

# Flange Bolt Torquing Engineering Specification

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#### Policy documents and ownership

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### The Policy Management System

To meet its business, regulatory and social responsibilities TCL maintains a policy management system.

This comprises operating principles, policies, standards, procedures and guidelines, together referred to as Policy Documentation, which are made available to Employees through the Policy Centre on the Todd intranet.

#### Alignment with the Group's Operating Principles

This Standard aligns with the Operating Principle of: Creating Value

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# 1 Scope

This Procedure is for use by Todd Energy and its nominated contractors and shall be applied to piping systems designed and constructed in accordance with piping classes specified by Todd Energy.

Tightening procedures and the bolt loading to be applied to ASME B16.5 and MSS SP44 flanges for the normal Todd Energy Piping Class combinations of flange, gasket and bolting materials are contained within this Standard.

Equipment flange joints and piping flange bolting within project supplied package equipment units (i.e., Propak LPG plant at MMPS) are not included in the scope of this standard. However, some special joints are appended to this document and will be added to from time to time.

This Procedure applies to all future work on existing installations as well as refurbishment and new project work.

Torque values for insulation joints shall be per manufacturer's recommendations and must consider lubrication requirements.

The torque values quoted in this Procedure are not intended for B7M or L7M bolts.

# 2 References

Reference	Document Name
	Piping Systems Specification and Selection
ASME PCC-1	Guidelines for Pressure Boundary Bolted Flange Joint Assembly
ASME B16.5	Pipe Flanges and Flanged Fittings
ASME B31.3	Process Piping

#### 3 Definitions

Definition	Description
FACS	Flange Assembly Control Sheet



### 4 Procedure

## 4.1 Requirements

The method of flange tightening is dependent on bolt size, system pressure rating, system service, and shall be in accordance with the following schedule.

The flogging of bolts is not permitted except where no other alternative method is available and has been approved by Maintenance Superintendent. i.e., flogging is required on KPS HPKO RV's.

Flange bolts shall be tightened by suitable torque devices. This includes all hydrocarbon systems in all pressure ratings including all utility systems with flanges.

# 4.1.1 General Requirements

Controlled torque wrenching shall be carried out using either manual or power assisted torque wrenches. The method chosen is dependent upon bolt loading, access, clearance and tooling availability, which can be determined by the site personnel.

All tooling used to torque up flanges must have a current calibration.

# 4.1.2 Torquing Procedure

To achieve joint tightness, it is important that the following procedure is adhered to:

- Check and ensure that the general requirements of Section 5.1 have been satisfied.
- To achieve uniform joint load/stress distribution the bolts shall be tightened in three stages representing 25%, 50% and 100% of the torque values stated in **Appendix A**. At each stage of tightening, bolts shall be tightened in a controlled sequence as stated in **Appendix A**.
- Finally, the bolts shall be chased (using the 2 forward 1 back method) round using the 100% torque value stated in **Appendix A** until no further movement occurs.



# 4.2 Thread Lubricants and Preservation Fluids

All bolts, except for PTFE coated studbolts and where a manufacturer specifies dry (no lubricant) fit, shall be treated with an anti-seize lubricant using one of the approved grades below:

- Molykote P37 general purpose anti seize for use on zinc-coated B7 & L7, B7M and L7M, stainless steel B8 and B8M, duplex and super stainless-steel stud bolts.
- Loctite 771 general purpose anti seize for use on zinc-coated B7 & L7, B7M and L7M, stainless steel B8 and B8M, duplex and super stainless-steel stud bolts.

If other approved lubricants are required to be used, this change must first be approved by the Technical Authority.

Once approved, the tabulated torque values shall be modified if lubricant coefficient of friction differs from the below. This can be achieved by adjusting the quoted torque by the ratio of the friction coefficients:

# Actual lubricant friction coefficient x Torque figure from Tables

Revised torque =

0.12

The use of lubricant with a coefficient of friction less than 0.10 can lead to excessive bolt stress being applied by wrenches and yielding or failure of flanges or bolting may result.

The coefficient of friction for PTFE coated bolts is significantly less than 0.10 and overstressing could occur if the appropriate torque values are not used.

