SPIRAL HEAT EXCHANGER

Installation, Operation and Maintenance Manual

IOM SHE-EN Rev.1 / ENGLISH

IMPORTANT: All other specific information on the general arrangement drawing or other specific documents provided by Alfa Laval with the equipment takes precedence over information in this document. 1

If there is a QR Code on the nameplate of the Spiral, scan it to access this Instruction Manual. 1

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Section 1 – Description

1. Introduction

This manual describes the design, installation, operation, and maintenance for the Spiral heat exchanger.
The Spiral heat exchanger is a welded heat exchanger. It offers a large heat transfer surface with a very reduced footprint.

2. The various models and their operation

In this manual the following models are called "Type 1V":

1V-L-1T	1V-L-1B	1V-L-1C	1T-C-1T
1V-L-2T	1V-L-2B	1V-L-2C	
1V-C-1T	1V-C-1C	1V-C-2T	
1V-C-2C	1G-C-1T	1G-C-2T	

In this manual the following models are called "Type 1H":

1H-L-1T	1H-L-1B	1H-L-1C
1H-L-2T	1H-L-2B	1H-L-2C

In this manual the following models are called "Type 2V":

2V-C-1T	2V-C-2T
2V-V-1T	2V-V-2T
2V-R-1T	2V-R-2T

In this manual the following models are called "Type 2G":

2G-C-1T	3G-C-1T	23G-C-1T
2G-C-2T	3G-C-2T	23G-C-2T

In this manual the following models are called "Type 3V":

3V-C-1T	3V-C-1C
3V-C-2T	3V-C-2C

In this manual the following models are called "Type 3H":

3H-C-1T	3H-C-2T
3H-C-1C	3H-C-2C

In this manual the following models are called "Type 4V":

4V-C-1T	4V-C-2T
4V-V-1T	4V-V-2T
4V-R-1T	4V-R-2T

In this manual, other more specific models are called by the first letters of their product name (LTL, COND, VAP, STW, STS…)

Type 1H (including STS)
Type 1 with spiral circulation in each circuit is designed for liquid - liquid application.
Do not use for condensation usage, this could lead to hydraulic shock.
Notice that STS is a type 1H model for application Sludge / Sludge.

Type 1V (including LTL)
Type 1 with spiral circulation in each circuit is designed for liquid - liquid application and sometimes for the condensation of liquid or gas into liquid.

Types 2V (including COND or VAP)
In a crossing flow, one of the fluids circulates along the axis of the unit, and the other circulates in a spiral flow.The crossing channel is open at the top and bottom.
The spiral channel is closed at the top and bottom.
The body of the unit is equipped with extensions shells on the 2 sides where the connections are located.

Type 2G
This unit may also be mounted at the top of a column (model 2G). In this case, the steam enters into the unit through the lower cone, goes up and travels through the center of the exchanger body - the center of the exchanger is open at the top and bottom - to come out in the upper shell, where it changes direction.
Fluid condensates through the exchanger body from the top to the bottom in the crossing flow, as in a type 2V.
The steam and the condensates are recovered outside the internal cone, condensates in the bottom part, and vapor or non-condensable gases in the top part.

Type 4V
The type 4 model means that several bodies have been mounted in a column in the same unit.
The operating principle remains the same as Type 2V.

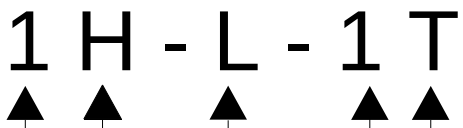
Type 3V
The cooling liquid enters from the side and circulates in a spiral toward the center of the unit, where it exits through a manifold attached to the lower cover.
The vapor enters in the center of the unit through a nozzle located in the upper cover. Its internal profile allows the uniform diffusion of the vapor in the spiral ring where it will condense.
A separate nozzle collects condensates and non-condensable gases. These nozzles are mounted on the top and bottom parts of the exit collecting box respectively.

Type 3H
Some applications, for example those involving fluids with especially high solid loads, require exchangers that operate in a horizontal position so as to reduce clogging risks. Therefore, a cylindrical extension is mounted on the open side of the vapor channel. This extension is equipped with a central horizontal partition, extended by some plates that penetrate approximately two thirds of the way into the body coils. The vapor enters through the upper part of the partitioned side and is then forced to travel across the entire upper area of the spiral body. Condensates are recovered in the lower part of the partitioned extension; non-condensable gases exit near the center of the same part below the central partition. The cooling fluid enters through the external channel and circulates in a spiral toward the center of the unit, where it exits through a nozzle attached to the cover opposite the side where the vapor enters. Do not condensate the cooling side, this leads to hydraulic shock.

Type STW
This unit with spiral flow on each side is designed for liquid-liquid usage. Sludge circulates in a channel accessible under the cover.

3. Naming

The name of the **customized unit** describes a heat exchanger in terms of unit type, mounting type, application type, number of channels, and center type.
For example:



Spiral Type
1, 2, 23, 3 or 4

Spiral Position
V = Vertical
H = Horizontal
T = Turnable
G = Mounted at the top of a column

Spiral Application
L = Liquid
C = Condenser
V = Evaporator
R = Reflux
SW = Sludge / Water
STS = Sludge / Sludge

Number of channels
1= 1 single hot channel and 1 single cold channel
2= 1 double hot channel and 1 double cold channel

Center Type
T =Tubular
R = reduced
C = Closed: 1 channel is completely closed
B = Bolted
W = Rolled and welded

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The name of the **standard unit** begins with the type (COND, LTL, VAP, STW, …) followed by the model (number or number + letter). 1

4. Construction

For each model, please refer to the overview diagrams as shown in sections 5 to 11 at the end of the manual. 1

5. Function & duty

The Spiral heat exchanger (SHE) is a heat exchanger used for heating or cooling (with or without heat recovery), steam heater, condenser, reflux condenser, reboiler, gas cooler, etc... Each of those duties requires a specific installation and the installation must be in conformity with the thermal data sheet and the general assembly drawing of the unit.

- **Pressure and temperature limits**
  Never run the SHE at higher pressure than the MAWP and/or lower/higher temperatures than the min/max temperatures which are indicated on the name plate. 

  A maximal differential pressure between both sides may be indicated on the unit (indicated on pressure differential plate or on nameplate). The differential pressure into the Spiral heat exchanger must never exceed this max allowed differential pressure even during start-up or test. 

- **Continuous & cyclical duty**
  SHE has been designed for continuous and stable operating conditions. SHE is not suitable for cyclical operating conditions, especially when sudden temperature changes with high amplitude could occur. 
  High cyclical duty (temperature and/or pressure) may create fatigue leading to a reduced lifetime of the unit.

- **Operating pressures**
  It is recommended that the SHE always has a differential pressure between the two circuits. An identical operating pressure on both circuits could make the plate pack behave like an accordion because of pressure inversion, creating fatigue, with the risk of a decreased lifetime.

- **Duty**
  In order to ensure optimal efficiency, it is strongly recommended to run your SHE as close as possible to the operating conditions used for the initial sizing of the heat exchanger. 

- **Corrosion risk**
  The material of the parts in contact with the used medium has been specified or chosen based on data supplied by the customer (fluid, composition, temperature, etc.). If the media passing through the unit and/or operating temperatures are different from those specified in the data sheet, the Customer is responsible for ensuring that the corrosion resistance is suitable.
  Special attention shall be given to the chloride content of the streams, as this is a frequent cause of corrosion of stainless-steel materials.
  Responsibility regarding the duty or cleaning medium and checking its compatibility with the materials used in the heat exchanger is with the customer or contractor, if otherwise not agreed with Alfa Laval. The quality of medium can considerably affect the operation and lifetime of the heat exchanger.

6. PED/Risk Analysis

All units delivered in the EEC (European Economic Community) follow the PED (Pressure Equipment Directive) with a level of risk depending on parameters such as nature of the fluid (gas, liquid, steam, fluid vapor pressure), and the danger level of the fluid, design pressure, volume of each circuit or design temperature.

These parameters will determine a PED Category to which is linked a risk analysis as per the PED. Make sure that all parameters used to define the category of your unit matches your operating conditions. 

Section 2 – Installation

1. Site Preparation

The unit must be installed on a support (flat flooring, skid or on counter-flanges) able to withstand the entire weight of the heat exchanger once filled with liquid. The dimensions are shown in the assembly plan.

The equipment is generally delivered assembled and tested (except for very big units). The only necessary procedure is the positioning of the anchoring bolts before installing the equipment.

Before throwing away the packaging, verify that it does not contain any parts delivered with the equipment.

Make sure that installation will allow easy opening of the cover for future maintenance operations.

NOTE!
Depending on the properties of the fluid, install Spiral heat exchanger within a spill containment tray to avoid any pollution due to potential leakage.

2. Connection

Installation of the unit must leave adequate room around the unit, so the cover has clearance to open for maintenance.

Connecting the exchanger must be done to avoid the effects of expansion/contraction that could place excessive stress on the connections. Avoid long straight lengths of pipe. Use elbows and / or expansion brackets or collars.

NOTE!
Comply with the maximum loads for the nozzles:
- specified on general arrangement drawing
or
- listed in Appendix - Section 12 / 5

Leave space of about 1mm (0.04 inch) more than the thickness of the seal between the flange joints and the corresponding face of the connecting pipe.

Before connecting the equipment, be sure to clean the pipes to keep any waste or debris that they may contain from entering the unit when placed into operation.

3. Valve and Pump Layout

Follow the standard rules of conduct for the design and operation of the installation. Take the necessary precautions to prevent “fluid hammer” and to avoid exceeding the equipment's design conditions.

To isolate the equipment, the connection network must include isolating valves. These valves are indispensable between the pumps and the unit.

All valves must be slow closing.

Pumps should always be started against closed valves, which will be open slowly, to avoid hydraulic shock. If the pump is remote (far) from the Spiral heat exchanger, ensure that the piping and the SHE are filled before opening the valves fully.

The flow rate must be increased slowly and gradually during commissioning and reduced progressively upon shutdown.

It is recommended to have "bypass" lines to ensure normal flow during maintenance of the unit. This will permit isolation of the Spiral heat exchanger while the process is running.

Do not use piston pumps. For other positive displacement pumps, a pressure relief bypass system is recommended. It is also preferred to use variable speed drive to control the pressure ramp during start-up and shutdown.

Install any other safety mechanism adapted to your specific process.

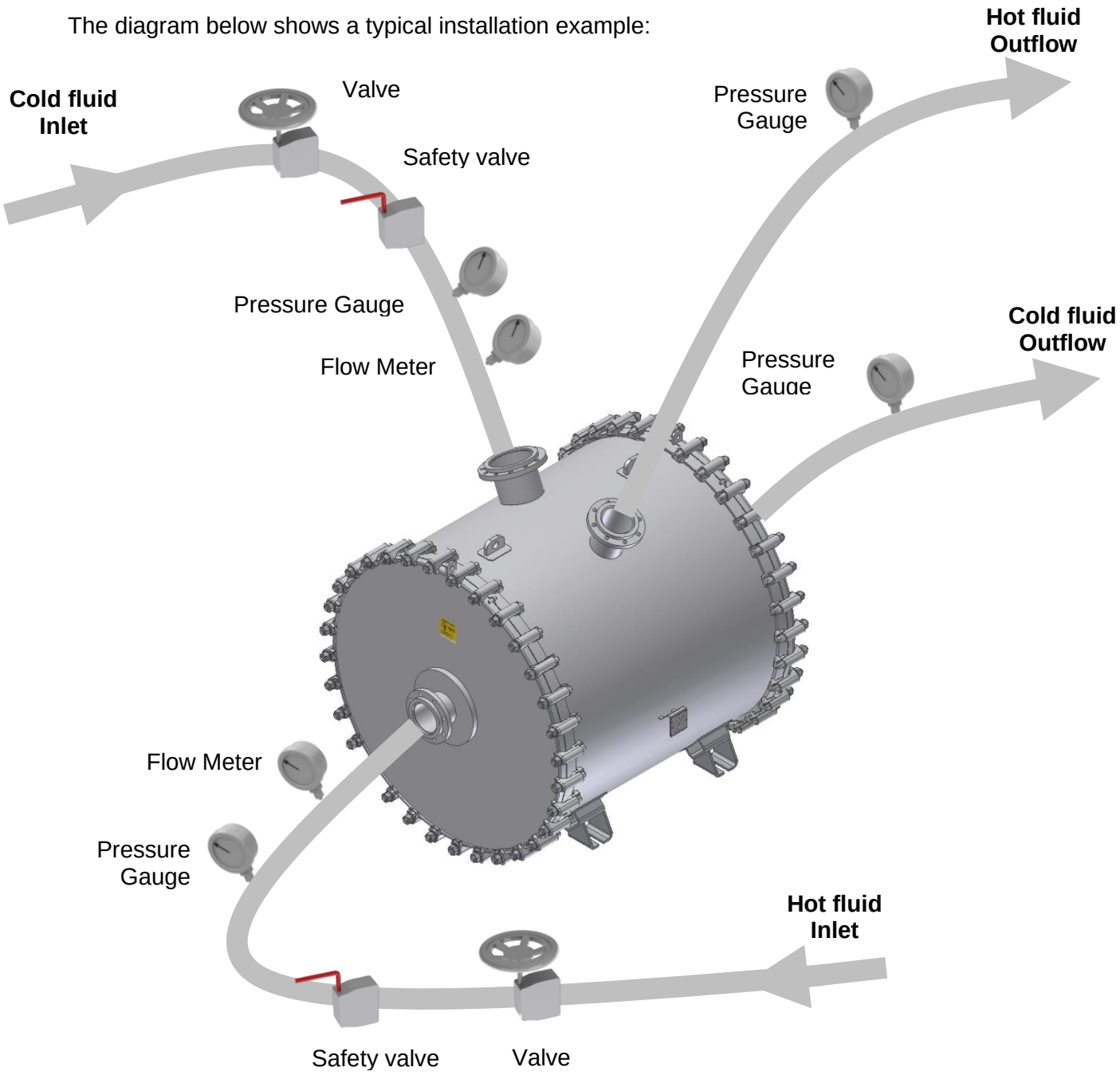
In the specifications for pumps and spiral exchangers, plan enough margins to allow for pressure increases or decreases greater than the values specified for the process. These margins are the result of possible variations in fluid properties, flow rate, sedimentation, or deposits on the heat transfer surface.

In case of different pressures on both sides, final user must install a safety system to prevent overpressure on the side with the lowest design pressure in case of internal leakage.

Units using steam as the heating medium should be provided with a steam trap, preferably of a type that automatically vents non-condensable.

Good engineering practice should be observed when using control valves provided with manual bypass and isolation valves.

The diagram below shows a typical installation example:



WARNING
To protect the unit from overpressure, the pressure value must be monitored on each channel. The pressure is given on the nameplate.

4. Positioning & handling

When moving the exchanger, only lift it using the specially designed devices on the body (lift rings, support legs).

The drains are capped, and no valves are provided.

Upon positioning, ensure that the body is properly aligned, and that the positions of the nozzles correspond to the connecting pipes as indicated in the drawing.

If the drain caps are removed, during reassembly the seal must be tightened with Teflon tape, paste or any other appropriate product. 1

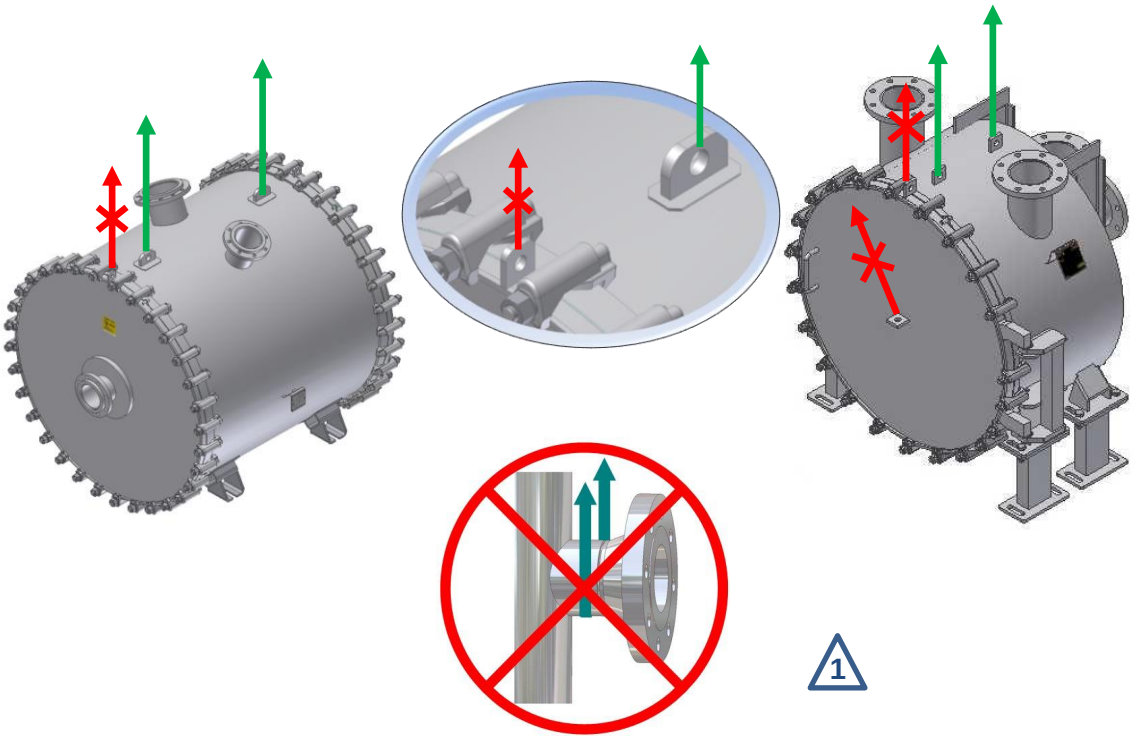
For each model, please refer to the overview diagrams as shown in sections 5 to 11 at the end of the manual. 1

WARNING
Never use the nozzles to lift the unit, as this may cause mechanical damage.

WARNING
Never use the cover lifting rings to lift the device, these are for lifting individual cover only. This may cause mechanical damage and risks for operators.

WARNING
It is very important to check that the capacity of the lifting means correspond to the lift weight.

WARNING
For safety reasons, never stand or work under suspended loads.



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5. Grounding connection

Please use the grounding lug(s) available for this purpose to connect the Spiral heat exchanger to Earth prior to operation start-up. 1

Section 3 – Operation

1. Before start-up

NOTE!
Check the tightening torque of the bolts
During shipping or long shut down, the cover seals and/or bolts may release or loosen. To ensure that the covers seal properly, tighten successively on diametrically opposed bolts.
The recommended tightening torque is listed in section 4 "maintenance," of chapter 7 "replacing the covers" in this manual.

Individual precautions
Since the heat exchanger in operation can operate with high temperatures and aggressive media, it is necessary to provide personnel protection equipment, in accordance with the applicable safety regulations and work safety codes at the customer site.

Personal protection
Make sure the unit has personal protection (a protection screen or cover is generally enough) or the appropriate insulation so that nobody can be hurt or burnt by touching the exchanger surfaces.

The liquid with the inlet operating temperature nearest the ambient temperature must be admitted first. 

In case of maximal differential pressure indicated on the unit (indicated on pressure differential plate or on nameplate), this differential pressure must never exceed the max allowed differential pressure indicated on the nameplate, even during start-up. 

To prevent fluid hammer and/or thermal shock to the unit, do not open/close the valves rapidly or engage the pumps suddenly. Adjust the pressure and flow rate gradually and slowly to prevent rapid variations in pressure and temperature. 

Always engage the pumps with the valves closed and then open them slowly. 

Verify that the heat exchanger is vented and filled with liquid before opening the intake valve. This is especially important when the pump is far away from the unit.

Positive displacement pumps must be engaged in "bypass" by slowly closing the valve in the "bypass" line or by slowly increasing the pump speed.

WARNING
Before pressurization, ensure that the unit temperature is not lower than the minimal design temperature indicated on the nameplate 

WARNING
Abrupt pressure variations may cause fluid hammer that could seriously damage the unit.

WARNING
Start-up must be gradual (respecting both conditions below):
- **heat rate shall not exceed 60°C (140°F) per hour to avoid thermal shocks or unnecessary stress on the unit** 

- **pressure build-up must be slow and controlled (minimum 5 minutes for pressures up to 15bar/147psi and 10 minutes for pressures above 15bar/147psi).**

2. Venting

So that the unit can operate according to the specifications, it is important that all residual air or gas be eliminated by venting.

Please find below some information about venting per model/type.

Model or type	Channel A	Channel B
LTL	self-venting	self-venting
COND/VAP	self-venting by A1 non-condensable in A3	self-venting by B2
STW	self-venting	self-venting
1H and 3H	self-venting	self-venting
1V	A3	B2
3V	A1/A3	B3
2V, 4V and 2G	self-venting	self-venting

Notice that, in some cases, some vents may be added or placed differently.
Please always refer to General Arrangement drawing to identify the position and the sort of vents (nozzle, ½''NPT…).

WARNING
In case of manual venting operation, never stay in front of the opening used as vent.

3. In Service

Do not exceed the maximum pressure indicated on the unit identification plate (see the sample identification plate in the section 12 of the appendix). Standard operating rules must be observed.

When indicated (see Section 12 – Appendix example of plates), do not exceed the maximum pressure differential between the both sides.

Avoid abrupt changeovers to prevent "fluid hammer" hydraulic shock and fatigue caused by the thermal dilation and contraction of fluids.

Maintain flow rates within the specified values. At lower rates, pressure and thermal efficiency losses are reduced. Lower rates than the specified values may lead to more rapid fouling.
Solid particles contained in the fluid may thicken and obstruct channel if flowrate decreases.

In facilities with several units, capacity variations are always best regulated by varying the number of units in service, rather than by varying the flow rates within the unit.

WARNING
The exchanger must not be exposed to open flame.

NOTE!
In all cases, the terms of use must conform to the specifications listed on the certificate of compliance.

4. Shut down

Let circulate the fluid, whose inlet temperature is the nearest to the ambient temperature. Switch off the feed of the fluid of the other side.

To prevent "fluid hammer" and thermal shock, feeds must be slowly shutdown. Close the valve gradually and stop the pumps when the valve is closed. Repeat the same procedure for the other side of the unit.

Units containing fluids that have a much lower boiling temperature than ambient temperature (e.g. Freon, ammonia) must not reach ambient temperature with the valves closed. While the Spiral exchanger is designed to withstand the pressure created, there is a clear risk of bodily injury if the unit is opened while it still contains these fluids. The piping must be designed so that continuous purging is possible.

The unit must not be drained if the planned shut-down period is of short duration, if the unit will not be opened and if there is no risk of clogging by deposit during this short stoppage. This will facilitate restart. For longer shut-down periods, the unit must be opened and dried.

For long stoppage or if there is a corrosion risk due to residual liquid (high level of chlorine, for example), the unit must be emptied, cleaned, drained and dried.

If there is a risk of freezing or if the unit must be left open, it must be washed with water and drained. During shutdown of the installation with a risk of freezing, draining the channels and opening the cover is recommended.

WARNING
After shut-down, the unit temperature must reach room temperature before being touched.

NOTE!
When using salted water or other corrosive chemical products, liquid must never be left in the unit. The device must be immediately washed with clear water or another product compliant with the liquid used in the unit.

