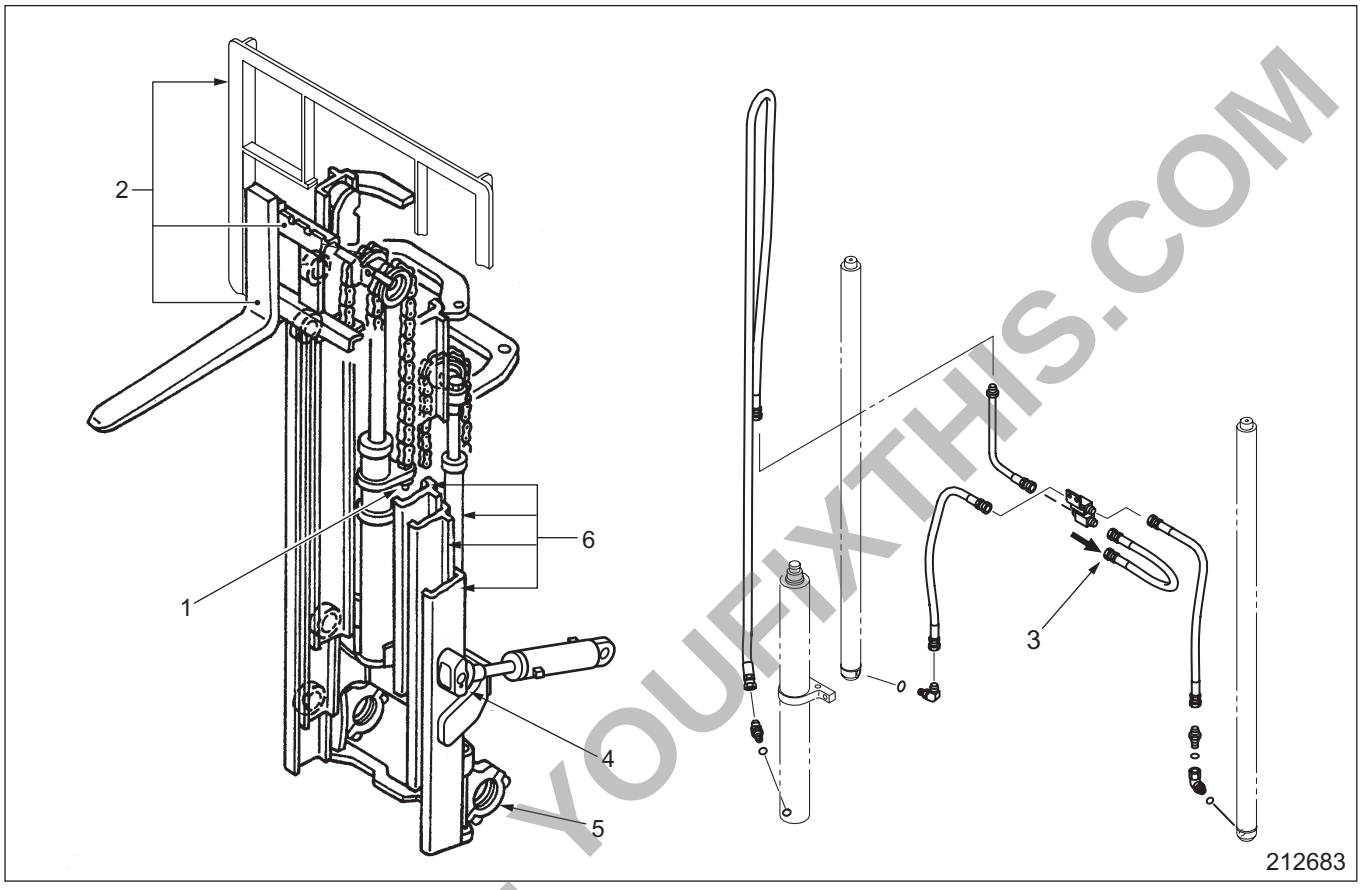
Removal and Installation

Mast and Lift Bracket Assembly

Triplex Mast Removal

Note: For replacing mast roller without removing mast from track, refer to page 19.



