Instruction- and Maintenance Manual
Strand jack system

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HEAVY LIFTING TECHNOLOGY®

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Preface

Dear customer,

This is the manual consists of two volumes:
Volume 1: Assembling, using and maintaining your Strand jack system.
Volume 2: Using and maintaining the Hydraulic Power Units (HPUs) for strand jack systems,

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 situation existing at the **time of publication**.
- We strive continuously to **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 replacement 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 interpretation and use of all information in this document and 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.	

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

Enerpac.

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1. Introduction

1.1. Manufacturer address

Enerpac Heavy Lifting Technology B.V.
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Fax. +31 74 243 03 38
Email: info.hengelo@enerpac.com
Website: www.enerpac.com

1.2. Declaration

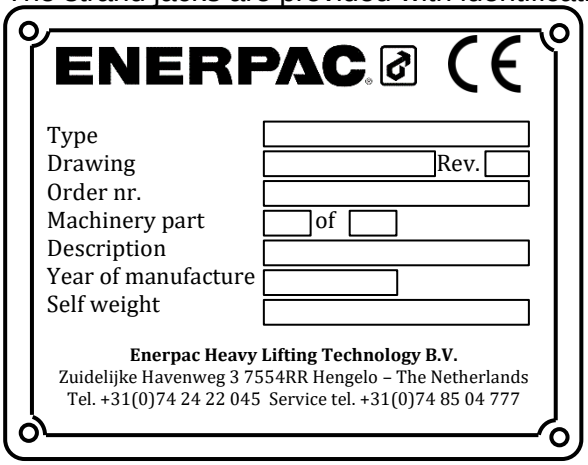
Declaration of Conformity according to Machine Directive 2006/42/EC

1.3. Referenced documents

Ref	Name	Identification	Manufacturer
1.	ASME B30.1-2015	Jacks, Industrial Rollers, Air Casters, and Hydraulic Gantries. (Safety Standard for Cableways, Cranes, Derricks, Hoists, Hooks, Jacks and Slings)	The American Society of mechanical Engineers
2.	Strand jack manual Volume 2: Hydraulic Power Unit (HPU)	ED.03237.00.001.R12	Enerpac
3.	Operation of electrical installations - Low voltage'	NEN 3140	NEN
4.	Operation of electrical installations	NEN-EN 50110-1	NEN
5.	General rules and safety requirements for systems and their components	NEN-EN-ISO 4413	NEN
6.	Technical handbook	As delivered	Enerpac
7.	EC Declaration of conformity		Enerpac
8.	Specification on the strands	BS5896	British standards

1.4. Identification

The strand jacks are provided with identification plates.



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 System is intended
- to lift a load in vertical direction
- to pull a load in any other direction.

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.

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 must always meet the technical specifications given by Enerpac in the construction file and the component construction lists for the machine. It is recommended to use original spare parts. 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 perform, either mechanical, hydraulically 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 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 hydraulics 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 below are in accordance with the standard as referred to in Ref [1] “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 a listed in this chapter.
- In other cases, the user may lease or rent the system from the system owner without supervisory, operational, maintenance, support personnel, or services from the system owner. In these situations, sections 1.8.1 and 1.8.2 shall apply.

1.8.1. The owner of the system

The responsibilities of the owner of the system are:

a) make sure the system meets the requirements as given in this manual as well as specific job requirements defined by the user.
b) make sure the system and all necessary components, specified by the manufacturer, meet the user's requested configuration and capacity.
c) providing the applicable capacity charts to the user
d) providing this manual to the user to enable correct assembly, disassembly, operation and maintenance information
e) make sure all inspections and maintenance activities are performed.
f) designating personnel for maintenance, repair, transport, assembly, and disassembly.
g) designating 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) complying with the requirements of this manual and all regulations applicable at the work site.
b) using supervisors for activities

c) 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
   - verifying that a frequent inspection has been performed

d) verifying that the system has the necessary capacity to perform the proposed operations in the planned configuration
e) ensuring the assigned operators have has been notified of adjustments or repairs that have not yet been completed, prior to commencing operations
f) designating personnel for inspections as required in the applicable chapter
g) designating personnel for maintenance, repair, transport, assembly, and disassembly
h) ensuring that all personnel involved in maintenance, repair, transport, assembly, disassembly, and inspection are aware of their responsibilities, assigned duties, and the associated hazards
i) ensuring 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:

j) ensuring that the system meets the requirements prior to initial site usage.
k) determining if additional regulations or requirements are applicable.
l) ensuring that a qualified person is designated as the system director.
m) ensuring that the operations are coordinated with other jobsite activities that will be affected by or will affect the operations.
n) 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

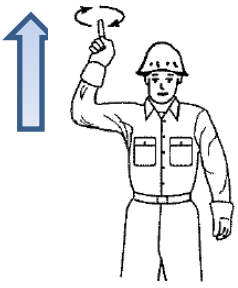
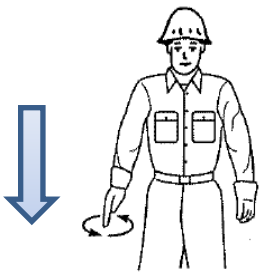
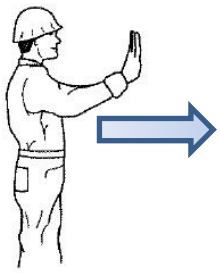
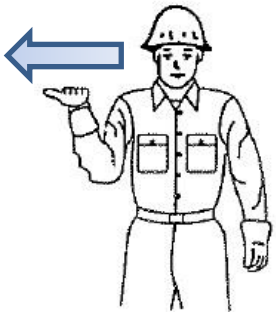
The system Operator shall be responsible for the following listed items.
The system Operator shall not be responsible for hazards or conditions that are not under his direct control and that adversely affect the system operations.
Whenever the system Operator has doubt as to the safety of operation, 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:

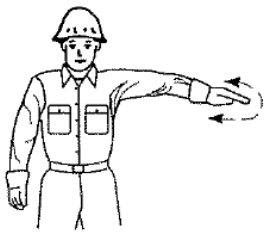
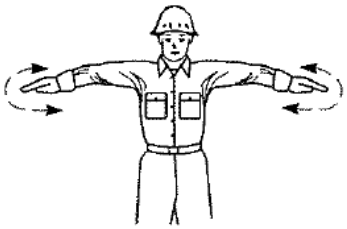
a) reviewing the requirements for the system with the Director before the operations.
b) knowing what types of site conditions could adversely affect the operation of the system and consulting with the system Director concerning the possible presence of those conditions.
c) understanding and applying 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 bask load rigging procedures. For responsibility of rigging the load and ensuring that the load is rigged properly
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.	
GANTRY TRAVEL. Arm extended forward, hand open and slightly raised, make pushing motion in direction of travel.		SIDE SHIFT. Palm up, fingers closed, thumb pointing in direction of motion, jerk hand horizontally.	

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 STRAND JACKS. Hold up: one finger for strand jack marked: "1," two fingers for strand jack marked "2". 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 the use
- the quality of the maintenance
- the service conditions the System is exposed to, like wet or salty environments
- the masses of the loads the System is exposed to.

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:

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

Subjects that must be followed are covered not only in this section; also in other sections are specific safety directions that must be read and followed.

2.1. Mandatory protective gear

While using the System ensure that the 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, and for maintenance has 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 **concentration** 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.

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

2.3. Symbols applied to the System

The System is labelled with
- warning symbols
- symbols with mandatory directions.

The tables below explain 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 commonly symbols with **mandatory directions** 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**

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

It is **strictly obligatory** to observe the warning symbols and the mandatory symbols 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.

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 3 "Operation of electrical installations - Low voltage'"
  - Ref 4 "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. Have any damage repaired 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 ports have been **switched**.

All parts and the length and quality of hoses meet the requirements Ref 5 "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 the **skin**:
  - rinse thoroughly with water
  - remove any contaminated clothing
  - wash the relevant body parts with soap.
- Contact with the **eyes**:
  - rinse thoroughly with water (5 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 “Hydraulic fluid safety information” of this manual.

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.
	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.

[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
	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 injure you seriously.

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 correct.
- **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.

- 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

The system is a linear winch, which can lift and lower a load. The load is attached to a bundle of strands. The strands on its turn are attached to a jack which pulls the strands upwards or let it downwards step by step. The top anchor and a bottom anchor hold the strands alternately, to enable the jack to return to its start position each step.

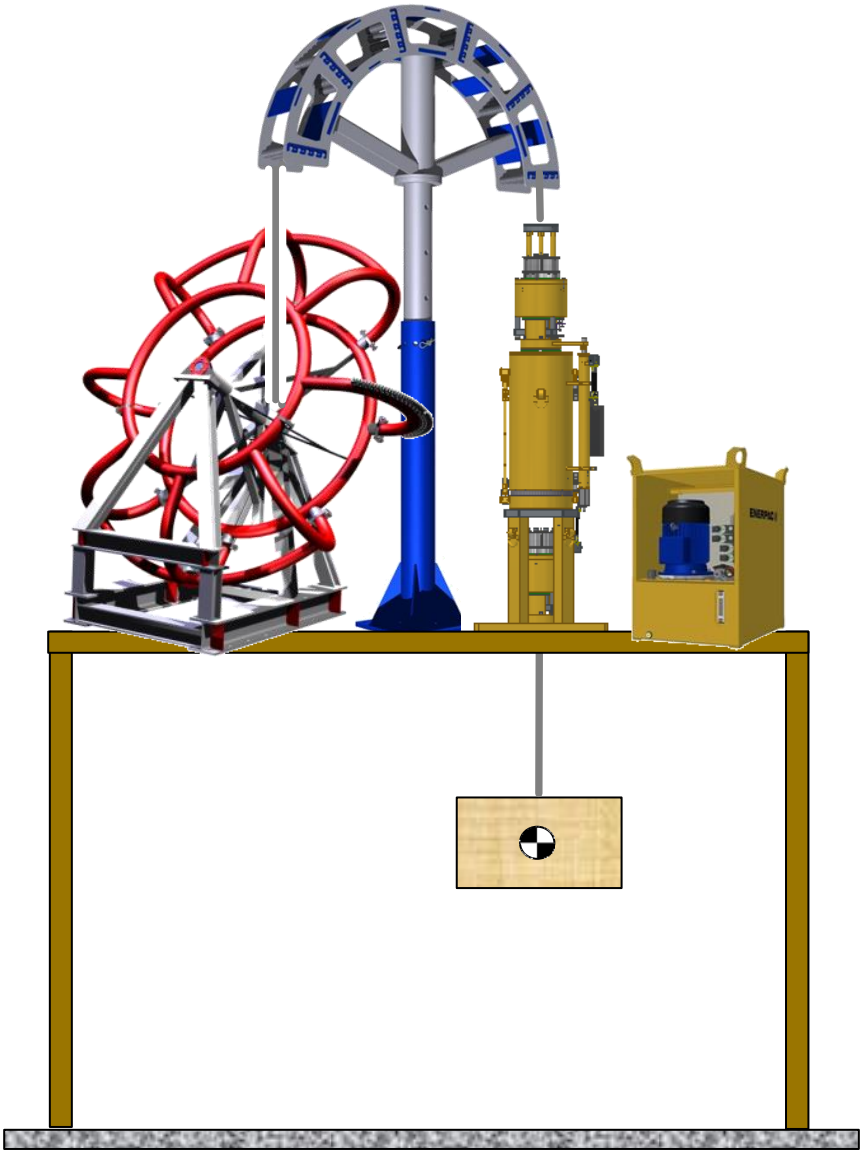
The system consists of the following main parts:

1. Strandjack
2. Lifting anchor
3. Palm tree *(optional)*
4. Strand dispenser *(optional)*
5. Recoiler *(optional)*
6. HPU (hydraulic power unit; reference is made to ref 2 “Strand jack manual Volume 2: Hydraulic Power Unit (HPU)”
7. Smartbox
8. Application running on a Laptop
9. Local control handheld; reference is made to ref 2 “Strand jack manual Volume 2: Hydraulic Power Unit (HPU)”

Description of the main parts:

- The lifting / lowering sequence is automated. The system is controlled by an application which runs on the laptop.
- The Smartbox interfaces between the laptop and the HPU
- The local control handheld enables the operator to control one strand jack manually and by wire, without the use of the laptop.
- Three cylinders are present inside the strandjack: two mini jacks controlling the anchors and one main jack bearing the load.
  Those jacks are powered by the HPU
- The load is attached to the strand jack by a lifting anchor.
- The strands protruding the top of the strand jack can be prevented from bending and kinking by the palm tree (optionally).
- During operation the strands can be coiled in the recoiler (optionally).
- In the installation phase the strands are transported in the strand dispenser

The illustration below shows a setup in which a palm tree and a recoiler are applied.
Note that the proportions are not realistic.

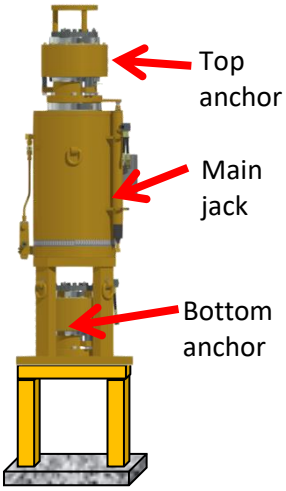


3.1. General

3.1.1. The principles

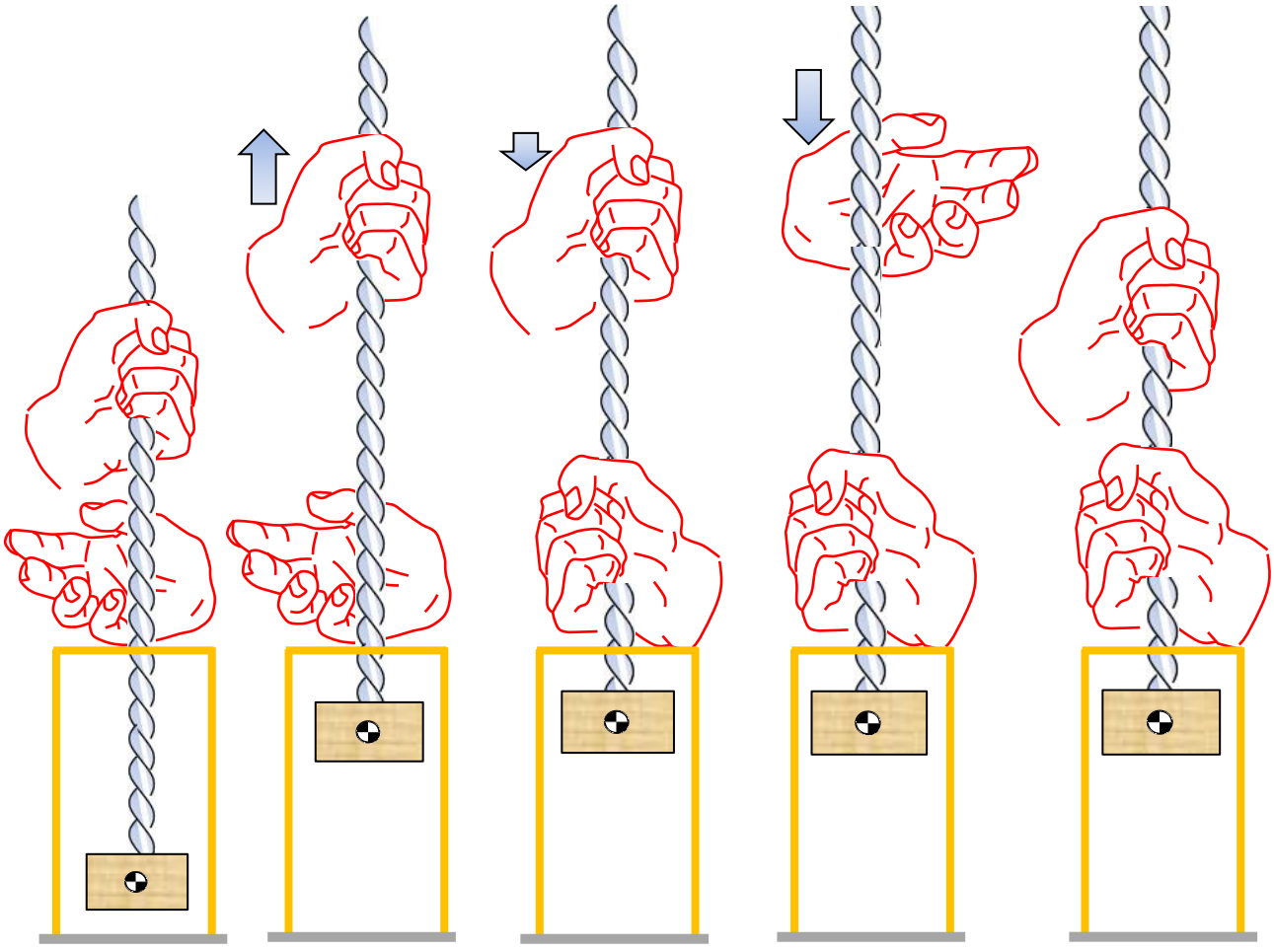
The top anchor and the bottom anchor of the strand jack are able to hold and to release the strand. The main jack performs the vertical movements.

- The top anchor is mounted on top of the main jack and follows the vertical movements of the main jack.
- The bottom anchor rests on the foundation of the strand jack and does not move in vertical direction.



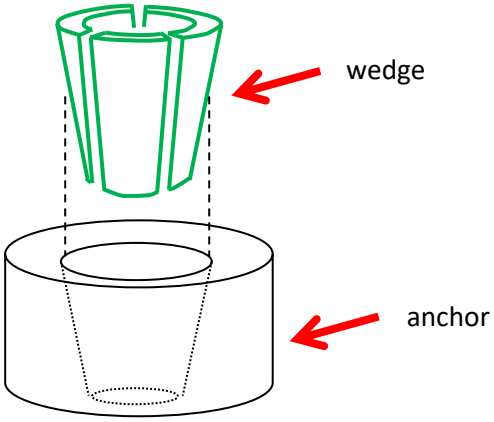
The principle has some similarity with lifting a load by two hands (“anchors”):

- The upper hand can fetch and release the strand, and moves up and down.
- The lower hand can fetch and release the strand, and rests on the table.



1. The upper hand holds the strand and thus bears the load
2. The upper hand moves upwards and thus lifts the load.
3. The lower hand closes. Then the upper hand slightly lowers, to transfer the load to the bottom hand.
4. The upper hand opens. Then the upper hand lowers.
5. The upper hand closes. The lifting cycle starts again.

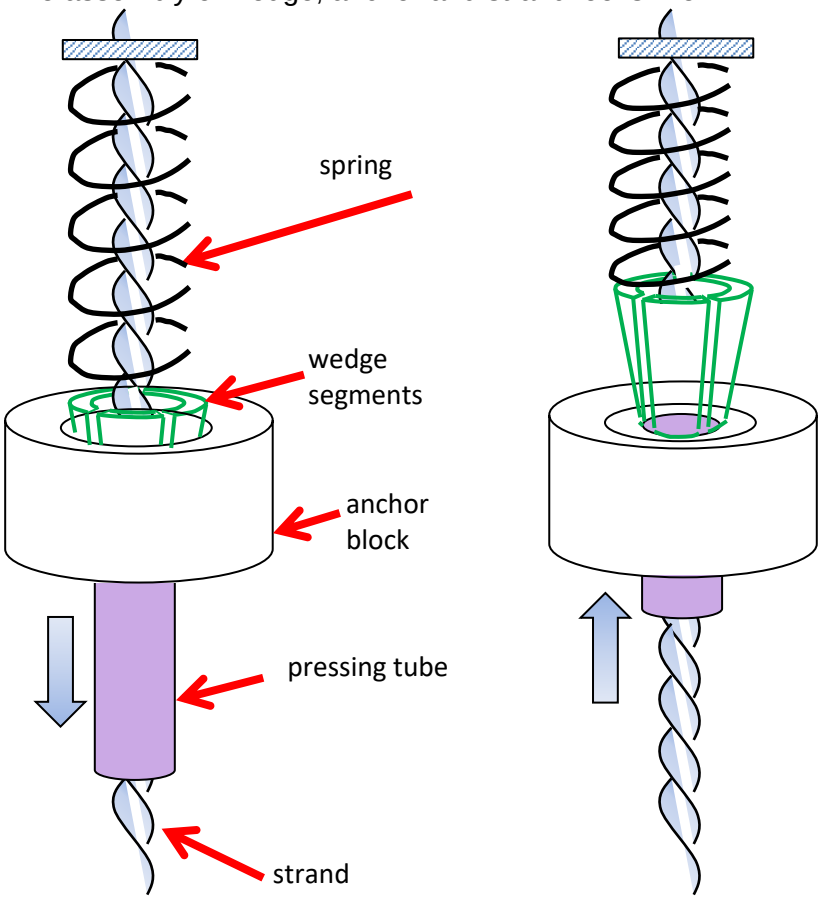
The anchors hold the strand using wedges:



A wedge consists out of three segments which fit in the hole of the anchor.
The strand is led through the wedge.

- When the wedge is pushed down into the anchor, the strand is held and cannot move downwards anymore. (Moving upwards is possible though, when the strand is pulled.) Pushing down the wedge is done by a spring.
- When the wedge is pushed out of the hole, the strand is released. It can move freely up and down. Pushing up of the wedge is done by a pressing pipe and a mini jack.

The assembly of wedge, anchor and strand looks like:

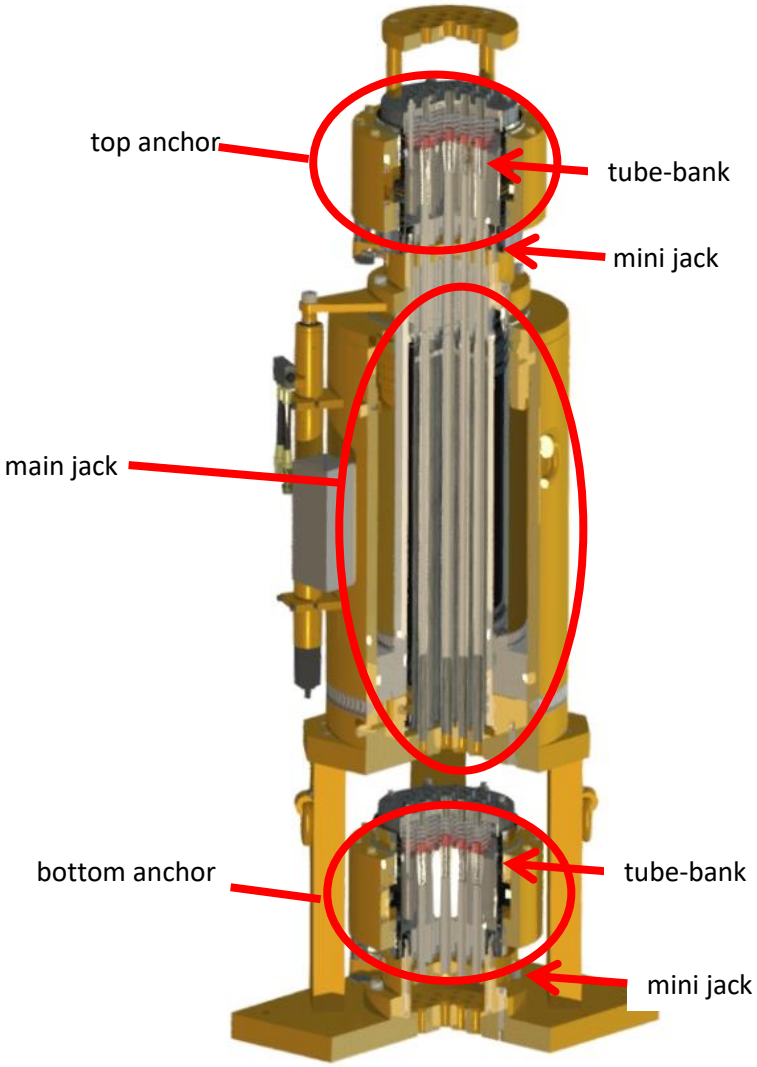


The strand is held; it cannot move downwards

The strand runs free

The drawing shows just one strand but one anchor can contain more strands.

How do these principles map on the real thing?



The strand jack contains a set of pressing tubes which open the wedges.
The pressing tubes operate simultaneously in tube-banks.

3.1.2. The Main Jack

The main jack lifts and lowers the load.
The jack is implemented as a hollow cylinder through which the strands are guided.
On top of the main jack the top anchor is mounted.

3.1.3. The top- and the bottom anchor

Both the top anchor and the bottom anchor are provided with a mini jack.
The mini jacks push the pressing tube upwards, to release the strands.
The top anchor also contains a system to guide the exit of the strands on the topside.

3.1.4. The strands

One single strand consists of seven steel wires, which are twisted and pressed together.
The number of applied strands may vary from system to system.

Different strands can be applied, depending on the type of the system and the operation:

- Diameter: 15.7 or 18 mm
- Winding direction: left or right

Only use strands supplied by Enerpac.

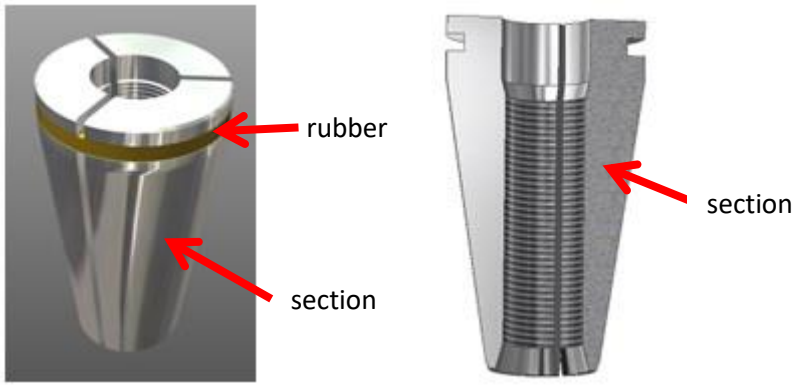
Hazard
Usage of an incorrect type of strands may

- damage the strandjack
- decrease the grip of the wedges on the strands which endangers the stability of your system.

Caution
To avoid rotating of the load when only one strand jack system is applied, half of the strands should be twisted clockwise and the other half counter clockwise.

3.1.5. The wedges

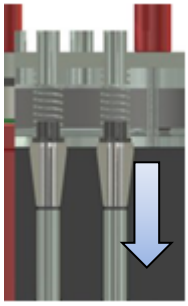
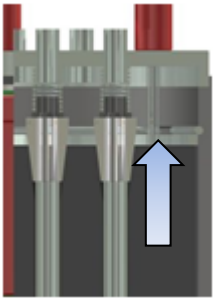
Wedges consist of three elements which are kept together by a rubber. The wedges fit in the holes of the anchors which have a similar shape. Once pressed into the holes, the strands which are led through the wedges are held.



The inner side of the wedges are provided with teeth to enable holding the strands. The teeth may leave imprints on the strand.
Wedges are subject to wear.

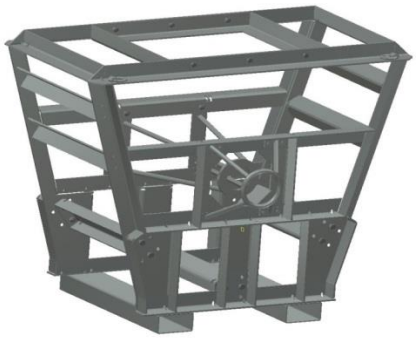
3.1.6. The mini jack

Mini jacks push up the pressing tubes, which push up the wedges.

	
The mini jacks are retracted. The wedges are pushed in the anchor block by the springs on top of the wedge.	The mini jacks are extended. The pressing tubes press the wedges out of the anchor block.
The wedges **hold** the strand; it cannot move downwards. (Moving upwards is still possible: when the strands are pulled upwards, the wedges will pulled out of the anchor block.)	The wedges **release** the strand The strand can move up and down.

3.1.7. The strand dispenser

Strands are delivered in a coil. In the coil mechanical energy is stored which releases when the coil is unpacked. The dispenser captures those forces.
Dispensers can only contain one coil of strands at a time.



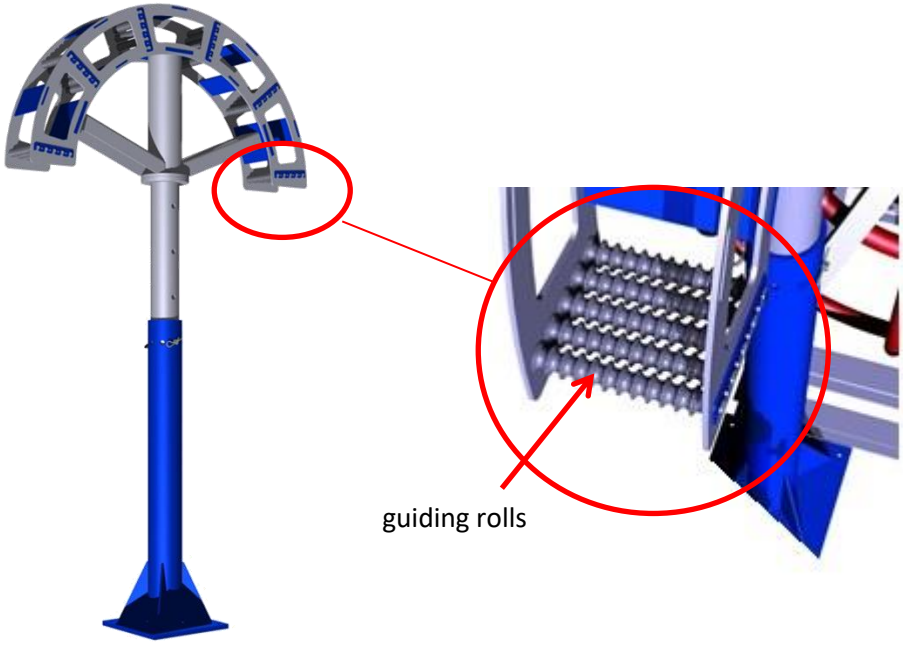
3.1.8. The palm tree

During lifting, the bundle of strands protrudes from the top of the Strandjack. The bundle will hang over by nature.

The palm tree can be used

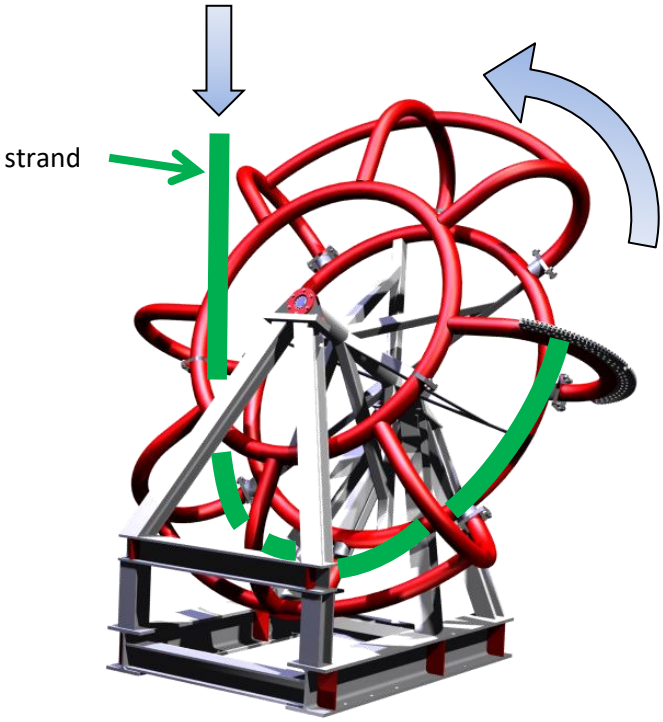
- to prevent the protruding strands from getting mixed up.
- to prevents excessive lateral force on the inner structure of the strand jack.

The palm tree is provided with guiding rolls.
Up to 48 strands can be guided.



3.1.9. The recoiler

The bundle of strands protruding the top of the strand jack can be coiled by the recoiler.
When lifting, the strand jack pushes the strands into the recoiler.
And when lowering, the strands are pulled out. The recoiler rotates by the force of the strands.



The strands enter the recoiler through the ring at the front side and are fixed to one of the ribs.

Different types of recoilers are available for different types of strands.

3.1.10. The smartbox

The Smartbox forms the interface between the laptop and the HPU's of the strand jack system. Apart from its Emergency button and the emergency reset button, the smartbox does not have any means to be operated by the user.

3.1.11. The local control handheld

The local control handheld enables the operator to control one strand jack unit manually. A wired connection is used.
The application running on the laptop is not applied.
Reference is made to ref 2 "Strand jack manual Volume 2: Hydraulic Power Unit (HPU)"

3.1.12. The HPU

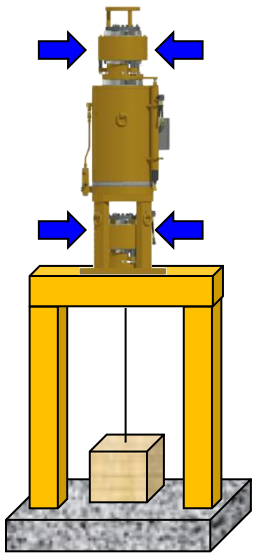
The main jack and the mini jacks are powered and controlled by the HPU (Hydraulic Power Unit). The HPU can either be a diesel or electric.