5. Draining

WARNING
To prevent potential injury of the operators, let the unit to cool down to ambient temperature before draining.

When the unit is stopped and disconnected from the distribution system, it may be drained.

Please refer to General Arrangement drawing to identify position of the drains.
Notice that, in some cases, channels are self-draining via main connections.
For some horizontal units installed on trunnion (like LTL), the unit needs to be turned ~90° to be completely drained

WARNING
Ensure that toxic, hazardous, lethal vapor or liquid are NOT released to the atmosphere or to the ground. These could cause injury to people and/or pollute the environment.

6. Storage

The unit must be stored indoor, in a room with a temperature of about 20°C (70°F) and with humidity of about 70%.

The bolting must be loosened during storage at negative temperatures (< 0°C, 32°F).

The unit must not be unpacked until installation. The manifolds must be capped with plastic or other protective material. This protection must only be removed at installation.

Other protection, with desiccant crystals is available upon request. Protection is provided by packets of desiccant crystals that are placed in the middle of the unit, in the nozzles and in the packing. For carbon steel unit, nitrogen protection is available upon request.

If spare parts are delivered with the unit, they can be stored without time limitation in their original packing and in a dry area (no outdoor storage). Gaskets must be stored in horizontal position.
Rubber joints (seals) such as nitrile seals are sensitive to ozone and light and must be protected with packaging.

WARNING
After a long shutdown (several months), check the tightening torque of clamps, all bolts and nuts, before re-starting.

WARNING
In case of manual draining operation, never stay in front of the opening used as drain.

Section 4 – Maintenance

1. Preliminary

Any maintenance actions must be done by qualified persons with genuine knowledge of the spiral heat exchanger and in accordance with the manufacturer's instructions. The inspection of units must comply with the existing procedures in place in the country where the unit is installed.

2. Fouling and clogging

Despite a low rate of fouling owing to the single channel construction, deposits of various kinds may occur on the wall surfaces. The deposits commonly consist of material of low thermal conductivity which will increase the total wall resistance. Consequently, a layer of deposits may severely reduce the overall heat transfer rate and crevice corrosion may occur under these deposits. Surface deposits will increase the risk of clogging due to the accumulation of solids. As a result, this will also increase the pressure drop due to reduced channel spacing and increased velocity.

3. Cleaning

The heat transfer surfaces should be kept clean to maintain design performance. Cleaning can be effectuated either by cleaning-in-place (without opening) or by manual cleaning after opening the unit.

Chemical cleaning

Frequently, the most efficient procedure is to flush the unit without removing the covers, using a suitable acidic or alkaline cleaning solution or in some cases, a hydrocarbon-based solvent. The pipework must be provided with valve branches to enable cleaning agents to circulate. For optimal results, the flow direction should be in the opposite direction of normal flow ("back flushing" mode). Proprietary cleaning agents should be used in accordance with the manufacturer's instructions. In this way, the compatibility with the materials of construction (metal and gaskets) is secured and warranties apply. Do not use solutions containing chlorides as their presence inevitably will lead to corrosion.

The flow rate of the cleaning solution should equal the design flow rate or higher so that the shear forces assist the cleaning operation by scrubbing. However, flow rates substantially lower than the design flow rate can provide acceptable cleaning efficiency if compensated for by a longer cleaning time. Note that the pH value of the cleaning liquid is crucial (for acidic solutions in particular) and it may be necessary to add more (concentrated) cleaning agent during the cleaning operation.

After cleaning, the unit should be completely flushed with hot water to remove any trace of cleaning agents, particularly if acids have been used. Check the pH and chloride content of flushing water. The unit should be drained and dried if not put back in operation.

The type of cleaning protocol and frequency of cleaning should be determined for each individual case depending on the fouling specie(s) and the severity of fouling formation.

As a rule of thumb, inorganic deposits should be combated with acidic cleaning solutions and organic deposits with alkaline cleaning solutions. The choice of cleaning agent, its concentration, the temperature and time, i.e. the cleaning protocol, hinges on the specific composition of the fouling specie(s). The guidelines given in the Table below show how to get rid of various common fouling species. For additional information on cleaning protocols, please contact your nearest Alfa Laval representative.

Type of deposit	Cleaning agent	Typical conditions
Organic (microbiological growth, algae, slime, proteins, grease etc.)	AlfaCaus	10 vol.%, 60 oC
Oil-related	Alpacon Multi CIP II AlfaCaus	10 vol.%, 60 oC
Asphaltic, tar, hydrocarbon-based	Paraffin or naphtha-based solvents followed by AlfaCaus	
Calcium carbonate Calcium phosphate	Alpacon Descalent II	10 vol.%, 60 oC
Iron oxides	AlfaPhos	10-20 vol.%, 60 oC

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WARNING
Never use hydrochloric acid or other substances containing chlorides as their presence will inevitably lead to corrosion of stainless-steel alloy components.

1

Mechanical cleaning
If chemical cleaning is not possible, remove the cover(s) and clean the unit manually by high-pressure hydro blasting. During cleaning, keep the unit in the horizontal position. Hot water jet and high-pressure steam can also be effective.

NOTE!
Before opening a Spiral heat exchanger, make sure it is empty. Collect the remaining fluid to avoid any pollution of the environment.

NOTE!
Always use the appropriate waste container to recover the spent cleaning solution

Back flushing
"Back flushing" is often effective if there is a tendency toward obstruction from the accumulation of solids at the inlet or in the first part of the channel. "Back flushing" consists of reversing the direction of the flow of one or both liquids or cleaning with water in the opposite direction of the normal flow. The flow rate during back flushing should preferably be higher than the normal rate of circulation in service for a period of 15-30 minutes.

4. Opening the unit

WARNING
Do not open the unit if the channels or even one of the channels is under pressure. Any attempt to open the unit while it is under pressure may cause bodily injury and/or irreparable damage to the unit.

WARNING
Do not stand in front of the cover during opening: residual liquid may cause bodily injury at the opening.

WARNING
For safety reasons, do not stand under suspended cover.

Sample safety plate located on the unit

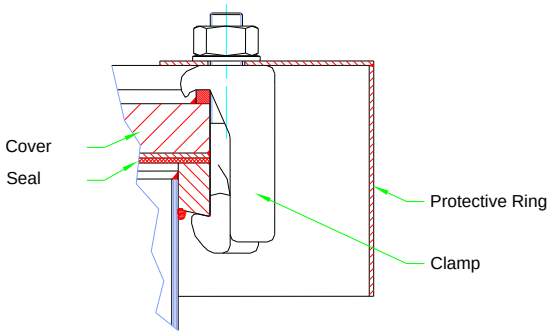
Instructions for opening a cover (see also diagrams from Section 5 to Section 11 at the end of this manual) 1

1. Let the unit cool before opening it. Close the main valves for the inlet and outflow openings. Verify that:
   - None of the unit's channels are under pressure, 1
   - Both channels have been drained (Refer to the Section 3 / paragraph 5).
2. Ensure that the unit is firmly attached to its support
3. Disconnect the piping network from the cover to be open. 1
4. If the unit is not equipped with a hinge, hold the cover by the lifting lug on the top of the cover, 1
5. Remove the bolting (pay attention not to lose bolting once removed from the unit).

NOTE!
We strongly recommend changing the gaskets each time the unit is open.
The graphite gaskets cannot be re-used after opening and must be systematically replaced.

The seal may adhere to the covers and/or to the sides of the unit body. When removing the residual parts of the seals, be careful not to damage the side facing the cover, the edges of the exchange surface in the body, and/or the circular flanges. The sealing surfaces of the cover must never be placed directly on the ground.

If it contains dangerous liquids, the unit may be equipped with a safety mechanism to prevent splashing in case of external leaks from the seals. It consists in an external deflector held in place by the locking clamps. It must be remounted after maintenance.



5. Inspection

Spiral heat exchangers with alternatively welded channels (most of the type 1 and 3 models) may also be inspected from each side of the exchanger.
If the height of the body of the unit is significant and/or the channels are narrow, it is sometimes necessary to use a borescope.

The channels must be inspected for:

- corrosion – often visible near the welds in the channels toward the exterior side of the body, and thus easy to detect.
- erosion – often visible in the center or edges of the inlet port and around the studs.
- fouling / obstruction - primarily in vertical unit, sedimentation of solids may occur in the lower part of the channel. Any accumulation of solids can be easily detected in the open channel in the lower part.
- mechanical damage – such damage will appear as deformations.

If there is significant corrosion or erosion, or if mechanical damage occurs, contact the manufacturer for information on the possibility of on-site repair.

WARNING
For unit provided with manhole, the access inside the equipment must be only authorized to the trained staff having to verify that the atmosphere is breathable.

6. Gasket replacement

NOTE!
Always put the old gaskets in an appropriate waste container.

Spiral sealing can be assured only with gaskets supplied by Alfa Laval.

Please read attentively this whole chapter before starting to change the gasket.

Change the gasket

1- Open the cover and outline the cover shape on the new gasket sheet.

Do not forget to outline the tabs that anchor the gasket (if existing - only on horizontal unit).

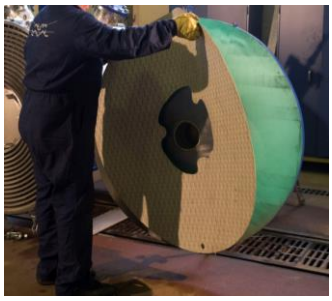
In case of Spiral with body flange, the new spare gasket is delivered by Alfa Laval with the external circular shape already cut. So, you can go directly to point 3 of this instruction.


2- Cut the gasket along the outline.


3- Position the gasket against the cover after having drilled holes for the locking pins (if there are some) and any potential drains and vents.


4- Locate the center of gasket. You can obtain its form by tapping the gasket lightly against the center.


5- Cut out the center shape and attach the gasket to the cover.



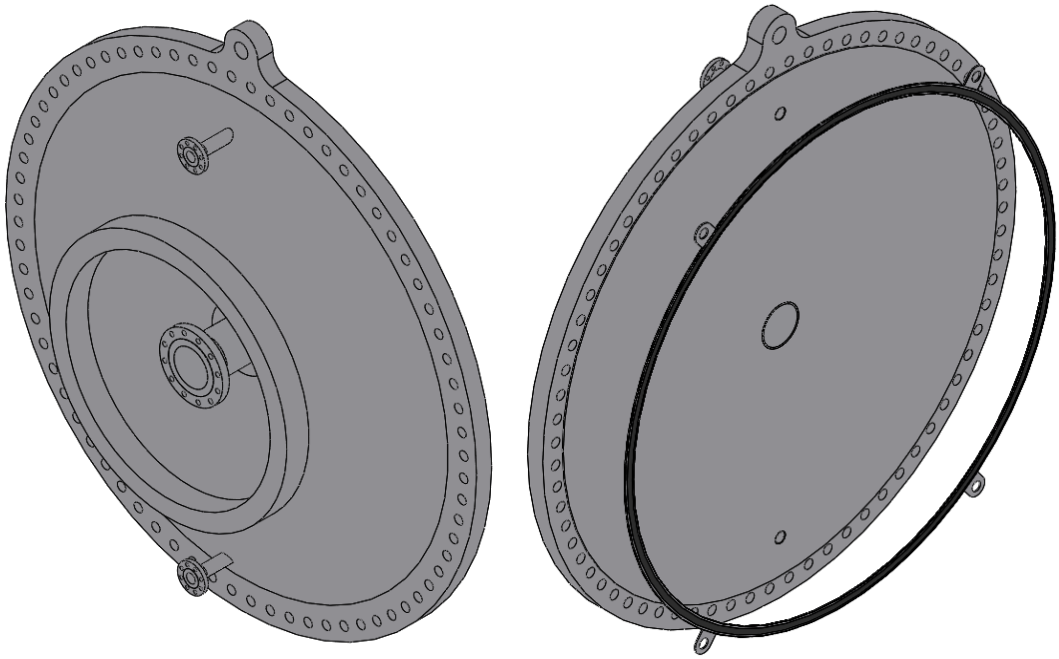
6- Attach the bolts.

Tighten them manually first, and then to the nominal tightening torque (*please refer to the following chapte*r).

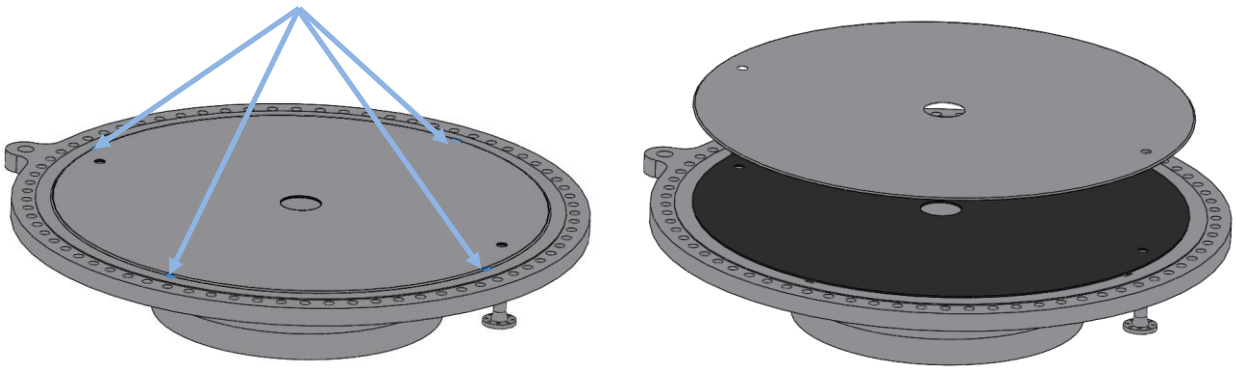
Gasket protection sheet or outer seal

In some specific cases, when opening the unit, you may detect the presence of a “gasket protection sheet “ (metallic thin sheet fixed on the gasket to avoid contact between gasket and fluid and/or to prevent any damage of the gasket that may appear when tightening the cover). There may also be presence of an outer seal (generally for high pressure Spiral heat exchanger).
The following instruction explains how to deal with them before changing the gasket.

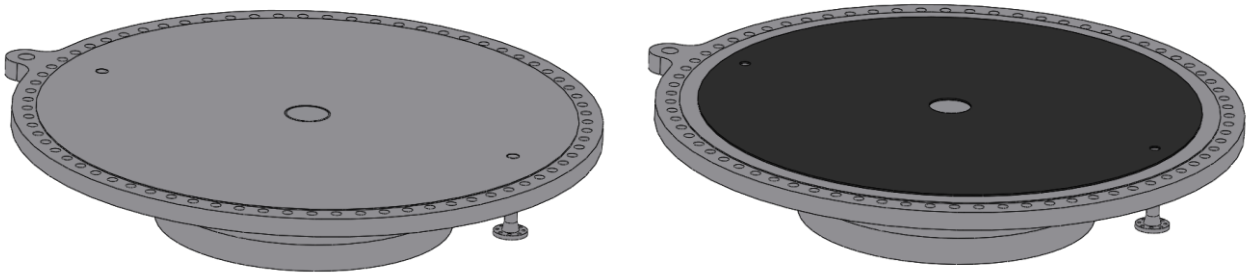
1- Open the cover and remove the outer seal (if there is one). A used outer seal cannot be re-used. Only install Alfa Laval genuine spare outer gasket.



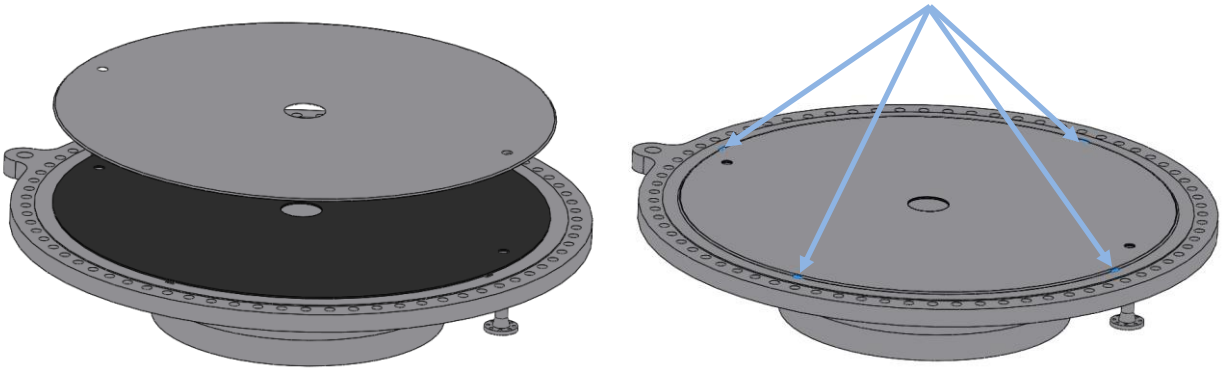
2- Place the cover horizontally and grind down the spot welds of the gasket protection sheet (if there is one). Remove the gasket protection sheet.



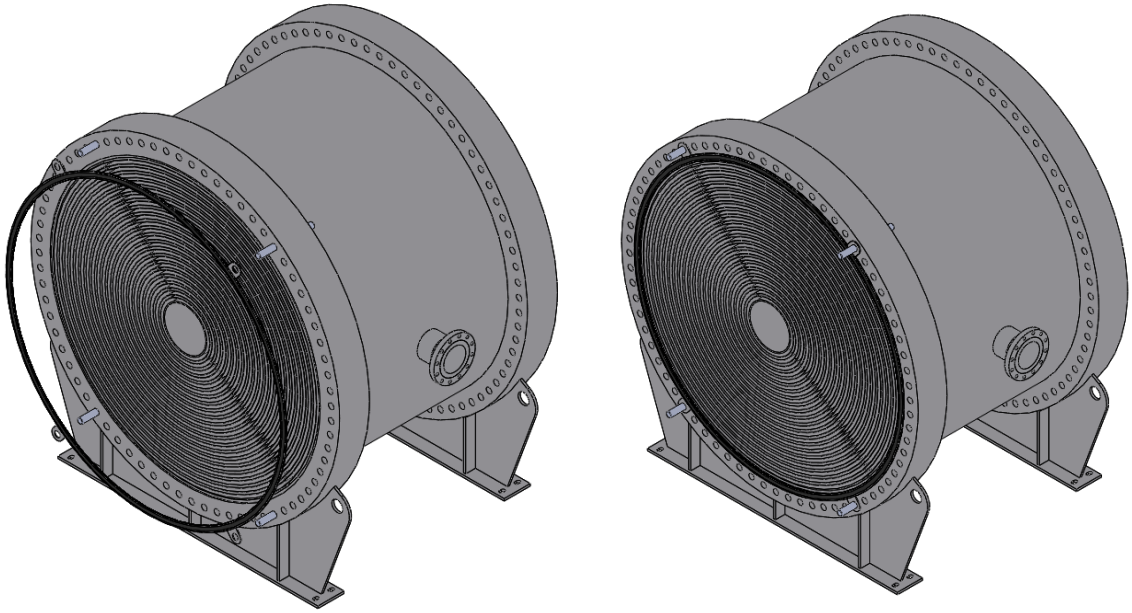
3 - Replace the gasket according to the instruction “*Change the gasket*” at the beginning of this chapter.



4- Once gasket is in place, put again the gasket protection sheet in place.
Hold it in place with 3 or 4 spot welds.



5- Put a new outer seal in place, using the lugs of the joint and threaded rods.

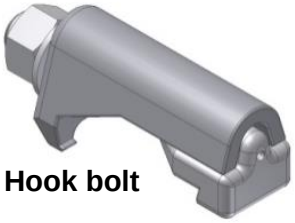


7. Remounting the covers

To facilitate mounting, the edge of each cover is engraved with a letter corresponding to side A for channel A and B for channel B. The two sealing rings on the unit are also engraved with the corresponding letter. The markings must match. The unit serial number is also engraved into the covers.

Alfa Laval uses two types of fasteners (bolts) for the attachment and the clamping of unit covers:

- ✓ hook bolts (clamps):
  the “hook bolt” is a unique design fastener, that is manufactured especially for Alfa Laval. Hook bolts are intended as a quick connection for smaller, or lower pressure units. The covers and unit bodies are design matched for using these fasteners.



Hook bolt

- ✓ tie rods (threaded rods):
  used for covers of the largest units or high-pressure units.

<u>Cover with hook bolts</u>

1. Check that the gasket is correctly in place (*refer to paragraph 6 of this section*).

2. Grease the rod threaded rods.

3. Using appropriate equipment, connect lifting slings to the cover lifting lugs, lift and move the cover back into its original position. Please note the cover identification and alignment marks must be matched to the unit.

4. Install the tightening clamps: the hook bolts must be placed around the perimeter of the cover, while maintaining the original quantity, spacing and pitch (please refer to GA Drawing).

5. Progressively tighten in a cross-pattern until the recommended torque is reached. Gradually tighten the diametrically opposed nuts with attention given to maintain an even gap between the cover and the unit flange to prevent the cover from distorting and crushing parts of the seal.

Do not apply the total recommended torque in one step. The tightening must be done in several steps:

- step 1: 60% of the recommended torque

- step 2: 100% of recommended torque

You can also apply ASME PCC-1 – *Guidelines for Pressure Boundary Bolted Flange Joint Assembly* – which describes different tightening sequence options that may be applied to properly secure the unit covers and flanges.

The recommended torque value is indicated on the nameplate of the Spiral heat exchanger.

If there is no recommended torque value indicated on the nameplate, you can find a minimal and a maximal torque value both indicated on the General Arrangement drawing of your Spiral. Then use the minimal torque value as the recommended torque value.

NOTE!
The maximum distance between two hook bolts must be regular. The number of bolts listed on the identification plate and/or the General Arrangement drawing must be respected.

NOTE!
Tighten the hook bolts before pressurizing the 2 channels.

6. In case of external leakage once the cover(s) is (are) tightened at recommended torque value, please re-tighten at recommended torque value + 15%.
We recommend reaching this maximal value in 2 times (one retightening at recommended torque value +7.5% and a last retightening at recommended torque value +15%).

Recommended torque value + 15% is the maximal acceptable torque value: never exceed it! It could cause mechanical strain in the sealing surface and damage the gaskets and/or the bolting.

Never tighten, re-tighten or loosen a cover under pressure and if its temperature is not at ambient temperature!

If external leakage still occurs after this re-tightening, please contact your Alfa Laval representative.

Cover with body flange and tie rods

1. Check that the gasket is correctly in place (*refer to chapter 6*).

2. Grease the rod threads, washers, nut threads and nuts contacting faces of all bolts for consistent tightening.

3. Using appropriate equipment, connect lifting slings to the cover lifting lugs, lift and move the cover back into its original position. Please note the cover identification and alignment marks must be matched to the unit.

4. Install the nuts, washers and threaded rods

5. Progressively tighten in a cross-pattern until the recommended torque is reached. Gradually tighten the diametrically opposed nuts with attention given to maintain an even gap between the cover and the unit flange to prevent the cover from distorting and crushing parts of the seal.

Do not apply the total recommended torque in one step. The tightening must be done in several steps:

- step 1: 50% of the rated torque
- step 2: 75% of the rated torque
- step 3: 100% of rated torque

You can also apply ASME PCC-1 – *Guidelines for Pressure Boundary Bolted Flange Joint Assembly* – which describes different tightening sequence options that may be applied to properly secure the unit covers and flanges.

