1 PURPOSE

The primary purpose of this procedure is to achieve the acceptable level of bolted flange joint integrity in the piping system & connection to equipment that have been identified & required tightening by bolt torque control. It is to be operated & carried out for effective and safe operation.

2 SCOPE

This procedure is applicable to all flanged connections in piping systems and connections to equipment regardless of sizes and classes identified and required tightening by bolt torque / tensioning controls at WASIT SKEC Package – 3 (Sulfur Recovery Unit – SRU), SAUDI ARABIA.

3 DEFINITIONS

Applied Load	The load which we applied by means of torque wrench.
Residual load	The load which remains after the torque tightening.
Tool Operating Pressure	The hydraulic pressure which we applied to hydraulic torque wrench.
Flange tightening Report	The report which we submit after the torque tightening.
Hydraulic Torque wrench	The hydraulic actuated ratchet design torque wrench with square drive and interchangeable castle wrench, which can operate up to maximum working pressure of 10000 psi (690bar).

4 REFERENCES

4.1 Saudi Aramco Reference

SAUDI ARAMCO ENGINEERING STANDARDS

SAES-L-100	Applicable Codes & standards for pressure piping Systems
SAES-L-109	Selection of pipe Flanges, Bolts and gaskets
SAES-L-350	Construction of plant piping
SAES-L-450	Construction of pipelines

SAUDI ARAMCO ENGINEERING PROCEDURES

SAEP-351 Bolted Flange Joint Assembly.

4.2 Industry Coded and Standards

American Petroleum Institute

AOI BULL 5A2 Bulletin on Thread Compounds for casing, Tubing and Line pipe

American Society of Mechanical Engineers

ASME B16.5	Pipe Flanges and Flanged Fittings NPS 1/2 through NPS 24
ASME B16.47	Large Diameter Steel Flanges NPS 26 through NPS 60
ASME B31.3	Process piping
ASME B31.4	Pipeline Transportation Systems for Liquid Hydrocarbons and other Liquids
ASME B31.8	Gas Transmission and Distribution piping Systems.
ASME PCC-1	Guidelines for pressure Boundary Bolted Flange Joint Assembly

Vendor Standard For Special Flange Size

Detailed customer specifications and manufacturers data sheet shall be referred. In case of any conflict between the documents, the customer specification will always prevail and control

5 RESPONSIBILITES

Bolting Supervisor / Foreman:

Ensure full compliance by all pre-commissioning foreman, pipe filters, and labour regarding the execution of the work in accordance with manufacturer's recommendations and CALEX (IMS) WAIST SKEC Project requirements and specifications. Confirm the availability of all materials, tools, equipment, and qualified personnel who will carry out the work. Ensure compliance by all labour & equipment operators and other associated craftsman in the execution of the requirements of this procedure, Project Quality Control procedures, relevant drawings, safety procedure and the CALEX (IMS) WAIST SKEC / ARAMCO project Specifications. Secure all necessary work permits.

Quality Control Inspector:

Conduct inspection in accordance with this procedure, Monitor daily bolt torquing and tensioning activities and verify strict compliance to CALEX (IMS) WAIST SKEC project requirements, specifications and manufacturer's recommendations. Prepare daily QC records and final acceptance documentation where ever required.

Safety Supervisor:

Check the work areas for any unsafe conditions. Ensure that all safety requirements have been adequately addressed and the work is carried out safely in accordance with CALEX (IMS) WAIST SKEC project safety procedures.

Process Engineer:

Prepare and submit Procedure for CALEX (IMS) WAIST SKEC Project review and approval. Provide technical support to site operation group. Provide latest revision of AFC (Approved for Construction) drawings, procedures, marked up drawings identifying flanges requiring bolt torque control, material specification standards and technical specifications. The process engineer shall be responsible for review of CALEX (IMS) WAIST SKEC Project drawings and data and the resolution of technical work.

6 OBJECTIVE

The objective of this document is to provide guidelines to ensure all bolted joints are leak Proof and fit for purpose through the following:

- Correct method
- Correct material
- Acceptable joint mating surfaces
- Proper joint alignment
- Appropriate new gaskets
- Acceptability of joint mating surface

7 QUALIFIED TECHNICIAN.

Torquing is a specialist skill. The nominated personnel for bolt Torquing & Tensioning will undergoes "**Hydraulic Torque Wrench Operating course**" from team Tentec, Manufacturers.

Summary qualified personnel together with the limits of their qualifications shall be maintained. Each Person shall carry and ID Badge which indicates the extent of his qualifications.

