On-Site Procedure

Rev Number	Date	Description	Prepared	Approved HSEQ	Approved TECH

DOCUMENT TITLE:

FLANGE HYDRAULIC TORQUE TIGHTENING METHOD STATEMENT

DOCUMENT REFERENCE:

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1.0 SCOPE

This procedure covers the Hydratight preferred system for flange tightening by the means of hydraulic torque wrench and should be used as the best practice internal procedure to follow. It is the objective of the procedure to provide a sealed flange first time in a safe manner whenever applied.

2.0 APPLICATION

This procedure applies to any flange, which has been assembled to be torque tightened.

3.0 DEFINITIONS

Applied Torque	Torque applied to a nut/bolt assembly by means of a calibrated Torque Wrench.
JIMS & JDMS	Software used for planning, managing and implementing 'Joint Integrity Assurance'.
Boltup & Informate	Bolt load calculation software that recommends tightening methods, tooling selection, torque and tension values.
Joint Completion Certificate	A Report completed giving details of the tightened joint.
Tag	A Tag, which is affixed to the flange before & after tightening to detail joint status for quick verification and traceability.
Hydraulic Torque Wrench	Hydraulic actuated ratchet design torque wrench with interchangeable square drive and hexagon cassettes which are normally powered by an air or electric operated pump unit up to a maximum operating pressure of 10,000 psi.

4.0 RELATED DOCUMENTS/REFERENCES

ECITB NSDS PF019 Assembly and Tightening of Bolted Connections

5.0 APPROVED OPERATORS

Hydraulic torque tightening is a specialist skill.

This procedure applies to all personnel who hold Hydratight TW1 competency status; personnel who have TW2 approval can only work under supervision of personnel holding TW1 status

Only technicians trained and competent in the use of bolt tightening equipment, who have completed a recognised competence assessment program, can carry out the controlled breakout/assembly and tightening of bolted joints.

6.0 SAFETY FIRST

Hydraulic power tools enable the user to more easily accomplish bolting tasks with increased force, accuracy and efficiency.

Due to the powered nature of the tools, with large forces generated from high-pressure fluid/air and electricity strict safety issues are followed through the tools proper design and documentation However, the user must accept the primary responsibility of safety when using hydraulic tools by carrying out site related risk assessments, reading, understanding, and complying with all operating instructions prior to and during operation.

In a commitment to facilitate user understanding of all operating instructions, Hydratight supplies operation manuals and upon request on site training courses.

This procedure and additional safety related sections contained towards the end of this document are designed to assist in the proper instruction for use and care of hydraulic tools and play a major role in preventing accidents and increasing safety.

7.0 PRE-JOB CHECKS

- Scope of Work has been identified
- On-site Technical Procedure has been read and understood
- Pipeline or vessel is free of pressure - if not STOP until a specific risk assessment is carried out and Safe method approved.
- Site specific Permit to Work is in place
- Generic Risk Assessment has been read and understood
- Job specific Risk Assessment has been carried out
- All members of the work party have read, understood and signed:
    - Permit to Work
    - Job Specific Risk Assessment
- PPE is suitable and sufficient for the task
- Equipment is suitable for the task, tested and in serviceable condition
- Access and egress to the work site is adequate and scaffold fit for purpose, tagged and inspected within the last seven days

8.0 JOB SPECIFIC CHECKS

- Check that the torque values to be applied have been recommended by the manufacturer, client or Hydratight bolt load calculation software and are applicable to the tools being used and for the flange and bolt material being tightened.
- Check the flange is correctly assembled and all nuts and bolts are correctly set for protrusion, with nut stampings visible and not against the flange face.
- If any check falls out of limit then the Technical Authority is to be informed for rectification. If rectification is not carried out, details are to be included on the Joint Completion Certificate or recorded in JIMS/JDMS.
- Select a wrench that will complete the tightening operation within 75% of maximum output.

9.0 EQUIPMENT

Hydraulic Torque Wrenches have different size square drive or direct fit hexagon cassettes that output various torque loads. Square drive vs. torque output data can be found in operating manuals or technical data spec sheets. All hydraulic wrenches are normally powered from an air or electric operated hydraulic power pack with a maximum working pressure of 10,000psi / 700 Bar.

