Full Torque Nut Coupling Installation

Gates couplings equipped with the "full torque nut" offer many advantages over a staked nut. Full torque nuts do not de-torque under vibration, create more consistent clamp load force, maintain a higher break loose torque, eliminate failure at the nut staking point and are extremely over torque resistant compared to staked nuts. However no coupling is over torque proof, and in cases of extreme over torque it is possible to damage the seal face on smaller couplings. According to SAE J514 the "smaller sizes (-2 through -8) of 37 degree flare fittings are less tolerant to over torquing than the larger sizes". In the past staked nuts tended to fail at the staking point before the seal face could be damaged, where as a full torque nut will not fail before seal face damage occurs. The only completely reliable method of creating a consistent leak free, long lasting connection is to ensure that the coupling is brought to the proper torque.

The best method of ensuring a coupling is brought to the proper torque is to use a torque wrench with crowfoot. To ensure the proper torque is met, use the flats method of torque verification. Flats method may be used alone in situations where a torque wrench is inaccessible or unavailable.

There are 7 steps involved in proper coupling installation:

1. Determine the correct torque value for your coupling using the tables in Appendix A.
2. Calculated the correct torque wrench setting using the equations in Appendix B.
3. Ensure that the seal face and threads are clean and in good condition. Do not lubricate coupling threads.
4. Hand tighten the connection by bringing seal face in contact and rotating the nut by hand until it stops.
5. Mark the coupling nut and backup hex with a line for flats method of torque verification.
6. Apply a wrench to the backup hex to prevent the coupling and hose from moving while tightening the nut with a torque wrench.
7. If a torque wrench cannot fit into the coupling area or if it is unavailable, flats method may be used to ensure that the coupling is properly tightened, as shown in figure 2.

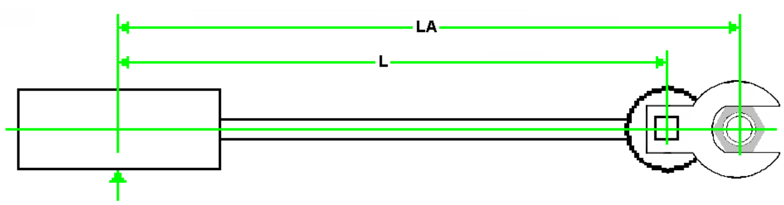

*Figure 1 - Torque wrench adjustment when using a crowfoot wrench. Torque Wrench Setting = Desired Torque * L / LA*

Before beginning the installation of a coupling, determine the correct torque specification utilizing the tables at the end of this document in appendix A. Only use the torque values specified from the manufacturer, do not use SAE torque recommendations. The minimum torque values are adequate for sealing in most applications, and the maximum torque values should never be exceeded. Once the appropriate torque is determined calculate the correct torque wrench setting. The most straight forward method of determining the correct torque setting is to multiply the desired torque by the length of the wrench from the center of the handle to the center of the drive (L) divided by the length of the wrench from the center of the handle to the crowfoot center (LA), as shown in figure 1. Additional methods of calculating the actual torque produced by a torque wrench and crowfoot combination are shown in appendix B at the end of this document.

Once the installation settings have been determined inspect the connections where the hose will connect and on the hose itself. Insure that threads and seal faces are clean and in good condition before proceeding. O-Rings should be lubricated with light oil, but threads should be completely dry unless making pipe thread connections (interference seal). Attach the male end of the hose onto the equipment first, since it may be necessary to rotate the entire hose assembly to tighten the male threads. Then route the hose into position while avoiding twisting the hose. Hand tighten the remaining coupling, by definition hand tight is 0.3-1 ft-lb or when the seal faces are touching and with the threads engaged the hex can no longer be rotated by hand. Mark a line across the coupling nut and backup hex for flats method verification of coupling torque, as shown in figure 2.

When ready to apply the final torque to the coupling place an open ended wrench on the backup hex of the coupling to prevent the hose from twisting during the final torque application. Failure to retain the backup hex during installation will also result in additional clamp load force that could cause damage to the seal face. Apply the torque wrench to the fitting nut and pull the torque wrench while keeping the backup hex still until the proper torque is achieved. The coupling nut must be in motion until for an accurate torque reading. If the nut is stopped before final torque value is achieved, it must be loosened and retightened until the torque is attained while the nut is in motion.