8 SAFETY

Due to the powered nature of tools, with large force generated from high pressure fluid/air and electricity strict safety procedure are following by Calex. For understanding the safety precautions Calex gives training to the operators in "**Hydraulic Torque Wrench operating course**". As also Calex will issue operation instructions and operation manuals to the technicians and Supervisors Personal shall wear basic PPE as per client's requirement when working in plant. The minimum requirements are:

1. Safety helmet
2. Safety boot
3. Safety glass
4. One piece coverall

Additional PPE must be provided depending on the nature of the job and hazards associated with it such as respirator, gas detector, chemical suit, airline, dust mask etc. Appendix II tabulates the counter measure for specific risk.

9 METHODS COVERED – BOLT TORQUING / TENSIONING

Torquing –Tightening flanged joints in which torsional loads are applied to the bolts causing the bolt to stretch, due to the relative movement between the nut threads. Ordinarily, the torque applied should not be outside of the 40-60% of minimum yield range.

Tensioning – Tightening flanged joints in which an axial force is applied to the bolts causing them to stretch, at which time the nut is snugged and the load is removed. Bolt tensioning is carried out using a hydraulic stud bolt tensioner.

10 EQUIPMENT

Standard Wrenches & Hydraulic operated torque wrench is used for doing the job. All the torque wrenches are operated either by air or electric and the maximum working pressure is 10000Psi /690 Bar. For low clearance job directly fit low profile tools are used. Calex has capability to do the job ranges from hexagonal nut size 27mm to 155 mm.

A REQUIRED TOOLS AND MATERIALS

- Standard Wrenches / Ring Spanners
- Manual Torque wrenches
- Hydraulic Torque Equipment (combination of air driven hydraulic pump, Sockets, threaded puller and hydraulic hoses
- Air compressor
- High pressure air hoses with whiplash arresters
- Bolts & Nuts / Permanent gaskets/ Marker / Approved Anti-seize lubricants
- Personnel protection Equipment (PPE)
- Body protection for working at heights and fall.
- Consumables

11 CALIBRATION

The following Torque elements will be calibrated as per standard.

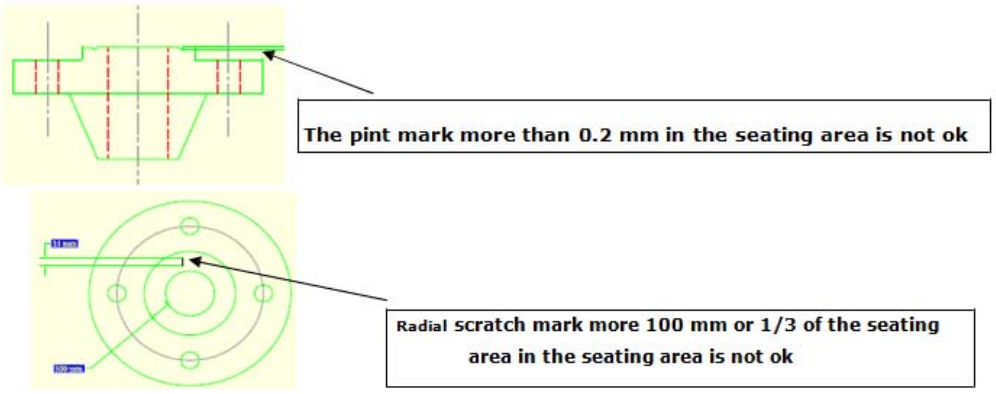
- Manual Torque wrench with adjustable torque scale
- Pressure indicator gauge in the hydraulic torque pump
- Pressure indicator gauge in the hydraulic tensioning pump.

12 PRE JOB CHECKS.

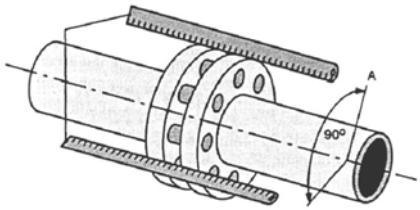
- Scope of the job has to identify.
- On-site technical procedure has to be read and understood.
- Pipe line and Vessel should be free from pressure, but if due to any circumstances there is pressure in the same then the Job need to be stopped immediately until a specific risk assessment is carried out and a safe method is approved from the client.
- Site specific work permit should be in place.
- Generic risk assessment has to be carried out and understood.
- All personnel involved in the job have to read and sign the Permit to work and Job Specific Risk assessment.
- PPE should be suitable and sufficient to the task.
- Equipment is suitable for the task and in serviceable condition.
- Access and agree to the work site is adequate and scaffold fit for purpose, tagged and inspected within last seven days

