**AREA: ALL AREAS (Example only)**

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| **VALVE & FLANGE TORQUE SEQUENCE/MANAGEMENT - SAFE WORK PROCEDURE** |

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| *Our Vision – “Zero Harm”*  *We believe an incident and injury-free workplace is achievable* | | | | | | |
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| **PURPOSE** | | | | | | |
| The purpose of this procedure is to provide safe and efficient work methods for torquing valve and flange joints. | | | | | | |
| **PRE-REQUISITES** | | | | | | |
| * Trained and Competent Tradesman Fitters & Boilermakers * Trained in the use of Tension Wrenches and Hytorc tooling * Trained and Competent Riggers and Scaffolders | | | | | | |
| **HEALTH AND SAFETY** | | | | | | |
|  | All jobs require a detailed safety analysis as the first step. Follow the steps in this Safe Work Procedure carefully and ensure that all work team members are involved in the pre-job planning and hazard identification. | | | | | |
| **ENVIRONMENTAL** | | | | | | |
|  | | To contain spills and protect the environment, follow the information contained in the Material Safety Data Sheet (MSDS) | | | | |
| **HAZARDOUS MATERIALS** | | | | | | |
| msds | | Always check what medium is associated with the piping /flange system you will be working on.  Obtain a Material Safety Data Sheet (MSDS), which is a document that contains information on the potential hazards (health, fire, reactivity and environmental) and how to work safely with the chemical product. | | | | |
| **PPE REQUIRED** | | | | | | |
|  | | |  | man01_0 | man22_0 |  |
|  | | | man19_0 | man03_0 | man05_0 |  |
| **RESPONSIBILITY** | | | | | | |
| It is the responsibility of ***all employees, supervisors and contractors*** to adhere to the approved procedures for all work. | | | | | | |

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| **TERM / ABBREVIATION** | | | | **MEANING** | | | |
| PPE | | | | Personal Protective Equipment | | | |
| SWP | | | | Safe Work Procedure | | | |
| JSA | | | | Job Safety Analysis | | | |
| ATW | | | | Authority to Work | | | |
| LOTO | | | | Lock out tag out | | | |
| TL | | | | Team Leader | | | |
| RF | | | | Raised flange face | | | |
| FF | | | | Flat flange face | | | |
| ASME | | | | American Society of Mechanical Engineers | | | |
|  |  | HAZARD | Raw Risk |  | Red tick | CONTROL | Res Risk |
| Pinching when using hydraulic torque tools. | | | 2CM8 | Maintain a safe distance from reaction surfaces. | | | 2EL6 |
| Handling Heavy Equipment | | | 2CM8 | Use correct manual handling techniques | | | 2EL3 |
| Sharp edges | | | 2CM8 | Wear leather gloves | | | 2EL3 |
| Pinch points | | | 2CM8 | Wear leather gloves | | | 2EL3 |
| Locks not removed after completion of work | | | 3CM13 | Ensure your personal locks are removed before leaving the job site | | | 3EL6 |
| Objects obstructing the work area | | | 2CM8 | Always maintain good housekeeping | | | 2EL3 |
| Falling objects from scaffolds | | | 3CM13 | All items including tools must be secured and the area under the scaffold taped off | | | 2EL3 |
| Pressure in piping | | | 4CS14 | Leave some bolts in the flange and open the flange only a few millimetres until it is proven the pipe is depressurized. | | | 2EL3 |
| Hand crush injury | | | 2CM8 | Install safety blocks between flange faces prior to removing the gasket. | | | 2EL3 |

procedure

1. **plan the job – JSA**
   1. Review all the hazards and controls in this SWP.
   2. Assemble all assigned work team members and do a final safety analysis. Each individual should do their own analysis identifying all hazards and putting in control measures.
   3. A detailed JSA is required for this task and everyone involved in the job should review and sign the JSA.
   4. The authorised person in charge of the work must show team members the nearest; Muster points, Eye wash stations, and Fire extinguishers and go through the Emergency evacuation procedures.
   5. Once the JSA has been completed make any necessary alterations to be made.
2. **prepare the work area – pre-start checks**
   1. Remove all slip, trip and fall hazards from the work area before starting the job.
   2. Apply CRC to all flange bolts.
   3. Assemble all tools and equipment required - carry out pre-start checks.
   4. Check that Hytorc/Tension Wrench has a current calibration.
   5. Check all electrical leads have current test tags.