10.0 CALIBRATION

The Pump must have a Calibration Certificate valid for the date of the task. If the Pump has no valid certificate, it should be re-calibrated or changed.

11.0 LUBRICATION OF NUT/BOLT ASSEMBLIES

If a lubricant is to be used, the following must be adhered to: -

1. Only approved lubricant will be used.
2. Never lubricate bolts with compounds that cannot be identified or where its coefficient of friction is not known.

3. All instructions for Torque Tightening should specify a Torque Value to be used with the specific lubricant. If not, consult with the Engineer responsible for the job or your mobilisation.
4. If the nut/bolt assemblies have been lubricated, check if it has been completed correctly and that (1) and (2) above are known.
5. If a lubricant needs to be applied, the correct procedure should be followed.
6. The lubricant must be applied to the nut seating face and the portion of bolt that the nut will be turning around the end to be tightened only. Apply the lubricant to the bolt and rotate the nut up and down the bolt to spread the lubricant evenly. If possible, do this with the bolt out of the flange to ensure the lubricant is spread correctly.

   If in doubt consult the On-site Technical Procedure for the Lubrication of Nut and Bolt Assemblies.

12.0 RECOMMENDED FLANGE BOLT TIGHTENING PROCEDURE

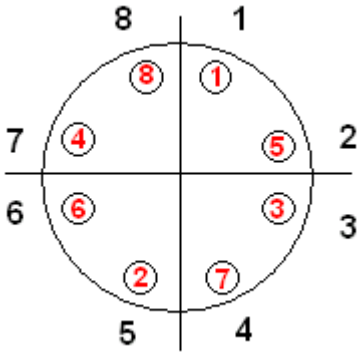
1. Measure the flange gap at a minimum of four points around the flange (larger flanges should be at eight points)
2. The bolt tightening sequence should begin at the point of the largest gap!
3. Mark the correct tightening sequence on the studs in a clockwise direction with chalk as per diagram. For the correct sequence see (ASME-PPC-1-2000).

Criss-Cross Tightening Sequence Examples:

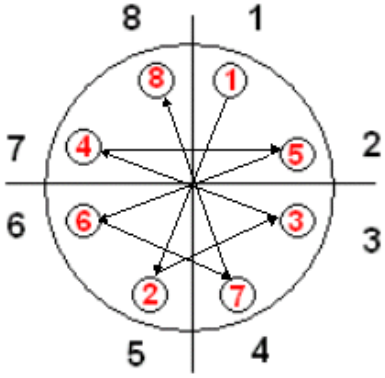
4 Bolt Flange 1-3-2-4
8 Bolt Flange 1-5-3-7-2-6-4-8
12 Bolt Flange 1-5-9-3-7-11-2-6-10-4-8-12
16 Bolt Flange 1-9-5-13-3-11-7-15-2-10-6-14-4-12-8-16
20 Bolt Flange 1-13-5-17-9-3-15-7-19-11-2-14-6-18-10-4-16-8-20-12
28 Bolt Flange 1-13-21-5-17-9-25-3-15-23-7-19-11-27-2-14-22-6-18-10-26-4-16-24-8-20-12-28
32 Bolt Flange 1-17-9-25-5-21-13-25-3-19-11-31-7-29-15-27-2-18-10-30-6-22-14-26-4-20-12-32-8-24-16-28

Note: Correct numbering of bolts should result in all odd numbered bolts around one side of the flange and all even numbered bolts around the other side.

Marked Up 8 Bolt Flange

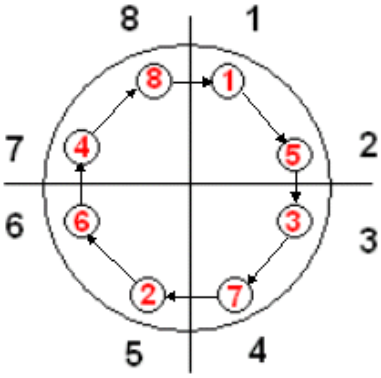


1st, 2nd, & 3rd Stage



Criss Cross Sequence

4th & Final Stage



Adjacent Bolt Sequence

4. Determine the Torque Value for the flange and bolt material being tightened as recommended by the manufacturer, client or Hydratight bolt load calculation software and that it is achievable with the tools being used. Check that the Flange size, class, rating and bolt material match those on the data sheet.