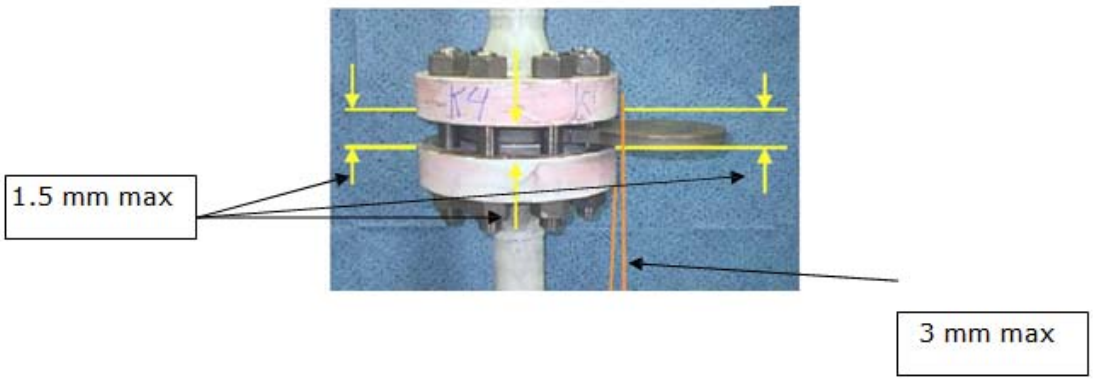
13 JOB SPECIFC CHECKS

- Check the Flange size, rating, type and material of the flanges.
- Check the Flange face .(if possible)



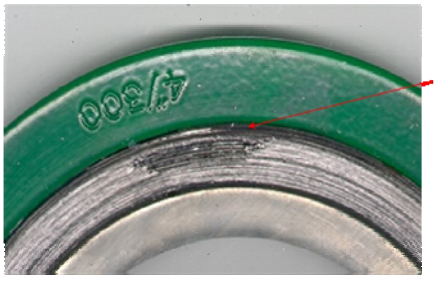
- Check the alignment of the Flange and gasket.
- Maximum allowable translation of Flange Centre line and Faces: 1.5 mm
- Max allowable out of parallel alignment of Flange faces: 0.25mm/100mm flange diameter, 1.5 mm max.
- Bolt Hole Alignment of Flange faces: 3mm max offset with bolts moving freely in both holes





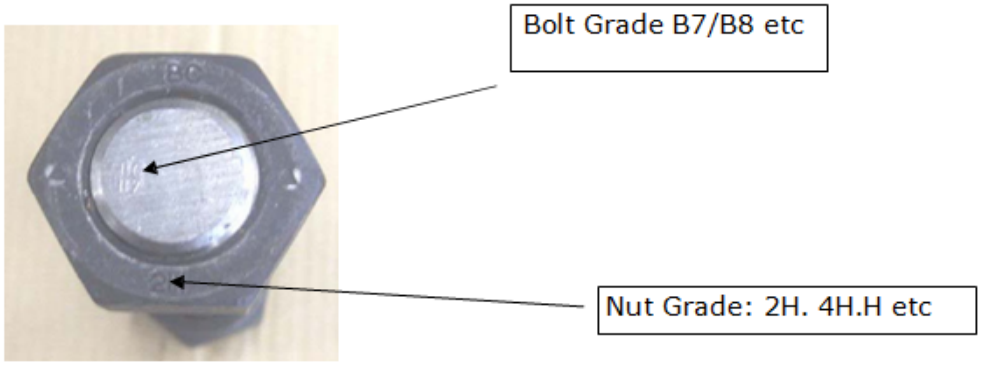
- Check the gasket to be used.

The Deep radial scratch against the gasket seating area is not acceptable (approx > 0.2)



If graphite is missing in the gasket seating, that will not be acceptable.

- Check the bolt Material

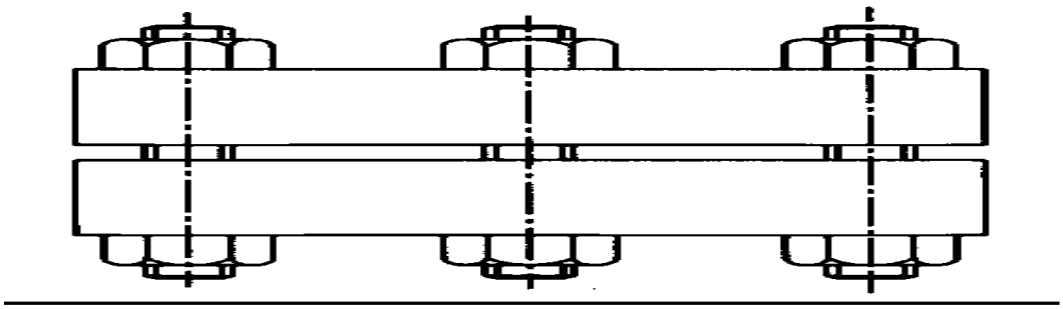


- Install all studs and nuts and hand tighten the same. Ensure that all the studs pass freely through the flange holes and then position the nut on either end of the stud in such a way that the crown of the stud projects beyond the face of the nut with a minimum of 3 threads seen from the face of the nut on either side (as shown in the diagram below).

- Check whether the lubricant is applied to stud threads over length and nut engagement and to face of nut which contact flange.

