



Industrial Performance Services

Industrial Tubular Catalyst Services

# HOT BOLTING STUD REPLACEMENT PROCEDURE

V:2023.1

# Hot Bolting Stud Replacement Procedure

January 2023

## 1.0 Purpose

- 1.1 The purpose of this procedure is to identify the minimum steps needed to evaluate, analyze and control hazards associated with safely performing stud torquing on bolted flange connections on a closed system containing sources of energy.
- 1.2 The requirements contained within this procedure are applicable to IPS★ITCS and affiliates.

## 2.0 Evaluate

- 2.1 If any of the following conditions exist STOP and call the Job Lead.
  - 2.1.1 Flammable Liquids – Liquids having a flash point below 100° F or 37.8 C°
  - 2.1.2 Hazardous Material – Any substance or compound possessing toxic, reactive, flammable or explosive properties as well as physical hazards associated with temperature, pressure, etc.
  - 2.1.3 The bolted connection has been previously leak repaired.
  - 2.1.4 Condition of the threads shows signs of visible corrosion, or other damage to studs such as pitting.
  - 2.1.5 Condition of the nuts are corroded, damaged or worn.
  - 2.1.6 The medium service is able to cause hydrogen embrittlement.
  - 2.1.7 The medium service is able to cause stress or caustic corrosion cracking.
  - 2.1.8 Gaulling of any fastener occurs at any time.
  - 2.1.9 The studs are threaded into the opposing flange connection.

## 3.0 Pre-Job Technical Review

- 3.1 Review job requirements and perform a job walk down with the customer.
- 3.2 Verify with customer the system pressure of the bolted connection.
- 3.3 Verify with customer the surface temperature of the bolted connection.
- 3.4 Verify with customer the stud material in the bolted connection.
- 3.5 Verify with customer the percentage of yield the studs were torqued to.
- 3.6 Verify with customer the same percentage of yield on the studs shall be maintained.
- 3.7 Verify with customer the lubricant to be used and its Coefficient Factor.
- 3.8 Verify with the customer the number of studs in the bolted connection.
- 3.9 For bolted connections with 4 or less studs, a pressure rated C-Clamp/Strong-Back must be used during the breakout of any single stud.
  - 3.9.1 Verify the line size and flange

<b>C-Clamps for Hot Swapping</b>				
*Using <i>Wright Tool</i> Heavy & Extra Heavy-Service Forged C-Clamps				
<b>Rating</b>	<b>Line Size</b>	<b>Minimum Test Load Required</b>	<b>Part No.</b>	<b>Test Load Based on Part No.</b>
<b>150#</b>	1/2"	3545 lbf	90102	7500 lbf
	3/4"	3545 lbf	90102	7500 lbf
	1"	3545 lbf	90102	7500 lbf
	1-1/4"	3545 lbf	90102	7500 lbf
	1-1/2"	3545 lbf	90102	7500 lbf
	2"	5650 lbf	90102	7500 lbf
	2-1/2"	5650 lbf	90102	7500 lbf
	3"	5650 lbf	90102	7500 lbf
<b>300#</b>	1/2"	3545 lbf	90102	7500 lbf
	3/4"	5650 lbf	90102	7500 lbf
	1"	5650 lbf	90102	7500 lbf
	1-1/4"	5650 lbf	90102	7500 lbf
	1-1/2"	8360 lbf	90103	8500 lbf
<b>600#</b>	1/2"	3545 lbf	90102	7500 lbf
	3/4"	5650 lbf	90102	7500 lbf
	1"	5650 lbf	90102	7500 lbf
	1-1/4"	5650 lbf	90102	7500 lbf
	1-1/2"	8360 lbf	90103	8500 lbf
<b>1500#</b>	1/2"	8360 lbf	90103	8500 lbf
	3/4"	8360 lbf	90103	8500 lbf
	1"	11,543 lbf	90108	12,500 lbf
	1-1/4"	11,543 lbf	90108	12,500 lbf
	1-1/2"	15,143 lbf	90103H	16,250 lbf
<b>2500#</b>	1/2"	8360 lbf	90103	8500 lbf
	3/4"	8360 lbf	90103	8500 lbf
	1"	11,543 lbf	90108	12,500 lbf
	1-1/4"	15,143 lbf	90103H	16,250 lbf
	1-1/2"	19,760 lbf	90104H	20,000 lbf



## 4.0 Pre-Job General Safety Review

- 4.1 Verify with the Customer Contact, conditions are as stated on the Pre-Job Assessment form.
- 4.2 Air requirements
  - 4.2.1 100 cfm and 100 psi air connection
  - 4.2.2 How much air hose will be needed to reach the job site
  - 4.2.3 If the air supply is not within a reasonable distance from the job site, an air compressor may be required so that an adequate amount of air is available to power pneumatic tools
- 4.3 Permits
  - 4.3.1 What types of permit(s) will be required
  - 4.3.2 Who approves, signs, and receives the permit(s)
- 4.4 Back-up Wrenches
  - 4.4.1 Only following style wrenches are approved for use as a Back-Up wrench for hydraulic and/or pneumatic torqueing or de-torqueing activity:
    - 4.4.1.1 The use of any Back-Up tool other than those shown below must be approved prior to use.