The recommended torque value is indicated on the nameplate of the Spiral heat exchanger.

If there is no recommended torque value indicated on the nameplate, you can find a minimal and a maximal torque value both indicated on the General Arrangement drawing of your Spiral. Then use the minimal torque value as the recommended torque value.

NOTE!
Tighten all the bolts before pressurizing the 2 channels.

6. In case of external leakage once cover(s) is (are) tightened at recommended torque value, please re-tighten at recommended torque value +15%.
We recommend reaching this maximal value in 2 times (one retightening at recommended torque value +7.5% and a last retightening at recommended torque value +15%).

Recommended torque value + 15% is the maximal acceptable torque value: never exceed it! It could cause mechanical strain in the sealing surface and damage the gaskets and/or the bolting.

Never tighten, re-tighten or loosen a cover under pressure and if its temperature is not at ambient temperature!

If external leakage still occurs after this re-tightening, please contact your Alfa Laval representative.

8. Tests

Hydraulic test
After reassembly of cover(s), a hydraulic test at the design pressure indicated on the name plate is mandatory (unless local regulation says otherwise) as the design pressure is the maximal pressure that the unit must mechanically withstand.

WARNING
If a max. allowed differential pressure is indicated on the unit (pressure differential plate or on nameplate) and/or the General arrangement drawing, the differential pressure during the hydraulic test must never exceed this value. The second circuit must be pressurized to secure the differential pressure.
Please refer to the specific hydraulic test procedure (contact Alfa Laval if you do not have it).

WARNING
Always perform the hydraulic test with all the covers fully tightened in place.

Hydraulic test should be carried out with one circuit empty, the other circuit being full & pressurized at the design pressure.

The pressure of the circuit in test may decrease due to compression of trapped gases, or a slight plate adjustment. In that case, it does not mean that the heat exchanger is leaking, adjust pressure and check again. It should have stabilized after half an hour.

A heat exchanger is leaking when a leak is observed between 2 circuits or when it leaks externally.

WARNING
If leakage occurs, retighten at nominal torque around the leak area. If leakage still occurs, please contact Alfa Laval Service Center or your Alfa Laval representative.

9. Troubleshooting

FOR LIQUID / LIQUID APPLICATION

	SYMPTOMS	POSSIBLE CAUSES	SOLUTIONS
1	Poor thermal performance upon commissioning	a) Air pockets b) Insufficient flow	a) Vent b) Check flow rates and temperature
2	Drop in thermal performance associated with a greater pressure drop or flow reduction	Fouling of the exchange surface	Clean See Section 4 paragraph 3 Ensure flow rates as specified
3	Drop in thermal performance with or without a drop-in pressure	Bypassing caused by a defective gasket or excessive pressure	Replace the cover gasket See Section 4 paragraph 6 Ensure operation at specified flow rates and/or at below design pressure
4	Significant drop in pressure despite relative maintenance of thermal performance	Blockage at inlet or outlet	If possible, clean by reversing the flow direction (back flushing) See Section 4 paragraph 3
5	External leakage	a) Damaged cover gasket b) Defective piping c) Relaxation of the gasket during shutdown or during shipment d) Thermal expansion during start-up	a) Replace the gasket See Section 4 paragraph 6 b) Repair the piping c) Tighten the hook bolts or the tie rods See Section 4 paragraph 7 d) Check the hook bolts or the tie rods See Section 4 paragraph 7 If the leakage persists, check the cover gasket. Contact Alfa Laval for assistance
6	Internal leakage	Exchange surface or weld joint, perforated by erosion, corrosion or mechanical damage	Contact Alfa Laval for assistance On-site repair may be possible

If issue cannot be fixed, please contact Alfa Laval for assistance.

FOR CONDENSER OR EVAPORATOR APPLICATION

In addition to the symptoms, causes, and solutions listed for liquid/liquid application, the following problems may occur:

	SYMPTOMS	POSSIBLE CAUSES	SOLUTIONS
7	Abrupt drop in thermal performance associated with a greater pressure drop or flow reduction in the vapor circuit	Inadequate extraction of non-condensable gases	Modify gas extraction using a suitable pump
8	Unstable thermal performance: - Fluctuation of condensate or cooling fluid outflow temperature - Condensation	Inadequate condensate extraction system Insufficient dimensions of the vapor inlet system	Modify the condensate extraction system using a suitable pump. Check the operation of the feed valve and/or pressure relief valve Replace with a larger size if necessary

If issue cannot be fixed, please contact Alfa Laval for assistance.
You can find a Troubleshooting Questionnaire in Appendix (Section 12 paragraph 6). Please fill it and send it to your Alfa Laval representative if necessary.

10. List of recommended replacement parts

Maintaining a stock of the following replacement parts is recommended for maintenance of the Spiral heat exchanger:

- ✓ hook bolts and/or tie rods: minimum 10% of the total number installed on the unit;
- ✓ gaskets: minimum 100% of the total number installed on the unit.

11. Preventive maintenance program (recommended)

Please find below the preventive maintenance program recommended by Alfa Laval.

№	Recommended periodicity	Type of operation	Notes
1	Daily	Supervision of key process parameters including temperature, pressure drop and media composition	If a contamination of media is observed, it is necessary to carry out a detailed analysis to check for possible internal leakage in the spiral Follow-up of pressure drop variation permits to anticipate a loss of performance (clean the heat exchanger to remove fouling or clogging)
2	Not less than once a week	External visual check	- state of bolts, flange connections and manifold - absence of external leak - absence of leakage of installed valves - state of fixing elements and grounding - state of control and measuring devices - absence of vibration or pulsation in the pipelines - absence of abnormal sound or noise inside the unit
3	Once per 3 years up to once per 6 years (during scheduled shut-down)	External and internal visual control	External control concerns external elements of the heat exchanger, including covers, body, connections, manifold and bolting (deformation, corrosion), all welds (crack, defects, corrosion...) and painting (local absence of coating, blister…) Customer can decide to proceed an internal examination (depending of criticality of equipment or in case of suspicion of possible issue). Then, it is necessary to estimate state of internal elements of the heat exchanger (check absence of deformations, of cracks, of defects in welds, of corrosion and erosion penetration damages) Internal examination requires the disassembly of the covers (Section 4 / paragraph 4). Alfa Laval can support you - contact your Alfa Laval representative
4		Mechanical and/or chemical cleaning	Procedure of cleaning according to Section 4 /paragraph 3 Delaying cleaning makes the recovery of initial heat transfer performances more difficult
5		Leak test	Test pressure = design pressure (as indicated on the nameplate)

If a default is detected, necessary actions must be taken as soon as possible to fix the issue.

Alfa Laval is on your side to provide you a large offer of services related to the Maintenance of the Spiral. Please contact your Alfa Laval representative.

12. Waste management and scrapping

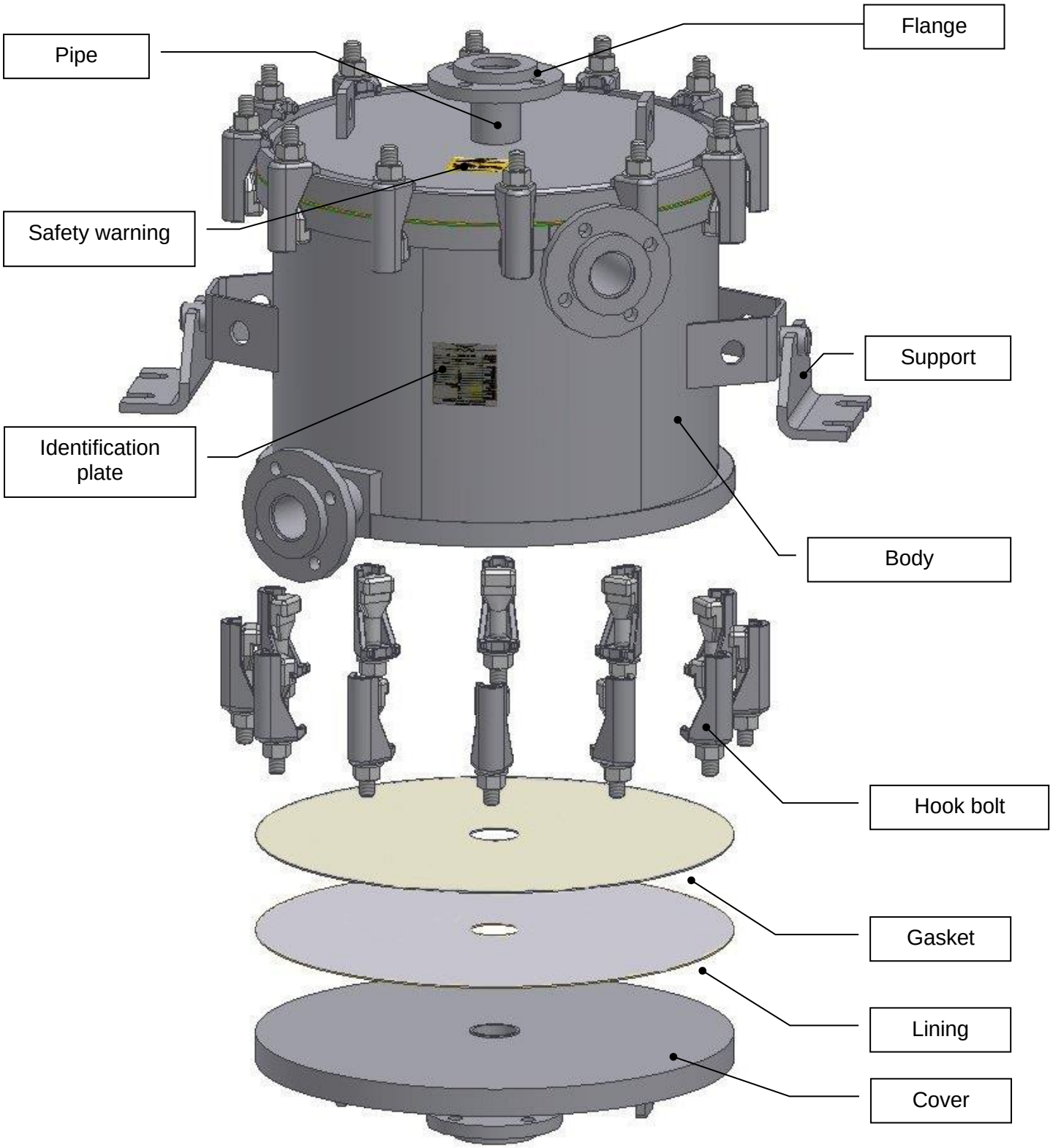
Throughout the lifecycle of the Spiral heat exchanger, the owner is responsible for managing the waste related to any equipment or material delivered by Alfa Laval (e.g. packing material of the delivered Spiral, packaging of spare parts, used spare parts like gaskets, etc.) according to the applicable local regulations regarding the protection of the environment.

The Spiral heat exchanger can be subject to scrapping if, according to results of a technical inspection, the end of life of the Spiral heat exchanger is confirmed. The owner is responsible for carrying out the disposal of the scrap-metal in accordance with the applicable local legislation and regulations regarding protection of the environment.

Section 5 – Diagrams for Type LTL

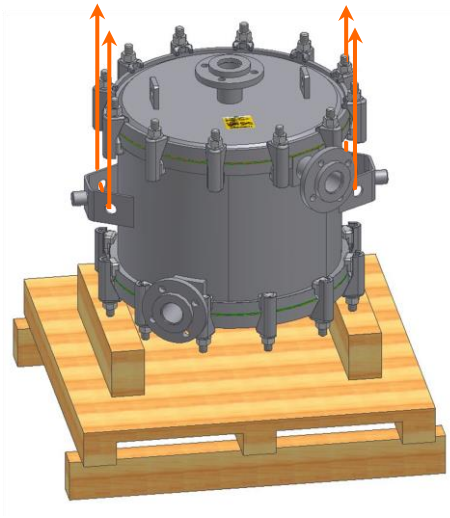
1. Construction

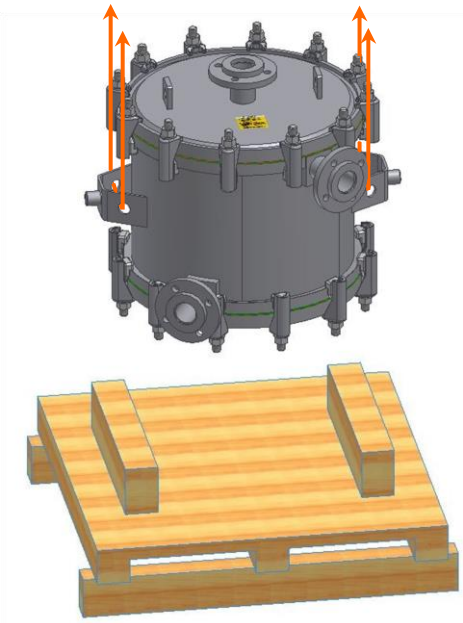
WARNING
For safety reasons, never stand or work under suspended loads.

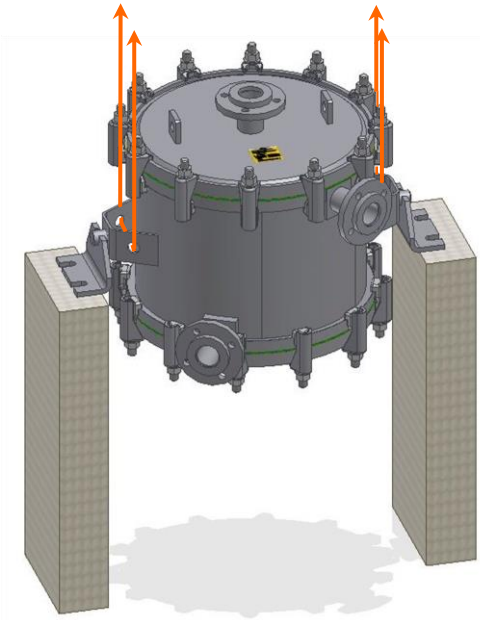


2. Handling and installation

Handling of the ALSHE Type LTL







1

WARNING
The Spiral may suddenly tilt and injury operator when a cover is removed. Place a temporary support under the unit to avoid tilting

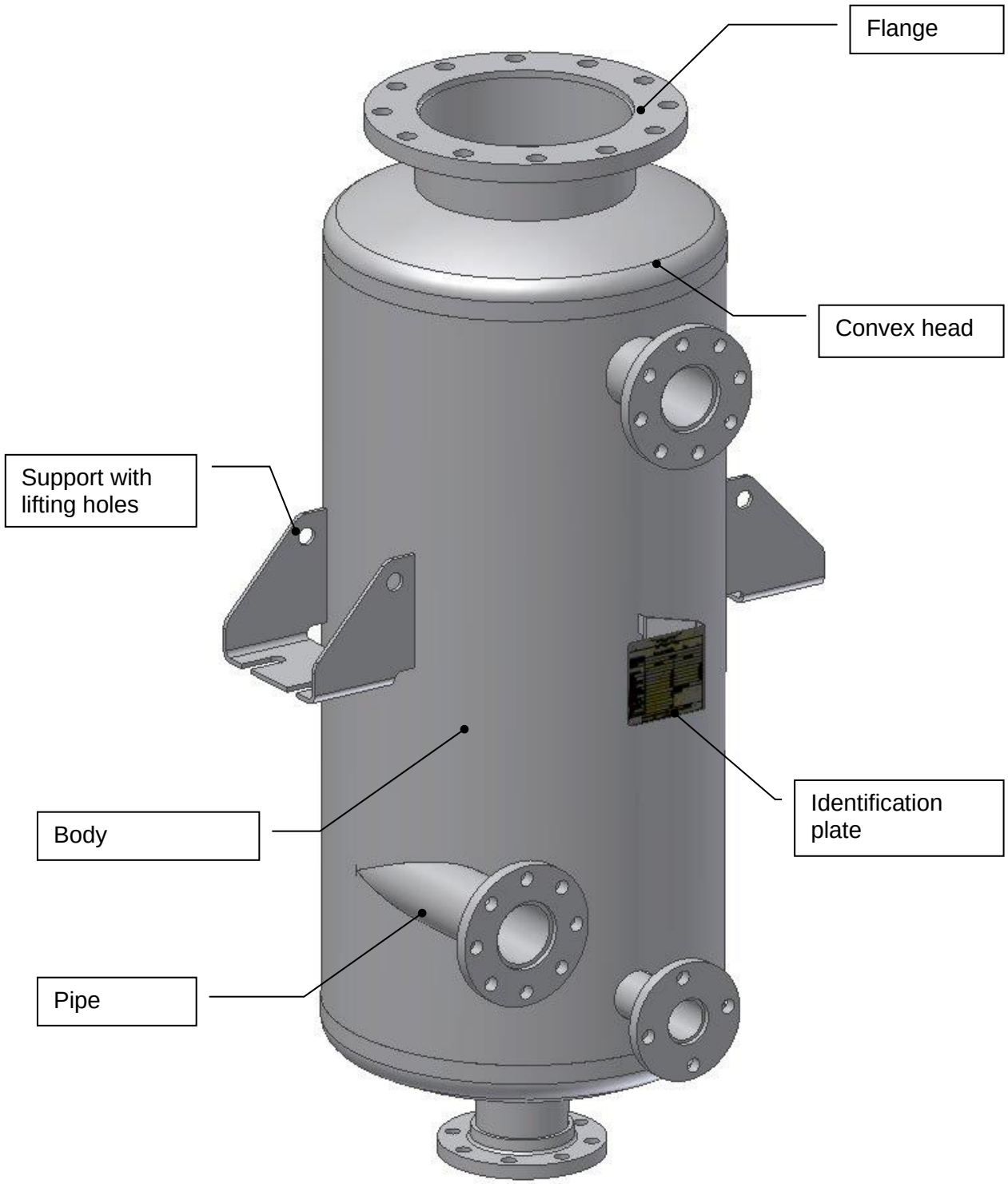
1

WARNING
A side where cover has been removed must never be oriented to the floor. The spiral may be damaged if not retained anymore by cover.

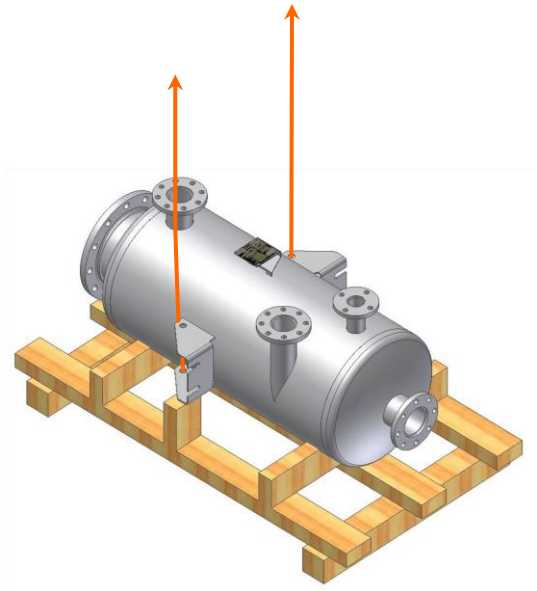
Section 6 – Diagrams for type COND/VAP

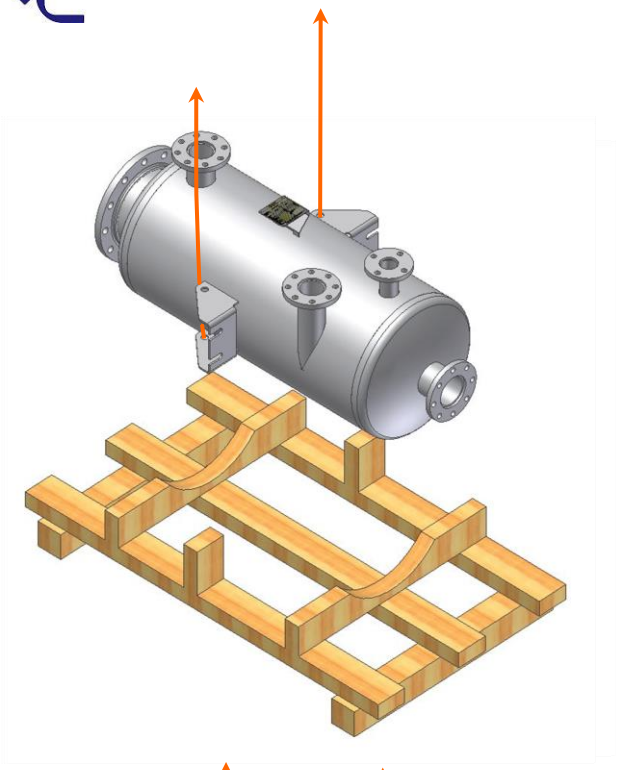
1. Construction

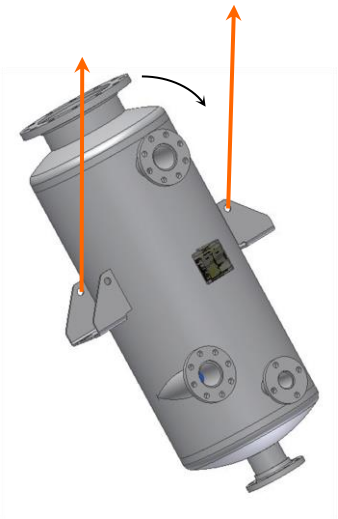
WARNING
For safety reasons, never stand or work under suspended loads.