- Check whether it is an approved lubricant or not. (Never lubricate the nut or bolt if whether the coefficient friction is not known).

- Ensure the nut runs freely down the thread of the studs.



14 BOLT TORQUING PARAMETERS:

The application of bolt tightening method shall be carried in accordance with the following parameters.

- Flanges and accessories are limited to the type of material, size, rating, type, service handled, the fluid temperature & environmental conditions.
- Bolting for flange joints shall be in accordance with ASME B16.5 / B16.47 Series “A” as applicable.

15 WORK SEQUENCE / PROCEDURE:

15.1 PRE-TORQUE AND TENSIONING ACTIVITIES

- Pre commissioning Supervisor / Foreman to Ensure all relevant documents have been approved by SKEC / Saudi Aramco prior to commencement of work, & that the latest version of IFC drawings, specifications including approved procedures are disseminated to concerned personnel who will carry out the work.
- Bolts shall be visually checked for cleanliness, proper dimensions (length/diameter/thread) and for any physical damage to shanks of threads, which would interfere with bolt assembly or performance.
- The flange face, particularly the seating area, shall be visually examined for cleanliness and ensure no damage such as scratches to exist.
- Verify that approved lubricant (anti-Seize) is used.
- Prior to execution of work. Verify field location and applicable torque / tension values for each joint to ensure that the flanged joint torque is clearly identified and marked for recording purposes.
- Ensure to erect, if so required, necessary scaffolding / access platforms for fitters prior to fit-up, bolt torquing and tensioning activities.
- Ensure relevant work permit are secured & available.

15.2 PREPARATION OF BOLT-UP

- Flange faces must be thoroughly cleaned. Special care to gasket seating surfaces-for metal gaskets such as grooves in ring joint flanges.
- Thoroughly inspect gasket surface on flange faces
- Check bolts for proper size, length, & conformance to specification.
- Verify that the flange alignment and parallelism are in accordance with procedure for piping installation around rotating equipment.

15.3 PRE-ASSEMBLY OF FLANGES

- Two bolts shall be installed diametrically opposite to each other & one bolt half way between the previously installed bolts for retaining the gasket.
- Gasket shall be inserted and centered between the flanges. Gasket must not be held in place with tape during flange alignment. Avoid use of graphite tape or any other foreign material to hide gasket seating surface imperfections.
- All flange joints shall be snugged up squarely so that the entire flange face bears uniformly on the gasket.

15.4 BOLT INSTALLATION SEQUENCE

- Prior to bolt installation; verify that the flange alignment and parallelism are in accordance with procedure for piping Installation around Rotating Equipment.
- Lubricate bolts by applying the approved anti-seize lubricant to the bolts and contact face of the nuts. Ensure that the entire threaded are is coated with lubricant and lubricant should not come into contact with gasket seating surface. PTFE coated bolts don't require lubricant.
- Install bolts on the bottom half of the flange, then install the gasket on the flange surface to be sealed. The gasket must be located centrally in the flange assembly and should not be forced into position.
- Bring the opposing flange into contact with the gasket, and then install the remaining bolts and nuts finger tight. Ensure that at least one (1) full thread is visible beyond the nut for all bolts.
- Proceed to tighten the bolts in sequential order as shown on in the Attachment – 1. Ensure that all bolts are snug tight and flanges are closely fit. For joints not shown in the attachment, client representative shall approve the tightening sequence.

Note: Flog tightening and use of heat or pull lifts for bolt tightening to correct misalignment of flanges are not allowed.

15.5 Manual Tightening without Torque Control procedures

- The joints regardless of bolt size that are not covered in torque control and tension control, and also the joints of non critical system where ever torque or tensioning is not recommended.
- All the bolts shall be wrench tightened in sequential order as per the Attachment – 1. Multiple sequence passes shall be made to verify uniform gasket compression. Joints is complete when all the bolts are wrench tight.

15.6 Manual Tightening with Torque control procedures (Manual Torquing)

- Unless otherwise specified, all joint that have bolt diameter 1" and below shall be tightened with manual torque wrenches.
- Torque the bolts to the final torque value as listed in Attachment – 3 in three passes using the sequential order as shown in Attachment – 1 for each pass. Apply 1/3rd of the final target torque value in the first pass, 2/3rd of final torque value in the second pass, and 100% of final torque value in the third pass. (Client's specified % torque value in each pass shall be given preference)
- The fourth (final) pass shall be run in a reverse sequence with 100% torque value setting.