Sequence

1 Nuts
2 Backrest, Lift bracket, Forks
3 High-pressure hose
4 Tilt socket pin
5 Mast support bearing cap, Bushing
6 Mast, Lift cylinder

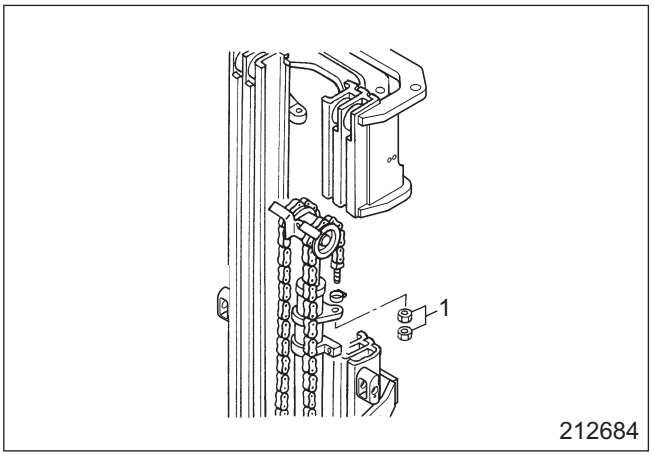
Suggestions for Removal

1. Removing lift bracket

(1) Tilt the mast forward, and lower the inner mast to the bottom. Slacken the lift chains, and remove the nuts 1 from the anchor bolts.

(2) Tilt the mast back to vertical position. Raise the inner mast until the lift bracket 2 becomes free. Then, slowly back the truck away, from the lift bracket and fork assembly.

Note: Before proceeding with any mast overhaul, measure the clearance between mast and rollers. Knowing which roller should be replaced or which shims need adjustment in advance allows efficient maintenance work.



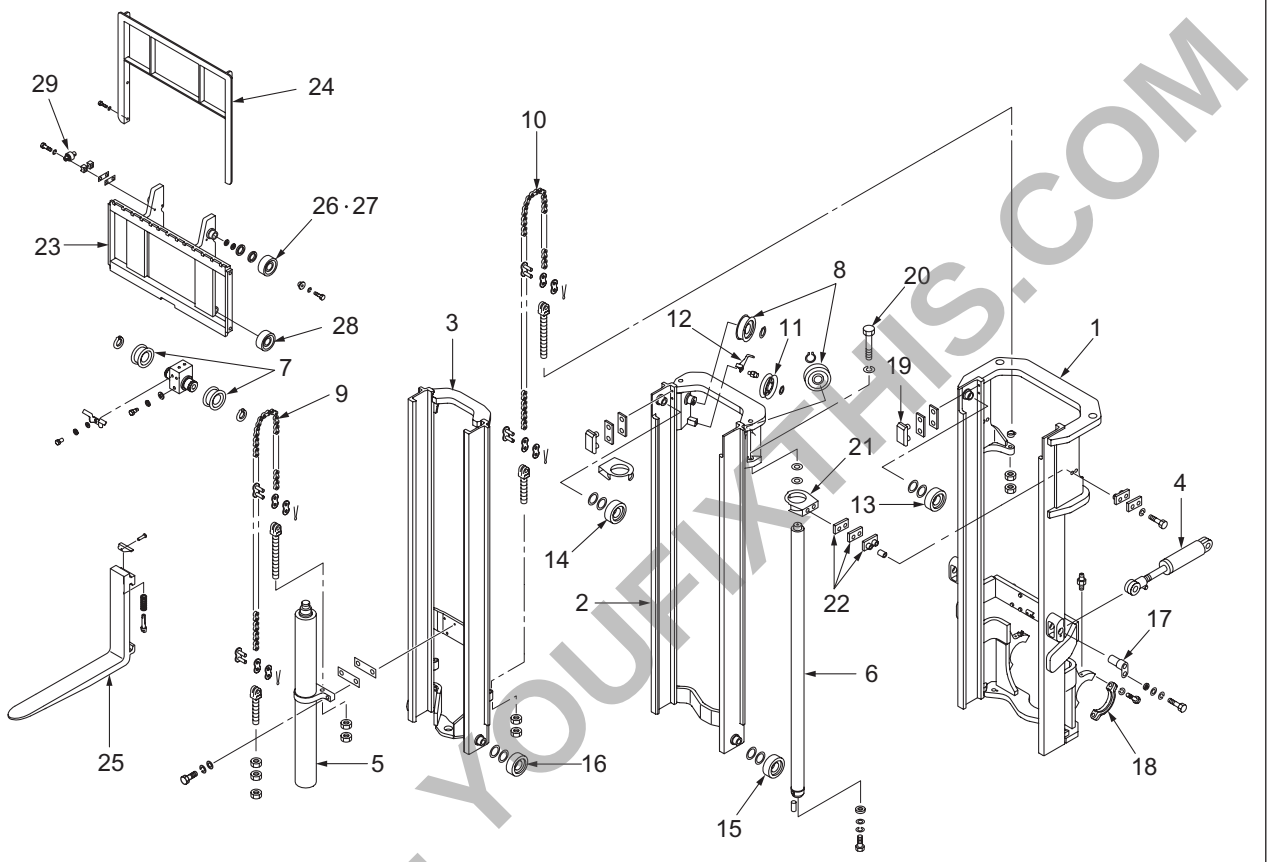
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Structure and Function

Triplex (Triple Full Free Panoramic) Mast (5M15D to 5M35D)

Note: For hydraulic lines, refer to “Installing Hydraulic Line” on the page 18.