# Torque values for PTFE coated bolts shall use the applicable tables in Appendix A. and are unlubricated.

### Greases containing molybdenum disulphide shall not be used.

# 4.3 Flange Assembly Quality Control

### 4.3.1 General

Each work activity which involves the breaking of flanges shall have a Flange Assembly Control Sheet (FACS) prepared and included within the Workpack or utilise the FACS in the Permit to Work system (checklist 59). The FACS is a register of all flanges that will be broken or disturbed including hot bolting during the work activity. This requires the Flange Assembler (Fitter), nominated/competent Checker for QA/QC to sign off that each flange has been assembled in accordance with this document. This procedure also applies to flanges that are being broken and reassembled as part of applying a Process Isolation, i.e., turning of spec blinds, spades, slip spades, blind flanges.

Alternative flange assembly control sheets are allowed provided they include all the information, methodology and checks as outlined in this flange procedure.

In addition to the Flange Assembly Control Sheet each flange set will have a Flange Assembly Tag (Refer **Appendix C**) attached, which will correspond with the relevant information, some of which is duplicated on the FACS. Both the tag and the FACS are to be completed concurrently as the flange is assembled and checked.

Flange tags are to remain in place during commissioning / pressure up so that all flange breaks can be identified by the commissioning team / operations. Flange tags are to be removed by



responsible commissioning team / operations at the completion of the commissioning / leak test phase and then disposed of.

The personnel who assemble the flange joint, the Fitter and then checked the assembled joint, the QA/QC Checker are individually responsible for completing their section of the Flange Assembly Tag and Flange Assembly Control Sheet.



#### 5 Responsibilities

#### 5.1 Work-pack Compiler or Task Focal

in conjunction with the assigned Todd nominated person responsible shall:

- Prepare the Flange Assembly Control Sheet and relevant drawing if applicable. Appendix B
- Ensure that all relevant sections of the Flange Assembly Control Sheet are completed prior to final handover to Operations.
- Ensure Completed Flange Assembly Control Sheet is kept as a record in the relevant location (MEX W/O, Project Handover doc, Shutdown Workpack, Permit (Checklist 59).

#### 5.2 Fitter

Person assembling the flange, the Fitter shall:

- Assemble the flange using correct methods and procedures and complete the quality control actions as defined in this procedure (Flange Assembly Control Sheet and Flange Tags).
- Completes the Flange Details on the Tag.
- Attaches Tag to made up flange set.
- Completes the FACS.

#### 5.3 QA/QC Checker

Provide a quality check of the flange assembly and complete the quality control actions as defined in this procedure (Flange Assembly Control Sheet and Flange Tags).

The QA/QC Checker shall include the following checks as a minimum:

- Visual check for flange off-set & angular misalignment (Vertical & Horizontal misalignment).
- Visual check gasket correctly centred in flange set.
- Visual check for loose stud bolts.
- Visual check for stud bolt free length (not bound at end of stud to other bodies).
- Visual check for exposed stud bolt threads. ASME requires full thread engagement with nut (nominally 1-3 threads exposed).
- Visual check for foreign objects in flange set (flange protection caps).
- Visual check for nuts installed correctly.
- Check Flange Assemble Control Sheet (FACS) torque values are correct for flange set and FACS is completed.

**Note:** The flange is to be checked by a person who is suitably experienced and qualified to check the flanges have been assembled correctly. The Checker may be a competent person involved with the flange assembly and tightening or another independent competent person who has carried out appropriate checks.



# 5.4 Todd Energy Operations / Commissioning team

- Complete the integrity testing of the flanges during commissioning phase and complete the quality control actions as defined in this procedure.
- Once flange joint has been commissioned remove the Flange Assembly tag and dispose of the tag accordingly.