A dedicated user manual is delivered with the HPU; refer to that manual for the details.
Reference is made to ref 2 "Strand jack manual Volume 2: Hydraulic Power Unit (HPU)"

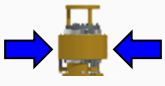
3.2. The operational flow

3.2.1. Lifting

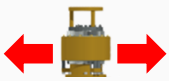
The lifting sequence is shown below.



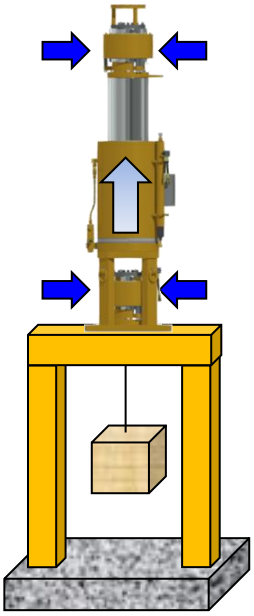
1. Both anchors hold the strand



Closed: the strand is held



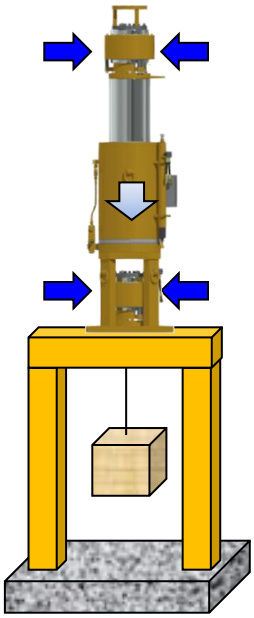
Opened: the strand is released



2. The main jack extends.
The load moves upwards. The upper anchor bears the weight of the load.

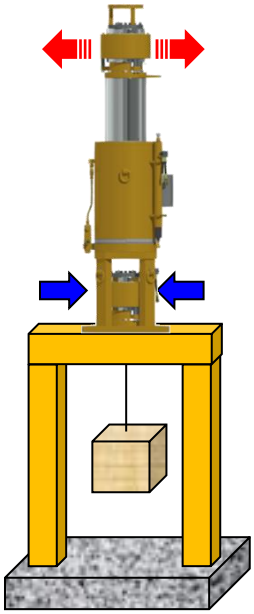
Though the bottom anchor is closed, due to the nature of wedges the strand can be pulled through the anchor in upwards direction.

The bottom anchor is kept closed for additional safety.

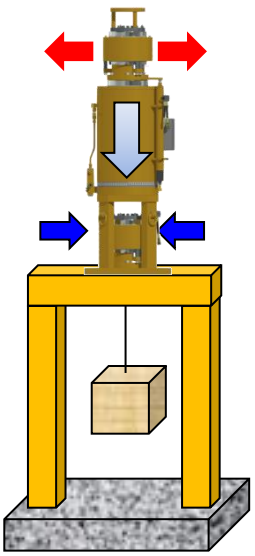


3. The main jack slightly lowers.

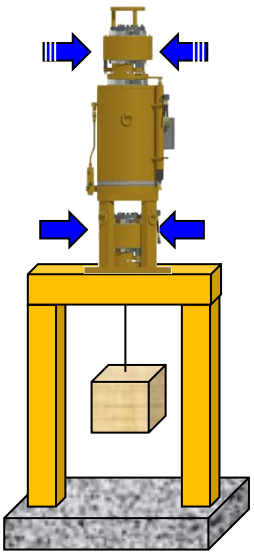
The weight of the load transfers towards the bottom anchor



4. The top anchor opens, and releases the strand.



5. The main jack lowers

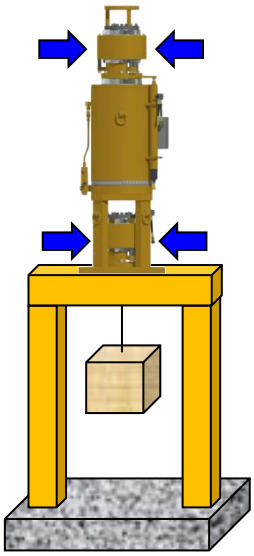


6. The top anchor closes.

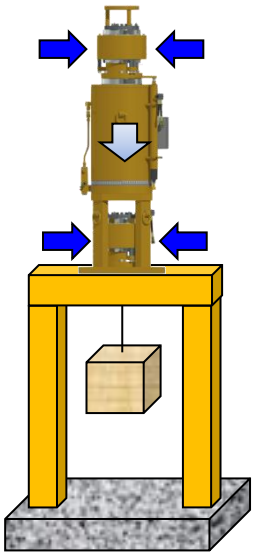
7. The cycle repeats

3.2.2. Lowering

The lowering sequence is below.

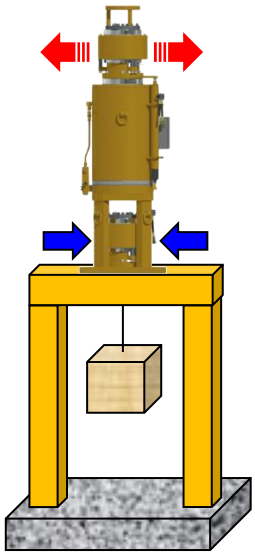


1. Both anchors hold the strand

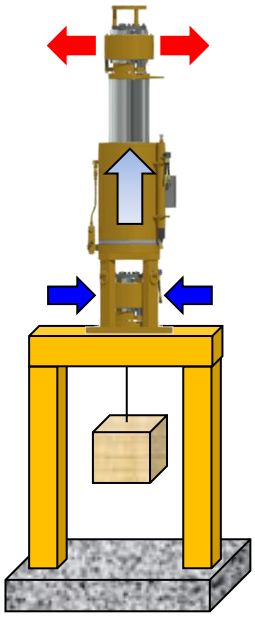


2. The main jack slightly lowers

The weight of the load transfers towards the bottom anchor

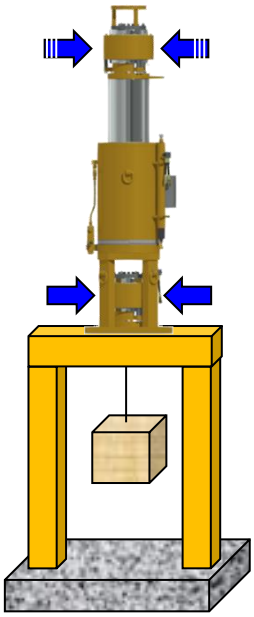


3. The top anchor opens, and releases the strand

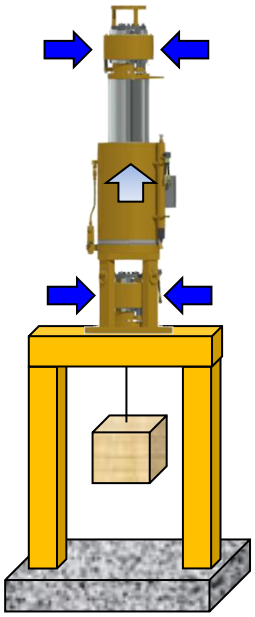


4. The main jack extends

The load does not move.

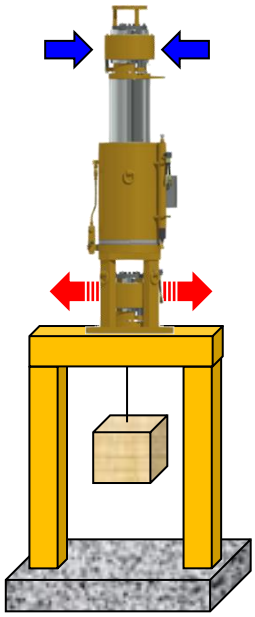


5. The top anchor closes.

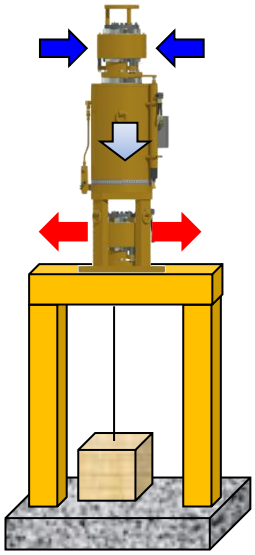


6. The main jack slightly extends.

The weight of the load transfers to the top anchor.



7. The bottom anchor opens, and releases the strand



8. The main jack lowers.

The load is lowered

9. The cycle repeats

3.3. System specifications

Temperatures		
Operating temperature	Min	-10°C
	Max	50°C
Storage temperature	Min	-25°C
	Max	60°C
Oil		
Type of oil	Shell Tellus S4 VE 46	
Pressure		
Max mini jack pressure	60 bar	
Hose length		
Max hose length	15 m	

For the system specifications of the applied HPU reference is made to ref 2 “Strand jack manual Volume 2: Hydraulic Power Unit (HPU)”.

Hazard
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.

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

3.4. Functional specifications

3.4.1. Lifting speed

The lifting speed of strand jacks are determined by
- the type of the strandjack
- the type of the applied HPU

For lifting speed see Appendix Z “Compatibility”.

3.4.2. Lifetime of the wedges

Wedges have a limited lifespan, which strongly depends on:
- The number of strokes of the strand jack
- The weight of the load
- The quality of the strands (rusty? dirty?)
- Weather conditions (wet?)
- Environment (salty?)

A typical value is 100 meters lifting with a stroke of 450 mm. Note that these values are **indicative**.

3.4.3. Lifetime of strands

Similar to wedges, also strands do have a limited lifespan, which strongly depends on:

- The number of strokes of the strand jack
- The weight of the load
- Weather conditions (wet?)
- Environment (salty?)

If the reduction of the diameter exceeds 5% of the nominal diameter then the strands have to be replaced.

3.4.4. Type

The strands have to comply to the standard as given in ref 8 “Specification on the strands“.

3.5. Dimensions

This manual is applicable for a wide range of strand jack systems. The pictures below show **some examples** of strand jacks, palm trees and recoilers, together with their main properties.

Strand jacks:

Type: HSL600 Height: 1924 mm Weight: 650 kG Capacity: 600 kN	Type: HSL2000 Height: 1992 mm Weight: 1300 kG Capacity: 2000 kN	Type: HSL4500 Height: 2214 mm Weight: 3050 kG Capacity: 4500 kN

Palm trees:

Type: heavy duty Height: 5530 Weight: 1300 kG Capacity: 55 strands	Type: 02533 Height: 4694 Weight: 700 kG Capacity: 48 strands	Type: small Height: 3710 Weight: 450 Capacity: 19 * 15.7 or 13 * 18 mm

Recoilers:

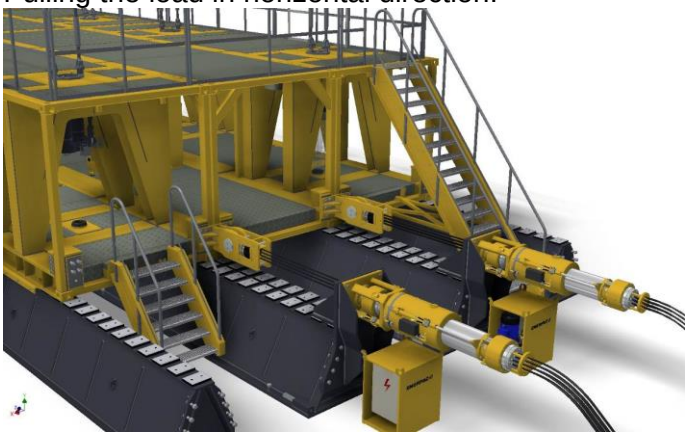
Type: SRCL1 Weight: 1125 kg Height: 2224 mm Capacity 15.7 mm strand 60 m, or 18.0 mm strand 40 m	Type: SRCM1 Weight: 800 kg Height: 2499 mm Capacity: 15.7 mm strand 31 m, or 18.0 mm strand 24 m

3.6. System configurations

Strand jacks can be applied in the following configurations:

- Lifting the load in vertical direction.
  This configuration is the most applied one.

- Pulling the load in horizontal direction:



Contact Enerpac if you want to apply other configurations than the depicted.

Enerpac cannot be held responsible for the use of other configurations than the proposed.

3.7. Service conditions

- When you want to apply strand jacks in other configurations than the proposed, additional calculations have to be made. Enerpac may advise.
- Configurations in which non-Enerpac lifting equipment (gantries, skidding systems) are applied are allowed as long as all static requirements with reference to strength, deflections and stability are fulfilled.
- The use of non-Enerpac components is allowed as long as those components are used in accordance with their own specifications.

4. Plan an operation

In this section, the planning of an operation as well as the general preparations are described

4.1. General preparations

Perform the following general preparations:

1. Make sure the following information is available:
   - Mass of the load
   - Centre of gravity of the load
   - Dimensions of the load
   - Lifting height
   - The load offset (defined in section 4.2.)
   - Bearing capacity of the subsoil

Caution: The mass of the load should be known with high accuracy since the value is used for safety calculations.

2. Determine what type of strand jack and what type of HPU is required.
   See Appendix Z “Compatibility”.

3. Determine the length of the strand
   (see section 4.2. “Determine the length of the strand”)
   Has the palm tree to be used?

4. Determine the number of strands to be applied
   (see section 4.3. “Determine the number of strands”)

5. Define the positioning of the strand jacks
   (see section 4.5. Define the positioning of the strand jack”)

6. Regard the position of the load’s centre of gravity with reference to the strand jacks
   (see section 4.6. “Regard the position of the load”)

7. If the length of the protruding strands exceeds 5 meters, then apply the palm tree.

8. Are you going to apply a recoiler?
   The necessity depends on the local situation. Is it a problem that the strands dangle down?

9. Determine the types of strand jack types you want to apply
   (To be entered into the in the application running on the laptop)
   Define the aliases for the systems.
   (To be entered in the application running on the laptop)

10. Make sure that the strands will be plumb within a tolerance of 1 %.

11. Make sure that the side load will not exceed 1.5 %

12. Consider the shifting of fluids or other materials that could change the location of the center of gravity of the load.

13. Make sure the weather conditions are fine; wind will not cause unacceptable side load

14. Make sure the strand jacks are supported by a structural surface of concrete, steel, or other material capable of supporting the imposed load. Eventually, engineering analysis as to be performed by a qualified person.

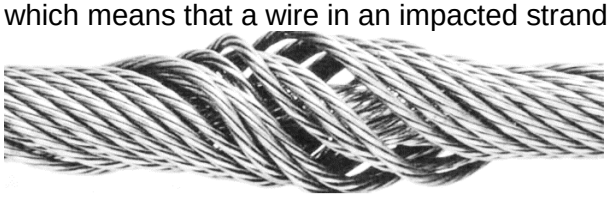
NB: Do not hesitate to call Enerpac for assistance for calculations.

15. Apply slings, shackles, and other rigging in accordance with their respective ASME B30.1-2015 Volumes; see Ref [1].

Populate checklist given in Appendix A “Checklist for planning” with the results of the preparation.

Hazard

- Failure to prepare correctly may result in loss of system stability during use.
- Do not use kinked strands; they may damage your strand jack caused by a “bird cage”, which means that a wire in an impacted strand separates from the core.



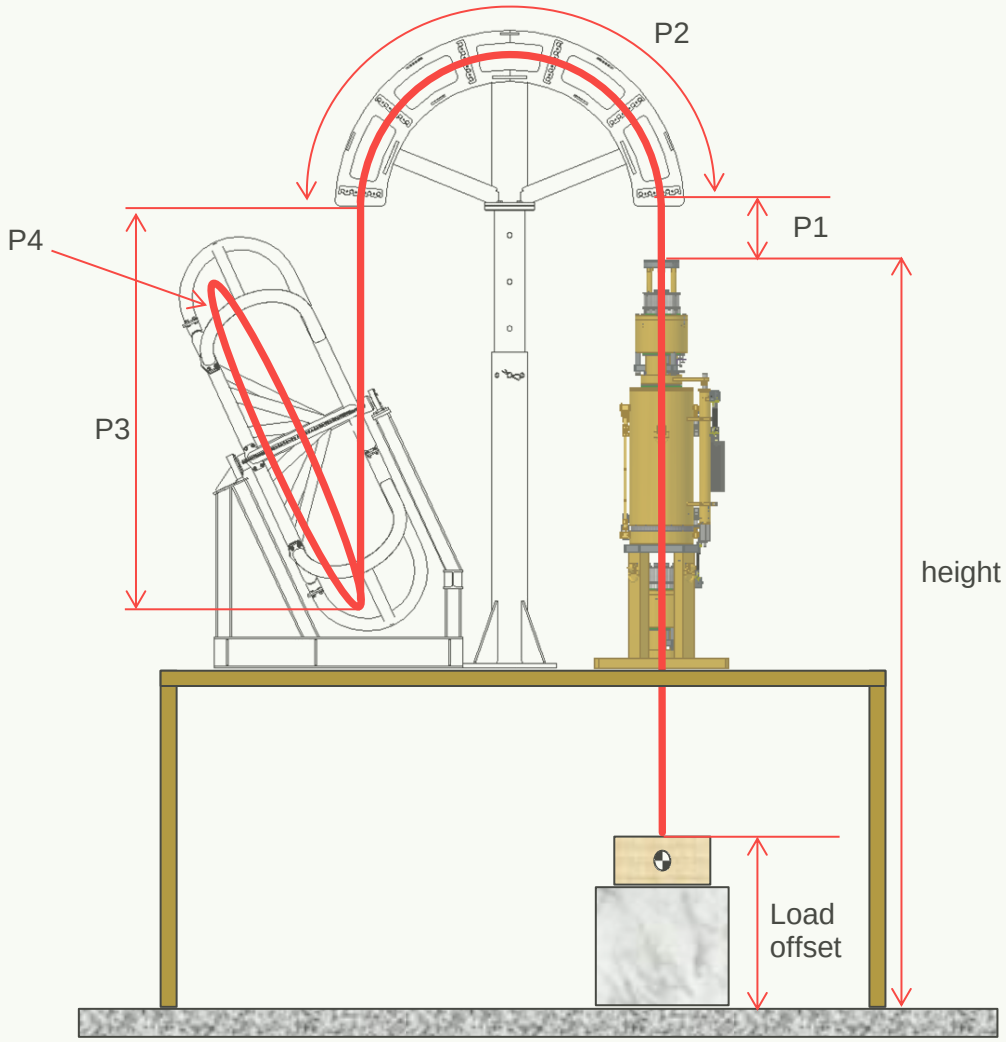
4.2. Determine the length of the strands

The required length of the strands is determined by:

1. The height of the top of the strand jack with reference to the ground
2. The height from where the load has to be picked up (the Load offset)
3. When a palm tree and recoiler applied:
   - the distance between the strandjack and the palm tree
   - the length of the curve of the palm tree
   - the distance to the bottom of the recoiler
   - one full stroke of the recoiler

Caution: otherwise the recoiler will not start turning.

Example: **Parameter**		**abbrev**	**value**
height the strandjack		height	5000 cm
offset of the load		offset	1000 cm
palm tree	distance between strand jack and guide	P1	100 cm
	length of the curve	P2	200 cm
distance to the bottom of the recoiler		P3	200 cm
one full stroke of the recoiler		P4	200 cm



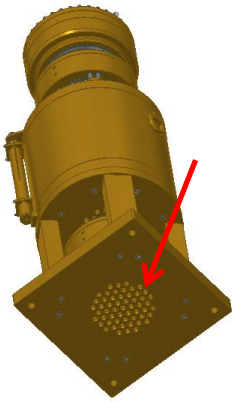
Required length of the strands:

$Length = height - Load - offset + P1 + P2 + P3 + P4$

= 5000 -1000 +100 +200 + 200 + 200 = 4700 cm

4.3. Determine the number of strands

The maximum number of strands is defined by the construction of the strand jack.

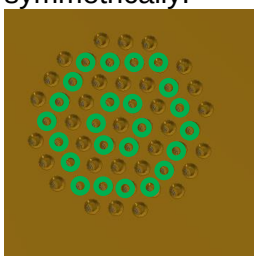


You may apply less than the maximum number of strands as long as the following requirements are fulfilled:

- The number of strands has to be proportional with the weight of load.
  E.g. when you use a 500-ton-type strand jack to lift a load with a weight of 250 ton, you can apply half the number of strands.

- The load per strand shall not exceed:
  - for 15.7 mm strands: 10 ton per strand
  - for 18.0 mm strands: 15 ton per strand
- Recommended safety margins:
  - 25% for strandjacks <600 ton
  - 10% for strandjacks > 600 ton.

If you apply less than the maximum number of strands, then make sure the strands are spread symmetrically.


(bottom view of a strand jack)

Caution: Asymmetrical spread of strands results in asymmetrical load of the strand jack which may cause instability.

4.4. Measures for loads exceeding 600 tons

If the weight of the load exceeds 600 tons then:

- Equal numbers of left-wound and right-wound strands have to be applied.
  Caution: If the requirement is not fulfilled, the anchor may start turning and there is a risk of “bird cage” in the strands.

bird cage

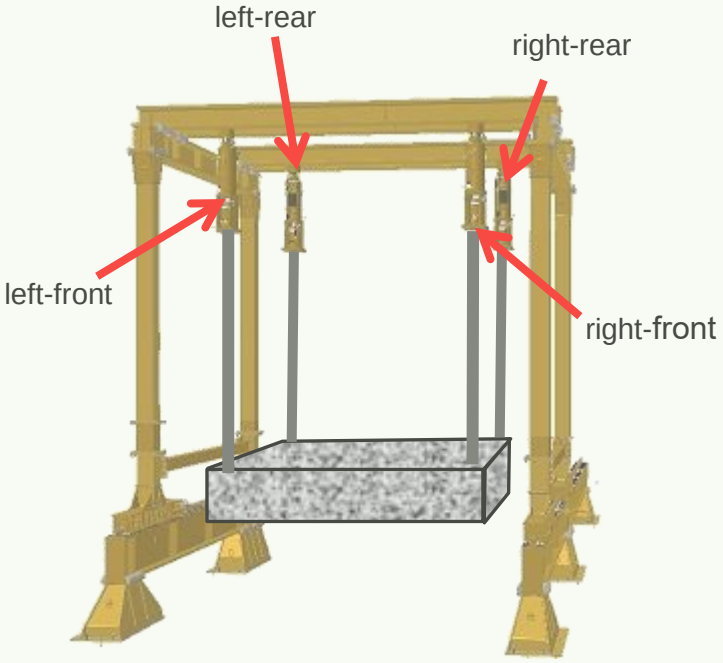
- A palm tree which can guide each strand individually has to be applied

4.5. Define the positioning of the strand jack

Define how the strand jacks have to be positioned with respect to each other and the load. Regard the following:

- How many strand jacks are you going to apply?
- How will they be positioned with reference to each other?
- What will the logical names (“aliases”) of the strand jacks be? (The aliases show up on the control screens on the laptop.)

Example:
You’re going to apply four strand jacks.



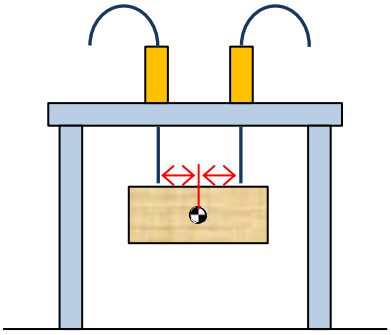
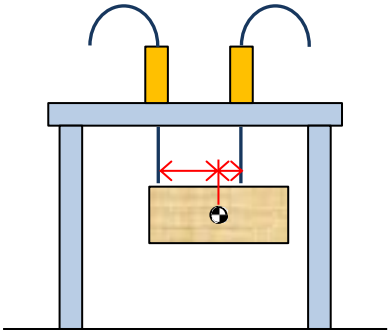
Reasonable aliases would be:

```
left-front   right-front
left-rear    right-rear
```

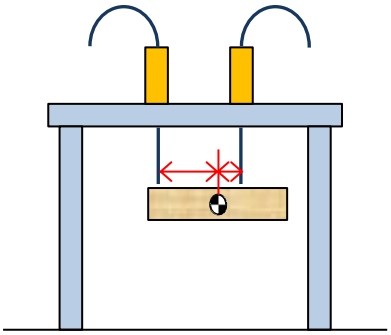
4.6. Regard the position of the load

Eccentric positioning of the load has a negative effect on the capacity of the system.

When the Centre of Gravity (COG) is not in the centre then the bearing capacity of the system decreases since not the full capacity of all strand jacks can be applied.
The figure below shows the principle:

<table>
<tr><td colspan="2">A load of 200 Te has to be lifted
Lifting is done by two Strandjacks with a capacity of 100 Te each
(The numbers are fictitious)</td></tr>
<tr><td>  </td><td>The load is positioned in the middle.
Each strand jacks is loaded until its capacity of 100 Te.</td></tr>
<tr><td>  </td><td>The load is positioned asymmetrically.

The load on the right strandjack has increased and exceeds 100 Te.

The system cannot lift the 200Te load anymore.</td></tr>
<tr><td colspan="2">Now, a limited load of only 120 Te is applied.</td></tr>
<tr><td>  </td><td>The right strand jack is loaded until its capacity of 100 Te.
The left strand jack bears far less than 100 Te. None of the Strandjacks is overloaded.

The capacity of the system has decreased, due to eccentric positioning of the load.</td></tr>
</table>

NB:
The more eccentric the COG of the load, the less the capacity of the system will be.

5. Install the System

This section describes how to install the system:

- mechanically
- hydraulically
- electrically
- the software on the laptop

Complete the checklist as given in Appendix B “Checklist for installing” while installing the system.

5.1. Mechanically

5.1.1. Positioning of strand jack and HPU

1. The position of the strand jacks depends completely on the situation on site and is out of scope of Enerpac.
2. Position the HPUs as close as possible to the strand jacks.
   This makes the mounting of the hydraulics easier.
3. Ensure that the strand jacks and the HPUs have been secured properly.

5.1.2. Use of the strand dispenser

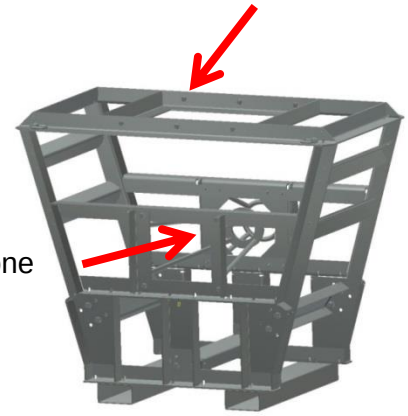
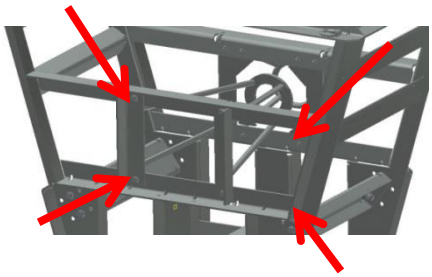
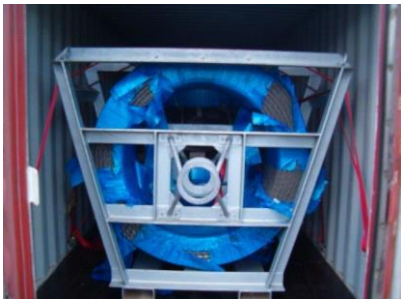
Strands are delivered in a coil. The coil is wrapped with steel bands since a lot of energy is stored in it. Once the coil is put in the strand dispenser, the bands can be cut and the strand can be retrieved in a safe way.

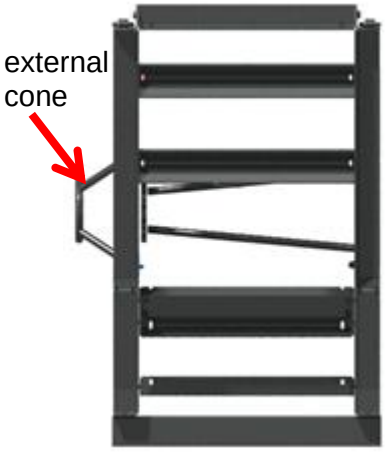
Follow the directions as given in this section carefully to avoid dangerous situations

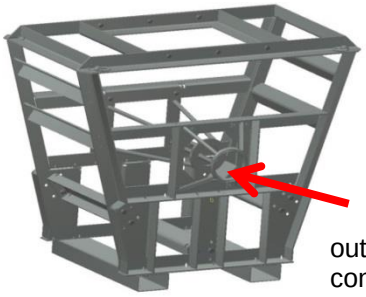
Hazard

- Unpacking the coil without using the strand dispenser may lead to uncontrolled movements of the coil, causing personal injury to people.
- Not properly applying the strand dispenser may cause injury to people.

Apply the strand dispenser as follows:

1.	Open the cone in the middle of the strand dispenser and the frame on top of the dispenser.	Top Frame Cone 
2.	Disassemble the four bolts of the cone. Then take the cone out of the dispenser	
3.	Remove the 6 bolts of the top frame. Then remove the top frame from the dispenser.	
4.	Put the coil in the strand dispenser.	
5.	Remove the blue packing material of the strand. Do not remove the metal straps	

6.	Put the unpacked strand into the strand dispenser. Check the position of the strand: There is a label “**FRONT”** or “**FRONT END**”. Place this side of the package to external cone of the dispenser. Wrongly positioning of the coil will cause tangling or bunching-up of the strand	 
7.	Assemble the cone to the dispenser. Insert the cone through the centre of the strand coil. The cone should not touch the inside of the coil. If so, reposition the coil by using different adjustment holes in the frame Make sure all bolts are tightened securely	
8.	Place some wood behind the coil to press the coil strands to the front of the dispenser. The strand windings will stay tightly against each other. This prevents jumping apart of the windings.	
9.	Verify that the strand package is mounted correctly.	

10.	Cut the metal straps around the strand coil. Use a large plier. Keep hands clear of coil and dispenser frame when cutting Mind the sharp edges of the banding. Wear gloves Wrapped strand coils contain stored energy which releases when the straps are cut Unravelling strand can cause personal injury or even death	straps
11.	Put the starting end of the strand through the outside cone of the strand dispenser. The starting end of the strand is on the inside of the coil. Stored energy will remain in the strand until it becomes straight. Do NOT stand in front of dispenser cone for stored energy can cause the strand to dispense out.	 outside cone
12.	Pull the strand out of the dispenser for the length you require. Enerpac recommends the following procedure: • Fastening a DIN 1142 wire rope clamp to the end of the strand. • Put a sling around it • Pull the sling through the outside cone. This can be done by hand or with the use of a fork truck for long pulls. Regardless the method you use, operate carefully!	wire rope clamp
13.	Cut the strand on the required length	
14.	Attach the end of the strand which is pointing out of the dispenser securely to the cone. This prevents self-dispensing of the strand Make sure the strand cannot jump out or move during transportation of the dispenser. Keep the unused and open strand coil in the dispenser for safe storage	

5.1.3. Prepare the ends of the strands

The strands have to be cut according to the required length.

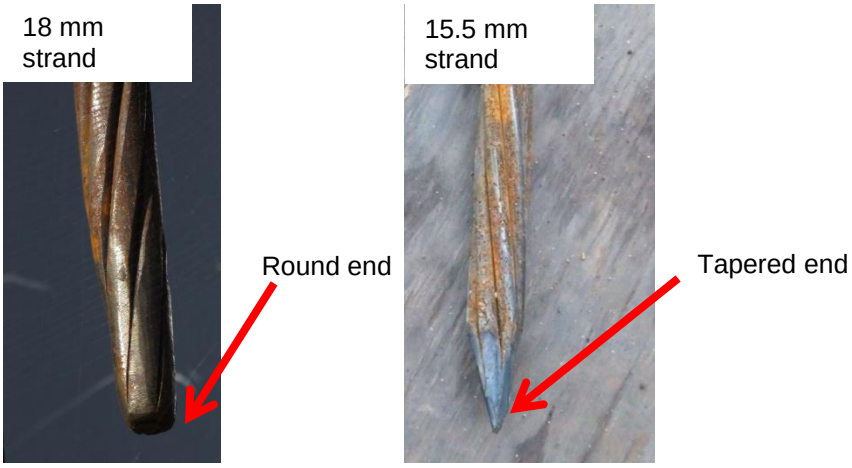
To cut the strands use an appropriate working surface:

- Width: a few meters
- Length: the length of the required length of the strand.
- Surface: hard and clean, possibly a tarpaulin or something similar.

The ends of the strands have to be prepared to enable proper guiding of the strand through the anchor.

Prepare both ends of the strand, to guide them easily through the anchors and the strand jack.

- the 15.7 mm has to have a tapered end
- the 18 mm has to have a rounded or a tapered end.