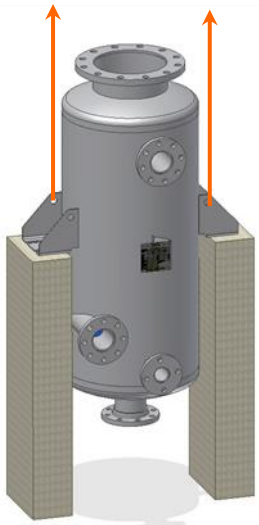
2. Handling and installation



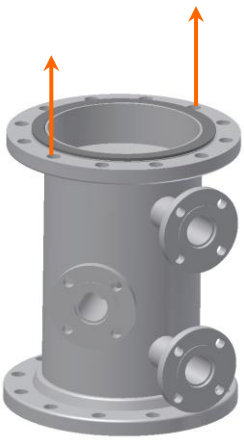




Type Cond/VAP



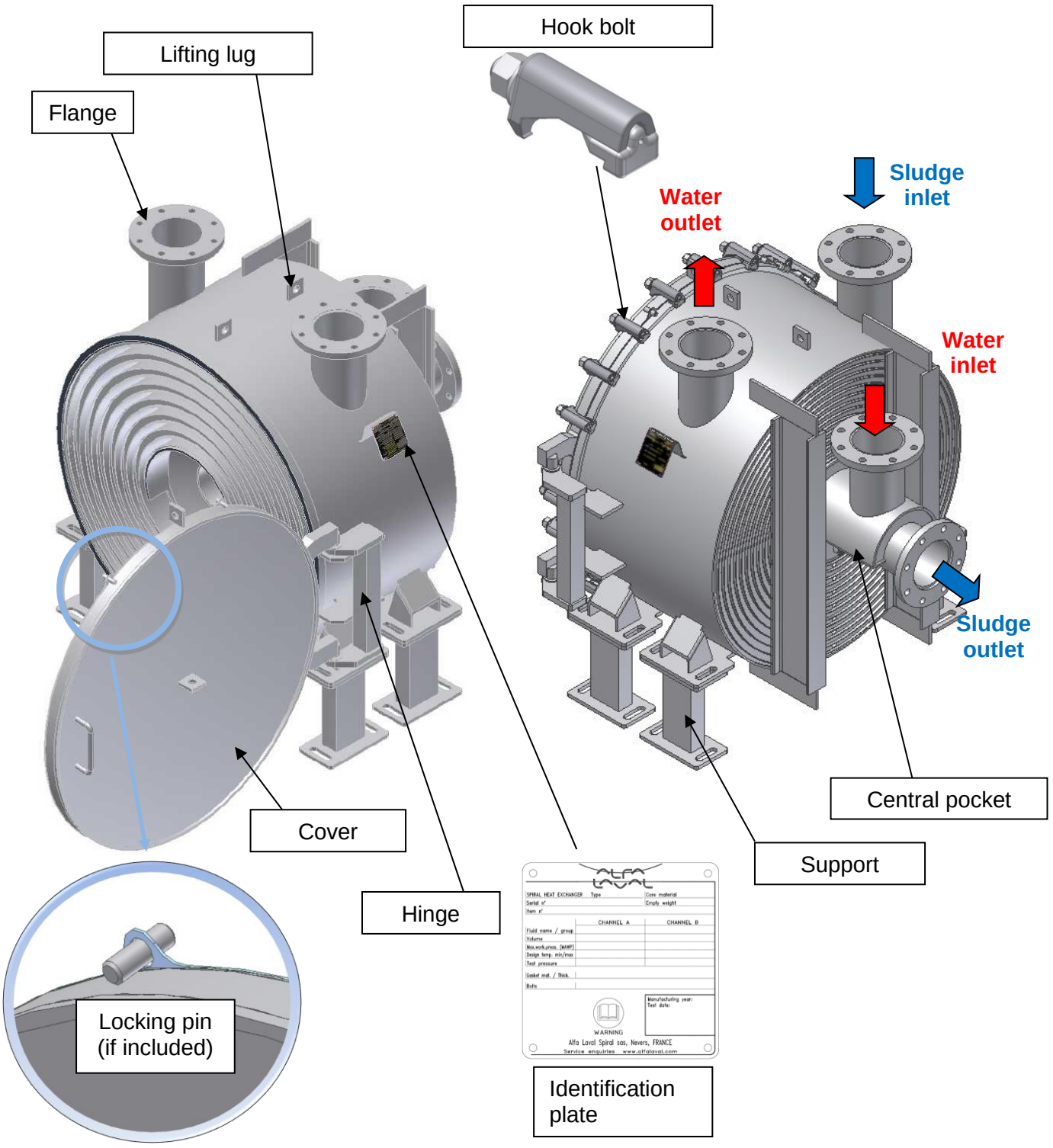
Type Cond 1S



Section 7 – Diagrams for type STW

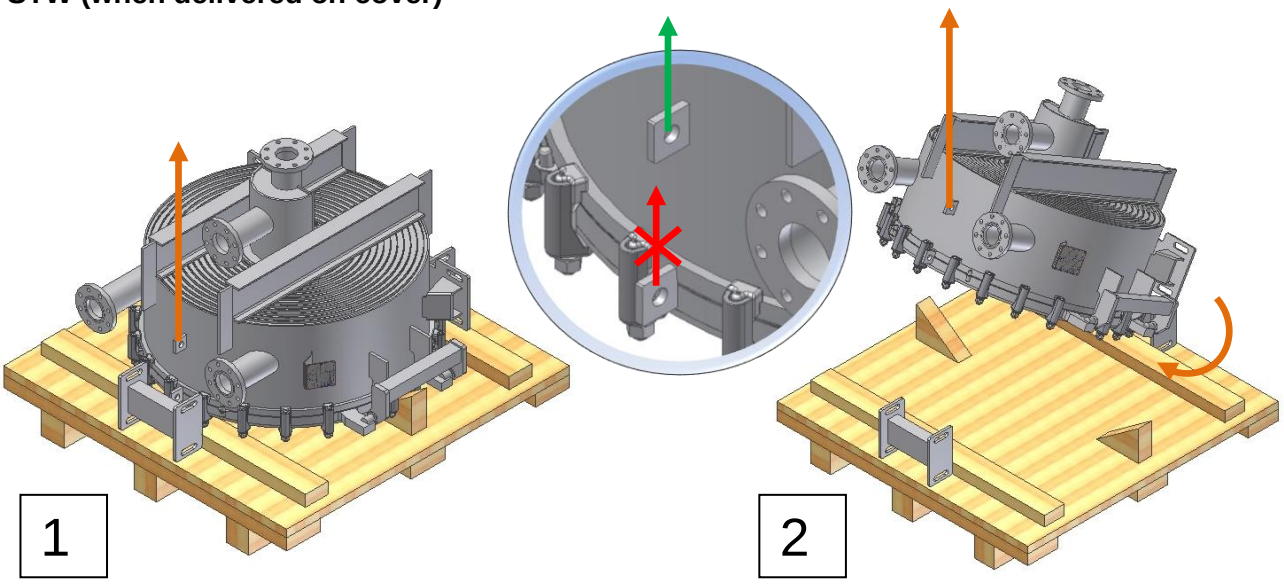
1. Construction

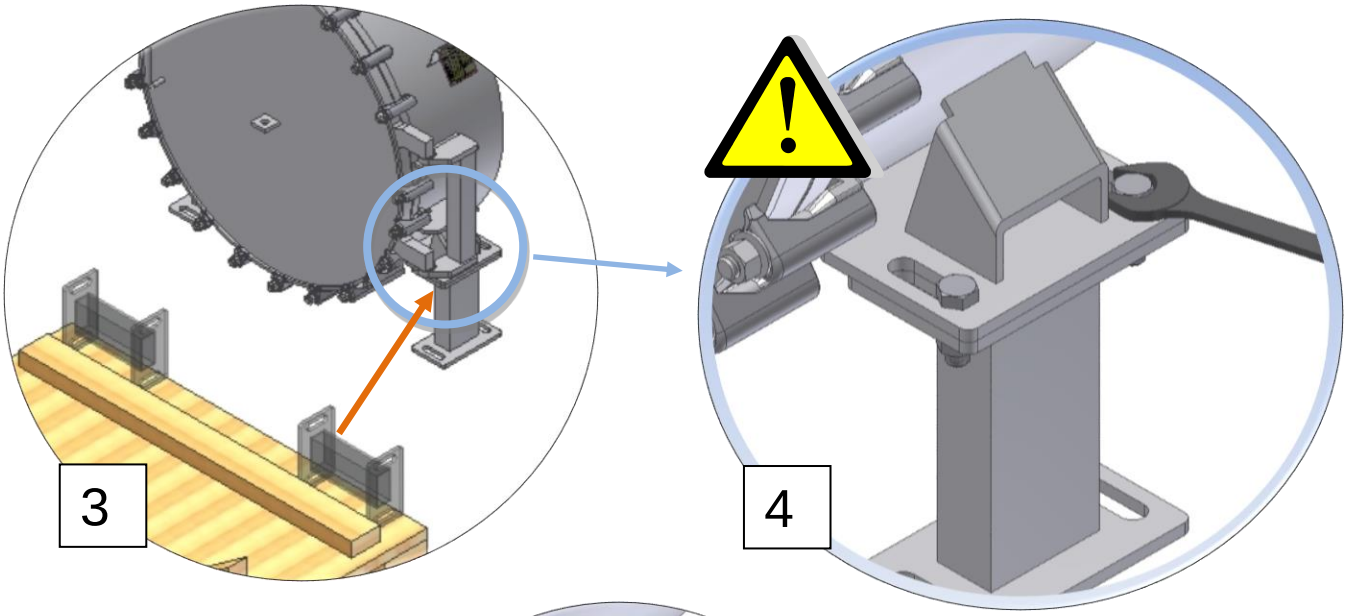
WARNING
For safety reasons, never stand or work under suspended loads.

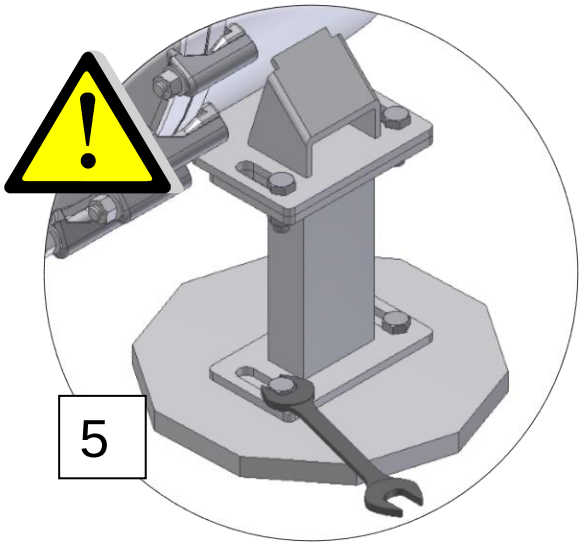


2. Handling and installation

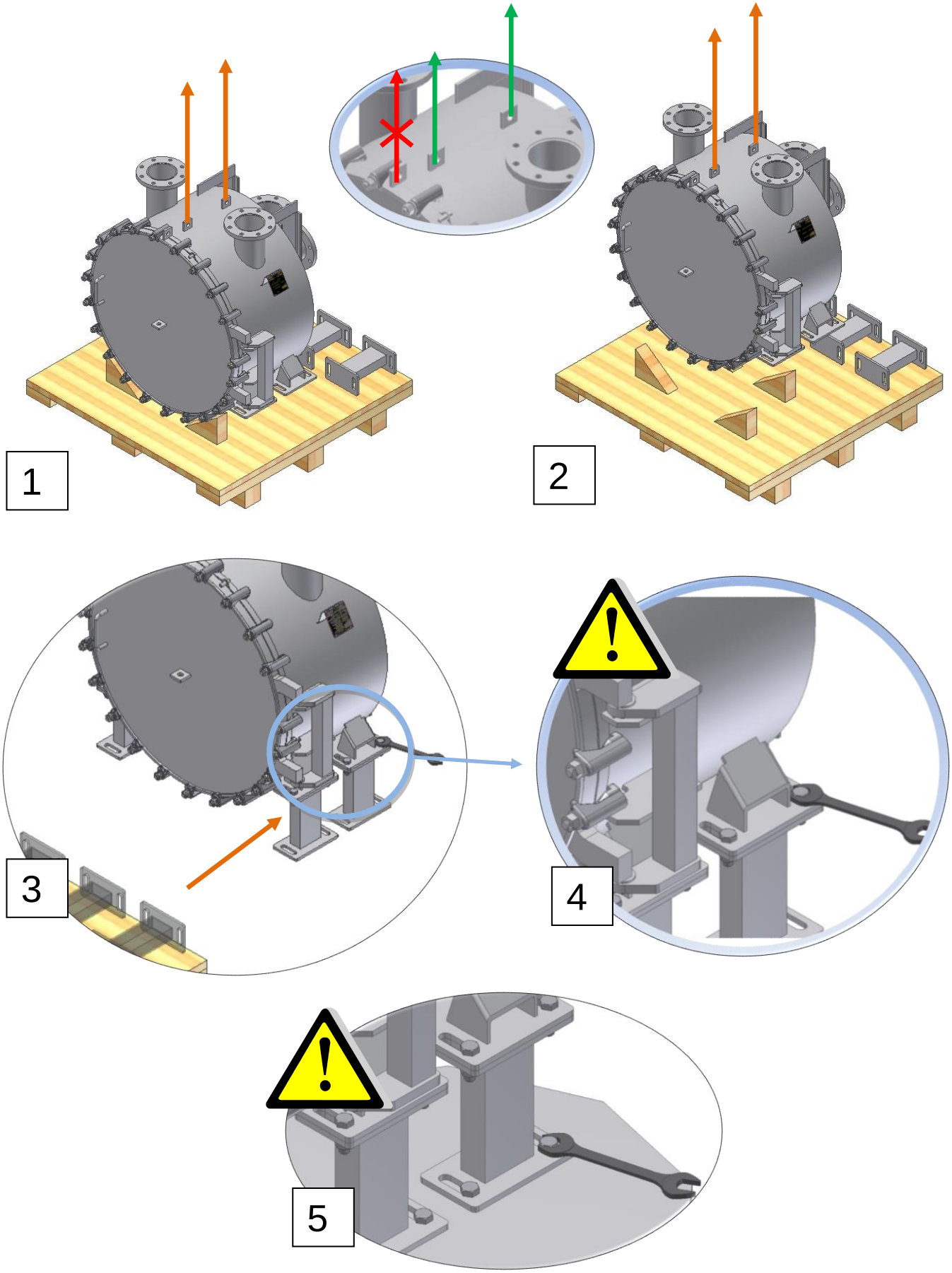
STW (when delivered on cover)





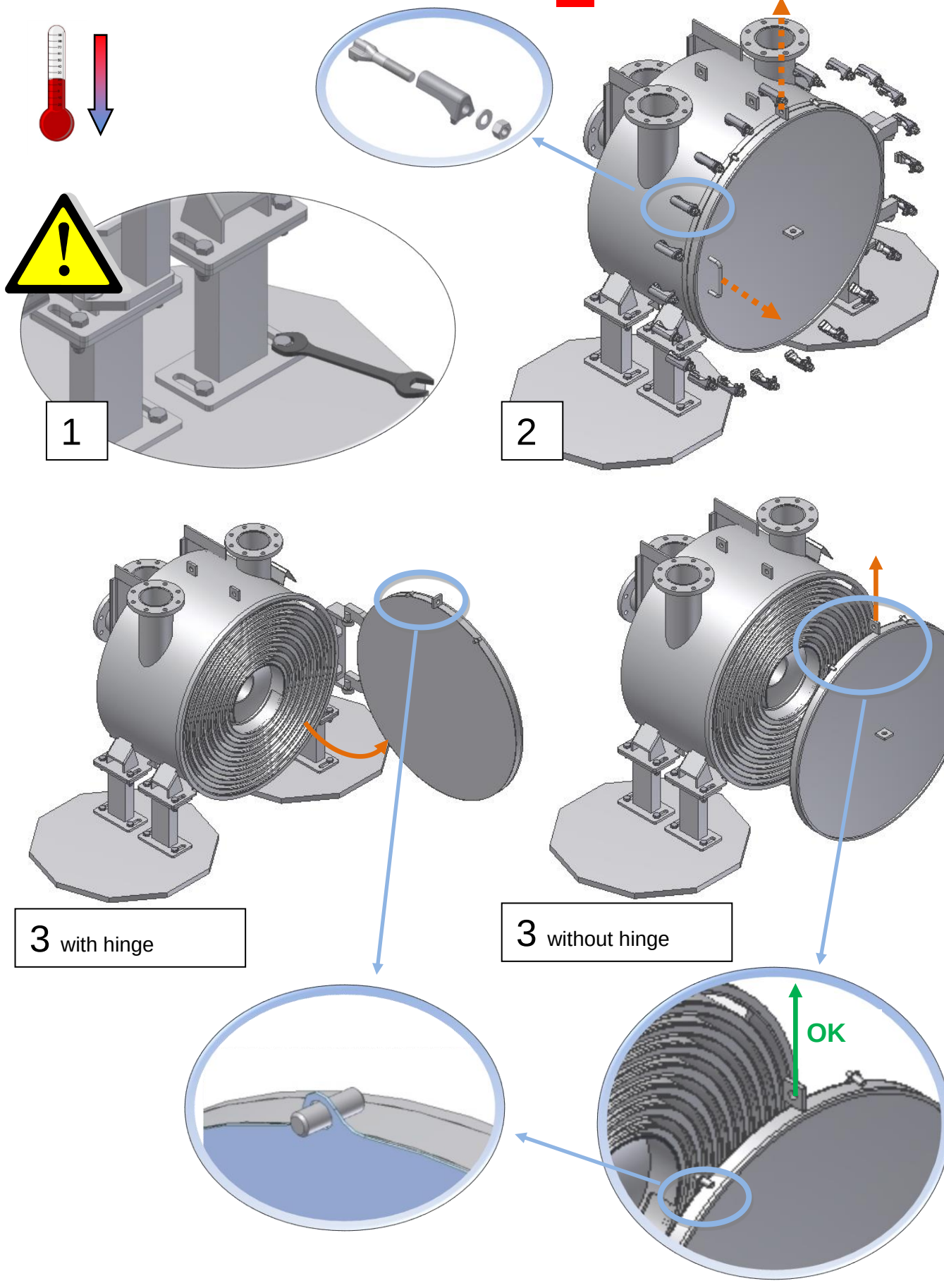


STW (when delivered in horizontal position)



3. Open the cover

If the unit is not equipped with a hinge, hold the cover by the lifting lug on the top of the cover.

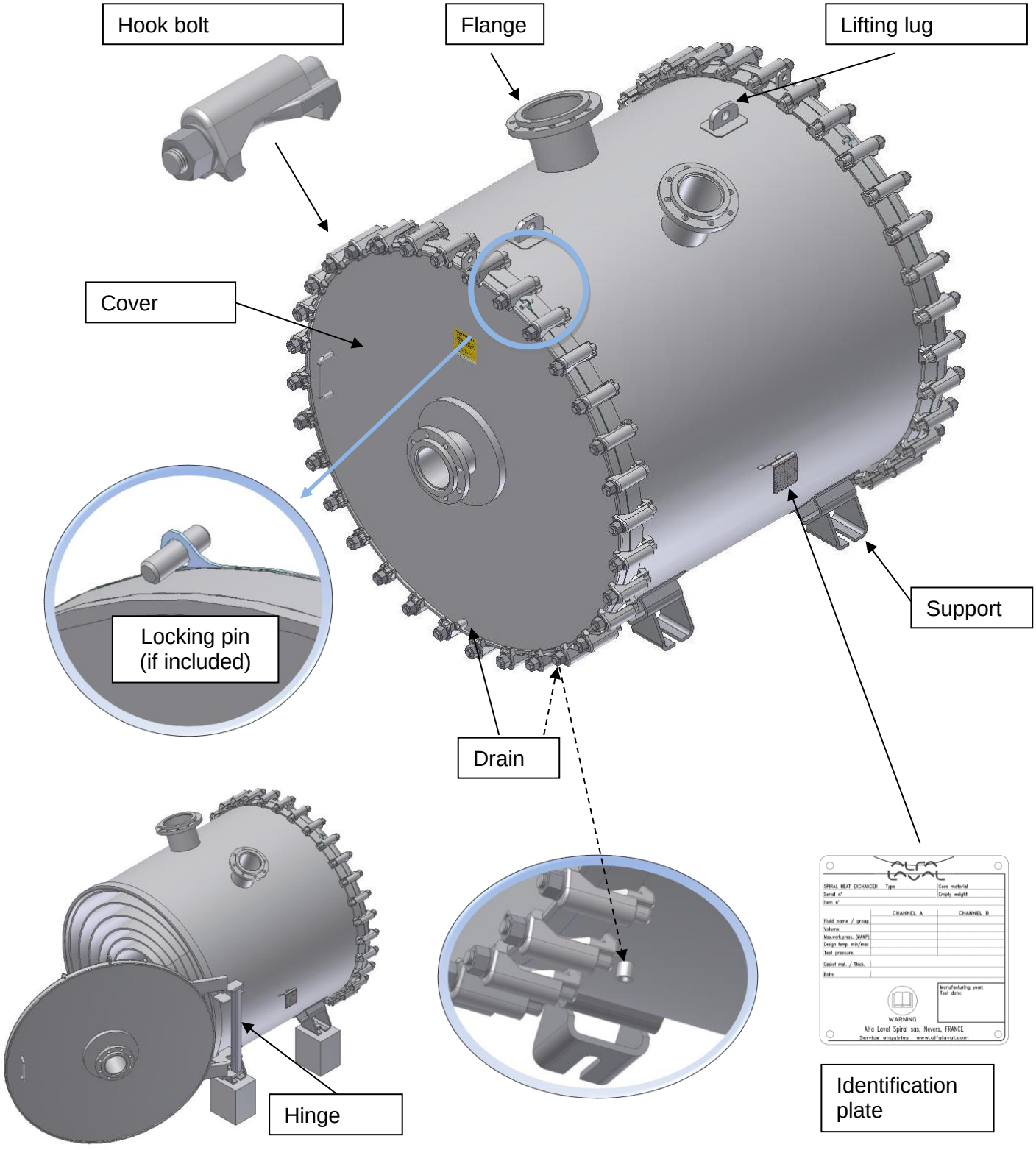


Section 8 – Diagrams for types 1H and 3H

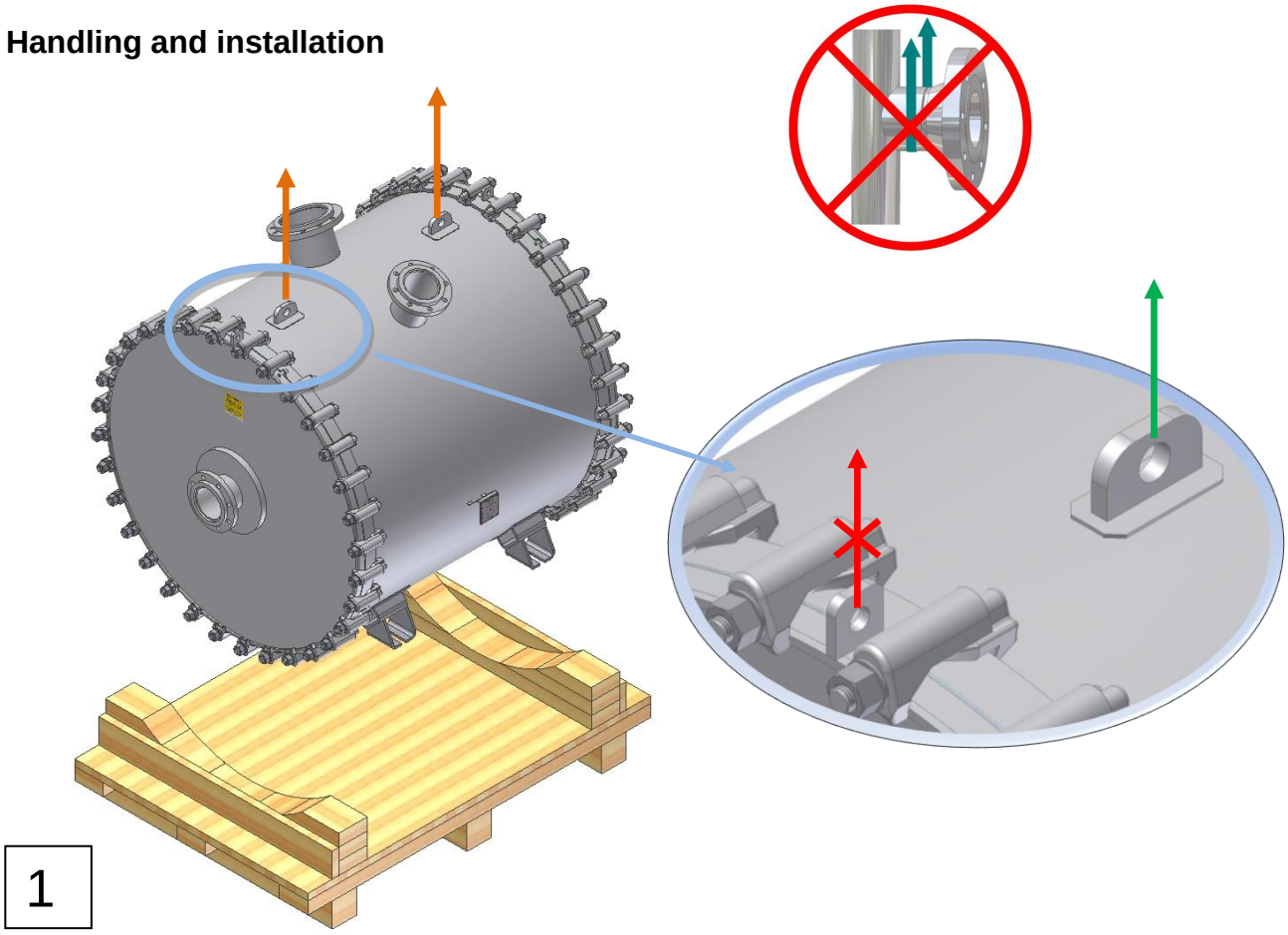
Please notice that STS is a type 1H.

