Manual overload can be set to a maximum of 120 of the expected load
Automatic overload	The allowed overload in automatic mode. Automatic overload can be set to a maximum of 110 % of the expected load
Delta stroke	When the system stopped, the height should be not change. When the moving is resumed, the system checks whether the height has still the original value, with a tolerance of the delta stroke.
Delta load	When the system stopped, the load should be not change. When the moving is resumed, the system checks whether the load has still the original value, with a tolerance of the delta load.
Max. rod pressure	Maximum pressure on the rod of the cylinder
Stationary restore	Time that it takes for the hydraulic power unit to go back to stationary speed when it’s running unloaded.
Design load	The load where the system was designed for to lift

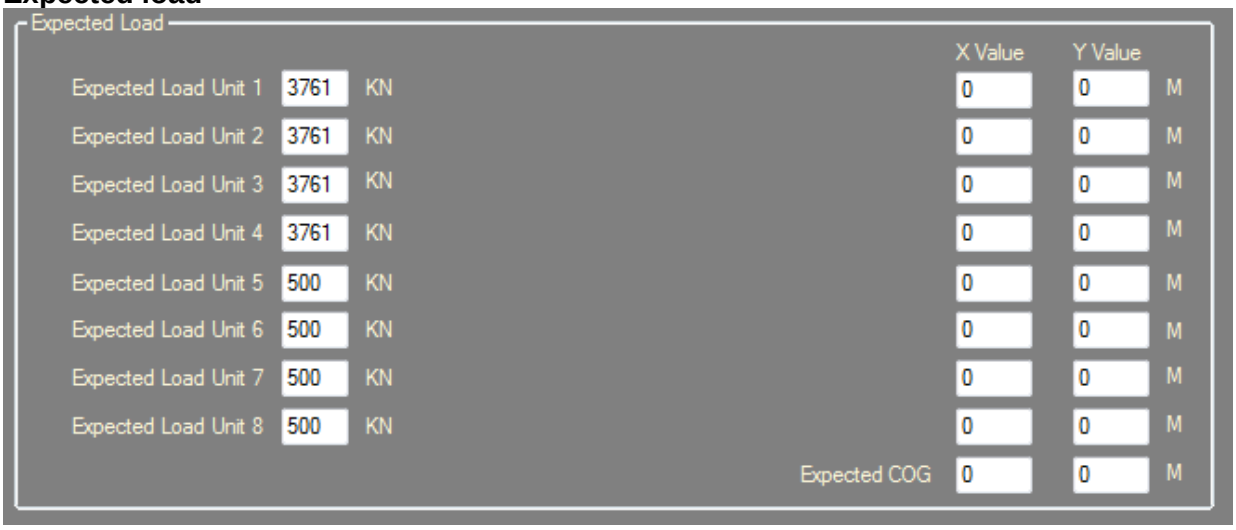
Installation setpoint	In installationmode no height regulation of the main jacks is applied. *(No "hysteresis")*. Instead, the main jacks are provided with a fixed amount of oil, being the Installation setpoint.
Mini jack timeout	Maximum time for the mini jacks to extend or retract

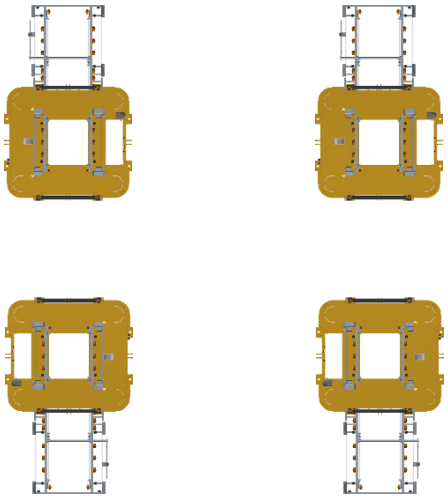
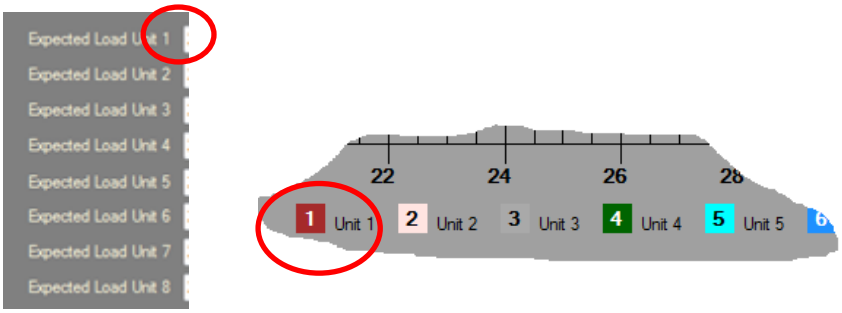
Unit alias:



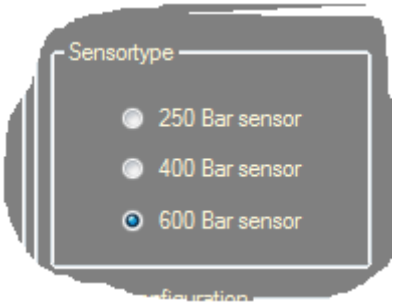
Unit 1 .. 8	Logical names can be assigned to the units, for instance "Left back", "Right back", Left front", "Right front". The logical names are shown on the main window.
Select	Select a unit to make it displayed in the main window.

Expected load



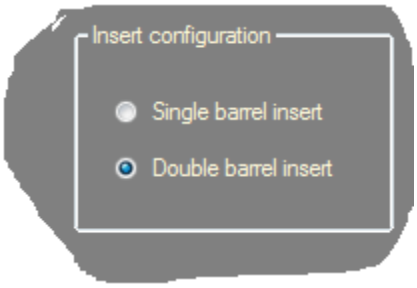
Expected Load Unit 1 .. 8	The load which you expect the unit will bear during the lifting operation. Protections (overload, preload) are based on this value.
X Value, Y Value	Enter the physical location of the units w.r.t. each other, to enable the system to calculate the COG of the whole system.  *(top view)* - You can define the zero-point of the grid where you want since only the respective distances of the units are relevant. - The numbers of the units are used in the COG All units screen: 
Expected COG	The X/Y position where you expect the COG to be located. It's displayed on the COG All units window.

Sensor type



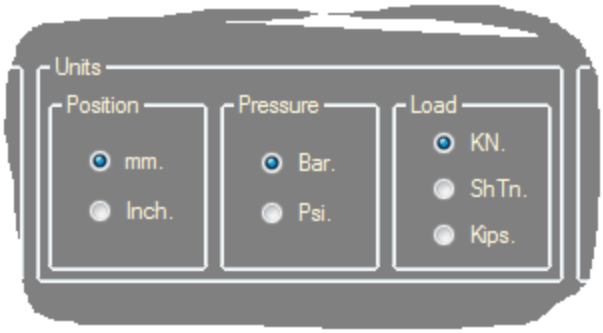
By default the correct sensor type is chosen.
Change if the sensor type was changed.

Insert configuration



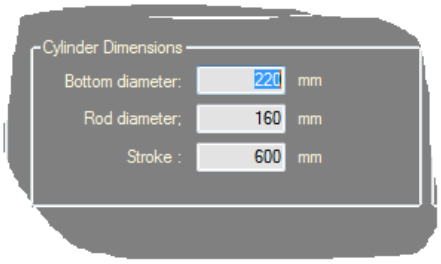
No functionality is implemented for this function; sorry … ☺

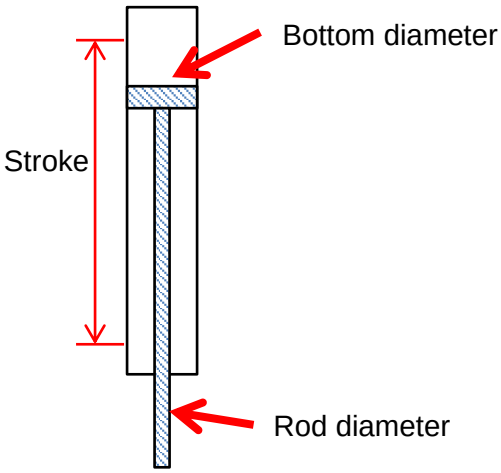
Units
The units in which all values are presented on the HMI can be chosen.
Use this window to set your preferences.



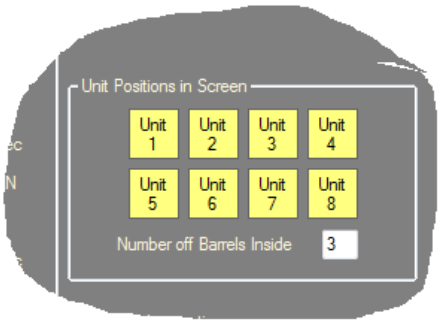
Position	Positions are displayed in - millimetres - inches
Pressure	Pressures are displayed in - Bar - Psi
Load	Loads are displayed in: - KN = kilo newton - Sh Tn = Short tons - Kips = kilo pascal

Cylinder dimensions
Use this field to set the dimensions of the main jacks.



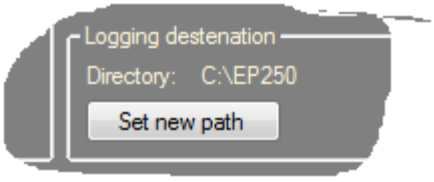


Unit Positions in Screen



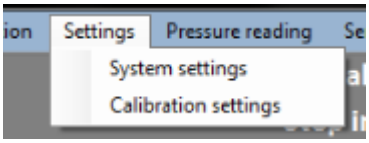
Unit 1 .. 8	Fixed indication	No functionality implemented
Number of Barrels Inside	Editable value	The value is used to display the Barrel count and the Actual Barrel Height on the main screen. - In manual mode the field can be updated manually. - In automatic mode the field is updated automatically.

Logging destination
Use this field to define the location where you want the logging file to be put.



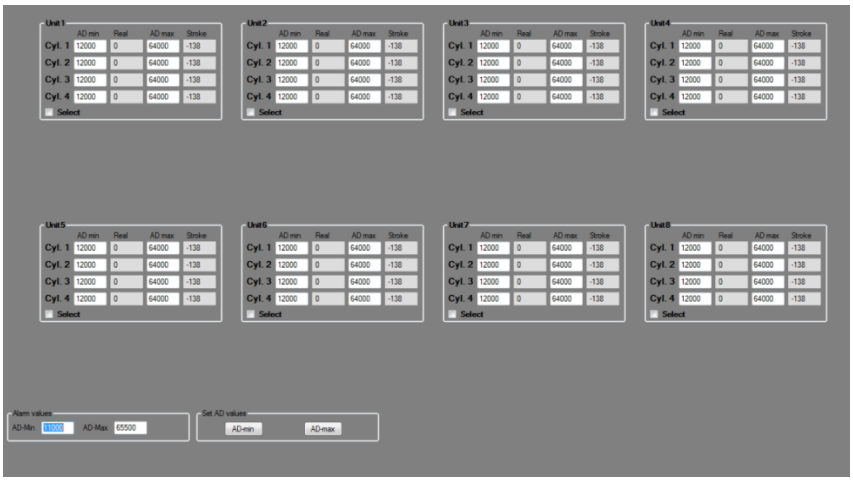
6.4.2.5 Settings / Calibration settings

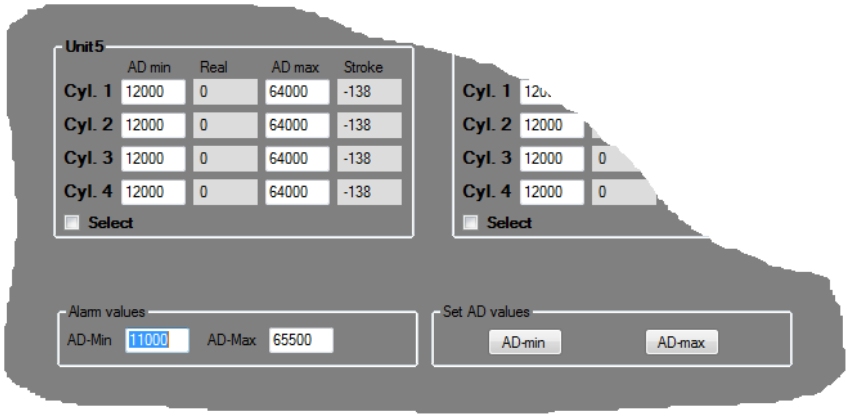
To use the Settings function click on Settings in the menu bar. Then click System settings.



The following window pops up:

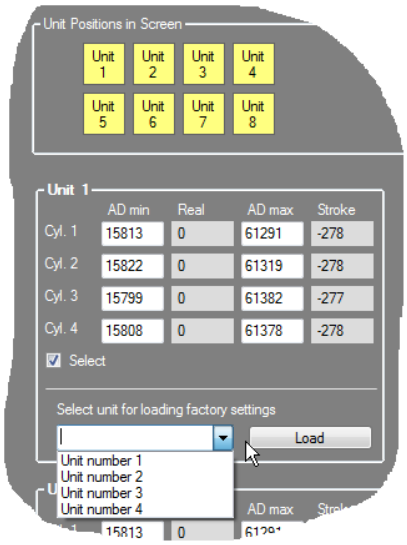
JS125 and JS250





AD min		Editable value	Digital value reflecting the minimal stroke of the cylinder
Real		Displayed value	Real value
AD max		Editable value	Digital value reflecting the maximal stroke of the cylinder
Stroke		Displayed value	Stroke in mm
Alarm values	AD-min	Editable value	If the stroke gets less than this value, an alarm is raised.
	AD-Max	Editable value	If the stroke exceeds this value, an alarm is raised.
Set AD values	AD-min	Button	The shown Ad min values are taken as the minimal values for the selected units
	Ad-max	Button	The shown Ad max values are taken as the minimal values for the selected units

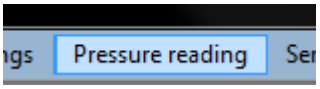
JS500



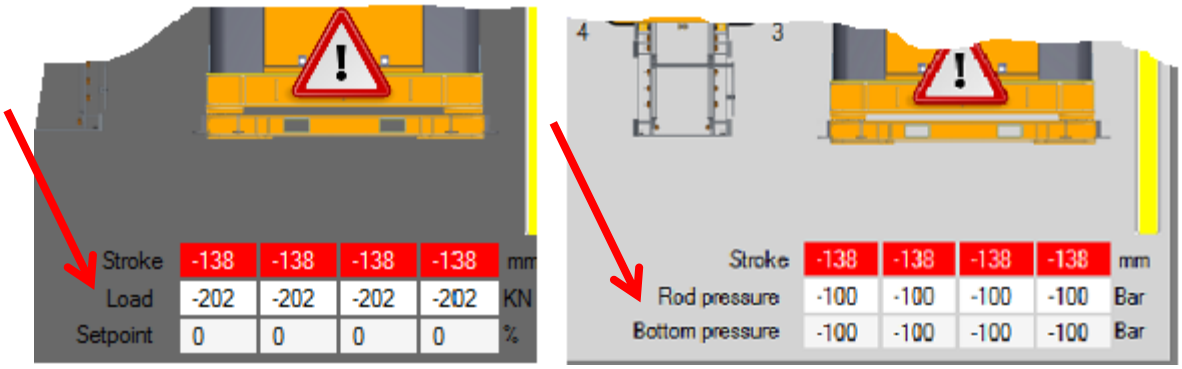
AD min		Editable value	Digital value reflecting the minimal stroke of the cylinder
Real		Displayed value	Real value
AD max		Editable value	Digital value reflecting the maximal stroke of the cylinder
Stroke		Displayed value	Stroke in mm
Alarm values	AD-min	Editable value	If the stroke gets less than this value, an alarm is raised.
	AD-Max	Editable value	If the stroke exceeds this value, an alarm is raised.
Set AD values	AD-min	Button	The shown Ad min values are taken as the minimal values for the selected units
	Ad-max	Button	The shown Ad max values are taken as the minimal values for the selected units
Select unit for loading factory settings		Dropdown menu	The factory settings of a unit can be coupled to the position of the unit in the setup used for a specific job

6.4.2.6 Pressure reading

To use the Pressure reading function click on pressure reading in the menu bar:



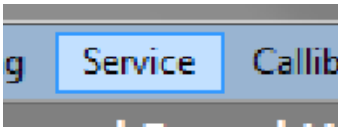
The Pressure reading function is used to toggle between the two types of data of the units. The data is shown in the unit data area of the main window:



Click Pressure reading to toggle between both types.