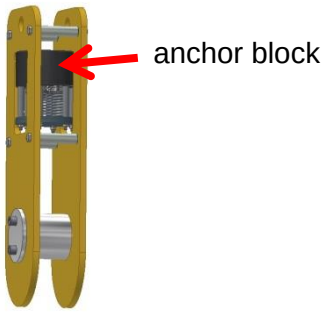
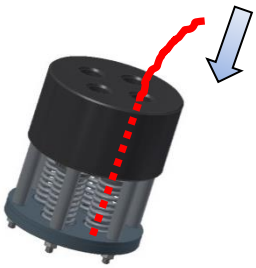
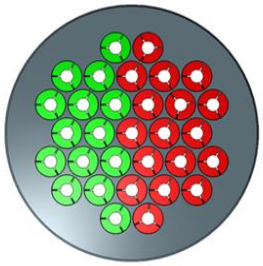
5.1.4. Mount the strands

To mount the strands, they have to be fed into the strand jack. This can be done while the strand jack is

- in upright position
- in horizontal position.

Choose the position which fits the best in the actual operational situation.

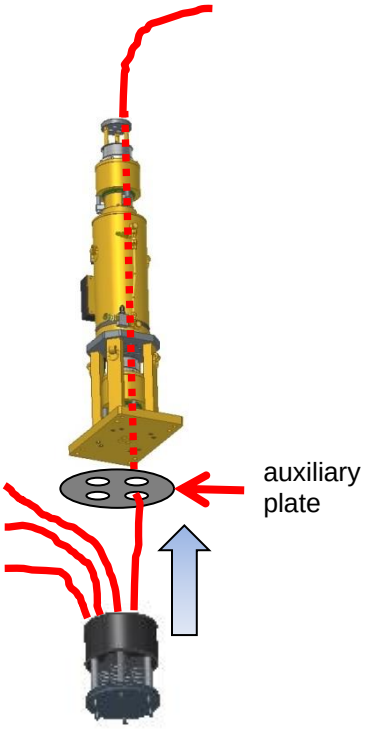
Proceed as follows:

1.	Inspect the strands. They should not be contaminated with dirt or other material that could foul the wedges.	
2.	Ensure that there are no obstacles which could cause bending of kinking the strands	
3.	Push the strands into the anchor block of the lifting anchor from the upside. • Make sure the strands hit the bottom plate	 
	• When you apply strands have different winding directions then make sure they are distributed regularly.	
	• For strand jacks > 600 tonn the following configuration is recommended: Left twisted strands right twisted strands	
4.	When the strand jack is in upright position then close the top anchor. *This will prevent the strands fall out.*	

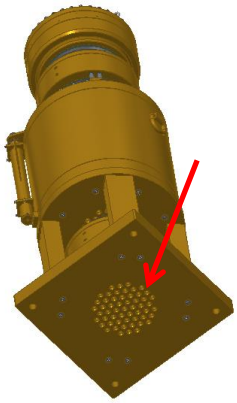
5. Feed the strands one by one into the strand jack in upwards direction:
   - through the bottom anchor
   - through the strand jack body
   - through the top anchor.

   The closed top anchor prevents the strands from falling out.

   - Ensure that the protruding section at the top of strandjack is at least as long as a stroke of the strandjack.
   - When the load will suspend on long strands than you might make use of the auxiliary plate to keep the strands aligned
   - Mount the strand in such a way that they are in parallel.

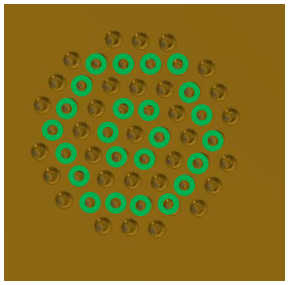


Attention: make sure the strands are aligned well; they shall not be mounted crossed.

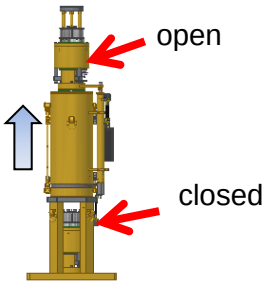


Attention: When you apply less than the maximum number of strands then make sure she strands are mounted symmetrically and concentric (rotational symmetrical). See section 4.3. “Determine the number of strands”

Attention: The angle between the strands and the strand jack shall be less than 1° in order to ensure free running of the strands.

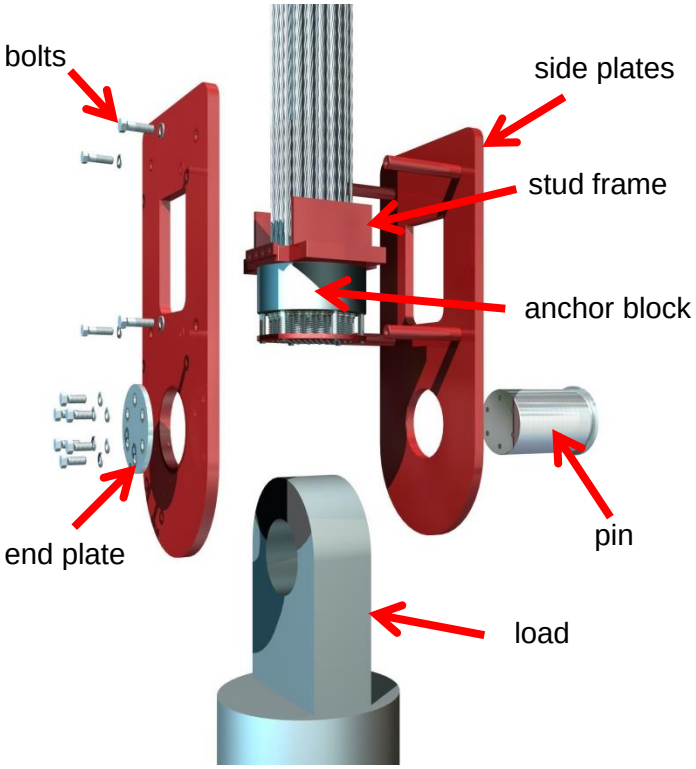


NB: Skipping a complete ring might make mounting the strands easier.

6.	If you **do** apply automatic tensioning then follow the directions given in section 7.3.1 “Tensioning the strands”. This can only be done when the system is fully operational. If you do **not** apply automatic tensioning then you have to tension all strands manually, using a vice grip as follows: a) Close the bottom anchor b) Open the top anchor c) Fetch one single strand with the vice grip d) Extend the main jack until the strand is tensioned e) Treat all other strands similarly *(Final pre-tensioning of the strands is performed in the preparation phase; see* • *section 7.2. “Preparations”* • *section 6.4.7 “Pre-tensioning”).*	

5.1.5. Attach the lifting anchor to the load

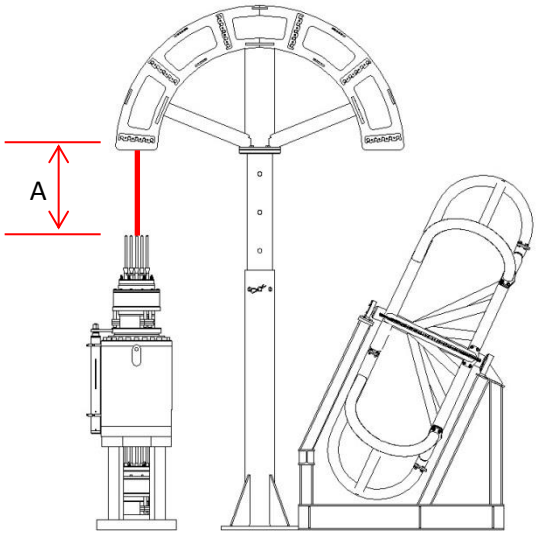
To attach the load to the strand jack proceed as follows:



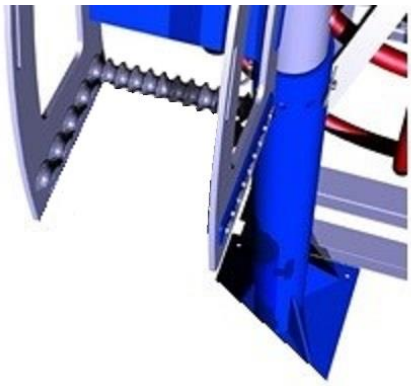
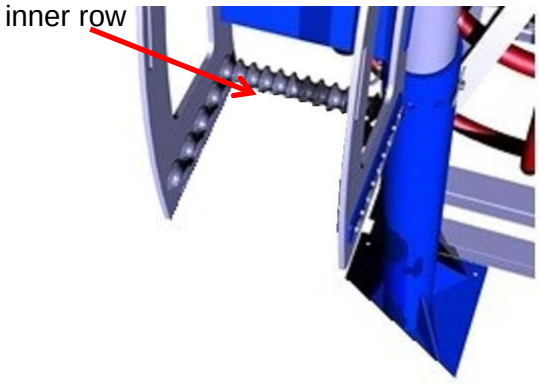
1. Mount the stud frame, if applicable.
   (Stud frames are only applied for the larger types of strand jacks.)
2. Mount the side plates. Use the bolts.
3. Mount the pin
4. Mount the end plate

5.1.6. Install the palm tree

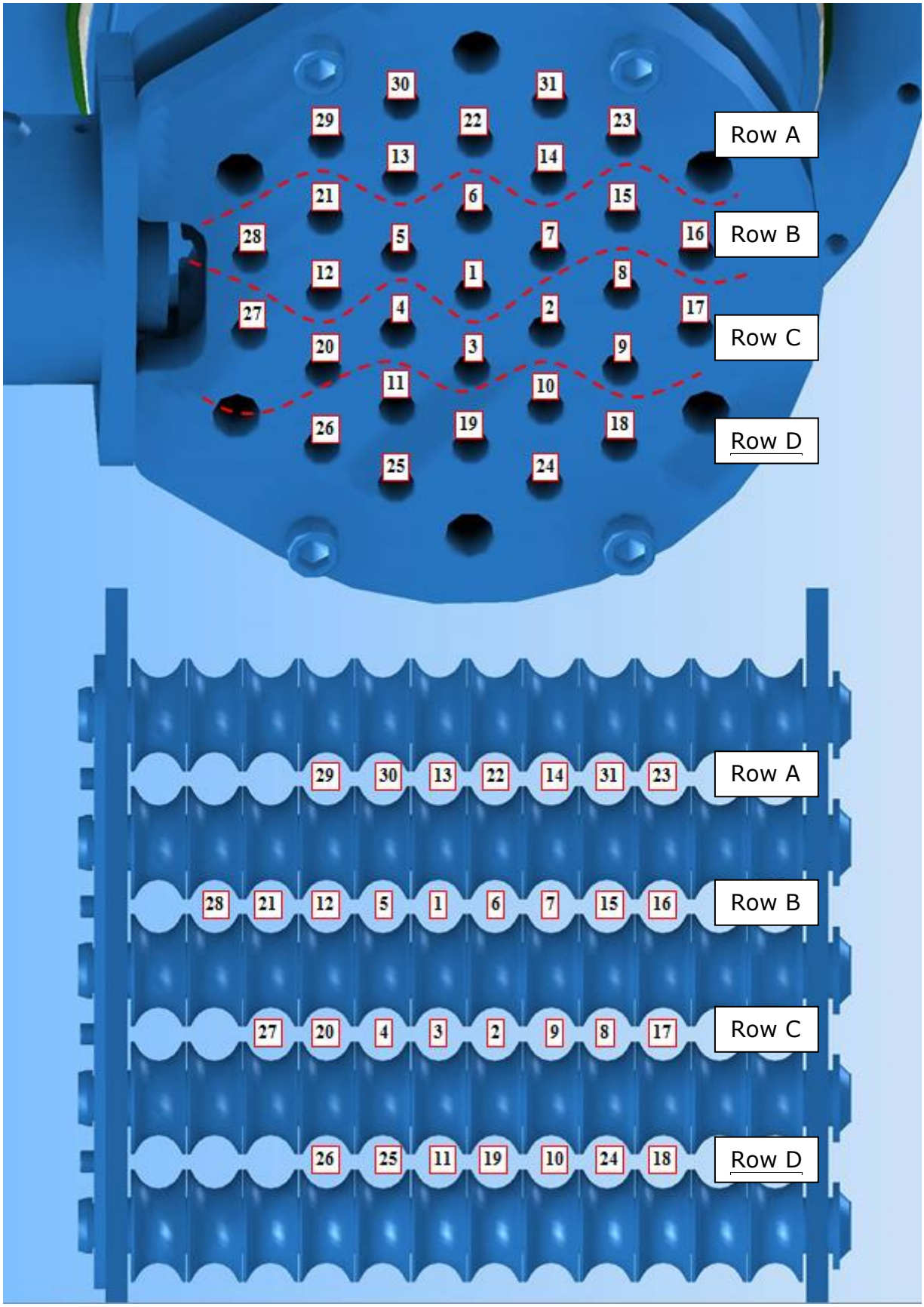
To apply the palm tree, proceed as follows

1.	Position the palm tree in such a position that • the strands are plumb • [A] has to be > 50 cm + the stroke of the strand jack	

For strand jacks >600 tons the following applies:

1.	Remove all guidings but the inner ones	
2.	Feed the strands which protrude from the top of the strand jack one by one into the palm tree: Start feeding at the inner row.	

3.	Carry on mounting the strands and guidings. Mount the strands in the same pattern as they leave the strand jack. *This prevents the strands from tangling.* Follow the scheme on the next page. **Caution** Deviation from the described may cause jamming of the strands.	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26
19
18
25
24
Row A
Row B
Row C
Row D
29
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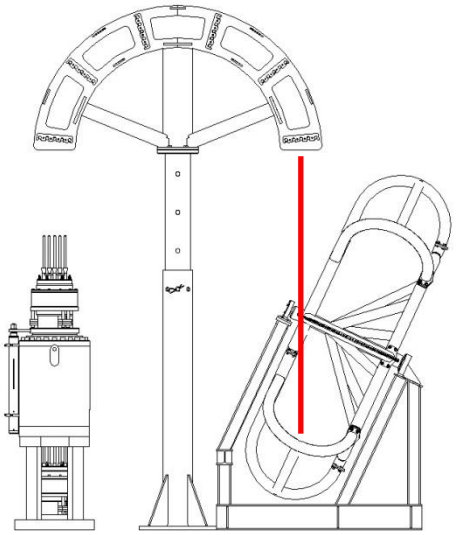
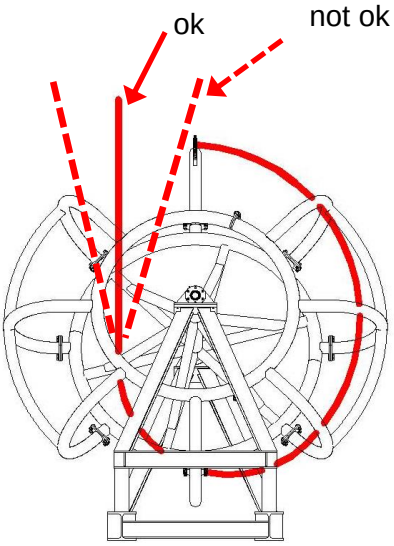
5.1.7. Install the recoiler

To apply the recoiler, proceed as follows:

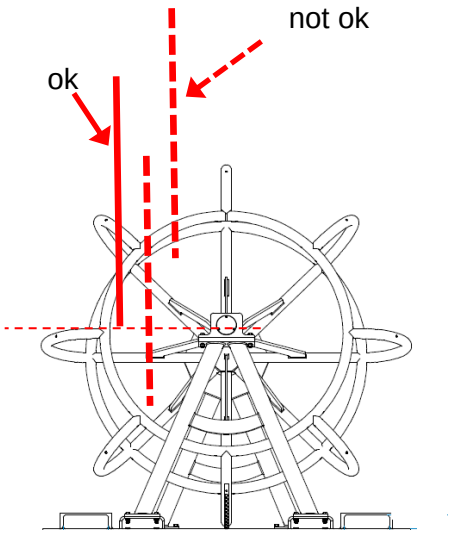
1. Position the recoiler in such a position…



- …that the strands are plumb

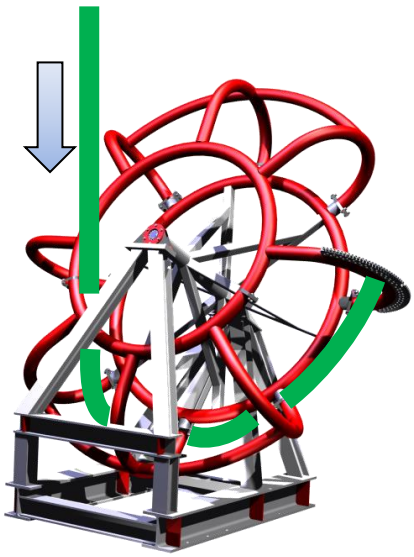


- … that bending of the strands is reduced to the minimum.



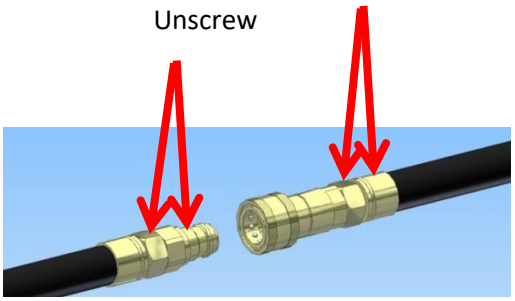
- … that the strands enter the recoiler in the middle of its height.

  In this way the strands are forced to the bottom and the middle of the ring.

2.	Lead the strands into the recoiler • …through the ring at the front side • … or use the lead-in tray, if present.	
3.	Fix the bundle of strands to the row of screws on one of the ribs	
4.	Make a full stroke.	

5.2. Hydraulically

Main directions for mounting the hydraulics:

1.	Inspect the couplings. Are they dirty? Are they damaged?	
2.	Clean the inner and outer side of the couplings before they are mounted; dirt might get in the system causing damage. Use degreaser.	
3.	Dry the couplings with paper and visually check them for dirt. *Do not use any brake cleaner or other detergents; they might affect the couplings.*	
4.	Hoses which are not mounted may be under pressure though, due to exposure to warmth. If so, it is hard to connect the couplings. To reduce the pressure in the hose: a) Twist the coupling off the hose. *A little until oil will come out* b) Turn the coupling tight again.	
5.	Screw the screw-coupling together to the end. *While tightening the couplings, the oil passage is opened up*	

Attention
When the couplings have not been tightened to the end, overpressure may occur which could damage the system.

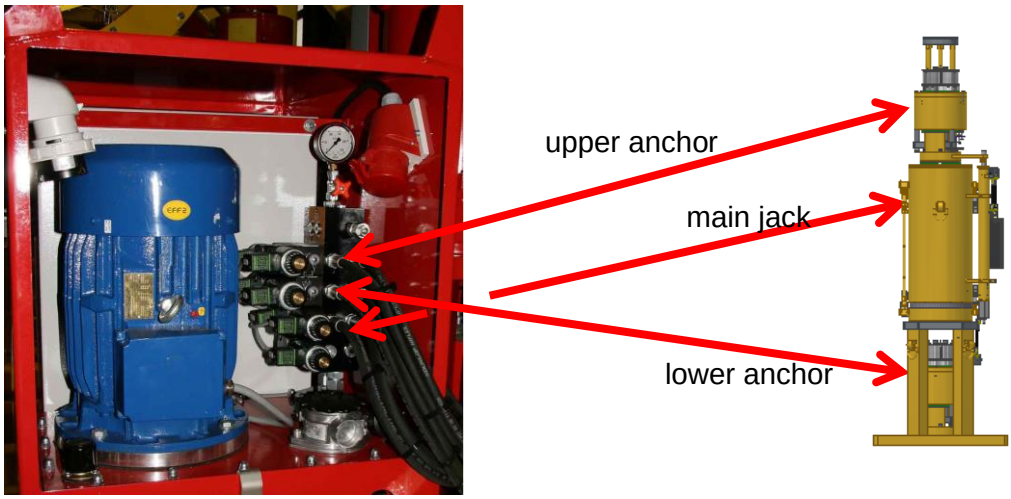
Attention
Dirt may damage the hydraulic system

5.2.1. The strand jack

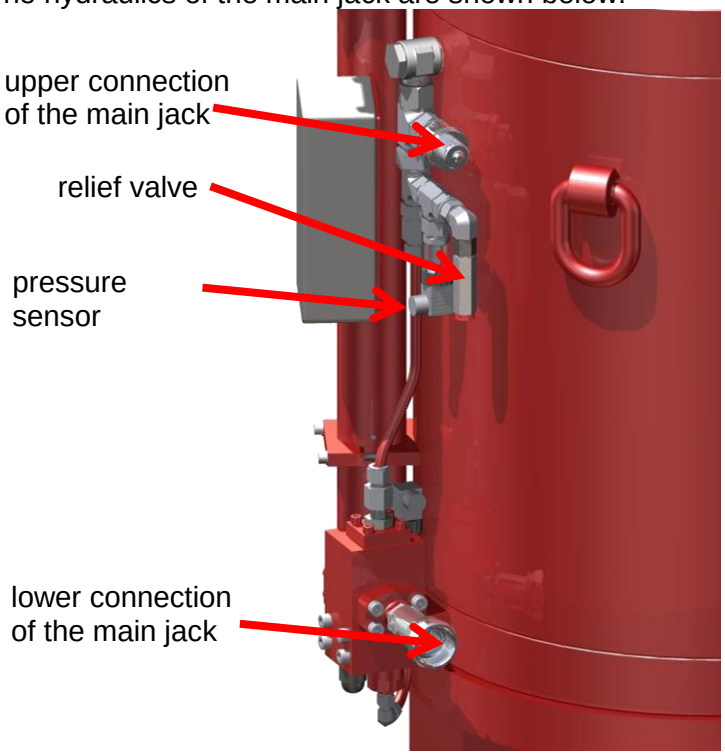
To mount the hydraulics of the system, follow the directions as given in the manual of the HPU; see Ref 2 “Strand jack manual Volume 2: Hydraulic Power Unit (HPU)”.

Attention: The connections of the HPU’s are slightly different for different types of HPU’s. Therefore, the following is only **indicative**.

Mount the hoses between the HPU and the strand jack as indicated below.
Note that all sockets are provided with naming plates.



The hydraulics of the main jack are shown below:



The relief valve is a safety device which prevents over-pressurizing of the main jack. Overpressure may occur when hydraulic sockets not connected properly.

Caution: The relief valve will spray oil when overpressure. Contact Enerpac when such is not allowed.

5.3. Electrically

Preconditions of installing the electrics are:

- The hydraulics have already been installed
- The power supply for the HPU should be present on the strandjack platform

This section explains

- how to connect the Smartbox with HPU's of the strand jacks
- how to connect the Smartbox with the laptop

5.3.1. Smartbox

The layout of the Smartbox is as follows:

Nr	Name	Description
1	Emergency button	Press to activate the emergency stop
2	Emergency release	• Blue indicator is lit then when the emergency circuit was activated • Button: press to lift the emergency
3	Data connector 1 and 2	Connectors for the data cables. Each connector can be connected to max 30 HPU's. As RS485 protocol is used.
4	Ethernet connector	Connector for Ethernet cables
5	Indicator emergency fuse	Is lit when the fuse of the emergency circuit is in defect
6	Fuse	Fuse for the emergency circuit : 2A. If blown then it is no longer possible to reset the emergency circuit.
7	Power connector	24V DC

5.3.2. Electric scheme for the data lines

Reference is made to section 5.4 of the HPU volume; see ref 2 “Strand jack manual Volume 2: Hydraulic Power Unit (HPU)”.

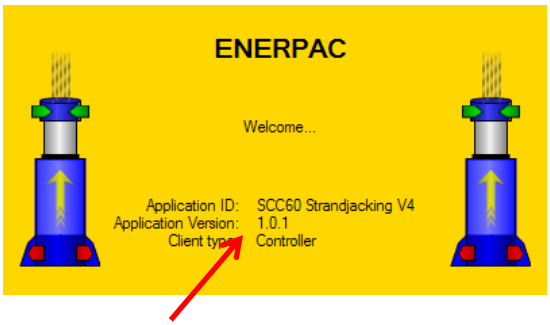
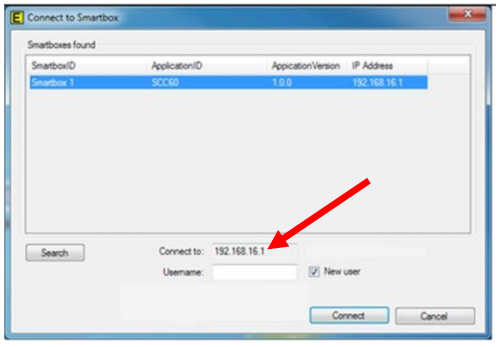
5.3.3. Connect the data lines and the power cables

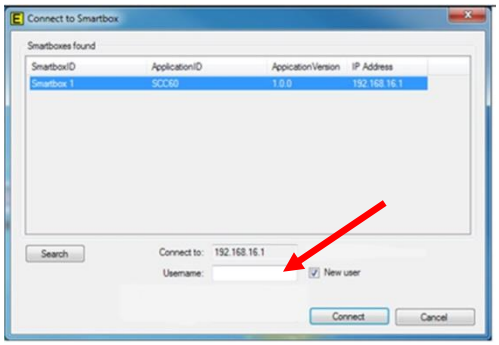
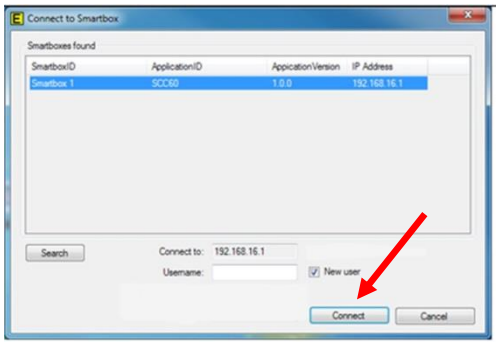
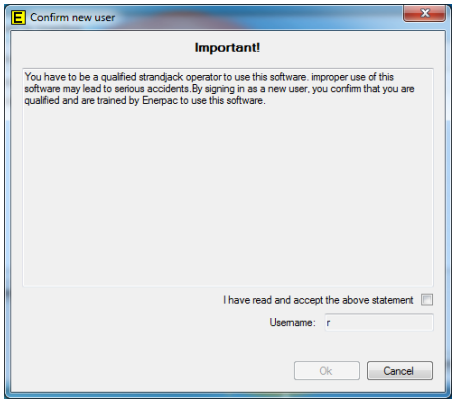
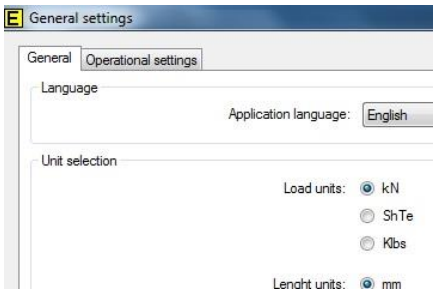
Reference is made to section 5.4 of the HPU volume; see ref 2 “Strand jack manual Volume 2: Hydraulic Power Unit (HPU)”.

5.4. Software

5.5. The strand jack

To install the application software on your laptop and make it run, proceed as follows:

1.	Open the internet browser (Wi-Fi is not required)	
2.	Populate the address bar of the browser with “http://smartbox“ *The internal webpage of the Smartbox starts.*	
3.	Click on setup in the menu bar.	
4.	Run the setup. Wait until it finished	
5.	Press “download”. *The software (the name depends on the strand jack type) is downloaded* *The blue icon appears on the desktop*	
6.	Click on the blue icon *The splash screen appears.* *On the screen the version of the software is shown.*	
7.	The software detected the presence Smartbox. The IP address of it should be shown: 192.168.16.1. If the field stays empty then • check the cables. • is the Smartbox switched on?	

8.	Create a new user by completing a username. ☞ Remember the username you entered. It is not possible to recover it from the Smartbox	
9.	Click on “Connect” *The connection between the application and the Smartbox is established.* *A message window appears.* Read the message. If agreed then fill enter a password of your choice and click Ok.	 
10.	Enter your preferences with reference to: - Language - Units in which values are displayed Use the “General” tab as described in section 6.4.1.2 “How to modify the general settings”.	

5.6. Tests after installation

Once the System is installed, it has to be tested:

- Functional tests
- Safety tests

Use is made of the laptop and the local control handheld.
For usage of those reference is made to section 6. “How to control the System”

5.6.1. Functional tests

To perform the functional tests proceed as follows:

Data communication		
1.	Switch the system on and make the hardware assignments • *Verify that no errors are shown on the laptop and on the control panel of the HPU*	☐
Movements of the jacks		
2.	Use the local control held to open and close the top and the bottom anchor. *Verify that:* • *the anchors function properly* • *the icons on the laptop reflect the real position of the anchors*	☐ ☐
3.	Use the local control handheld to extend and retract the main jack. *Verify that:* • *the jack moves properly* • *the icons on the laptop reflects the real position of the jack*	☐ ☐
Measuring devices		
4.	Calibrate the system.	
5.	Use the local control handheld to extend the main jack100 mm from the bottom. Measure by hand the moved distance and compare with the values on the screen. • *Verify that the measured value matches with the displayed value.*	☐
6.	Use the local control handheld to extend the main jack100 mm from the top Measure by hand the moved distance and compare with the values on the screen • *Verify that the measured value matches with the displayed value.*	☐
Automatic lifting and lowering functioning		
7.	Let the system carry out an automatic lifting operation without a load attached. Let preferable at least 3 cycles be performed. *Verify:* • *proper functioning of the system* • *proper automatic levelling of strand jacks* • *no error reports are given on the laptop* • *no fault indicators are lit on the HPU*	☐ ☐ ☐ ☐
8.	Let the system carry out an automatic lowering operation without a load attached. Let preferable at least 3 cycles be performed. *Verify:* • *proper functioning of the system* • *proper automatic levelling of strand jacks* • *no error reports are given on the laptop* • *no fault indicators are lit on the HPU*	☐ ☐ ☐ ☐

5.6.2. Safety tests

To perform the safety tests proceed as follows:

Oil leakages top anchor		
1.	Apply a pressure gauge on the rod side of the jack. Use the local control handheld to extend the jack. Apply full pressure. Maintain the pressure for five minutes *Verify that* • *the seals of the jack do not leak oil* • *there is no oil leakage on the piston seals* • *the pressure did not drop significantly*	☐ ☐ ☐
2.	Use the local control handheld to retract the jack. Apply full pressure. Maintain the pressure for five minutes *Verify that* • *the seals of the jack do not leak oil* • *there is no oil leakage on the piston seals* • *the pressure did not drop significantly*	☐ ☐ ☐
3.	Use the local control handheld to repeatedly extend and retract the jack for 5 mm in retracted position. *Verify that* • *the seals of the jack do not leak oil* • *there is no oil leakage on the piston seals*	☐ ☐
Oil leakages bottom anchor		
4.	Apply a pressure gauge on the rod side of the jack. Use the local control handheld to extend the jack. Apply full pressure. Maintain the pressure for five minutes *Verify that* • *the seals of the jack do not leak oil* • *there is no oil leakage on the piston seals* • *the pressure did not drop significantly*	☐ ☐ ☐
5.	Use the local control handheld to retract the jack. Apply full pressure. Maintain the pressure for five minutes *Verify that* • *the seals of the jack do not leak oil* • *there is no oil leakage on the piston seals* • *the pressure did not drop significantly*	☐ ☐ ☐
6.	Use the local control handheld to repeatedly extend and retract the jack for 5 mm in retracted position. *Verify that* • *the seals of the jack do not leak oil* • *there is no oil leakage on the piston seals*	☐ ☐
Oil leakages main jack		
7.	Apply a pressure gauge on the rod side of the jack. Use the local control handheld to extend the jack. Apply full pressure. Maintain the pressure for five minutes *Verify that* • *the seals of the jack do not leak oil* • *there is no oil leakage on the piston seals* • *the pressure did not drop significantly*	☐ ☐ ☐

8.	Use the local control handheld to retract the jack. Apply full pressure. Maintain the pressure for five minutes *Verify that* • *the seals of the jack do not leak oil* • *there is no oil leakage on the piston seals* • *the pressure did not drop significantly*	 ☐ ☐ ☐
9.	Use the local control handheld to repeatedly extend and retract the jack for 5 mm in retracted position. *Verify that* • *the seals of the jack do not leak oil* • *there is no oil leakage on the piston seals*	 ☐ ☐
Emergency buttons		
10.	Use the laptop to perform an automatic lifting operation without load. Press the emergency button on the HPU while the system is running. *Verify that* • *All movements stop* • *The HPU is shut down*	 ☐ ☐
11.	Repeat the test, but now press the emergency button on the Smartbox. *Verify that* • *All movements stop* • *The HPU (with either an electrical or a diesel engine) is shut down*	 ☐ ☐
12.	Repeat the test, but now press the HALT button on the laptop. *Verify that* • *All movements stop* • *The HPU (with either an electrical or a diesel engine) is shut down*	 ☐ ☐

6. How to control the System

This section describes how to control the system:

- using the controls of the HPU and the local control handheld
- using the screens as shown on the laptop

6.1. The Emergency buttons

Emergency stop buttons are provided:

Button		When the button is pressed then…
The HMI, running on the laptop		• The HPU's of all Strandjack units stop. • all vertical movements are stopped
Smartbox		
HPU's of the Strandjack units		• The HPU on which the button was pressed stops. All movements are stopped • If the HPU is set to Remote then other HPU's which are set to Remote stop as well.