Major Components (most parts come in pairs, left and right)

1 Outer mast
2 Middle mast
3 Inner mast
4 Tilt cylinder
5 First lift cylinder (one piece)
6 Second lift cylinder
7 First lift chain wheel
8 Second lift chain wheel
9 First lift chain
10 Second lift chain
11 Hose pulley
12 Hose guard
13 Outer mast roller
14 Middle mast upper roller
15 Middle mast lower roller
16 Inner mast roller
17 Tilt socket mounting pin
18 Mast support cap
19 Mast strips
20 Lift cylinder upper mounting bolt
21 Cylinder bracket
22 Cylinder clamps
23 Lift bracket
24 Backrest
25 Forks
26 Lift bracket upper roller
27 Lift bracket middle roller
28 Lift bracket lower roller
29 Side roller

On the triplex mast, the free-lift height extends to the top of the mast, and the overall mast height remains the same until the upper edge of the backrest exceeds the top of the mast.

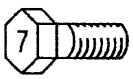
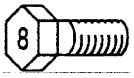
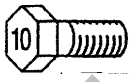
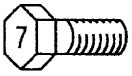
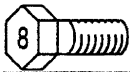
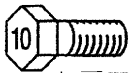
The mast assembly consists of the inner mast, middle mast, outer mast, lift bracket, first lift cylinder and second lift cylinders.

The first lift cylinder raises the lift bracket, while the second cylinder operates the three-stage telescopic mechanism and lift bracket.

The first cylinder is equipped with upstroke cushioning and the second cylinder is equipped with down cushioning and both cylinders have no return hose because they have an internal drain.

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Tightening Torque for Standard Bolts and Nuts

	Nominal Size		Pitch		With Spring Washer 101656								
													
	mm	in.	mm	in.	N·m	kgf·m	lbf·ft	N·m	kgf·m	lbf·ft	N·m	kgf·m	lbf·ft
	6	0.24	1	0.04	7.4	0.75	5.4	9.6	0.98	7.1	12.7	1.3	9.4
	8	0.32	1.25	0.05	16.7	1.7	12.3	22.6	2.3	16.6	30.4	3.1	22.4
	10	0.39	1.25	0.05	34.3	3.5	25.3	45.1	4.6	33.3	69.6	7.1	51.4
	12	0.47	1.25	0.05	63.7	6.5	47.0	82.4	8.4	60.8	122.6	12.5	90.4
	14	0.55	1.5	0.06	102.0	10.4	75.2	132.4	13.5	97.6	191.2	19.5	141.8
	16	0.63	1.5	0.06	154.9	15.8	114.3	202.0	20.6	149.0	287.3	29.3	211.9
	18	0.71	1.5	0.06	224.6	22.9	165.6	292.2	29.8	215.5	413.8	42.2	305.2
	20	0.79	1.5	0.06	310.9	31.7	229.3	404.0	41.2	298.0	573.7	58.5	423.1
	22	0.87	1.5	0.06	413.8	42.2	305.2	537.4	54.8	396.4	763.0	77.8	562.7
	24	0.95	1.5	0.06	547.2	55.8	403.6	711.0	72.5	524.4	1006.2	102.6	742.1
	27	1.06	1.5	0.06	794.3	81.0	585.9	1032.6	105.3	761.6	1451.1	148.0	1070.5
	30	1.18	1.5	0.06	1100.3	112.2	811.5	1430.8	145.9	1055.3	2012.3	205.2	1484.2
	33	1.30	1.5	0.06	1467.1	149.6	1082.1	1907.4	194.5	1406.8	2680.2	273.3	1976.8
	36	1.42	1.5	0.06	1918.2	195.6	1414.8	2493.8	254.3	1839.4	3497.1	356.6	2579.3
	39	1.54	1.5	0.06	2461.5	251.0	1815.5	3198.8	326.2	2359.4	4469.9	455.8	3296.8
Metric fine thread	Nominal Size		Pitch		With Spring Washer 101656								
													