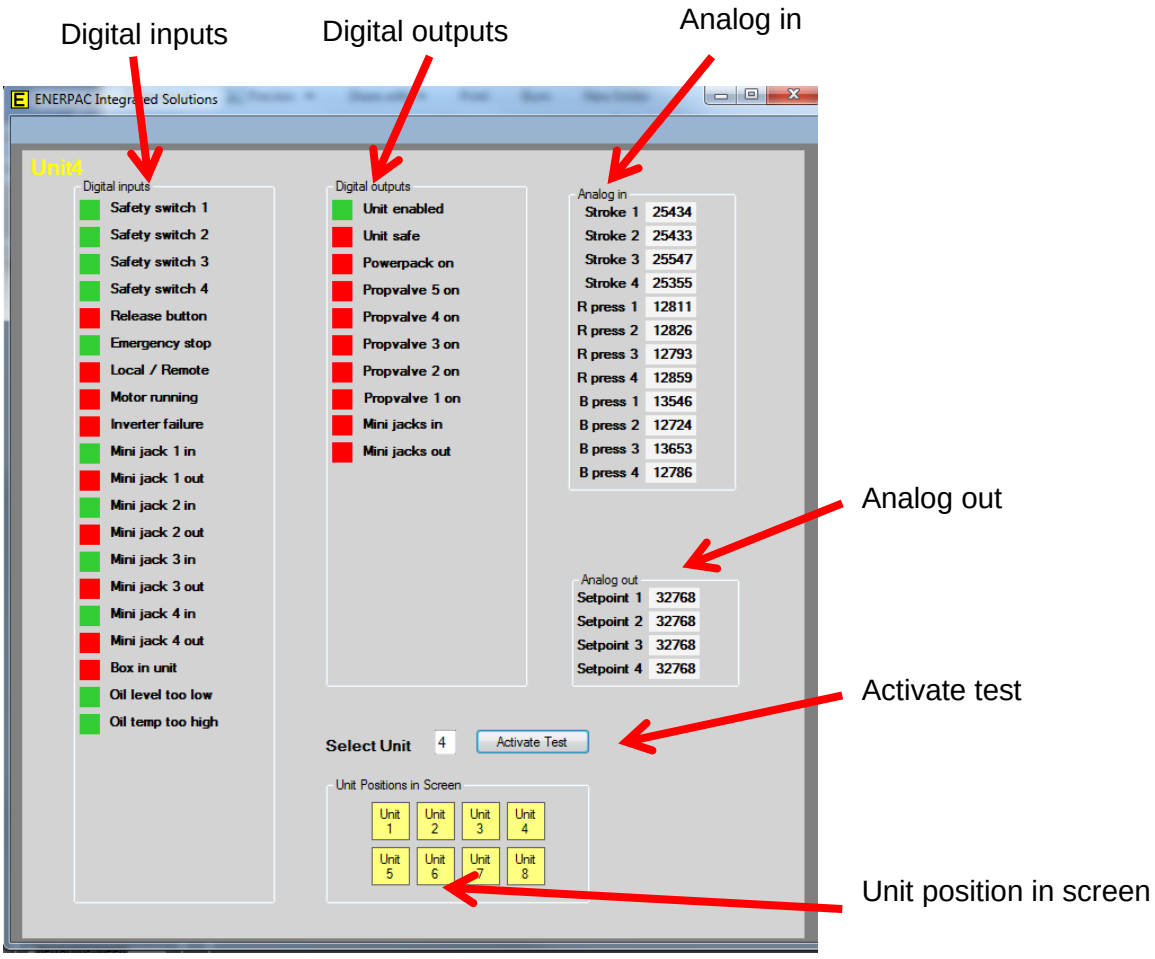
6.4.2.7 Service

To enter the Service function, click in the menu bar on Service.



The Service window shows a number of technical values for a specific unit:

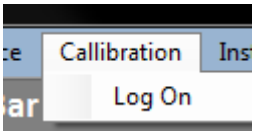
- status of input discretes and output discretes
- values of analog input values and output values



Digital inputs	Position of input switches: - Green: input is high - Red: input is low
Digital outputs	Position of output switches: - Green: output is high - Red: output is low
Analog in	Numeric values of analog inputs
Analog out	Numeric values of analog outputs
Selected Unit, Activate Test	Enter the number of the unit from which you want to see the values. Then click Activate Test
Unit Positions in Screen	No function

6.4.2.8 Calibration

To enable Calibration, click on Calibration in the menu bar; then click on Log on.



In calibration mode the main jacks can be extended an retracted to their physical limits.

Hazard
For the JS500, the calibration should be executed without the End Barrel in the system or with the End Barrel locked by the mini Jacks. When failing to follow this requirement the **system will be damaged** and causes potential **hazards to personnel.**

Caution
Safety precautions are switched off when Calibration is active.

For calibrating the system follow the instructions given in par 7.5“Calibration”.

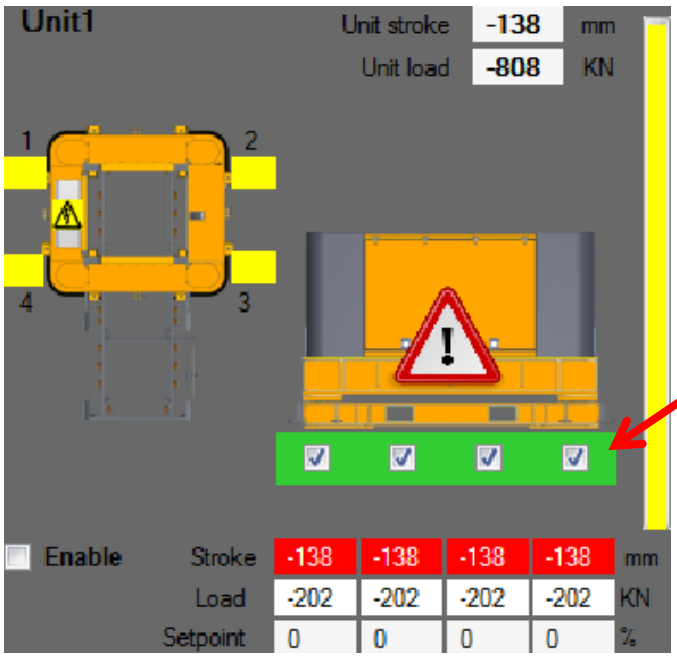
6.4.2.9 Installation mode

To enter the Installation mode, click on Installation in the menu bar:

Installation mode enables the operator to control the system manually in all aspects, to solve unexpected or difficult situations. In fact, it's an emergency mode.

The installation mode differs from normal operation on the following:

- All safety measures are switched off
- No automatic levelling is applied to the main jacks (*"hysteresis"*).
- Main jacks can be selected individually:
  -
  -
  -



main jacks 1,2,3,4

Installation mode is only applicable for manual mode, not for automatic mode.

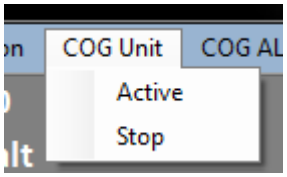
Do not execute an operation in installation mode.

Hazard
Operating the system in Installation mode may causes potential **hazards to personnel** and **damage to the system**, due to the fact that all safety precautions are switched off.

Hazard
For the JS500, the main cylinders may not be extended when only the End Barrel is in the system and is not locked. When failing to follow this requirement the **system will be damaged** and causes potential **hazards to personnel.**

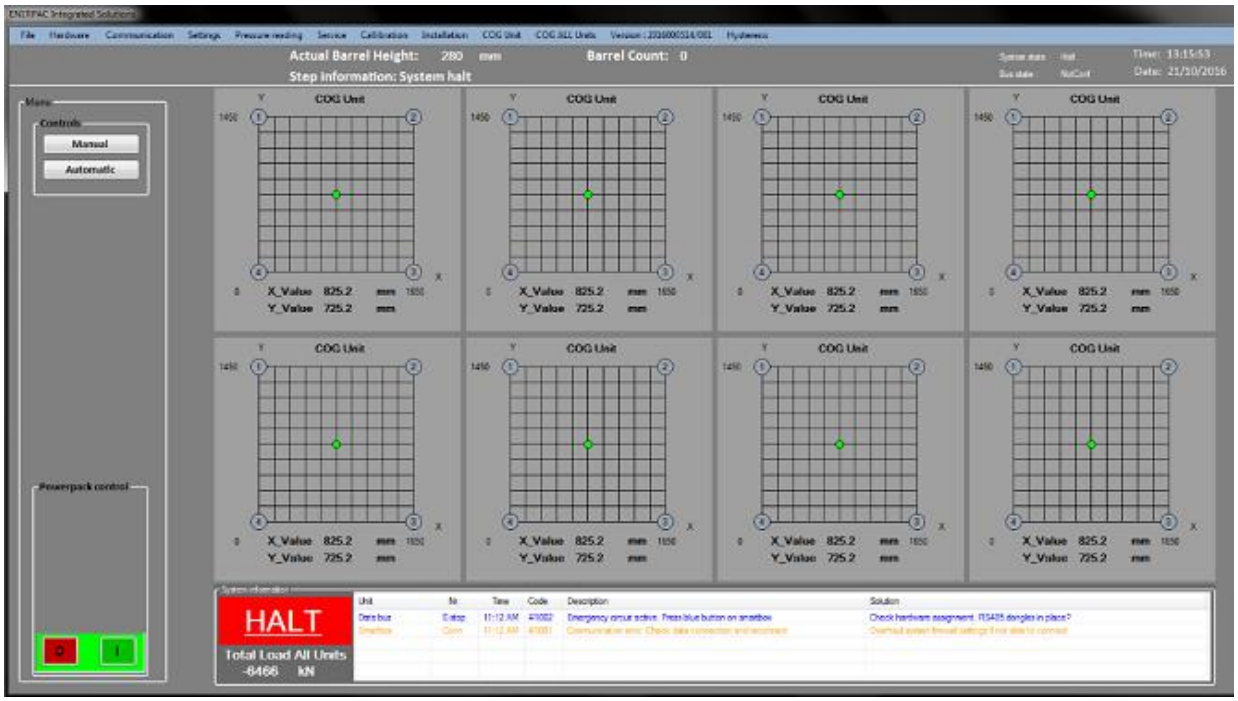
6.4.2.10 COG of a single unit

To show the COG of the Unit, click COG Unit in the Menu bar, then click Active.



To quit the display of the COG, click COG Unit and then Stop.

The main window shows the COG's of all selected units:

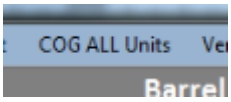


Per unit the COG is shown:

- the COG

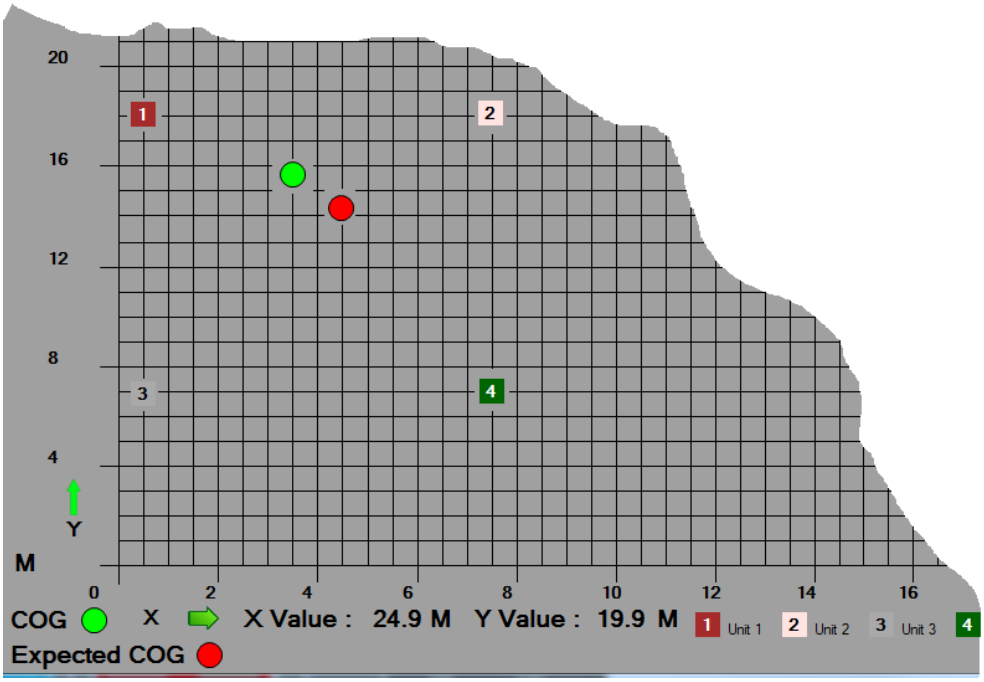
6.4.2.11 COG of the complete system

To show the COG of the complete system, click COG All Units in the menu bar.



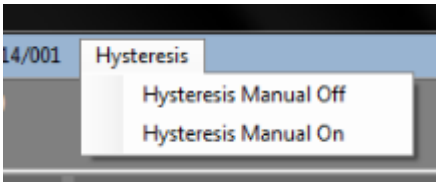
A new window pops up, on which is shown:

- The position of the expected COG.
  (You entered it in the Expected load field of the Settings menu.)
- The measured COG as a result of measured oil pressures of the main jacks
- The positions of all units
  (You entered them in the Expected load field of the Settings menu.)



6.4.2.12 Hysteresis

To set “Hysteresis”, click in the menu bar on the main screen on Hysteresis.



When switched on, the movements of the main jacks are synchronised: their heights are kept equally within a certain bandwidth, by regulating their extending / retracting speeds.

6.4.3 Logging

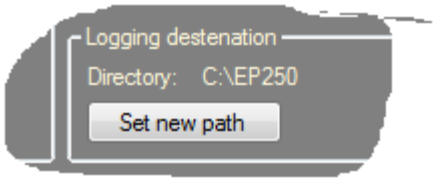
Logging of data is always switched on; it cannot switched off.

Two types of logging are available

- Logging of error messages
- Logging of system data

The logging files can be used for evaluation purposes and for fault finding.