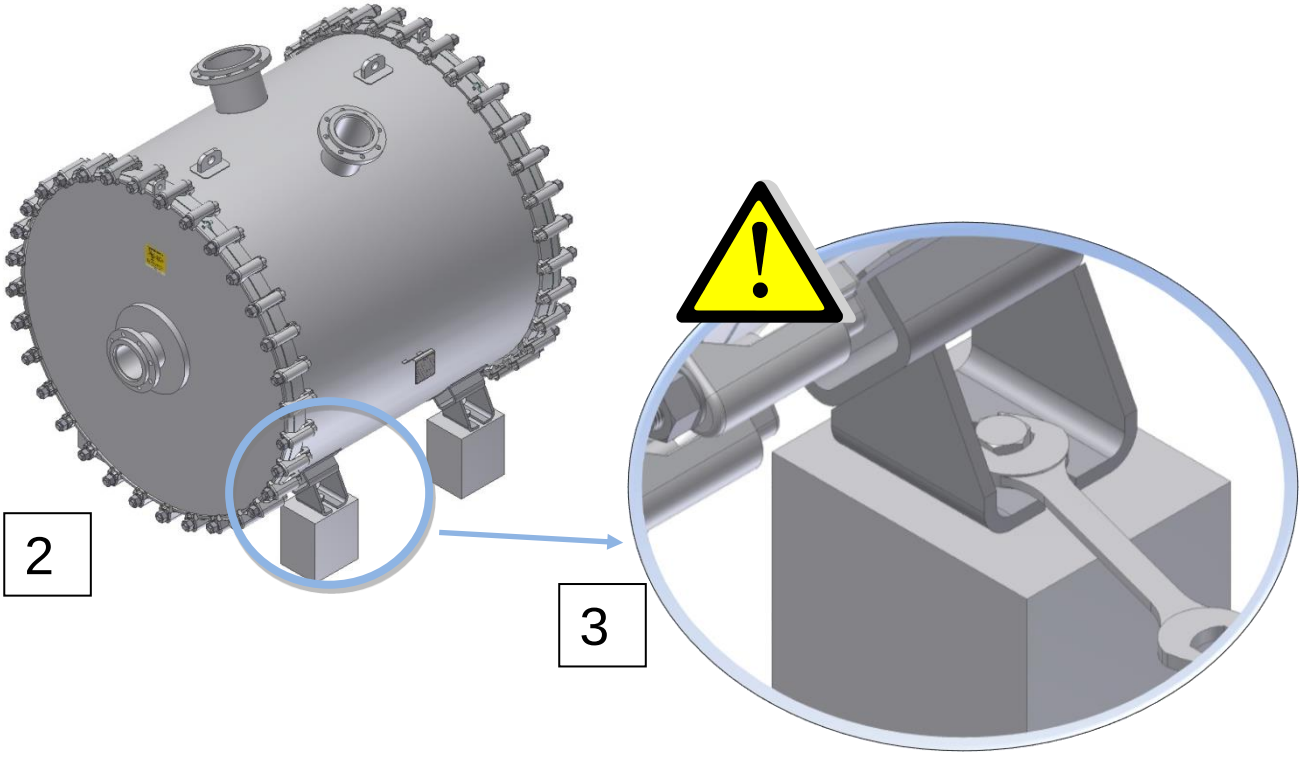
1. Construction

WARNING
For safety reasons, never stand or work under suspended loads.

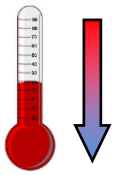


2. Handling and installation

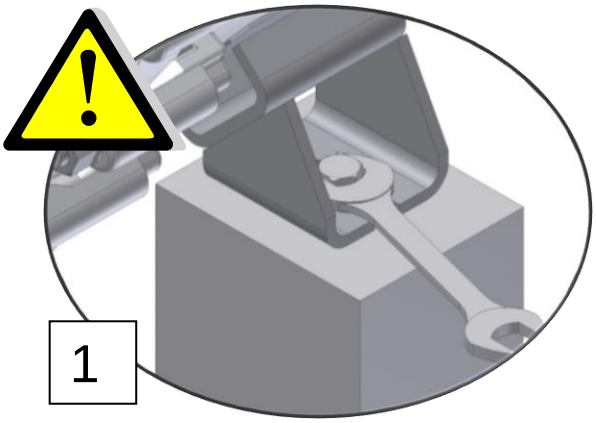


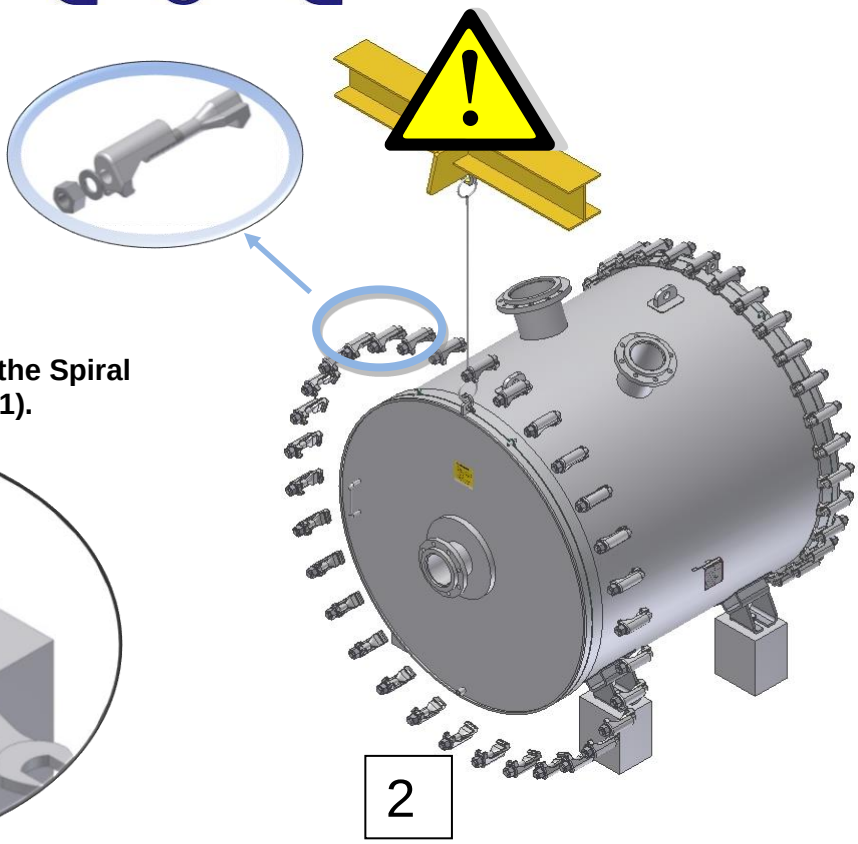


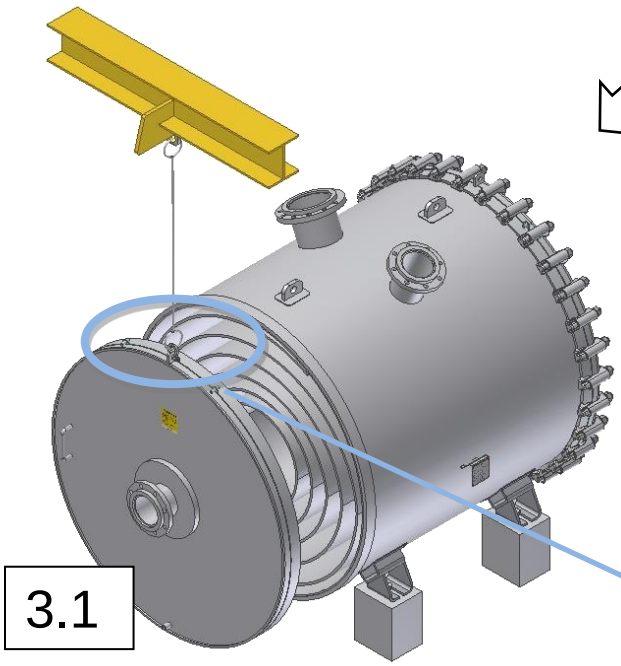
3. Open the cover

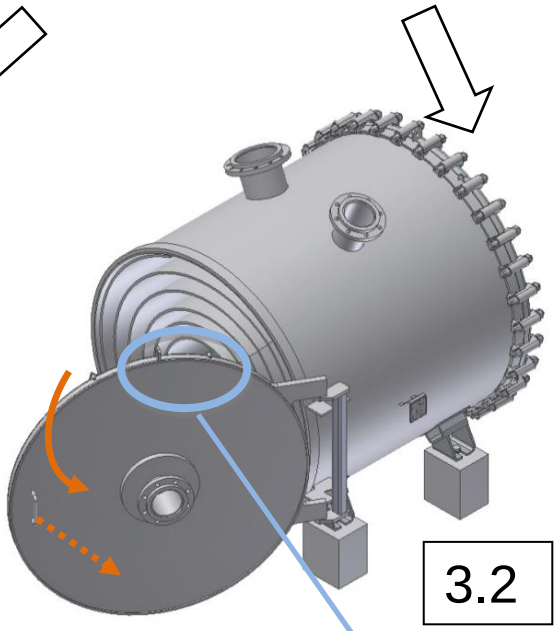


WARNING
For safety reasons, check that the Spiral is firmly anchored to the floor (1).

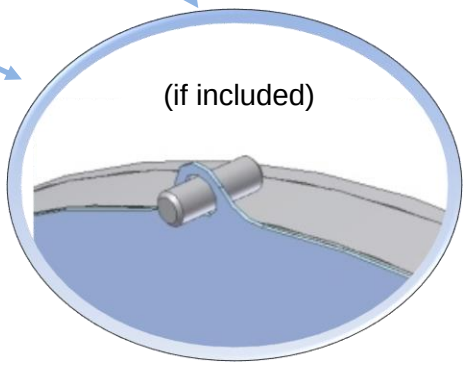






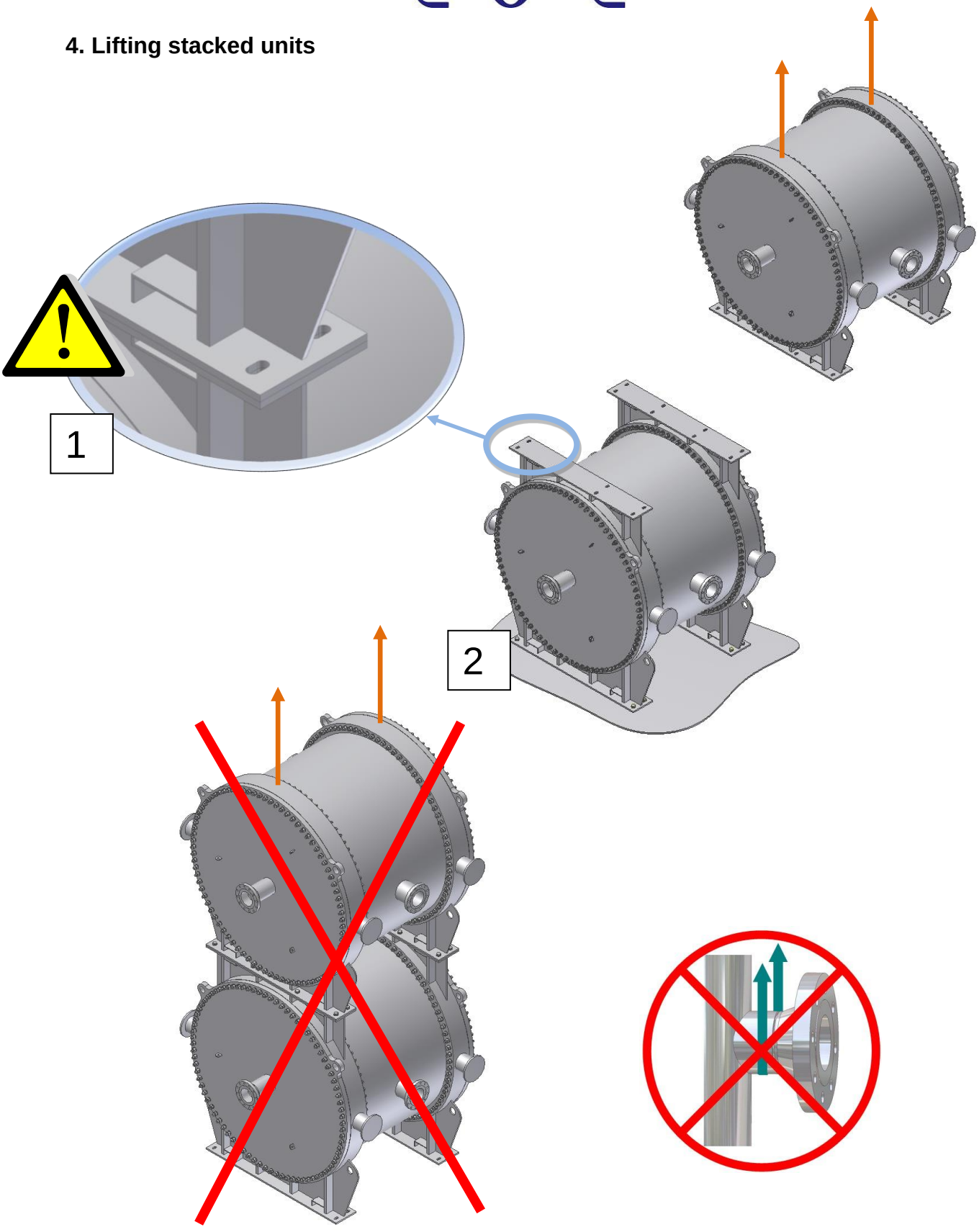


(1)



WARNING
A side where cover has been removed must never be oriented to the floor. The spiral may be damaged if not retained anymore by cover.

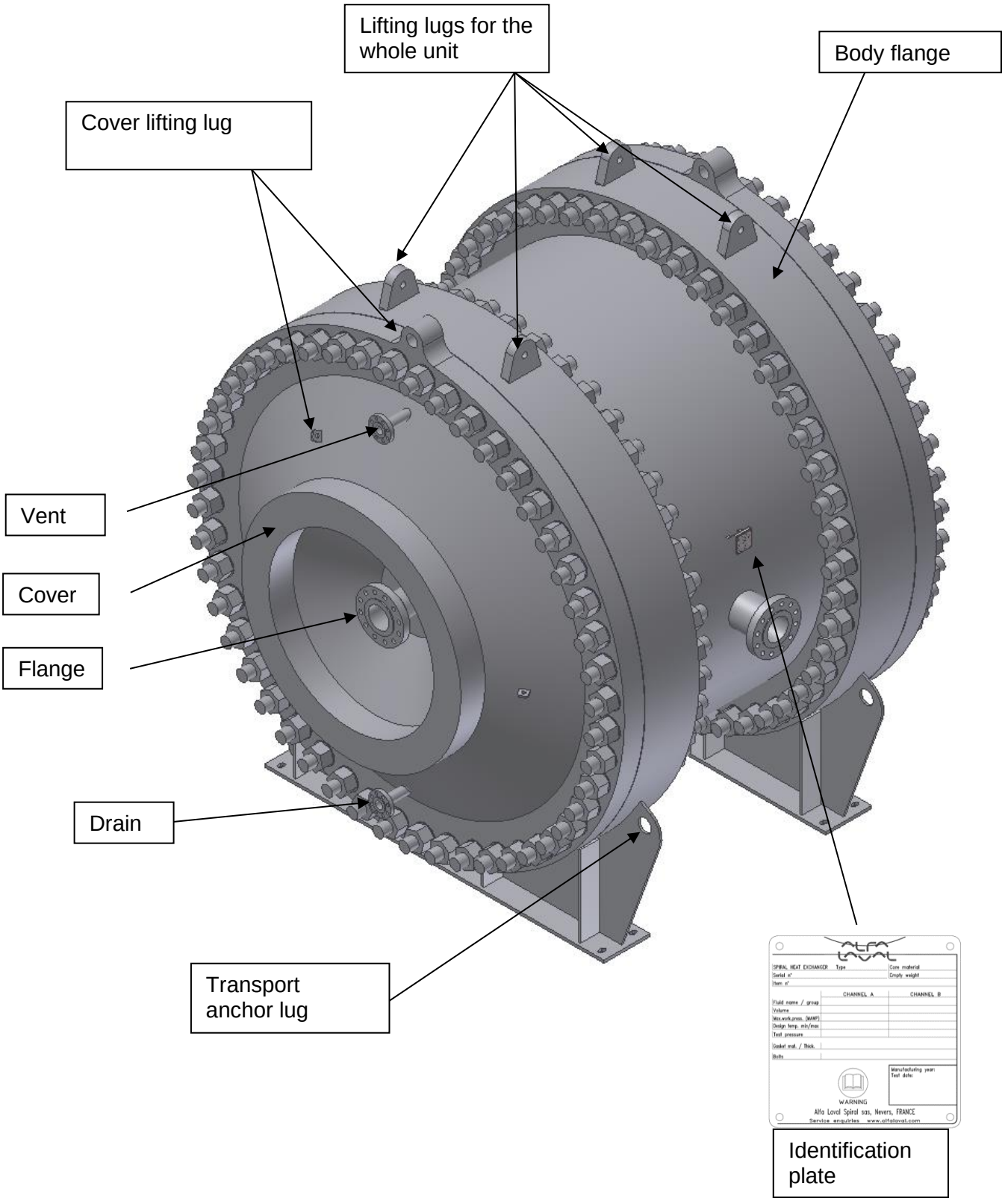
4. Lifting stacked units



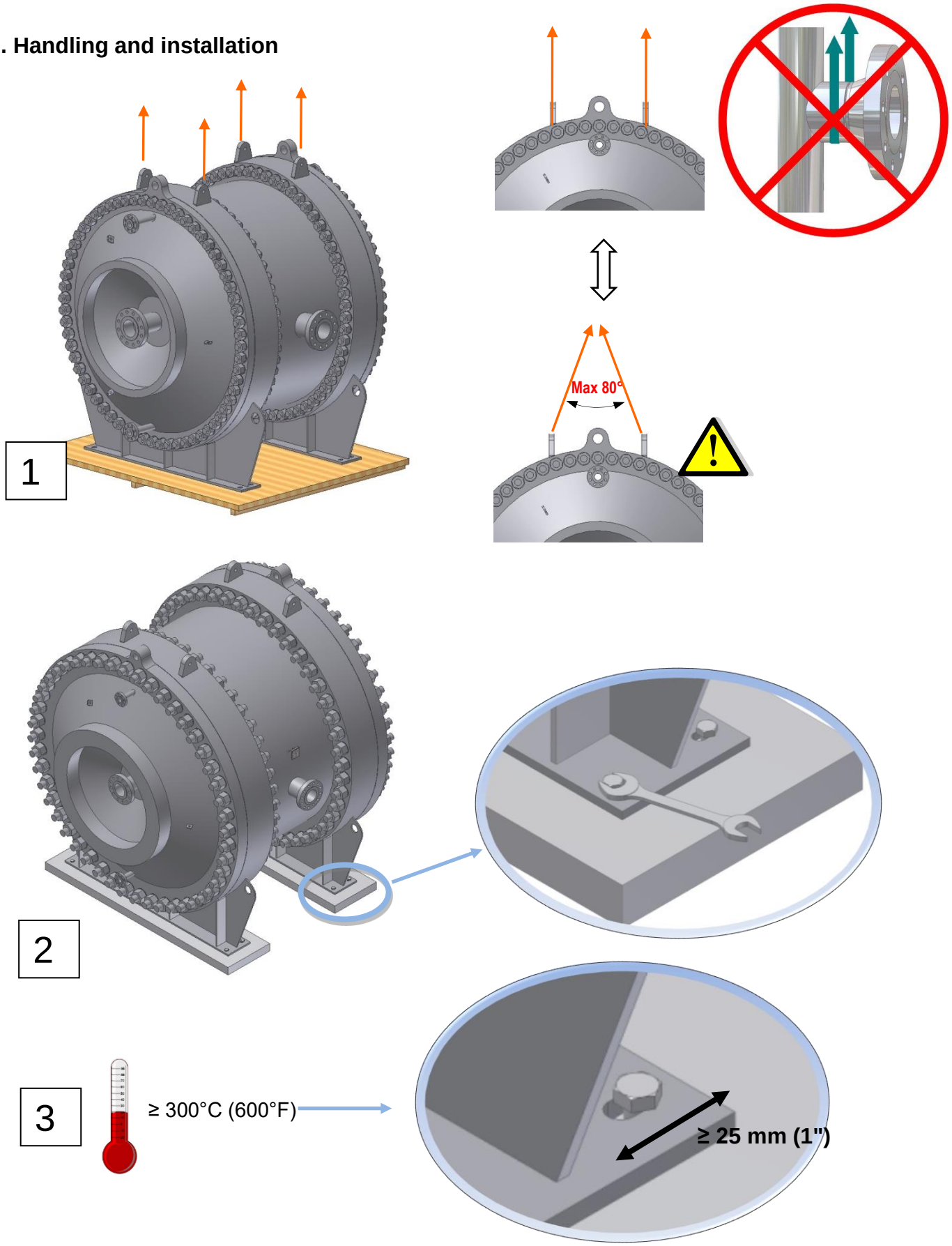
Section 9 – Diagrams for type 1 high pressure

1. Construction

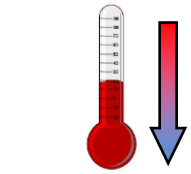
WARNING
For safety reasons, never stand or work under suspended loads.