   Visually check that the flange has been correctly assembled and the correct gasket is fitted. Check Nut Stampings are the correct way around.

5. First tightening stage should be limited to a maximum of 30% of the final Torque setting.
6. Second tightening stage should be limited to a maximum of 60% of the final Torque setting.
7. Third tightening stage should be carried out at the 100% Torque setting.
8. On the Fourth and Final tightening stage, change from diagonal tightening to adjacent bolt-to-bolt tightening clockwise using the 100% Torque setting and chase around flange until nuts finally stop rotating.

   Note: First, second and third stages should be tightened using the criss cross tightening sequence and the fourth stage should be tightened using the adjacent clockwise bolt to bolt sequence as shown in the diagrams above
9. Using a small hammer tap test each bolt to check the sound of the bolt rings true, dull or vibrating bolts should be retightened to the correct value.
10. Complete a Flange Tag and attach to the joint
11. Ensure that the work area is left in a safe and tidy condition and that any Permit to Work has been signed off.
12. Record all tightening information on a Joint Completion Certificate
13. Input all tightening data into JIMS or JDMS or clients Data management system if applicable

13.0 TOOL FITTING & OPERATION

Using hydraulic torque wrenches:

Note: Operation by one person is always recommended unless the wrench cannot be handled safely. When two personnel are required then communication both verbal and visual must be maintained at all times between the tool handler and remote control/pump operator. The tool must not be energised without notification from the tool handler.

1. Ensure that the Power Console is full of Hydraulic Oil and if an Air Power Console is being used, that the Air Lubricator has sufficient oil in it.
2. Make sure that all Air and Hydraulic Couplings are clean and free from dirt.
3. Square Drive Tools Only: Check that the correct size Impact Socket has been selected and that it has a Retaining Ring and Pin.
4. Check that the Square Drive is in the correct position for tightening operations.
5. Attach the Impact Socket and secure it with the Retaining ‘O’ Ring and Pin.
6. Position the Reaction Arm for the best angle and safe operation then engage the retaining device.
7. Hex Head Tools Only: Check that the correct size Hex Head has been selected for the relevant power head and that it is fitted correctly.
8. With the tool removed from the flange and safely positioned on the ground, connect the hydraulic hoses to the tool and the power console via the quick release fittings ensuring that all locking collars/thumbscrews are fully tightened.

9. Connect the pump to an air supply with whip checks and pins at all connections. Switch on air supply and check system for leaks.
10. The torque wrench is operated via a remote control pendant, which is connected to the pump unit. To extend the actuator depress the Actuator Extend Control Button until the actuator makes a complete stroke then release to allow the actuator to return.
11. Ensure that the torque tool is removed from the flange! Then proceed to set the pump to the required pressure for tightening by turning the 'Torque Control Valve' clockwise to increase pressure or counter clockwise to decrease pressure while actuating the tool until the required pressure is displayed on the pump calibrated pressure gauge.

    Note: Always remove the tool from the flange and place on a surface where reaction will not be possible when setting/altering the pump pressure or adjusting reaction points!

    For two man operation ensure the communication procedure is clear and understood before proceeding.
12. Fit the tool onto the bolt via the nut ensuring that correct and safe reaction is achieved.

    Note: Pinch Points are present around all reaction areas and in tight spaces. Hands and fingers must be kept clear from pinch points at all times.
13. To tighten the nut, depress the Actuator Extend Control Button until the actuator makes a complete stroke then release to allow the actuator to return. Continue to stroke the actuator for further strokes until the required torque load and pump pressure is achieved and the nut is tight.

    Note: If the back nut begins to move while tightening a backing spanner must be fitted to the nut reacting off the next adjacent nut to prevent turning. Backing spanners must be secured to prevent accidental release by being tied off or other methods. Backing spanners also introduce pinch points.
14. Repeat steps 11 to 13 for all bolts/nut to be tightened.