Use the Settings / System settings function on the menu bar to modify the destination where the logging files area written to:



6.4.3.1 Logging of error messages

All error messages are written to a file.
The logging file looks like:

```
11:11:57 @ Start of new session @
11:12:00  Unit type: Data bus E-stop code: #1002 Failure: Emergency circuit active, Press blue button
11:24:58  Unit type: Smartbox Conn. code: #1001 Failure: Communication error. Check data connection an
11:25:00  Unit type: Smartbox Conn. code: #1001 Failure: Communication error. Check data connection an
11:25:26  Unit type: Smartbox Conn. code: #1001 Failure: Communication error. Check data connection an
11:25:36  Automatic Overload changed from 100 to 100 %
11:25:40  Unit type: Smartbox Conn. code: #1001 Failure: Communication error. Check data connection and
11:25:55  Unit type: Pushup unit 1 code: #0018 Failure: Powerpack failure
11:25:58 ** Error messages manually removed **
11:26:16 ** Calibration Mode **
11:26:23  Unit type: Pushup unit 1 code: #0042 Failure: Negative Load in system of more than -40kN
11:26:26  Unit type: Pushup unit 1 code: #0042 Failure: Negative Load in system of more than -40kN
11:26:27  Unit type: Pushup unit 1 code: #0042 Failure: Negative Load in system of more than -40kN
11:26:29  Unit type: Pushup unit 1 code: #0042 Failure: Negative Load in system of more than -40kN
11:26:33  Unit type: Pushup unit 1 code: #0042 Failure: Negative Load in system of more than -40kN
11:26:37  Unit type: Pushup unit 1 code: #0042 Failure: Negative Load in system of more than -40kN
11:27:08 ** Error messages manually removed **
11:27:08 ** Calibration Mode **
11:27:48 ** Calibration mode exit **
11:27:53  Unit type: Pushup unit 1 code: #0043 Failure: Manual Overload.
11:28:00  Unit type: Pushup unit 1 code: #0043 Failure: Manual Overload.
11:28:14  Unit type: Pushup unit 1 code: #0043 Failure: Manual Overload.
11:28:58  Unit type: Pushup unit 1 code: #0043 Failure: Manual Overload.
11:34:57 ** Calibration Mode **
11:35:06 ** Error messages manually removed **
11:35:06 ** Calibration Mode **
11:35:28 ** Calibration mode exit **
11:36:11  Unit type: Pushup unit 1 code: #0042 Failure: Negative Load in system of more than -40k
11:40:19  LoadPosition changed from 0 to 15 mm
11:40:19  Automatic Overload changed from 100 to 100 %
11:40:28 ** Error messages manually removed **
11:40:37  Unit type: Pushup unit 1 code: #0043 Failure: Manual Overload.
11:41:02  Unit type: Pushup unit 1 code: #0043 Failure: Manual Overload.
11:41:03  Unit type: Pushup unit 1 code: #0040 Failure: Not all Mini Jacks Nr 4 are In or Ou
11:41:07  Unit type: Pushup unit 1 code: #0040 Failure: Not all Mini Jacks Nr 4 are In or O
11:41:07  Unit type: Pushup unit 1 code: #0043 Failure: Manual Overload.
11:41:57  Unit type: Pushup unit 1 code: #0043 Failure: Manual Overload.
11:42:32  Unit type: Pushup unit 1 code: #0043 Failure: Manual Overload.
11:42:34  Unit type: Pushup unit 1 code: #0043 Failure: Manual Overload.
11:42:36  Unit type: Pushup unit 1 code: #0043 Failure: Manual Overload.
11:46:07  Automatic Overload changed from 100 to 100 %
11:46:10 ** Error messages manually removed **
11:53:55 @ End of session @

16:19:49 @ Start of new session @
16:19:53  Unit type: Smartbox Conn. code: #1001 Failure: Communication error. C
16:19:53  Unit type: Data bus E-stop code: #1002 Failure: Emergency circui
16:21:13 @ Start of new session @
16:21:15  Unit type: Smartbox Conn. code: #1001 Failure: Communicat
16:21:15  Unit type: Data bus E-stop code: #1002 Failure:
16:24:12 @ Start of new session @
16:24:14  Unit type: Smartbox Conn. code: #
16:24:14  Unit type: Data bus E-stop code
16:25:31 @ Start of new session @
16:25:33  Unit type: Smartbox Conn.
16:25:33  Unit type: Data bus E-
16:25:47  LockOpenLoad changed
16:25:47  DeltaPressure char
```

6.4.3.2 Logging of system data

Always when the main jacks are extending of retracting, data is logged with a periodicity of 20 sec. The data is written into a file. The following items are logged:

- Data of the whole system:
  - Action: Extend or Retract
  - Position: mm or Inches
  - Pressure: Bar or Psi
  - Load: kN or Short Tonne or Kips
  - Time off day
  - Actual Height
  - Number off barrels inside

- Data of the individual units:
  - Alias off the Unit
  - Stroke 1
  - Stroke 2
  - Stroke 3
  - Stroke 4
  - Unit Stroke
  - Load 1
  - Load 2
  - Load 3
  - Load 4
  - Expected Load
  - Unit Total Load

The logging file looks like:

```
mm,Bar,kN,Left back,-310,-310,-310,-310,-310,-316,-316,-316,-316,5000,-
1263,13:23:23,1300,0,
Right back,-310,-310,-311,-309,-310,-316,-316,-316,-316,2500,-1263,13:23:23,1300,0,
Unit3,-280,-280,-280,-280,-280,-316,-316,-316,-316,2500,-1263,13:23:23,1300,0,
Unit4,-173,-173,-173,-173,-173,-316,-316,-316,-316,2500,-1263,13:23:23,1300,0,
Left front,-310,-310,-310,-310,-310,-316,-316,-316,-316,2500,-1263,13:23:23,1300,0,
,,,,,,,,,,,13:23:23,1300,0,
,,,,,,,,,,,13:23:23,1300,0,
Unit8,-173,-173,-173,-173,-173,-316,-316,-316,-316,2500,-1263,13:23:23,1300,0,
,mm,Bar,kN,Left back,-310,-310,-310,-310,-310,-316,-316,-316,-316,5000,-
1263,13:23:43,1300,0,
Right back,-310,-310,-311,-309,-310,-316,-316,-316,-316,2500,-1263,13:23:43,1300,0,
Unit3,-280,-280,-280,-280,-280,-316,-316,-316,-316,2500,-1263,13:23:43,1300,0,
,,,,,,,,,,,13:23:43,1300,0,
Left front,-310,-310,-310,-310,-310,-316,-316,-316,-316,2500,-1263,13:23:43,1300,0,
,,,,,,,,,,,13:23:43,1300,0,
,,,,,,,,,,,13:23:43,1300,0,
Unit8,-173,-173,-173,-173,-173,-316,-316,-316,-316,2500,-1263,13:23:43,1300,0,
,mm,Bar,kN,Left back,-310,-310,-310,-310,-310,-316,-316,-316,-316,5000,-
1263,13:24:03,1300,0,
Right back,-310,-310,-311,-309,-310,-316,-316,-316,-316,2500,-1263,13:24:03,1300,0,
Unit3,-280,-280,-280,-280,-280,-316,-316,-316,-316,2500,-1263,13:24:03,1300,0,
```

For evaluation purposes, you may convert the contents of the file into excel format.

6.5 The trolleys

6.5.1 The JS125

Each trolley is provided with an electro cabinet. At the front of it is a control panel.
The control panel is intended for

- controlling the trolley locally for setup of the system
- showing errors and statuses of the trolley.

Attention
Local control is only intended for setting up the system, do not use it when traveling with load!

No	Type	Name	Description
1.	indicator	Power on	The power was switched on by button [11]
2.	switch	Control rem/loc	3. When in remote then the unit is controlled by the remote control. Buttons [4], [6] and [8] do not apply. 4. When in local, the unit can be controlled from the control panel for setting up of the system
3.	Indicator / button	Emergency active	Is lit when the emergency button [7] or the emergency has been pressed. Press the red off button [11] to recover from an emergency stop.
4.	switch	For/Rev	To travel the unit forward and reverse
5.	indicator	Motor failure	Is lit when a motor failure occurs.
6.	switch	Speed low/high	To set the speed. This in only applicable when the system is set to local by [2].
7.	button	Emergency stop	Press in case of emergency. The trolley will stop moving. When the trolley was in remote as set by [2] then other trolleys which are switched in remote are switched off as well. Turn the button to recover from an emergency stop.

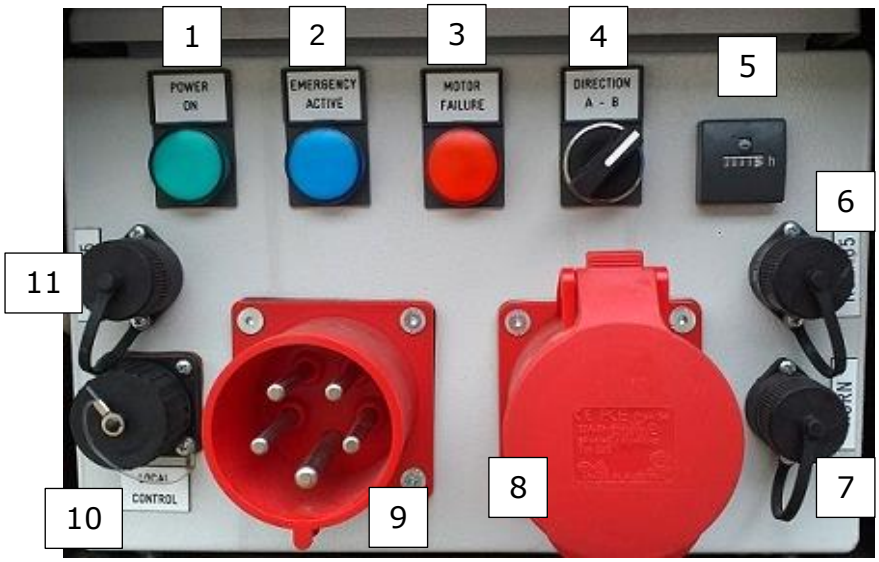
8.	switch	Direction	To set the positive travel direction of the unit. Can be used to mirror the movement of the trolley so they run in the same direction.
9. 10.	socket	RS485	Socket for the data cables, to daisy chain the trolleys and wire up the remote control.
11.	Indicator / button	On/off	To switch on the system to an operational state. If switched on, the indicator in between of the buttons is lit. 

6.5.2 The JS250

6.5.2.1 The control panel

Each trolley is provided with an electro cabinet. At the front of it is a control panel.
The control panel is intended for setup of the system and for showing errors and statuses.

Attention
Local control is only intended for setting up the system, do not use it when traveling with load!



No	Type	Name	Description
1	indicator	Power on	The power was switched on by button [11]
2	Indicator / button	Emergency active	Is lit when the emergency button [7] or the emergency has been pressed. Press the red off button [11] to recover from an emergency stop.
3	indicator	Motor failure	Is lit when a motor failure occurs.
4	switch	For/Rev	To set the positie travel direction.
5	indicator	Hour counter	The number of hours the system has been powered on.
6	socket	RS485	Data cable
7		Horn	to connect an acoutical alarm device

8			Power out
9			Power in
10		Local control	To connect the remote control dongle
11		RS485	Data cable

6.5.2.2 Local control

The operator can control one unit for setting up the system with the manual control unit. For manual control of one unit the device shown can be used.

NB
Note that the local control unit may only be used for positioning of one unit when setting up the machine. There may not be any load on the trolley when using the local control.

Caution
Never use the local control device if other components are connected to the trolley.

Hazard
Any component that is connected to the trolley will be forced into the same movement as the trolley. This can lead to unexpected movement of these components and injure you seriously

6.5.3 The remote control console

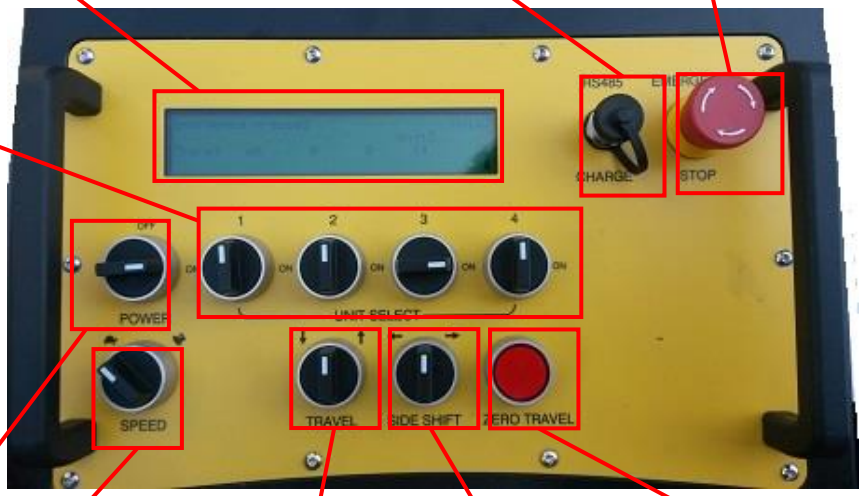
The trolleys are remotely controllable by the remote control console.

The controls

1 Displays the travelled distance

2 Connection for
- fixed wiring (RS845)
- to charge the battery

3 Emergency stop. When pressed, all trolleys which are in remote control are switched off. (Use the control panels of the trolleys to recover.)



9 To select the trolleys to be controlled

(De-activation may be useful for individual travelling during installation.)

8 To switch the remote control console on and off

7 -unused-

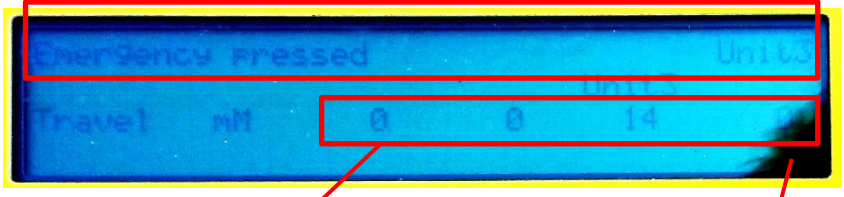
6 To travel the selected trolleys

5 -unused-

4 To reset the measeurement counter of all trolleys.

The display:

1 Errors and warnings



2 Travelled distances per trolley

3 battery status

7 Execute an operation

7.1 Risks and Warnings

Address the following subjects:

NB

- Proper handling of the system is essential for safety.
- Observe the system while operating.
- Make sure the working area is fenced off.

Hazard

- **Improper use** of the machine may result in accidents causing damage not only to the machine itself, but also to objects and goods in its vicinity or mounted to the machine, as well as injuries to people in the immediate area, and possibly even death.
- Failure to adhere to the **checklists** may result in serious injury to the user, possibly even death.
- Even if all safety measures are taken and the system is operated correctly, there will remain a **residual risk** of tumbling of the system.
- Although the system monitors that the system stays level, it cannot not detect failure of for example the support/ground at a specific location. This might lead to non-level lifting of the load. To detect this a theodolite should be used to monitor the load.

Caution

- Failure to **prepare correctly** for a lifting operation may result in total loss of machine stability during use.
- When lifting, always assume a **worst-case scenario**. The wind can be unpredictable, quickly changing speed and direction. Do not take any chances: strong wind means 'no go'!