To resolve the 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 the HPU was in Remote then the Reset button on the Smartbox is lit.
   Press that button to reset the Smartbox

4. Restart the System

6.2. Local control using the local control handheld

Reference is made to section 6.2 of the HPU volume; see ref 2 “Strand jack manual Volume 2: Hydraulic Power Unit (HPU)”.

6.3. Control panel

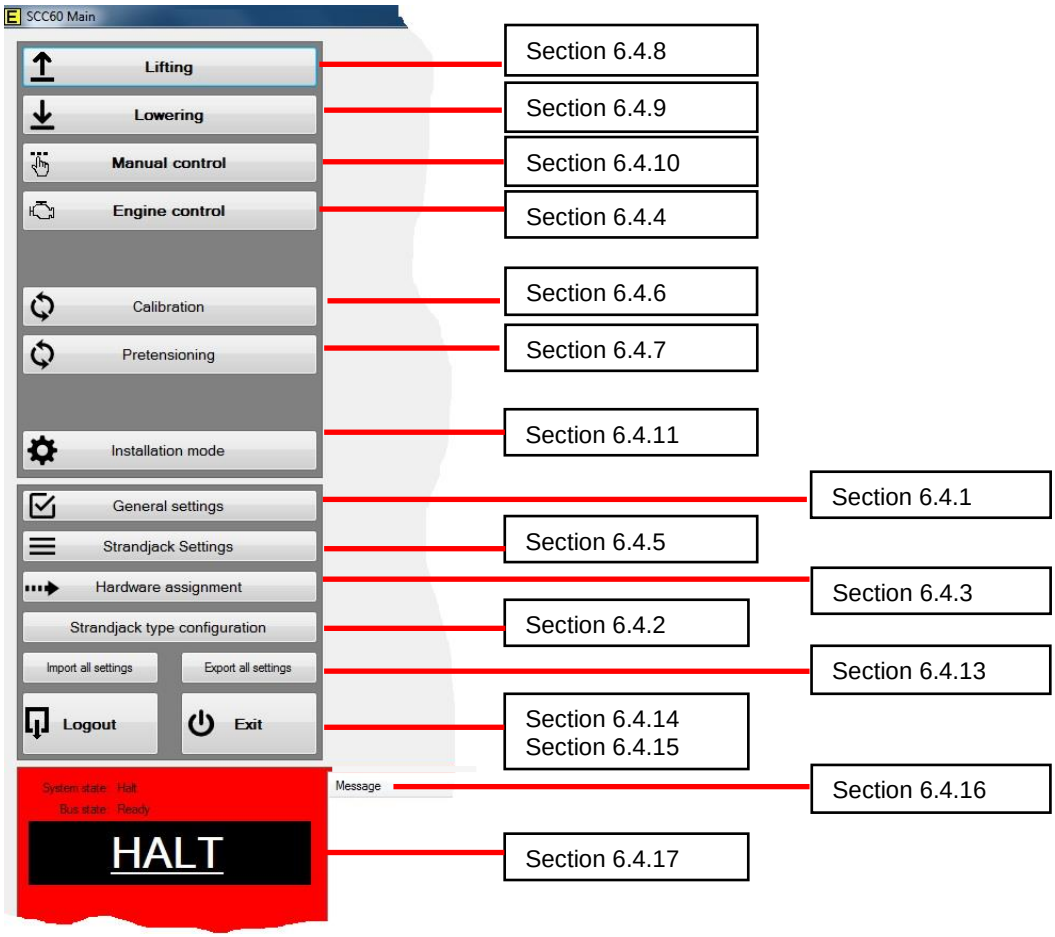
Reference is made to section 6.2 of the HPU volume; see ref 2 “Strand jack manual Volume 2: Hydraulic Power Unit (HPU)”.

6.4. Computer

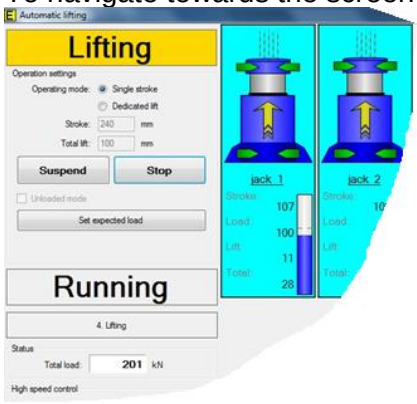
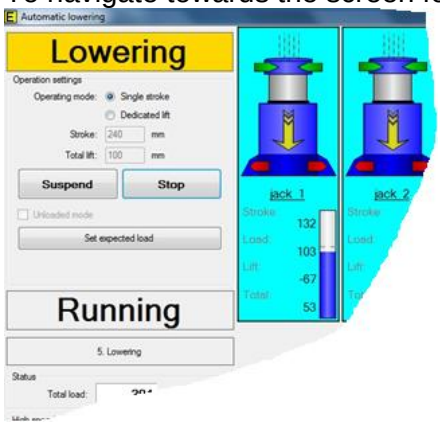
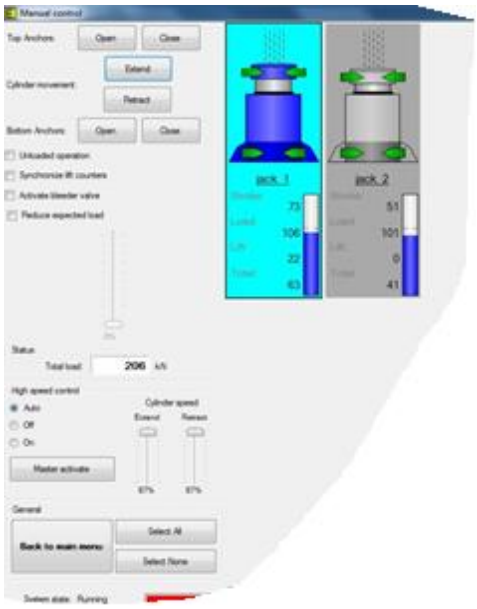
This section explains how to control the system by the application running on the laptop.

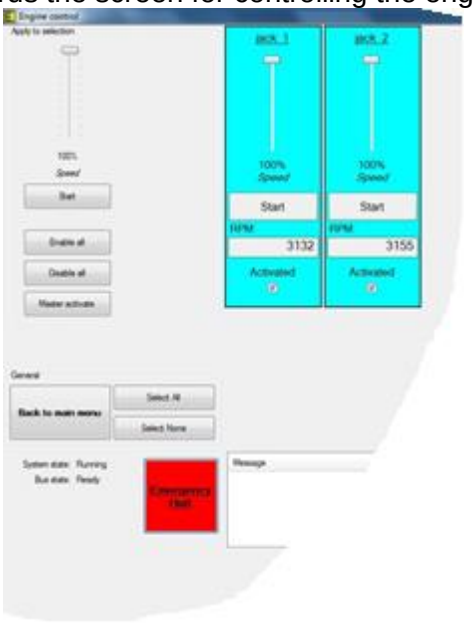
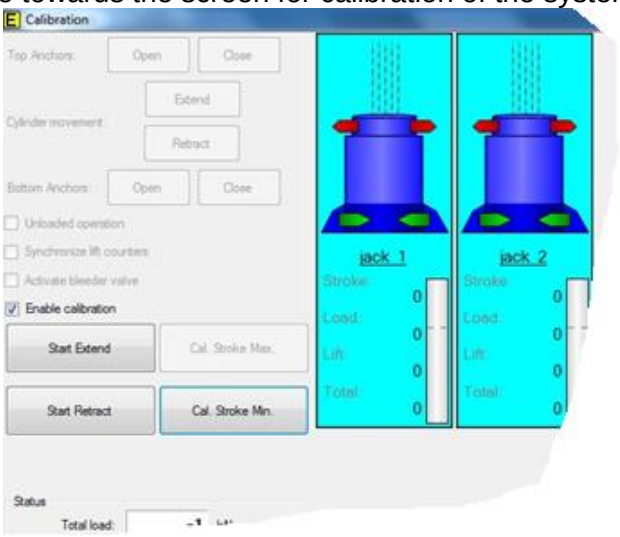
The use of the main screen and of all sub-screens is described in full detail.

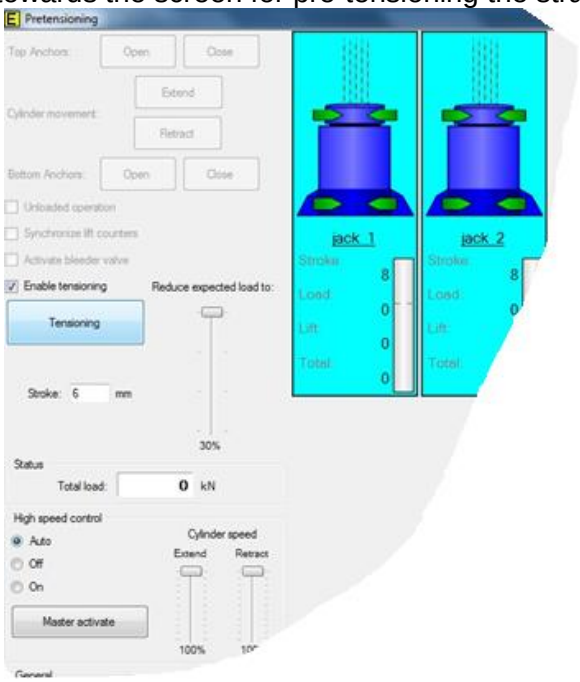
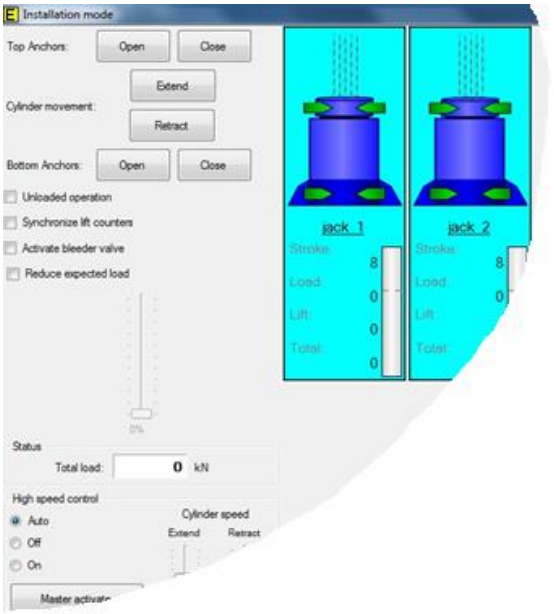
The main screen shows a set of navigation buttons.
The figure below show them, together with the sections in which the invoked functions are described:

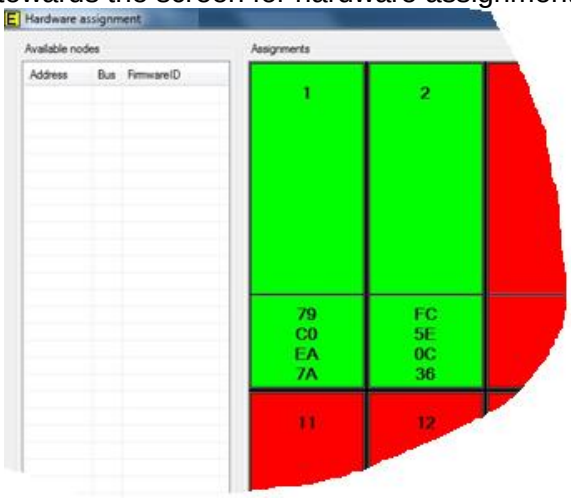


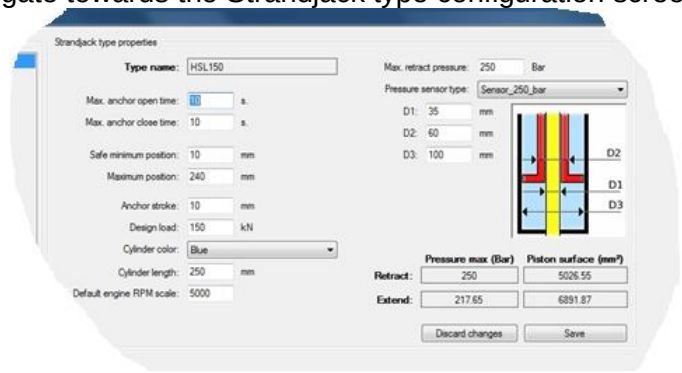
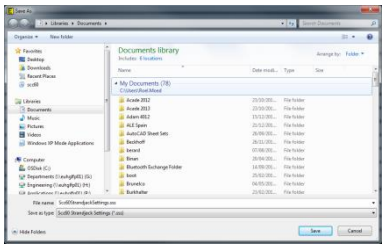
The table below shows a brief description of the invoked functions:

1.	Lifting	To navigate towards the screen for automatic lifting: 
2.	Lowering	To navigate towards the screen for automatic lowering: 
3.	Manual Control	To navigate towards the screen for controlling the system manually. 

4.	Engine Control	To navigate towards the screen for controlling the engine:  Use the screen to activate and deactivate the engine and to set its properties e.g. running speed.
5.	Calibration	To navigate towards the screen for calibration of the system: 

6.	Pre tensioning	To navigate towards the screen for pre-tensioning the strands:  Pre-tensioning means: putting force on the strands without real lifting the load.
7.	Installation mode	To navigate towards the Installation mode screen. Installation mode is similar to lifting / lowering, but without safeguarding.  Use installation mode in emergency cases only

8.	General settings	To navigate towards the screen for general settings: In this screen you can set your own preferences with respect to language and the units in which the values are shown.
9.	Strandjack settings	To navigate towards the Strand jack configuration screen: In this screen you can set • The alias of the units • Type of applied strand jack
10.	Hardware assignment	To navigate towards the screen for hardware assignments.  On this screen you are enabled to assign the MAC addresses to physical the layout of your strandjack system.

11.	Strandjack type configuration	You navigate towards the Strandjack type configuration screen:  Here you can edit the properties of strand jack types, and add new types.
12.	Import all settings Export all settings	To import all settings of the program from the hard drive or external storage device and to store the settings. 
13.	Logout	To log of. The Smartbox keeps running
	Exit	To log off and to stop the smartbox
14.	Message	Field for showing system messages
15.	HALT	To switches the system off immediately. The cylinders will not move anymore.

6.4.1. General settings

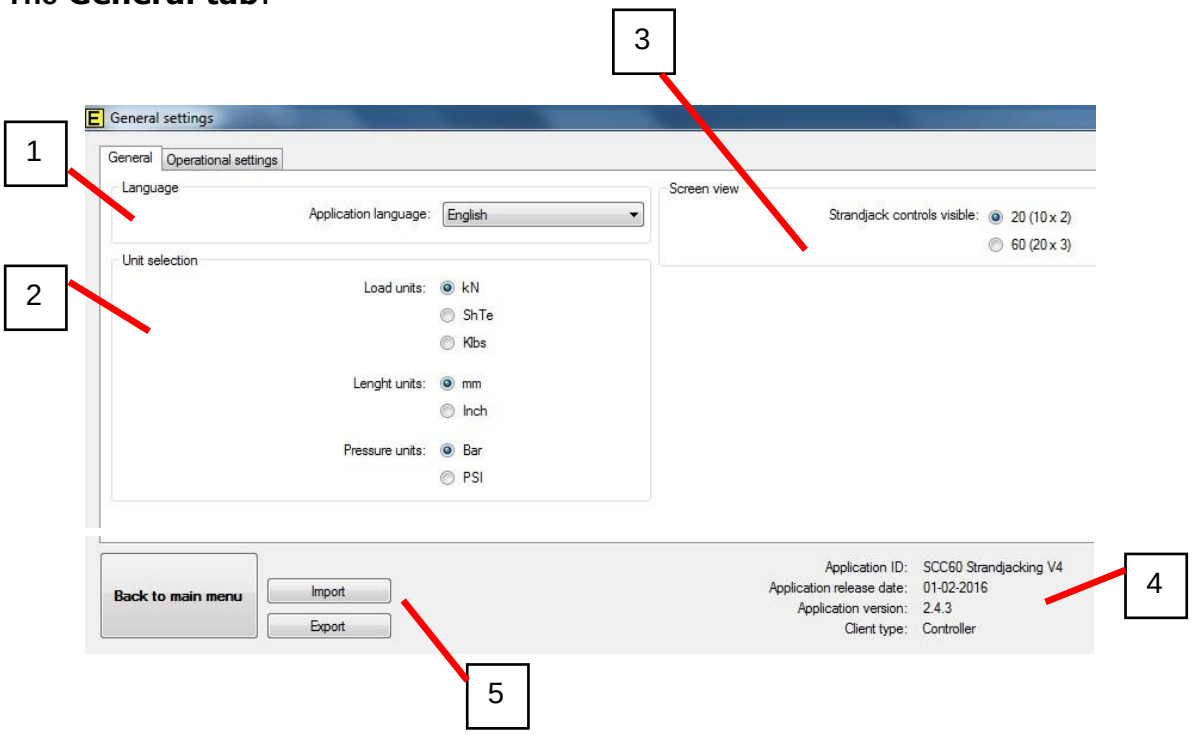
This function enables the user of the system to modify settings and system parameters.

6.4.1.1. The General settings screens

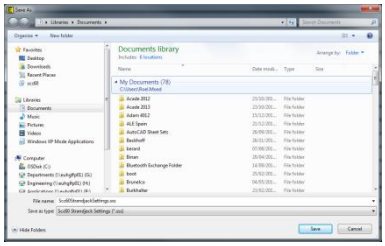
The screen for General settings has three tabs:

- The General tab:
  settings of language, and the units in which values have to be displayed
- The Operational settings tab:
  Parameters for the system e.g. time-out values and allowed overloads.
- The IO and Alarm config tab:
  Setting of RPM alarm
  To invoke this function press “General settings” and then press CTRL+ALT+R

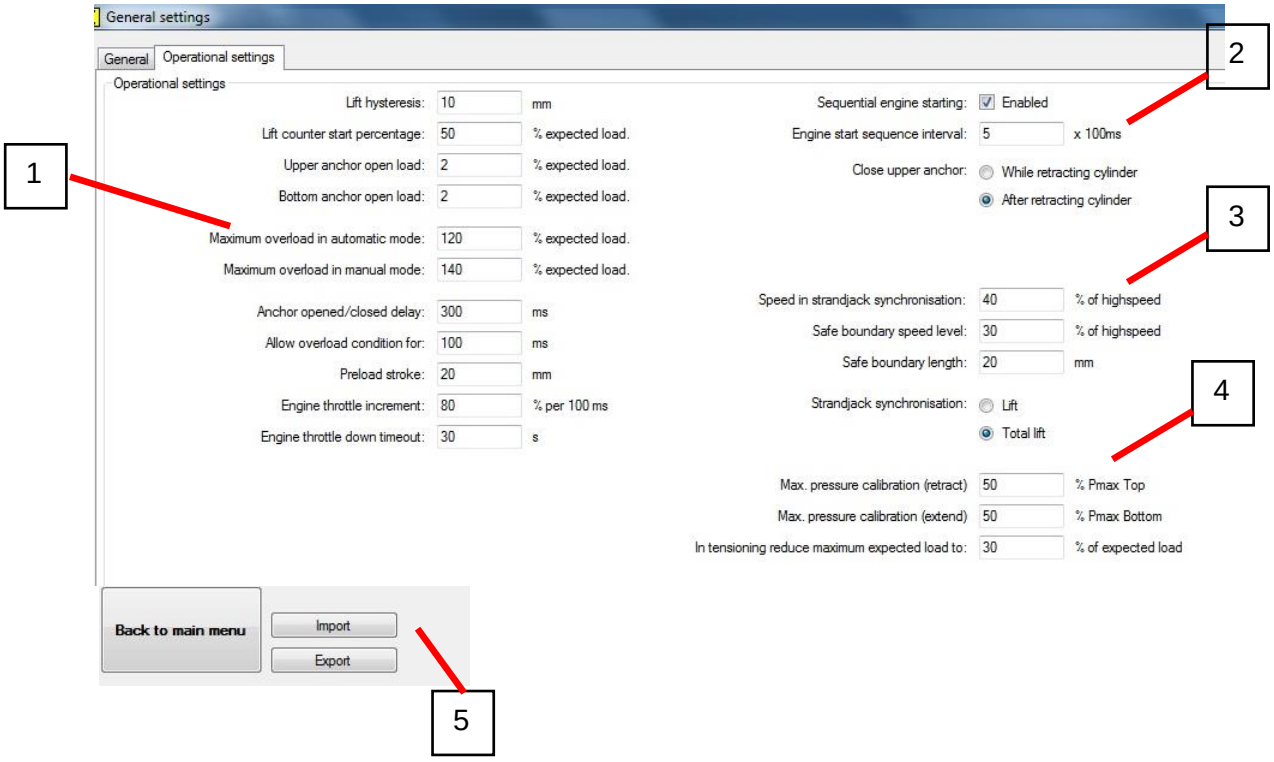
The General tab:



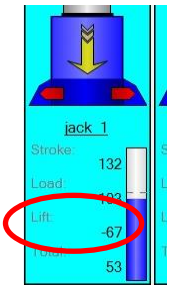
1.	Language	Pick your favourite language: English, Dutch, Polish
2.	Unit selection	Pick your favourite units for load, length and pressure
3.	Screen view	Set the number of strand jack icons you want to have displayed on the screen: • 2 rows of 10, or • 3 rows of 20
4.	Name and version of the software	Use these data when communicating with Enerpac about the software
5.	Import	To import all settings of the program from the hard drive or

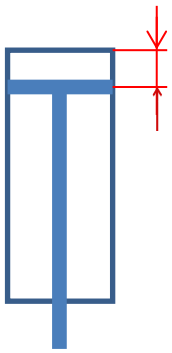
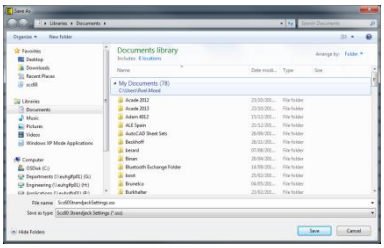
	Export	external storage device and to store the settings. 

The Operational settings tab:



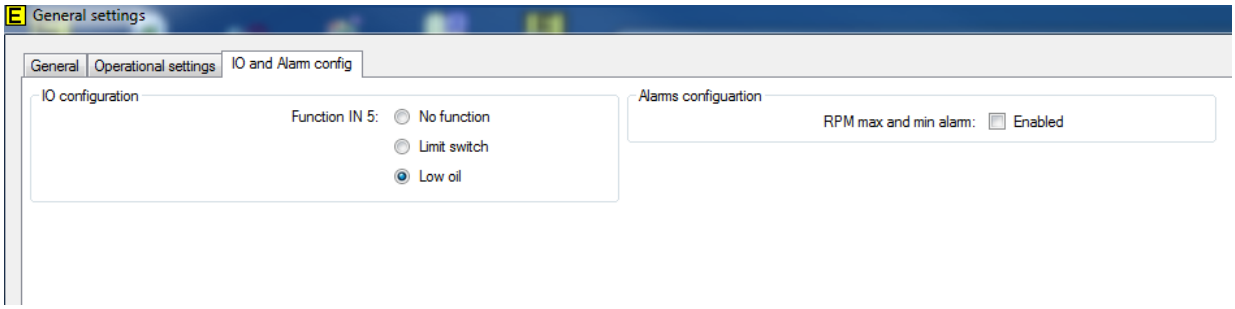
All parameters have been set when the system was delivered.
It is not likely that you would have reason to change any of these settings.

1.	Lift hysteresis	The bandwidth in which the lifting heights of the strand jacks are kept while lifting (synchronisation). The higher the value, the more the lifting heights of the strand jacks can differ during operation. A typical value is 10 mm. *(NB: the term "hysteresis" is used here in another meaning than its actual meaning of the word.)*
	Lift counter start percentage	"Lift" is the distance the load moved within the current cycle →. So, the value is reset every cycle. To eliminate measuring errors, "Lift" only starts counting when a certain percentage of the expected load was sensed by the system. That percentage is the "Lift counter start percentage". 
	Upper anchor open load Bottom anchor open load	Opening of an anchor while it is bearing load is dangerous: the load would drop. Since the load will never be exactly zero, a limit has to be set for allowing opening of the anchor. Example: When you put 5% for this value, then 95% of the weight of the load should have been transferred before this anchor can be opened.
	Maximum overload in automatic mode	If the measured load exceeds this value • the automatic cycle stops • a failure message is reported To get out of the overload situation, you might use manual mode.
	Maximum overload in manual mode	If the measured load exceeds this value • the moving of the strand jacks stops • a failure message is reported To solve the problem you might increase the expected load. Keep thinking is recommended.
	Preload stroke	Within a movement of this size the main jack has to experience the load.
	Engine throttle incrementing	The rate of the speed change of the HPU. The settings may depend on the behaviour and the applied type of HPU, in combination with the weight and sensitivity of the load.
	Engine throttle down timeout	If the engines run at increased speed but no power is required anymore, the speed is decreased to minimum, but with a delay. The settings may depend on the behaviour and the applied type of HPU.
2.	Sequential engine starting	If enabled the motors are started sequentially, not simultaneously. This may prevent overload of the electricity supply.
	Engine start sequential interval	Delay time for sequentially starting
	Close Upper Anchor	• While retracting cylinder: the upper anchor is being closed while the main jack is still retracting • After retracting cylinder: the upper anchor is only closed when the main jack is fully retracted

3.	Speed in Strandjack synchronisation.	If a Strandjack get ¾ of the Lift hysteresis [see 1] ahead of the others then its moving speed will reduced with this percentage
	Safe boundary speed level	The moving speed of the strandjack will decrease when it gets into the safe boundary length, to enable a smooth stop.
	Safe boundary length	The end position of the stroke of the strand jack minus this value. Within this area the main jack moves with Safe boundary speed level. 
	Strandjack synchronisation	The lifting heights of all strand jacks is kept equal automatically (“hysteresis”). But the reference point can be chosen: • Lift position Reference point for automatic levelling of the load (“hysteresis”); is reset after each cycle. • Total lift Reference point which is set once at start of the operation and is not reset between the cycles “Total lift” avoids accumulating errors. But in practice “Lift position” shows less problems w.r.t. synchronization alarms. **NB:** Use “Total lift” after lifting with not all available strandjacks, in order to keep prevent inequality.
4.	Max pressure calibration retract	When calibrating, the end-of-stroke positions of the jacks are detected by an increase of the pressure.
	Max pressure calibration extend	
	In tensioning reduce maximum expected load to	The maximum force used for pre-tensioning. The value might depend on the type of the applied strands.
5.	Import Export	To import all settings of the program from the hard drive or external storage device and to store the settings. 

IO and Alarm Config:

To invoke this function press CTRL+ALT+R

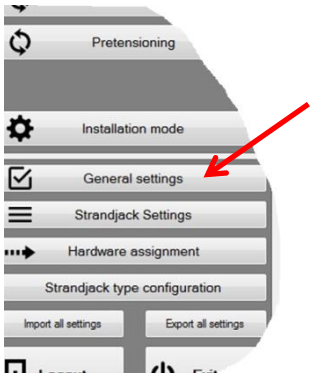


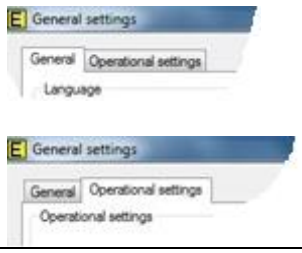
1.	Function IN 5	IN5 is a spare input to which the following sensors can be connected: • No function • Limit switch A switch can be mounted to stop the jack at a defined stroke. • Low oil A sensor which detects low oil level
2.	Alarms configuration	Check, to enable automatic raising of an alarm when the RPM of the HPU exceeds the limits.

6.4.1.2. How to modify the general settings

Hazard
Incorrect values of parameters may cause **hazards to personnel** and the **equipment**.

To modify the settings of the system proceed as follows:

1.	Invoke the function via the main screen	

2.	Select a tab for General settings of Operational settings.	
3.	Change the value of parameters on one of the three screens. The values will immediately be active after you changed then.	
4.	To import all settings of the program from the hard drive or external storage device and to store the settings.	
5.	Press “back to the main menu” to finish	

6.4.2. Strandjack type configuration

This function enables the user

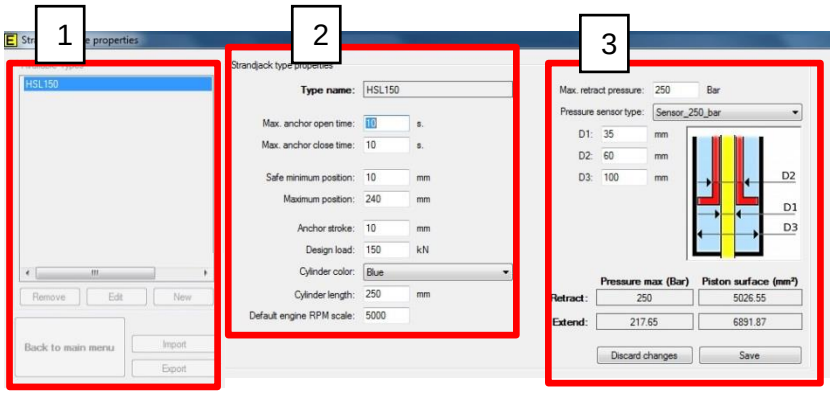
- to edit the properties of pre-defined main jack types, and
- to add new types.

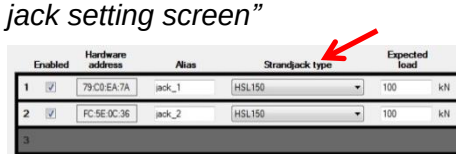
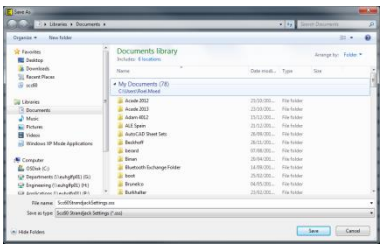
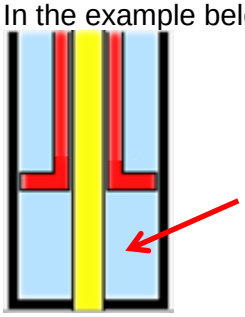
- Though this mode is called “configuration”, in this mode no jack types are configured, but only defined.
  The actual configuration (which means: take a certain type in use) is performed in section 6.4.5 “Strandjack Settings”
- At delivery, your system was already provided with a default set of types. It is not likely that you have to edit the properties of existing types, or that you have to add new types.

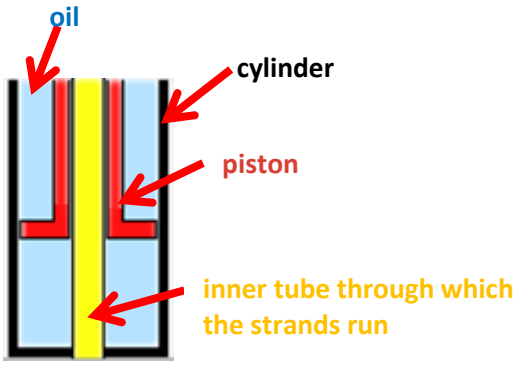
Caution
Leave changing of the jack settings to experts

6.4.2.1. The strand jack type properties screen

The layout of the screen is as shown below:

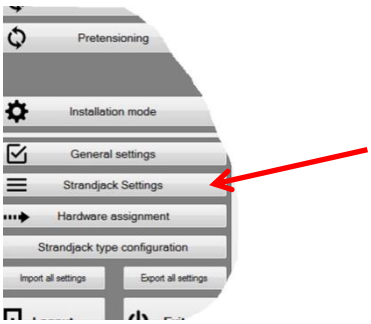
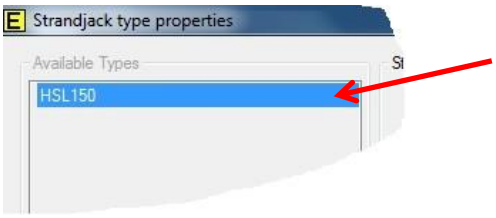


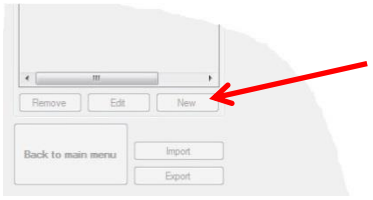
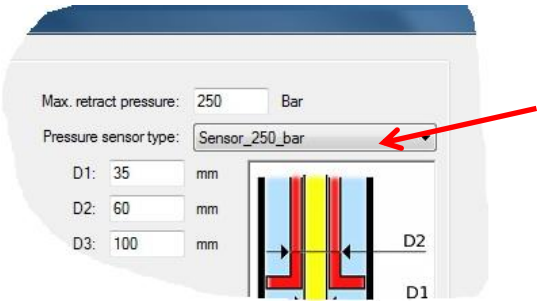
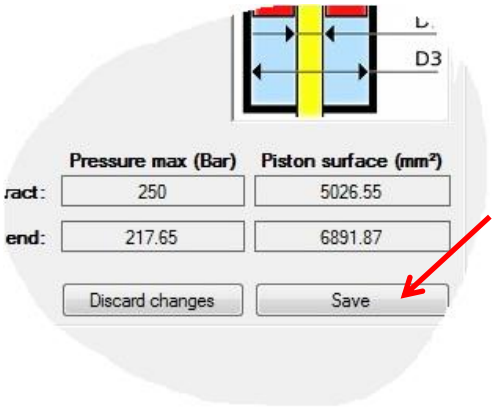
1.	Available jack types	A list of the already defined jack types *Note that the currently applied jack types are shown in window Strand jack Settings window; see section 6.4.5.1 "The strand jack setting screen"* 
	Remove Edit New	To handle a jack type
	Import Export	To import all settings of the program from the hard drive or external storage device and to store the settings. 
2.	Max. anchor open time Max. anchor close time	Timeout value for opening / closing action of the anchor *If within this timespan the anchor did not open / close, the system will stop. A failure message is generated.*
	Safe minimum position Safe maximum position	The operational minimum / maximum stroke of the main jack. *To prevent the piston hits the ends of the cylinder, some space has to be left at both ends.*
	Anchor stroke	When lifting and the main jack reaches the top position, the main jack retracts over a distance of the "anchor stroke". Now, the load is taken over by the bottom anchor, and the wedges of the top anchor can be opened.
	Design load	The nominal capacity of the strand jack. *If the design load is exceeded, the system will stop.* *A failure message is generated.*
	Cylinder color	The color of the inner side of the main jack as shown. In the example below it is blue. 
	Cylinder length	The maximum stroke of the main jack.
	Default engine RPM scale	The analog input signal from the diesel engine is scaled by this value.
3.	Max retract pressure	Maximum pressure on the rod side of the jack. *If the pressure exceeds this value, the system will stop.* *A failure message is generated.*

	D1, D2, D3	Dimensions of the main jack. D1 = Ø inner tube D2 = Ø main cylinder D3 = Ø piston *These values are applied by the software for load calculations.* 
	Pressure sensor type	The applied sensor type, as defined in the hydraulic design of the system.
	Retract / Extend pressures	Max allowed pressures The values are used by the software to calculate the load
	Retract / Extend piston surfaces	The values are used by the software to calculate the load
	Discard changes	Leave the screen without having made any changes
	Save	Save the changes you made. The new values are taken into account immediately.