15.7 Flange Bolt Tightening With Hydraulic Torque Control Procedures

- The following bolt joints are covered under hydraulic torque application:
- Unless otherwise specified, all flange joints with bolt diameter above 1" and up to 2"
- Bolt diameters 3" and above, which are not covered under "hydraulic bolt tensioning".
- The flange joints, recommended by the vendor for hydraulic torque application, irrespective of bolt diameter.
- The flange joints, which are recommended for bolt tensioning, but not having sufficient bolt length or sufficient room to accommodate the Bolt tensioners (up on approval from client).
- Torque the bolts to the final torque value as listed in Attachment – 3 in three passes using the sequential order as shown in Attachment – 1 for each pass. Apply 1/3rd of the final target torque value in the first pass, 2/3rd of final torque value in the second pass, and 100% of final torque value in the third pass. (Client's specified % torque value in each pass shall be given preference)
- The fourth (final) pass shall be run in a reverse sequence with 100% torque value setting.

15.8 Flange Bolt Tensioning With Tension Control Procedures

- The following bolt joints are covered under hydraulic tension application:
  - Flange Size above 50" for flange rating ASME 300#.
  - Flange Size above 28" for flange rating ASME 600#.
  - Flange Size above 20" for flange rating ASME 900#.
  - Flange Size above 12" for flange rating ASME 1500#.
  - Flange Size above 4" for flange rating ASME 2500#.
  - The flange joints, recommended by the vendor for hydraulic tension application, irrespective of bolt diameter

- The bolt tensioning procedure is described in part 15-B of this document.

- The projection of the stud bolt above the face of the nut shall be at least one(1) diameter of the bolt. For example, for a 2-1/4" bolt, the projection of the stud bolt above the face of nut shall be equal to or more 2-1/4" (57 MM).

15-A PROCEDURE FOR BOLT TORQUING

Step 1 Align flanges and gasket. Forced tightening is not allowed to overcome non acceptable alignment tolerances. Clamp securely in place.

Step 2 Apply lubricants to stud threads over length and nut engagement and to face of nut which contacts flange. Ensure that the nuts run freely down the thread of the studs.

Step 3 Install all studs and nuts hand tight, ensure that studs pass freely through the flange holes. Position the nut on one end of the stud such that only the crown of the stud projects beyond the face of the nut. The excess stud length should project beyond the nut on the other side

Step 4 Mark the correct tightening sequence in the stud in a clock wise direction with permanent marker, as shown in the diagram.

Step 5 For insulting gaskets like PIKOTEK, enough gap (½" of gap is recommended) should be available between flange faces to avoid any damage to seals during inserting the gaskets, if due to any reasons, seals are damaged, change the seal before installing PIKOTEK

Step 6 Matting flange faces and the gaskets should be dry and free from grease, oil or water.

Step 7 Tighten studs per the Stud Bolt Tightening Sequence as per the Attachment 01**,** an appropriate tool should be used such as air impact wrench or equivalent.

Step 8 For joints containing RTJ or spiral Wound Gaskets, repeat step 7.

Determine the torque values for the flanges and the bolt material as recommended by the manufacturer or client or by Calex (IMS) standard tool values approved by the tool manufacturer. (Tentec).

- Apply the 30 % of the final torque value in the first stage by criss cross direction.(Attch.5)
- Apply the 60 % of the final torque value in the second stage by criss cross direction.
- Apply the 100% of the final torque value in the third /fourth stage by criss cross direction.
- At final stage start tightening from the highest number of Bolt in the counter clock wise direction.

- Using a small hammer lap test each bolt to carry out the sound test, dull or vibrating bolt will be retightened to required value.
- After complete a metal tag has to put on the job, to visually identifying the job has completed.
- Make sure that your area is clean and tidy .Also your permit has to be signed off.
- Records all your data on your Flange tightening Report (FTR). If any remarks with the joint it has to be registered in the FTR and need to be approved by the Client. The white copy of the FTR need to submit to the client and the yellow with us for future reference.

15-B PROCEDURE FOR BOLT TENSIONING.

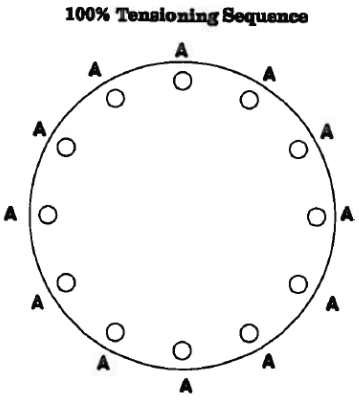
Tensioning can be done by 4 methods.

1. 100% tensioning
2. 50% tensioning
3. 33% tensioning
4. 25% tensioning

The method of tensioning will be depend upon of the availability of tools & the criticality of the joint. For more accuracy 100% or 50% tensioning is preferred.