Attention

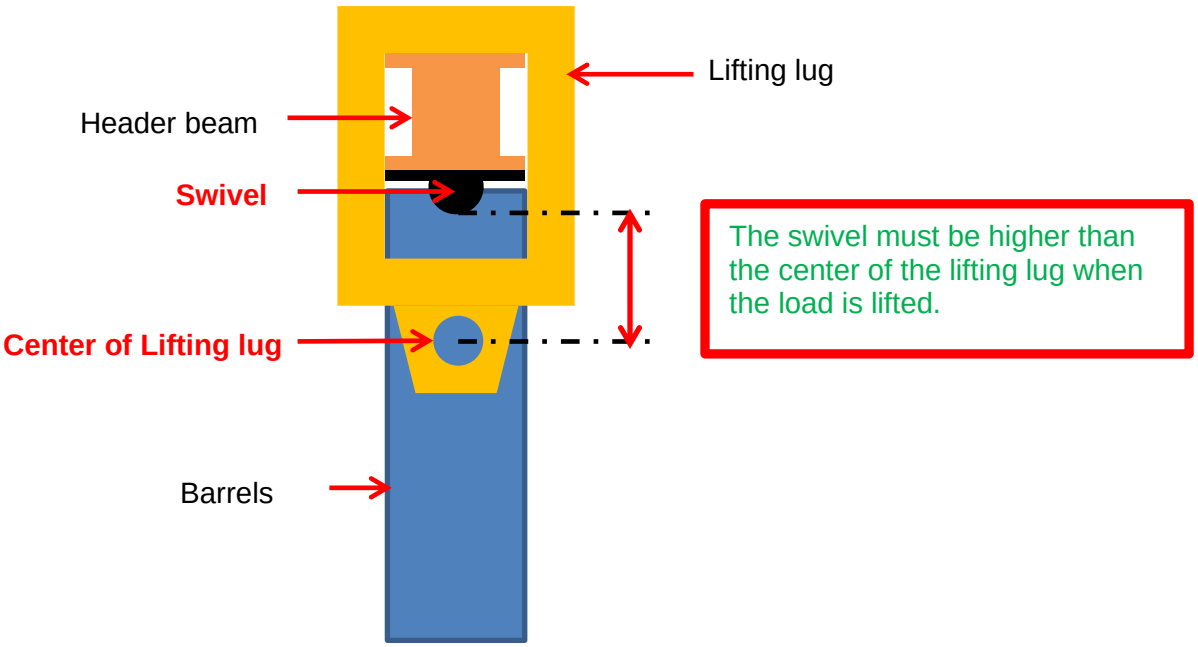
- It is of the utmost importance to **read this manual** carefully before setting up the machine..
- Adhere to the **checklists** during all work activities: during preparation for the lifting operation, system construction, and for lifting the load.
- A unit is only part of the central emergency stop system if the control selector switch is in the **remote position**.
- Ensure that the load avoids contact with a gantry leg or any obstructions while lifting, side shifting, or traveling.
- Ensure that the gantry legs, header beams, and other components of the gantry system avoid contact with any obstructions while traveling.
- The operator should have an unobstructed view of the system and load during operation of the system. If this is not possible, a signalperson shall be used with an effective means of communication to provide directions to the operator.
- Communication among personnel involved in the operation shall be maintained continuously during all movement of the load. If at any time communication is disrupted, the operator shall stop all movements until communication is restored.
- Signals to the operator should be in accordance with the standards

prescribed in section 1.9 “Hand signals”. If special signals are required, they shall be agreed upon by the operator and support personnel prior to the lifting operation. Signals shall be discernible or audible at all times. No action shall be taken unless signs are clearly understood.

- The operator shall obey any stop signal.

- No unauthorized people should be close to the system during operation
- Follow the warnings on the stickers without question
- The load shall be fixed to the swivels

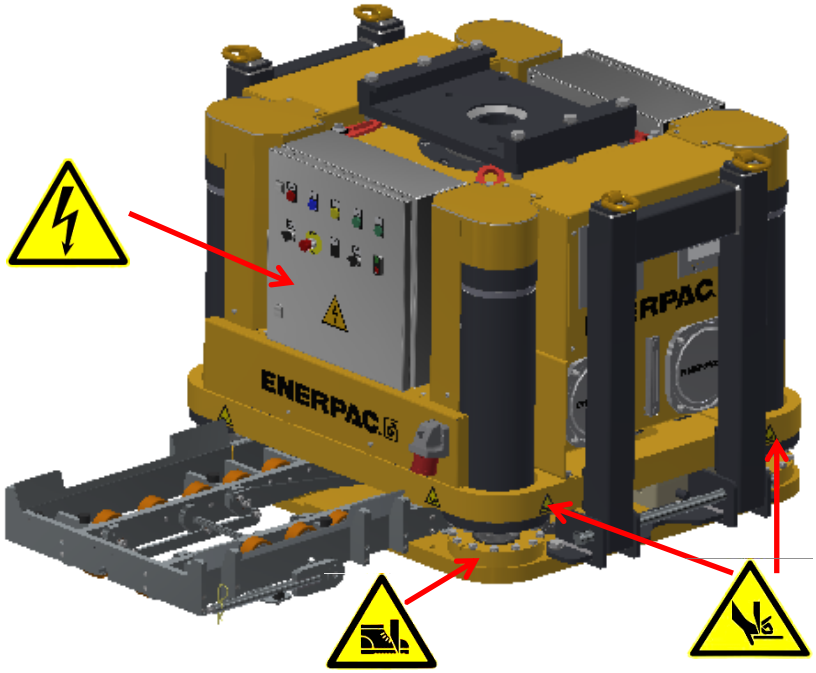
Hazard
Despite all inherent safe design measures, safeguarding and complementary protective measures, there will always be the **residual risk** of tumbling of the system.



7.2 Warning symbols

Warning symbols are put on the system at the indicated spots:

- Unit:



- JS125 trolley:

- JS250 trolley

The meanings of the labels are explained in section 2.3 “Symbols applied to the System”.

7.3 Lift the load

To execute a lifting operation proceed as follows.

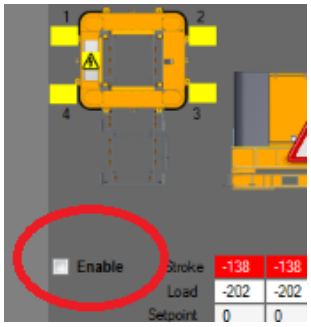
Reference is made to

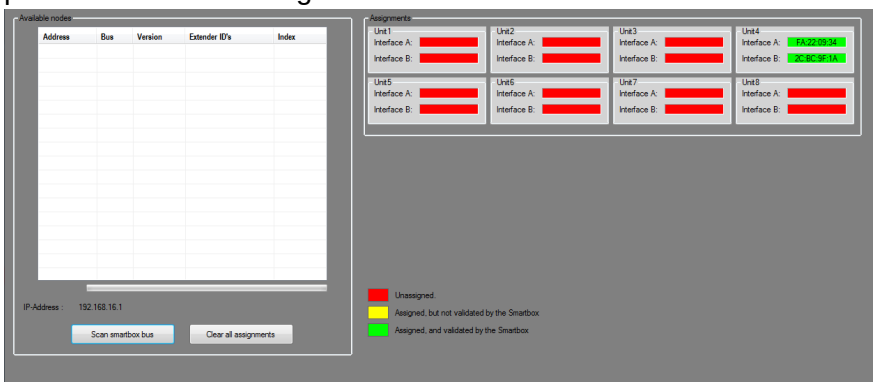
- Section 6.2 “The control panel on the electro cabinet” abbreviated with “CP”
- Section 6.4 "The human machine interface (HMI) on the laptop “

Pre-condition is that the load was already positioned upon the system.

7.3.1 Initiating

1. Make sure the checklists
   A “Checklist for planning” and
   B “Checklist for installing the system”
   are completed and signed off
2. Complete checklist D “Recording a lifting operation” during the operation.
3. Start the system:
   1. Switch the system on; use the main switch CP[11] and the on/off button CP[10]
   2. Verify that the Power on indicator CP[5] and the Motor running indicator [4] on the electro cabinet are lit
   3. Verify that the Motor failure indicator CP[1] is dimmed
   4. Set the Control Rem/loc switch CP[9] to Rem (= remote)
   5. Switch the laptop on and start the app for the push up system
   6. Use the Communication option in the menu bar [HMI] to verify that the communication is fine
4. Click Manual on the main screen HMI
5. Enable the units you want to use:

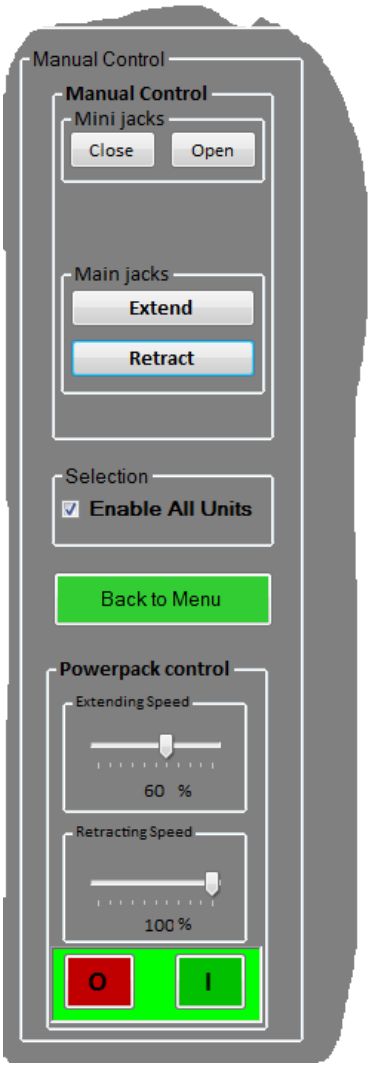


6. Make sure the hardware assignments are ok. The applicable units should be green. If not, perform hardware assignments.
7. 

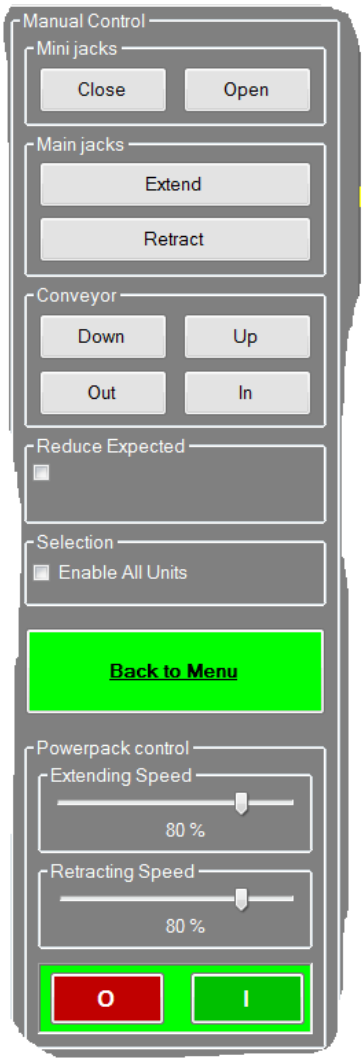
8. Configure the oil circuits of the system if you want to deviate from the default.
   Use the Settings option of the Menu bar [HMI]

7.3.2 Manual operation

Without automatic insert table



With automatic insert table



1. Perform initiating; see par 7.3.1 “Initiating”.
2. Click Manual on the main screen
3. Set the Extending speed and the Retrackting speed of the HPU.
   For critical loads or difficult situations choose low values.
4. Click “enable all units”
   On the main screen the units turn light grey.
5. Set the Units in Remote
6. Switch the HPU on; use the button on the HMI.
7. Use the buttons Close and Open to control the mini-jacks.
   Use the buttons Down, Up, Out and In to control the automatic insert tabel (conveyor).
   Use the buttons Extend and Retract to control the main jacks
   Use the button Set Expected Load (no visible in the picture above).

Hold the load for 30 seconds after each movement to verify that the load in the cylinder and the stroke of the cylinders does not change. Significant changes of cylinder load and/or stroke may indicate a leaking (piston) seal. Lower the load such that the load is resting on the barrel resting

point area, such that the cylinders are not loaded. Do not continue the operation until the cause of the deviation is found and resolved.

Hazard
Significant changes in cylinder load and/or stroke may indicate a leaking seal. Stop the execution until the cause is found and resolved.

7.3.2.1 Reduce expected load functionality

The reduce expected load functionality should be used when the load that needs to be lifted is not completely level at the start of the lift or when putting the load down. The functionality is explained below for starting to lift a load that is not level and lowering a load that is not supported by a level support. Note that for this functionality the hysteresis between the units should be switched off.

Hazard
When the hysteresis is switched off the program does not keep the stroke of the units within a specified limit. When the load is not properly monitored with for example theodolites, this might lead to instability and causes potential **hazards to personnel** and **damage to the system**.

The stroke of the units are normally controlled and kept within hysteresis. This would mean that one of the units starts to lift the load while the other units are not yet in contact. The unit that is in contact will exert the maximum force on the load while the load is not yet supported at the other locations. This might lead to undesired effects.

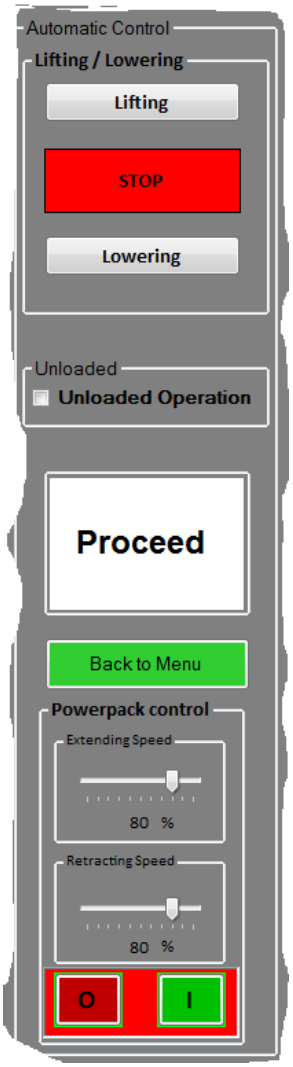
1. With the reduce expected load functionality the maximum force applied by the system is limited to the set percentage, 25% for example.
2. When this percentage is reached the system will stop and the unit that has reached the previously defined percentage can be disabled.
3. The other units can now be extended till the next unit reaches the load.
4. Steps 1 till 3 should be repeated till all units are in contact with the load.
5. The next step is to increase the expected load to 50% and repeat steps 1 till 4.
6. Further increase the expected load to 75% and 100% while repeating steps 1 till 5.

When lowering a load on a support that is not level, the steps are more or less reversed as described below:

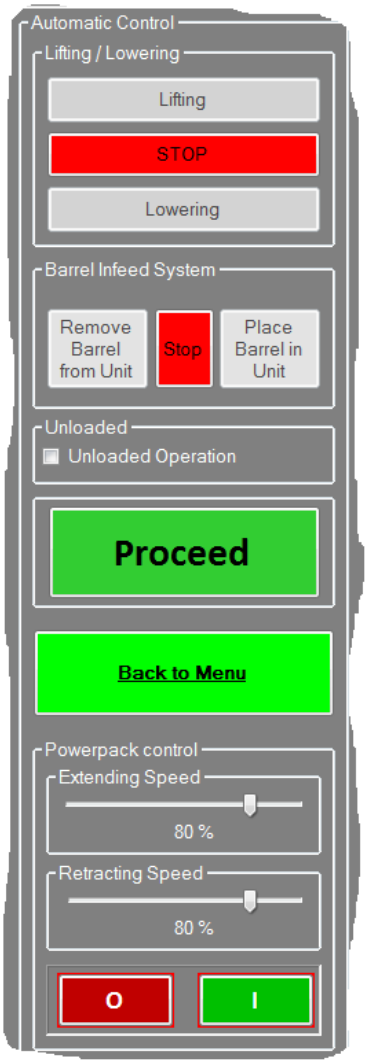
1. With the reduce expected load functionality the force applied by the system is limited to the set minimum percentage, 75% for example.
2. When this percentage is reached the system will stop and the unit that has reached this minimum level can be disabled.
3. The other units can now be retracted till the next unit reaches the minimum percentage.
4. Steps 1 till 3 should be repeated till all units are at the minimum percentage.
5. The next step is to decrease the expected load to 50% and repeat steps 1 till 4.
6. Further decrease the expected load to 25% and 0% while repeating steps 1 till 5.