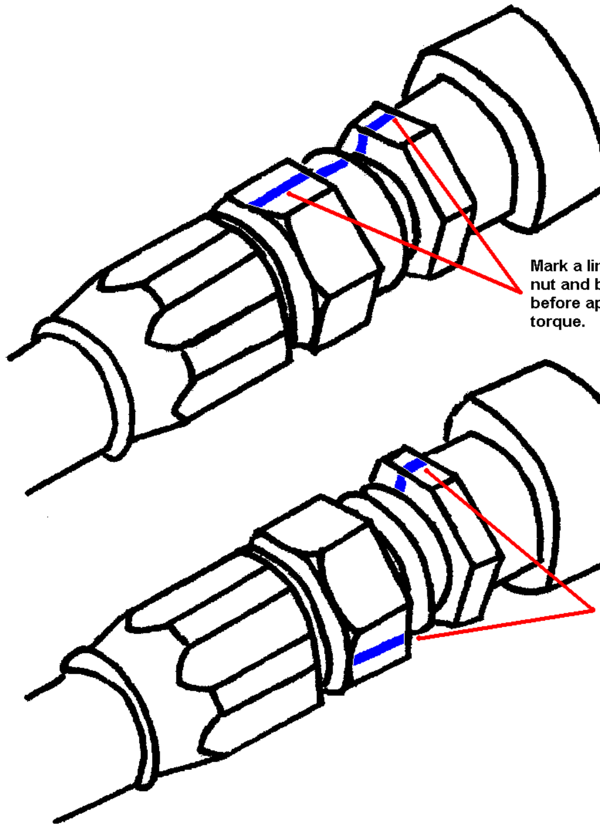

Figure 2 - Flats Method of verifying coupling torque.

Once the couplings have been attached with the proper torque the installation may be verified with the flat method, as shown in figure 2. The mark placed on the nut and backup hex after hand tightening should have rotated 1 to 1.5 flats during final tightening. The flat method may also be used in situations where couplings are inaccessible with the torque wrench to ensure that the coupling is tightened properly. At this point in time, if desired, the nut and backup hex may be marked to indicate if the coupling loosens over time.

Appendices, Figures, and Tables

Appendix A – Torque Charts for Gates Couplings

Appendix B – Calculating Torque Wrench Settings When Using a Crowfoot

Appendix A – Torque Charts for Gates Couplings

Conversion	Formula
ft-lb to N-m	[ft-lb]*1.3558 = [N-m]
ft-lb to in-lb	[ft-lb]*12 = [in-lb]
N-m to in-lb	[N-m]*8.8508 = [in-lb]

Table 1 - Conversion factors for other units

JIC, SAE 45°, ORFS, O-Ring Boss, Gates Adapterless, and MegaSeal										
Dash Size	JIC 37°, SAE 45° & MegaSeal (Steel)		JIC 37°, SAE 45° & MegaSeal (Brass)		Flat Face O-Ring Seal (Steel)		SAE O-Ring Boss (Steel) & Gates Adapterles ≤ 4000 PSI		SAE O-Ring Boss (Steel) & Gates Adapterless > 4000 PSI	
1/16 inch	ft-Lb		ft-Lb		ft-Lb		ft-Lb		ft-Lb	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
-3									8	10
-4	10	11	5	6	10	12	14	16	14	16
-5	13	15	7	9					18	20
-6	17	19	12	15	18	20	24	26	24	26
-8	34	38	20	24	32	40	37	44	50	60
-10	50	56	34	40	46	56	50	60	72	80
-12	70	78	53	60	65	80	75	83	125	135
-14					65	80			160	180
-16	94	104	74	82	92	105	111	125	200	220
-20	124	138	75	83	125	140	133	152	210	280
-24	156	173	79	87	150	180	156	184	270	360
-32	219	243	158	175						

Table 2 - Torque specifications for US style coupling terminations.

DIN 24, DIN 60, and Inverted Cone			
Size		Torque	
mm		ft-Lb	
Light Series Tube OD	Heavy Series Tube OD	Min	Max
6		7	15
8		15	26
10	8	18	30
12	10	22	33
14	12	26	37
15	14	30	52
	16	30	52
18	20	44	74
22	25	59	89
28	30	74	111
	38	74	162
35		133	184
42		148	221

Table 3 - Torque specifications for DIN 24, DIN 60, and Inverted Cone style coupling terminations.

BSP 30° Inverted Cone and JIS		
Dash Size	Torque	
1/16 inch	ft-Lb	
	Min	Max
-2	7	9
-4	11	18
-6	19	28
-8	30	36
-10	37	44
-12	50	60
-16	79	95
-20	127	152
-24	167	190
-32	262	314

Table 4 - Torque specifications for BSP 30° inverted cone and JIS coupling terminations.

NPTF	
Dash Size	**Max Torque**
1/16 inch	**ft-Lb**
-2	20
-4	25
-6	35
-8	45
-12	55
-16	65
-20	80
-24	95
-32	120

Note:
1. The torque values obtained from tightening pipe threads can vary considerably depending on thread condition. Adequate sealing can occur at values much lower than the maximum values listed above. Only enough torque to achieve adequate sealing should be used.
2. When using a male tapered pipe thread with a female straight or parallel pipe thread, maximum values are 50% of those listed in the table.
3. If thread sealant is used, maximum values shown should be decreased by 25%.

Table 5 - Torque specifications for NPTF dry seal pipe threads.

4-Bolt Flanges		
Dash Size	**Bolt Size**	**Torque**
1/16 inch	**inch**	**ft-lb**
-8	0.31	17
-12	0.38	26
-16	0.44	43
-20	0.50	65
-24	0.63	130
-32	0.75	220

Note:
1. Alight faces and finger tighten bolts before applying final torque in a pattern. The seal faces must be parallel with even bolt tension to seal properly.
2. Torque values apply to bolts which are plated or coated in light engine oil.
3. Before assembly lubricate O-Ring with light oil (SAE 10W or 20W).

Table 6 - Torque specifications for 4-Bolt flange connections.

SAE Male Flareless Assembly (MFA)
After hand tight rotate nut one full turn (8 flats).

Table 7 - Torque specification for SAE Male Flareless Assembly (MFA).

Flats Method Values		
Termination Type	**Dash Size**	**Flats**
	1/16 in	
JIC	4	1.5 – 1.75
JIC	6	1.0 – 1.5
JIC	8	1.5 – 1.75
JIC	10	1.0 – 1.5
JIC	12	1.0 – 1.5
JIC	16	.75 – 1.0
JIC	20	.75 – 1.0
JIC	24	.75 – 1.0
JIC	32	.75 – 1.0
JIS	4	0.5 – 1.5

Note:
1. Seal faces must be in contact and the fitting fully hand tightened before marking flats.
2. Flats method is most accurate for the first assembly cycle, for multiple disassembly/assembly cycles torque values are more reliable.
3. Tightening 2 flats or more is analogous to sever over torque and may damage seal faces.

Table 8 - Flats method values for selected terminations.

Appendix B – Calculating Torque Wrench Settings When Using a Crowfoot

There are several methods of determining the correct setting on the torque wrench when using a crowfoot. All of the methods involve making the setting proportional to the effective change in length of the wrench multiplied by the desired final torque. Graphical representations of the measurements needed are shown in the definition of variables section, while the equations to determine the torque wrench settings are shown in the equations section.

Definition of Variables

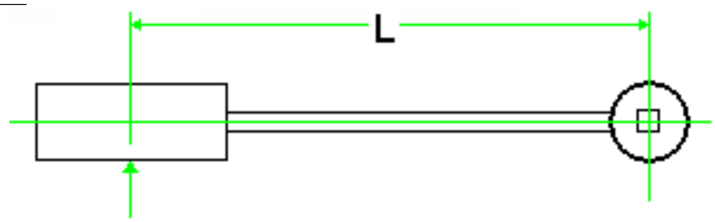

Figure 3 - L ≡ Distance from center of torque wrench handle to the center of the socket drive.