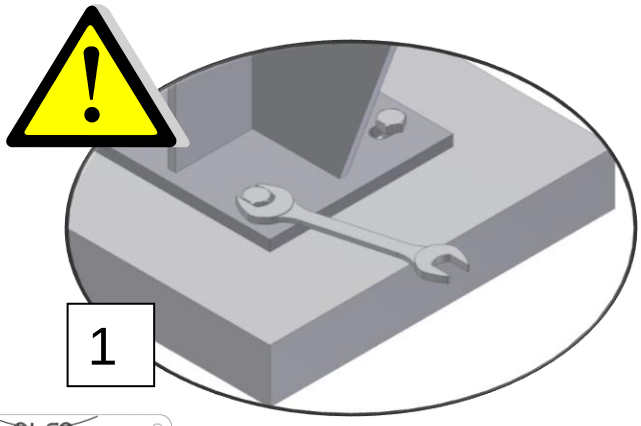


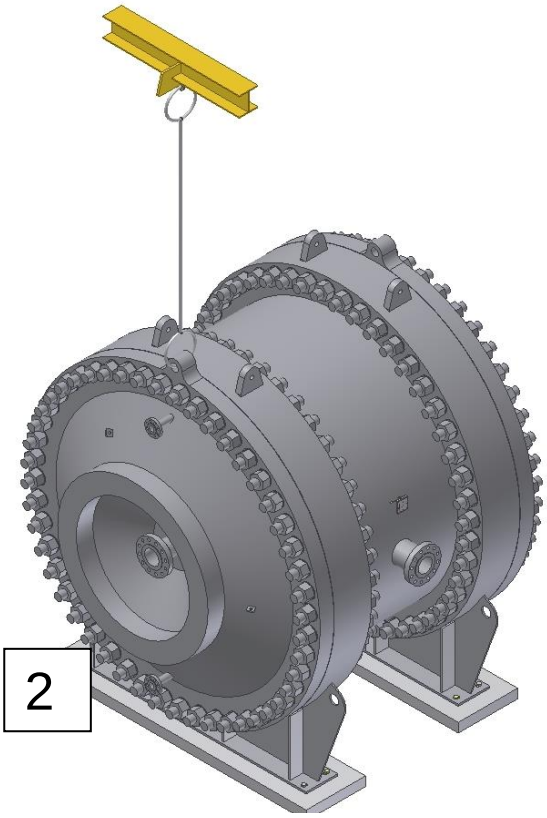
2. Handling and installation

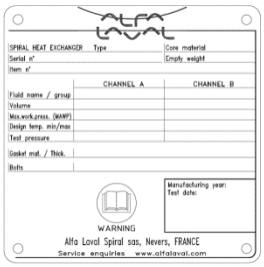


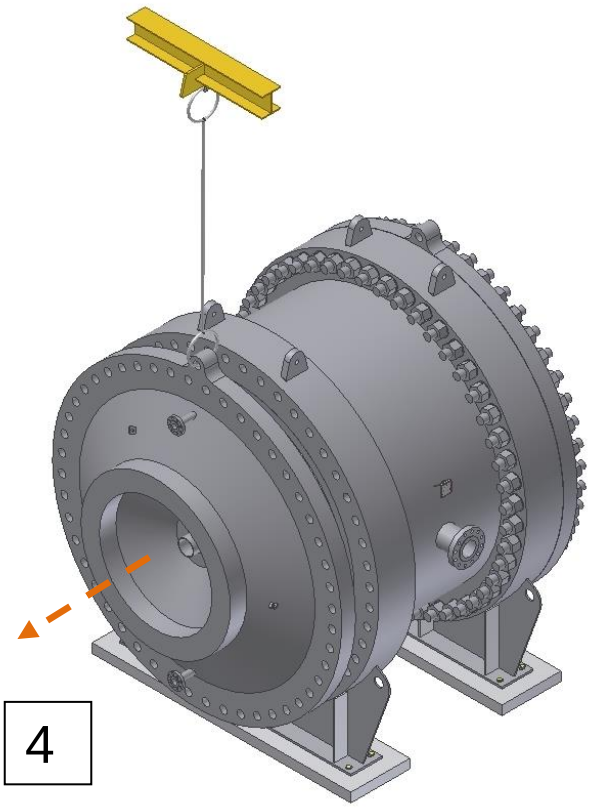
3. Open / close covers





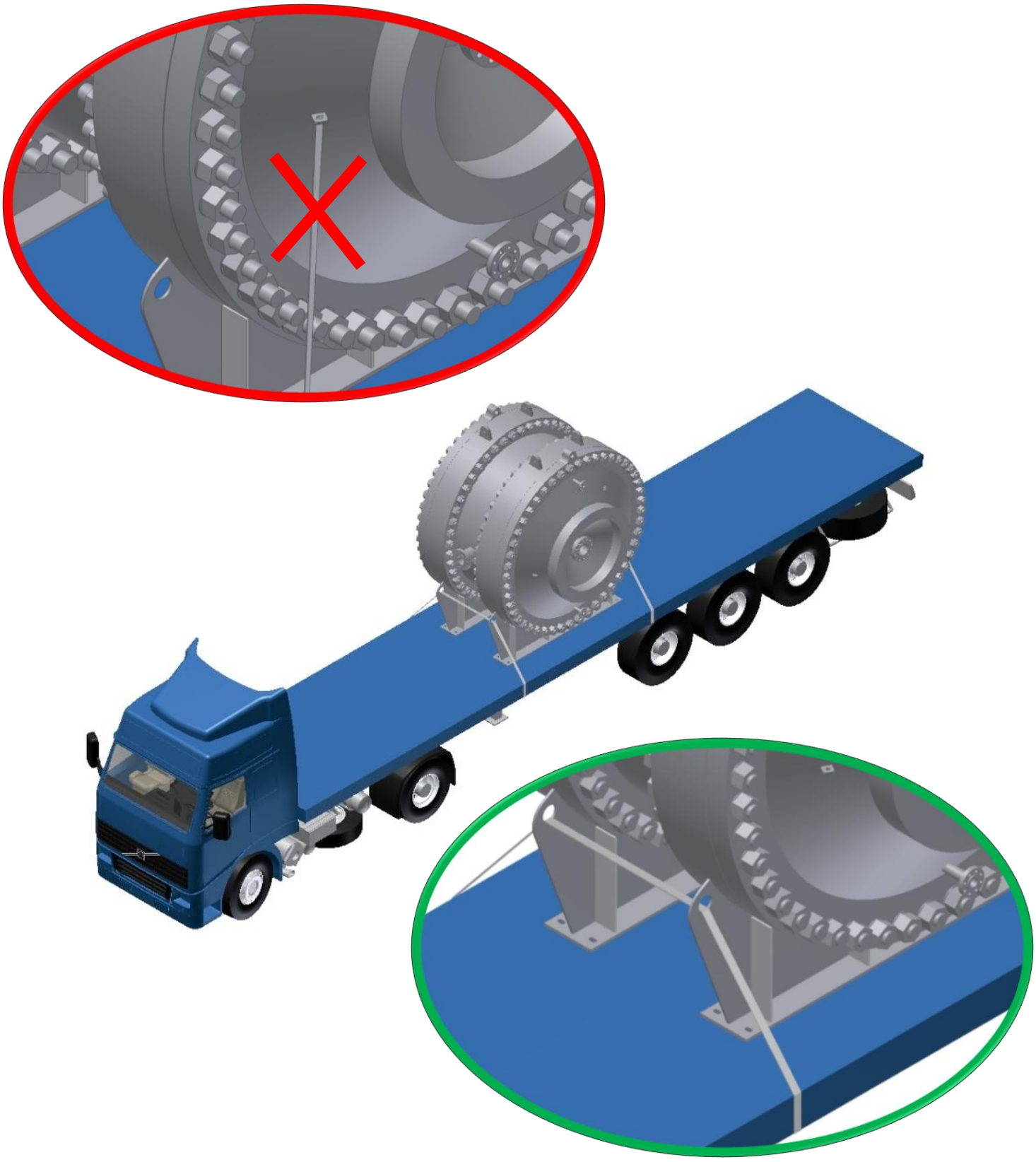






WARNING
A side where cover has been removed must never be oriented to the floor.
The spiral may be damaged if not retained anymore by cover.

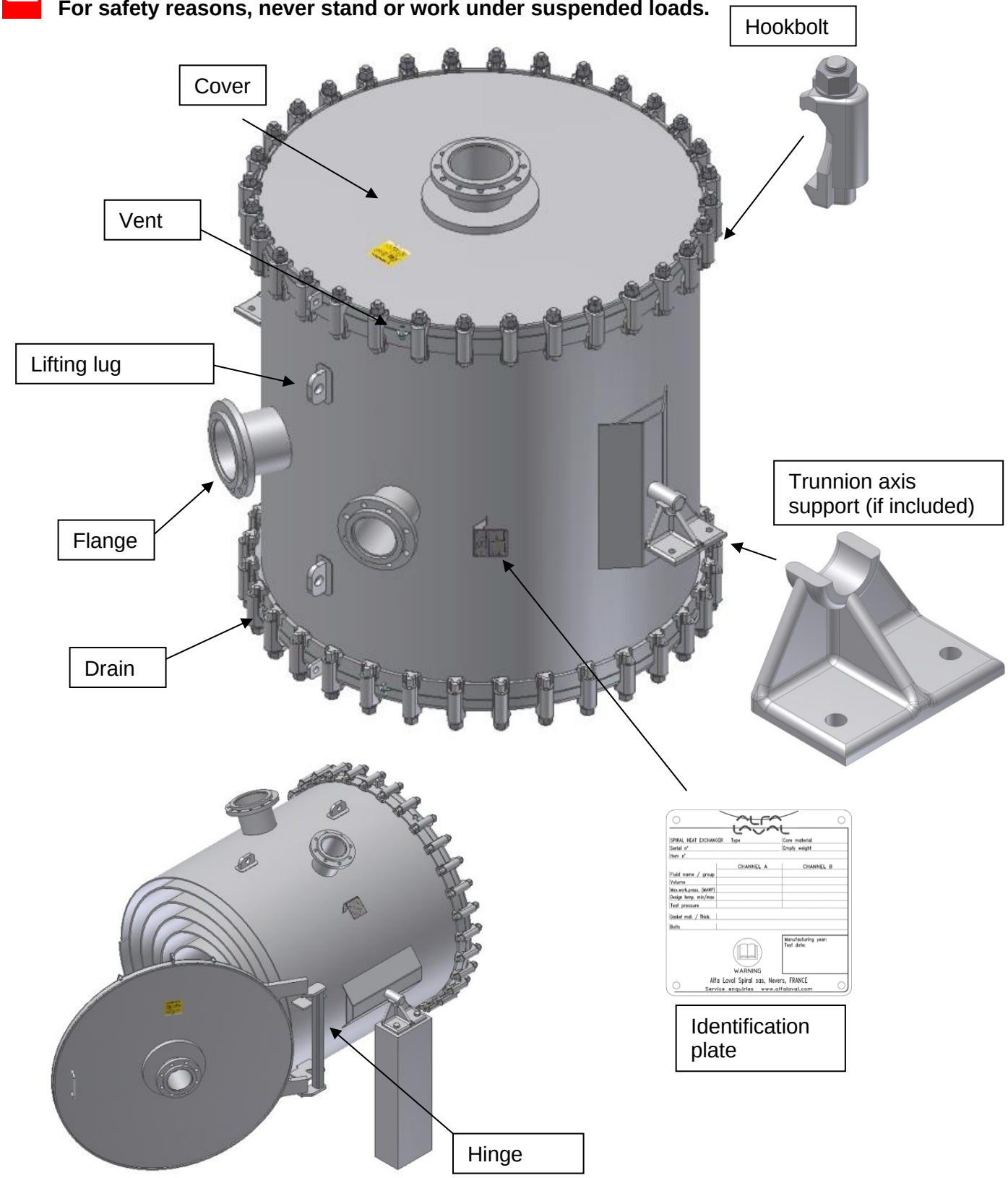
4. Transport



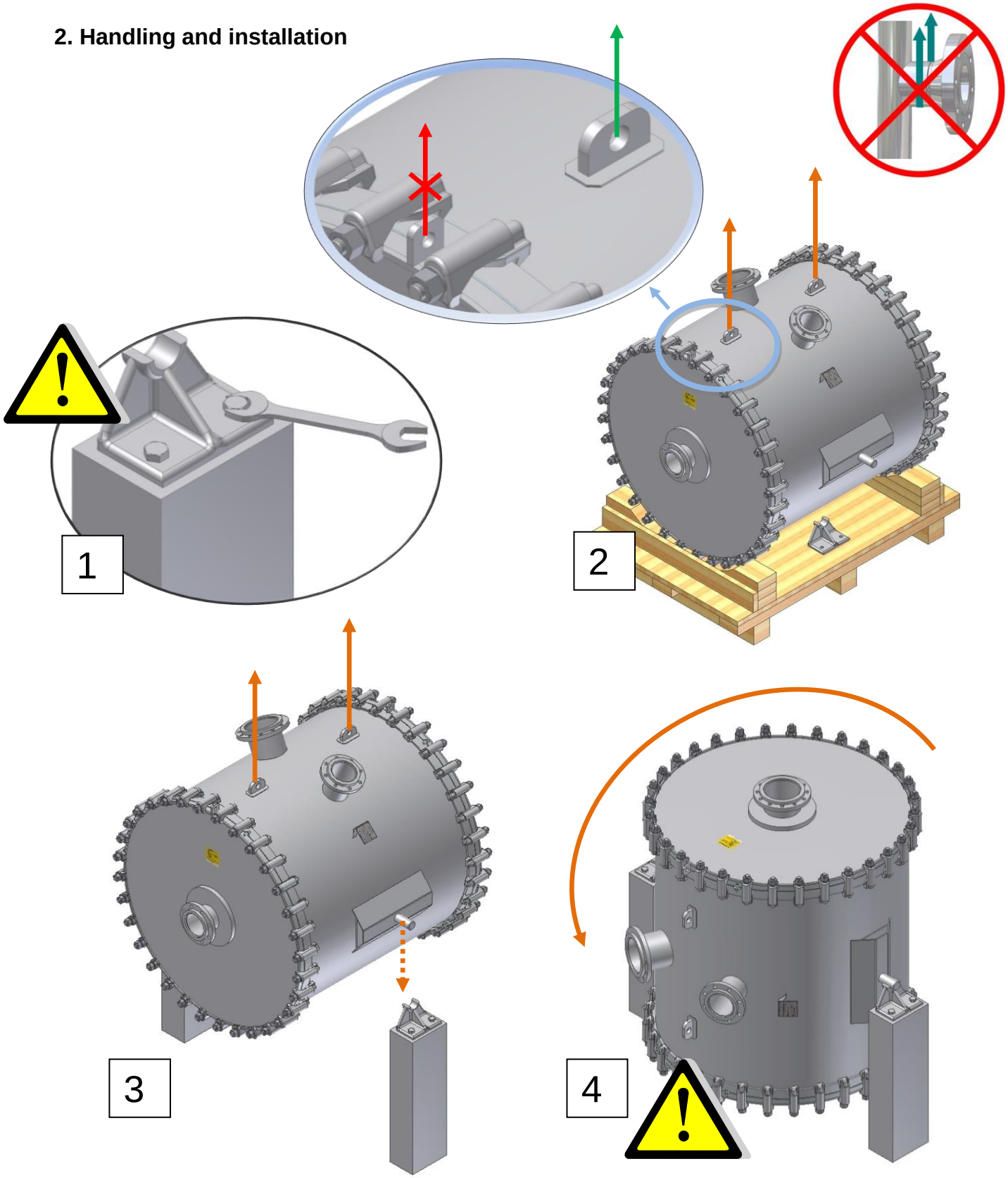
Section 10 – Diagrams for types 1V and 3V

1. Construction

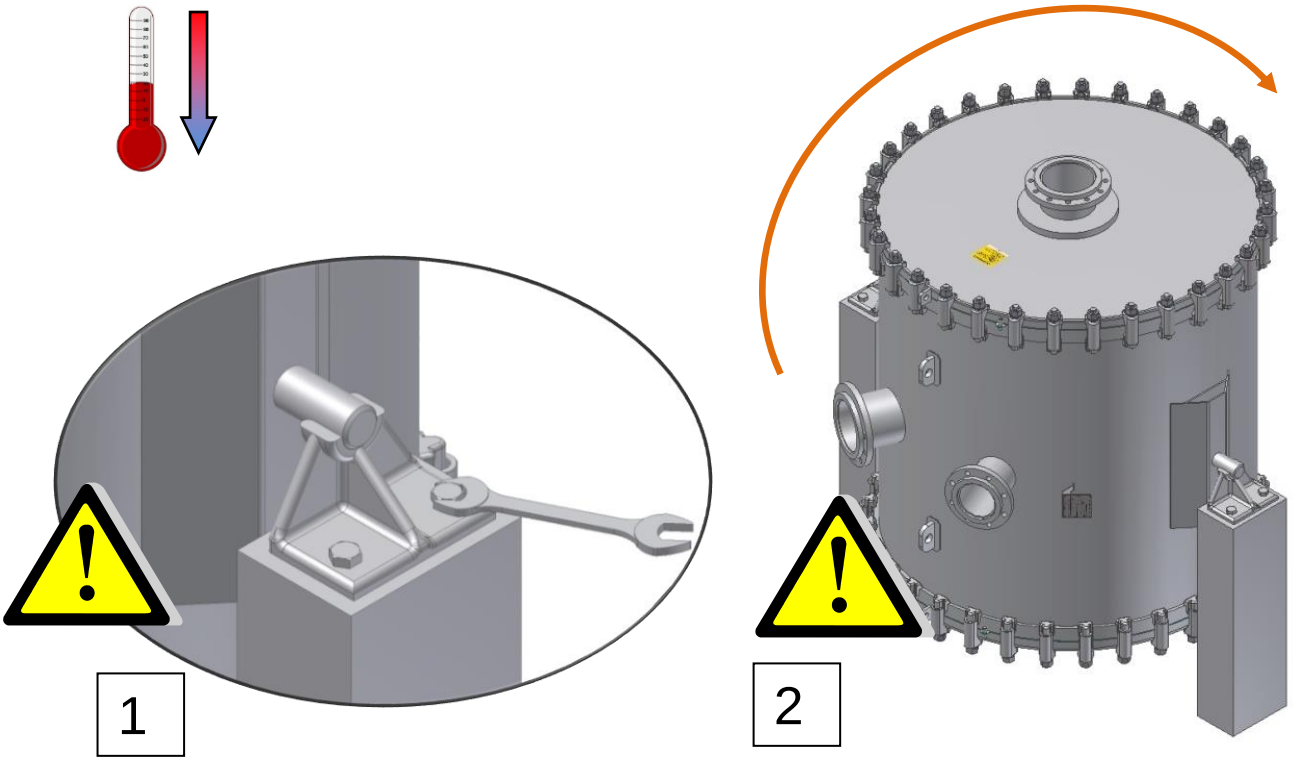
WARNING
For safety reasons, never stand or work under suspended loads.