7.3.3 Automatic operation

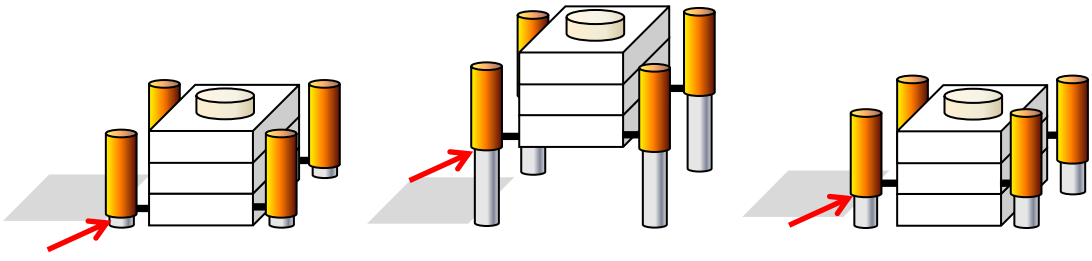
Without automatic insert table



With automatic insert table



The following positions are taken by the system:



load position top position lock-open position

1. Perform initiating; see par 7.3.1 “Initiating”.
2. Click Automatic on the main screen
3. Set the Extending speed and the Retrackting speed of the HPU
4. Eventually click Unloaded Operation if you do not want to lift a real load
5. Switch the HPU on
6. If you’re going to **lift** a load:
    a) Starting point of the cycles depends situation of the push-up, assuming all push-ups in load position, mini locks extended (barrel fetched)
    b) Click lifting
    c) Press “Next step” on each unit”. Then press the proceed button on the laptop.
    d) System raises to top position
    When reached, the next step indicators are lit
    e) Insert new barrel (manually or automatically)
    f) Push next step on each unit
    g) Click proceed on laptop
    h) System retracts to lock-open
    i) System retracts mini jacks
    j) System retracts main jacks to load position
    k) System extends mini jacks
    l) Jump to a

7. If you’re going to **lower** a load:
    a) Starting point of the cycles depends situation of the push-up, assuming all push-ups in load position, mini locks retracted
    b) Click lowering
    c) Press Next step on each unit
    d) Click proceed on the laptop
    e) System raises to lock-open
    f) System extends mini jacks
    g) System raises the main jacks to top position
    h) When reached, the next step indicator is lit
    i) Remove the barrel (manually or automatically)
    j) Press Next step on each unit
    k) Click Proceed button on the laptop
    l) System lowers to load position
    m) System retracts mini jacks
    n) Jump to a

Hold the load for 30 seconds after each movement to verify that the load in the cylinder and the stroke of the cylinders does not change. Significant changes of cylinder load and/or stroke may indicate a leaking (piston) seal. Lower the load such that the load is resting on the barrel resting point area, such that the cylinders are not loaded. Do not continue the operation until the cause of the deviation is found and resolved.

Hazard
Significant changes in cylinder load and/or stroke may indicate a leaking seal. Stop the execution until the cause is found and resolved.

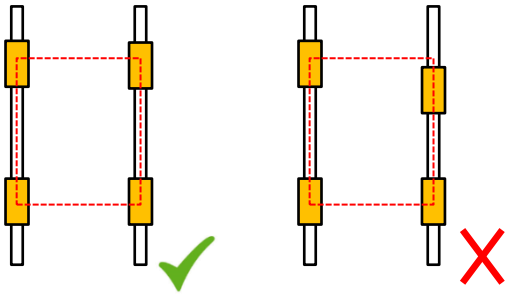
Hazard
For the JS500, the main cylinders may not be extended when only the End Barrel is in the system and is not locked. When failing to follow this requirement the **system will be damaged** and causes potential **hazards to personnel.**

7.4 Move the load horizontally with the trolley

To move the load in horizontal direction, apply the capability of the trolleys.

Proceed as follows:

1.	Make sure the units are passive  **Hazard** travelling while the units are moving up or down may endanger the stability of the system.	
2.	Switch all trolleys to remote. (valid for the JS125)	
3.	Switch the remote control console on. • Verify the battery status as shown in the display. • The blue lamp will turn off	
4.	Start all the trolleys: (valid for the JS125) • Press the green start button. *The green indicator will light up.*	
5.	Select all trolleys on the remote control console	
6.	As long the remote is switched on, the travel counts will be stored and displayed. It is possible to reset all counters to zero by means of the “zero travel” button.	

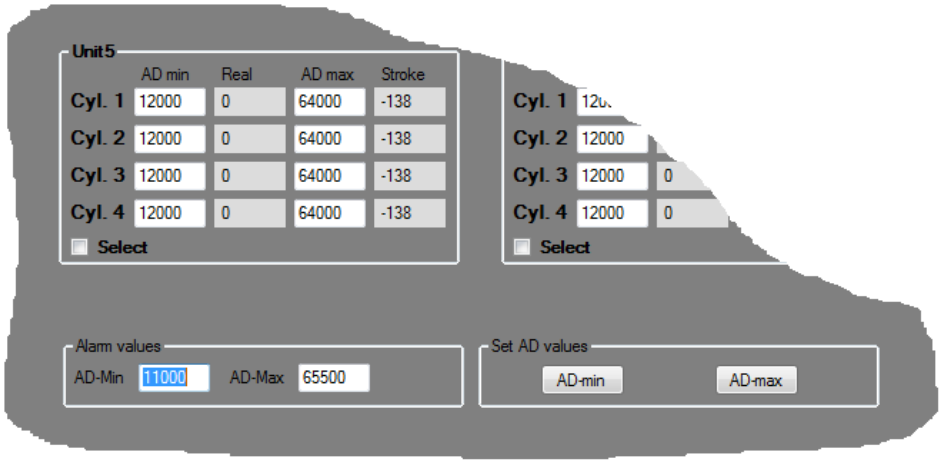
7.	Travel all trolleys synchronously. Monitor the travelled distances shown in the display. Also measure the actual distance.	
8.	While travelling make sure the trolleys stay equally in distance.  **Hazard** The stability of the system is in danger when the trolleys get out of sync.	

NB
Do not shut off the remote control during travelling! The travel distance of each trolley will be set to zero when you start up the remote control again. All deviations between the trolleys are lost and must be checked and adapted as within the start position.

NB
Check if the data and power cables will not stick behind something and will be damaged.

7.5 Calibration

Calibration is executed per unit.
Reference is made to par 6.4.2.5 “Settings / Calibration settings”.



To **calibrate** the main jacks of a specific unit proceed as follows:

1. Go to the main menu
2. Click Manual
   The system gets into the manual mode
3. Click Calibration, then click Log On
   A password is required to enter the mode
   You’re logged off automatically when you leave calibration.
4. Click enable
5. Click Settings / Calibration settings on the menu bar
   The calibration window as depicted above is shown
6. Select the unit that has to be calibrated with the Select checkbox

Hazard
For the JS500, the calibration should be executed without the End Barrel in the system or with the End Barrel locked by the mini Jacks. When failing to follow this requirement the **system will be damaged** and causes potential **hazards to personnel.**

Calibrate the minimum value:

7. Press Retract until the main jacks of the unit are fully retracted
8. Click AD-min inside the Set AD values group
9. Click File in the menu bar; then click save and exit

Calibrate the maximum value:

10. Press Extend until the main jacks of the unit are fully extended
11. Click AD-max inside the Set AD values group
12. Click File in the menu bar; then click save and exit

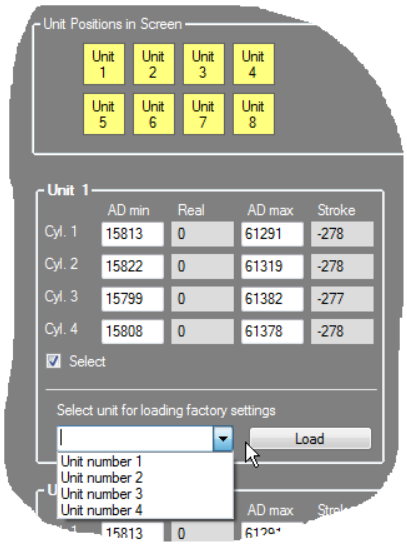
You may **enter** the minimum and maximum values if you know them, probably from an earlier calibration. Then there is no need to extend and retract the cylinders.
Proceed as follows:

1. Select a unit
2. Add the values in the fields AD Min and AD Max

3. Click AD-min inside the Set AD values group
4. Click AD-max inside the Set AD values group
5. Click File in the menu bar; then click save and exit

Alternatively, for the JS500, it is possible to use the factory settings of a specific unit. Then there is no need to extend and retract the cylinders.

1. Select a unit
2. Use the drop down menu to select the correct unit number for the unit position in the setup used for a specific job
3. Click File in the menu bar; then click save and exit



To enter the values for which you want an **alarm** raised, proceed as follows:

1. Select a unit
2. Enter the minimal and maximum values in the field Alarm values
3. Click File in the menu bar; then click save and exit

NB
Calibration is always required when a stroke sensor has been replaced.

This function has to be executed by a specialist.

Caution
No safety precautions are active during calibration.

During calibration the movements of the main jacks are not synchronised; be aware that the jacks won't extend / retract equally.

Hazard
For the JS500, the calibration should be executed without the End Barrel in the system or with the End Barrel locked by the mini Jacks. When failing to follow this requirement the **system will be damaged** and causes potential **hazards to personnel.**

8 Solve problems

This chapter describes localization and solving of problems.

- A main problem localization procedure is given.
- A list of possible problems is given, together with causes and possible solutions.

8.1 Main problem localization procedure

In case of anomalies proceed as follows to solve the problem:

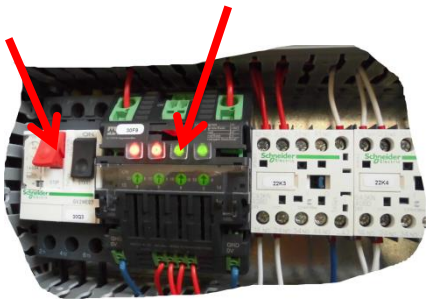
1. Was any Emergency stop button pressed?
2. Is the communication between laptop and the system broken?
   Use Communication / Connect on the HMI to re-establish the connection.
3. Is any error indicator lit on one of the HPU's?
4. Is any error message visible on the HMI of the laptop?
5. Are there are mechanical blockades?
6. Is any hydraulic leakage is visible?
7. Are any fuses tripped?
   Check the fuses inside the electro cabinets.
8. Call Enerpac of you need assistance.

8.2 List of problems and solutions

The table below lists a number of errors and problems which may appear during the use of the system, together with possible causes and solutions.

8.2.1 Main problems

Symptom	Possible cause	What to do…
Main problems		
A unit does not move while the others do	The unit is not selected	Select the unit on the HMI

Symptom	Possible cause	What to do…
Loss of functionality	Fuses tripped	Check the fuses inside the Electro cabinet Cabinet fuse:  Motor fuse: 

8.2.2 Error reports of the units

Ident	Error description	Possible solution
0001	Communication error. Check data connection and reconnect	Overhaul system firewall settings if not able to connect
0002	Stroke measurement below minimum. Broken wire?	Check cables, connectors and mechanical attachment
0003	Stroke measurement exceeds maximum. Shortcut?	
0004	Load pick up error	Adjust expected load. Check preload stroke and mini-jack state
0005	Load drop off error	Adjust expected load. Check preload stroke
0006	Top anchor open timeout	Adjust timeout value and check top anchor hydraulics and sensors
0007	Top anchor close timeout	
0008	Bottom anchor open timeout	Adjust timeout value and check bottom anchor hydraulics and sensors
0009	Bottom anchor Close timeout	
0010	Unit design load overload	Reduce load
0011	Stroke measurement exceeds minimum	Stroke measurement exceeds minimum. Shortcut?
0012	Bottom pressure reading exceeds maximum. Shortcut?	Stroke measurement exceeds maximum. Shortcut?
0013	Rod pressure reading below minimum. Broken wire?	Rod pressure reading exceeds minimum. Shortcut?
0014	Rod pressure reading exceeds maximum. Shortcut?	Rod pressure reading exceeds maximum. Shortcut?
0015	Top anchor closed during calibration process"	Open top anchors in manual mode
0016	Expected load overload	Adjust expected load settings
0017	Emergency circuit active. Press blue button on smartbox	Check hardware assignment. RS485 dongles in place?
0018	Local operation active	Remote control disabled
0019	Powerpack failure	Stop all engines, check powerpack instruments
0020	Emergency stop activated on Unit	Check powerpack and reset emergency stop on Unit
0021	Preload pick-up error	Check expected load and preload stroke setting
0022	Both anchos open	Close at least one anchor
0023	Mini jack status fault	Make sure all mini jacks status are equal
0024	Unit not assigned	Open harware assign page and assign the correct hardware to the unit
0025	Hydraulic oil Level Low	Refill hydraulic oil
0026	Hydraulic oil level too low	Do not use system. Refill hydraulic oil
0027	Oil temperature too high	Do not use system. Check powerpack for air flow obstructions
0028	Delta stroke fault	Check hoses and connections for leakage
0029	Delta load fault	Check hoses and connections for leakage, check if there are no obstructions
0030	Safety switch active	Check calibration and setting of the main jack, do not continu if problem isn't resolved
0031	Bottompressure exceeds maximum	Check oil pressure and pressuresensor
0032	Rodpressure exceeds maximum	Check oil pressure and pressuresensor
0033	Rodpressure during extending exceeds maximum	Check connection of the oil hoses
0034	Mini jack retraction fault	Check hydraulic hoses and sensor wiring
0035	Mini jack extension fault	
0038	Strokesensor Fault Nr 1.	Stroke sensor is more then 10mm difference
0039	Strokesensor Fault Nr 2.	Stroke sensor is more then 10mm difference
0040	Strokesensor Fault Nr 3.	Stroke sensor is more then 10mm difference
0041	Strokesensor Fault Nr 4.	Stroke sensor is more then 10mm difference
0042	More than 2 safety switches activated	Check Cylinder strokes

0043	Not all Mini Jacks Nr 1 are In or Out"	Check Positions, Proximity switches and cables from Mini Jack Nr 1
0044	Not all Mini Jacks Nr 2 are In or Out"	Check Positions, Proximity switches and cables from Mini Jack Nr 2"
0045	Not all Mini Jacks Nr 3 are In or Out"	Check Positions, Proximity switches and cables from Mini Jack Nr 3
0046	Not all Mini Jacks Nr 4 are In or Out"	Check Positions, Proximity switches and cables from Mini Jack Nr 4
0047	Cilinder 1 Overloaded, Max = 1840kN	Check Load and / or Pressure sensors Cilinder 1
0048	Cilinder 2 Overloaded, Max = 1840kN	Check Load and / or Pressure sensors Cilinder 2
0049	Cilinder 3 Overloaded, Max = 1840kN	Check Load and / or Pressure sensors Cilinder 3
0050	Cilinder 4 Overloaded, Max = 1840kN"	Check Load and / or Pressure sensors Cilinder 4
0051	Negative Load in system of more than -40kN"	Check Positions and Mini Jacks.
0052	Manual Overload	Check Load and Manual Overload setting or Expected Load Setting Manual overload is Max 120% Expected Load
0053	Automatic Overload	Check Load and Automatic Overload setting or Expected Load Setting Automaticl overload is Max 110% Expected Load
0054	Oil filter clogged	Check oil filter for dirt and/or replace filter
0055	File Calibrations_Settings.Dat not found	Check calibration
0056	File Settings_Settings.Dat not found	Check system settings

Hazard
Performing repairs on the system may cause dangerous effects when not executed by well-skilled personnel.

NB
The tables are intended as a first aid kit. Contact Enerpac if you need assistance.

9 Storage

9.1 System

For storage of the System, there is difference between temporary storage and storage for a long period:

- Short term storage:
  Cover the units with a tarpaulin in order keep electrical and other moisture-sensitive components dry, especially when stored in open air.
- Long term storage:
  Enerpac recommends a dry and closed space.

NB
During storage in the open air, cover the units with a tarpaulin in order keep electrical and other moisture-sensitive components dry.
The tarpaulin is not included in the delivery, but can be added as an option.

9.2 Smartbox and laptop

- Handle the laptop according it's specifications.
- Store the Smartbox on a dry and clean place.

10 Maintenance

Keep the machine in good condition to obtain optimum performance from your machine and to guarantee the safety of the users.