6.4.2.2. How to modify the strand jack type settings

To modify the types of main jacks, or to add new types, proceed as follows

1.	Invoke the function via the main screen	
2.	Pick the strand jack type that you want to edit	

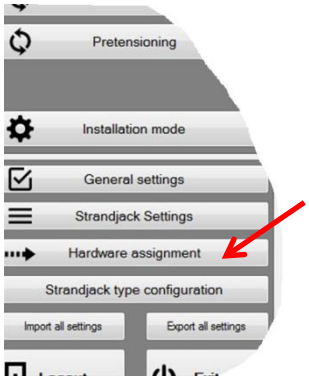
3.	Use Remove, Edit or New	
4.	Select the sensor type which has to be applied for the selected strand jack type	
5.	Edit the numeric values	
6.	Save the settings or discard your changes	

6.4.3. Hardware assignment

Hardware assignment enables the operator assign to make the MAC addresses of the individual strand jack units to the computer.

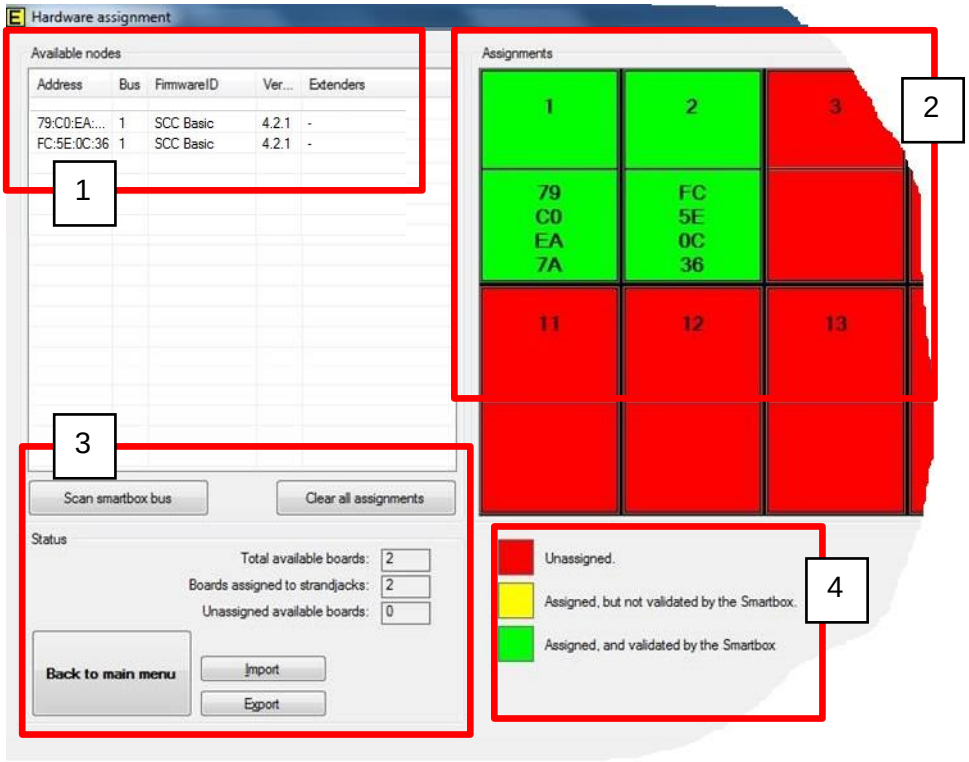
6.4.3.1. The hardware assignment screen

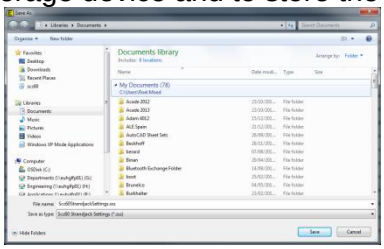
Enter the mode via the main screen:



The layout of the screen is shown below:

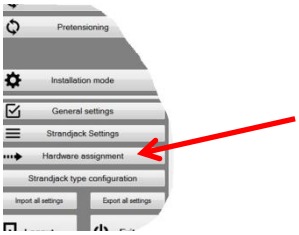
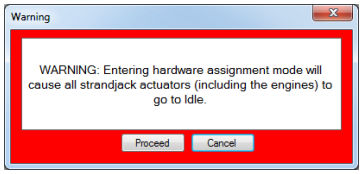
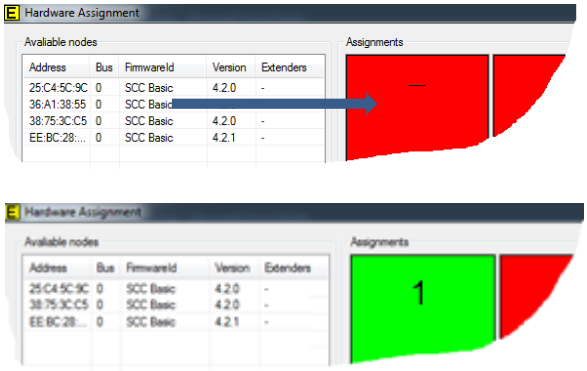
Default the screen shows 20 strand jack assignments.
If you want to operate more than 20 strand jacks then use the General settings “Strandjack controls visible” item to make 60 strand jack assignments shown. Reference is made to section 6.4.1 “General settings”.



1	Available nodes: Address	The list of all strand jack units as detected by the Smartbox. The MAC address of a HPU. *The MAC addresses of the HPU's are shown on their name-plates:*
2	Assignments	Each block represents a 'controller' of the Smartbox. To each controller a strand jack unit can be assigned. • Red: no strand jack unit is assigned • Yellow: assigned but not recognized • Green: a strand jack unit is assigned; its MAC address is shown in the green block.
3	Scan smartbox bus	Press to scan for connected HPU's. This might be necessary when a HPU was switched on while the program was already running. Detected HPUs show up in the list "Available nodes".
	Clear all assignments	All assignments are cleared. All blocks in the "Assignments" part turn red
	Total available boards Boards assigned to strand jacks Unassigned available boards	Statistics about the assignments
	Import Export	To import all settings of the program from the hard drive or external storage device and to store the settings. 
4	Legend	As described in the picture

6.4.3.2. How to perform hardware assignments

1.	Set the number of strand jack controllers you want to have displayed: 20 or 60. Use General settings "Strandjack controls visible"; reference is made to section 6.4.1 "General settings".	

2.	Click on Hardware assignment in the main menu	
3.	Read the warning. Then confirm. Enter the password “1234”	
4.	Select a line in the “Available nodes” pane and drag towards one of the controllers in the Assignments pane *The block in the Assignments pane turns green.* *The dragged line has disappeared from the Available nodes pane.*	
5.	Perform [1] .. [4] for all strand jack units	

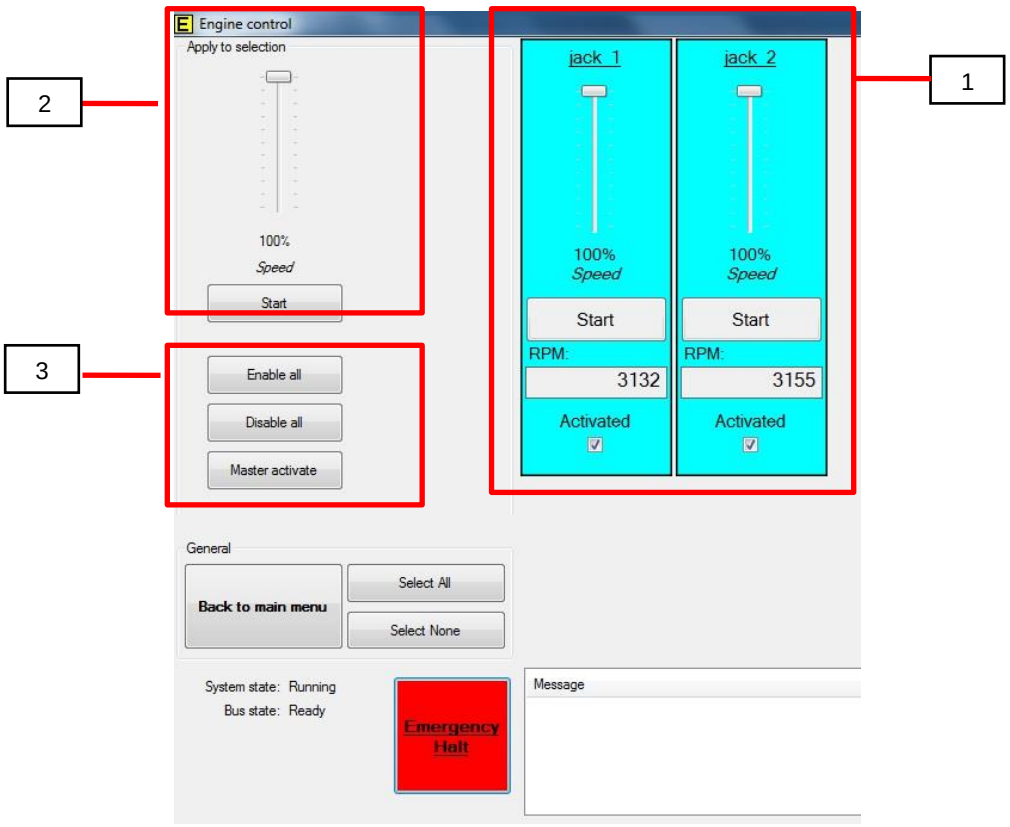
6.4.4. Engine control

Engine control enables the operator to perform settings for the engines of HPU’s:

- Activation of the HPU’s.
  Activation is a preparation phase of the HPU’s, prior to starting.
- Setting of running speed if the engines of the HPU’s.
  It is possible to differentiate the running speeds for individual HPU’s.
  This may be useful when strand jacks of different types are used.
- Start/stop of the engines

6.4.4.1. The engine control screen

The layout of the screen is as follows:

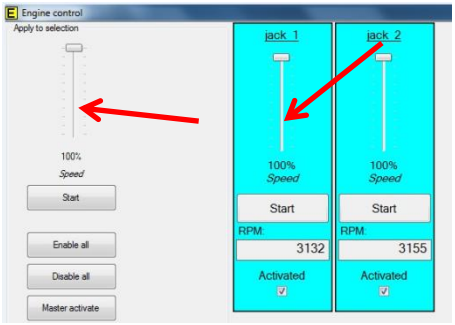


Some terms explained here in advance:

Term	Diesel HPU	Electro HPU
Select	The HPU is getting controllable by the program	
Activate	The machinery is set to ignition; the electric circuits are switched on.	The motor starts running
Start	The starting-engine of the diesel is activated. The diesel engine will start.	(has no meaning)
Enable	All selected HPU's are activated at the same time.	
Master activate	All selected HPU's are activated one by one, after each other. The time gap delay between the starts is set in General settings.	

1.	Icons Slider for speed Start button RPM Activated checkbox	• Click on an icon to select the strand jack. *The icon turns blue.* *Commands can be passed to the HPU* • Click again to deselect *The icon turns grey* *The HPU will be def for commands* To set the running speed of the HPU To start the HPU Running speed of the HPU • Check the box to activate *The HPU is activated* • Check again to de-activate. *The motor is switched off.*
2.	Slider for speed Start button	To set the speed for all enabled HPU's simultaneously. To start the engines of the selected HPU's.
3.	Enable all	To enable all selected strand jack. Diesel HPUs are put to ingition Electro HPU's are running
	Disable all	The motors of the HPU's are stopped
	Master activate	Activate all selected strand jacks at once

6.4.4.2. How to perform engine control

1.	Invoke the function via the main screen	
2.	Click on the icons of the HPU's you want to apply. *The icons of the selected systems turn blue*	
3.	Check the checkbox "Activated" of the selecter HPU's. *Diesel HPU's are set to ignition* *Electro HPU's will start running*	
4.	Click on the Start button of the selected HPU's *Diesel HPU's will start running*	
5.	To adjust the running speeds of the HPU's: • Use the main slider to adjust the speed of all HPU's simultaneously • Use the sliders of the individual systems for individual speed regulation. This option is useful when different types of jacks are applied. *The running speed of the engine are adjusted*	

6.4.5. Strandjack Settings

This function enables the user to define the properties of the applied strand jacks:

- hardware addresses
- aliases
- types

Other settings in this mode are:

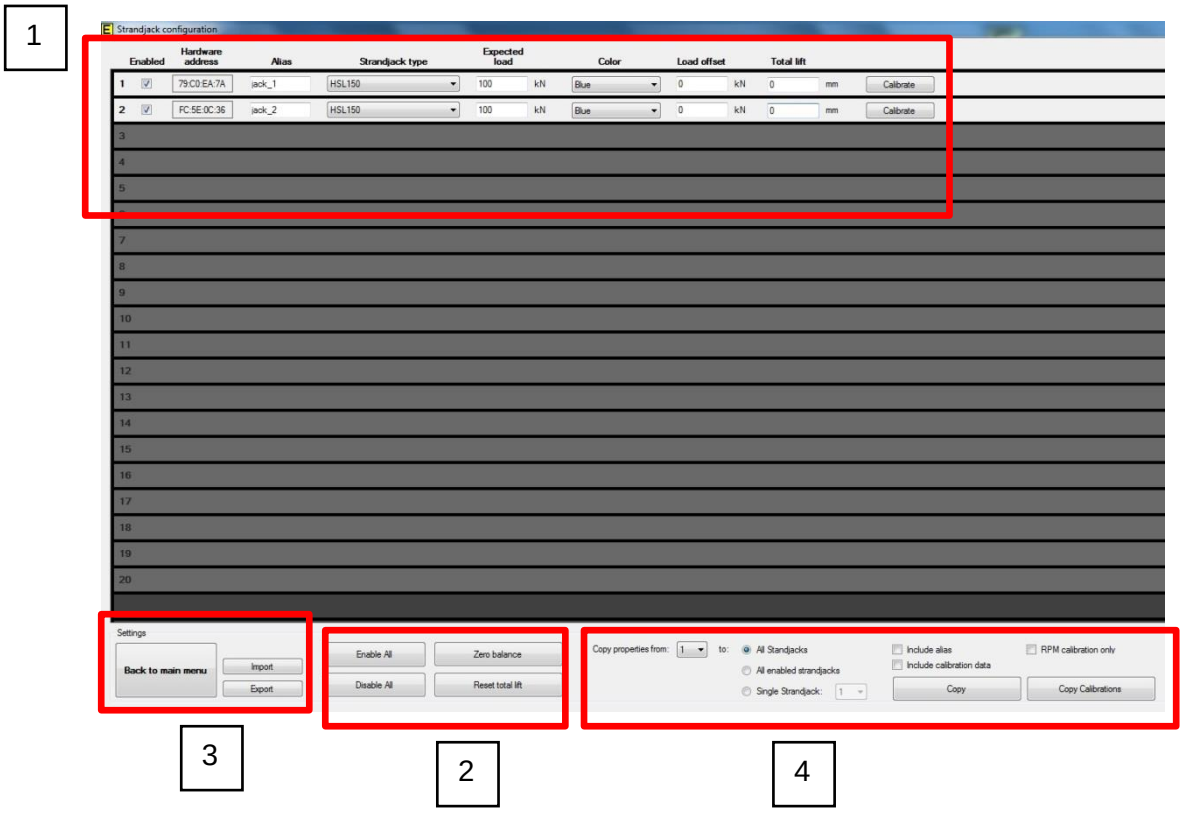
- the expected load for the current operation
- the load offset
- the total lifting height

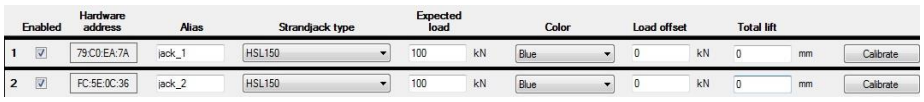
Operations which can be executed in this mode are:

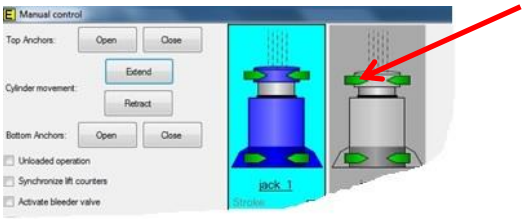
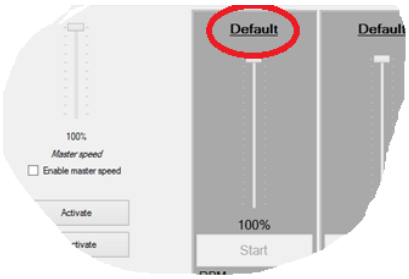
- Import / export of settings
- Enable / disable strand jacks

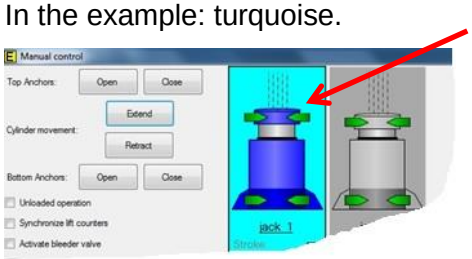
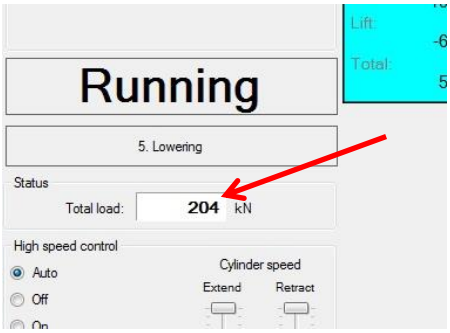
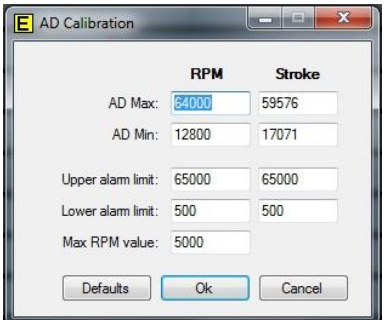
6.4.5.1. The strand jack setting screen

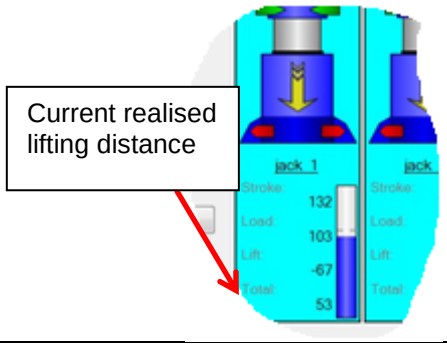
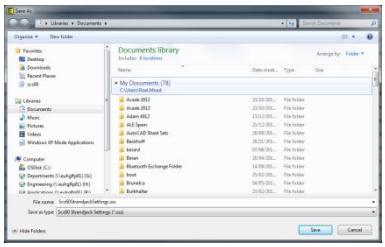
The layout of the screen is shown below:



1.	

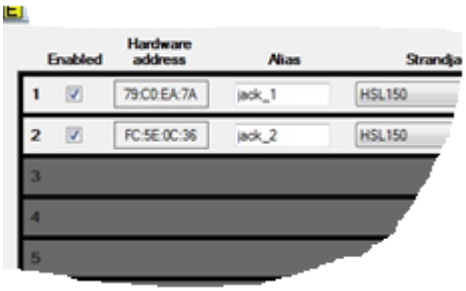
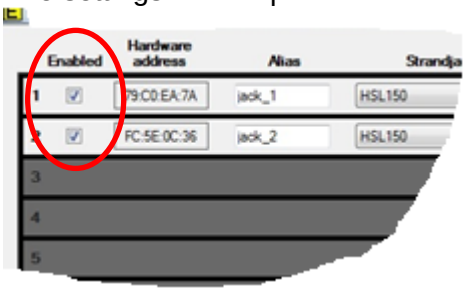
	Enabled	Check the box to enable the strand jack. Enabling is only possible when hardware assignment was successfully; see section 6.4.3 “Hardware assignment”. When enabled: • the strand jack is controllable and will follow commands. • the strand jack becomes visible on the control screens of ○ lifting ○ lowering ○ manual control ○ engine control 
	Hardware address	The MAC addresses of the strand jacks. Those are visible on the identification plates.
	Alias	You can give descriptive names to strand jacks, e.g.: Left | Right, One | Two. The Aliases show up on the control screens and in the failure messages of the system. 
	Strandjack type	To select strandjack types from a predefined list. *(Jack types can be defined in the menu “Jack configuration”; see section 6.4.2 “Strandjack type configuration”* Different strand jack types may be applied within one system configuration.
	Expected load	The weight of the load which is going to be lifted. By default this value is set equal to “maximum design load” as set in the Jack Types window. Here you can modify the value. Enter accurate values; they’re used for safety calculations. Inaccurate or wrong values will cause the system stop. Error reports will show up on the display of the laptop.

	Color	To set the colour of individual strand jack icons on the screen of lifting, lowering, manual control and engine control. In the example: turquoise.  Usage of different colors may be helpful to recognize different types of strand jacks.
	Load offset	To correct the load as measured by the system with a fixed offset for tara weight. This enables you to let only the **net** weight of the load be displayed. The field represents the total weight of the parts which do not belong to the real load, such as strands, lifting frames. 
	Total Lift	The required distance the load has to be lifted. • Upwards (lifting) is positive. • Downwards (lowering) is negative. The value can be set at any time in the settings menu.
	Calibrate	To show the calibration values and the limit values for alarms. 
2.		
	Enable All Disable All	To enable / disable all HPU's simultaneously. The strand jack becomes visible on the control screens; see earlier.
	Zero Balance	To reset the measured load. The load is calculated from the pressure inside the main jack. When the top anchor is in opened position, the load is held by the bottom anchor, so the measured load should be indicated '0'. If the value deviates from 0, use this button to zero the value.

	Reset total lift	To reset the displayed lifting height (lift) of <u>all</u> strand jack systems. When the load has been attached to the strand jacks the lift counters may differ. Use the button when you're about to start lifting. 
3.		
	Import Export	To import all settings of the program to and from the hard drive or external storage device and to store the settings. 

4.

The buttons in this area enable the operator to copy settings from one strand jack unit to another

Copy properties from	The strandjack which will be the source of the data
to	• All Strandjacks The settings area copied to all strand jacks in the list, even those who are note enabled:  • All enabled strand jacks The settings area copied to the “Enabled” strand jacks:  • Single Strandjack use the drop down menu to pick the destination
Include alias	Check the box if you want to copy the logical name as well. *(This would be a bit weird, since it is more logical to give the strand units unique names.)*
Include calibration	Check the box if you want to copy the calibration values as well. *(This would be a bit weird, since the calibration values do belong to specific strand jack units.)*
RPM calibration only	Check the box if you want the RPM calibration being copied, but not the Stroke.

Copy	Press the button to copy.
	The following values are copied:
	• Alias (if “Include alias” is checked)
	• Strand type
	• Expected load
	• Colour
	• Load offset
	• Total lift
	• Calibration data (if “Include calibration data” is checked)
	  ○ RPM
	  ○ Stroke (if “RPM calibration only” is NOT checked)

5.	Copy Calibrations	Press the button to execute the copy action.
		The following values are copied:
		• Calibration data (if “Include calibration data” is checked)
		  ○ RPM
		  ○ Stroke (if “RPM calibration only” is NOT checked)

6.4.5.2. How to modify the strand jack settings

Just edit the values on the screen.
They are applied immediately; no confirmation is required.

6.4.6. Calibration

This function enables calibration of sensors within the system.

Calibration is the process to line-up the analogue / digital numeric input values which represent the strokes of the cylinders, with the real strokes.

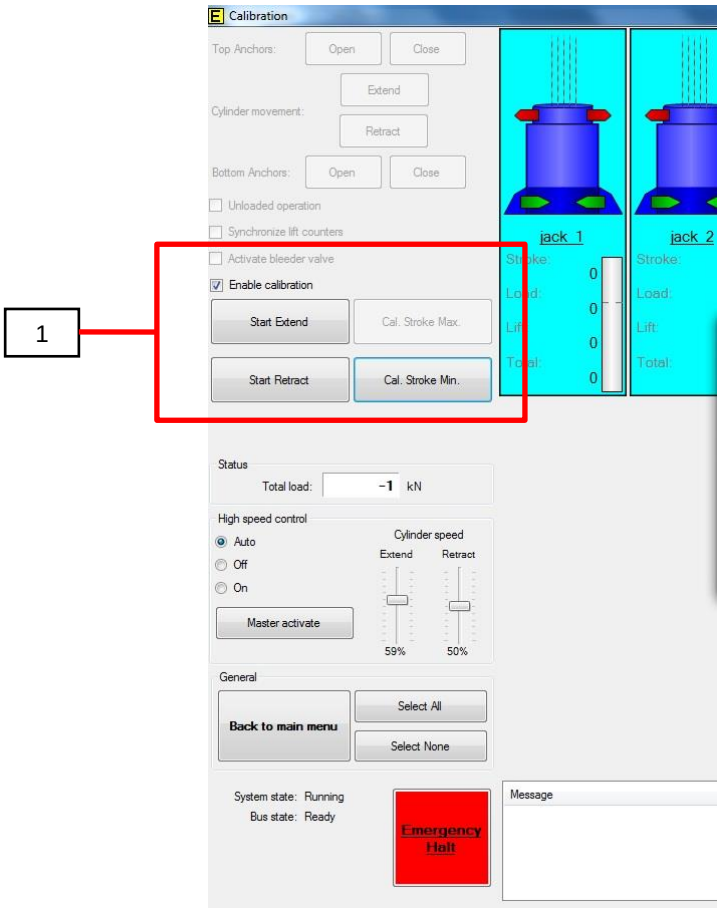
Calibration has to be performed
- every time the system is set up for a lifting operation
- if you changed the position of the HPU in the settings menu after calibration was performed.

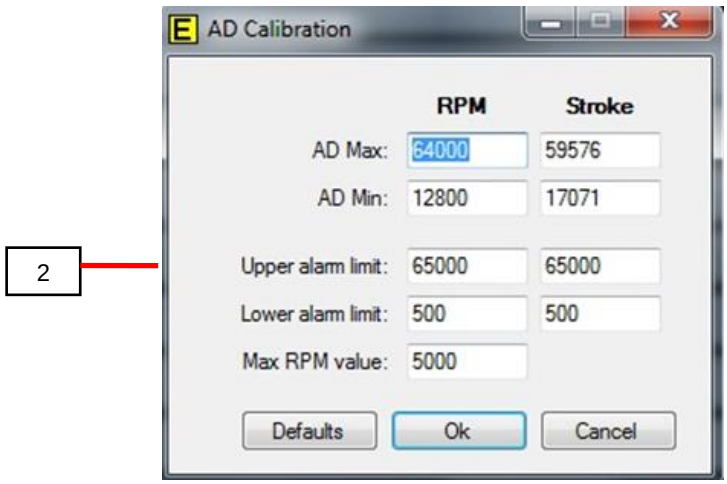
The basic principle of calibration is:
1. The cylinders are extended to the max.
   The current input value is regarded as the value representing the maximum extension.
   (The value is shown in the strandjack type properties menu.)
2. The cylinders are retracted to the minimum
   The current input value is regarded as the value representing the minimum extension.
   (The value is shown in the strandjack type properties menu.)

Preconditions for calibrations are:
- the bottom anchors should be closed
- the top anchors have to be opened
- the speed sliders have to be set to 50%

6.4.6.1. The calibration screen

The layout of the screen is shown below:





The items which are specific for calibration are described below:

<table>
<tr><td>1.</td><td colspan="2">Start extend

Cal Stroke max.

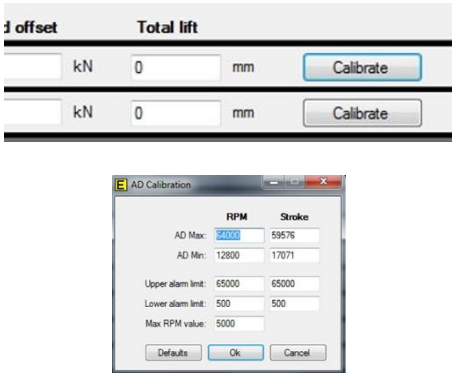
Start retract

Cal. Stroke Min.</td><td>To start the calibration process of the maximum value.
The selected strandjack(s) are extended automatically to their max position.

To save the calibrated value of the maximum stroke.

To start the calibration process of the minimum value.
The selected strandjack(s) are retracted automatically.