# 6 Procedure

ΑΟΤΙΟ	N	ВҮ
1.	Identify flanges and mark-up on the appropriate drawings.	Work Pack Compiler / Task Focal or Fitter
2.	Prepare the Flange Assembly Control Sheet (FACS)	As above
3.	<ul> <li>Assembly</li> <li>Upon initial makeup of the flange joint, the Fitter shall ensure that the correct gasket type and rating is used, and that the stud bolts are of the correct size, length, and material in accordance with Todd Energy Document No. 6030_DC045 TMM3NS003 Piping Systems Specification and Selection, or as shown on the isometric drawing.</li> <li>The Fitter shall: <ul> <li>Assemble the flange using correct methods and procedures.</li> <li>Attach the Flange Assembly Tag Appendix C</li> <li>Complete the flange assemble section of the Flange Assembly Tag</li> <li>Sign the Flange Assembly Control Sheet (Fitter) Appendix B</li> </ul> </li> <li>NOTE: should the flange not be tightened at the time of assembly, the Flange Assembly Tag must not be attached, and Control Sheet shall not be signed until the appropriate</li> </ul>	The Fitter
4.	<ul> <li>QA/QC Checker</li> <li>Carry out the checks as per section 6.3.</li> <li>Visual check for flange offsets &amp; angular misalignment (Vertical &amp; Horizontal misalignment)</li> <li>Visual check gasket correctly centred in flange set.</li> <li>Visual check for loose stud bolts</li> <li>Visual check for stud bolt free length (not bound at end of stud to other bodies)</li> <li>Visual check for exposed stud bolt threads ASME requires full thread engagement with nut (nominally 1-3 threads exposed.)</li> <li>Visual check for foreign objects in flange set (Flange protection caps)</li> <li>Visual check for nuts installed correctly.</li> <li>Check Flange Assemble Control Sheet (FACS) torque values are correct for flange set and FACS is completed.</li> <li>Fill in and sign the Checked QA QC section of the Flange Assembly Tag</li> <li>Sign the Flange Assembly Control Sheet (OA/OC Checker)</li> </ul>	QA/QC Checker may be a competent person involved with the flange assembly and tightening or another independent competent person who has carried out appropriate checks.



ACTI	N	BY				
	Appendix B					
6.	Operations / Commissioning team	Operations / Commissionir				
	Check each Flange tag is correctly filled out.	lean				
	• Carry out commissioning / integrity testing of the flanged joints, i.e., visual and snoop test etc					
	<ul> <li>Remove the completed tag from Flange set and dispose of appropriately, sign procedure that integrity test has been completed.</li> </ul>					



# Appendix A – Bolt Tightening Sequence & Recommended Bolt Torque Tables

No. of Bolts	Sequentially Clockwise Sequence													
4	1-3-2-4													
8	$1-5-3-7 \rightarrow 2-6-4-8$													
12	$1-7-4-10 \rightarrow 2-8-5-11 \rightarrow 3-9-6-12$													
16	$1 \text{-} 9 \text{-} 5 \text{-} 13  \rightarrow  3 \text{-} 11 \text{-} 7 \text{-} 15  \rightarrow  2 \text{-} 10 \text{-} 6 \text{-} 14  \rightarrow  4 \text{-} 12 \text{-} 8 \text{-} 16$													
20	$1\textbf{-}11\textbf{-}6\textbf{-}16 \hspace{0.1 in} \rightarrow \hspace{0.1 in} 3\textbf{-}13\textbf{-}8\textbf{-}18 \hspace{0.1 in} \rightarrow \hspace{0.1 in} 5\textbf{-}15\textbf{-}10\textbf{-}20 \hspace{0.1 in} \rightarrow \hspace{0.1 in} 2\textbf{-}12\textbf{-}7\textbf{-}17 \hspace{0.1 in} \rightarrow \hspace{0.1 in} 4\textbf{-}14\textbf{-}9\textbf{-}19$													
24	$1\text{-}13\text{-}7\text{-}19 \hspace{0.1in} \rightarrow \hspace{0.1in} 4\text{-}16\text{-}10\text{-}22 \hspace{0.1in} \rightarrow \hspace{0.1in} 2\text{-}14\text{-}8\text{-}20 \hspace{0.1in} \rightarrow \hspace{0.1in} 5\text{-}17\text{-}11\text{-}23 \hspace{0.1in} \rightarrow \hspace{0.1in} 3\text{-}15\text{-}9\text{-}21 \hspace{0.1in} \rightarrow \hspace{0.1in} 6\text{-}18\text{-}12\text{-}24$													
28	$\begin{array}{cccccccccccccccccccccccccccccccccccc$													
32	$\begin{array}{cccccccccccccccccccccccccccccccccccc$													

# **Bolt Tightening Sequence**

# API 6A 5000psi Type 6B Flange Torque Ratings

		API 6A 5000psi Type 6B												
		Lubricated Studbolts (no PTFE)												
Din	Class	2501, 2511, 2541												
Ріре	Class	50, 50/	A, 50D (fo	or sizes ≥ 2	" NB)									
Nominal Flange Size	Corresponding Pipe Size	Stud Size	Nut AF	Tor	que									
inch	inch	inch	inch	N.m	lbf.ft									
2 1/16	2	7/8	1 7/16	405	300									
2 9/16	2 1/2	1	1 5/8	605	445									
3 2/16	3	1 1/8	1 13/16	895	660									
4 1/16	4	1 1/4	2	1205	890									