For 100% tensioning

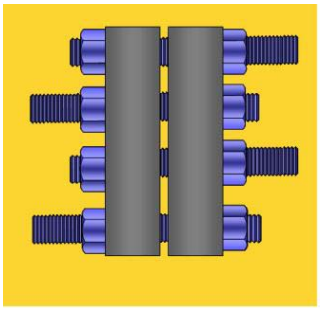
FIGURE 01



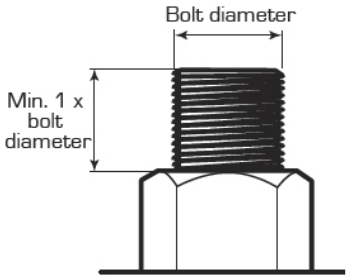
100% Tensioning Process: In this process, Tensioners are installed at all the bolts as shown in Figure 01.

A. As all the bolts are stretched simultaneously, only pressure B is used to tension the bolts to the target bolt load. Pressure A is not applicable.
B. Apply pressure B and sung the nuts using a tommy bar. Release the pressure.
C. Re-apply pressure B and check that all the nuts are fully tightened with a tommy bar. Release the pressure and remove the hydraulic tensioners.
D. As a Final check, use a hammer to “ring” each nut to ensure that none are slack.

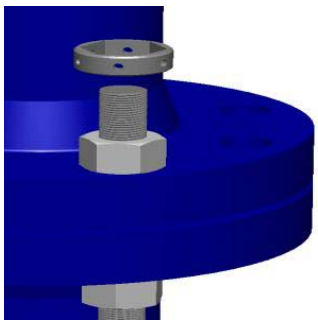
1. Align the bolt as shown in the figure.



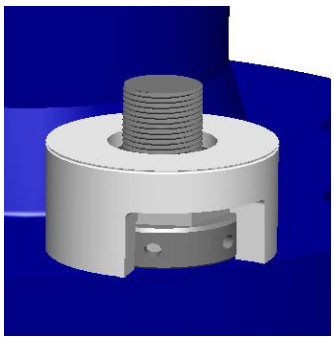
2. Install Hydraulic tensioners in all bolt as per the below diagram.



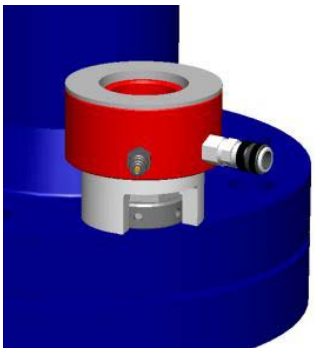
1- Insert Nut running Socket



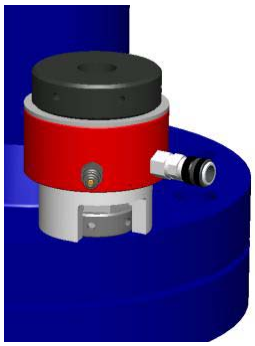
2- Insert Bridge



3- Insert Load cell



4- Insert Puller



Connect all the inter connecting hose and link Hose.

3. Measure the grip length of the flange at least four points of the flange. If it is bigger flange measure min eight points.(Flange bigger 24")
4. Before giving the pressure please check the Inlet pressure of air (should be min 7 bar).
5. Before starts check the oil level of the pump.
6. Before starting the job cross check your fittings is seated properly.
7. Slowly raise the pressure up to 1000 psi and verify any leak is there from the fittings. If so cross check the seating of the fittings. If the fitting is not seated properly reduce the pressure to zero and fit it properly. Otherwise again raise the pressure slowly and watch if the leak stop. If not reduce the pressure and replace the hose. Do not pressurize the system while the hoses are leaking.
8. Raise the pressure up to the 40% of the required applied bolt stress. Check the flange alignment to ensure that gap is closing up evenly. Any misalignments up to the limits can be

corrected by individual bolt loads. Misalignment greater that those given in the section 7 shall be investigated and corrective action has taken before proceeding the tensioning.

9. Continue to increase the pressure the pressure until 70% of the bolt stress is achieved and check the flange alignment.

10. Provided satisfactory checks have been made, increase the pump pressure to achieve 100% of the applied stress.

11. Tighten the service nut firmly.

12. Reduce the pressure to zero.

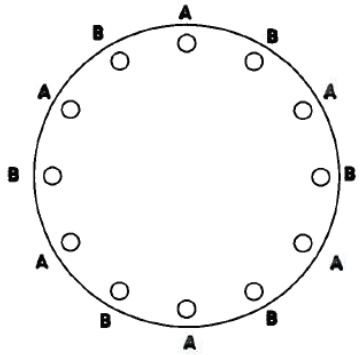
13. Keep the system ideally for 3-4 min, to allow the oil to return back to the oil tank.

14. Re pressurize the system min 3 times in a stud to reduce the Tool load loss transfer.

For 50% percentage Tensioning.

FIGURE 02

50% Tensioning Sequence



1. Mark all the bolts as A& B and install tensioners in “A” bolts as shown in the Figure 02, as described in the 100% tensioning .