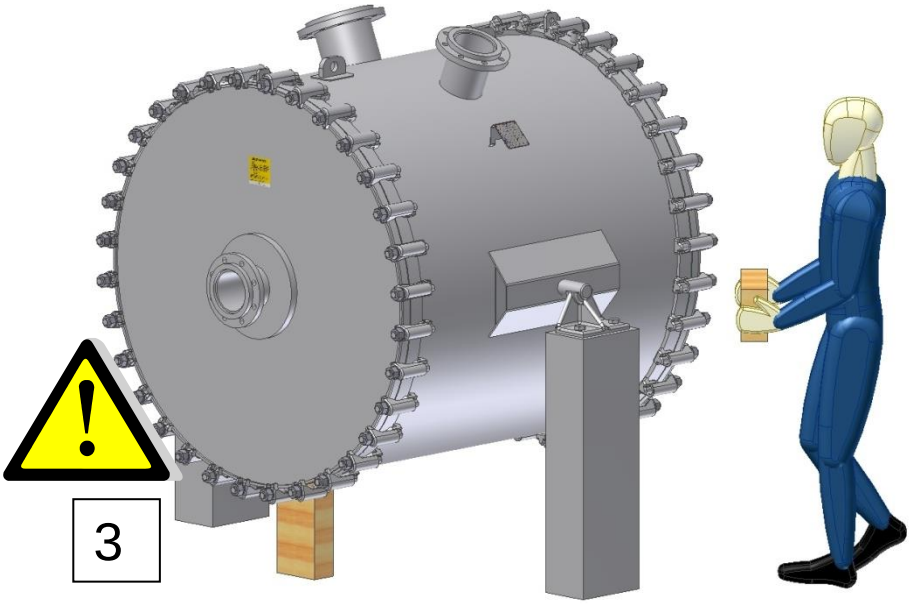


2. Handling and installation

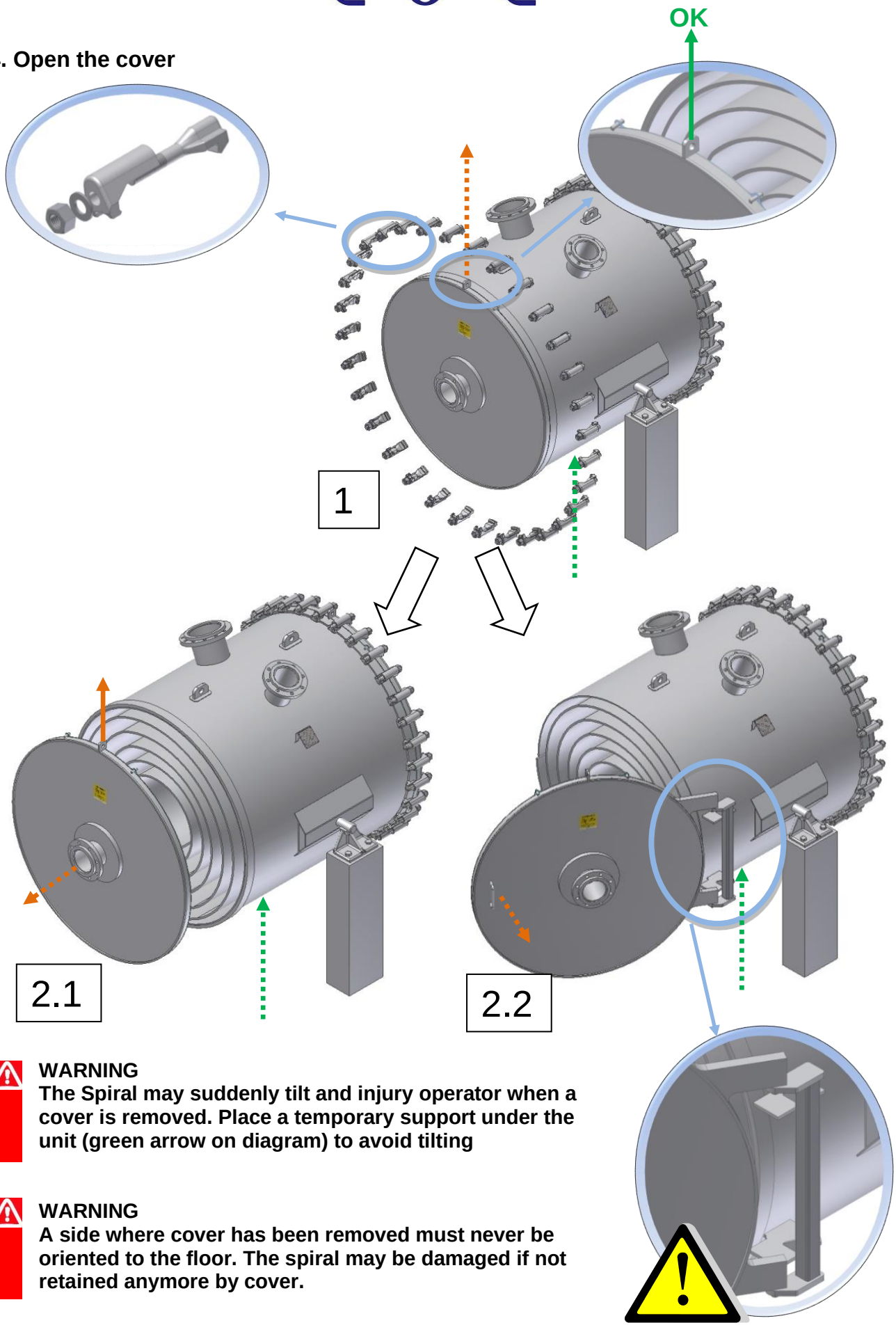


3. Rotate the unit





4. Open the cover



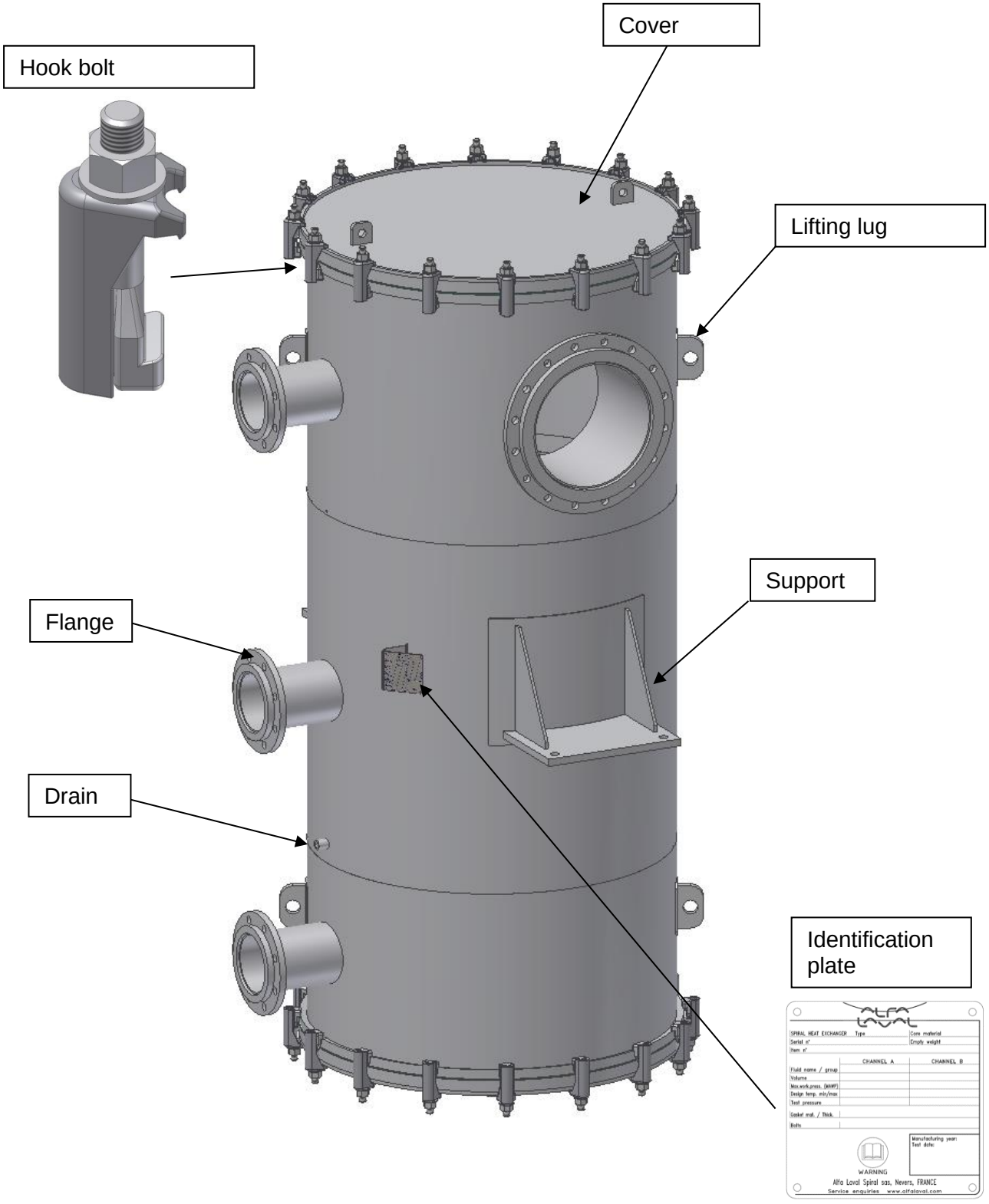
WARNING
The Spiral may suddenly tilt and injury operator when a cover is removed. Place a temporary support under the unit (green arrow on diagram) to avoid tilting

WARNING
A side where cover has been removed must never be oriented to the floor. The spiral may be damaged if not retained anymore by cover.

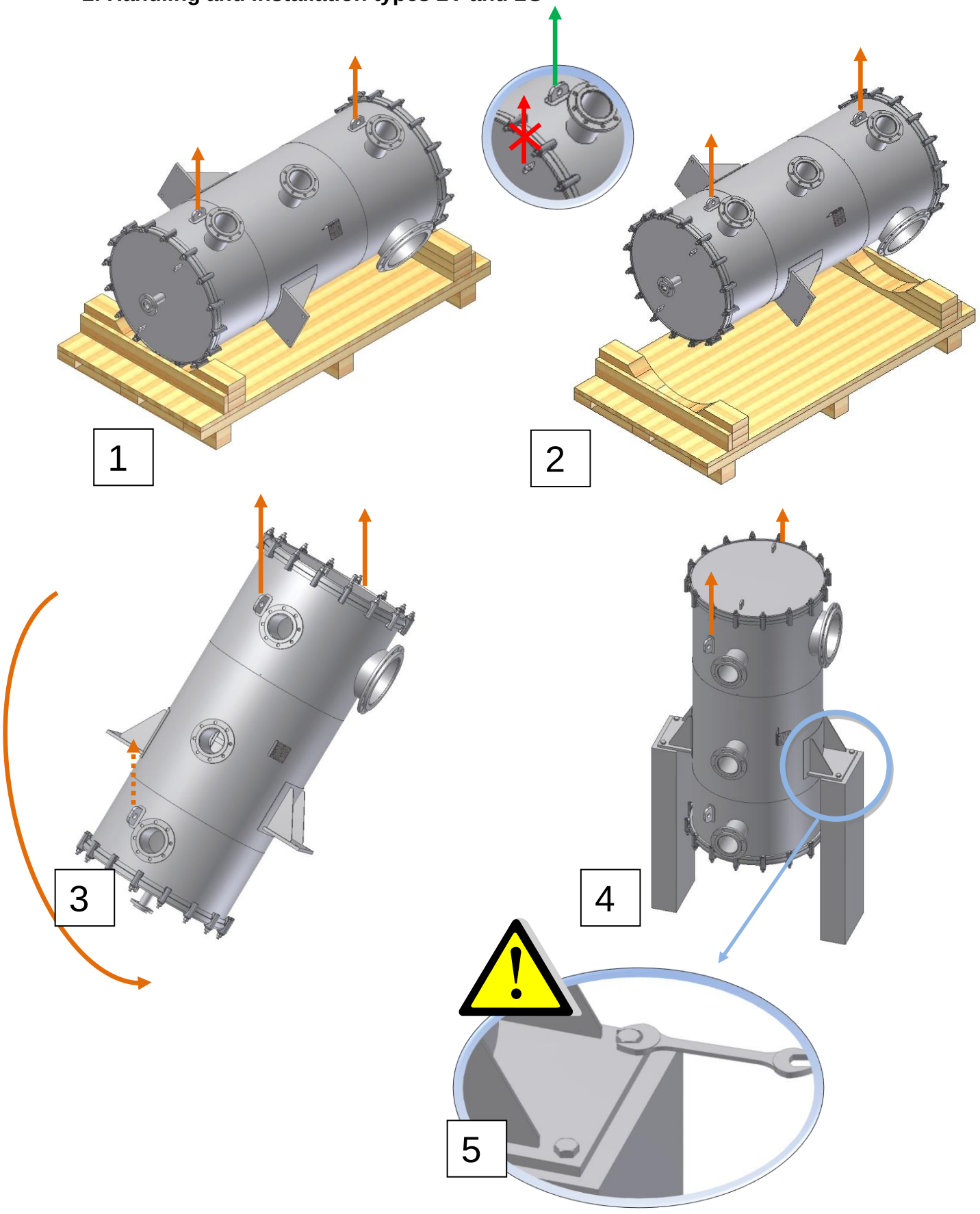
Section 11 – Diagrams for types 2V, 2G and 4V

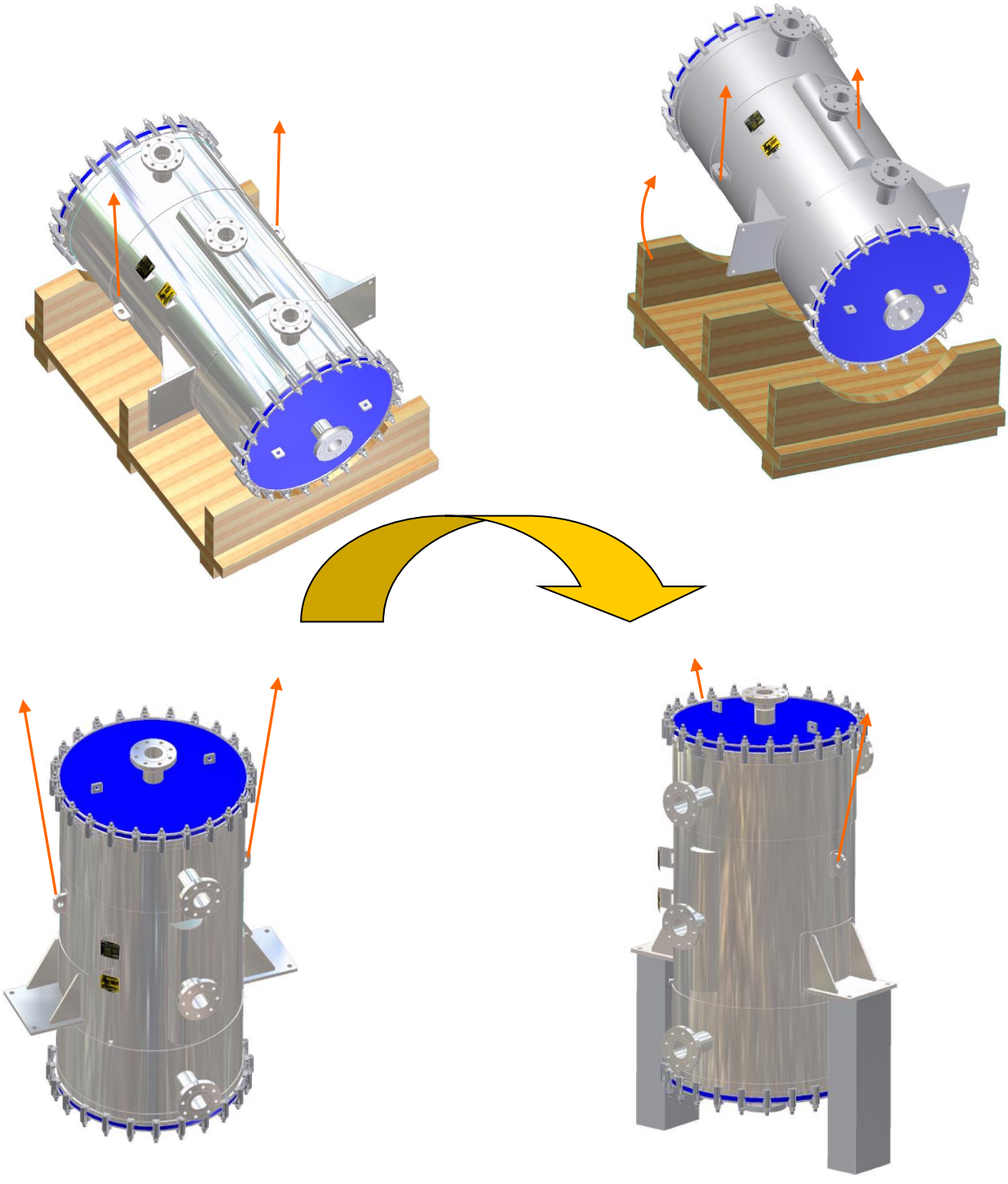
1. Construction

WARNING
For safety reasons, never stand or work under suspended loads.

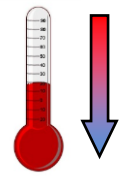


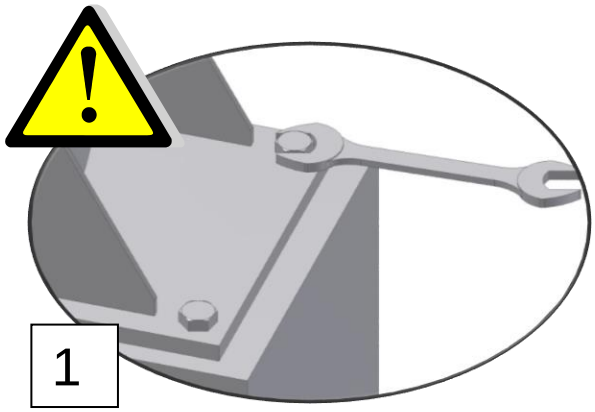
2. Handling and installation types 2V and 2G

