## GENERAL SPECIFICATION

## SPECIFICATION

FOR

AIR COOLED HEATEXCHANGER

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Neptune Energy Netherlands B.V.

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1.0 INTRODUCTION

1.1 GENERAL

This specification defines the minimum requirements for the thermal and mechanical design, supply of materials, fabrication, inspection, testing, guarantee and delivery of an air-cooled heat exchanger, to be installed on an offshore platform in the Dutch Sector of the North Sea. For equipment tagnumbers and details see the datasheets.

1.2 SUPPLIER’S RESPONSIBILITY

Supplier shall be responsible for the complete design, construction, testing and for the process- and mechanical guarantees of the equipment, including full compliance with all applicable design codes and standards, as listed in Section 2 of this document, the requirements of the certifying authority (NoBo), and with good practice in the oil and gas industries to be accepted by Buyer.

Supplier shall be responsible for obtaining certification from the certifying authority.
2.0 CODES AND STANDARDS

The Equipment covered by this specification shall be designed, constructed and tested in accordance with the requirements of this specification, the attached data sheets, other referenced Buyer’s specifications and the referenced codes, standards and regulations, unless specially excluded by this specification:

All international codes and standards mentioned or referred to in any of Buyer’s documents shall be the latest issue in use at the date of purchase order, except where noted otherwise, and believed in the possession of Suppliers supplying the requested materials. None of the requirements mentioned herein shall be construed as voiding any part of any such code or standard as referred to in Buyer’s documents.

2.1 CODES, STANDARDS AND REGULATIONS

The Heat Exchanger covered by this specification shall be designed, constructed and tested in accordance with the requirements of this specification, the attached data sheets, other referenced project specifications plus the following standards, codes and regulations:

- EU – ATEX Directive 94/9/EC.
- EU – Certification conform European Rules, including “CE” – marking.
- Dutch Mining Regulations – October 2002 (Mijnbouw Wet).
- Dutch Rules for working environment (ARBO arbeidsomstandigheden wet).
- Dutch Rules for Pressure Vessels (Stoomwezen).
- API 661 Air cooled Heat Exchangers for General Refinery Services.
- ASME B16.5 Pipe Flanges and Fittings.
- ASME B 1.20.1 Pipe threads- general purpose (inch).
- ASME B16.20 Ring type joint gaskets for pipe flanges.
- ASME B16.21 Non-metallic flat gaskets for pipe flanges.
- IEC 60034 Rotating electrical machines.
- ISO 1940/1 Mechanical Vibrations – Quality Requirements for the Balancing of rigid rotors. Part 1: determination of acceptable residual unbalance.
- ISO 3744 Acoustics, determination of sound power level of noise sources. – engineering methods for free field conditions.
- ISO 8372 Mechanical Vibrations of machinery having a rotation frequency in range between 10S-1 and 200 S-1.
- NEN 3410 Safety Requirements for High Voltage Installations in Potentially Explosive Gas Atmospheres.
- IEC 60034 Rotating electrical machines.
- NEN 10204 Metallic products – types of inspection documents.
- NEN-EN 13445 Unfired Pressure Vessels.
- NEN-EN 13480-1 thru 5 Industrial Piping Systems.
- NEN-EN-ISO 1461 Hot Dip Galvanized Coating on Fabricated Iron and Steel Articles
- NEN-EN 50014 thru
- NEN-EN 50020 Electrical Apparatus for Potential Explosive Atmospheres.
2.2 BUYER’S SPECIFICATIONS

103 Supplier Document Requirements (SDR) latest revision
201 Supply and fabrication of steel structures latest revision
403 General Specification for Pressure Vessels latest revision
501 Specification for piping design latest revision
502 General Specification for piping fabrication and pressure testing latest revision
   (including attachment I and II)
503 General Specification for Pipe, Fittings and Valves latest revision
524 General Specification for Coating of Threaded Fasteners latest revision
525 General Painting and Coating Specification latest revision
610 Specification for General Construction of Electrical, Instrumentation latest revision
   and Telecommunication Installations

2.3 ORDER OF PRECEDENCE FOR DOCUMENTS

In the case that conflicts arise between the applicable requirements, as from within this document, its associated specifications, datasheets, etc. and from within the aforementioned applicable codes, standards, laws and statutory regulations, Supplier shall bring the matter to Buyer’s attention for resolution and approval in writing. In all cases the most stringent requirements shall apply.

The ‘Stoomwezen’ rules and calculations or NEN-EN 13480 1 thru 5 shall be used for the parts where these are more stringent than NEN-EN 13445.

Should any conflict occur as a result of complying with the applicable requirements, the order of precedence shall be as follows:

1) Data sheets.
2) Technical specification; this document.
3) Referenced specifications.
4) Codes and Standards referred to within this document and its attachments.

Compliance by the Supplier with the requirements of this document shall not relieve Supplier of the responsibility to furnish complete equipment and accessories of a proper mechanical design suited to meet the specified performance and service conditions and/or local codes governing health and safety.

2.4 CERTIFYING AUTHORITY

The certifying authority will be a Notify Body as defined in Pressure Equipment Directive 2014/68/EU.
3.0 SCOPE OF SUPPLY

3.1 GENERAL

The Supplier’s “Scope” shall include, as a minimum, the following:

Tube bundles comprising of:

- Finned tubes
- Split headers with flanged in-/outlet-nozzles and blinded vent-/drain connections
- External blinds, plugs, caps, bolts/nuts and gaskets
- Bundle frame and tube supports
- Expansion bolts as required to allow for thermal expansion
- Manually controlled, pneumatically actuated adjustable louvers, 2 section per bay, for airside control range improvement.

Fans with fan rings and supports complete with:

- Manual variable pitch fans
- Transmissions
- Electric motors, all suitable for VSD as per attached datasheet
- Plenums
- Supporting structure (for fans, plenums and bundles)
- Vibration switches
- Fan protection screens
- Lubrication facilities
- Earthing to structure

General:

- Surface preparation and coating as per coating specification
- Nameplate brackets and SS nameplates
- All required ladders and grated platforms/walkways to access and maintain the equipment. (see sketch on datasheet)
- Lifting lugs (suitable for single point lift of the complete, assembled unit)
- 2 earthing bosses
- Spare parts for start-up and commissioning (> 10 % spare for bolts, nuts gaskets) and for 2-year normal operation.
- Special tools, equipment and devices for transportation, erection and installation, operation, maintenance and handling
- Seaworthy packing as specified in the Purchase Order including long-term preservation storage to be applied before shipment
- Supplier shall base his bid on this specification, however, in case of commercially /technically more attractive alternatives Supplier is requested to submit for approval detailed optional bids for any of his proposed alternative(s) in addition to the base case.
3.2 SCOPE OF SUPPLY BY OTHERS AND/OR BUYER

Following shall be supplied by others and/or Buyer, unless specified otherwise:

- Control stations of off/automatic/hand-on type or start/stop type for electric motors
- Electric motor starters or VSD (e.g. circuit breaker-contactor combinations) by Buyer.
- Wiring of packages/skids up to DCS and ESD

3.3 DEVIATIONS

All deviations from the requirements of this specification and its attachments shall be stated and separately listed in the Tender. In the absence of such a statement, it shall be assumed that the requirements of this specification are met in full.

3.4 COOLER ARRANGEMENT

The cooler arrangement shall be supplied as cooling units for installation in a common supporting frame to allow for minimum installation logistics. Supplier to provide a setting plan with his proposal including information on supporting requirements for the coolers. Supplier to inform Buyer if the plotspace given in the datasheets is insufficient.

4.0 ENVIRONMENTAL DATA

The equipment will be located outside, subject to a corrosive saliferous marine environment.

4.1 AREA CLASSIFICATION

All equipment shall be suitable for a Zone 2, Gas Group IIA, Temperature Class T3 hazardous area.

All equipment and materials must be certified according ATEX requirements for the specified hazardous area.

EEX materials shall comply to NEN-EN 50014 through NEN-EN 50020.

4.2 DESIGN

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5.0 DESIGN REQUIREMENTS

5.1 GENERAL

It is the Supplier’s responsibility to ensure that the methods employed in the design and construction of the equipment to be supplied, comply with the datasheets, codes and standards detailed in this specification and with accepted good practice in the oil and gas industries.

5.2 DESIGN REQUIREMENTS – PROCESS

For detailed process data, see attached data sheets.

Guarantees

The Thermal and Mechanical design of the Air Cooler shall be carried out by the Supplier.

The Supplier shall provide both the Thermal and Mechanical guarantees for the equipment provided against process and mechanical conditions given on the data sheets. When physical properties are not given by the Buyer, the Supplier shall use the physical properties for the process fluids from reputable and acceptable sources. Where properties are not available the Supplier shall refer to the Buyer for guidance and final agreement.

5.3 DESIGN REQUIREMENTS – MECHANICAL

5.3.1 Tubes and Fins

Design by Supplier; information on principal elements (material, wall thickness, type of fins, layout cooler) to be included in bid.

Tubes shall be seamless and no jointers are allowed.

Due to the offshore environment the fins shall be constructed and protected to resist corrosion and possess sufficient mechanical strength to avoid buckling or damage from handling. Where fins are secured on the tubes by a groove and wrapping technique the exposed steel surface shall be coated.

For temperatures up to 360°C tubes with embedded fins shall be used.
For temperatures up to 230°C Bimetallic tubes with extruded fins shall be used.
L-foot finning shall be limited to a maximum temperature of 150°C and shall be used only with the prior approval of the Buyer.

Supplier shall propose a suitable fin material and demonstrate in his proposal what additional precautions have been taken to control corrosion.

Discontinuous fin surfaces shall not be used. Welded tube to tubesheet joints shall not be used.
5.3.2 Tube Bundles and Headers

Tube bundles shall be constructed to minimize vibration and should be rigid and self-contained to enable them to be handled as a unit. They shall be provided with lifting lugs. The construction shall be such as to prevent sagging of tubes with consequent meshing and deformation of fins.

Bundles should be made up from straight tubes with a header at each end. Provisions shall be made for access to all tubes for cleaning and plugging. Plugs shall be of the gasket shoulder type, with hexagon heads and parallel shank long enough to completely fill the header threads.

No threaded part of the plug shall be allowed in contact with the process fluid where crevice corrosion is likely to occur. In such cases two part plugs with gasket compressor shall be used.

Unless otherwise specified cover plate type headers shall not be used. The design of the header box-plates shall be such as to avoid the possibility of deflection and distortion. For the mechanical design, all welds of the plates of the header boxes shall have full penetration butt welds. No fillet welds are allowed.

All welding on partition plates and stiffening plates shall be fully penetrated and continuous welded.

5.3.3 Header Nozzles

Header nozzles shall be designed for the maximum allowable loads stated in API Standard 661, Figure 8. Nozzles are plumb and level in any direction within 0.5°. The tolerance for nozzle location (measured at flange) is plus or minus 1.5 mm for elevation, 5° for orientation, and plus or minus 1.5 mm for projection.

All reinforcing pads shall be provided with 0.25" API tell-tale hole for inspection for internal leaks, and shall be filled with grease after testing. Pads are tested with air at 1.0 barg prior to post-weld heat treatment, if required, and final hydrostatic test. Reinforcing pad material shall be the same as the header material.

Each header shall be provided with a blinded vent and drain at the high and low points respectively.

Where severe crevice corrosion or erosion may occur, only butwelded connections shall be used.

5.3.4 Fans and Louvres

Supplier to determine the number of bays; each with at least two fans. All fans shall have manually adjustable blade pitch.

Each fan shall be arranged for independent operation, unless otherwise specified on the data sheets. The fans shall be balanced both statically and dynamically. Fan assemblies shall be designed for remote lubrication.

The maximum speed at the tip of the fans shall not exceed 45 m/s. Overall noise limitation at a distance of one metre for the complete unit shall be 85 dBA (SPL).
The fans shall be electric motor driven through a V-belt speed reduction mechanism. V-belts shall be anti-static and multiple belts are to be supplied in matched sets. The belts should be adjustable without the need to remove the V-belt guard completely. The guard may be hinged in sections to permit easy access to the belts. The selection of V-belt sizes shall ensure that the number of different sizes of belts is kept to a minimum. Pulley wheels shall be of a duplex stainless steel. Aluminium is not acceptable.

Electric motors and speed reduction shall not be installed in the hot air stream from the coolers.

Each motor fan assembly shall have a re-settable vibration switch, make Murphy or Robert Shaw, comprising a double pole, double throw switch inside a certified explosion proof enclosure, interfacing with Buyer’s ESD System. The optimum location of the switch is the responsibility of the Supplier. Location of vibration switches shall give good accessibility for Buyer’s cable connections and shall allow resetting of the vibration switches without disassembly of any part of the cooler. Supplier shall state vibration levels at which the vibration switch shall operate, and the vibration level above which reset should not be operable.

The gas outlet temperature is controlled by controlling the speed of the fans by means of VSD drive. During low ambient temperature conditions one of the fans may be switched off.

Supplementary control in the form of manually controlled, pneumatically actuated adjustable louvres shall be applied, 2 sections for each bay.

Due attention should be paid to sizing of the louvre actuator with regard to fouling/corrosion of the louvre mechanism; consequently a well sized actuator and louver hinges made from SS 316 and Teflon are required. (see referenced drawing on datasheet).

5.3.5 Electric Motors

Electric motors shall be make LOHER. Motor for use in hazardous areas shall be EEXd for winding part and EEXe for connection part.

All motors shall be suitable for VSD drive (VSD drive by others).

Connection boxes shall be supplied complete with gland according to Buyer’s specification 610.

Unless otherwise specified, motors over 20 kW shall be provided with space heaters (230V AC, 50 Hz), motors below 20 kW subject to Supplier’s recommendation. Space heaters shall be connected to a dedicated auxiliary terminal box, and shall be engraved as follows:

"ISOLATE HEAT SUPPLY BEFORE REMOVING COVER"

Enclosure degree of protection of motors shall be in accordance with Buyer’s specification 610. Winding insulation shall be class F with class B temperature rise.

Motors shall be sized for cold start up under the worst ambient conditions and without process medium in the tube bundle.

The motor shall be hung under the cooler structure; Supplier shall fully describe the method for removal, and specific attention is drawn to the need for adequate weather (rain water) protection of exposed motors, particularly at shaft end.
5.3.6 Instrumentation:

All instruments shall be certified for use in hazardous area zone 2, IIA, T3.

5.3.7 Cabling, Wiring and Installation:

All instrumentation- and electrical cabling/wiring shall be routed to separate terminal boxes at skid edge, except for the cabling/wiring to the e-motors, which shall be routed directly to the motors’ termination boxes. See Buyer’s specification 610.

5.3.8 Plenum chambers, Supporting, Stairways, Platforms, Ladders, and Drain pans

Supplier shall provide plenum chambers, and a rigid steel structure for supporting the equipment. Each fan shall be separately partitioned. Supplier’s proposal shall clearly define stairways, ladders and platforms included in his proposal. The platform width shall not be less than 840 mm. The flooring for the platforms shall be of the open grid type, unless agreed otherwise. Platforms shall be provided for access to each header, each louvre-actuator and mechanism (if any) and for the lubrication of all bearings. Supplier shall provide a drainpan under the header nozzles and under header plugs (both sides) to prevent any leakage (during production or during maintenance/inspection) from these items.

5.3.9 Loadings

Tow-out loadings shall be considered in the design of the exchangers, which shall be designed to withstand forces of +/- 1.0 g at any time in any direction unless otherwise stated on the data sheet.

5.3.10 Nameplates, tags and marking

In addition to the required Pressure Equipment Directive nameplate, a SS 316 nameplate, 3 mm thick, shall be provided with the following minimum information:

- Buyer’s equipment title, Purchase Order number and tagnumber
- Fabrication serial number and year built
- Design Code
- The maximum allowable working pressure, barg.
- The maximum allowable working temperature, °C.
- Shop test pressure, barg
- The effective extended surface, m²
- Tube diameter and material grade
- Weights (kg) empty and operating
- Number of fans
- Total installed power, kW.
- PWHT (Post Weld Heat Treatment), (if any is required).

The SS 316 nameplate bracket shall be provided by Supplier and welded to the equipment. The nameplate shall be securely fixed to this bracket using screws or rivets. Permanent nameplates shall also be provided identifying each instrument in accordance with IEC regulations.
Electrical and Instrumentation
Labels, marking and identification shall be as per Buyer’s specification 610.

The Supplier shall ensure that all identification and marking corresponds to the drawings. Where no identification or markings appear on the drawings, as-built drawings showing identification and markings must be supplied.

5.3.11 Padeye Design and Lay Out

For the purpose of the cooler design the following load criteria shall be used:

**Transportation**
Unless specified otherwise the equipment connections to the cooler, the skid cooler structure and tie down points shall be designed for a one (1) G lateral load in any direction in conjunction with 1.25 times the dead load. A load factor of 1.00 shall be used.

**Static Loads**
The load should include skid dead load, all equipment piping and supports, piping reactions and liquid loads. For calculation a load factor of 1.10 should be applied to all loads.

**Dynamic**
All rotating equipment package components should be designed such that the natural frequency of the assembly of sub components is 50% less or 150% more than the equipment operating frequency-range.

The complete, fully assembled unit shall be suitable for onshore single point lifting by padeyes / lifting lugs without the danger of unacceptable deformation.

For installation purpose the cooler shall be dismountable into parts with a maximum weight of 12 mT. Each item shall be designed for an offshore single point lift. Additional required lifting aids if required (padeyes, spreader-bar, etc.) shall be included.

Each item shall be designed with padeyes for lifting using the following criteria:

- Calculated weight contingency factor: 1.1
- Impact factor for lifting: 2.0
- A 25-75 % split on the lifting loads should be applied to the 2 diagonals of a 4-sling single point lift.

Lifting lugs shall be positioned for a balanced lift. Design and calculation of the lifting lugs shall be submitted for approval. The lifting lugs shall be subjected to an individual load test of twice the calculated load. On completion of the load test all welds shall be subject to 100 % MPI testing.

Further reference is made to Buyer’s structural specification 201.

5.3.12 Design Life

The equipment shall be of proven design of a high reliability and a design life of 20 years. The design fatigue life shall be 50 years (safety factor = 2.5)
5.4 PLATFORM UTILITIES

Electrical Power

AC:
400/230 V AC, 3-phase and neutral, ¾ wire, 50 Hz, solidly earthed neutral, IE “TN-S” in accordance with IEC 364-3, for equipment like driver e-motors, heaters, etc.

230 V AC, 1-phase, neutral and earth, 2/3 wire, 50 Hz, solidly earthed neutral, IE “TN-S” in accordance with IEC 364-3, for equipment like heat tracing, burner management system, control circuit, etc.

DC:
24V DC (not earthed), for Local Control Panel, controls, instrumentation, monitoring system.

5.4.1 Work Air

Instrument Air:
Temperature: 5 to 50 °C
Normal pressure: 7 to 8.5 barg
Minimum: 6 barg
Maximum: 10 barg
6.0 FABRICATION REQUIREMENTS

All fabrication and welding to pressure containing parts shall be in accordance with Buyer’s Specification 502.

A “weld plan” shall be prepared for each item which will include an outline drawing which identifies all welds envisaged related to the relevant welding Procedure No., parent material group and thickness. All pressure containing parts shall have full penetration welds.

Tube to tubesheet joints shall be expanded and are subject to Certifying Authority (NoBo) approval.

Welding procedures shall be confined to Manual Metallic Arc and Tungsten Inert Gas unless otherwise approved by Certifying Authority and the Buyer.

All weld on pressure parts shall be 100% X-Ray include Nozzle to shell weld.

6.1 FABRICATION AND WELDING OF STRUCTURE

All fabrication and welding to non-pressure containing parts shall be in accordance with Buyer’s specification 201.

Fabrication will be according to the Pressure Equipment Directive 2014/68/EU, but as a minimum according to Stoomwezen regulations (RTOD) or NEN-EN-13480-1 thru 5.

Weld Inspection:
All welds shall be visually inspected after completion. Throat thickness of all fillet welds shall be dimensionally checked.
Regardless of code requirements, a minimum of one spot radiograph shall be applied to each header or nozzle butt weld.
All welds shall be visually inspected after completion.
Throat thickness of all fillet welds shall be dimensionally checked.
Regardless of code requirements, a minimum of one spot radiograph shall be applied to each header or nozzle butt weld.

For plate-wall thickness >50 mm also Ultrasonic examination (in accordance with Stoomwezen and/or NEN-EN-13480) is required.

6.2 MATERIALS, WORKMANSHIP AND SUITABILITY

All materials and parts included in the construction of the Heat Exchangers shall be new, unused and of the highest grade, being free from all defects or imperfections likely to affect their performance.
7.0 MATERIALS

7.1 GENERAL

Materials shall be as per Pressure Equipment Directive 2014/68/EU requirements and as indicated on the individual data sheet. Material certificates shall be supplied for all materials showing all test results required by the relevant material specification and Unfired Pressure Vessels requirements and referenced standards.

All aluminium parts shall be Marine Grade.
Fan blades shall be marine grade aluminium or GRP.
Unless otherwise approved, fan hubs shall be constructed of mild steel epoxy coated.

7.2 BOLTING

Bolts and nuts shall be furnished by the Supplier for all cover plates, blind flanges and bolted attachments supplied with the exchangers. Bolts and nuts shall be new.

Bolting for pressure containing parts shall be in accordance with specifications 503 and 524.

Bolting in structural and supporting steel shall be in accordance with Specification 201.

7.3 FLANGES

Unless stated otherwise on the data sheet the flange material shall be of a similar quality to the appropriate exchanger part including impact properties.

7.4 GASKETS

Gaskets for access plugs shall be annealed solid metal of the same material as the plug.
No asbestos containing materials shall be used.
8.0 INSPECTION, TESTING AND CERTIFICATION

8.1 INSPECTION

A pre-inspection meeting will be initiated as required by the assigned inspector. The specification, inspection, testing and packing requirements will be reviewed with Supplier’s manufacturing and quality control personnel.

All inspection and testing shall be conducted and interpreted by qualified persons using proven techniques and equipment and in strict accordance with the code and its appendices.

Supplier shall give at least 2 (two) weeks notice to Buyer prior to inspections, tests and any other hold points so that Buyer can arrange for attendance.

During inspection/testing it shall be the Supplier’s responsibility to provide suitable protection and safeguards against damage. Testing tools, equipment and facilities shall be made available by the Supplier.

The approval of the work by the Buyer’s inspector and subsequent release of the exchangers for shipment shall in no way relieve the Supplier from the responsibility for carrying out all of the provisions of this specification and/or the fulfilment of code requirements and the Certifying Authority. Any defects/malfunctions of the equipment/systems shall be rectified and re-inspected/tested, at the Supplier’s expense. Evidence will be required that such faults have been rectified in a satisfactory manner, the Buyer will then decide whether the testing may be continued or tests are to be repeated.

Materials:
Inspection, Testing and Certification, procedures and acceptance criteria of materials shall comply with the requirements of:

- This document
- The Certifying Authority (NoBo)
- PED (Pressure Equipment Directive 2014/68/EU)

8.2 TESTING

The Supplier shall submit the proposed test procedures to the Buyer, as per SDR prior to the commencement of the tests. Testing shall be performed in accordance with the approved test procedures, submitted by the Supplier for review.

Test procedures shall include:

- The relevant specifications.
- Provisions for assuring that the prerequisites for a given test have been met.
- Description of test to be carried out.
- List of calibrated instrumentation and test equipment will be used.
- Acceptance criteria.
The complete cooler will be tested for functionality at the Supplier’s shop after erection.

The equipment/systems supplied shall be tested and accepted in two stages:
- Factory Acceptance Test (FAT).
- Issue of final certificate.

**Factory Acceptance Test (FAT)**
Prior to the FAT, the equipment/systems shall have been completely tested by the Supplier as follows:
- All piping and tubing shall have been adequately tested for leaks.
- All electrical circuits shall have been actuated to check their function.
- All nameplates shall have been checked for correct spelling and size of letters.

The Supplier shall perform all other tests as required to present the equipment/systems in first class operating condition.
A FAT shall consist of, as a minimum, a full function test of the equipment/system. Before shipment to the fabrication site, satisfactory functioning and performance of the system, must be demonstrated to the satisfaction of the Buyer.

**Hydrostatic (Pressure) Testing:**
All pressure retaining equipment and parts (i.e. tubes, headers, etc.) shall be hydrostatically pressure tested, performed by Supplier in accordance with the applicable requirements.
The hydrostatic test pressure shall be maintained for at least 30 minutes.
Standard type gaskets, relating to flange facing, shall be used.
A suitable rust inhibitor and wetting agent shall be added to the test water.
Tell-tale holes in reinforcing pads, if any, shall be left open after testing.

In case of stainless steel materials:
- Test water: fresh water
- Maximum allowable chloride content: 30 ppm.

After hydrostatic pressure testing the equipment shall be carefully rinsed with chloride free water and dried immediately. Drying shall consist of wiping dry or air-drying the inaccessible areas. General hot air drying is not required.

Hydrostatic pressure test certificates shall be provided.