#### Notes:

Notes:		Notes:
1. Flange Rating	API 6A 5000psi Type 6B	1. Flange Rating
2. Flange Materials	As per API 6A	2. Flange Materials
3. Bolting Materials	ASTM A193 Grade B7, ASTM A320 Grade L7,	3. Bolting Materials
	K500 Monel, Super Duplex UNS S32760 FLT	
4. Gasket Type	Ring Joint	4. Gasket Type
5. Service Temperature	Minus -46C to +120C	5. Service Temperature
6. Lubricant	Molykote P37 or Loctite 771	6. Lubricant

		API 6A 5000psi Type 6B PTFE coated (unlubricated) studbolts										
Pine	Class	2501, 2511, 2541										
Fipe	e Class	50, 50,	A, 50D (fo	r sizes ≥ 2'	' NB)							
Nominal Flange Size	Corresponding Pipe Size	Stud Size	Nut AF	Tor	que							
inch	inch	inch	inch	N.m	lbf.ft							
2 1/16	2	7/8	1 7/16	260	190							
2 9/16	2 1/2	1	1 5/8	380	280							
3 2/16	3	1 1/8	1 13/16	540	400							
4 1/16	4	1 1/4	2	750	555							

# API 6A 5000psi Type 6B As per API 6A ASTM A193 Grade B8M - PTFE Coated

**Ring Joint** Minus -46C to +120C None

#### 7. Pipe spec 50, 50D applicable for pipe sizes < 2" NB. For pipe sizes $\ge$ 2"NB, refer API 6A flange torque table.

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# ASME B16.5 Flange Torque Ratings for Carbon Steel and Duplex Flanges

Nut Factor 0.16

	F	lange (	Class 15	0	F	lange (	Class 30	0	Flange Class 600				Flange Class 900				Flange Class 1500				Flange Class 2500				
Pipe Size	Stud	Area	Stress	Torque	Stud	Area	Stress	Torque	Stud	Area	Stress	Torque	Stud	Area	Stress	Torque	Stud	Area	Stress	Torque	Stud	Area	Stress	Torque	
inch	inch	in^2	ksi	lbf.ft	inch	in^2	ksi	lbf.ft	inch	in^2	ksi	lbf.ft	inch	in^2	ksi	lbf.ft	inch	in^2	ksi	lbf.ft	inch	in^2	ksi	lbf.ft	
1/2	1/2	0.126	50	40	1/2	0.126	50	40	1/2	0.126	50	40	3/4	0.302	35	105	3/4	0.302	35	105	3/4	0.302	35	105	
3/4	1/2	0.126	50	40	5/8	0.202	50	85	5/8	0.202	50	85	3/4	0.302	35	105	3/4	0.302	35	105	3/4	0.302	35	105	
1	1/2	0.126	50	40	5/8	0.202	50	85	5/8	0.202	50	85	7/8	0.419	35	170	7/8	0.419	35	170	7/8	0.419	35	170	
1 1/2	1/2	0.126	50	40	3/4	0.302	50	150	3/4	0.302	50	150	1	0.551	35	255	1	0.551	35	255	1 1/8	0.728	35	380	
2	5/8	0.202	50	85	5/8	0.202	50	85	5/8	0.202	50	85	7/8	0.419	35	170	7/8	0.419	35	170	1	0.551	35	255	
2 1/2	5/8	0.202	50	85	3/4	0.302	50	150	3/4	0.302	50	150	1	0.551	35	255	1	0.551	35	255	1 1/8	0.728	35	380	
3	5/8	0.202	50	85	3/4	0.302	50	150	3/4	0.302	50	150	7/8	0.419	35	170	1 1/8	0.728	35	380	1 1/4	0.929	35	540	
4	5/8	0.202	50	85	3/4	0.302	50	150	7/8	0.419	50	245	1 1/8	0.728	45	490	1 1/4	0.929	35	540	1 1/2	1.405	35	985	
5	3/4	0.302	50	150	3/4	0.302	50	150	1	0.551	50	365	1 1/4	0.929	45	695	1 1/2	1.405	35	985	1 3/4	1.979	35	1615	
6	3/4	0.302	50	150	3/4	0.302	50	150	1	0.551	50	365	1 1/8	0.728	45	490	1 3/8	1.155	35	740	2	2.652	30	2120	
8	3/4	0.302	50	150	7/8	0.419	50	245	1 1/8	0.728	50	545	1 3/8	1.155	45	955	1 5/8	1.680	35	1275	2	2.652	30	2120	
10	7/8	0.419	50	245	1	0.551	50	365	1 1/4	0.929	50	775	1 3/8	1.155	45	955	17/8	2.303	35	2015	2 1/2	4.291	30	4290	
12	7/8	0.419	50	245	1 1/8	0.728	50	545	1 1/4	0.929	50	775	1 3/8	1.155	45	955	2	2.652	35	2475					
14	1	0.551	50	365	1 1/8	0.728	50	545	1 3/8	1.155	50	1060	1 1/2	1.405	45	1265	2 1/4	3.422	30	3080					
16	1	0.551	50	365	1 1/4	0.929	50	775	1 1/2	1.405	50	1405	1 5/8	1.680	45	1640	2 1/2	4.291	30	4290					
18	1 1/8	0.728	50	545	1 1/4	0.929	50	775	1 5/8	1.680	50	1820	17/8	2.303	45	2590									
20	1 1/8	0.728	50	545	1 1/4	0.929	50	775	1 5/8	1.680	50	1820	2	2.652	45	3180									
24	1 1/4	0.929	50	775	1 1/2	1.405	50	1405	17/8	2.303	50	2880	2 1/2	4.291	45	6435									

Notes:

1. Flange Rating

2. Flange Materials ASTM 105, ASTM A350 Grade LF2, ASTM A182 F51 (S31803)

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- ASTM A193 Grade B7, ASTM A320 Grade L7, K500 Monel, Super Duplex UNS S32760 FLT 3. Bolting Materials
- Compressed Fibre (Class 150 only), Spiral Wound (all sizes), RTJ (Class 1500 and 2500) 4. Gasket Type

5. Service Temperature

Minus -46C to +120C Molykote P37 or Loctite 771 6. Lubricant

7. Pipe spec 50, 50D applicable for pipe sizes < 2" NB. For pipe sizes  $\ge$  2"NB, refer API 6A flange torque table.

# ASME B16.5 Flange Torque Ratings for Carbon Steel and Duplex Flanges - PTFE Coated (unlubricated) Studbolts

Nut Factor 0.12

	F	lange (	lass 15	0	Flange Class 300				Flange Class 600				F	lange (	Class 90	0	FI	ange C	lass 150	0	Flange Class 2500				
														_	_										
Pipe Size	Stud	Area	Stress	Torque	Stud	Area	Stress	Torque	Stud	Area	Stress	Torque	Stud	Area	Stress	Torque	Stud	Area	Stress	Torque	Stud	Area	Stress	Torque	
inch	inch	in^2	ksi	lbf.ft	inch	in^2	ksi	lbf.ft	inch	in^2	ksi	lbf.ft	inch	in^2	ksi	lbf.ft	inch	in^2	ksi	lbf.ft	inch	in^2	ksi	lbf.ft	
1/2	1/2	0.126	50	30	1/2	0.126	50	30	1/2	0.126	50	30	3/4	0.302	35	80	3/4	0.302	35	80	3/4	0.302	35	80	
3/4	1/2	0.126	50	30	5/8	0.202	50	65	5/8	0.202	50	65	3/4	0.302	35	80	3/4	0.302	35	80	3/4	0.302	35	80	
1	1/2	0.126	50	30	5/8	0.202	50	65	5/8	0.202	50	65	7/8	0.419	35	130	7/8	0.419	35	130	7/8	0.419	35	130	
1 1/2	1/2	0.126	50	30	3/4	0.302	50	115	3/4	0.302	50	115	1	0.551	35	195	1	0.551	35	195	1 1/8	0.728	35	285	
2	5/8	0.202	50	65	5/8	0.202	50	65	5/8	0.202	50	65	7/8	0.419	35	130	7/8	0.419	35	130	1	0.551	35	195	
2 1/2	5/8	0.202	50	65	3/4	0.302	50	115	3/4	0.302	50	115	1	0.551	35	195	1	0.551	35	195	1 1/8	0.728	35	285	
3	5/8	0.202	50	65	3/4	0.302	50	115	3/4	0.302	50	115	7/8	0.419	35	130	1 1/8	0.728	35	285	1 1/4	0.929	35	405	
4	5/8	0.202	50	65	3/4	0.302	50	115	7/8	0.419	50	185	1 1/8	0.728	45	370	1 1/4	0.929	35	405	1 1/2	1.405	35	740	
5	3/4	0.302	50	115	3/4	0.302	50	115	1	0.551	50	275	1 1/4	0.929	45	520	1 1/2	1.405	35	740	1 3/4	1.979	35	1210	
6	3/4	0.302	50	115	3/4	0.302	50	115	1	0.551	50	275	1 1/8	0.728	45	370	1 3/8	1.155	35	555	2	2.652	30	1590	
8	3/4	0.302	50	115	7/8	0.419	50	185	1 1/8	0.728	50	410	1 3/8	1.155	45	715	1 5/8	1.680	35	955	2	2.652	30	1590	
10	7/8	0.419	50	185	1	0.551	50	275	1 1/4	0.929	50	580	1 3/8	1.155	45	715	1 7/8	2.303	35	1510	2 1/2	4.291	30	3220	
12	7/8	0.419	50	185	1 1/8	0.728	50	410	1 1/4	0.929	50	580	1 3/8	1.155	45	715	2	2.652	35	1855					
14	1	0.551	50	275	1 1/8	0.728	50	410	1 3/8	1.155	50	795	1 1/2	1.405	45	950	2 1/4	3.422	30	2310					
16	1	0.551	50	275	1 1/4	0.929	50	580	1 1/2	1.405	50	1055	1 5/8	1.680	45	1230	2 1/2	4.291	30	3220					
18	1 1/8	0.728	50	410	1 1/4	0.929	50	580	1 5/8	1.680	50	1365	17/8	2.303	45	1945									
20	1 1/8	0.728	50	410	1 1/4	0.929	50	580	1 5/8	1.680	50	1365	2	2.652	45	2385									
24	1 1/4	0.929	50	580	1 1/2	1.405	50	1055	17/8	2.303	50	2160	2 1/2	4.291	45	4830									