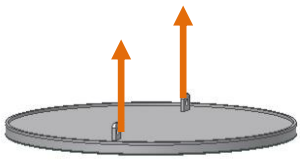


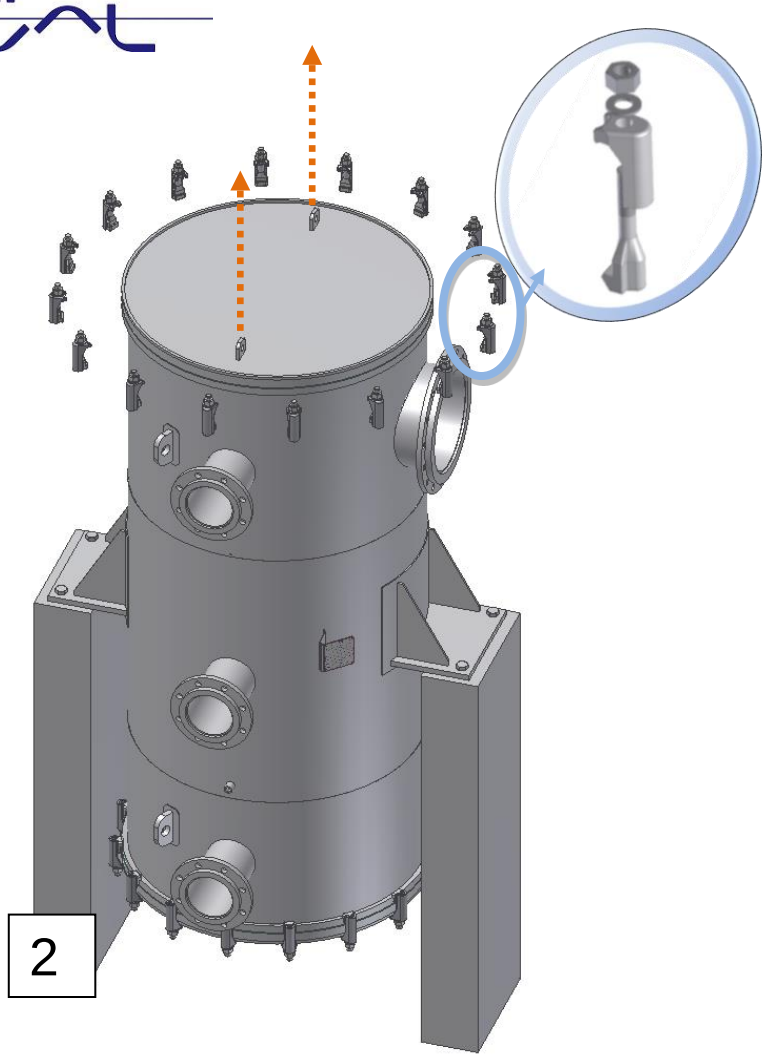


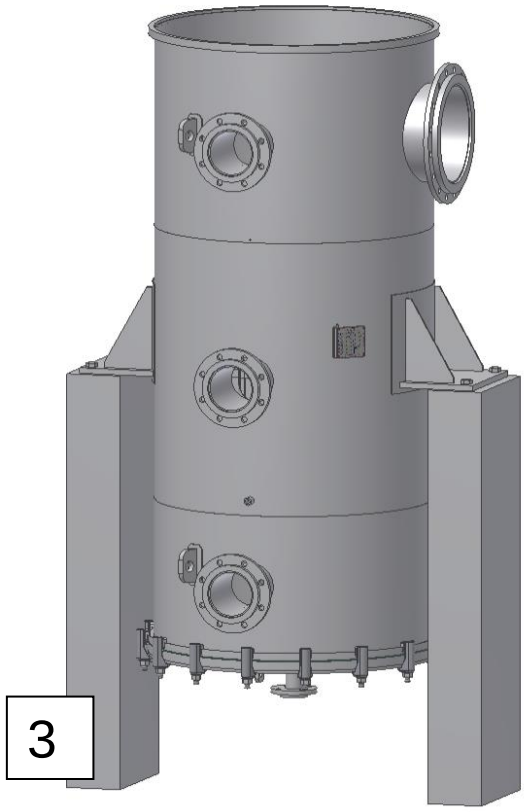
3. Open the cover



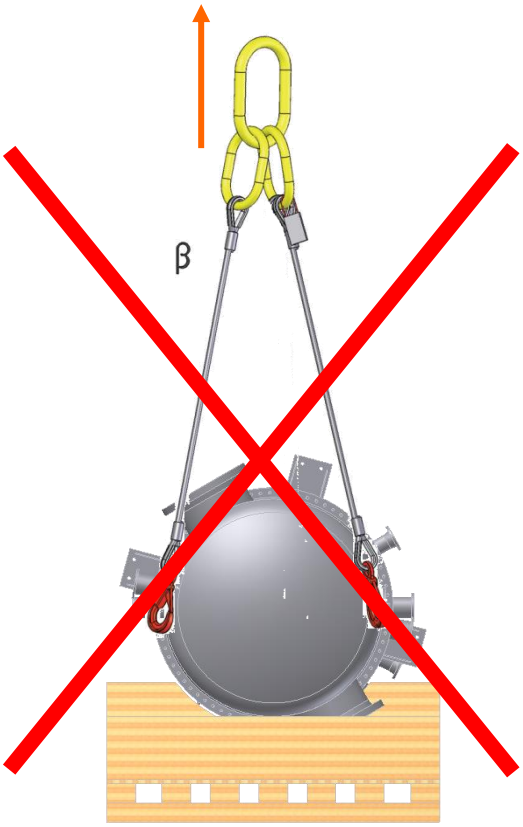


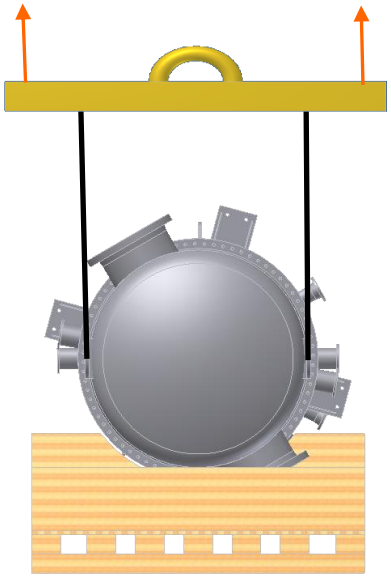


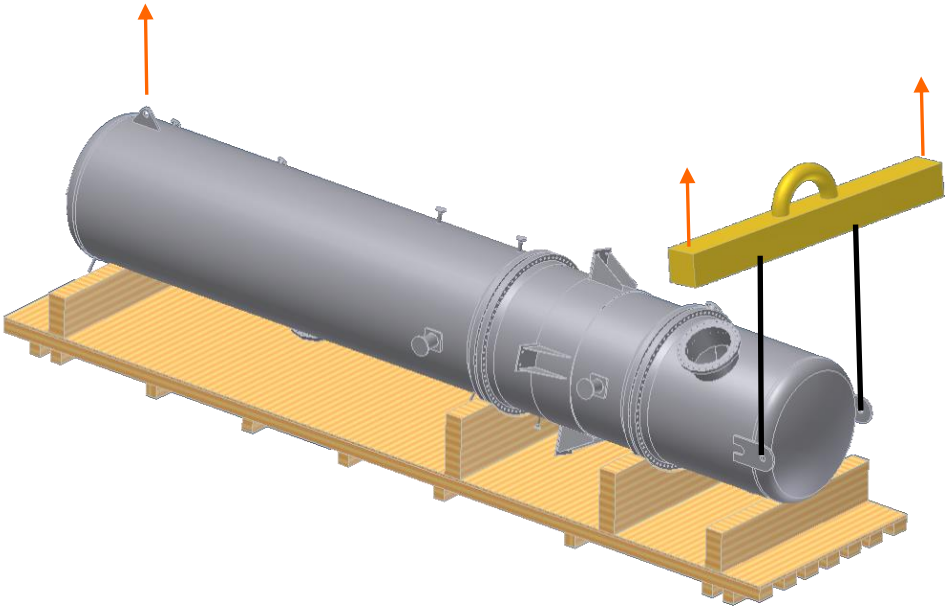


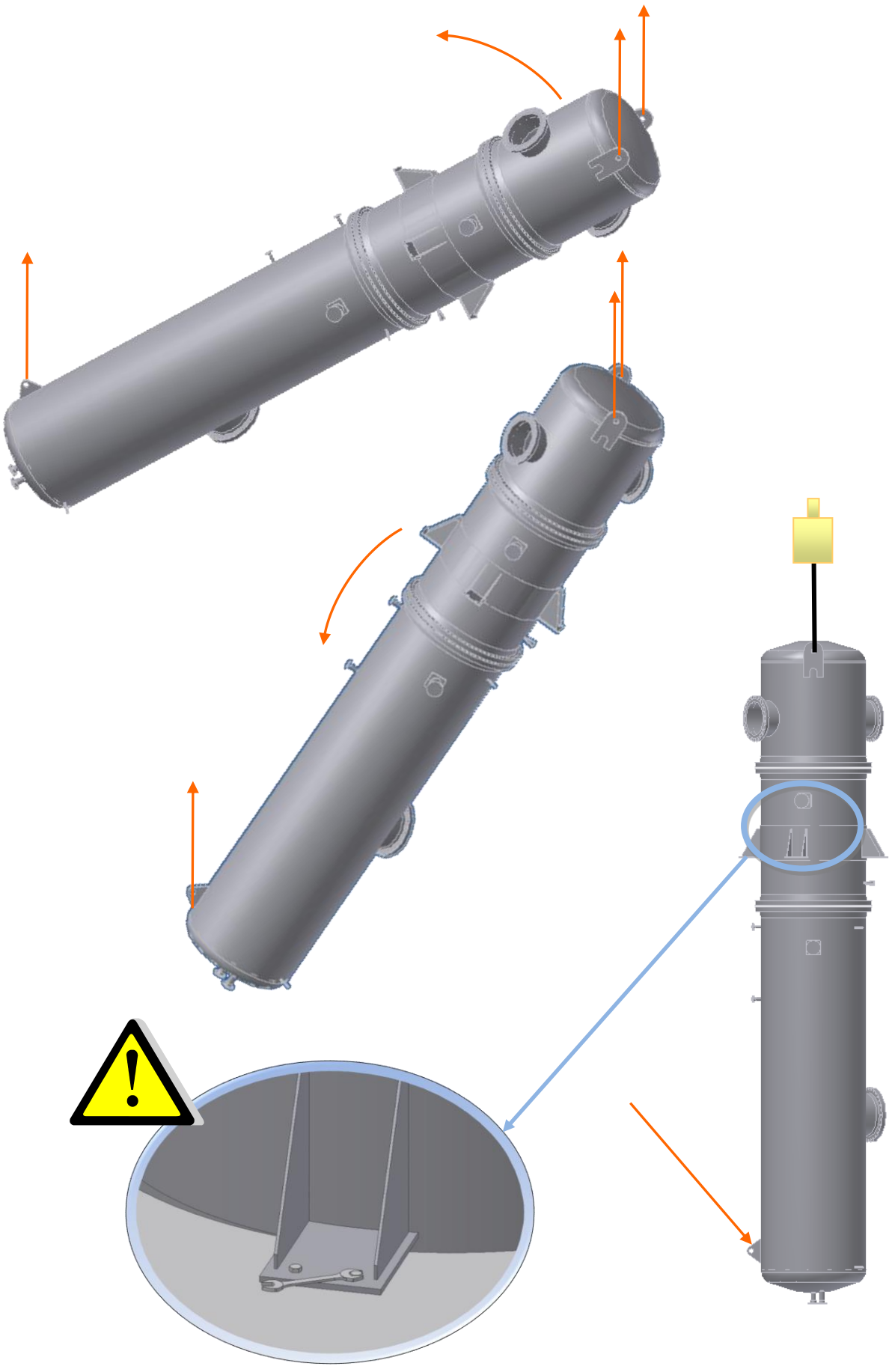


4. Handling and installation types 4V





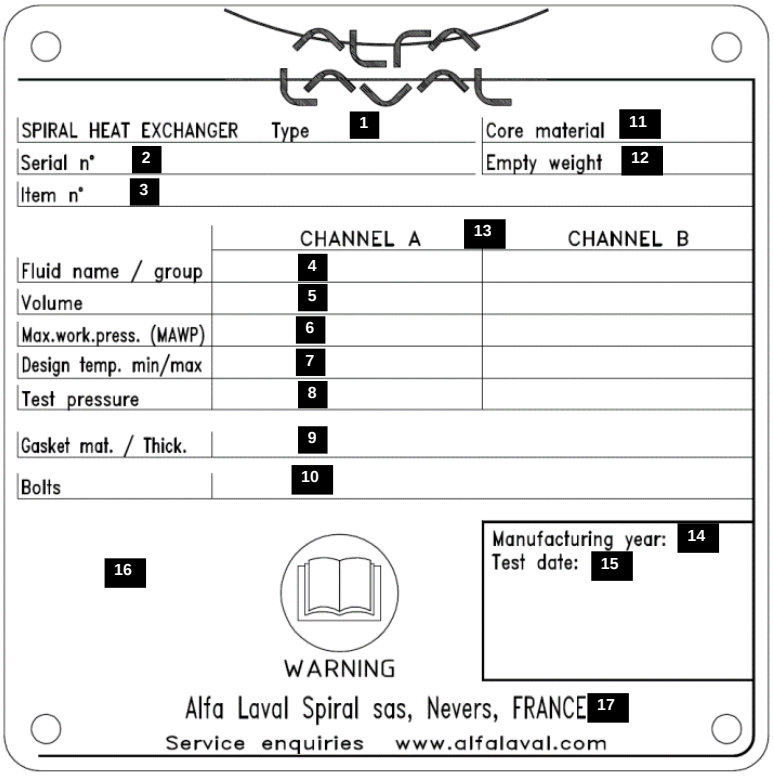




Section 12 – Appendix

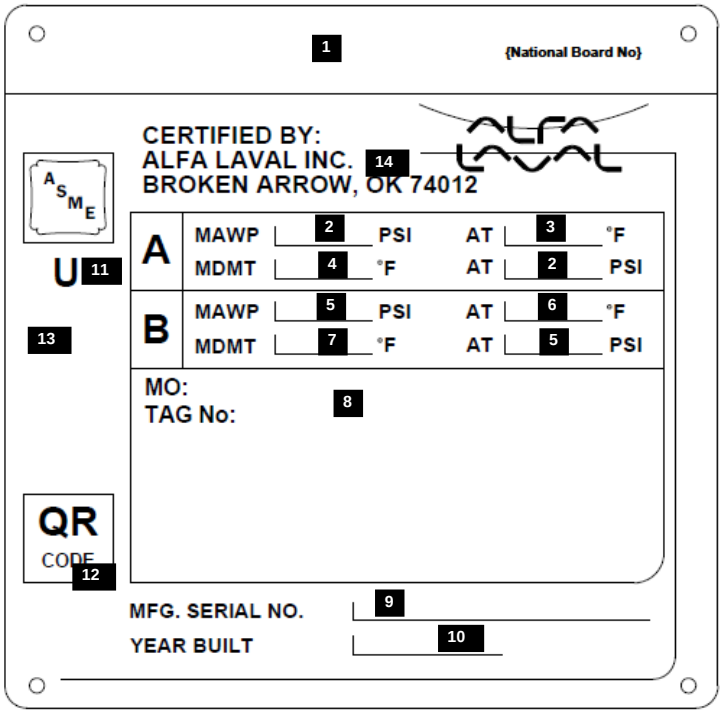
1. Identification nameplate

1) Model name & Equipment type
2) Serial number
3) Reference number
4) Fluid name & group
5) Volume
6) Maximum Allowable Working Pressure
7) Min/Max Design Temperature
8) Test pressure
9) Gasket material/Thickness
10) Bolting = recommended torque value
11) Exchanger material
12) Empty weight
13) Channel A/B
14) Manufacturing year
15) Test date
16) QR Code (when available)
17) Manufacturer



2. ASME nameplate (USA factory only)

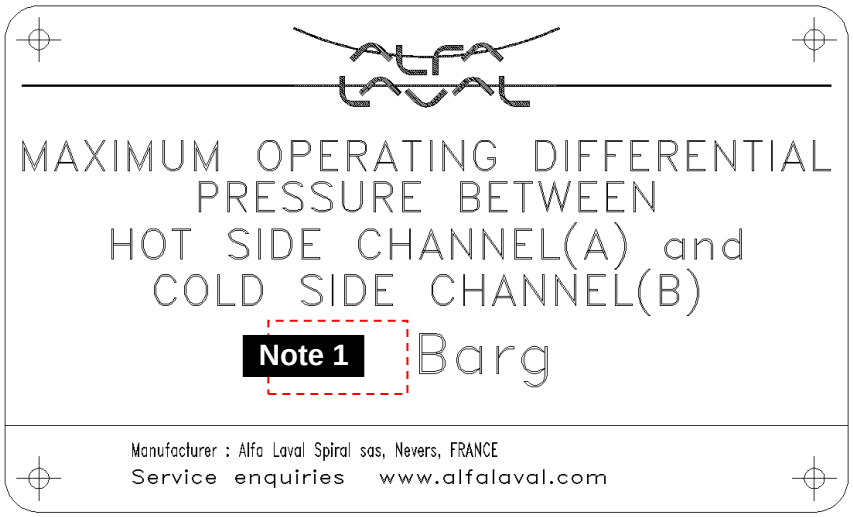
1) National Board Number
2) Circuit “A” MAWP
3) Circuit “A” Design Temperature
4) Circuit “A” MDMT
5) Circuit “B” MAWP
6) Circuit “B” Design Temperature
7) Circuit “B” MDMT
8) Additional Information
(e.g. Unit Tag, P.O. #, CRN #...)
9) Manufacturing serial number
10) Year built
11) “U” Stamp
12) QR Code (if available)
13) HT, PHT, RT, UT (if required)
14) Manufacturer



NOTE
MAWP = Maximum Allowable Working Pressure
MDMT = Minimum Design Metal Temperature

Notice that some old nameplates may indicate in addition of this information the MAEWP (Maximum Allowable External Working Pressure) at design temperature for each circuit.

3. Pressure differential plate (if necessary) 1



1

Note 1) Maximum operating differential pressure between the hot side channel (A) and the cold side channel (B)

The value listed in the dotted box is the maximum pressure differential between the 2 channels. Do not exceed this pressure as it may damage the exchanger body.

4. Safety information

1

2

1) Shut down pressure on both sides before opening a cover.

2) Otherwise it can lead to operator injury and heavy damage to the exchanger. See instruction manual.

3

3) Tighten the bolts before use (read instruction manual).

4

4) Do not use this lug for lifting exchanger.

5. Allowable nozzle loads (<u>only applicable for Spiral manufactured in France</u>)

Refer to Appendix Section 12/1 and 2 to determine manufacturing location. Standard Nozzle loads listed in tables below are only applicable for Nevers – France if not listed on general arrangement drawing.
These values are standard loads: they do not consider any other specific loads, which may be specified in the calculation notes and/or drawing.

Nozzle loads will be listed on the general arrangement for units manufactured outside Nevers – France, if applicable.

For units manufactured in another factory than Nevers- France, these values are not applicable by default. Check on the general arrangement drawing if some allowable nozzle loads are applicable and what their values are.

Notations:
Fx, Fy, Fz Forces
Mx, My, Mz Moments

Directions of forces and moments on connection:

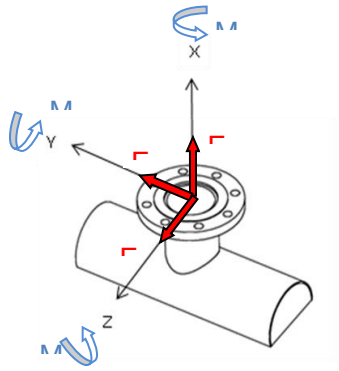
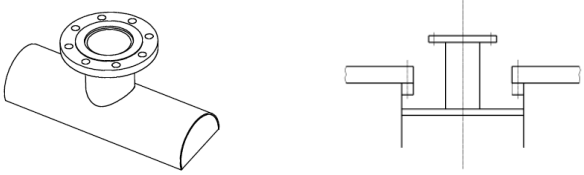
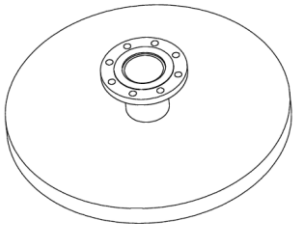


Table 1 : Connection on collecting box and central caps



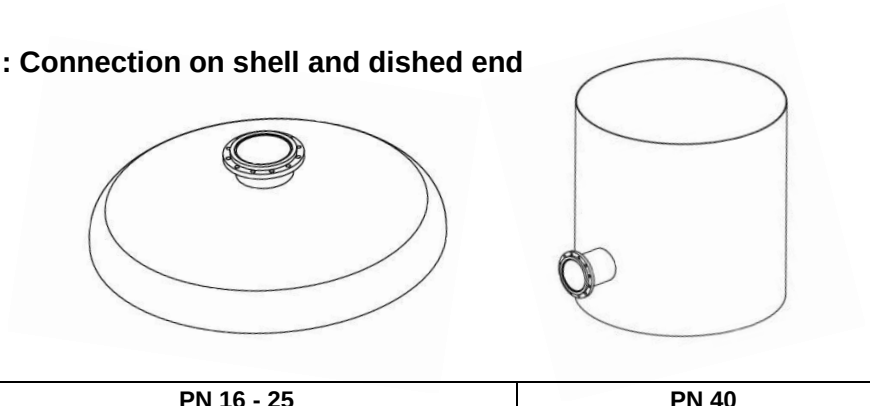
Nom. size		PN 16 - 25 (ASME rating 150)						PN 40 (ASME rating 300)				PN 63 - 100 (ASME rating 600)			
DN	(NPS)	*Fx = Fy = Fz*		*My = Mz*		*Mx*		*Fx = Fy = Fz*		*Mx = My = Mz*		*Fx = Fy = Fz*		*Mx = My = Mz*	
		N	(lbf)	N.m	(lb.ft)	N.m	(lb.ft)	N	(lbf)	N.m	(lb.ft)	N	(lbf)	N.m	(lb.ft)
25	(1")	100	(22)	0	(0)	0	(0)	100	(22)	0	(0)	150	(34)	5	(4)
50	(2")	250	(56)	50	(37)	150	(111)	250	(56)	100	(74)	350	(79)	150	(111)
80	(3")	500	(112)	150	(111)	250	(184)	500	(112)	250	(184)	650	(146)	300	(221)
100	(4")	500	(112)	200	(148)	500	(369)	750	(169)	400	(295)	800	(180)	500	(369)
150	(6")	750	(169)	200	(148)	500	(369)	1000	(225)	450	(332)	1500	(337)	550	(406)
200	(8")	1000	(225)	200	(148)	750	(553)	1500	(337)	500	(369)	2000	(450)	600	(443)
250	(10")	1500	(337)	250	(184)	750	(553)	1500	(337)	750	(553)	2500	(562)	900	(664)
300	(12")	1500	(337)	300	(221)	750	(553)	2000	(450)	750	(553)	3000	(674)	1000	(738)
350	(14")	2000	(450)	300	(221)	1000	(738)	2500	(562)	1000	(738)	4000	(899)	1500	(1106)
400	(16")	2500	(562)	350	(258)	1000	(738)	3000	(674)	1500	(1106)	4500	(1012)	2000	(1475)
450	(18")	3000	(674)	350	(258)	1500	(1106)	3500	(787)	2000	(1475)	5000	(1124)	3000	(2213)
500	(20")	3000	(674)	500	(369)	1500	(1106)	4000	(899)	2500	(1844)	6000	(1349)	4000	(2950)

Table 2 : Connection on cover



Nom. size		PN 16 - 25 (ASME rating 150)				PN 40 (ASME rating 300)				PN 63 - 100 (ASME rating 600)			
DN	(NPS)	*Fx = Fy = Fz*		*Mx = My = Mz*		*Fx = Fy = Fz*		*Mx = My = Mz*		*Fx = Fy = Fz*		*Mx = My = Mz*	
		N	(lb)	N.m	(lb.ft)	N	(lb)	N.m	(lb.ft)	N	(lb)	N.m	(lb.ft)
25	(1")	100	(22)	0	(0)	100	(22)	0	(0)	150	(34)	5	(4)
50	(2")	250	(56)	100	(74)	250	(56)	150	(74)	350	(79)	150	(111)
80	(3")	500	(112)	250	(148)	500	(112)	250	(184)	650	(146)	300	(221)
100	(4")	500	(112)	500	(258)	750	(169)	500	(295)	800	(180)	600	(332)
150	(6")	750	(169)	750	(553)	1000	(225)	800	(590)	1500	(337)	1000	(738)
200	(8")	1 000	(225)	1 000	(738)	1500	(337)	1 400	(1033)	2000	(450)	1 700	(1254)
250	(10")	1 500	(337)	1 700	(1254)	1500	(337)	2 000	(1475)	2500	(562)	2 500	(1844)
300	(12")	1 500	(337)	2 400	(1770)	2000	(450)	3 000	(2213)	3000	(674)	4 000	(2950)
350	(14")	2 000	(450)	3 200	(2360)	2500	(562)	4 000	(2950)	4000	(899)	5 500	(4057)
400	(16")	2 500	(562)	4 000	(2950)	3000	(674)	5 000	(3688)	4500	(1012)	7 500	(5532)
450	(18")	3 000	(674)	4 500	(3319)	3500	(787)	6 000	(4425)	5000	(1124)	9 500	(7007)
500	(20")	3 000	(674)	5 000	(3688)	4000	(899)	7 000	(5163)	6000	(1349)	12 000	(8851)

Table 3 : Connection on shell and dished end



Nom. size		PN 16 - 25 (ASME rating 150)						PN 40 (ASME rating 300)				PN 63 - 100 (ASME rating 600)			
DN	(NPS)	*Fx = Fy = Fz*		*My = Mz*		*Mx*		*Fx = Fy = Fz*		*Mx = My = Mz*		*Fx = Fy = Fz*		*Mx = My = Mz*	
		N	(lbf)	N.m	(lb.ft)	N.m	(lb.ft)	N	(lbf)	N.m	(lb.ft)	N	(lbf)	N.m	(lb.ft)
25	(1")	100	(22)	0	(0)	0	(0)	100	(22)	0	(0)	150	(34)	5	(4)
50	(2")	250	(56)	50	(37)	150	(111)	250	(56)	100	(74)	350	(79)	150	(111)
80	(3")	500	(112)	150	(111)	250	(184)	500	(112)	250	(184)	650	(146)	300	(221)
100	(4")	500	(112)	200	(148)	500	(369)	750	(169)	400	(295)	800	(180)	500	(369)
150	(6")	750	(169)	250	(184)	500	(369)	1000	(225)	450	(332)	1500	(337)	550	(406)
200	(8")	1000	(225)	250	(184)	750	(553)	1500	(337)	500	(369)	2000	(450)	600	(443)
250	(10")	1500	(337)	300	(221)	750	(553)	1500	(337)	750	(553)	2500	(562)	900	(664)
300	(12")	1500	(337)	400	(295)	750	(553)	2000	(450)	750	(553)	3000	(674)	1000	(738)
350	(14")	2000	(450)	400	(295)	1000	(738)	2500	(562)	1000	(738)	4000	(899)	1500	(1106)
400	(16")	2500	(562)	500	(369)	1000	(738)	3000	(674)	1500	(1106)	4500	(1012)	2000	(1475)
450	(18")	3000	(674)	500	(369)	1500	(1106)	3500	(787)	2000	(1475)	5000	(1124)	3000	(2213)
500	(20")	3000	(674)	700	(516)	1500	(1106)	4000	(899)	2500	(1844)	6000	(1349)	4000	(2950)
600	(24")	3000	(674)	700	(516)	1500	(1106)	4000	(899)	2500	(1844)	6000	(1349)	4000	(2950)

6. Troubleshooting questionnaire

If the Spiral fails, following documents are requested for analysis/ expertise:

- ✓ Trouble shooting questionnaire / GEFA1090
- ✓ Process Flow Diagram
- ✓ Design Datasheet (CAS print out)
- ✓ Pictures of the failures

Thank you in advance for sending these as soon as possible, in order for us to have as many details as possible to handle the problem and help you out.

Troubleshooting Questionnaire GEFA 1090:

1 – Customer Information

Company Name		Contractor (if applicable)	
Contact Name		Contact Name	
Email/Tel		Email/Tel	

2 – Exchanger Information

Exchanger Type [1]		Serial No. [2]	
GA Drawing No.		Delivery Date	
Material		Gasket material	
Start-up Date		Failure Date	
Manufacturing site		Last service date	
First Time Failure	☐ Yes ☐ No		

3 – Actual Operating Data

	Circuit A			Circuit B		
Fluid						
Actual Flowrate (kg/h)						
Actual Operating Pressure	barG	→	barG	barG	→	barG
Actual Operating Temperature	°C	→	°C	°C	→	°C
Actual Heat Duty (kW)						
No. of passes						

4 – Process Description

Cyclic Duty (if applicable)	☐ Pressure	☐ Temperature
Operation	☐ Steady	☐ Unsteady
Frequency	_____ cycles/week	Amplitude _____ bar/min or °C/min
Start-up ramp	_____ bar/h	_____ °C/h
Shutdown ramp	_____ bar/h	_____ °C/h
Control system	☐ Manual	☐ Automatic
Vent/drain connected	☐ Yes	☐ No
Pump/compressor location	☐ Upstream	☐ Downstream
→ Specify type of pump and/or compressor	_____	
Risk of full vacuum	☐ Yes	☐ No
→ Specify the scenario that would cause it	_____	
Control valve position for steam heater, reboiler and condenser	☐ Steam inlet	☐ Condensate outlet
For reboiler	☐ Once through	☐ Circulating

5 – Exchanger Problems and Observations

Describe the problem:

Problem detection during: operation? service/maintenance?

External leakage: Yes / No detection method: Location:

Internal leakage: Yes / No detection method:

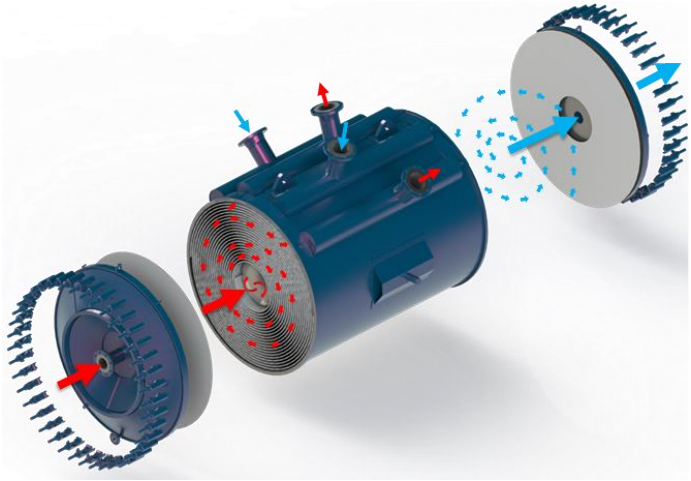
Thermal performance issue: Yes / No If Yes, provide details:

Pressure drop issue: Yes / No Actual pressure drop:

6 – Other Required Information (tick if provided together with this questionnaire)

- ☐ P&ID
- ☐ Original datasheet and fluid properties
- ☐ Operating data - temperature, pressure and flowrate (minute-data in an excel file preferred)
- ☐ Pictures of the leakage or damages
- ☐ Operational history - shutdown, service, cleaning, inspection, etc.

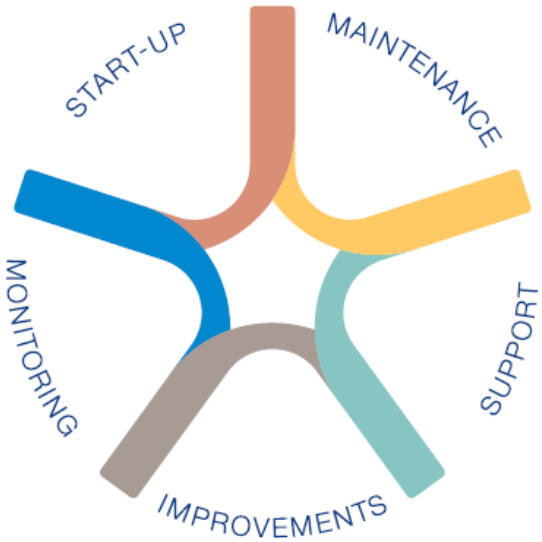
Note:
Please provide as much information as possible.
We will get in contact with you if more information is required.
[1] – Exchanger type: Compabloc / Spiral/ DuroShell
[2] – Serial number can be found on the GA drawing and the exchanger's nameplate



From day 1, Alfa Laval is here with service to keep you growing.

Please discover our unique Service program composed of both preventive and reactive services to keep your equipment performing and your business increasing.

- ✓ Commissioning supervision
- ✓ Installation supervision



- ✓ Cleaning
- ✓ Spare parts
- ✓ Repair

- ✓ Performance audit
- ✓ Condition audit

- ✓ Training
- ✓ Troubleshooting
- ✓ Technical support
- ✓ Exclusive stock

- ✓ Redesign

Please contact your local Alfa Laval representative for extending your performance.

Visit our website at **www.alfalaval.com**

or click on the QR Code just on the right

Original Instructions: