Base Load Power Hub (BLPH)

INSTRUCTION OPERATING MANUAL
H2 STORAGE VESSEL
V-25001 A÷F

Document Number: 1723001756-MAC-MAN-00019

Document Class: 3

ROSETTI MARINO

1	NO COMMENTS - APPROVED - WORK MAY PROCEED
2	MINOR COMMENTS - REVISE AND RESUBMIT - WORK MAY PROCEED
3	MAJOR COMMENTS – REJECTED – DO NOT PROCEED
4	APPROVAL NOT REQUIRED

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Sign	Date
	10-07-2024

1	25/06/2024	Issue for Information (IFI)	M. Toniolo	D. Passerini	D. Passerini
0	26/04/2024	Issue for Information (IFI)	M. Toniolo	D. Passerini	D. Passerini
Rev.	Date	Description	Prepared	Reviewed	Approved

B&R BREMBANA&ROLLE

Revision / Change Log

Rev.	Description
0	Issue for Information (IFI)
1	Issue for Information (IFI)

HOLD LIST

No.	Description
1	
2	
3	
4	

CLIENT:	**ROSETTI MARINO**
PURCHASE ORDER No.:	**1723001756 123A90A**
END USER:	**CROSSWIND**
ENGINEERING	**ROSETTI MARINO**
PROJECT:	**BLPH PLATFORM**
SITE:	**HOLLANDSE KUST NOORD SITE V**
ITEM:	**V-25001 A÷F**
EQUIPMENT TYPE:	**HORIZONTAL EQUIPMENT**
SERVICE:	**H2 STORAGE VESSEL**
MANUFACTURER	**BREMBANA & ROLLE S.p.A.**
JOB NOMBER:	**23096**
SERIAL NUMBER	**23096-01-SNA÷SNF**

REV.	DESCRIPTION	DATE	ORIGINATOR [Project Eng.]	CHECK [Project Eng.]	APPROVAL [Engineering Mgr.]
1	Issued for APPROVAL	14/06/2024	M. Toniolo	M. Toniolo	D. PASSERINI
0	Issued for APPROVAL	15/04/2024	M. Toniolo	M. Toniolo	D. PASSERINI

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FOREWORD

SCOPE

This manual covers the minimum requirements for handling, installation, operation and maintenance of pressure equipment manufactured by Brembana&Rolle.

This manual is divided in two sections: the first section deals with the general instructions for all types of equipment, the second section gives guidelines for specific type of pressure equipment, manufactured by Brembana&Rolle listed here below:

- Horizontal Equipment

In some cases, it is not possible to identify the equipment in only one of the above mentioned category; in this case User/Contractor shall take into consideration instruction of all the categories that characterise the equipment.

REFERENCE DOCUMENTS

All activities and operations in the scope of this manual shall be done strictly in accordance, with the following documents:

- General Arrangement drawings:
  B&R ref.: 23096-01-EGA1 (Client Doc. no. 1723001756-MAC-DA-00004)
- Shipping drawings:
  B&R ref. 23096-01-ESH1 (Client Doc. no. 1723001756-TI-DD-00021)
- Mechanical calculations and nozzle loading calculations:
  B&R ref. 23096-01-EMC1 (Client Doc. no. 1723001756-MAC-CAL-00003)
- Bolt tightening procedure: PART OF THIS DOCUMENT
- TECHNICAL SPECIFICATION 123A90-DDL-MAC-SP-50026_01

Any conflict discovered among the above mentioned documents shall be brought to the attention of B&R and solved before proceeding with the works. Other specific documents may be issued by B&R whenever required by special applications of the pressure equipment; they will be pointed out to the attention of the involved personnel by means of notes on the General Arrangement drawings.

SECTION 1

GENERAL INSTRUCTIONS

The employed personnel shall be of proved experience and skill about activities of pressure equipment operation, handling and movement. Works shall be executed according to the documents mentioned in the foreword.

Tools and materials used during field operation are not supplied by B&R excluding those indicated on the General Arrangement drawing and its attachments or those specifically requested by the Contractor during the negotiation and the design phase (thus are excluded all the tools necessary to undress the equipment of the ancillaries and appurtenances used during the transport and stocking time till the start-up of the equipment).

The equipment shall be installed and put in service in accordance with applicable requirements of the State or the Local Authorities, and with applicable regulations.

The equipment are designed for the combination of the maximum pressure and the maximum temperature indicated on the nameplate as design data. In any case this combination shall not be exceeded, except for special services (e.g. steam-out, dry-out) agreed between Manufacturer and Contractor and that are indicated on the design data of the GA drawing.

Design pressure for which equipment have been designed is considered to be the maximum allowed. Contractor and User shall include in this value all possible contribute of pressure.

The tags of the equipment covered by this procedure are the following:

ITEM	SERVICE
V25001 A÷F ①	HYDROGEN STORAGE VESSEL

1 PROTECTION FOR TRANSPORT, STORAGE, HANDLING

1.1 PREPARATION OF ITEMS FOR SHIPPING

The items shall be internally and externally cleaned, in manner to remove weld spatters, scales, rust, cuts, filings and any other foreign material. For SS, clad, alloy lined steels, stainless steel brushes shall be used on alloy. Solvents shall be free of chlorides.

After hydrostatic test the water shall be completely drained from the item and then the pressure vessel shall be wiped and blown dry. For stainless steel units, air temperature is limited to 50 °C.
The item shall be externally coated, following surface preparation and coating cycles in full adherence to the applicable painting data-sheets and specification.

The machined surfaces that do not require painting (such as gasket contact surface of flanges not closed with process blind flanges) shall be cleaned and coated with a rust preventive such as grease or peeling product (i.e. Tectyl 846 or similar/equivalent product approved), before closing. All openings shall be made watertight against external atmosphere.

All flanged connections which are not furnished with permanent blinds shall be covered with rubber gaskets 3 mm thick and 6 mm minimum thick, full diameter, steel plate covers. The covers shall be installed with at least 4 bolts (except for the items with nitrogen blanket which require all the openings are closed with full bolting covers and marked with appropriate tag). Flanges drilled for bolting larger than 3/4" diameter may be secured with 3/4" diameter bolts and suitable cut washers. Flanged openings shall be covered with taped heavy plastic sheet. Tape containing chlorides shall not be used on stainless steel.
Bolts thread of pressure retaining bolts, if not otherwise protected, shall be coated with molybdenum disulphide based anti-seizing lubricant.

The items included in the supply shall be conditioned for shipping in accordance with the table below.

ITEM	NITROGEN internal overpressure ≥ 0.3 bar g	SILICA GEL
V25001 A÷F ①	☒	☐

Threaded vent holes shall be protected by a suitable plugging, at least by silicone application or heavy grease.
Pieces or parts used for protection or reinforcement purposes must not be welded to the equipment.
Surface areas of the item which may come in contact with the slings shall be covered with rubber strips or similar to prevent any type of damages during lifting operation.
All internals shall be shipped installed securely in place.

1.2 SPARE PARTS

Spare parts like gaskets, stud bolt, special tools shall be separately boxed for each mean item. The spares shall be labelled with the equipment item number and cross reference to the relevant drawing.

The box for spare shall be wrapped in waxed paper, the internal protection of box shall be water-proof lined paper and suitable for handling by forks.

1.3 INSPECTION BEFORE SHIPPING

All items shall be inspected before shipping, to verify draining, drying, cleaning, blasting and coating quality.

All spare parts boxes shall be inspected for quantity, quality and suitability of package.

Only after satisfactory result of all packing and marking requirements set forth in this procedure, the items shall be released for shipping.

1.4 CERTIFICATION BEFORE SHIPPING

At least, the sandblasting and coating inspection certificates shall be inserted in the Data Book.

1.5 INSPECTION AFTER SHIPPING

The equipment must be submitted to a scheduled visual inspection to check the integrity of the surface coating and to insure that nitrogen pressure (if any) does not decrease below the minimum requirement. Specifically, the pressure target value of 0.3 barg shall be checked and restored anytime the internal pressure is found lower; a touch-up of surface coating only is requested in case of local defect are observed.

The timing of this visual check must be as much frequent as possible at the beginning of the shipping and storage period and can be progressively reduced based on the positive result of the inspection; namely from 7 days up to once a month.

With continuing positive inspection results, sudden failure will not be expected. This justifies for enlarged timing between two subsequent visual checks. Nevertheless, care shall be paid to the accessibility at the equipment by unauthorized people, as this may be cause for voluntary or not damaging actions. (i.e. recovery of blind flanges, studs and nuts, etc. is not uncommon in an extended site area where different Companies are operating).

1.6 TRANSPORT AND STORAGE

It is assumed that the storage of the equipment at site will take place in a covered area, since weather conditions are expected to be the most probable cause of degradation of the protection foreseen on outer surfaces.

The equipment are protected for the transport and storage prior to erection as necessary against physical damage and/or corrosion which may occur due to the method and conditions of transport and the time which may elapse before erection, up to maximum of three months. For longer storage periods, protection shall be restored by the User at site, with particular attention to the protection of machined surfaces and the compatibility (e.g. against corrosion) of any material used for physical protection.

In case the items are covered with tarpaulin, insure that there is no direct contact between the equipment surface and the covering sheets and, better, a sufficient light is granted in order to let air circulate freely around the equipment.
This, especially in the high humidity areas (sea, tropical, etc.), where the change of air saturated conditions during the 24 day hours easily drive to the formation of water condense on surfaces where no air refreshing is granted, will prevent the condense to form and persist between the equipment and the tarpaulin, promoting a quicker paint degradation.

1.7 HANDLING

Handling must be executed by means of proper devices. Before lifting the equipment, centre of gravity and weight shall be checked on the name plate or on the reference documentation to select the proper lifting tools to be adopted (e.g. chains, slings, shackles).

During loading and unloading operations lifting points (trunnions, lugs, painted lifting points on apparatus) shall be used in order to avoid the possibility of distortion of the equipment and any of its parts. It is strictly forbidden to lift or to move the equipment by fastening others braces like nozzles or supports without written permission of the manufacturer. Any damage must be immediately notified to Brembana&Rolle.

Manoeuvring of horizontal equipment, supported by two saddles, shall be carried out by means of lifting bands surrounding the vessel body and straddling the centre of gravity. Where different lifting point are not indicated on the reference documentation, lifting band shall be located closer as possible outward the saddle position to avoid any sliding between band and the equipment.

2 INSTALLATION

All the ancillaries, as listed below, used during the transport operation and the storage period shall be removed from the equipment; where possible after the apparatus has been put in the proper location for service:

- Wooden saddles or supports
- Any external protection such as polyethylene sheets
- Shipping blind flanges, gaskets and bolts
- Internal protection by use of silica gel bags or nitrogen filling with annexed bottle
- Special paint for protection of face and external edge of flanges

Integrity of the nameplate must be checked and all the information must be well readable. The good condition of the equipment shall be checked and particular attention shall be paid to ensure that no damages occurred during transport and handling.

Operating position of the equipment is indicated on the reference document. Equipment must always be installed by the supports forecast on the vessels and it is not allowed to support / hang equipment by means of external piping.

A visual examination shall be executed according to the same procedure as per maintenance activities as detailed in 1.4. Special care must be paid to avoid to leave tools inside the equipment.

Before the equipment is installed and connected to the piping, an internal inspection of the equipment is mandatory, to establish whether or not a general flushing and/or suitable chemical cleaning is required, wherever not already scheduled prior to plant start-up. Special care must be paid to avoid tools are left inside the apparatus.

2.1 FOUNDATION

Supports shall be set upon the foundation and secured down with bolts where the bases are properly drilled. Foundations shall be adequate to support the equipment and its maximum capacity. Only the type of equipment support (saddles, brackets, lugs, legs, etc.) shown in the general arrangement drawing must be used to transmit loads to foundations. Each hole in the base plates must have its own foundation bolt. If not indicated on the drawing, the material for anchorage bolts shall be at least Class 8.8, and bolt diameter shall be not smaller than the hole diameter minus 3 (three) mm.

2.2 INSULATION

Insulation shall be applied as per Contractor requirements: in case not even insulation for personnel protection is foreseen, but operating temperature might make the contact or closeness harmful to health, clear warnings shall be put close to the apparatus location to workers.

2.3 ACCESS, OPENINGS AND CLEARANCE

The equipment shall be installed with sufficient clearance from associated structures and other apparatuses to provide safe (for dangerous service to human health and environment equipment shall be located in isolated site), efficient working by operators and to provide ready access for cleaning, inspections and maintenance.