Notes:

1. Flange Rating 2. Flange Materials

ASTM 105, ASTM A350 Grade LF2, ASTM A182 F51 (S31803)

5. Doiting Materials	ASTM A195 Grade b7, ASTM A520 Grade L7, K500 Monel, Super Duplex ONS 552760 FL
4. Gasket Type	Compressed Fibre (Class 150 only), Spiral Wound (all sizes), RTJ (Class 1500 and 2500)
5. Service Temperature	Minus -46C to +120C
6. Lubricant	None

7. Pipe spec 50, 50D applicable for pipe sizes < 2" NB. For pipe sizes ≥ 2"NB, refer API 6A flange torque table.

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# ASME B16.5 Flange Torque Ratings for Stainless Steel Flanges

Nut Factor 0.16

	Flange Class 150				Flange Class 300			Flange Class 600			Flange Class 900					
Pipe Size	Stud	Area	Stress	Torque	Stud	Area	Stress	Torque	Stud	Area	Stress	Torque	Stud	Area	Stress	Torque
inch	inch	in^2	ksi	lbf.ft	inch	in^2	ksi	lbf.ft	inch	in^2	ksi	lbf.ft	inch	in^2	ksi	lbf.ft
1/2	1/2	0.126	47.5	40	1/2	0.126	47.5	40	1/2	0.126	47.5	40	3/4	0.302	47.5	145
3/4	1/2	0.126	47.5	40	5/8	0.202	47.5	80	5/8	0.202	47.5	80	3/4	0.302	47.5	145
1	1/2	0.126	47.5	40	5/8	0.202	47.5	80	5/8	0.202	47.5	80	7/8	0.419	45	220
1 1/2	1/2	0.126	47.5	40	3/4	0.302	47.5	145	3/4	0.302	47.5	145	1	0.551	45	330
2	5/8	0.202	47.5	80	5/8	0.202	47.5	80	5/8	0.202	47.5	80	7/8	0.419	45	220
2 1/2	5/8	0.202	47.5	80	3/4	0.302	47.5	145	3/4	0.302	47.5	145	1	0.551	45	330
3	5/8	0.202	47.5	80	3/4	0.302	47.5	145	3/4	0.302	47.5	145	7/8	0.419	45	220
4	5/8	0.202	47.5	80	3/4	0.302	47.5	145	7/8	0.419	45	220	1 1/8	0.728	45	490
5	3/4	0.302	47.5	145	3/4	0.302	47.5	145	1	0.551	45	330	1 1/4	0.929	45	695
6	3/4	0.302	47.5	145	3/4	0.302	47.5	145	1	0.551	45	330	1 1/8	0.728	45	490
8	3/4	0.302	47.5	145	7/8	0.419	45	220	1 1/8	0.728	45	490	1 3/8	1.155	40	845
10	7/8	0.419	45	220	1	0.551	45	330	1 1/4	0.929	45	695	1 3/8	1.155	40	845
12	7/8	0.419	45	220	1 1/8	0.728	45	490	1 1/4	0.929	45	695	1 3/8	1.155	40	845
14	1	0.551	45	330	1 1/8	0.728	45	490	1 3/8	1.155	40	845				
16	1	0.551	45	330	1 1/4	0.929	45	695								
18	1 1/8	0.728	45	490	1 1/4	0.929	45	695								
20	1 1/8	0.728	45	490	1 1/4	0.929	45	695								
24	1 1/4	0.929	45	695												