14.0 SAFETY REQUIREMENTS

Risk Assessments will be undertaken according to Hydratight and Operator procedures. This may result in extra safety requirements. The following list gives minimum requirements.

- Eye protection must be worn BS 2092-2.
- Gloves must be worn.
- Do not exceed maximum pressure for the tool.
- Wear Safety boots and overalls.
- Observe site-specific safety requirements.
- Observe all equipment operating instructions.
- Observe all safety instructions in the Operation and Maintenance Manual for the specified Torque Wrench.
- Observe COSHH instructions when using penetrating oils.

15.0 TORQUE TIGHTENING DO'S & DON'T'S

Do's

- Ensure that you are fully conversant with the safe use of the tools and their operating procedures.
- Check that the loads/pressures stated are applicable for the tools being used and for the flange or bolt material being tightened.
- Number the studs as an aid for applying the correct criss cross tightening sequence.
- Make sure that the full thread engagement of the nut on the bolt has been achieved.
- Hand tighten the nuts first, ensuring that the correct face of the nut will seat squarely onto the flange surface.
- Use correct lubricant and identify its co-efficient of friction before use.
- Ensure that the torque reaction foot, if being used, is engaged correctly.
- Ensure that the backing spanner, if being used, is engaged correctly and secured.
- Wear suitable protective clothing.
- Observe COSHH instructions when using hydraulic oil or lubricating compounds.

Don't's

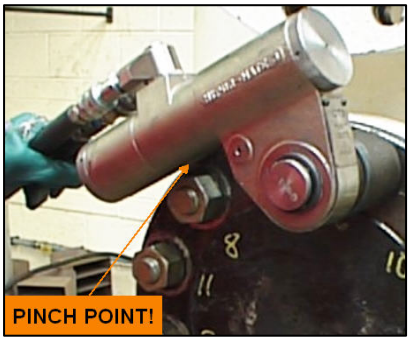
- Never pressurise unconnected hydraulic couplings.
- Never torque damaged or corroded bolts.
- Never stand in line with the bolt axis when tools are pressurised.
- Never hold hydraulic wrenches at their pinch/reaction points when energising.
- Do not draw the flange up tight on one or two bolts, as this will cause local gasket crushing or pinching of the gasket.
- Do not over tighten bolts; take particular care with small bolts, i.e. less than 1" diameter.

16.0 PINCH POINTS AND CORRECT REACTION METHODS

- Pinch Points are present around reaction areas and in tight spaces. Hands and fingers must be kept clear from pinch points at all times. Examples of common pinch points are detailed below
- Improper reaction set up and /or incorrect socket size will cause a concentration of stress that can make the tool, socket, or nut vulnerable to fracture. The common cause of socket breakage is cocking, a condition when the socket fits over the nut at an angle. Examples of "how to " and "how not to" react with and without a reaction arm are detailed below.

RSL Hex & Square Drive Wrench Pinch Points

CT Torque Wrench & Backing Spanner Pinch Points



17.0 SUMMARY OF WRENCH SAFETY POINTS

General

- Operation by one person is always recommended unless the wrench cannot be handled safely, then communication both verbal and visual must be maintained at all times between the tool handler and remote control/pump operator. The tool must not be energised without notification from the tool handler.
- Tool must be removed from application at all times and placed in a location where reaction is not possible when altering pump pressure.
- Operator must read and understand all operating instructions before using all equipment.
- Incorrect reacting will cause high stresses on the tool and socket, which may result in possible breakage and injury.
- High hydraulic pressure hazard use with correct protection.
- Keep hands clear from all pinch points.
- Do not strike or modify any equipment.
- Tool must be removed from application at all times for aligning the socket or hexagon with the nut and reaction point. This operation will be achieved safely by rotating the drive forward manually, not by inching using hydraulic power.

Square Drive Wrench Heads

- If solid square engagement is not possible, rotate reaction arm instead of lifting
- Do not react without clearance under reaction arm, rotate to avoid cocking
- Avoid any angular engagement
- Never react in reversed position

Hexagon Wrench Heads

- Avoid any angular engagement
- Do not react on spline
- No angular adjustment allowed, in line reaction only