This chapter describes

- the maintenance **jobs** to be carried out
- the required **skills** for the maintenance jobs
- the **time-intervals** the jobs have to be performed in.
  The time intervals are given for regular frequency of use and normal severity of service conditions.
  The time intervals have to be taken proportionally shorter when
  - the system is applied more often than regular, which is once per month
  - the system is used in exceptional service conditions, like wet or salty environments
  - the system is applied to the limits of its capacity
  - the system is applied for special service. The time interval has to be discussed with Enerpac.
- The time intervals may be varied based on experience gained on the service life of systems used in similar circumstances.
- If the system was idle for at least 6 months, all inspections as listed in the following section with a prescribed frequency of at least 6 months have to be performed.
- Prior to use, all new, altered, modified, or repaired hydraulic gantry systems shall be inspected to verify compliance with the applicable provisions of this section. Written records are not required.

NB

- Only perform maintenance on the units if they are **not under load**
- Only perform maintenance on the units if the **header beams** have been removed.
- Any maintenance procedures not detailed in this section can only be performed by or in **consultation** with Enerpac.
- For use of **spare parts** reference is made to section 1.7 “Modifications”.

NB

- If the system has been idle for more than 12 months than it shall be inspected prior to use completely.

For health reasons, we advise to use lifting tools in case the weight of a component which must be replaced is more than 23 kg.

Use the following grease for maintenance purposes:
Kroon oil Labora grease.

Remark:
Check and adhere the maintenance instructions within the sub-supplier manuals of applied components. See paragraph 1.3Referenced documents and the delivered Enerpac handbook.

10.1 Rules to be observed for maintenance

Due to the regulations as stated in Ref 6 “ASME B30.1-2015” observe the following rules for maintenance:

1. If the system was **idle** for at least 12 months, all inspections as listed in the following section with a prescribed frequency of at least 12 months have to be performed.
2. Prior to use, all **new, altered, modified, or repaired** hydraulic components shall be inspected to verify compliance with the applicable provisions of this section. Written records are not required.
3. Only perform maintenance if the system is **not under load**.
4. Only perform maintenance if all **lifting beams** have been removed.
5. Any maintenance procedures **not detailed** in this section can only be performed by or in consultation with Enerpac.
6. For use of **spare parts** reference is made to section 1.7 “Modifications”.
7. Make certain that you are **familiar** with the powerpack and its use. Read the user manual carefully and in full and request instructions from the operator where needed.
8. Only perform maintenance work if you are **qualified** do to so. Unauthorized personnel may not open the Power pack.
9. Follow all instructions given on the **warning symbols** on the powerpack.
10. Follow all **safety instructions** in this manual.
11. When working with **flammable liquids**, take the applicable safety regulations into account.
12. Only perform maintenance work after the powerpack has been **shut down**. Before starting maintenance, make sure the powerpack is secured against unauthorized use. Put up warning signs.
13. Make certain that the hydraulic system is **not under pressure**. Use the manometer.
14. If maintenance has to be executed while the system is **running** then a person has to be present to supervise, and to stop the machine if needed. This also applies for work on the electrical system if the system needs to be powered.
15. Do not **spill** any oil and similar fluids. Be mindful of the environment and the costs of cleaning up.
16. Make certain that you apply personal protection equipment (**PPE**) and take any other safety precautions required by the working conditions.
17. Make sure that you know the location of **fire alarms**, firefighting facilities and fire extinguishers.
18. Only use suitable work **equipment**. Prevent damage due to use of unsuitable equipment.
19. Without the express consent of the manufacturer, you are not allowed to make any **changes**, additions or adjustments to the Powerpack which affect the safety of the machine. This also applies to installation and adjustment of safety devices, covers and valves and to welding work on load-bearing parts.
20. Make certain that the powerpack is made **ready for operation** after the maintenance work was been completed. Inform the operator.

10.2 Responsibilities

Due to the regulations as stated in Ref 6 “ASME B30.1-2015” observe the following rules for responsibilities.

The maintenance tables indicate for each maintenance jobs whether it has to be performed either by the owner or by the manufacturer.

Contact the manufacturer for the following maintenance work:

- Adjusting the pressure in the hydraulic system.
- Adjusting and repairing hydraulic pumps and setting up hydraulic pumps.
- Adjusting and repairing control valves for all main functions.
- Adjusting the electrical system and repairs to the control system.
- Replacing parts.

In these cases the maintenance work for the owner is limited to identification of a fault.

10.3 General inspections

10.3.1 Bolts

Check if all bolts are tightened.
A torque setting list is available within appendix F.

10.3.2 Visual check of all welding

Check all welding visually on irregularities.

10.3.3 Check for irregularities

Check the System for irregularities visually.

10.3.4 Check for corrosion

Check the System for corrosion visually. Check if steel components like bolts are corroded or damaged. Replace those parts.

10.3.5 Inspect the readability of the warning signs

Clean the warning sign if dirty. Replace the warning signs if damaged or no longer present.
The position of the warning signs are mentioned in section

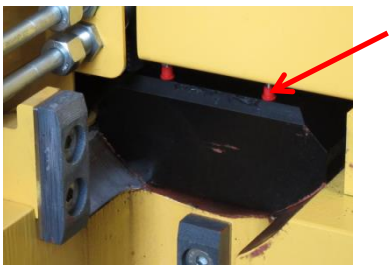
10.4 Mechanics

Before layup of the System, lubricate/ grease components such as bearings, connecting pins and bolts to prevent corrosion.

Maintenance jobs to be executed:

Subject	Action	Person O (owner) EE (Enerpac expert)	First 40 hours	8 hours Daily	40 hours Weekly	Each 500 hours Each year	2000 hours Every 2 years	10000 hours Every 10 year	Remarks
1. Main									
1.1. Mechanical frame	Clean the frame	**O**		x					
	Maintain the paint	**O**			x				
1.2. Main jacks	Grease the cylinders against rust.	**O**		x					
1.3. Insertion system	Oil the moving parts	**O**			x				
1.4. Guiding pads	Check on damage and excessive wear	**O**		x					See [2] below
1.5. Mini jacks	Grease the mini-jacks	**O**			x				See [1] below

Some of the maintenance jobs need extra directions; those directions are given in the table below.

1.	Grease the mini-jacks with copper grease or equivalent.	
2.	Check on damage and excessive wear	

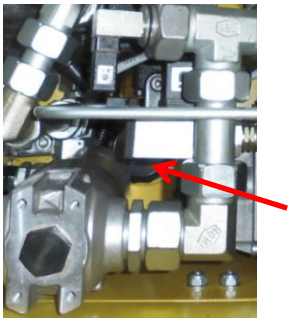
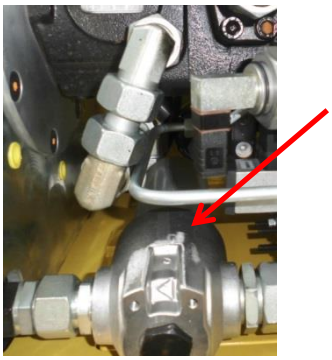
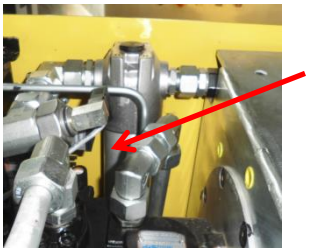
10.5 Hydraulics

Maintenance jobs to be executed:

Subject	Action	Person O (Owner) EE (Enerpac expert)	First 40 hours	8 hours Daily	40 hours Weekly	500 hours yearly	2000 hours 2 years	10000 hours 10 years	Remarks
1. Hydraulic pump, tank and cooler									
1.1. Pump	Check on oil leakage, damages and paint work	O/EE		x					
	Check if the bolts are still tightened	O/EE	x			x			
1.2. Hydraulic tank	Check on oil leakage, damages and paint work	O/EE		x					
	Check if the bolts are still tightened	O/EE	x			x			
	Replace all seals	EE						x	
	Replace the level gauges	EE						x	
	Drain the tank (water and sludge)	EE					x		
1.3. Valves	Check on oil leakage and damages	O/EE		x					
	Check if the bolts are still tightened	O/EE	x			x			
	Replace all seals	EE						x	
	Check all valve settings	O/EE					x		
1.4. Manifolds	Check on oil leakage and damages	O/EE		x					
	Check if the bolts are still tightened	O/EE				x			
1.5. Oil	Take an oil sample to analyze	EE					x		Change oil if necessary
	Replace the hydraulic oil	EE						x	See [2] below
	Check the oil level	O/EE		x					See [1] below
1.6. Hydraulic filter	Replace the filter element	EE				x		x	And replace if indicated See [3] below
1.7. seals	Replace the seals of the filter housing	EE						x	
1.8. Breathers	Replace the breather	EE				x			
1.9. Bellhousing	Check on damages	O/EE					x		
	Check if the bolts are still tightened	O/EE	x					x	
	Replace motor pump coupling	EE						x	
1.10. Cooler	Check on oil leakage and damages	O/EE		x					
	Check if the bolts are still tightened	O/EE	x			x			
	Clean the cooler	O/EE				x			
	Measure pressure difference “delta p” at the cooler	EE						x	

2. Hydraulic connections									
2.1. Pipes, hoses and brackets	Check on oil leakage and damages	O/EE		x					
	Check if the couplings are tightened well.	O/EE	x			x			
	Replace all seals within the piping (Waldform)	EE						x	
	Replace all hoses	EE					x		
	Replace all plastic brackets	EE					x		
2.2. Couplings and quick-screw couplings	Check on oil leakage and damages	O/EE		x					
	Check if the couplings are tightened well.	O/EE		x		x			
	Replace all seals of the couplings	EE						x	
	Replace fast couplings and screw couplings	EE					x		
2.3. Gauges, measurement sensors	Check on damages	O/EE		x					
	Check the tightening bolts, nuts and components	O/EE		x		x			
	Replace all seals	EE						x	
	Replace all gauges	EE						x	
3. Housing									
3.1. Common	Check on damages and paint	O/EE		x					
	Check if the bolts are still tightened	O/EE	x			x			
	Replace all seals, door seals and inspection hatches	EE						x	
	Grease the hinges and locks	O/EE				x			
	Replace engine feet	EE						x	
4. Cylinders									
4.1. Common	Check on leakages	O/EE		x					
	Check if the bolts are still tightened	O/EE	x			x			
	Replace all seals	EE						x	
	Grease the bearings	EE			x				

Some of the maintenance jobs need extra directions; those directions are given in the table below.

	Check the level of the hydraulic oil.	
1.	Top up the oil or replace it	 *(top view)*
2.	Replace the oil filter	  *(topview)*

10.6 Electrics

Work on the devices must be performed by a competent, qualified electrician or by trained personnel under the direct supervision of a qualified electrician, in compliance with all applicable rules and regulations (such as the Dutch standard NEN 3140: ‘Operation of electrical installations - Low voltage’ and/or international standard NEN-EN 50110-1: ‘Operation of electrical installations’).

Switch off the power before inspection, maintenance or repair of SYSTEM. Make sure that the relevant parts are no longer receiving power. If possible, make an earth connection. Insulate any adjacent components that are still receiving power.

Check and inspect the electrical system of the SYSTEM at regular intervals. Problems, such as loose connections, damaged or stuck wiring, must be resolved immediately. Only use original fuses and circuit breakers with the correct current value.

 **HAZARD**	**Hazard** Electricity is dangerous to people. Only perform maintenance work after the HPU has been shut down. Before beginning maintenance work, always make certain that the HPU is secured against unauthorized use.

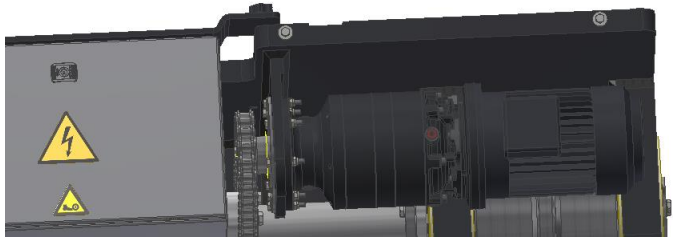
Maintenance jobs to be executed:

Subject	Action	Person O (owner) EE (Enerpac expert)	First 40 hours	8 hours Daily	40 hours Weekly	Each 500 hours Each year	2000 hours Every 2 years	10000 hours Every 10 year	Remarks
1. Electro motor									
1.1. General	Check on damages	O/EE		x					
	Make ventilation system free from dust	O/EE	x			x			See [1] and [2] below
2. Cables and connectors									
2.1. General	Check on damages	O/EE		x					
3. Devices									
3.1. SCC Smartbox	Remove dust								
3.2. Laptop	Replace the battery	EE					x		

Some of the maintenance jobs need extra directions; those directions are given in the table below.

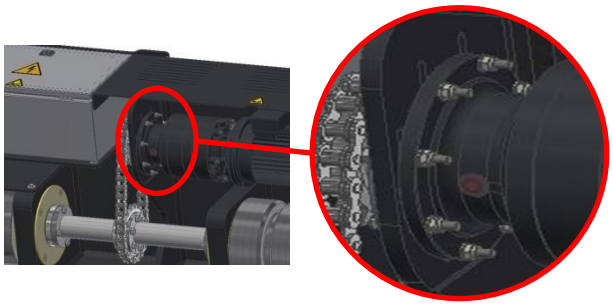
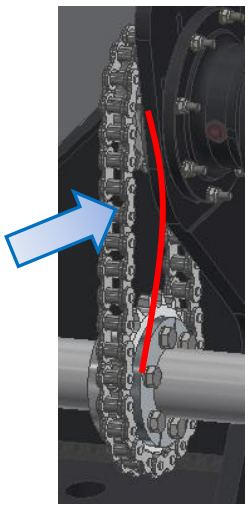
1.	Clean the ventilation system of the motor	
2.	Clean the radiator of the oil cooler	

10.7 Trolley JS125

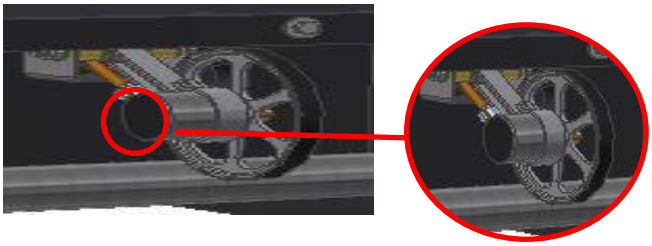
Subject	Action	Person O (owner) EE (Enerpac expert)	First 40 hours	8 hours Daily	40 hours Weekly	Each 500 hours Each year	2000 hours Every 2 years	10000 hours Every 10 year	Remarks
1. Main									
1.1. Mechanical frame	Clean the frame	O		x					
	Maintain the paint				x				
1.2. Ventilation	Make ventilation system of the electromotor free from dust 		x			x			
1.3. Chain	Tension and grease the chain. See section 10.7.1 “Tension and grease the chain”					x			
1.4. Travelling distance sensor	Check the travelling distance sensor See section 10.7.2 “Maintain the travelling distance sensor”			x					

10.7.1 Tension and grease the chain

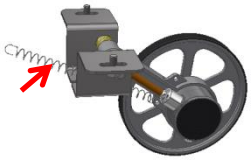
To tension and grease the chain of the trolley proceed as follows:

1.	Loosen the bolts	
2.	Press the driving aggregate in upward direction. The chain is tensioned correctly when there is 10 mm slack at its mid-point; use hand power. Caution: tensioning the chains too tight might harm the driving mechanism	
3.	Fasten the bolts. Apply torque settings according to Appendix F “Torque settings”	
4.	Grease the chain with Kroon Oil multipurpose grease 3	

10.7.2 Maintain the travelling distance sensor



1. Check whether the travelling distance sensor runs free and smoothly, and has sufficient grip on the axis of the trolley to prevent slipping.
2. Check the spring

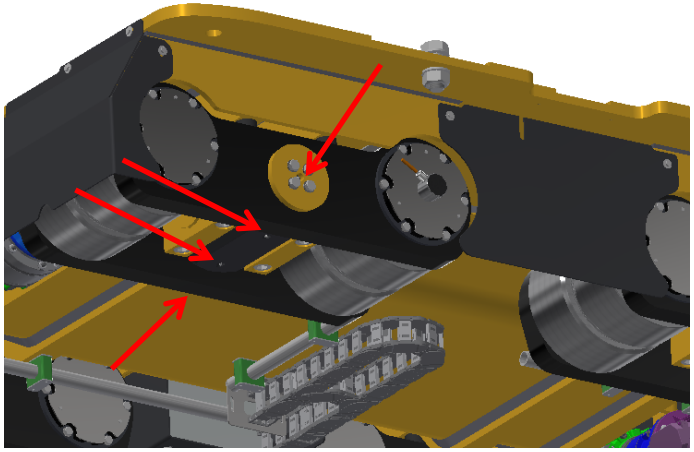


3. Clean the mechanism

10.8 Trolley JS250

Subject	Action	Person O (owner) EE (Enerpac expert)	First 40 hours	8 hours Daily	40 hours Weekly	Each 500 hours Each year	Every year	10000 hours Every 10 year	Remarks
1. Main									
1.1. Mechanical frame	Clean the frame	O		x					
	Maintain the paint				x				
1.2. Grease the nipples	(The locations of the nipples are shown below)						x		

The locations of the nipples:



11 Quality

not applicable

12 Recycling

To recycle the System at the end of its lifetime, proceed as follows:

- Drain the fluids like:
  - hydraulic oil
  - lubricating oil
  - coolant
- Remove the batteries.
- Dismount the electric components and electric wiring.
- Dismount rubber and plastic components.
- Dismount the metal components.