Equipment having covers that permit inspection of the interior shall be installed so that these openings are easily accessible.

All fast-openings shall be equipped with adequate instrumentation to avoid that accidentally they can be opened even-if a differential pressure exists between inside of the vessel and room condition.
Where necessary, ladders and platforms shall be installed to give access to valves and other control device.

Safety devices, and important equipment fittings, shall be located and installed so that they are readily accessible for operation, inspection, maintenance and removal.

Process piping shall be connected to the equipment with proper gaskets. Piping development shall be designed to avoid any nozzle loading other than specified in the reference documents.

2.4 REMOVABLE PARTS

Removable parts such as demister, trays, stairs, platform, etc… shall be securely fixed. To avoid that during service they can accidentally move a tack weld between nuts and screw shall be performed. If it is not possible to weld an unscrew device shall be used.

2.5 PRESSURE RELIEVING DEVICES, PRESSURE AND TEMPERATURE GAUGES

Before the equipment is put in service adequate devices to ensure that design parameters are not exceeded shall be installed, directly on the equipment connected to the service nozzles, where requested by the Contractor, or on the connecting pipe-line. These devices (e.g. pressure and temperature gauges, chemical cleaning nozzles, pressure relieving devices: valves, bursting disk) even they are or not part of the scope of supply of the manufacturer shall be selected by the Contractor.

2.6 FIRE PROOFING AND EXTINGUISHER

Where indicated by the Contractor fire proofing shall be installed to prevent the structures and an excessive overheating of the fluid up to the flash point at the operating pressure. In any case is responsibility of the User to define which devices and facilities shall be installed in the plant to prevent fire.

2.7 EARTHING LUG

Equipment earthing lug shall be connected to the ground with electric cable or strip with adequate size according to User instructions.

2.8 FIRE IGNITION SOURCE

The User will provide devices and facilities in order to avoid fire ignition source as settled in the Risk Analysis.

3 OPERATION

As a statement all general instructions shall be observed. The equipment shall not be put in service for conditions other than for which it has been designed.

Any change of the operating condition (not limited to pressure and temperature) will involve a redesign of the equipment: Contractor shall check if the stated corrosion allowance and used material are still compatible with eventual new fluid and the expected life, taking into account the possible corrosion rate already consumed. A new mechanical design will be performed by the manufacturer upon Contractor's request, otherwise Manufacturer is not responsible anymore for all consequences due to change of the design condition.

It is strictly forbidden to open any closure, joints or other parts during operating. During operation only authorised personnel can stand near the equipment and only after having followed all the safety procedure instruction of the plant under the User's responsibility.

3.1 START-UP & SHUT-DOWN

Start-up of the equipment shall be executed gradually. At least at half of the operating pressure a step-check shall confirm the evidence of no deformation or damage and no leaking from connection. Particular care shall be taken for all components that have no possibility to deform freely. Pressure, temperature and eventual noises shall be checked.

4 MAINTENANCE & INSPECTION

As a general statement Contractor and User shall define an inspection schedule taking into account:

- field activities
- experience about the used material
- experience about the media in conjunction with the corrosion allowance that has been asked the manufacturer to take into account in the design
- environment around the field

For missing information due to process, Contractor and User shall acknowledge themselves referring to technical literature or standard. In any case the inspection schedule shall observe, as a minimum, all the requirements of the legislation in force in the Country where the equipment is put in service.

If the inspection schedule is not defined and inspection activities are not carried out and adequately recorded, the Manufacturer's responsibility is broken off. Inspection shall be carried out at least once a year. Not scheduled inspections shall be executed for reduced performance or odd noises.

Inspection may be external or internal and can be executed by mean of several non-destructive examination methods. The inspection method may be performed when the equipment is operating on-stream or depressurised, but shall provide the necessary information that the essential sections of the equipment are of a condition to continue to operate for the expected time interval. On-stream inspection, included while under pressure, may be used to satisfy inspection requirements provided the accuracy of the method can be demonstrated, and in any case shall be executed under User's responsibility.

Inspection of environment in which the equipment operates includes:
external painting or coating in order to establish if there is any possibility further ambient corrosion
good condition of instruments and safety equipment
tight of foundation bolts

All inspection activities shall be executed with care about the safety of the involved personnel and the environment under the User of delegate society's responsibility.

4.1 EXTERNAL INSPECTION

The purpose of an external inspection is to provide information regarding the overall condition of the pressure vessel. In particular:

Insulation or other covering
If it is found that external coverings such as insulation and corrosion resistant linings are in good condition and there is no reason to suspect any unsafe condition behind them, it is not necessary to remove them for inspection of the equipment. However, it may be advisable to remove small portions of the coverings in order to investigate their condition and the condition of the metal wall.

Evidence of leakage
Any leakage of gas, vapour or liquid shall be investigated. Leakage coming from behind insulation coverings, supports or evidence of past leakage shall be thoroughly investigated by removing any covering necessary until the source is established.

Structural attachments
The pressure equipment location shall be checked for adequate allowance for expansion and contraction, such as provided by slotted bolt holes or unobstructed saddle. Attachments such saddles or other supports shall be examined for distortion or cracks at welds.

Connections
Reinforcing plates (if any), nozzles or other connections should be examined for cracks, deformation or other defects. Bolts and nuts should be checked for corrosion or defects. Tell-tale holes in reinforcing plates shall remain open to provide visual evidence of leakage as well as to prevent pressure build up between the equipment and the reinforcing plate. Accessible flange faces shall be examined for distortion and to determine the condition of gasket-seating surfaces.

Cuts or Gouges
Cuts or gouges can cause high stress concentrations and decrease the wall thickness. Depending upon the extent of the defect, it may be necessary to repair the area by welding or patching. If these activities are be performed without Brembana&Rolle approval guarantee will be no longer in force.

Surface inspection
The surfaces of shell and heads shall be examined for possible cracks, blisters, bulges, and other evidence of deterioration, giving particular attention to support attachment and knuckle regions of the heads.

Welded joints
Welded joints and the adjacent heat affected zones shall be examined for cracks or other defects. Superficial NDE is recommended.

4.2 INTERNAL INSPECTION

The following activities shall be performed to support the inspection:
inspection plugs and covers shall be removed;
equipment shall be sufficiently cleaned to allow for visual inspection of internal and external surfaces;
equipment shall be reclaimed and internal atmosphere shall be tested to check the presence of dangerous and lethal gases.

A general visual inspection is the first step in making an internal inspection. All parts of the vessel shall be inspected for corrosion, erosion, blistering, deformation, cracking and laminations. In particular:

Connections
Threaded connections shall be inspected to ensure that an adequate number of threads are engaged. All openings leading to any external fittings or controls shall be examined as thoroughly as possible to ensure they are free from obstructions.

Closures
Any closures, which are used frequently in the operation of an equipment, shall be checked by the Inspector for adequacy and wear. A check shall also be made for cracks at areas of high stress concentration.

Corrosion
The type of corrosion (pitted or uniform), its location and any obvious data shall be established. Data collected for equipment in similar service will aid in locating and analysing corrosion in the equipment being inspected. The liquid level lines, the bottom and the shell area adjacent to and opposite inlet nozzles are often locations of most severe corrosion. Welded seams and nozzles and areas adjacent to welds are often subjected to accelerated corrosion.
Sacrificial anodes, where installed, shall be weighed/measured to evaluate the corrosion rate. If it is necessary, upon Contractor's instructions, they shall be substituted.

The above indicated inspections are not limiting to any eventual further control that the qualified personnel could by themselves carried out in order to establish the remaining life of the equipment.

4.3 INSPECTION INTERVALS FOR CORROSIVE SERVICE

New pressure equipment are placed in service to operate under their conditions for a period of time determined by the service conditions and corrosion rate. If the pressure equipment shall remain in operation over the expected time, the allowable conditions of service and length of time before the next inspection shall be based on the condition of the equipment as determined by the inspection.

5 RETIRING

All removable internal parts shall be removed to avoid that during handling they can move or fall outside of the pressure equipment during handling.
Before retiring, all chambers of the pressure equipment shall be washed, neutralised and drained. Washing water shall be treated before pouring in the pit to prevent any pollution to the environment.
Special care shall be paid to lifting points before removing the equipment, to ensure that they are not damaged. If lifting devices have been cut after the installation, the equipment shall be hoisted straddling the centre of gravity and in any case a design evaluation shall be performed to verify if the lifting points are sufficient strong.

S E C T I O N II

1 HORIZONTAL EQUIPMENT

Horizontal Equipment shall be lifted using their own lifting devices installed. Unless otherwise noted they must be kept in the operating position during handling activities.
A spreader-beam may ① be used to maintain vertical the direction of the slings connected.
① Refer to shipping drawing of the equipment.

S E C T I O N III

BOLT UP (FLANGE TIGHTENING SPECIFICATION)

1 TOOLS

None restriction is given for the use of tools from different trade mark other than the ones used in the manufacturer's shop. It is responsibility of the Owner to select different tools than those proposed in the following procedure. The Owner shall ensure that tools are used within the calibration expiring date.
Plant Operation manual shall include the tools to be used.

2 PRELIMINARY INSPECTION

The flange, the gaskets and the bolting (including nuts and washers) shall be inspected before to proceed

2.1 FLANGE

Main flange dimensions shall be checked acc.to the Manufacturer's drawings, i.e. internal and external diameters, bolt circle diameter, gasket seating diameter, number and size of the bolt holes. In case of blind threaded holes, inner threading shall be free of any defects, diameter and pitch shall be acc.to the drawings.
Gasket seating surface shall have the finish indicated in the Manufacturer's drawings.
The seating surface shall be free of scratches, dirt, scale and rust; in case of previous welding activities close to the bolted joint, the seating surface shall be free of any weld spatter. In case the joint is assembled after a previous operating period all traces of old gasket material shall be removed.
In case of defects in flange facing finish for raised face and large male and female flanges permissible imperfections can be evaluated acc.to TEMA Fig.F-4.
Depending upon the Purchaser's requirements and/or experience in shop/field flatness tolerance shall be checked on gasket seating surface acc.to API-660 §.9.8.
Flange holes shall be free of any defect and clean. Nut bearing surface shall be free of scores and burrs.

2.2 BOLTING

Bolting, nuts and washers materials shall be checked against the manufacturer's drawing. Care shall be taken if coated bolts or nuts are specified on the manufacturer's drawing: in this case shall be checked on the delivery note of the Bolts manufacturer that applied coating is the same than specified within manufacturer's drawings.
Bolting shall be checked to ensure that all dimensions are acc.to the Manufacturer's drawing: diameter, pitch and length. In case of necked down bolts, the unthreaded portion of the bolt shall have an evenly diameter shown in the Manufacturer's drawing, the length of threaded and unthreaded portion shall respect the construction drawing. In case of drilled bolts the inner bolt shall be checked too.
External surface of the bolts and nuts shall not be damaged and free of any rust and corrosion
If not otherwise forbidden (e.g. coated bolts) bolt threading shall be adequately lubricated. Molycote 1000 (e.g. or equivalent) is suggested if not otherwise stated (see notes on construction drawing prior to proceed); prior to apply the paste, maximum allowable temperature acc.to technical data sheet for the given grade shall be checked against the design pressure marked on the construction drawings.

2.3 GASKET

Gasket type and material shall be checked against the manufacturer's drawing.
Inner, outer sealing diameters and inner/outer stop devices stop devices diameters of the gasket shall comply with the dimensions shown on manufacturer's drawing.

2.4 TOOLS

Tools shall be inspected before to proceed, particular care for hoses of hydraulic and pneumatic devices to ensure the safety of the personnel.

3 INSTALLATION

With reference to the Manufacturer's drawing, check if centring devices, such as centring dowels or peripheral centring plates shall be installed.
If centring devices are not foreseen insert at least four bolts in the rest flange to facilitate the centring during the assembly of the joint. In case it is not possible assembly the joint after the insertion of the bolts (for instance hinged closure, without translation movement), bolts shall be installed later on.
In case of bolts equipped with collar bolts all the bolts shall be installed at this stage.
Place the gasket on the rest flange, if the plane gasket is in vertical position spray adhesive can be used to temporarily keep the gasket in position.
Close the flanged joint, taking care that male, female, recess and raising surface match each other's to avoid damage of edges.
As joint has been closed complete the insertion of the bolts, and tight slightly by hand all the bolts.
Depending upon the size of the bolts and Purchaser's requirements bolt can be tightened by torque the nuts or by tensioning the bolt. Purchaser requires that bolts up-to Ø50 mm shall be tightened by torque, bolts greater than Ø50 mm are recommended to be tightened by tensioning. Hydraulic bolt tensioner type used is Tentec or SPS (Hydraulic Tensioning Technology Ltd., Plymouth House, Guns Lane, West Bromwich, West Midlands B70 9HS, England).

4 TIGHTENING

Both for bolt torque or tensioning, tightening shall be performed with a rotating cross pattern sequence. Bolts position shall be marked on the flange rim with a crayon, the second bolt to be tightened shall be in diametric opposite position, i.e. given position 0° at the first bolt, and the second one shall be at 180°. The third bolt to be tightened shall be at 270°, the fourth bolt shall be at 90°. After completion of the this first sequence, tightening proceeds with groups of four bolts each time, and by starting with the bolt adjacent to the first bolt of the previous round moving in clockwise direction.
After final torque/tension is reached, tighten in rotational order in clockwise direction followed by a round in the counterclockwise direction.
If time permits, repeat rotational clockwise / counterclockwise rotations after a minimum dwell time of four hours.

4.1 BOLT TORQUING

For small size bolts hand wrench can be adopted. The wrench shall be set for the proper torque to be transferred to the bolts.
For greater sizes pneumatic or hydraulic wrench shall be used, in this case diagram provided by the tool suppler shall be read to establish the pump pressure correlated to the requested torque moment.
For detailed information and safety the reader is requested to refer to the user manual of the tools.
In any case is forbidden to use hammer wrenches.
Tightening may proceed with the general instruction provided below.

4.2 BOLT TENSIONING.

In order to use bolt tensioner faces of the nuts shall be provided with holes to engage the tommy bar necessary to rotate the nut. If nuts are not provided with holes, nut rotating socket shall be installed.
Bolt tensioning is requested for bolts equal or greater than Ø 50 mm.
The operator shall ensure that enough protrusion of the bolt is available beyond the nut face on the side to be tensioned. Particular attention shall be paid to bolts with collar: in this case first the bolts shall be tightened on the side of the flange facing the collar by hand and being sure that collar is in contact with the end of the socket, further tensioning will be performed on the opposite side, i.e. form the flange that does not face the of the collar.

The operator shall perform the tensioning of more than one bolt each time, as requested on the data sheet at the end of the procedure.
Bridge shall be installed on the bolt/s to be tensioned, paying attention that the bridge window is radially facing out from the center of the circular flanged joint. Load cells shall be fitted above the bridges, and screw the threaded insert on the end of the nut. Fully screw the insert in order to go to stop on the cells, make all the connection with hoses to the pump taking care that the allowable pressure is greater than the one requested to tension the bolts. This pressure shall be read on the diagram supplied by the tools supplier versus the requested maximum load as given in data sheet.
System shall be pressurized and by use of the tommy bar back down the nuts toward the joint face.
Check of bolts elongation shall be performed if requested by the Purchaser.

4.3 TIGHTENING DATA SHEET

TIGHTENING DATA SHEET

EQUIPMENT	PRESSURES		FLANGED JOINT		BOLT/NUTS				
ITEM TAG	DES. [barg]	TEST [barg]	TAG	SIZE	SIZE	MATERIALS	QT.	TORQUE VALUE	JACK LOAD
V25001 A÷F ①	40	57.2	M1/M1	24" 300# Manway	1 ½"	SA-193 B7 SA-194 2H	24	Max 2754 Nm	--
V25001 A÷F ①	40	57.2	3N	1" 300# Inspection	5/8"	SA-193 B7 SA-194 2H	4	Max 158 Nm	--

NOTES

1) Load values shall be achieved by cycles: 50%, 75% and 100% of the target value.
2) At least four bolts for each step shall be tensioned simultaneously.
3) Minimum Target values of tension load equal to test load plus 20% margin, if not already defined in the mechanical calculation .
4) Torque = k*D*F/1000 == > Nut factor k = 0.23.

TYPICAL BOLT SEQUENCE