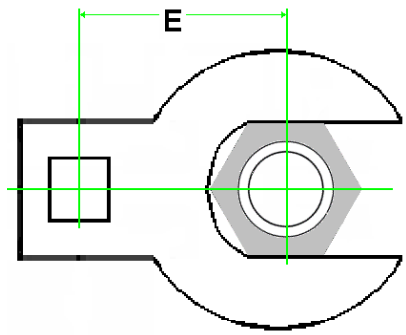

Figure 4 - E ≡ Distance from the center of the socket drive to the center of crowfoot. A nut is shown for illustrative purposes only.

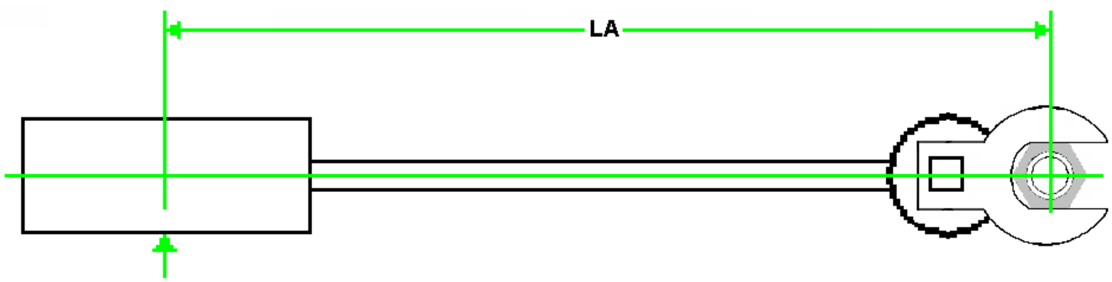

Figure 5 – LA ≡ Distance from the center of the torque wrench handle to the center of crowfoot. A nut is shown for illustrative purposes only.

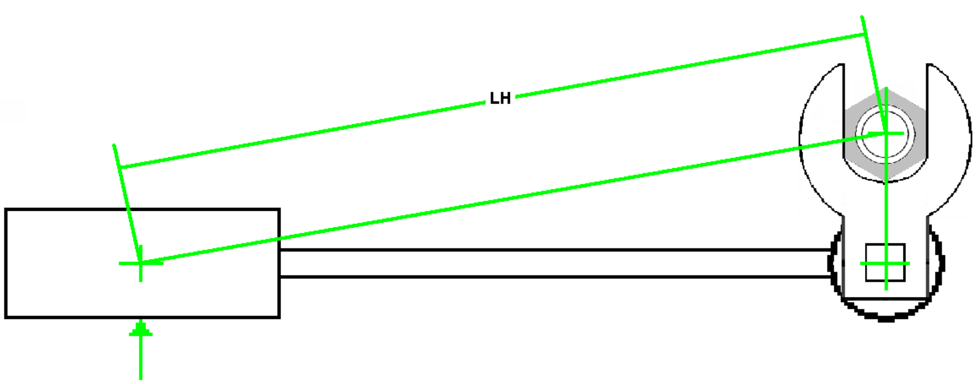

Figure 6 – LH ≡ Distance from center of the torque wrench handle to center of crowfoot, when mounted at 90°. A nut is shown for illustrative purposes only.

TD ≡ Desired torque at the fitting from the tables in appendix A.
TS ≡ Torque setting indicated on wrench.

Equations

Equation 1 – Torque setting if the crowfoot is placed in line with respect to the wrench, figure 5:

$$TS = TD * L / LA$$
$$\text{or } TS = TD * L / (L + E)$$

Equation 2 – Torque setting if crowfoot is placed at 90° with respect to the wrench, figure 6:

$$TS = TD * L / LH$$
$$\text{or } TS = TD * L / \sqrt{(L^2 + E^2)}$$

Equation 3 - To estimate the crowfoot size (E), figure 4:

E = Drive Size * 0.5 + Distance between Drive & Open End + Wrench Size * 0.5774