Collect all material, sort it and let it be recycled by a specialized company.

Attention
Dispose all material in a responsive way.

13 Index

Appendices

A.Checklist for planning

1. **Project**

Project	
Customer	
Location	
Date	

2. the load

☐	Mass of the load	
☐	Centre of gravity of the load	
☐	Dimensions of the load	
☐	The position of the load's centre of gravity within the units	
☐	The wind load	

3. Calculations

☐	Bearing capacity of the subsoil	
☐	Foundation required?	
☐	Height of the required foundation	

4. Commitment

Preparations by: Date:

Signature:

Approved by: Date:

Signature:

B.Checklist for installing the system

1. Project

Project	
Customer	
Location	
Date	

2. Installation of the units

☐	Checklist A “Checklist for planning” completed and signed off
☐	The lifting capacity of forklifts and cranes is sufficient
☐	The electrics are installed
☐	The units are put in place
☐	The units are aligned
☐	The load is fixed to the swivels with bolts

3. Installation of the trolleys (Optional)

☐	Checklist A “Checklist for planning” completed and signed off
☐	Position the trolleys with its electrical cabinets in such way that the cabinets are on the outer side of the tracks, away from the load.
☐	The running direction of all trolleys has been adjusted and tested.

4. Commitment

Installations by: Date:

Signature:

Approved by: Date:

Signature:

C.Logging Maintenance

Maintenance activities		
Activity	**Date**	**Remark**

D.Recording a lifting operation

1. Project

Project	
Customer	
Location	
Date	
Mass of the load	

2. Recording of activities

	Activity	Time
☐	The checklist in Appendix A " Checklist for planning" has been completed and signed off	
☐	The checklist in Appendix B "Checklist for installing the system" has been completed and signed off	
1		
2		
3		
4		
7		
8		

Activity	Time

	Activity	Time
9		
10		
11		
12		
13		
15		
16		
17		
18		

3. Commitment

Executed by: Date:

Signature:

Approved by: Date:

Signature:

E.Hydraulic fluid safety information

SAFETY DATA SHEET
According to EC No 1907/2006 as amended as at the date of this SDS
Shell Tellus S4 VE 46
Version 1.2 Revision Date 02.01.2020 Print Date 03.01.2020

1. Identification of the substance/mixture and of the company/undertaking

1.1. Product identifier

Trade name	Shell Tellus S4 VE 46
Product code	001F8443

1.2. Relevant identified uses of the substance or mixture and uses advised against

Use of the Substance/Mixture	Hydraulic oil
Uses advised against	This product must not be used in applications other than those listed in Section 1 without first seeking the advice of the supplier.

1.3. Details of the supplier of the safety data sheet

Manufacturer/Supplier	Shell Nederland Verkoopmaatschappij B.V. Weena 70 3012 CM Rotterdam Netherlands
Telephone	(+31) 0900 202 2710
Telefax	-
Email Contact for Safety Data sheet	If you have any enquiries about the content of this SDS please email lubricantSDS@shell.com

1.4. Emergency telephone number

National Poison Information Centre (NVIC): Tel. nr. +31 30 - 2748888 (24 hrs a day and 7 days a week). Only for the purpose of informing medical personnel in cases of accidental intoxications.
+31 (0)10 4313233
National Poison Information Centre (NVIC): Tel. nr. +31 30 - 2748888 (24 hrs a day and 7 days a week). Only for the purpose of informing medical personnel in cases of accidental intoxications.
+31 (0)10 4313233

2. Identification of the substance/mixture and of the company/undertaking

2.1. Classification of the substance or mixture

Classification (REGULATION (EC) No 1272/2008
Based on available data this substance / mixture does not meet the classification criteria.

2.2. Label elements

Labelling (REGULATION (EC) No 1272/2008)

Hazard pictograms	No Hazard Symbol required	
Signal word	No signal word	
Hazard statements	PHYSICAL HAZARDS: Not classified as a physical hazard according to CLP criteria. HEALTH HAZARDS: Not classified as a health hazard under CLP criteria. ENVIRONMENTAL HAZARDS: Not classified as environmental hazard according to CLP criteria.	
Precautionary statements	Prevention Response Storage Disposal	No precautionary phrases

Safety data sheet available on request

Sensitising components	Contains triazole derivatives. May produce an allergic reaction

2.3. Other hazards

This mixture does not contain any REACH registered substances that are assessed to be a PBT or a vPvB. Prolonged or repeated skin contact without proper cleaning can clog the pores of the skin resulting in disorders such as oil acne/folliculitis. Used oil may contain harmful impurities. High-pressure injection under the skin may cause serious damage including local necrosis. Not classified as flammable but will burn

3. Composition/information on ingredients

3.1. Mixtures

Chemical nature: Blend of polyolefins and additives

Hazardous components

Chemical name	CAS-No. EC-No. Registration number	Classification (REGULATION (EC) No 1272/2008)	Concentration [%]
Distillates (Fischer - Tropsch), heavy, C18-50 – branched, cyclic and linear	848301-69-9 482-220-0 01-0000020163-82	Asp. Tox.1; H304	85- 95
Triazole derivative	91273-04-0 401-280-0	Skin Corr.1B; H314 Skin Sens.1A; H317 Aquatic Chronic1; H410	0,01 - 0,05

4. First aid measures

4.1. Description of first aid measures

Protection of first-aiders: When administering first aid, ensure that you are wearing the appropriate personal protective equipment according to the incident, injury and surroundings.

If inhaled: No treatment necessary under normal conditions of use. If symptoms persist, obtain medical advice.

In case of skin contact: Remove contaminated clothing. Flush exposed area with water and follow by washing with soap if available. If persistent irritation occurs, obtain medical attention. When using high pressure equipment, injection of product under the skin can occur. If high pressure injuries occur, the casualty should be sent immediately to a hospital. Do not wait for symptoms to develop. Obtain medical attention even in the absence of apparent wounds.

In case of eye contact: Flush eye with copious quantities of water. Remove contact lenses, if present and easy to do. Continue rinsing. If persistent irritation occurs, obtain medical attention.

If swallowed: In general no treatment is necessary unless large quantities are swallowed, however, get medical advice.

4.2. Most important symptoms and effects, both acute and delayed

Symptoms: Oil acne/folliculitis signs and symptoms may include formation of black pustules and spots on the skin of exposed areas. Ingestion may result in nausea, vomiting and/or diarrhoea. Local necrosis is evidenced by delayed onset of pain and tissue damage a few hours following injection.

4.3. Indication of any immediate medical attention and special treatment needed

4.4. Treatment: Notes to doctor/physician:
Treat symptomatically.
High pressure injection injuries require prompt surgical intervention and possibly steroid therapy, to minimise tissue damage and loss of function. Because entry wounds are small and do not reflect the seriousness of the underlying damage, surgical exploration to determine the extent of involvement may be necessary. Local anaesthetics or hot soaks should be avoided because they can contribute to swelling, vasospasm and ischaemia. Prompt surgical decompression, debridement and evacuation of foreign material should be performed under general anaesthetics, and wide exploration is essential.

5. Firefighting measures

5.1. Extinguishing media

Suitable extinguishing media: Foam, water spray or fog. Dry chemical powder, carbon dioxide, sand or earth may be used for small fires only. Do not use water in a jet

Unsuitable extinguishing media

5.2. Special hazards arising from the substance or mixture

Specific hazards during firefighting: Hazardous combustion products may include: A complex mixture of airborne solid and liquid particulates and gases (smoke). Carbon monoxide may be evolved if incomplete combustion occurs. Unidentified organic and inorganic compounds

5.3. Advice for firefighters

Special protective equipment for firefighters: Proper protective equipment including chemical resistant gloves are to be worn; chemical resistant suit is indicated if large contact with spilled product is expected. Self-Contained Breathing Apparatus must be worn when approaching a fire in a confined space. Select fire fighter's clothing approved to relevant Standards (e.g. Europe: EN469).

Specific extinguishing methods: Use extinguishing measures that are appropriate to local circumstances and the surrounding environment

6. Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

Personal precautions: 6.1.1 For non emergency personnel: Avoid contact with skin and eyes.
6.1.2 For emergency responders: Avoid contact with skin and eyes

6.2. Environmental precautions

Environmental precautions: Use appropriate containment to avoid environmental contamination. Prevent from spreading or entering drains, ditches or rivers by using sand, earth, or other appropriate barriers.
Local authorities should be advised if significant spillages cannot be contained

6.3. Methods and materials for containment and cleaning up

Methods for cleaning up: Slippery when spilt. Avoid accidents, clean up immediately. Prevent from spreading by making a barrier with sand, earth or other containment material.
Reclaim liquid directly or in an absorbent. Soak up residue with an absorbent such as clay, sand or other suitable material and dispose of properly

6.4. Reference to other sections

For guidance on selection of personal protective equipment see Chapter 8 of this Safety Data Sheet., For guidance on disposal of spilled material see Chapter 13 of this Safety Data Sheet

7. Handling and storage

General	Use local exhaust ventilation if there is risk of inhalation of vapours, mists or aerosols. Use the information in this data sheet as input to a risk assessment of local circumstances to help determine appropriate controls for safe handling, storage and disposal of this material.
Precautions	

7.1. Precautions for safe handling

Advice on safe handling	Avoid prolonged or repeated contact with skin. Avoid inhaling vapour and/or mists. When handling product in drums, safety footwear should be worn and proper handling equipment should be used. Properly dispose of any contaminated rags or cleaning materials in order to prevent fires.

7.2. Conditions for safe storage, including any incompatibilities

Other data	Keep container tightly closed and in a cool, well-ventilated place. Use properly labeled and closable containers. Store at ambient temperature. Refer to section 15 for any additional specific legislation covering the packaging and storage of this product.
Packaging material	Suitable material: For containers or container linings, use mild steel or high density polyethylene. Unsuitable material: PVC.
Container Advice	Polyethylene containers should not be exposed to high temperatures because of possible risk of distortion.

7.3. Specific end use(s)

Specific use(s)	Not applicable

8. Exposure controls/personal protection

8.1. Control parameters

Occupational Exposure Limits

Biological occupational exposure limits

No biological limit allocated.

Monitoring Methods

Monitoring of the concentration of substances in the breathing zone of workers or in the general workplace may be required to confirm compliance with an OEL and adequacy of exposure controls. For some substances biological monitoring may also be appropriate.

Validated exposure measurement methods should be applied by a competent person and samples analysed by an accredited laboratory.

Examples of sources of recommended exposure measurement methods are given below or contact the supplier. Further national methods may be available.

National Institute of Occupational Safety and Health (NIOSH), USA: Manual of Analytical Methods http://www.cdc.gov/niosh/

Occupational Safety and Health Administration (OSHA), USA: Sampling and Analytical Methods http://www.osha.gov/

Health and Safety Executive (HSE), UK: Methods for the Determination of Hazardous Substances http://www.hse.gov.uk/

Institut für Arbeitsschutz Deutschen Gesetzlichen Unfallversicherung (IFA) , Germany http://www.dguv.de/inhalt/index.jsp

L'Institut National de Recherche et de Securité, (INRS), France http://www.inrs.fr/accueil

8.2. Exposure controls

Engineering measures

The level of protection and types of controls necessary will vary depending upon potential exposure conditions. Select controls based on a risk assessment of local circumstances. Appropriate measures include Adequate ventilation to control airborne concentrations. Where material is heated, sprayed or mist formed, there is greater potential for airborne concentrations to be generated.

General Information:

Define procedures for safe handling and maintenance of controls. Educate and train workers in the hazards and control measures relevant to normal activities associated with this product. Ensure appropriate selection, testing and maintenance of equipment used to control exposure, e.g. personal protective equipment, local exhaust ventilation. Drain down system prior to equipment break-in or maintenance. Retain drain downs in sealed storage pending disposal or subsequent recycle. Always observe good personal hygiene measures, such as washing hands after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants. Discard contaminated clothing and footwear that cannot be cleaned. Practice good housekeeping.

8.3. Personal protective equipment

The provided information is made in consideration of the PPE directive (Council Directive 89/686/EEC) and the CEN European Committee for Standardisation (CEN) standards.Personal protective equipment (PPE) should meet recommended national standards. Check with PPE suppliers.

Eye protection	If material is handled such that it could be splashed into eyes,protective eyewear is recommended. Approved to EU Standard EN166.
Hand protection	Where hand contact with the product may occur the use of gloves approved to relevant standards (e.g. Europe: EN374, US: F739) made from the following materials may provide suitable chemical protection.
Remarks	PVC, neoprene or nitrile rubber gloves Suitability and durability of a glove is dependent on usage, e.g. frequency and duration of contact, chemical resistance of glove material, dexterity. Always seek advice from glove suppliers. Contaminated gloves should be replaced. Personal hygiene is a key element of effective hand care. Gloves must only be worn on clean hands. After using gloves, hands should be washed and dried thoroughly. Application of a non-perfumed moisturizer is recommended. For continuous contact we recommend gloves with breakthrough time of more than 240 minutes with preference for > 480 minutes where suitable gloves can be identified. For short-term/splash protection we recommend the same but recognize that suitable gloves offering this level of protection may not be available and in this case a lower breakthrough time maybe acceptable so long as appropriate maintenance and replacement regimes are followed. Glove thickness is not a good predictor of glove resistance to a chemical as it is dependent on the exact composition of the glove material. Glove thickness should be typically greater than 0.35 mm depending on the glove make and model.
Respiratory protection	No respiratory protection is ordinarily required under normal conditions of use. In accordance with good industrial hygiene practices, precautions should be taken to avoid breathing of material. If engineering controls do not maintain airborne concentrations to a level which is adequate to protect worker health, select respiratory protection equipment suitable for the specific conditions of use and meeting relevant legislation. Check with respiratory protective equipment suppliers. Where air-filtering respirators are

suitable, select an appropriate combination of mask and filter. Select a filter suitable for combined particulate/organic gases and vapours [Type A/Type P boiling point > 65°C (149°F)] meeting EN14387 and EN143.