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| **TOOLS EQUIPMENT & MATERIALS REQUIRED** | | |
| tools and equipment | Standard PPE. | Personal Locks. |
| Correct gasket or sealing rings to the piping or valve specification. | Wire brush. If the flange is stainless then a stainless wire brush is required. |
| Flange Alignment tools | Electrical extension leads. |
| Tension wrench or Hytorc. | Scraper. |
| Correct sockets. | Fine emery paper. |
| Flange gap measuring tool/vernier/gap gauge tool. | Clean rags. |
| Flange spreader | Danger Tape. |
| Torch. | Correct bolts & nuts for flange type. |
| Hardened washers if required. | Permanent marking pen. |
| Oil spill absorbents pads or medium | Safety blocks for flange opening. |
| Denso Tape | Anti Seize |

1. Isolations – lock out tag out
   1. The authorized person in charge of works informs the authorized person in control of the equipment on what equipment will be worked on.
   2. The authorized person in control of the equipment or assigned production personnel isolates all isolation points.
   3. The authorized person in control of the equipment or his delegate (2 IC) verifies isolations and then applies his “Out Of Service” Tag and “Isolation” Tag to all primary isolation points.
   4. The authorized person in control of the equipment and the authorized person in charge of works fill out the “Authority to Work” form for the maintenance work to be carried out.
   5. The authorized person in charge of the work applies his “Work In Progress” Tag, “Personal Lock and Danger Tag” on the lockbox after the operations lock is applied.
   6. The authorized person in charge of the work informs all personnel involved in the work to sign on the ATW form & to apply their “Personal Lock and Danger Tags” on the Lockbox scissors.
2. **Flange DISASSEMBLY ASME RF/FF**
   1. Double-check the ATW that it matches the work description. Am I working on the correct flange?
   2. If the piping system has spring supports make sure they are set in a locked position.
   3.  For safety reasons, not all bolts should be taken out before the flange is opened. This applies to all size flanges. Always assume there is a possibility of pressure in the pipeline until proven otherwise. See Fig 1



Fig. 1

* 1. If a Hytorc is used set the pump at maximum pressure and if possible, use four tools during disassembly.
  2. Loosen ½ a turn at a time following the cross-wrenching procedure until the tension is off all bolts.
  3. Loosen the bolts until there is a few millimetres of clearance between the nuts and the flange.
  4. Carefully hit the flange with a large soft hammer until the gasket loosens.

**WARNING:**

With the use of a hydraulic spreader, it is important to remember the following:

If there are one or more bolts stuck in the flange’s bolt hole, this can mean that there is tension in the pipe system. In that case, great care should be taken in further disassembly of the flange, and potentially securing the pipe should be considered. Contact your supervisor if there is a doubt or a need for action.

* 1. Use two spreaders either hydraulic or mechanical. This will yield an even opening.
  2. Insert safety blocks when the desired opening is achieved. Never put fingers in the flange opening until these safety blocks have been inserted. See Fig. 2 below.
  3. Keep the lowest bolts in the flange joint so the gasket does not fall out.
  4. Remove the gasket carefully avoiding any damage to the flange faces.

1. Flange sealing surface inspection
   1. Immediately after the flanges are disassembled the sealing surfaces should be cleaned and inspected.



Fig. 2

* 1. If there is damage to the sealing faces this should be reported immediately to your supervisor.
  2. As a guide the sealing surface roughness should not exceed 6.3 micrometres for pressurised systems and 3.2 micrometres for vacuum service.

See ASME PCC-2-2011 Appendix D for Acceptance limits of the flatness and damage on the gasket surface.

* 1. Any tension in the piping system that requires a great force to bring the flanges parallel to each other than described in this procedure then it will be reported to your supervisor and Reliability Engineering for evaluation of risk and needed corrective action. Fig 3 below



Fig. 3

* 1. We may have a skewed flange but within permitted manufactured tolerance. In this circumstance it can be corrected but extreme care must be taken.
  2. In such cases the bolts must be tightened first in the area where the distance between the flange faces is greatest.



Fig. 4

* 1. First install all flange bolts.
  2. With the alignment of a skewed flange no more the half the bolts will be used. Every second bolt must remain loose.
  3. Tighten any bolt in the flange where the gap between the faces is greatest.
  4. Use no more than 40% of the final bolt torque using either a hytorc or torque wrench
  5. Go around the flange several times until the faces are parallel.