Notes:

Flange RatingASME B16.5Flange MaterialsASTM A182 F316LBolting MaterialsASTM A193 Grade B8M Class 2Gasket TypeSpiral WoundService Temperatur Minus -120C to +120CLubricantMolykote P37 or Loctite 771

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# Appendix B – Flange Assembly Control Sheet

Work Order	/Project No			Site					
Compiled b	У			Date		(to be prepa			
PROCEDU	RE								
<ul> <li>No. and fill in the flange details on this control sheet and on the Flange Assembly Tag.</li> <li>2. Fitter to install Flange Assembly Tag to the flange set when the flanges are assembled and tightened.</li> <li>3. Fitter to update the Flange Assembly Tag and Flange Assembly Control Sheet.</li> <li>4. QA/QC Checker to check the flange make-up, as per checklist on reverse of Flange Assembly Tag</li> <li>5. At the completion of work on the system an as per isolation procedure the flange can be released to Operations or commissioning team for commissioning testing.</li> <li>6. On completion of commissioning, Operations / commissioning team remove the Flange Assemble Tag and dispose.</li> <li>7. The Flange Assembly Control Sheet is to be archived with the completed work pack or work instruction records.</li> </ul>									
FLANGE	FLANGE	DETAIL	F	ITTER	Q	A / QC CHECKER			
	Size & Class	Torque	Date	Sign	Date	Sign			
ACCEPTED	AS CORRECT I	<u> 3Y: (</u> Designat	ed Todd Su	pervisor)	<u>ı                                    </u>				
Name:		Signed	l:	Dat	e:				





FLANGE TAG NO.	FLAN	IGE DET	AIL	FITTER		QA/QC CHECKER	
	Size & Class	Torque	Date	Sign	Date	Sign	Date



# Appendix C – Flange Assembly Tag

FLANGE DETAILS         Flange/Step No.:	۱G 🏬
Flange/Step No.: Flange Size: Flange Class/Rating: Gasket Type: Torque Required: Tool Used/Type: FITTER Name: Sign: Date:	
Flange Size: Flange Class/Rating: Gasket Type: Torque Required: Tool Used/Type: FITTER Name: Sign: Date:	
Flange Class/Rating: Gasket Type: Torque Required: Tool Used/Type: Tool Used/Type: FITTER Name: Sign: Date:	
Gasket Type: Torque Required: Tool Used/Type: FITTER Name: Sign: Date:	
Torque Required: Tool Used/Type: FITTER Name: Sign: Date:	
Tool Used/Type: FITTER Name: Sign: Date:	
FITTER Name: Date:	
Name: Sign: Date:	
Sign: Date:	
QA/QC CHECK (AS PER REVERSE OF TAG)	
Name:	
Sign: Date:	

	FLANGE TODD ENERGY ASSEMBLY TAG
	QA/QC CHECKS
•	Visual misalignment check (vertical, horizontal and angular)
•	Visual check gasket correctly sized and centered in flange set
•	Visual check for loose stud bolts
•	Visual check for stud bolt free length (not bound at end of stud to other bodies)
•	Visual check for exposed stud bolt threads (minimum 2 threads)
•	Visual check for foreign objects in flange set (flange caps/debris)
•	Visual check for nuts installed correctly
•	Check Flange Assemble Control Sheet (FACS) torque values are correct for flange set and FACS is completed



# Appendix D – Special Joints

#### Torque Settings for Mangahewa Special Joints

-					oonorai							
REF	TAG	JOINT	SITE	STUD MATERIAL, SIZE & NUMBER OF	CLASS	GA DRAWING NUMBER	OTHER DETAIL	TORQUE SETTING REFERENCE	TORQUE SETTING ft-Ibs			
	SHELL AND TUBE HEAT EXCHANGERS											
1	125-E-113	Header Box Shoulder Plugs	MHW G	SS 316L 1" 1/8-12 UNF	900#	125-20004-01		O&M Manual M-503350-QR24461- G18001A	206-280			
2	125-E-123	Header Box Shoulder Plugs	MHW G	SS 316L 1" 1/8-12 UNF	900#	125-20005-01		O&M Manual M-503350-QR24461- G18001A	206-280			
3	125-E-202	Header Box Shoulder Plugs	MHW G	SS 316L 1" 3/8-12 UNF	1500#	125-20006-01		0&M Manual M-502088-QR19577- G18-049B	190-260			

# Torque Settings for Kapuni Special Joints

General

REF	TAG	JOINT	SITE	STUD MATERIAL, SIZE & NUMBER OF	CLASS	GA DRAWING NUMBER	other Detail	TORQUE SETTING REFERENCE	TORQUE SETTING ft- Ibs
				SHELL AND TUB	E HEAT EXCHAN	IGERS			
1	E-5006 LPS Inlet Heater	Channel head cover to head	KPS	B7 3/4" x 20 of	300# SS	943-20-007 Sheet 3 & 4		Refer to "NZ201311041" (Sheet 1)	140-180
2	E-5006- LPS Inlet Heater	Channel Heads to shell	KPS	B7 3/4" x 20 of	300# SS	943-20-007 Sheet 3 & 4		Refer to "NZ201311041" (Sheet 1)	140-180
3	E-2855-57 E-2815-17 Bastex Gas/gas Exchangers	Bonnet return ends (shellside)	KA1 KA8	B7 1" 1/8 x 20 of	600# SS	941-20-522 Sheet 1 & 3		Refer to "NZ201311041" (Sheet 1)	355 - 545
4	E-2855-57 E-2815-17 Bastex Gas/gas Exchangers	Stub end flange (tube side inlet/oulet)	KA1 KA8	B7 1" 1/8 x 12 of	1500# TS	941-20-522 Sheet 5		Refer to "SILLUS RING installation instructions" (Sheet 2)	280-320

#### Flange Bolt Torquing Engineering Specification



	AIR COOLED HEAT EXCHANGERS											
5	E-0505A & B Condensate Cooler	Header box shoulder plugs	KPS	ASTM A105 1" 1/8 x 12 UNF	300#	943-20-073 Sheet 4,8 & 9		Email from Scott Hodges (26/03/19) (Sheet 3)	200-450			
6	E-5013A & B Stabiliser Condensor	Header box shoulder plugs - in/outlet end	KPS	ASTM A105 1" 1/8 x 12 UNF 27mm	300#	943-20-014 Sheet 4 & 6	Hudson P44 plugs	Email from Scott Hodges (26/03/19) (Sheet 3)	200-450			
7	E-5013A & B Stabiliser Condensor	Header box shoulder plugs - return end	KPS	ASTM A105 1" 1/8 x 12 UNF 30.2mm	300#	943-20-014 Sheet 4 & 6	Hudson P445 plugs	Email from Scott Hodges (26/03/19) (Sheet 3)	200-450			
8	E-5009 & E- 5020 LPS Compressor Coolers	Header box shoulder plugs	KPS	ASTM A105 1"1/8 x 12 UNF	600#				200-450			
9	E-9131A & E- 9231A Afterstage Coolers	Header box shoulder plugs	KA8	SA-479-304L 7/8" x 14 UNF 25.4mm	600#	941-20-02925/45			200-240			
10	E-9131B & E- 9231B Afterstage Coolers	Header box shoulder plugs	KA8	SA-479-304L 3/4" x 16 UNF 25.4mm	600#	941-20-02926/46			160-210			
11	E-2651	Header box shoulder plugs	КАб	SA-182-F316L 1" 3/8 x 12 UNF	1500#	941-20-0601 Sheet 1		Email from Scott Hodges (29/03/19) (Sheet 4)	440-502			



# **Revision and Approval Details**

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