Thermal hazards: Not applicable

8.4. Environmental exposure controls

General advice: Take appropriate measures to fulfill the requirements of relevant environmental protection legislation. Avoid contamination of the environment by following advice given in Section 6. If necessary, prevent undissolved material from being discharged to wastewater. Wastewater should be treated in a municipal or industrial wastewater treatment plant before discharge to surface water. Local guidelines on emission limits for volatile substances must be observed for the discharge of exhaust air containing vapour.

9. Physical and chemical properties

9.1. Information on basic physical and chemical properties

Appearance	Liquid
Colour	Colourless
Odour	Slight hydrocarbon
Odour Threshold	Data not available
pH	Not applicable
pour point	: -48 °CMethod: ISO 3016
Initial boiling point and boiling range	> 280 °Cestimated value(s)
Flash point	260 °C, Method: ASTM D92 (COC)
Evaporation rate	Data not available
Flammability (solid, gas)	Data not available
Upper explosion limit	Typical 10 %(V)
Lower explosion limit	Typical 1 %(V)
Vapour pressure	< 0,5 Pa (20 °C) estimated value(s)
Relative vapour density	> 1estimated value(s)
Relative density	0,832 (15,0 °C)
Density	: 832 kg/m3 (15,0 °C) Method: ISO 12185
Solubility(ies)	
Water solubility	negligible
Solubility in other solvents	Data not available
Partition coefficient: n- octanol/water	log Pow: > 6(based on information on similar products)
Auto-ignition temperature	> 320 °C
Decomposition temperature	Data not available
Viscosity	
Viscosity, dynamic	Data not available
Viscosity, kinematic	46 mm2/s (40,0 °C), Method: ISO 3104 8,7 mm2/s (100 °C), Method: ISO 3104
Explosive properties	Not classified
Oxidizing properties	Data not available

9.2. Other information

Conductivity: This material is not expected to be a static accumulator

10. Stability and reactivity

10.1. Reactivity: The product does not pose any further reactivity hazards in addition to those listed in the following sub-paragraph

10.2. Chemical stability: Stable. No hazardous reaction is expected when handled and stored according to provisions

10.3. Possibility of hazardous reactions

Hazardous reactions: Reacts with strong oxidising agents.

10.4. Conditions to avoid

Conditions to avoid: Extremes of temperature and direct sunlight

10.5. Incompatible materials

Materials to avoid: Strong oxidising agents

10.6. Hazardous decomposition products

Hazardous decomposition products: No decomposition if stored and applied as directed

11. Toxicological information

11.1. Information on toxicological effects

Basis for assessment: Information given is based on data on the components and the toxicology of similar products. Unless indicated otherwise, the data presented is representative of the product as a whole, rather than for individual component(s).

Information on likely routes of exposure: Skin and eye contact are the primary routes of exposure although exposure may occur following accidental ingestion

Acute oral toxicity

Product: LD50 rat: > 5.000 mg/kg
Remarks: Low toxicity: Based on available data, the classification criteria are not met.

Acute inhalation toxicity: Remarks: Based on available data, the classification criteria are not met.

Acute dermal toxicity: LD50 Rabbit: > 5.000 mg/kg
Remarks: Low toxicity: Based on available data, the classification criteria are not met.

Skin corrosion/irritation

Product: Remarks: Slightly irritating to skin., Prolonged or repeated skin contact without proper cleaning can clog the pores of the skin resulting in disorders such as oil acne/folliculitis., Based on available data, the classification criteria are not met.

Serious eye damage/eye irritation

Product	Remarks: Slightly irritating to the eye., Based on available data, the classification criteria are not met.
Respiratory or skin sensitisation	
Product	Remarks: For respiratory and skin sensitisation; Not a sensitiser. Based on available data, the classification criteria are not met.
Components	Triazole derivative: Remarks: May cause an allergic skin reaction in sensitive individuals.
Germ cell mutagenicity	
Product	Remarks: Non mutagenic, based on available data, the classification criteria are not met.
Reproductive toxicity	
Product	Remarks: Not a developmental toxicant., Does not impair fertility. Based on available data, the classification criteria are not met.
STOT - single exposure	
Product	Remarks: Based on available data, the classification criteria are not met.
STOT - repeated exposure	
Product	Remarks: Based on available data, the classification criteria are not met.
Aspiration toxicity	
Product	Not an aspiration hazard.
Further information	
Product	Remarks: Used oils may contain harmful impurities that have accumulated during use. The concentration of such impurities will depend on use and they may present risks to health and the environment on disposal., ALL used oil should be handled with caution and skin contact avoided as far as possible. Remarks: High pressure injection of product into the skin may lead to local necrosis if the product is not surgically removed. Remarks: Slightly irritating to respiratory system. Remarks: Classifications by other authorities under varying regulatory frameworks may exist.
Summary on evaluation of the CMR properties	
Germ cell mutagenicity-Assessment	This product does not meet the criteria for classification in categories 1A/1B.
Carcinogenicity-Assessment	This product does not meet the criteria for classification in categories 1A/1B.
Reproductive toxicity - Assessment	This product does not meet the criteria for classification in categories 1A/1B.

12. Ecological information

12.1. Toxicity

Basis for assessment	Ecotoxicological data have not been determined specifically for this product. Information given is based on a knowledge of the components and the ecotoxicology of similar products. Unless indicated otherwise, the data presented is representative of the product as a whole, rather than for individual component(s).(LL/EL/IL50 expressed as the nominal amount of product required to prepare aqueous test extract).
Product:	
Toxicity to fish (Acute toxicity)	Remarks: LL/EL/IL50 > 100 mg/l Practically non toxic: Based on available data, the classification criteria are not met.
Toxicity to crustacean (Acute toxicity)	Remarks: LL/EL/IL50 > 100 mg/l Practically non toxic: Based on available data, the classification criteria are not met.
Toxicity to algae/aquatic plants (Acute toxicity)	Remarks: LL/EL/IL50 > 100 mg/l Practically non toxic: Based on available data, the classification criteria are not met.
Toxicity to fish (Chronic toxicity)	Remarks: Data not available
Toxicity to crustacean (Chronic toxicity)	Remarks: Data not available
Toxicity to microorganisms (Acute toxicity)	Remarks: Data not available
Components:	Triazole derivative
M-Factor (Short-term (acute) aquatic hazard)	1

12.2. Persistence and degradability

Product: Biodegradability	Remarks: Not readily biodegradable., Major constituents are inherently biodegradable, but contains components that may persist in the environment.

12.3. Bioaccumulative potential

Product: Bioaccumulation	Remarks: Contains components with the potential to bioaccumulate.
Partition coefficient: n-octanol/water	log Pow: > 6Remarks: (based on information on similar products)

12.4. Mobility in soil

Product: Mobility	Remarks: Liquid under most environmental conditions. If it enters soil, it will adsorb to soil particles and will not be mobile. Remarks: Floats on water.

12.5. Results of PBT and vPvB assessment

Product: assessment	This mixture does not contain any REACH registered substances that are assessed to be a PBT or a vPvB.

12.6. Other adverse effects

Product: Additional ecological information	Does not have ozone depletion potential, photochemical ozone creation potential or global warming potential., Product is a mixture of non-volatile components, which will not be released to air in any significant quantities under normal conditions of use. Poorly soluble mixture. Causes physical fouling of aquatic orgasms

13. Disposal considerations

13.1. Waste treatment methods

Product	Recover or recycle if possible. It is the responsibility of the waste generator to determine the toxicity and physical properties of the material generated to determine the proper waste classification and disposal methods in compliance with applicable regulations. Do not dispose into the environment, in drains or in water courses. Waste product should not be allowed to contaminate soil or ground water, or be disposed of into the environment. Waste, spills or used product is dangerous waste.
Contaminated packaging	Dispose in accordance with prevailing regulations, preferably to a recognized collector or contractor. The competence of the collector or contractor should be established beforehand. Disposal should be in accordance with applicable regional, national, and local laws and regulations.
Local legislation	
Waste catalogue	EU Waste Disposal Code (EWC):
Waste Code	13 01 11*
Remarks	Disposal should be in accordance with applicable regional, national, and local laws and regulations. Classification of waste is always the responsibility of the end user.

14. Transport information

14.1. UN

ADN	Not regulated as a dangerous good
ADR	Not regulated as a dangerous good
RID	Not regulated as a dangerous good
IMDG	Not regulated as a dangerous good
IATA	Not regulated as a dangerous good

14.2. Proper shipping name

ADN	Not regulated as a dangerous good
ADR	Not regulated as a dangerous good
RID	Not regulated as a dangerous good
IMDG	Not regulated as a dangerous good
IATA	Not regulated as a dangerous good

14.3. Transport hazard class

ADN	Not regulated as a dangerous good
ADR	Not regulated as a dangerous good
RID	Not regulated as a dangerous good
IMDG	Not regulated as a dangerous good
IATA	Not regulated as a dangerous good

14.4. Packing group

ADN	Not regulated as a dangerous good
CDNI Inland Water Waste Agreement	NST 3411 Mineral Lubricating Oils
ADR	Not regulated as a dangerous good
RID	Not regulated as a dangerous good
IMDG	Not regulated as a dangerous good
IATA	Not regulated as a dangerous good

14.5. Environmental hazards

ADN	Not regulated as a dangerous good
ADR	Not regulated as a dangerous good
RID	Not regulated as a dangerous good
IMDG	Not regulated as a dangerous good

14.6. Special precautions for user

Remarks	Special Precautions: Refer to Section 7, Handling & Storage, for special precautions which a user needs to be aware of or needs to comply with in connection with transport.

14.7. Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code

Not applicable for product as supplied. MARPOL Annex 1 rules apply for bulk shipments by sea.

15. Regulatory information

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

REACH - List of substances subject to authorisation (Annex XIV)	Product is not subject to Authorisation under REACH
Volatile organic compounds	0 %
Other regulations	The regulatory information is not intended to be comprehensive. Other regulations may apply to this material. Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), annex XIV. Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), annex XVII. Directive 2004/37/EC on the protection of workers from the risks related to exposure to carcinogens or mutagens at work and its amendments. Directive 1994/33/EC on the protection of young people at work and its amendments. Council Directive 92/85/EEC on the introduction of measures to encourage improvements in the safety and health at work of pregnant workers and workers who have recently given birth or are breastfeeding and its amendments.

The components of this product are reported in the following inventories

EINECS	All components listed or polymer exempt
TSC	All components listed

15.2. Chemical safety assessment
No Chemical Safety Assessment has been carried out for this substance/mixture by the supplier.

16. Other information

16.1. Full text of H-Statements

H304	May be fatal if swallowed and enters airways
H314	Causes severe skin burns and eye damage
H317	May cause an allergic skin reaction
H410	Very toxic to aquatic life with long lasting effects

16.2. Full text of other abbreviations

Aquatic Chronic	Long-term (chronic) aquatic hazard
Asp. Tox.	Aspiration hazard
Skin Corr.	Skin corrosion
Skin Sens.	Skin sensitisation

16.3. Abbreviations and Acronyms

ACGIH	American Conference of Governmental Industrial Hygienists
ADR	European Agreement concerning the International Carriage of Dangerous Goods by Road
AICS	Australian Inventory of Chemical Substances
ASTM	American Society for Testing and Materials
BEL	Biological exposure limits
BTEX	Benzene, Toluene, Ethylbenzene, Xylenes
CAS	Chemical Abstracts Service
CEFIC	European Chemical Industry Council
CLP	Classification Packaging and Labelling
COC	Cleveland Open-Cup
DIN	Deutsches Institut fur Normung
DMEL	Derived Minimal Effect Level
DNEL	Derived No Effect Level
DSL	Canada Domestic Substance List
EC	European Commission
EC50	Effective Concentration fifty
ECETOC	European Center on Ecotoxicology and Toxicology Of Chemicals
ECHA	European Chemicals Agency
EINECS	The European Inventory of Existing Commercial Chemical Substances
EL50	Effective Loading fifty
ENCS	Japanese Existing and New Chemical Substances Inventory
EWC	European Waste Code
GHS	Globally Harmonised System of Classification and Labelling of Chemicals
IARC	International Agency for Research on Cancer
IATA	International Air Transport Association
IC50	Inhibitory Concentration fifty
IL50	Inhibitory Level fifty
IMDG	International Maritime Dangerous Goods
INV	Chinese Chemicals Inventory
IP346	Institute of Petroleum test method N° 346 for the determination of polycyclic aromatics DMSO-extractables KECI = Korea Existing Chemicals Inventory LC50 = Lethal concentration fifty
LD50	Lethal Dose fifty per cent.
LL/EL/IL	Lethal Loading/Effective Loading/Inhibitory loading LL50 = Lethal Loading fifty
MARPOL	International Convention for the Prevention of Pollution From Ships
NOEC/NOEL	No Observed Effect Concentration / No Observed Effect Level
OE_HPV	Occupational Exposure - High Production Volume PBT = Persistent, Bioaccumulative and Toxic
PICCS	Philippine Inventory of Chemicals and Chemical Substances
PNEC	Predicted No Effect Concentration
REACH	Registration Evaluation And Authorisation Of Chemicals
RID	Regulations Relating to International Carriage of Dangerous Goods by uail
SKIN_DES	Skin Designation
STEL	Short term exposure limit
TRA	Targeted Risk Assessment
TSCA	US Toxic Substances Control Act
TWA	Time-Weighted Average
vPvB	very Persistent and very Bioaccumulative

16.4. Further information

Training advice	Provide adequate information, instruction and training for operators
Other information	No Exposure Scenario annex is attached to this safety data sheet as it is a non-classified mixture containing no hazardous substances. Under Article 31 of REACH, a SDS is not required for this product. Therefore, this SDS has been created on a voluntary basis to pass on potentially relevant information required under Article 32. A vertical bar (|) in the left margin indicates an amendment from the previous version
Sources of key data used to compile the Safety Data Sheet	The quoted data are from, but not limited to, one or more sources of information (e.g. toxicological data from Shell Health Services, material suppliers' data, CONCAWE, EU IUCLID date base, EC 1272 regulation, etc).

This information is based on our current knowledge and is intended to describe the product for the purposes of health, safety and environmental requirements only. It should not therefore be construed as guaranteeing any specific property of the product.

F. Torque settings

Inspect all bolt joints which may pose a hazard to people and machines at fixed intervals and check their torque.
Apply the torque values unless indicated otherwise on the drawing.

Nominal size	Strength class	Course pitch [Nm] (Copper-grease) 0.08	Fine pitch [Nm] (Copper-grease) 0.08
M4	8.8	2.2	
	10.9	3.2	
	12.9	3.8	
M5	8.8	4.3	
	10.9	6.3	
	12.9	7.4	
M6	8.8	7.4	
	10.9	10.9	
	12.9	12.5	
M7	8.8	12.0	
	10.9	17.5	
	12.9	20.5	
M8	8.8	18	19
	10.9	26	28
	12.9	31	32
M10	8.8	36	37
	10.9	52	55
	12.9	61	64
M12	8.8	61	63
	10.9	90	93
	12.9	105	109
M14	8.8	97	103
	10.9	145	150
	12.9	165	175
M16	8.8	145	155
	10.9	215	225
	12.9	250	270
M18	8.8	210	230
	10.9	300	330
	12.9	350	380
M20	8.8	300	320
	10.9	420	460
	12.9	500	530

Nominal size	Strength class	Course pitch [Nm] (Copper-grease) 0.08	Fine pitch [Nm] (Copper-grease) 0.08
M22	8.8	400	430
	10.9	570	610
	12.9	670	710
M24	8.8	510	640
	10.9	730	900
	12.9	850	1060
M27	8.8	750	920
	10.9	1070	1310
	12.9	1250	1530
M30	8.8	1000	1280
	10.9	1450	1820
	12.9	1700	2130
M33	8.8	1400	1700
	10.9	1950	2430
	12.9	2300	2840
M36	8.8	1750	2230
	10.9	2500	3170
	12.9	3000	3710
M39	8.8	2300	2850
	10.9	3300	4050
	12.9	3800	4740