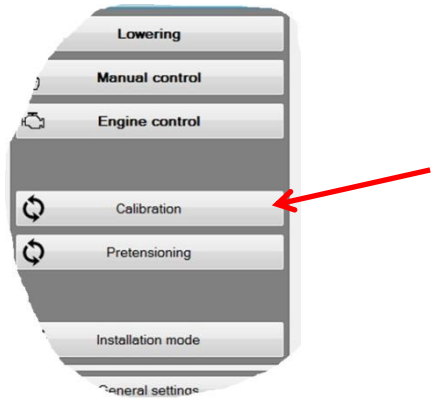
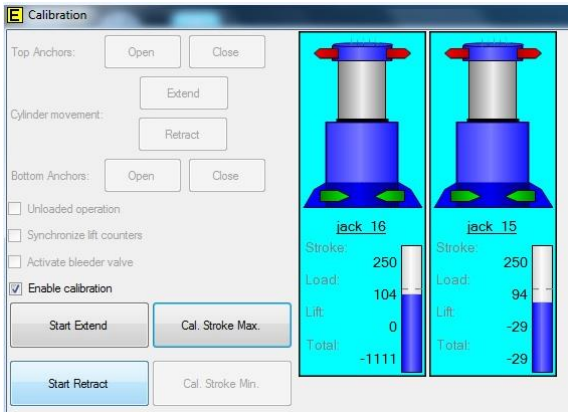
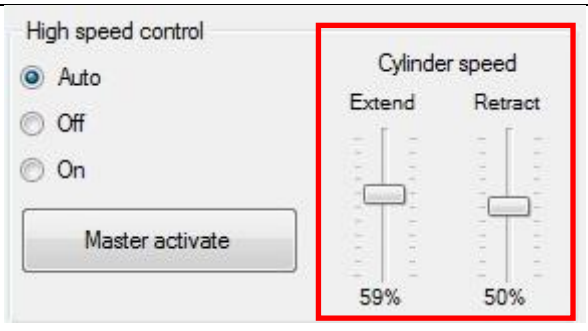
To store the calibrated value of the minimum stroke.</td></tr>
<tr><td>2.</td><td colspan="2">When using the Calibrate button

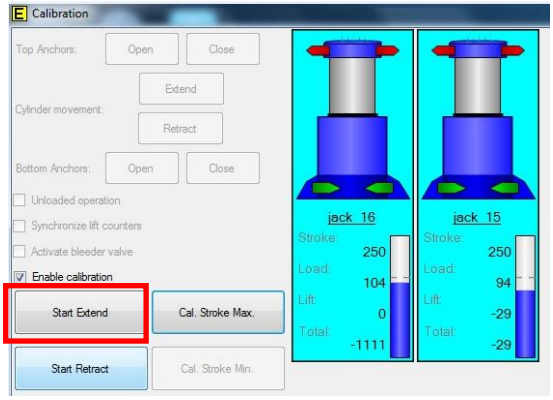
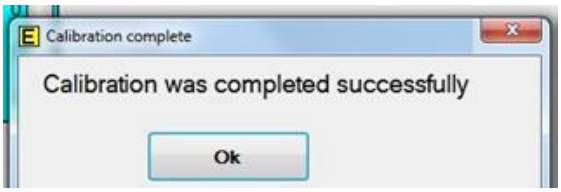
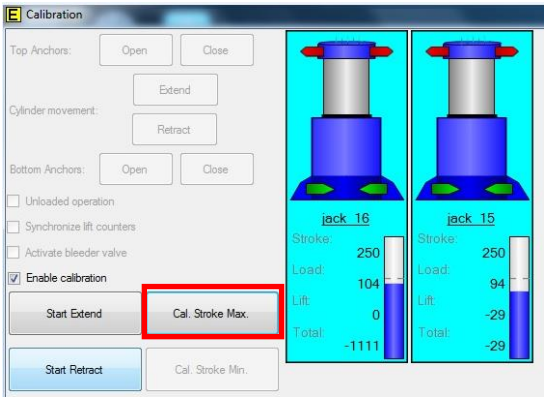
the calibration values are shown:
• the fields Ad Max and AD Min are populated by the calibration process.
• all fields in the pane can be edited.</td><td> 
</td></tr>
<tr><td></td><td rowspan="2">AD Max</td><td>RPM</td><td rowspan="2">The highest numerical value that can be received</td></tr>
<tr><td></td><td>Stroke</td></tr>
<tr><td></td><td rowspan="2">AD Min</td><td>RPM</td><td rowspan="2">The lowest numerical value that can be received</td></tr>
<tr><td></td><td>Stroke</td></tr>
<tr><td></td><td rowspan="2">Upper alarm limit</td><td>RPM</td><td rowspan="3">If the limits are exceeded
• an alarm is raised is enabled in General settings
• an error report is given
• the system stops</td></tr>
<tr><td></td><td>Stroke</td></tr>
<tr><td></td><td rowspan="2">Lower alarm limit</td><td>RPM</td></tr>
<tr><td></td><td>Stroke</td><td></td></tr>
<tr><td></td><td colspan="2">Max RPM value</td><td>The system will not let the engine run faster than this value</td></tr>
<tr><td></td><td colspan="2">Defaults</td><td>To set all fields to the factory defaults</td></tr>
<tr><td></td><td colspan="2">Ok</td><td>To confirm the values.
The values are saved.
They are applied immediately.</td></tr>
<tr><td></td><td colspan="2">Cancel</td><td>To leave the pane</td></tr>
</table>

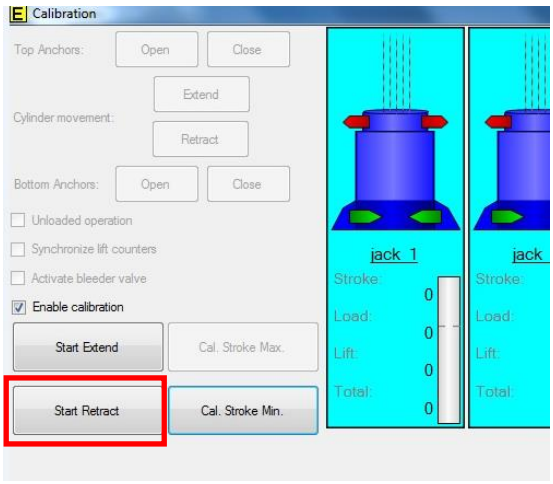
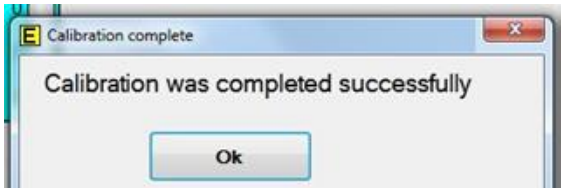
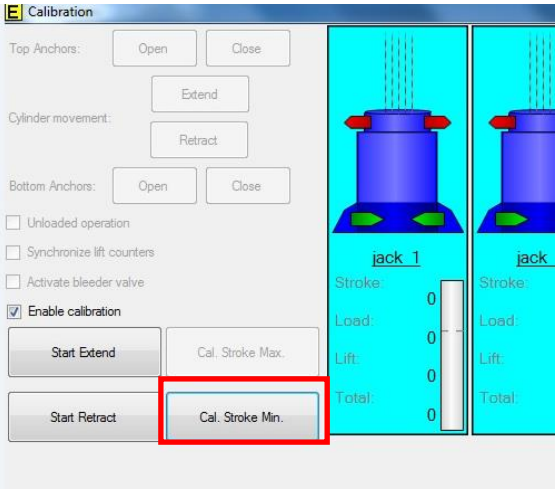
6.4.6.2. How to calibrate

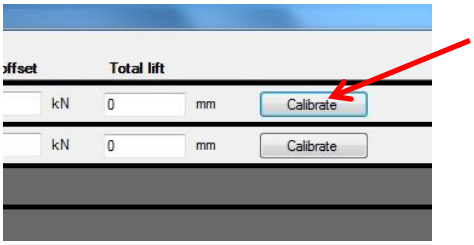
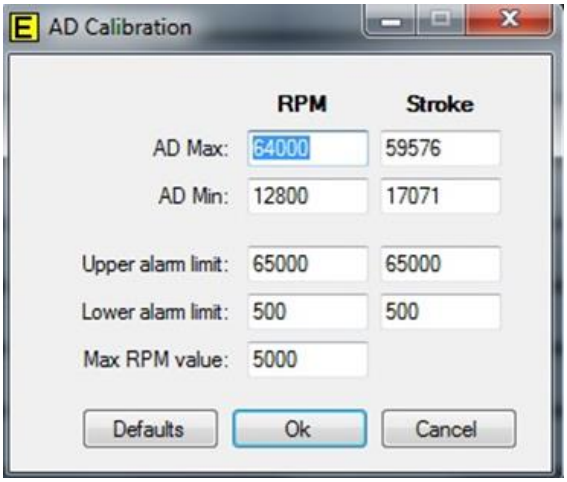
To calibrate the system proceed as follows.

- Calibration has to be performed each time the Strandjacks are set-up.
- For calibration
  - the bottom anchors are closed
    (if any load is attached, then it is held by the bottom anchor)
  - the top anchors have to be in opened position
  - the speed sliders have to be set to 50%

1.	Invoke the function via the main screen	
2.	Select the strandjacks that need to be calibrated by clicking on the icons (Calibration can be done simultaneously for more strand jacks.) For selecting all strand jacks you can use the “Select All” button. Click on Master activate to enable the engines of the HPU of the selected Strandjacks. *The icons of the selected systems turn blue*	
3.	Verify that the top anchors are in opened position	
4.	Set the “cylinder speed” to 50% Set the High speed control on “**Auto**”	

5.	Press “Start Extend” *The main jack extends until the maximum position is reached*. The maximum position of the Strandjack is reached when a predefined pressure occurs. That pressure is defined in General Settings When the Strandjacks reached their end position a report shows up	 
6.	Press “Cal Stroke Max” *The calibrated values of maximum stroke are saved*.	

7.	Press “Start Retract *The main jack retracts until the minimum position is reached*. When the Strandjacks reached their minimum position a report shows up	 
8.	Press “Cal Stroke Min” *The calibrated values of minimum stroke are saved*. *The calibration is completed.* The calibration values can be made visible using the Calibration button in the Strand jack settings menu	

9.	Verify the calibration values by using the Calibration button on the Strand jack settings screen; see section 6.4.5 “Strandjack Settings”.	 

6.4.7. Pre-tensioning

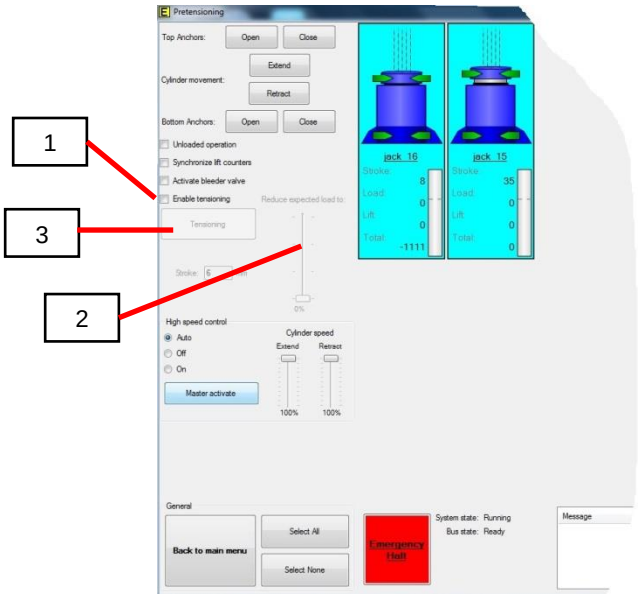
Pre-tensioning has to be applied to make all strands evenly tensed when a load is lifted.

The principle of the pre-tensioning process is to load the strands with a force off and on repeatedly. After a few cycles the strands are lined up.

Pre-tensioning can be performed for more strand jacks simultaneously.
As soon as a certain pre-defined load is reached in one of the strand jacks that strand jack is taken out of the pre-tensioning process.

6.4.7.1. The pre-tensioning screen

The layout of the screen is shown below:

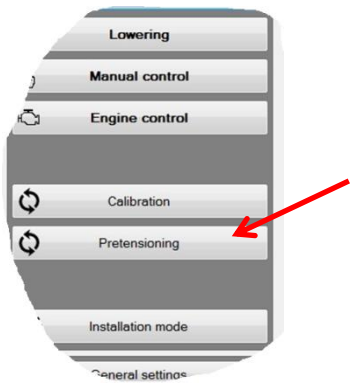


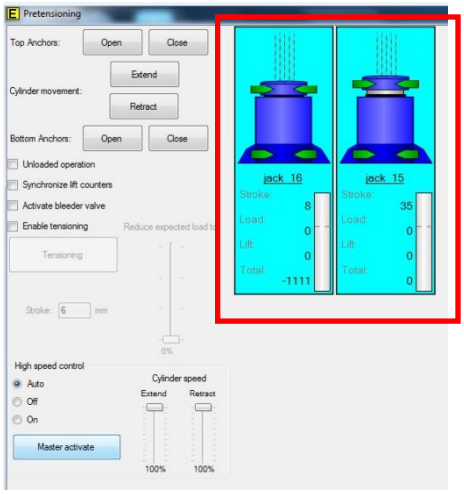
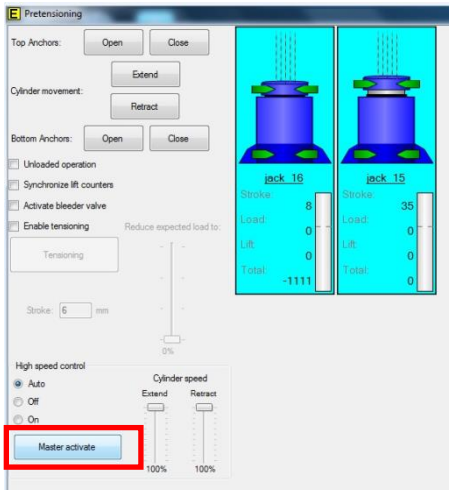
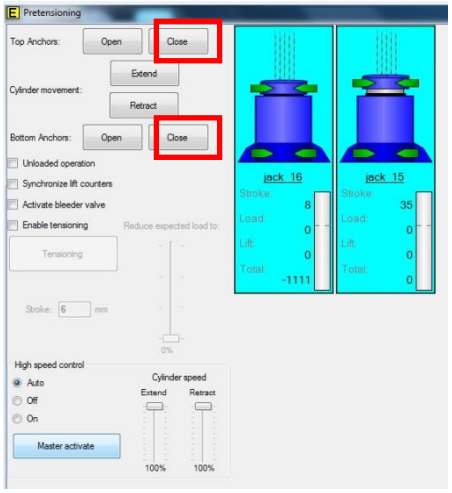
The specific pre-tension items on the screen are explained in the next table.

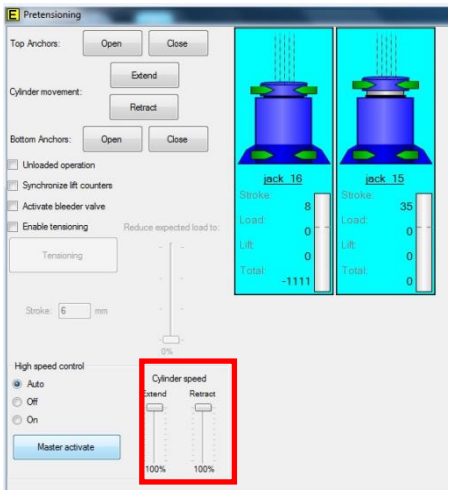
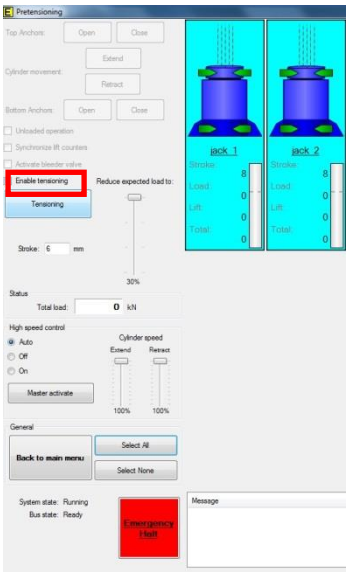
1.	Enable tensioning	To enable the function. The “Tensioning” button and the “Reduce expected load slider” become active.
2.	Reduce expected load to	To set the expected load to a percentage of the expected load, to limit the force on the strand while being tensioned.
3.	Stroke	The maximum stroke the main will make for tensioning. The value is limited to 30 mm.
4.	Tensioning	Button to start the pre-tensioning process. Keep the button pressed. The process stops when one of the strand jack units reaches the expected load, or when you release the button.

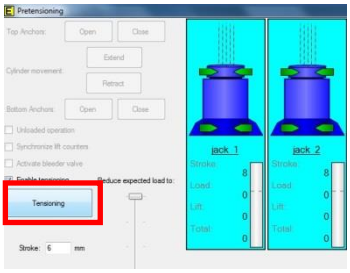
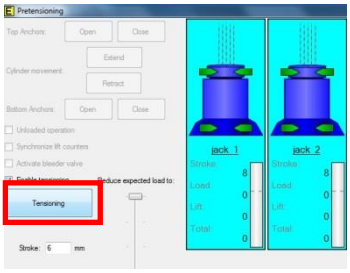
6.4.7.2. How to perform pre-tensioning

To perform pre-tensioning,

1.	Invoke the mode via the main screen	
2.	Make sure eventual attached load is held by the bottom anchor	

3.	Equal the lengths of the strands between the load and the lifting anchor by hand as much as possible. If one strand is too loose, then 1. Open the top anchor 2. Apply the vice grip on the strand on the loose strand 3. Extend the main cylinder until the required tension is reached *Now, all strands do have the more or less same length between the load and the strand jack*	
4.	Click on the strand jack(s) you want to pre-tension. More strand jacks can be pre-tensioned at the same time. *The selected icon(s) turn blue*	
5.	Click on Master activate *The engines of the selected strand jacks are activated*	
6.	Close the upper and the bottom anchors. *The top and bottom close*	

7.	Set the Cylinder speed to the max by moving the slider to the top.	
8.	Check “enable tensioning”	
9.	Use the Reduce expected load slider to increase the tension in the strands.	
10	Set the stroke to 6 mm. That is the default value. Enerpac advices to use the default. The maximum stroke for tensioning is 30 mm.	

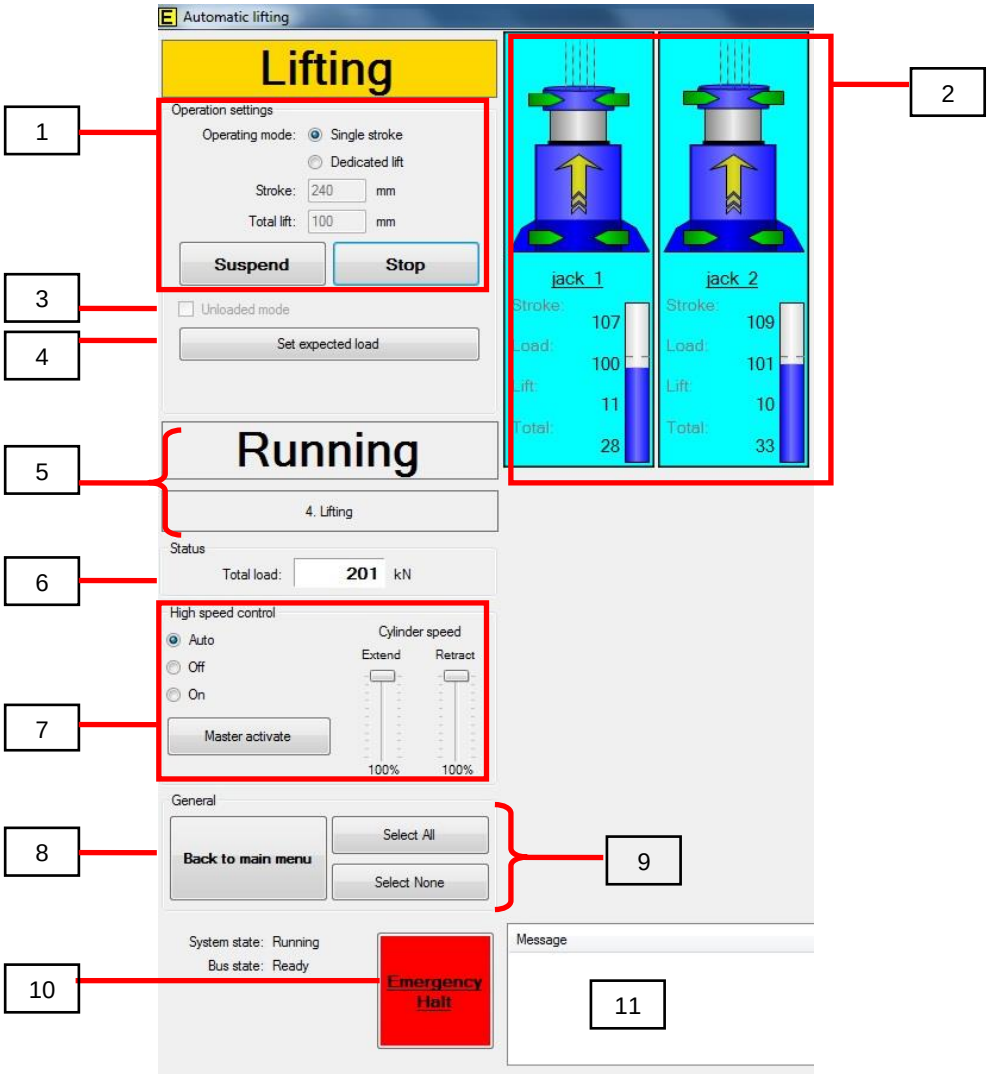
11	Press “Tensioning”. *Tensioning of the Strandjacks is performed automatically by extending and retracting repeatedly with the stroke as set in step [8].* • *Tensioning continues as long as you keep the button pressed.* • *Tensioning stops when one of the strandjacks reaches the load as set in step [7].*	
12	Deselect the Strandjack that reached the max load by clicking on its icon. *The icon turns grey*	
13	Continue Tensioning by pressing “Tensioning” again	
14	Repeat the steps [9] .. [11] until all Strandjacks are tensioned. *Now, all strands do have the more or less same length between the load and the strand jack*	

6.4.8. Lifting

This function enables the lifting of a load. The sequence of lifting steps is performed automatically.

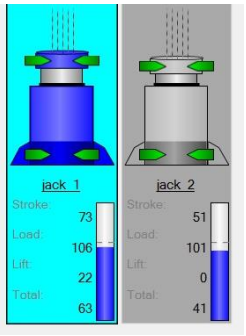
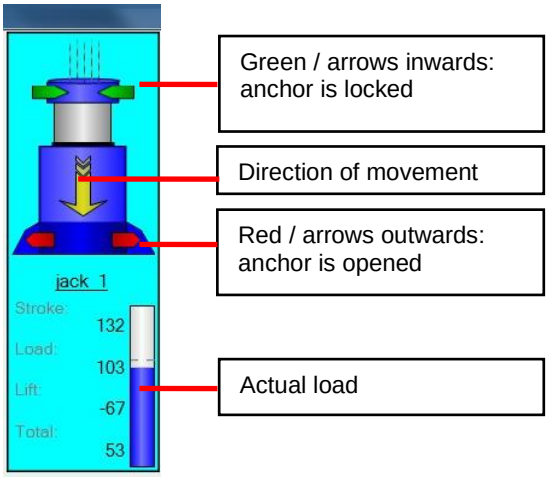
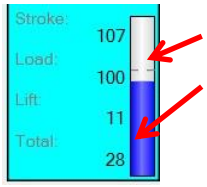
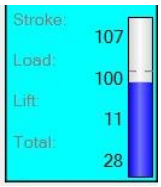
6.4.8.1. The lifting screen

The layout of the screen is shown below:



Some terms explained here in advance:

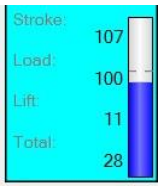
Term	Diesel HPU	Electro HPU
Select	The HPU is getting controllable by the program	
Activate	The machinery is set to ignition; the electric circuits are switched on.	The motor starts running
Start	The starting-engine of the diesel is activated. The diesel engine will start.	(has no meaning)
Enable	All selected HPU's are activated at the same time.	
Master activate	All selected HPU's are activated one by one, after each other. The time gap delay between the starts is set in General settings.	

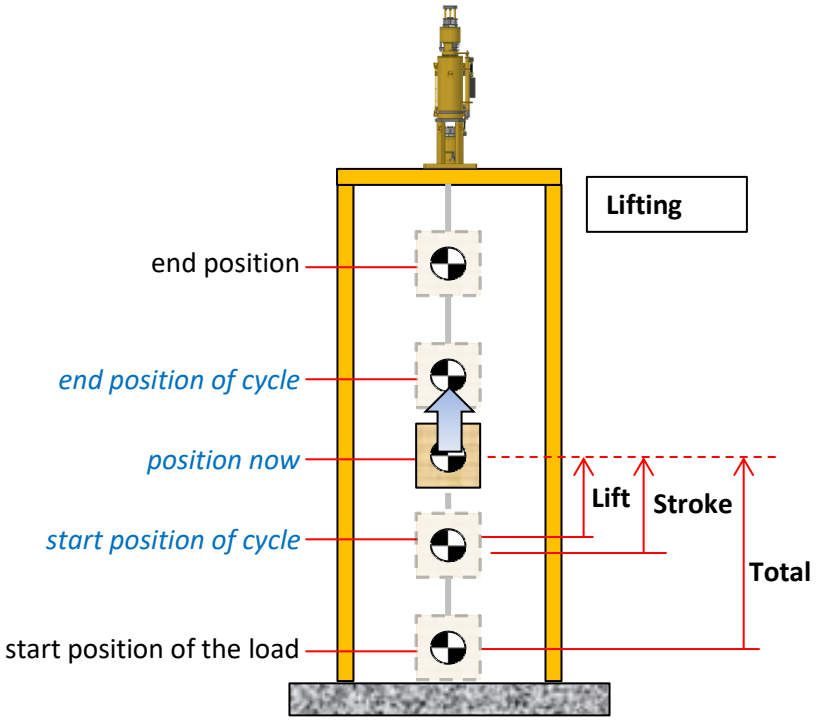
1.	Operating settings	• Single stroke: only one lifting cycle is performed • Dedicated lift: the system performs more lifting cycles repeatedly, until the load reaches the required height. The fields Stroke and Total lift have to be populated. • Start: to start the automatic lifting cycle • Stop: the finish the automatic cycle • Suspend: to interrupt the automatic lifting cycle. Press start to resume.
2.	Actual operation situation during the lifting	Click on an icon to make the strand jack controllable. The icon turns blue →. Click again to de-activate.    Dashed line: expected load Actual Load (% of the exp. Load): Green: 0 .. 50% Blue: 50 .. 100 % Rood: > 100 % If the load exceeds the max overload (set in General settings) then the system stops.  **Stroke:** the actual stroke of the main jack, including the safety distance at the bottom [mm]. **Load:** the measured load of the strand jack [kN] **Lift:** the height of the load w.r.t. the start position of the cycle [mm]. *The value differs from Stroke, since:* • *when lifting:* ○ *"Stroke" starts counting immediately. Start value is the safety distance at the jack bottom.* ○ *"Lift" only starts counting when a certain percentage of the weight of the load is*

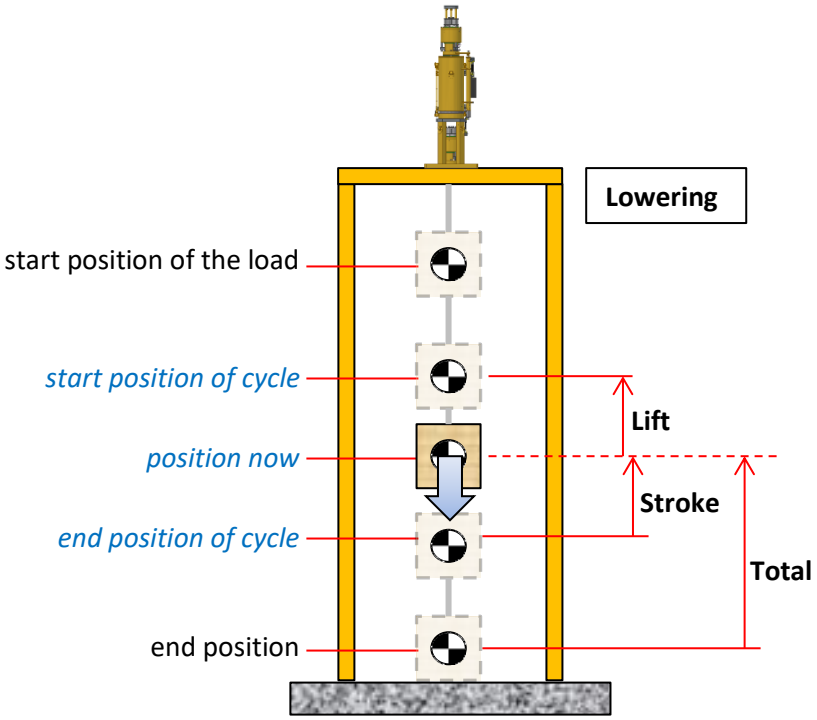
	sensed. The start value is zero. • *when lowering: "Lift" starts at zero and increases while Stroke starts with a high value and decreases.*
Total:	the actual height of the load w.r.t. "earth". [mm]

Note that at start of each lifting and each lowering cycle the jack extends a small distance for pre-tensioning. This distance is visible in "Stroke", but during this movement "Lift" kept zero.

The illustrations below visualise the values of Lift, Stroke and Total during a lifting and a lowering operation. The positions of the load within one lifting-cycle are indicated in blue.



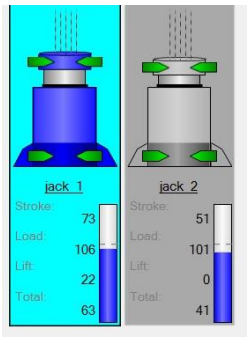




A numerical example for lowering:

Start-position of cycle:	the main jack was fully extended at 480 mm
Position now:	the main jack is now retracted to 300 mm
End position of cycle:	the main jack will be retracted to 20 mm
"Lift":	is now 300 - 480 = -180 (note the minus value)
"Stroke":	is now 300

(The pre-tensioning stroke of the jack is not taken in account.)

3.	Unloaded mode	To run automatic cycles with less than 50 % of the expected load. (Useful for test purposes.) NB: This option is switched off automatically when the system detects > 50 % of the expected load.
4.	Set expected load	To set the weight of the load you're going to lift. The value is also visible in the Strandjack settings menu. If you press the button, the actual load of the strand jack is taken as expected load. The value is used for safeguarding, in order to prevent overload.
5.	Running ….	Shows the current phase of the lifting sequence.
6.	Total load	Shows the sum of the actual load of all strand jacks.
7.	High speed control Cylinder speed Master activate	• Auto: the speed is calculated automatically according to the load and the actual stroke of the cylinders. This mode is de default, and the recommended setting. Recommended! • Off: a low lifting / lowering speed is chosen • On: a high lifting / lowering speed is chosen. *(not recommended)* Pick a value depending on the properties of the lifting operation. To set the extending / retracting speed of the main jack, as a percentage of the speed as set by "High speed control" buttons To activate the engines of all selected HPU's
8.	Back to the menu	To return to the main screen
9.	Select All Select None	• Select All: to select all strand jacks. *All strand jacks can be used.* *The icons turn blue.* • Select None *No strand jack can be used.* *The icons areas turn grey* 
10.	Emergency Halt	To switch the system off immediately: • The cylinders will not move anymore. • The system gets into HALT Press the reset button on the Smartbox to lift the emergency situation.
11.	Message	Field in which system messages are shown

6.4.8.2. How to perform automatic lifting

Automatic lifting is basically similar to automatic lowering.
Reference is made to section 6.4.9.2 "How to perform automatic lowering".

6.4.9. Lowering

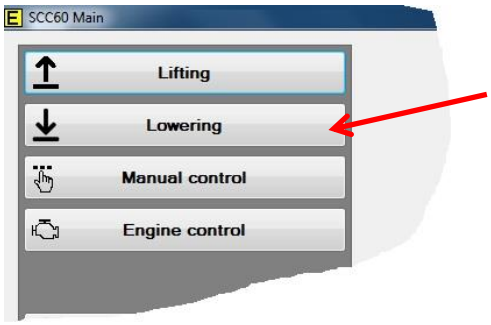
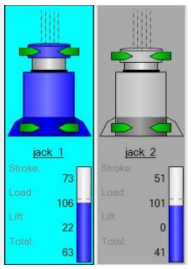
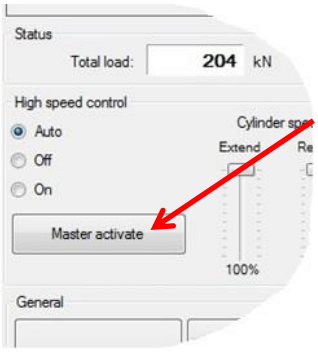
This function enables the lowering of a suspending load. The sequence of lowering steps is performed automatically.