**Functional Testing**
Supplier shall supply test procedure(s) for functional testing of the complete equipment/systems over their full functional ranges.
Test procedure(s) shall be established to demonstrate that the equipment/systems and all associated components will function satisfactorily in service.
The test programme shall ensure that all the testing required is identified, performed and documented.
Instrument/electrical full function tests will be required at Supplier’s works as far as practically possible, given the nature of the equipment.
The equipment/systems shall be functionally tested in accordance with the approved test procedures.
Testing shall consist of the Supplier’s routine tests and shall generally comply with the instrument and electrical packaged equipment requirement specifications.
Functional testing of each instrument shall be performed at the Supplier’s works and certificates obtained.
The complete equipment/systems shall be given an integrity of circuit test at the Supplier’s works.

The Supplier shall operate the equipment for a sufficient period of time to verify the mechanical operability of the systems, but not less than 4 hours.
Functional test result report with figures and certificates shall be provided by the Supplier.

8.3 CERTIFICATION

Certification and documentation shall be in accordance with PED category IV, module G.
With regard to witnessed tests Supplier shall prepare a report on these tests and the results of these tests. These reports shall be included in the “Data Books”. All Data Books produced shall be complete and copies submitted to Buyer for review not later than 2 weeks after the date of completion of the tests.

All certified documents shall have approvals of:

- Certifying Authority
- Supplier / manufacturer
- Company

All certificates are to be available for counter signature by the Certification Authority. ATEX classification certificates for all equipment to be certified shall be submitted with drawings for approval.
Type test certificates for electric motor shall be provided.
For all EEX materials Supplier shall furnish a certificate from an official laboratory accepted by the certifying authority, indicating suitability for use in the specified hazardous area.

Material certification requirements:

- Components subjected to the Pressure Equipment Directive 2014/68/EU rules shall comply with these, but as a minimum to Stoomwezen Rules and/or NEN-EN-13480.
- All other components (support structures and stiffening’s) shall be certified in accordance with NEN-EN 10204 2.2 as a minimum.

Supplier shall store in good order all certificates, fully catalogued and indexed NDT test records, mechanical test certificates, welding qualification certificates, material certificates and hydrostatic-, performance- and functional test certificates for a minimum of 10 years, or as stated in the PED requirements, after acceptance by certifying authority.
Copies of all certificates shall be included in the “Data Books”.
9.0 PAINTING AND PREPARATION FOR SHIPMENT

Where painting is specified for the exchanger, nozzles shall be painted on the flange edges, inside bolt-holes, and up to the gasket surface. Painting, protective coatings and the procedures for the preparation of surfaces shall be as specified in the general painting and coating specification; Buyer’s specification 525. Bolted support structure shall be hot-dipped galvanised as per Buyer’s Specification 525. Stainless steel shall be pickled and passivated.

The Supplier shall stencil in a prominent position in 50 mm high characters the dry lifting weight of the heat exchanger and (if required) for stress relieved components the words “NO WELDING PERMITTED”.

All machined surfaces and threaded connections shall be protected by coating with rust preventative.

Flanged openings shall be protected with rubber lined steel plate cover attached by proper bolting or strapping and sealed with a plastic compound. Screwed connections shall be protected with threaded forged steel plugs.

Header plugs, drain-/vent blinds etc., shall be installed “as final”. Bolting shall be torqued as per Buyer’s specification 502.

When shipped loose, motors, transmissions, guards, blades, etc. shall be tagged with the item number and purchase order number to facilitate match up with the appropriate package in the field. Tags and wire shall be stainless steel. All such items shall be suitably boxed and securely attached to the package.

Start up spare parts will be delivered with the packages and identified separately. Spare parts shall be separately packaged according to their category (start-up and commissioning) and correctly labelled.

Each package shall contain lists of contents one inside and one outside the package. The package shall have external identification corresponding to the order number. All loose items shipped with the equipment shall be tagged with order number and item identification. Each item of equipment shall be checked for its suitability to resist a horizontal force of 1g in any direction. Where equipment is not adequate, then brackets for attaching sea fastenings shall be provided by the Supplier.

Any special equipment (spreader beams and/or other handling devices) shall be enclosed for use during site handling and installation activities. Supplier shall provide lifting and installation procedures.

Centres of Gravity of the packages.

All equipment shall be packed in robust packages and be provided with adequate and safe lifting and handling facilities. The Supplier shall stencil in a prominent position in 50 mm high characters the dry lifting weight of each package and indicate the centre of gravity.