### Unapproved Back-Up Tools



- 4.5 Before any use inspect the entire tool system, including hoses. Gauge, sockets and backup wrenches.
  - 4.5.1 Do not use kinked hoses, oversized or heavily worn sockets, backup wrenches, damaged tools, pumps, connectors or gauges.
  - 4.5.2 Connect system to operate from a safe distance.
  - 4.5.3 Checkout tool function with drive or hex ratchet turning in one direction only.
  - 4.5.4 Checkout gauge from a safe distance that needle is on zero at no pressure and at 10,000 psi at high pressure.
  - 4.5.5 With system on at 10,000 psi check system visually for leaks.
- 4.6 Decontamination of equipment, if applicable.

- 4.6.1 Does the customer have a means of decontaminating equipment and tools that may come in contact with chemicals or radioactive material?
- 4.6.2 If hazardous waste is generated, does the plant have areas for disposal?
- 4.6.3 Review Communications Procedure with all persons on work crew.

## 5.0 Communications Procedure

- 5.1 If a team of two or more persons are working together to loosen or tighten a bolted assembly, a communication plan must be discussed and used.
  - 5.1.1 The communication plan may be verbal, visual, hand signals or radio. All persons involved must understand the communication method and it must be documented on the JSEA.
  - 5.1.2 Whenever possible, the wrench operator should be the only person operating the pump.
- 5.2 Communication OPTIONS:
  - 5.2.1 OPTION #1 With normal eye contact/noise level: A. “Hand Motion Signals” • Clinched Fist Represents = “All-Stop” • Protruding Index Finger Represents = “Activate” • Fully extended hand with repeated opening & closing of fist represents = “Assistance Needed” B. “Head Motion Signals” • Vertical Up & Down Motion Represents = “Activate” • Horizontal Side to Side Motion Represents = “All-Stop” • Vertical Head Down Position with Horizontal Side to Side Motion Represents = “Assistance Needed” Note: With option #1 the two equipment operators must maintain (4) four feet distance.
  - 5.2.2 OPTION #2 With limited eye contact/above normal noise level: A. Add Additional Personnel to Ensure Eye-to-Eye Contact. B. Utilize Headset Radio Communications for Equipment Operators.
  - 5.2.3 OPTION # 3 With no eye contact/high noise level: A. Utilize Headset Radio Communications for Equipment Operators. B. Safe Work Procedures for use with hydraulic torque equipment and Impact Wrenches.
    - 5.2.3.1.1 It is mandatory to use a lanyard with your back-up wrench when working from an elevated position.
    - 5.2.3.1.2 All power being supplied to the power tools on the bolted assembly must stop before any repositioning of the back-up wrench is done.
    - 5.2.3.1.3 The person repositioning the back-up wrench must communicate to the person operating the power supply that the back-up wrench needs repositioning and the power being applied must cease.
    - 5.2.3.1.4 The person operating the power supply controls must confirm.
    - 5.2.3.1.5 The person operating the power supply controls will put the power supply controls down and remove the tool.
    - 5.2.3.1.6 Once the back-up wrench has been repositioned, the person on the back-up wrench will confirm that their hands and fingers are clear of the wrench and pinch points and will give the power supply controller clearance to continue applying power.
    - 5.2.3.1.7 The person operating the power controls will not operate the tool until they have received clear communication that

- 5.2.3.1.8 it is safe to resume from the person operating the back-up wrench.  
The person using the opposite wrench will not apply any force until they have received clear communication that it is safe to resume from the person operating the back-up wrench.

## 6.0 Procedure

- 6.1 Complete and review Job Safety Environmental Analysis (JSEA) with participating employees.
  - 6.1.1 A plant JSEA is acceptable in lieu of the IPS★ITCS JSEA as long as all points are covered.
- 6.2 For bolted connections with 4 or less studs, the appropriate pressure rated C-Clamp/Strong-Back shall be installed and tightened, next the fastener being loosened, and only removed after that stud has been retightened throughout this procedure.
- 6.3 Using an approved marker only, number the stud tightening sequence per ASME PCC-1 guidelines.
- 6.4 Set the torque-up wrench to 100% of the targeted torque value.
- 6.5 Set the breakout torque wrench to 150% - 200% of the targeted torque value.
- 6.6 Using the breakout wrench, loosen stud number (1).
- 6.7 Remove stud number (1) and replace it with only a new stud and nuts of the appropriate diameter, thread pitch, length and material along with washers as applicable.
- 6.8 Using the customer specified lubricant from 3.7, liberally apply it to the thread contact surface and to nut/flange contact surfaces.
- 6.9 Reinstall the nut.
- 6.10 Verify stud markings all face the same direction and nut markings are facing out.
- 6.11 After allowing some time for the stud to reach full temperature, use the torque-up wrench and tighten stud number (1) to 100% of the targeted torque value.
- 6.12 Move to stud number (2) 180 degrees apart from stud number (1) and repeat steps 6.8 thru 6.12.
- 6.13 Move to stud number (3) 90 degrees apart from stud number (2) and continue to repeat steps 6.8 thru 6.14 until 100% of studs have been changed out and re-torqued.
- 6.14 Starting over at stud number 1, perform a full sequential start pattern pass of all studs at 100% of targeted valve
- 6.15 Follow the start pattern pass with rotational “ringer” passes until there is no further movement of the nuts.
- 6.16 Perform relaxation passes a minimum of 4 hours after pass 4 has been completed if allowed by customer.
- 6.17 Record all information on Flange Make-Up Data Sheet
- 6.18 Ensure work area is left in a clean and safe condition and all permits and LO/TO has been signed off.