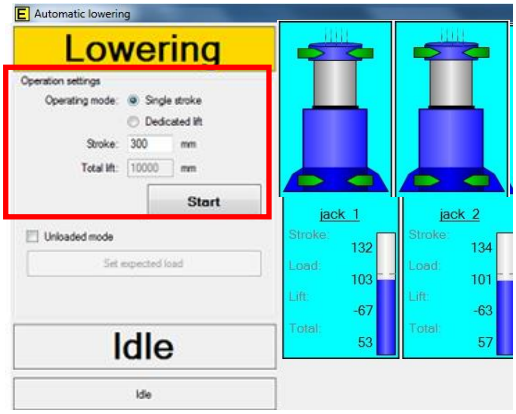
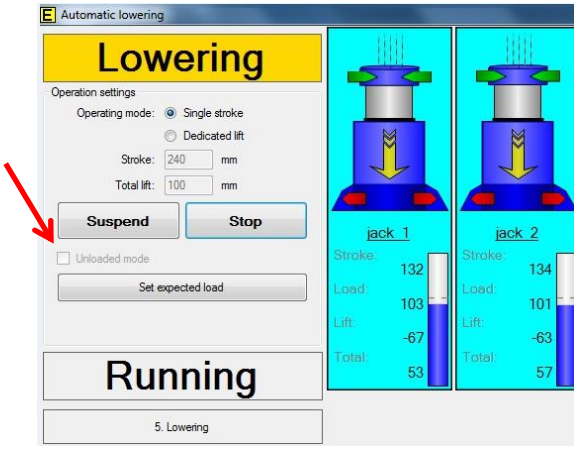
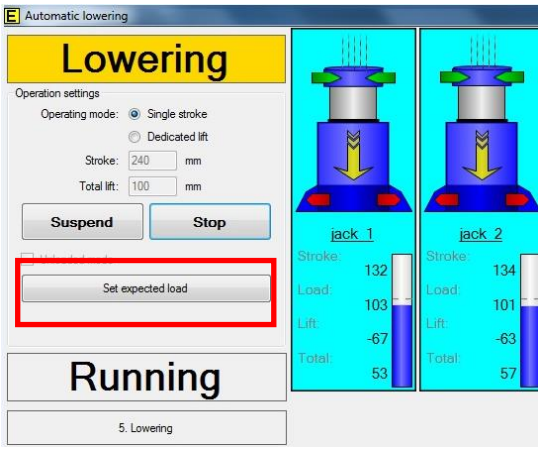
6.4.9.1. The lowering screen

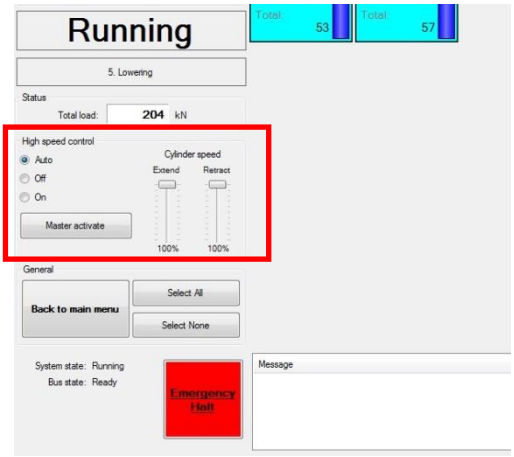
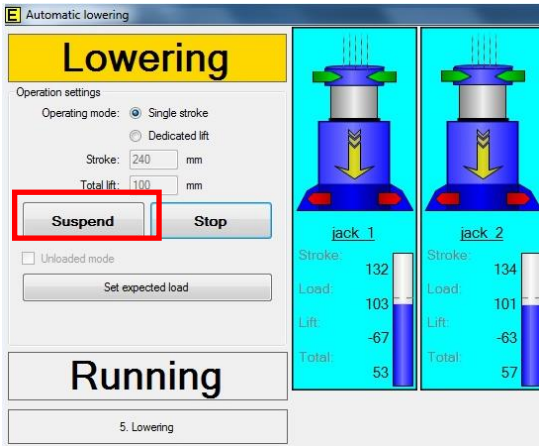
The functionality on the screen is similar to lifting. Therefore, for a description of the screen reference is made to section 6.4.8.2 “How to perform automatic lifting”

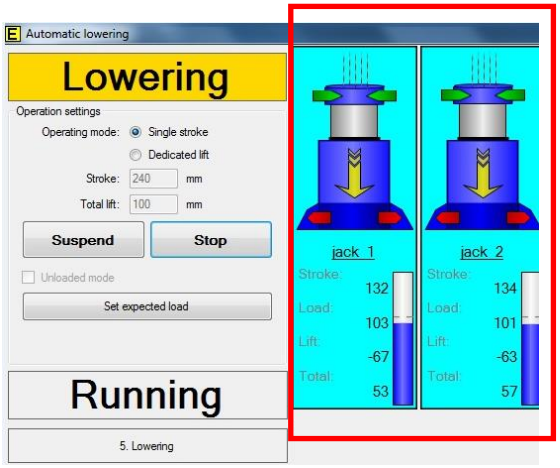
6.4.9.2. How to perform automatic lowering

To perform automatic lowering, proceed as follows:

1.	Invoke the function via the main screen	
2.	Click on the icons of the required strand jacks want to apply *The clicked icons turn blue.* *The selected systems are active now.*	
3.	Click on Master activate *All selected HPU’s are activated*	

4.	Select the operating mode.	
5.	If you want to let the system operate with little load attached, or no load at all, then select Unloaded mode.	
6.	Press “Set expected load” to enter the weight of the load to be lifted. *During the operation the value will be updated with the actual measured load.*	

7.	Set the required extending and retracting speeds of the main jack	
8.	Press the Start button. *The system starts lowering.* *The Suspend button appears.*	

9.	Monitor the status and the activities of the system. If you chose “Unloaded mode” and the system sensed a load of 50% of the expected load then the system stops and shows an alarm.	

6.4.10. Manual control

In manual control the operator is enabled to control manually:

- lifting / lowering movements of the strand jacks
- opening and closing of the top- and the bottom anchor.

There is no automatic execution of a sequence.

Safety aspects of the mode:

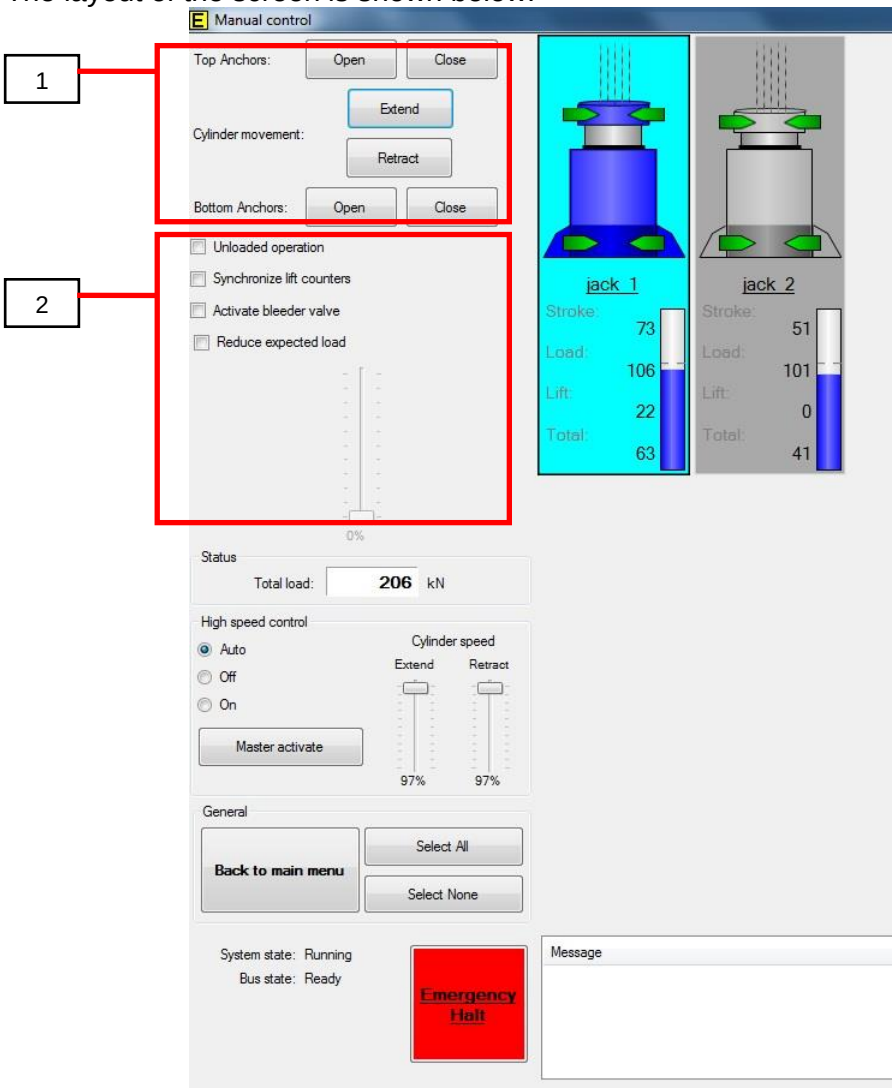
- The system still safeguards that not both the top anchor and the bottom anchor are released simultaneously.
- When lifting, it is possible to lift the load with the bottom anchor in opened position. But Enerpac strongly recommends to lift with the bottom anchors closed, to gain extra safety. (The strand can be pulled through the bottom anchor in upwards direction, due to the properties of the wedge.)

Enerpac recommends **NOT** to use manual control for lifting loads, due to limited safeguarding.

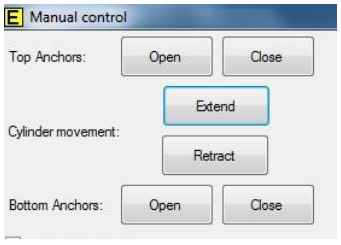
Hazard
Using manual control to lift a load is potentially dangerous, due to limited safeguarding.

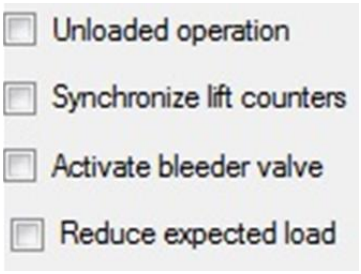
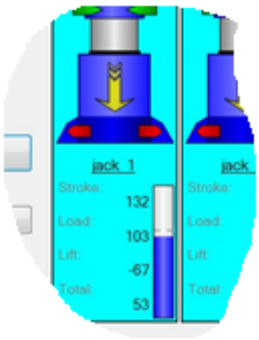
6.4.10.1. The Manual control screen

The layout of the screen is shown below:



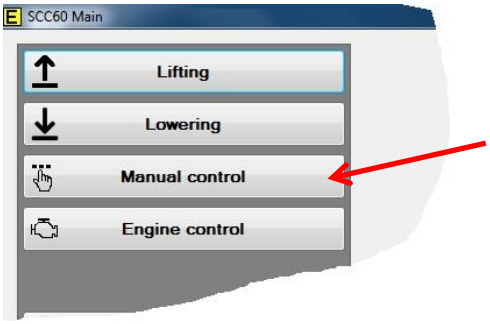
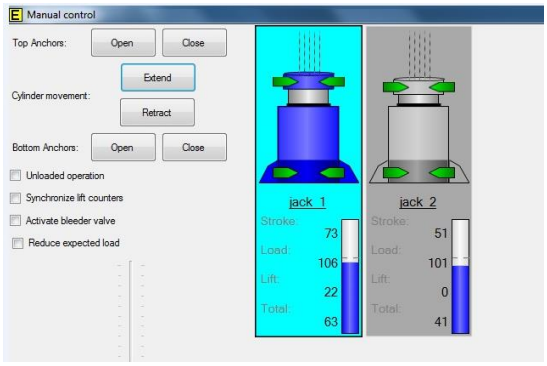
The table below describes the items on the screen which are specific for Manual control. Items which are not indicated are equal to similar to those in the Lifting screen; reference is made to section 6.4.8.1 “The lifting screen”.

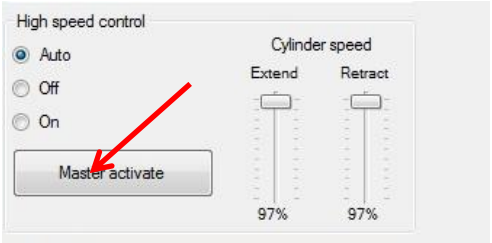
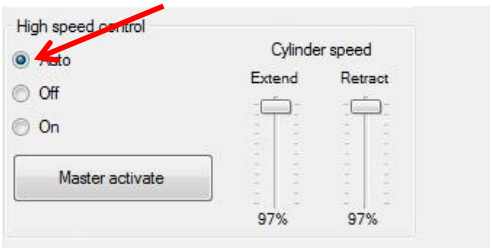
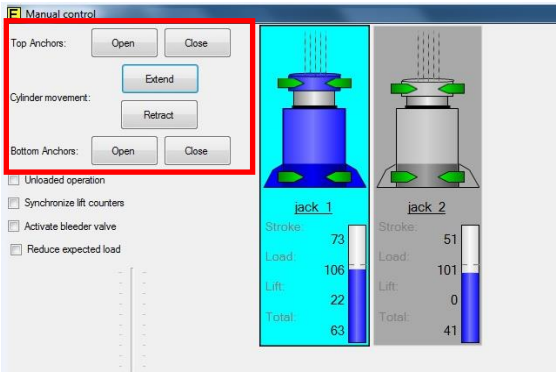
1.	Use Open and Close to control the Top- and Bottom Anchors. The system still safeguards these actions: it is not possible to open the top- and the bottom anchor simultaneously. Use Extend and Retract to control the main jack	

2.	• **Unloaded operation**: Select the “unloaded mode” button if you want to move the main jack without load attached. You might use this function for testing purposes. NB: If the load exceeds a percentage of the expected load, the system stops and gives an alarm. • Select the **synchronized lift counter** to synchronize the “Lift” values • Click **Activate bleeder valve** to control a valve which leaves out the oil from the main jack. Optional. • Select **Reduce expected load** to reduce the expected load value. Useful for perform pre-tension.	 

6.4.10.2. How to perform manual control

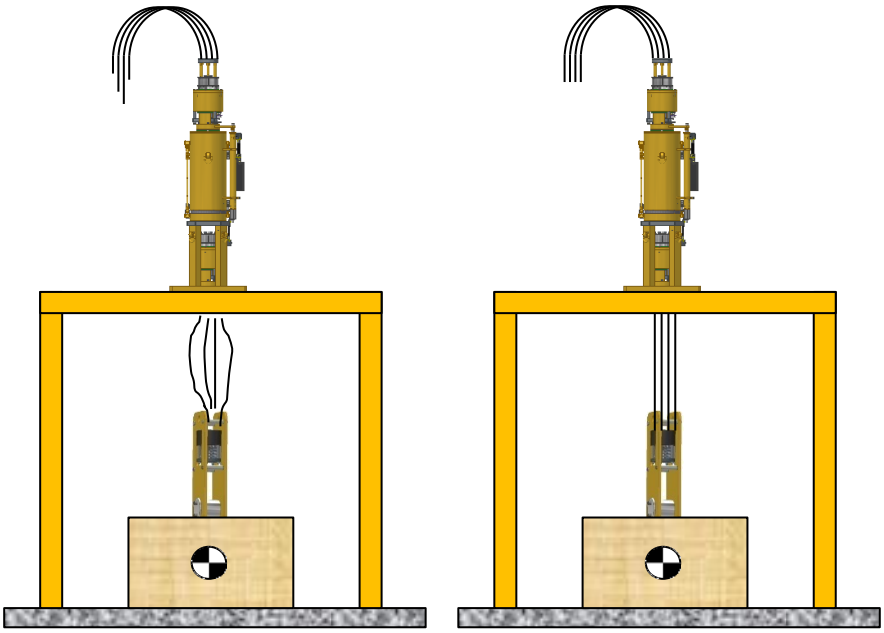
To perform manual control, proceed as follows:

1.	Invoke the function via the main screen	
2.	Click on the icons of the strand jacks you want to use *The icons of the selected units turn blue.* *The units are activated.*	

3.	Click on Master activate *The engines of the selected strand jacks are activated*	
4.	Set High speed control default on “Auto”.	
5.	Use the “open” and “close” buttons of the top anchors and the bottom anchors to control them Use “Extend” or “Retract” to move the Main Cylinder	

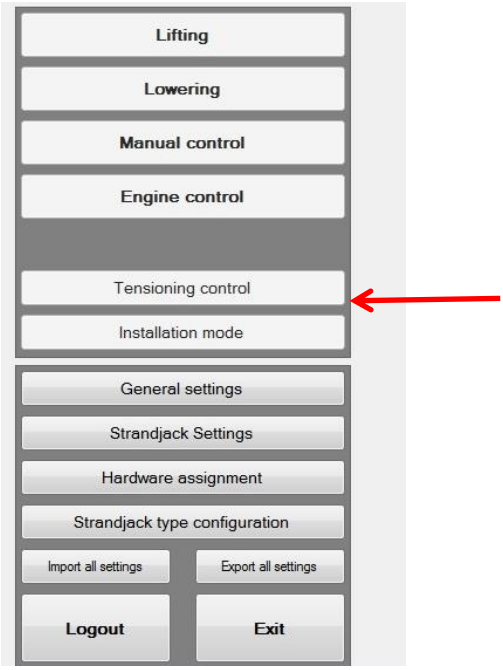
6.4.11. Tensioning of the strands

Tensioning of the strands is required in order to distribute the load over all strands equally.



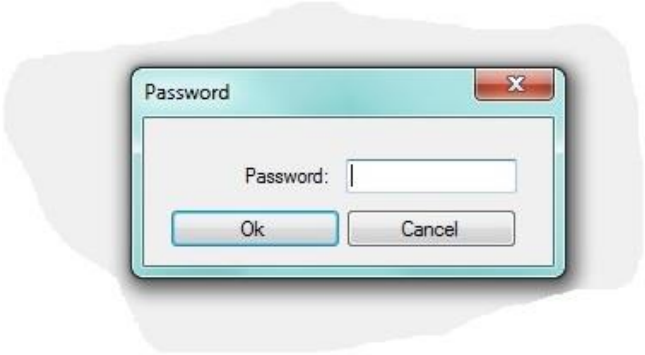
Strands not tensioned Strands tensioned

Tensioning is controlled by the SCC.

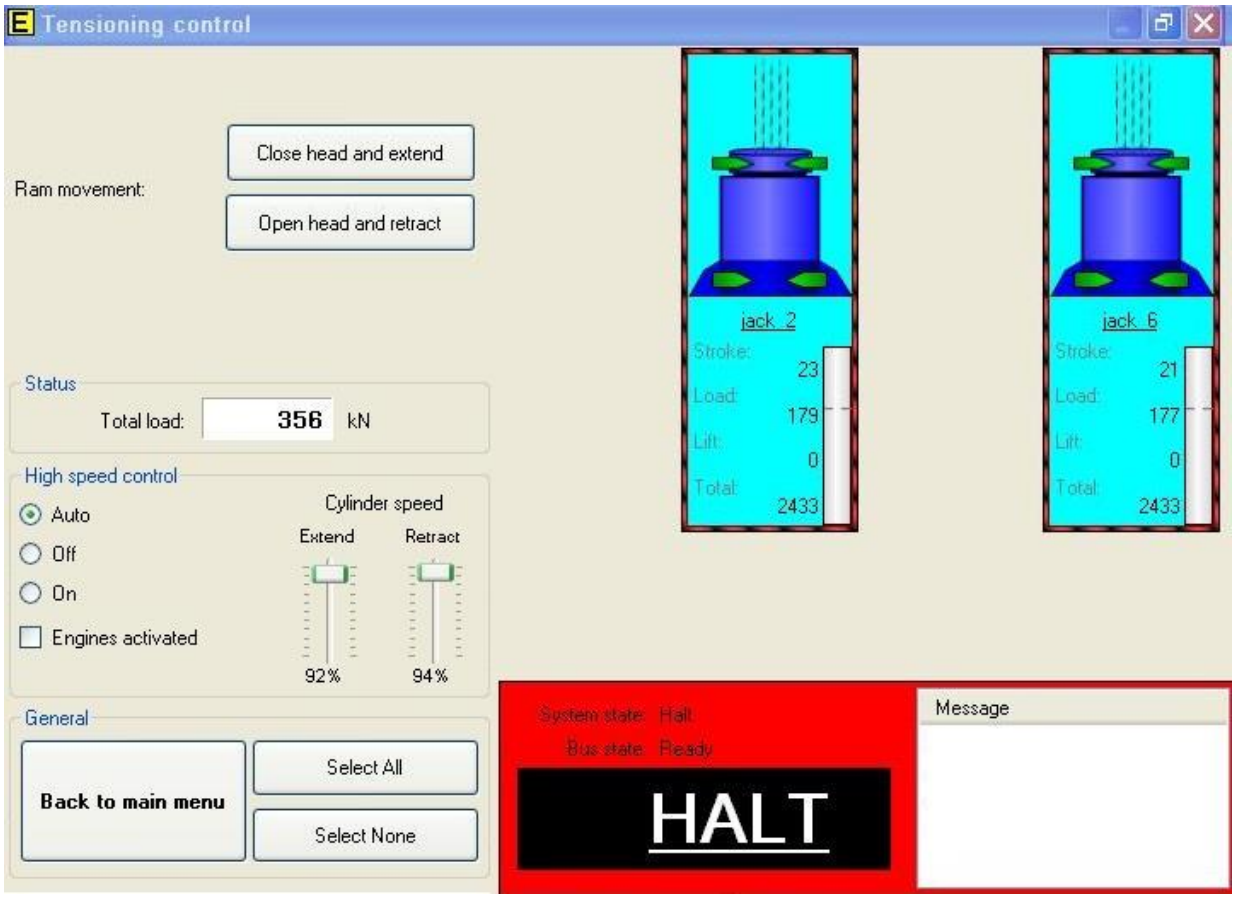


The principle of tensioning is as follows:
The strand jack performs several very small strokes upwards and downwards. The cycle is executed automatically.
Each cycle the strands are tensioned more.
Once one single strand is fully tensioned, it its diameter decreased a little due to the force on it. This small clearance ensures the strand is not tensioned more.
Tensioning has to be stopped when all strands are tensioned equally.

To start tensioning press “Tensioning control”. Then enter the password.



The following screen shows up:



Use the screen to execute the tensioning procedure.

6.4.12. Installation mode

Installation mode is equal to manual control, but in installation mode all safeguarding is switched off:

- Top- and bottom anchors can be opened simultaneously
- No follow-up is given to detected errors like overloads

Only use installation mode in emergency cases, to overcome unexpected difficulties with the load or with the system.

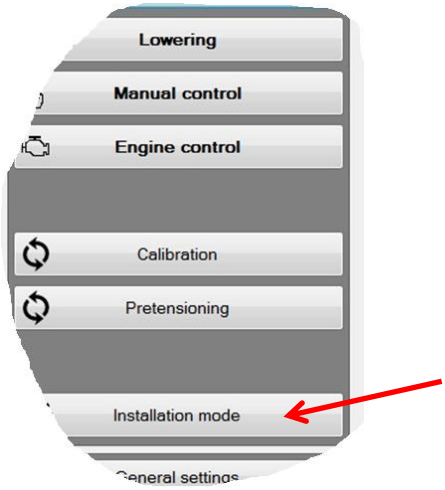
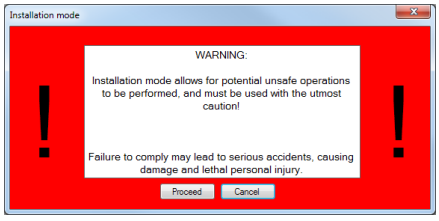
Hazard
Since all **safeguarding is switched off** in installation mode, use of this mode is **intrinsically unsafe**. There are potential hazards to personnel and the machine. Only use the installation mode when you ran out of opportunities.

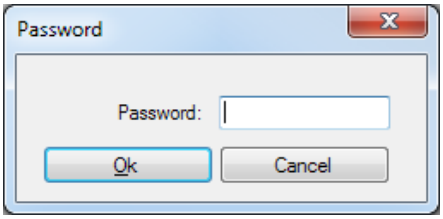
6.4.12.1. The installation mode screen

The layout of the screen is similar to manual control; reference is made to section 6.4.10 “Manual control” screen.

6.4.12.2. How to use the Installation mode

To perform installation mode, proceed as follows:

1.	Invoke the function via the main screen	
2.	Read the message which appears after you entered installation mode. Click on Proceed	

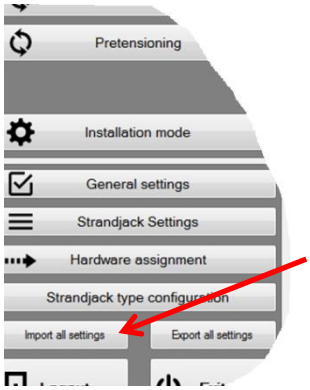
3.	Use password “5678” *After confirming, access is obtained to the Installation mode.*	

6.4.13. Import and Export all settings

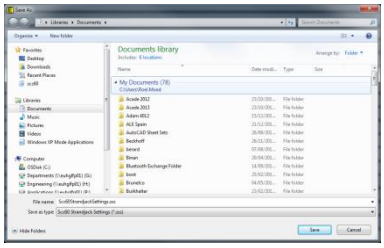
This function enables the operator

- to import all settings of the program from the hard drive or external storage device
- to write all settings towards the hard drive or external storage device

Enter the mode via the main screen:



Windows Explorer is applied:



6.4.14. Logout

To leave the program, use Logout.
The program keeps running; you or another user can login again.

6.4.15. Exit

To quit the program use Exit.
The program stops.

6.4.16. Messages

A list of all possible messages is given in Appendix G “Error messages”.

6.4.17. Halt

The button acts as an emergency button:

- All movements of the system are stopped
- All HPU's are switched off
- The Smartbox keeps running.

For all emergency handling reference is made to section 6.1. "The Emergency buttons".

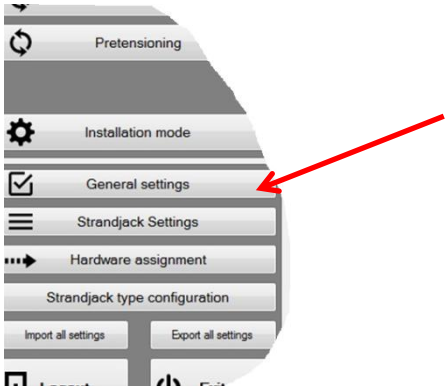
6.5. Auxiliary (optional)

This function is intended to control additional hydraulic devices e.q. a rotation unit or skidding units. The HPUs have to be provided with an additional IO extender.

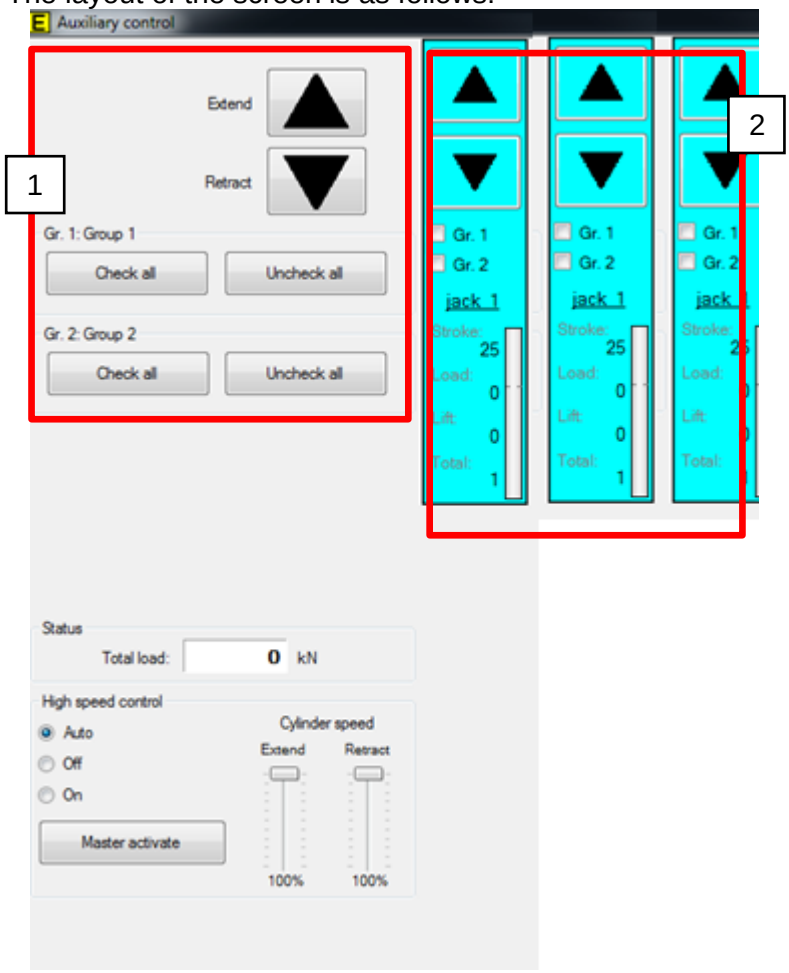
Contact Enerpac if you want to apply this function

If the function is implemented, you can activate the Auxiliary screen by the main screen:

1. press General settings
2. CNTRL+ALT+R.



The layout of the screen is as follows:



Two jacks additional jacks can be assigned to “Group1” or “Group 2”.

1.	Extend, Retract	To control all jacks of all selected strand jack systems All jacks in the same group are moving
	Check all Group 1 Uncheck all Group 2	To assign / deassign all units for Group 1 or Group 2. (The function is similar to the individual “Gr.1” and “Gr.2” checkboxes on the individual units.)
2.	Arrow up, arrow down	Control the jack of the concerned strand jack system
	Checkboxes Gr1, Gr2	Assign the auxiliary jacks for Group 1 or Group 2
	Stroke, Load, Lift, Total	See section 6.4.8.1 “The lifting screen”

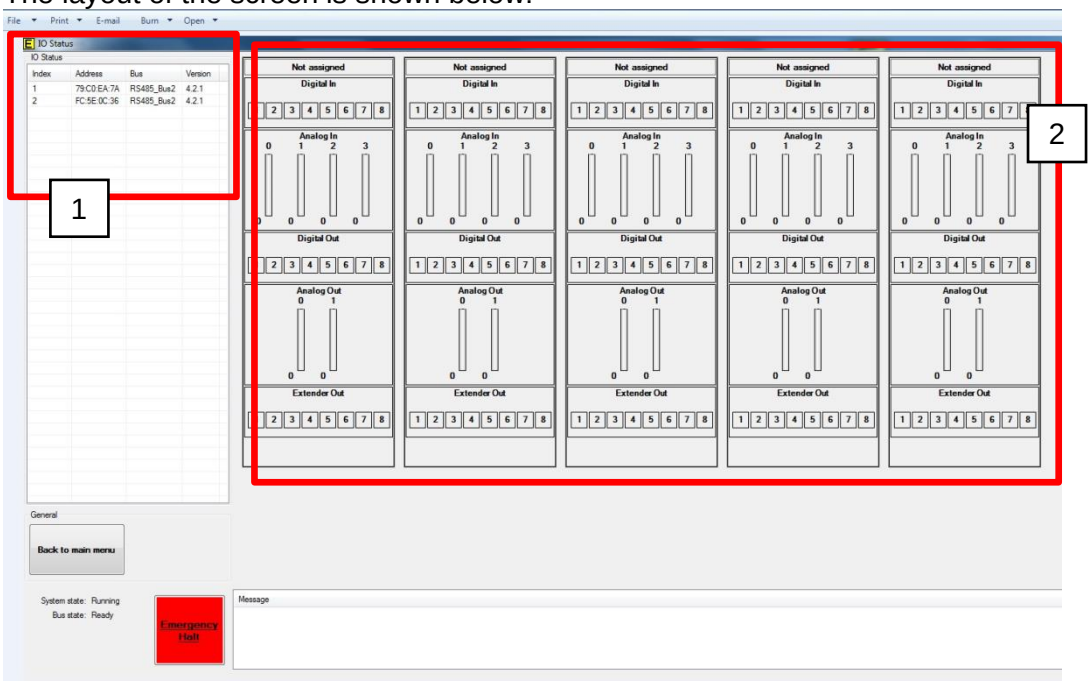
If an auxiliary jack is assigned to Group 1 then the outputs 1 and 2 of the first DO extender are controlled by the Extend/Retract arrows.
If an auxiliary jack is assigned to Group 2 then the outputs 3 and 4 of the first DO extender are controlled by the Extend/Retract arrows.

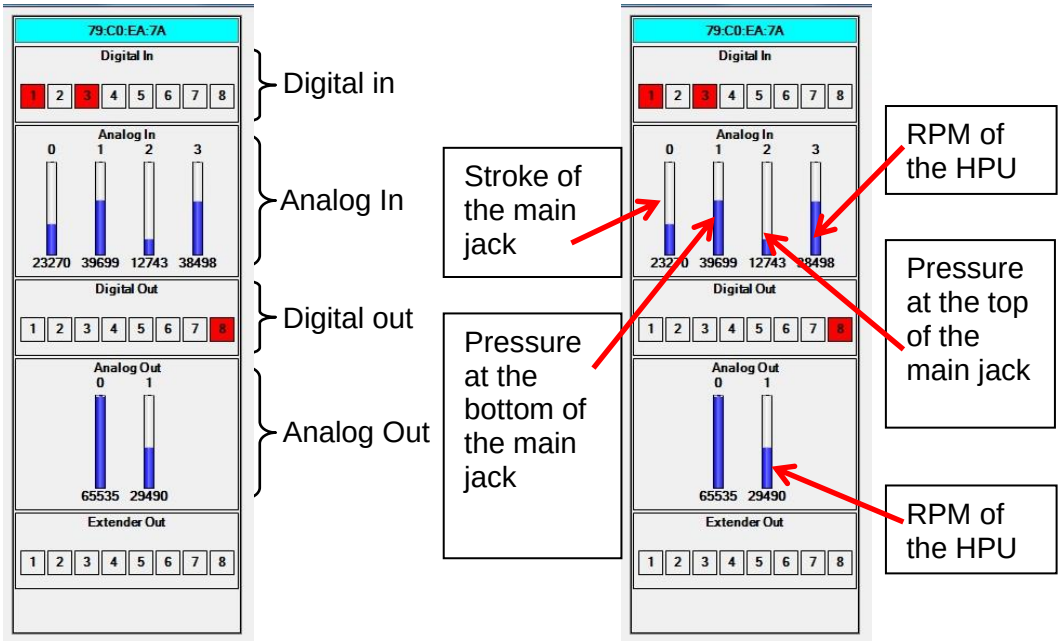
6.6. IO status menu

The IO status menu enables the maintainer to verify the values of the digital IO values. This is useful for diagnostic and maintenance purposes.

6.6.1.1. The IO status menu screen

To invoke the function, press the button “Alt” and “T” simultaneously.
The layout of the screen is shown below:



1.	The list of all connected HPU’s	
2.	Icons representing the HPU’s. For Digital in and Digital out reference is made to the hydraulic scheme. 	