1. **FlANGE ALIGNMENT**
   1. Flanges should always be aligned before tightening begins.
   2. Use your available alignment tool.
   3. How the alignment tool is used depends on the trade’s person’s evaluation.
   4. After the first alignment, insert all bolts to see they can move freely.
   5. If some bolts do not move freely you will have to move the alignment tool. All bolts must move freely in the flange bolt holes.
   6. Never align the flange connection with the bolts alone. Always use an alignment tool.
   7. A qualified rigger and a crane may be needed to assist with flange alignment for larger piping.
   8. If you cannot pull the flange surfaces parallel contact your supervisor.
2. gasket installation AND CENTERING
   1. Carry out a final check for seal surface damage and cleanliness.
   2. The opening between the flanges should be larger than the thickness of the gasket
   3. Always install a new gasket and ensure it is the correct type.
   4. Coating gaskets with adhesives and anti seize is not allowed.
   5. In some cases especially with small piping wall thickness the inner diameter maybe too small that will restrict flow. Check and use the correct gasket.
   6. Insert the lowest bolts if the piping is horizontal to prevent the gasket from falling out.
   7. Check that the gasket has the correct inside and outside diameter.
   8. Check the gasket is sitting correctly
   9. Use a torch and see that the gasket will sit up against all bolts around the flange.
   10. The bolts will centre the gasket on the contact surfaces.
3. assembly – bolt INSPECTION AND PREPERATION
   1. The bolt and nut material grades should be correctly identified before they are used. Nuts and bolts without markings should never be used
   2. Check the length of the stud or bolt to avoid short bolting and excessive threads. Bolts, studs and nuts shall be cleaned using a wire brush to remove any dirt on the threads.
   3. The bolt’s threads and the nut’s contact surface should be checked for burrs, damage and wear.
   4. All damaged bolts and nuts should be replaced.
   5. Bolt lubrication is critical and if a special lubricant is specified it should be used.
   6. The bolt threads should not be lubricated before assembly only after they have been inserted.



Fig. 5

* 1. All bolts should be numbered to assist in the correct torquing sequence.

Be aware that friction in a bolts thread is very hard to predict. Damage free threads and the use of lubrication reduce friction significantly. when we use a torque wrench or hytorq most of the torque is directed at countering friction. If bolt threads are damaged and not lubricated, we will not achieve the desired clamping force for the specified torque.

1. **SEQUENCE AND TORQUING PROCEDURE** 
   1. When bolt loading requires a torque higher than 678 Nm (500 ft/lbs) to apply, hydraulic bolt torquing is recommended.
   2. Insert all remaining bolts/studs and nuts so they are hand-tight.
   3. All bolts and studs must have full thread engagement.
   4. All bolts or studs are to be numbered with a permanent marker to allow the correct tightening sequence to be followed.
   5. Tighten the bolts with hand wrenches or an impact gun on low pressure until the nuts and bolts are snugs against the flange.
   6. Follow the tightening sequence shown in Fig. 6 below.
   7. An air impact gun cannot be used to achieve the final torque.
   8. Verify that the gap between the flanges stays uniform by measuring in four equally spaced locations during the tightening process. This is important for an even clamping load on the gasket. See Fig 6



* 1. Additional torque may be applied to the two bolts that straddle the maximum gap to achieve uniformity, but the torque load should not exceed 40% of the final hurdle.
  2. Final torquing of the entire bolt pattern by torque wrench or hytorc should be tightened around the flange at least three times at 30%, 70% and 100% of the calculated torque.
  3. After the three basic torque passes are completed, repeat the torquing of nuts at least once using the final torque in a crisscross manner until no further rotation of the nut is observed.
  4. Denso Tape is to be applied to nuts and exposed threads to prevent corrosion.

The sequence in which the bolts and nuts are tightened greatly influences the distribution of the loads acting on the gasket (gasket seating stress). Improper bolt tightening leads to a broad preload scatter and may result in the required minimum gasket seating stress not being reached through ultimate leakage.

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**Fig. 7**

ASME PCC-1-2013 (PAGE 33) States. “The simultaneous use of multiple tools spaced evenly around a flange has been shown to give equal or even superior tightening parity and parallel closure in less time than using a single tool in a cross pattern

1. **COMPLETE THE JOB - care**
   1. Check the work area for any potential hazards that may have been created.
   2. Remove all rubbish and place it in the appropriate rubbish bin.
   3. Follow the area “ICARE” standard, clean up the work area, and pack up and store all equipment and tools.
   4. Notify the Team Leader in that area that the job is completed.
   5. Conduct the post-job safety analysis.
   6. Ensure all paperwork and the job work pack are filled out and returned to your Team Leader.
   7. Whenever any changes in the task occur:

* Review the SWP.
* Complete the Controlled Document Creation, Review and Release Form.
* Hand the form to your Team Leader.
  1. Initiate and register the form with Document Control

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| cid:image010.png@01CBFAA8.25C0E780 | Please use this symbol at the end and put the appropriate text about reporting any faults or defects to your Team Leader as soon as practicable if the responsibility is more severe than they should be informed immediately. |

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|  | **Information that prevents injury to people** |

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|  | **Information that prevents damage to equipment** |

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|  | Important information that needs to be highlighted, tips & key points |