2. Continue the procedure as described in the 100 % tensioning from step 3 to7.

3. Apply the Pressure A as described in the tensioning procedure from 8 to 14.

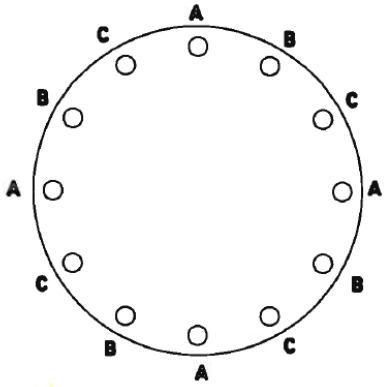
4. Remove the tensioners from the bolts “A” and Insert the tensioners on “B” bolts as above. Apply the pressure B on the bolts as described above in 100% tensioning from step 6-14.

5. **Check the break loose pressure** of the bolt by putting tensioners on bolts “A”. The break loose pressure should be more than pressure “B”. If not put the tensioners again on Bolts “B” and apply Pressure “A” on the “B” bolts. And apply pressure on “B” on bolts “A”. And again check the break loose of the bolts.

For 33% & 25% percentage Tensioning.

FIGURE 03

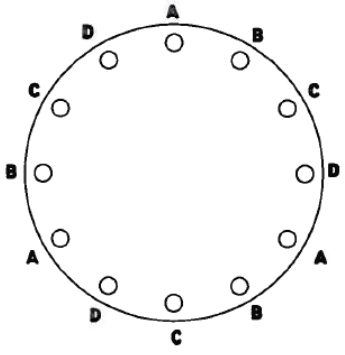
33% Tensioning Sequence



1. Align the bolts the as per the 50% of tensioning.
2. For 33% tensioning mark the bolts as A, B, C as shown in figure 03 and install the tensioners first on A and apply the pressure A and then on B and apply the pressure B and again put the tensioners on bolt C and then apply the pressure C. Check the break loose pressure on bolts A & B. It has to more than pressure C. Otherwise put the tensioners on bolt C and again give the
   pressure A and B in B and A in C. After check the break loose again.

FIGURE 04

25% Tensioning Sequence



3. For 25% tensioning mark the bolts as A, B, C & D as shown in the Figure 04 and install the tensioners first on A and apply the pressure A and then on B,C and D and apply the pressure B,C,D respectively..

Check the break loose pressure on bolts A, B,& C. The pressure has to be more than D. Otherwise put the tensioners on bolt D and again give the pressure A and then in C,B,A Respectively.

Break loose Tensioning Check – it is important to check and record this as it helps in verifying the joint's integrity.

16 BOLT TORQUING AND TENSIONING ACTIVITES:

16.1 The application of bolt tightening method shall be carried our in accordance with the following parameters.

16.1.1 Flanges and accessories are limited to the type of material, size, rating, type, service handled, the fluid temperature & environmental conditions.

16.1.2 Bolting for flange joints shall be in accordance with ASME B16.5 / B16.47 Series "A" as applicable.

16.2 BOLTING PROCEDURE FOR FLANGED CONNECTIONS –

16.2.1 Make sure that flanges & gasket are align, force tightening of bolts and nuts are not allowed to overcome non acceptable alignment tolerances.

16.2.2 Apply lubricants (Nickel based Anti-Seize) to studs threads over length and nut engagement & face of nut which contacts flange. Ensure that the nuts run freely down the thread of the studs.

16.2.3 Install all studs & nuts hand tight, ensure that studs pass freely through the flange holes. Positions the nut on one end of the stud such that only the crown of the stud projects beyond the face of the nut. The excess stud length should project beyond the nut on the other side.

16.2.4 Number each stud according to its position in the flange as shown on Figure : SAEP-351-01.

16.2.5 For insulating gasket like PIKOTEK, enough gap (1/2" of gap is recommended) should be available between flange faces to avoid any damage to seals during inserting the gaskets, if due to any reason, seals are damaged, change the seal before installing PIKOTECK

16.2.6 Matting flange faces and the gaskets should be dry and free from grase, oil or water

16.2.7 Tighten studs as per stud bolt tightening sequence, for 4 to 32 bolts use Figure SAEP-351.01 & 36 to 68 bolts see Figure SAEP-351-02

16.2.8 Tighten the stud bolts in stage to obtain the final required torque from the appropriate torque valve Table-SAEP-351-02.The first stage should be more than 30% of the final torque. The final torque shall be within ± 5% of the required torque values.

Apply the torque evenly to each stud bolt tightening sequence. The final torque must be within ± 5% of the required values per stud bolt tightening procedure.

16.3 HYDRAULIC BOLT TENSIONING PROCEDURE

16.3.1 Application of bolt tensioning equipment shall strictly be in accordance with the manufacturer's instruction manual and safety procedure.

Personnel using equipments for hydraulic bolt tensioning must have adequate trainings / experiences in the application.