6.6.1.2. How to use the IO status menu

1.	Press the button “Alt” and “T” simultaneously. This is possible in all menus. *The IO status screen is shown*	
2.	Assign a strand jack unit by dragging one of the HPUs listed in the left part towards the icons in the pane at the right. *The assigned icons turn blue*	
3.	Evaluate the shown values. Eventually, share the data with Enerpac if there might be any problem..	

7. Execute an operation

Operating the System is only permitted if you are certified by Enerpac as an authorised operator.

7.1. Risks and Warnings

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

Address the following subjects:

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.

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: if the wind is strong, that means it's a 'no go'!
- Do not operate strand jacks when a **person is close** to them.

Attention

- It is of the utmost importance to **read this manual** carefully before setting up the machine. Failure to prepare correctly for a lifting operation may result in total loss of machine stability during use.
- Adhere to the **checklists** during all work activities: during preparation for the lifting operation, system construction, and for lifting the load.
- Local **control** is only permitted if there is a beam attached to the unit.
- 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 any obstructions while lifting
- Ensure that the strand jack system does not come in contact with any obstructions.
- While lifting check periodically the adjustment to maintain planned load orientation.
- 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

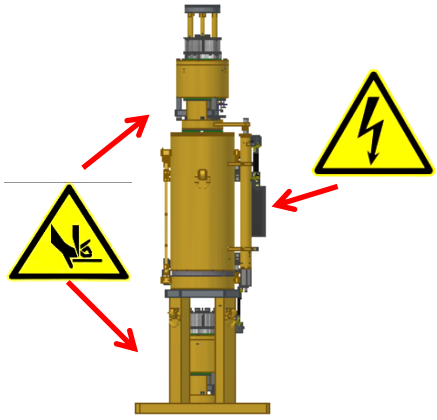
communication is restored.

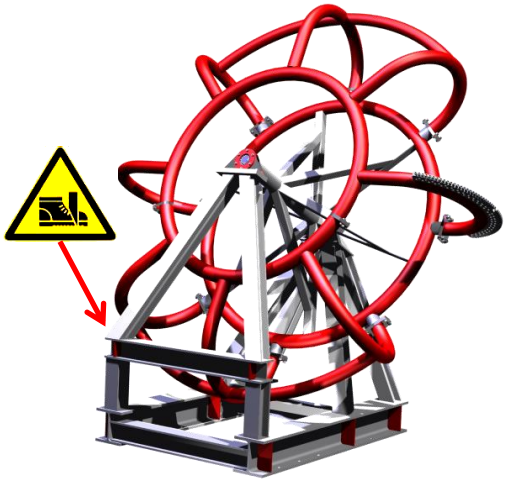
- Signals to the operator should be in accordance with the standards prescribed in section 1.9. “Hand signals”. If special signals are required, they shall be agreed upon by the operator and support personnel prior to the lifting operation. Signals shall be discernible or audible at all times. No action shall be taken unless signs are clearly understood.
- Load handling personnel shall obey any stop signal.

Pay attention to Appendix E “Hydraulic fluid safety information”.

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

The following labels and signs are applied on the System.





The meaning of the symbols is explained in section 2.3. “Symbols applied to the System”.

7.2. Preparations

To prepare a lifting operation follow the steps as described in the table.

- Execute the steps in the sequence they're described.
- Do not skip steps.

	Action	**Reference to …**
1.	Plan the operation	section 4. "Plan an operation"
2.	Complete the **checklists** and let them approve	Appendix A "Checklist for planning" Appendix B " Checklist for installing"
3.	**Record** all activities	Appendix C "Recording a lifting operation"
4.	**Start** the system: • Start the application on the laptop • Switch the smartbox on	
5.	Reset the **emergency circuit**	Section 6.1. "The Emergency buttons"
6.	If you want to add or edit jack types then perform **strand jack type configuration** If you stored settings on hard disk or USB then import them.	Section 6.4.2.2 "How to modify the strand jack type settings"
7.	Make the **hardware assignments**	Section 6.4.3.2 "How to perform hardware assignments"
8.	**Configure** the system	Section 6.4.5.2 "How to modify the strand jack settings"
9.	Perform the **general settings.** If you stored settings on the hard disk or USB then import them.	Section 6.4.1.2 "How to modify the general settings"
10.	Switch the **HPU** on	Section 6.3. "Control panel"
11.	Start the **engines**	Section 6.4.4.2 "How to perform engine control"
12.	Perform the **functional tests**	Section 5.6.1 "Functional tests"
13.	**Calibrate** the system	Section 6.4.6 "Calibration"
14.	Perform **pre-tensioning** of the strands	Section 6.4.7.2 "How to perform pre-tensioning"

7.3. Execute

This section describes how to execute lifting operations:

- Tensioning the strands
- Automatic lifting / lowering
- Manual control using the laptop
- Manual control using the local control handheld
- Usage of Installation mode

Jump to the relevant chapter hereafter to execute the required operation.

☞ Follow the steps in the sequence in which they are described.
Do not skip any step

7.3.1. Tensioning the strands

At start of a lifting operation the strands have to be tensioned.
If you apply a the tensioner then proceed as follows:

	Action	**Reference to …**
1.	Follow the instructions	Section 6.4.11 “Tensioning of the strands”
2.	Check the system	Section 10.2.4 “Checks after operation”

7.3.2. Automatic lifting / lowering

Note that the procedures for lifting and lowering are similar.

Proceed as follows:

	Action	**Reference to …**
1.	Follow the instructions	Section 6.4.8.2 “How to perform automatic lifting” Section 6.4.9.2 “How to perform automatic lowering”
2.	Check the system	Section 10.2.4 “Checks after operation”

7.3.3. Manual control using the laptop

For manual control using the laptop proceed as follows:

	Action	**Reference to …**
1.	Follow the instructions	Section 6.4.10.2 “How to perform manual control”
2.	Check the system	Section 10.2.4 “Checks after operation”

7.3.4. Manual operation using the local control handheld

For operating the system using the local control handheld proceed as follows:

	Action	**Reference to …**

1.	Follow the instructions	Section 6.2. “Local control using the local control handheld”
2.	Check the system	Section 10.2.4 “Checks after operation”

Manual operation with local control handheld should only be applied during installation and maintenance.

Hazard
During manual operation with the local control handheld it is possible to open the bottom and top anchor simultaneously. In that case the load will fall out in an uncontrolled manner.

7.3.5. Operate without safeguarding

Operating the system without safeguarding is possible using “Installation mode”.

The functionality of this mode is equal to manual mode, but without any safeguarding.

Installation mode is intended only to be used
- for installation purposes, and
- in emergency cases.

To apply installation mode proceed as follows:

	Action	**Reference to …**
1.	Follow the instructions	Section 6.4.12.2 “How to use the Installation mode”
2.	Check the system	Section 10.2.4 “Checks after operation”

Hazard
In the installation mode **no safeguarding** is active. It is possible to open the upper and the bottom anchor simultaneously, which would cause the load drop.

8. Solve problems

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

1.	Was any Emergency stop button pressed?	Check why the button was pressed. Then reset the emergency circuit; see section 6.1. “The Emergency buttons”
2.	Is any error message visible on the laptop?	Solve the problem accordingly
3.	Is any error indicator lit on one of the Strand jack control panels?	Solve the problem accordingly
4.	Are there any mechanical blockades?	Solve the problem accordingly
5.	Is any damage visible of electrical cables?	Make a repair
6.	The synchronisation of the height of the load (“hysteresis” does not work properly	Calibrate the height sensors; see section 0 “ How to calibrate”
7.	Is any hydraulic leakage visible?	Make a repair
8.	Are any fuses tripped? Check the fuses inside the electro cabinets of the HPU’s.	Check why the fuse was tripped. Then reset the fuse
9.	Are there communication problems?	Check the data cables and sockets Eventually use the IO status menu; see section 6.6.1.2 “How to use the IO status menu” and communicate the results with Enerpac experts
10.	Do you assume problems with sensors?	
11.	The system stopped while lifting or lowering a load.	Perform all checks [1] .. [10] If you got into an emergency situation, you might • apply Installation mode. See section 6.4.12.2 “How to use the Installation mode” • apply the local control handheld, in order to control the system manually. See section 6.2. “Local control using the local control handheld”

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

Contact Enerpac if you need assistance.

9. Storage

Proper storage is essential for the condition of the strandjack, especially when it has been stored in an environment with high humidity and/or salty environment for a long period.

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.

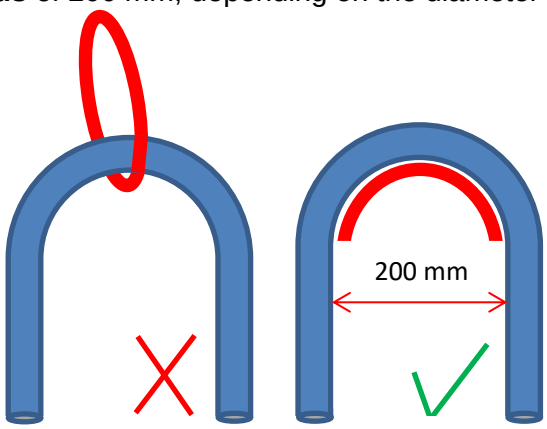
☞ During storage in the open air, cover the units with a tarpaulin in order keep electrical and other moisture-sensitive components dry.
The tarpaulin is not included in the delivery, but can be added as an option.

9.2. Smartbox and laptop

- Store the laptop according its specifications.
- Store the Smartbox on a dry and clean place.

9.3. Hydraulic hoses

- Store hoses in a **frost-free**, cool, dry space with medium air humidity (condensation free).
- Keep hoses out of direct **sunlight** (UV radiation).
- Keep hoses out of the outlet flow of ventilators (drying effect).
- Protect hoses against exposure to **ozone** (released during welding work).
  Ozone causes accelerated ageing of hoses (splitting due to dryness).
- Protect hoses against dirt and **moisture**.
- Preferably store hoses in a **horizontal** position.
  When you store the hoses in **vertical** position use hose brackets with a minimal bend **radius** of 200 mm, depending on the diameter of the hose.



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.
  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.

- 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.
- Only apply **spare parts** provided by Enerpac. If parts of foreign make are applied, all guarantees will be void.

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

10.1. Hydraulics

Maintenance jobs to be executed:

Subject	Action	Person O (Owner) EE (Enerpac expert)	First 40 hours	Before use	40 hours Weekly	500 hours yearly	2000 hours 2 years	10000 hours 10 years	Remarks
1. System									
1.1. Tests	Perform functional tests see section 5.6.1 “Functional tests”	O			x				
2. Hydraulic connections									
2.1. Pipes, hoses and brackets	Check on oil leakage and damages	O		x					
	Check if the couplings are tightened well.		x			x			
	Replace all seals within the piping (Walform)	EE						x	
	Replace all hoses						x		
	Replace all plastic brackets						x		
2.2. Couplings and quick-screw couplings	Check on oil leakage and damages	O		x					
	Check if the couplings are tightened well.			x		x			
	Replace all seals of the couplings	EE						x	
	Replace fast couplings and screw couplings						x		
2.3. Gauges, measurement sensors	Check on damages	O		x					
	Check the tightening bolts, nuts and components			x		x			
	Replace all seals	EE						x	
	Replace all gauges							x	

3. Cylinders									
3.1. Common	Check on leakages	O		x					
	Check if the bolts are still tightened		x			x			
	Replace all seals	EE						x	
	Grease the bearings				x				

10.2. Mechanical

Caution: Poor maintenance may cause bird caging of the strands.
Maintenance jobs to be executed:

Subject	Action	Person O (owner) EE (Enerpac expert)	First 40 hours	Before use	40 hours Weekly	Each 500 hours Each year	2000 hours Every 2 years	10000 hours Every 10 year	Remarks
1. Main construction									
1.1. Main construction	Visual check of all welding	O		x					
	Visual check painting			x		x			
	Visual check on corrosion and damages			x	x				
	Check all bolts.					x			
	Visual check of the hoisting lugs					x			
	Inspect the readability of the warning signs. Clean if obscured by dirt. Restore if damaged or even no longer present					x			
	Perform the after-operation checks. See section 10.2.4 “Checks after operation”			x					
2. **Wedges, strands and tube-banks**									
2.1. Wedges	Inspect the wedges; eventually replace them See section 10.2.1 “Inspect the wedges”.	O		x					
2.2. Strands	Inspect the strands. See section 10.2.2 “Inspect the strands”			x					
2.3. Tube-banks	Inspect the tube-banks See section 10.2.5 “Inspect the tube-banks”			x					
3. **Recoiler**									
3.1.	Grease the plugs See section 10.2.3 “Maintain the recoiler”.	O			x				

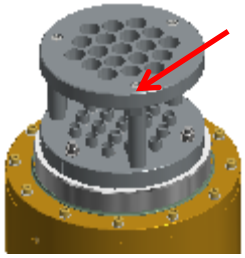
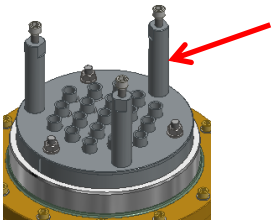
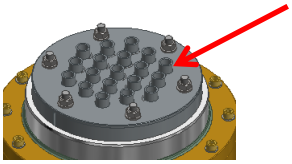
10.2.1. Inspect the wedges

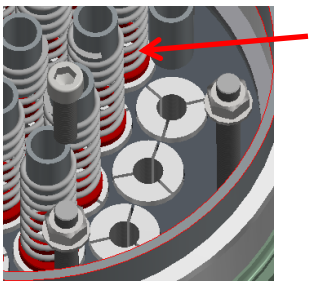
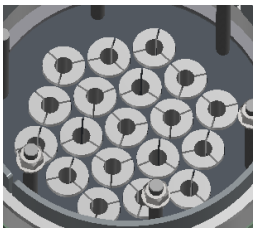
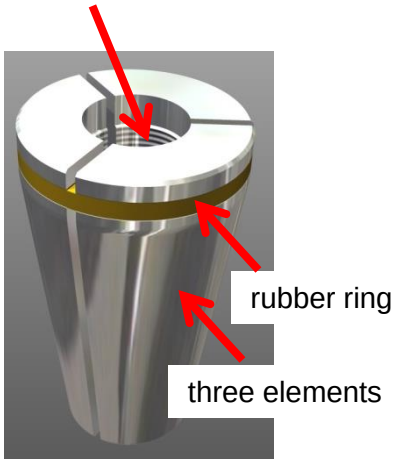
The wedges have to be inspected regularly. For additional criteria reference is made to Ref [1] “ASME B30.1-2015”.

To inspect the wedges they have to be removed. Removal is possible even with a load attached to the system, as long as the load is not carried by the concerned anchor.

Attention
Enerpac strongly recommends mounting of new wedges for each operation.

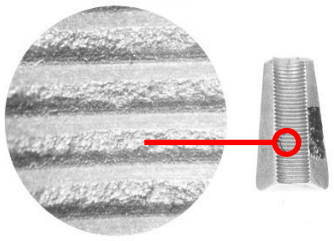
Proceed as follows to dismount and inspect the wedges:

1.	Make sure the anchor is in unlocked position. The pressing tubes are in down position.	
2.	Remove the pretensioning plate and the pins. The pins (when attached to the top anchor) have flat ends, so they can be held with a spanner.	
3.	Remove the distance tubes	
4.	Remove the topplate of the tube-bank. The wedges are pushed into the anchor block by springs. The more wedges are mounted, the more springs and the more pressure on the plate. **Caution** Loosen the pins and bolts carefully as the plate with the pipes is under tension due to the springs underneath.	

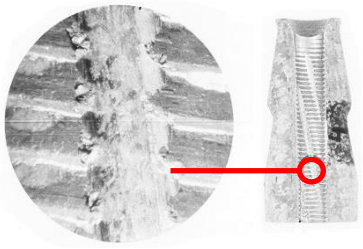
5.	Remove all springs and spring caps. *The tops of the wedges become visible*	 
6.	Remove the wedgesfrom the anchor block. Each wedge consists of three identical elements which are held together by a rubber ring.	
7.	Remove the rubber ring. Thoroughly clean the wedge using degreaser. Remove any rust and ingrained dirt with a steel brush. Wedges filled with rust and dirt cannot get a good grip on the strands. This may have disastrous effects.	

8. Assess the wear of the wedges:

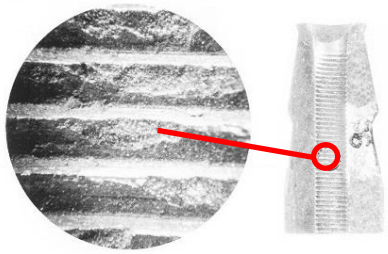
- The pitch should be at least 1.5 mm.
  Here the limit of permissible wear is reached.
  Remove the wedge.



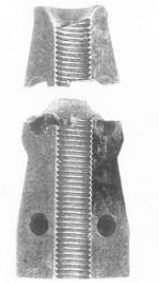
- The strand has slipped through the wedge and the pitch is damaged.
  Remove the wedge.



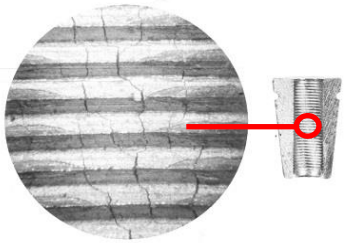
- Teeth broke out.
  Remove the wedge.



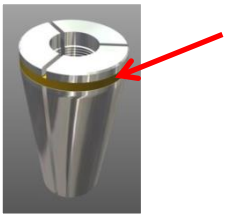
- The wedge has fractured. That may be caused by lack of the surplus length of the strand.
  Remove the wedge.

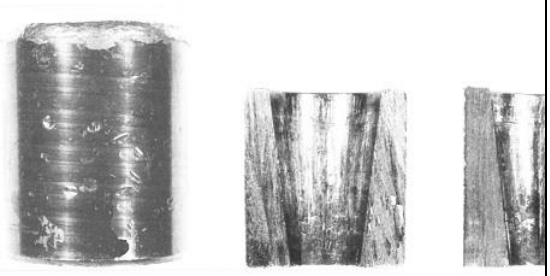


- The wedge shows cracks.
  Hair cracks are no cause for concern.
  But when cracks extend right through and the tips of the wedge are broken off, the wedge then remove the wedge.



- The rubber O-ring should not be degraded due to dry rot, reduced elasticity or damage



9.	Inspect the anchor block. The anchor block has to be replaced if the tapers have been damaged through pulling in the wedges, or if material has been torn away.	
10	Lubricate the **outside** of the wedges. Use stick lubricant or another type of pressure resistant grease. Do not use oil Ensure there is no grease on the inside of the wedges. **Caution**: grease would reduce the grip of the wedge on the strand.	
11	If you applied a tensioner then inspect its wedges. The inner side of the wedges should be smooth, undamaged and clean.	

10.2.2. Inspect the strands

The strands have to be inspected regularly.
For additional criteria reference is made to ref 1 “ASME B30.1-2015”.
Inspect the strands for the following conditions:

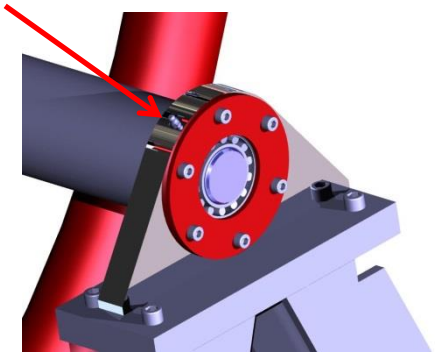
- Contamination with foreign materials that could cause fouling of the wedges
- Reduction of diameter greater than 5% below the nominal diameter
- Pitting or reduction in the strand diameter caused by corrosion
- The presence of lubricants on the strand surface
- Kinks or breaks of any kind
- Bird caging or similar distortions to the strand

Caution
The environment has a great influence on the condition of the strands, especially a salty environment has bad influence on the strands

Attention
Do never weld close to strands; they might become brittle by the heat.

10.2.3. Maintain the recoiler

Grease the nipple:



10.2.4. Checks after operation

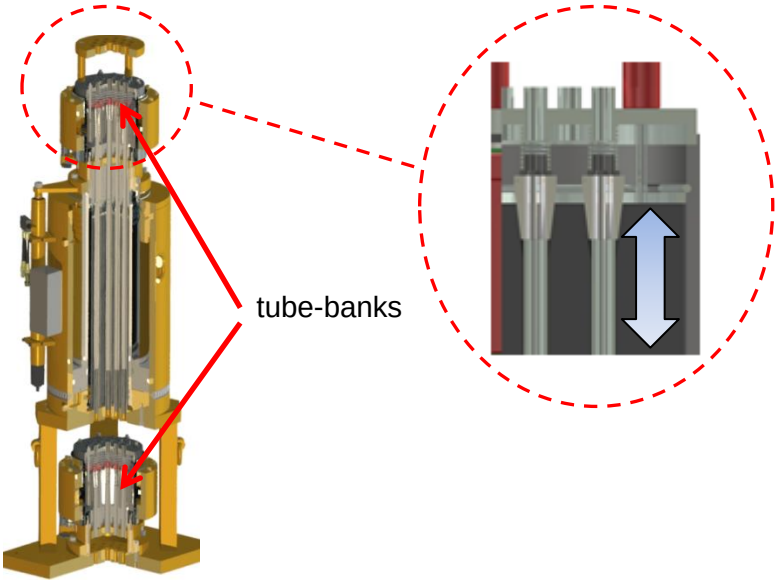
1. Clean the strandjack with a cloth.
2. Clean and inspect the wedges.
   Rusty strands might have left dirt on the wedges.
   Check whether the wedges can be reused. If not then replace them.
   Reference is made to section 10.2.1 “Inspect the wedges”.
3. Check on
   - oil leakages
   - mechanical damage
   - damage to the electrics
   - damage to the paint. Touch up damages.
4. Visually inspect the rod.
   When dirt then clean with a degreaser.
   If the damage is substantial, a new protective coating can be applied. Contact Enerpac.
5. Visually inspect bolted connections.
6. Visually inspect
   - electrical power cables
   - data cables

   Replace damaged cables.

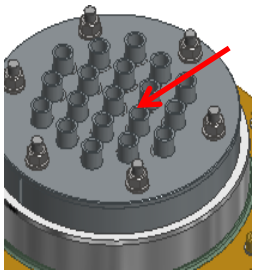
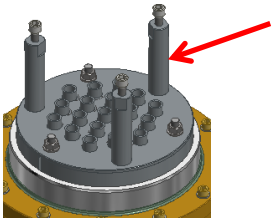
10.2.5. Inspect the tube-banks

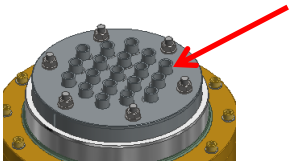
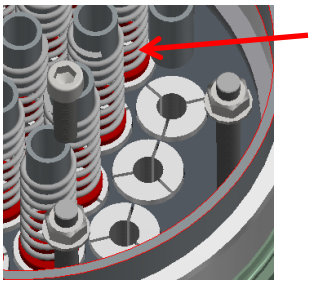
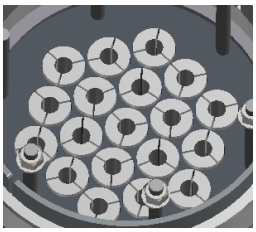
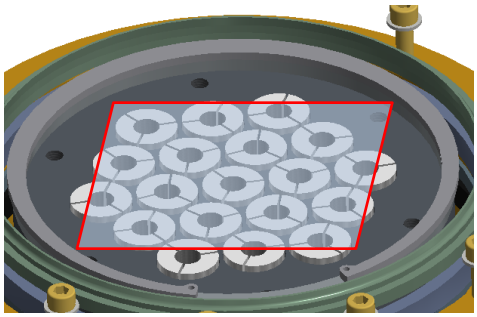
The tube-banks contain the pressing pipes which open the wedges.
The functioning of the tube-banks has to be inspected to verify that all wedges are always in the same plane.

- If so, all wedges fetch and release the strands at the same time.
- If not, some wedges may fetch or release their strand earlier or later than other wedges do.



Proceed as follows, both for the upper and the lower anchor:

1.	Make sure the anchor is in unlocked position. The pressing tubes are in down position.	
2.	Remove the pretensioning plate and the pins. The pins (when attached to the top anchor) have flat ends, so they can be held with a spanner.	
3.	Remove the distance tubes.	

4.	Remove the topplate of the tube-bank. The wedges are pushed into the anchor block by springs. The more wedges are mounted, the more springs and the more pressure on the plate. **Caution** Loosen the pins and bolts carefully as the plate with the pipes is under tension due to the springs underneath.	
5.	Remove all springs and spring caps *The tops of the wedges become visible*	 
6.	Verify that the tops of the wedges are in line. No wedge should be higher or lower than the others. **Caution** If a wedge is not in line, the tube-bank may be damaged and has to be repaired. Operation is not allowed.	
7.	Open the anchor, which means: put pressure on the pressing tubes. *The wedges raise and come out*	
8.	Verify that the tops of the wedges are in line, similar to step [6] of this procedure.	
9.	Re-assemble the anchor in reverse order	

10.3. Electrics

Maintenance jobs to be executed:

Subject	Action	Person O (owner) EE (Enerpac expert)	First 40 hours	Before use	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		x					
	Wipe it clean and free from dust		x			x			
2. Cables and connectors									
2.1. General	Check on damages	O		x					
3. Devices									
3.1. Main switch	Replace the main switch	EE						x	
3.2. Laptop	Replace the battery						x		

11. Quality

Not applicable

12. Dismantling the system

To dismantle the system at the end of its lifetime, proceed as follows:

- Drain the fluids:
  - hydraulic oil,
  - lubricating oil,
  - coolant,
  - and fuel.
- 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.

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Appendices

A.Checklist for planning

1. **Project**

Project	
Customer	
Location	
Date	
Weight of the load	

2. Capacity

Step	Check	Item	value
1.	☐	Mass of the load	... kN
	☐	Centre of gravity of the load	... mm
	☐	Dimensions of the load	... mm
	☐	Lifting height	... mm
	☐	Load offset	... mm
	☐	Bearing capacity of the subsoil	... kN
2.	☐	Type of strand jack Type of HPU	
3.	☐	Required length of the strands	... mm
4.	☐	The number of strands if not the maximum number of strands is applied	...
5.	☐	The positions of the strand jacks are determined	
6.	☐	The position of the COG of the load is regarded	
7.	☐	A palm tree is applied	Y/N
8.	☐	A recoiler is applied	Y/N
9.	☐ ☐ ☐	If the weight of the load > 600 tons: • opposite-wound strands are applied • two dispensers are applied • a palm tree is applied which can guide each strand individually	
10.	☐	The strands will be plumb within a tolerance of 1 %	
11.	☐	The side load will not exceed 1.5 %	
12.	☐	Any possibility of shifting fluids that may change the centre of gravity of the load	Y/N
13.	☐	Weather conditions will not cause dangerous side load	
14.	☐	The support of the strand jacks is capable to support the imposed load.	
15.	☐	Slings, shackles and other rigging is applied according to their specifications	

3. Commitment

Preparations by: Date:

Signature:

Approved by: Date:

Signature:

B.Checklist for installing

1. Project

Project	
Customer	
Location	
Date	
Weight of the load	

2. Inspection

☐	Strands are clean and in good condition
☐	Wedges clean and in good condition
☐	No corrosion on rod
☐	No damage to the power cables and data cables
☐	Oil level of the HPU is ok

3. Pre-Operating Check

☐	The tests as described in section 5.6.1 “Functional tests were OK
☐	The tests as described in section 5.6.2 “Safety tests” were OK
☐	The strands are plumb within a tolerance of 1 %
☐	The side load will not exceed 2 %
☐	The load is free to move

4. Commitment

Installations by: Date:

Signature:

Approved by: Date:

Signature:

C.Recording a lifting operation

1. Project

Project		Description	
Customer		Weight	
Location			
Date			

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” has been completed and signed off	
1		
2		
3		
4		
7		
8		
9		

	Activity	Time
10		
11		
12		
13		
15		
16		
17		
18		

3. Commitment

Executed by: Date:

Signature:

Approved by: Date:

Signature:

D.Checklists for maintenance

Hydraulics:

Subject	Action	Date	Remark
1. System			
1.1. Tests	Perform functional tests		
2. Hydraulic connections			
2.1. Pipes, hoses and brackets	Check on oil leakage and damages		
	Check if the couplings are tightened well.		
	Replace all seals within the piping (Walform)		
	Replace all hoses		
	Replace all plastic brackets		
2.2. Couplings and quick-screw couplings	Check on oil leakage and damages		
	Check if the couplings are tightened well.		
	Replace all seals of the couplings		
	Replace fast couplings and screw couplings		
3. **Cylinders**			
3.1. Common	Check on leakages		
	Check if the bolts are still tightened		
	Replace all seals		
	Grease the bearings		

Mechanical:

Subject	Action	Date	Remark
1. Main construction			
1.1. Main construction	Visual check of all welding		
	Visual check painting		
	Visual check on corrosion and damages		
	Check all bolts.		
	Visual check of the hoisting lugs		
	Inspect the readability of the warning signs. Clean if obscured by dirt. Restore if damaged or even no longer present		
	Perform the after-operation checks.		
2. Wedges and strands			
2.1. Wedges	Inspect the wedges; eventually replace		
2.2. Strands	Inspect the strands; eventually replace		

Electrics:

Subject	Action	Date	Remark
1. Electro motor			
1.1. General	Check on damages		
	Wipe it clean and free from dust		
2. Cables and connectors			
2.1. General	Check on damages		
3. Devices			
3.1. Main switch	Replace the main switch		
3.2. laptop	Replace the battery		

E. Hydraulic fluid safety information S4 VE 46

For safety information reference is made to section E of ref 2 “Strand jack manual Volume 2: Hydraulic Power Unit (HPU) “.

F. Torque settings

For torque settings reference is made to section F of ref 2 “Strand jack manual Volume 2: Hydraulic Power Unit (HPU)”.

G. Error messages

The following error messages may be shown on the laptop:

Error message	Error Message
0000	No alarm
0001	A hardware emergency halt occurred
0002	Software generated an emergency halt
0003	The Scc60 user generated an emergency halt
1000	Low oil
1001	Local control active
1002	Emergency Halt
1003	Invalid bottom anchor state
1004	Invalid upper anchor state
1005	Inverter failure
1006	Aux output gr. 1 state invalid
1007	Aux output gr. 2 state invalid
1008	Limit switch is activated
1009	There's a strandjack's tensioning head state invalid
2000	Overload
2001	Bottom pressure overload
2002	Top pressure overload
2003	Designload overload
2004	RPM sensor value too high/short circuit
2005	RPM sensor value too low/broken wire
2006	Stroke sensor value too high/short circuit
2007	Stroke sensor value too low/broken wire
2008	Stroke sensor value too high/short circuit
2009	Stroke sensor value too low/broken wire
200A	No load detection within preload stroke
200B	Cylinder position below minimum
200C	Cylinder position above maximum
200D	Top pressure sensor value too high/short circuit
200E	Top pressure sensor value too low/broken wire
200F	Bottom pressure sensor value too high/short circuit
2010	Bottom pressure sensor value too low/broken wire
2011	Load detected in unloaded operation
2012	There's a strandjack's loadcell sensor AD reading too high
2013	There's a strandjack's loadcell sensor AD reading too low
2014	Tensioning load overload
3000	Invalid start position
3001	Strandjack out of lift hysteresis
3002	Anchors of inactive strandjacks not closed
3003	Upper anchor timeout
3004	There's a strandjack's time allowed for a lower head transit exceeded
3005	No load detected within preload stroke
3006	Unexpected load release
3007	Unexpected load detected
3008	Load not released withing anchorstroke

Error message	Error Message
3009	Bottom anchor not closed
300A	Upper anchor not closed
300B	Bottom anchor not open
300C	Upper anchor not open
300D	Invalid stroke value
300E	Load not released within preload stroke
300F	Load not above anchor open load within anchor stroke
3010	There's a strandjack's time allowed for a tensioning head transit exceeded
3011	There's a strandjack's tensioning head not closed although it should be
3012	There's a strandjack's tensioning head not open although it should be
3013	There's a strandjack's tensioning head detected although it shouldn't be
3014	There's a strandjack's hardware configuration mismatching the tensioning related settings
4000	System in halt state
4001	There's a bus network error
4002	There's a Smartbox power failure
4003	Communication error
4004	System Error
4005	Configuration Error
4006	Load is above anchor open load, can't open top anchors

Z. Compatibility

The table below shows the compatibility of the strand jacks and the HPUs, as well as the lifting speeds.
Note that the speeds are the **net** values. They include:

- time necessary for locking and releasing of the anchors
- time necessary for repositioning of the main jack

Theoretical lifting speed [m/hr]					
Strand jack type	**Applied HPU / lifting speed [meters/hour]**				
	2.2 kW	**7.5 kW**	**15 kW**	**18.5 kW**	**30 kW**
HSL150	13				
HSL300		16			
HSL450		16			
HSL600		13			
HSL700		13			
HSL1000		9			
HSL2000		6	9		
HSL3000			6		
HSL4500				6	10
HSL5000				6	10
HSL6500				4	7
HSL8500					6
HSL10000	(no HPU specified for)				
HSL12500	(no HPU specified for)				