# Competency Assessment

No.	Questionnaire	C/NYC
Q1		
A1		
Q2		
A2		
Q3		
A3		
Q4		
A4		
Q5		
A5		

Enclosed Attachments	
Risk Assessment	<input checked="" type="checkbox"/>
Environmental Aspect and Impact	<input checked="" type="checkbox"/>
Training and Competency	<input checked="" type="checkbox"/>
Measure and Evaluation Tools	<input checked="" type="checkbox"/>

# Competency Checklist

To be filled out by Trainer and signed by Employee, Assessor and Supervisor before being returned to the HSEQT Manager for recording purposes.

Procedure	Competency	Date	Competent YES / NO	Employee Signature

(Please tick appropriate box)

This employee is competent in performing the job.


This employee has not attained the competency level.

\*

\* *If the employee has not attained all competency levels, the General Manager must assess the action to be taken, provide an extension of training or alternative action as listed below.*

Alternate action to be taken: \_\_\_\_\_

Signed By	Employee:	_____	Date:	_____
	Trainer:	_____	Date:	_____
	Assessor:	_____	Date:	_____
	Regional Manager:	_____	Date:	_____

# Environmental Aspects and Impacts

## Identified Environmental Aspects and Impacts

The following table is a summary of the likely environmental aspects and impacts that may be identified during site inspections. The significance of each impact needs to be assessed using the Risk Assessment Model.

Activity	Aspect	Impact
<b>Purchasing &amp; Administrative Work</b>	Consumption of goods	Conservation of natural resources
	Consumption of energy (eg. Electrical equipment and facilities)	Release of greenhouse gases and atmospheric pollution; Consumption of natural resources; Habitat loss
	Generation of waste (eg. Paper)	Consumption of space for waste disposal; Habitat loss
<b>Climate Control</b>	Consumption of energy	Release of greenhouse gases and atmospheric pollution; Consumption of natural resources; Habitat loss
	Generation of noise	Disturbance to community; Habitat loss
<b>Cleaning of – offices / vehicles</b>	Storage, use and release of chemicals	Contamination of air, water or soil; Risk to human health
<b>Transport (Fleet vehicles / staff travel)</b>	Consumption of energy	Release of greenhouse gases and atmospheric pollution; Consumption of natural resources; Loss of habitat at all stages of generation; Light pollution
	Consumption of goods (eg. Oil)	Consumption of natural resources; Generation of waste; Habitat loss; Biodiversity impacts
	Generation of waste (eg. Oil)	Consumption of space for waste disposal; Potential contamination of water or soil; Habitat loss
	Exhaust emission	Release of greenhouse gases and atmospheric pollution
	Use of dangerous goods (eg. Batteries)	Potential contamination of air, water or soil; Risk to human health
	Generation of noise	Disturbance to community; Habitat degradation
<b>Operations</b>		

Sample only.  
To be filled in

# Risk Assessment

Risk Assessment // insert name here

Step No: Logical sequence	Sequence of Basic Job Steps documented in the Procedure, Work Instruction and project plans. Break down Job into steps.  Each step should be logical and accomplish a major task.	Potential Safety & Environmental Hazards/Impacts at the site of the Job  Identify the actual and potential health and safety hazards and the environmental impacts associated with each step of the job.	Risk Rating  Refer to the risk matrix or HSEQT.PRO. Risk Mgt	Recommended Corrective Action or Procedure  <i>Determine the corrective actions necessary to reduce the risk to as low as reasonably practical (ALARP) refer to HSEQ.PRO.Risk Mgt. The risk must be reduced or controlled to ALARP before work commences.</i>  Document who is responsible for implementing the controls to manage each hazard identified.	Risk Rating refer to the risk matrix or HSEQT.PRO.Risk Mgt
1.					
2.					
3.					
4.					
5.					

# Audit



<b>Process:</b> insert// <b>Procedure:</b> Insert //		Date:	Audited by:	
		Location of Audit:	Area Mgr/Supervisor:	
Item	Question	Evidence Sited	Comments	Conformance Score 0,3,5
1.				
2.				
3.				
4.				
5.				
6.				
7.				
AUDITOR'S SIGNATURE:		CONFORMANCE SCORE:     / 25		0 – Non-Conformance 3 – Continuous Improvement Opportunity 5 – Total Conformance
SAFETY REP'S SIGNATURE:		CONFORMANCE %:		