16.3.2 Prior to bolt tensioning, all flanges and bolts shall be prepared and pre-assembled, including the lubrication of studs and nuts, check bolt free thread protrusion requirement for use of tensioning method.

16.3.3 On application where several bolts are tensioned simultaneously, all tensioning tools shall be connected to the same hydraulic pump unit.

16.3.4 When using tensioning device, the stud must protrude beyond the nut to allow attachment of the tensioning device. The other end of the stud must extend with considerable length past the nut. All stud bolt protrusions must only be on the same side of the flanged joint. Protrusions may be alternated from one side to the other if interference occurs with the tensioning device.

Break loose Tensioning Check – it is important to check and record this as it helps in verifying the joint's integrity.

16.3.5 Fill out Flange tightening Report detailing the flange reference, details, tools and method employed, values of tensioning and Break Loose pressure.

17 TEMPORARY GASKETS AND THEIR CONTROL

- Temporary flange connection (temporary gaskets) should be identified & marked.

- Flange joint in any line, that are identified as temporary must be marked by the “bolt tightening crews”.
- The flanges so identified as temporary connection will be confirmed by the QC inspectors, who will include those in the pre-test punch list as part of the “B” punch items during the reinstatement time.
- During reinstatement, new permanent gasket shall be installed. Flanged joints for piping and equipment must not be disassembled by loosing studs bolts consecutively around the flange until the bolts are removed. This may cause warping of the flanges. As a minimum, two passes shall be made in loosening bolts and the bolting pattern under sequential order shall be followed.

18 STUD BOLT ADDITIONAL TIGHTENING PROCEDURE – applicable during conduct of Pressure Testing

17.1 Depressurize the piping system and re-torque stud bolts to maximum torque value shown on Table-SAEP-351

17.2 If leak does not stop after re-torqueing has been performed, disassemble the flange joint and inspect as follows:

17.2.1 Inspect stud bolts and nuts for defects or damage to threads or improper cleaning of threads.

17.2.2 Inspect flange faces for damage, misalignment.

17.2.3 Inspect gasket for damage or defects.

17.2.4 After all defective and damaged items have been repaired or replaced, reassemble the flange joint using a new gasket and tighten the bolts using the maximum torque values.

19 TORQUE / TENSIONING VALVES

Applicable torque / tensioning valves for tightening shall be in accordance with the following SAEP-351 Torque Tables

See:

Attachment No.3 – Table SAEP-351-02 Torque Values for Low alloy steel bolts

- Table SAEP-351-03 Torque Values for Isolating Gasket (PIKOTEC)

Attachment No - Bolt Load details for bolt Tensioning

20 FLANGE TRACEABILITY IDENTIFICATION TAGGING

- An identification tag (temporary laminated tag) shall be installed on every flange joint after the completing the torque/tensioning work displaying the joint number, torque value applied, tightening technician and date of joint torque completed.
- After inspection and acceptance, this temporary tag shall be removed and a permanent SS tag (tied with SS strips and ball lock system), mentioning the Joint specification as per drawing shall be installed.

21 QUALITY ASSUARANCE AND CONTROL.

- All stages of work shall be inspected in accordance with the approved Quality Control Procedure (QCP) / Inspection and Test plan. & record on field inspection / Test Report Forms- **SATR-L-2001**
- Calibration certificate for torqueing / tensioning equipment shall be submitted prior to use of equipment.

22 TORQUE TIGHTENING DO OR DO NOT.

Do

- Ensure that you are fully conversant with the safe use of tools and their operating procedure.
- Check that the load /pressure that you got is applicable for the flange and Bolt material that you are going to tight. Also the tool can go safely with pressure. (80 % of the total capacity).
- Number the studs to aim correct criss cross direction sequence.
- Make sure that correct face of the nut will seat properly into flange face.
- Make sure that all bolts are Hand tightened
- Identify the correct lubricant and it's co-efficient of friction.
- Make sure that all the bolts are properly lubricated.
- Ensure torque reaction foot seat properly.
- Ensure that your backing spanner is seat properly, if you are using.
- Before stopping the job, do lap test and ensure the bolt is loaded by sound effect.

DO NOT

- Never un-connect the coupling when the system is under pressure.
- Never torque on a damaged bolt or a corroded one.
- Never stand in a line with bolt axis, when the system is under pressure.
- Never hold hydraulic equipment at their pin point or reaction point when the system is energising.
- Do not over tight the flange especially for small bolt diameter (diameter less than 1")

23 ATTACHEMENT

Attachement-1	: Flange bolt tightening sequence (Figure –SAEP-351-01/02)
Attachement-2	: Flange bolt tensioning sequence
Attachement-3	: Torque value for Low –Alloy steel bolting (Table –SAEP-351-01/02/03)
Attachement-4	: Bolt load details for Bolt Tensioning
Attachement-5	: Torque Tightening Criss cross Direction & Load Variation Chart