	6	0.24	1	0.04	8.6	0.88	6.4	10.8	1.1	8.0	14.7	1.5	10.8
	8	0.32	1.25	0.05	19.6	2.0	14.5	26.5	2.7	19.5	36.6	3.7	26.8
	10	0.39	1.25	0.05	41.2	4.2	30.4	53.0	5.4	39.1	81.4	8.3	60.0
	12	0.47	1.25	0.05	74.5	7.6	55.0	97.1	9.9	71.6	144.2	14.7	106.3
	14	0.55	1.5	0.06	119.6	12.2	88.2	155.9	15.9	115.0	226.5	23.1	167.1
	16	0.63	1.5	0.06	182.4	18.6	134.5	237.3	24.2	175.0	338.3	34.5	249.5
	18	0.71	1.5	0.06	263.8	26.9	194.6	343.2	35.0	253.2	487.4	49.7	359.5
	20	0.79	1.5	0.06	365.8	37.3	269.8	475.6	48.5	350.8	674.7	68.8	497.6
	22	0.87	1.5	0.06	486.4	49.6	358.8	632.5	64.5	466.5	897.3	91.5	661.8
	24	0.95	1.5	0.06	643.3	65.6	474.5	836.5	85.3	617.0	1183.7	120.7	873.0
	27	1.06	1.5	0.06	934.6	95.3	689.3	1215.0	123.9	896.2	1707.3	174.1	1259.3
	30	1.18	1.5	0.06	1294.5	132.0	954.8	1682.8	171.6	1241.2	2367.3	241.4	1746.0
	33	1.30	1.5	0.06	1726.0	176.0	1273.0	2243.8	228.8	1654.9	3153.8	321.6	2326.1
	36	1.42	1.5	0.06	2256.5	230.1	1664.3	2934.1	299.2	2164.1	4114.0	419.6	3035.0
	39	1.54	1.5	0.06	2896.0	295.3	2135.9	3763.8	383.8	2776.0	5258.3	536.2	3878.3

Remarks: 1. The tolerance on these torques is ±10%.

2. These torques are for “dry” condition.

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Troubleshooting

Lift bracket and inner mast will not move smoothly	Clearance between lift rollers and side rollers incorrect	Readjust clearance.
	Rollers binding on their shafts	Relubricate of replace.
	Mast strip clearance incorrect	Shim adjust. 0.1 to 0.5 mm (0.004 to 0.020 in.)
Lift bracket or inner mast binds	Too much clearance on side rollers	Readjust by adding shims.
	Lift chains unequally tensioned	Readjust.
	Shim adjustments unequally made on between left and right lift cylinders (at maximum height)	Readjust.
Mast makes noise	Rollers not rotating smoothly on their shafts	Relubricate of replace.
Load descends (drift)	Lift cylinder packing damaged	Replace.
	Sliding (inside) surface of lift cylinder tube damaged	Replace.
Whole mast shakes	Mast-support bushing or metal worn	Retighten or replace.
Mast is distorted	Off-center loading or overload	Replace mast assembly.
Fork tips differ in height	Finger bar bent	Repair or replace.
	Forks bent	
	Un-even loading	

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Service Data

A: Standard value B: Repair or service limit
Unit: mm (in.)

Item					Mast Model	5M15D 5M20D	5M25D	5M30D 5M35D
Chains	Chain extension			mm (in.)/20 links	A	317.5 (12.5)	381 (15)	508 (20)
					B	327 (12.9)	392 (15.4)	523 (20.6)
Rollers	Main roller external diameter			S	A	99 (3.9)	113.8 (4.5)	113.8 (4.5)
				M	A	100 (3.9)	115 (4.5)	115 (4.5)
				L	A	101 (4.0)	116 (4.6)	116 (4.6)
				LL	A	102 (4.0)	117 (4.6)	117 (4.6)
	Side roller external diameter				A	42 (1.7)	42 (1.7)	42 (1.7)
Dimensions (Reference)	Triplex mast	Width of outer mast B			A	610 (24)	670 (26.4)	670 (26.4)
		Width of middle mast B1			A	516 (20.3)	568 (22.4)	568 (22.4)
		Width of inner mast B2			A	426 (16.8)	468 (18.4)	468 (18.4)
		Width of lift bracket C			A	408 (16.1)	458 (18)	458 (18)
Clearance	Masts	Clearance between main roller circumference and mast thrust surface F			A	1.0 (0.04) or less		
		Clearance between main roller side surface and mast thrust surface G			A	0.1 to 0.5 (0.004 to 0.020)		
		Clearance between inside mast and mast strip G2			A	0.1 to 0.5 (0.004 to 0.020)		
	Lift brackets	Clearance between upper and lower roller circumference and inner mast thrust surface F			A	1.0 (0.04) or less		
		Clearance between middle roller side surface and inner mast thrust plate G			A	0.1 to 0.5 (0.004 to 0.020)		
		Clearance between lower roller side surface and inner mast thrust surface G			A	0.1 to 0.5 (0.004 to 0.020)		
		Clearance between side roller circumference and inner mast surface G1			A	0.1 to 0.5 (0.004 to 0.020)		
Finder bar bend					A	5.0 (0.2) or less		

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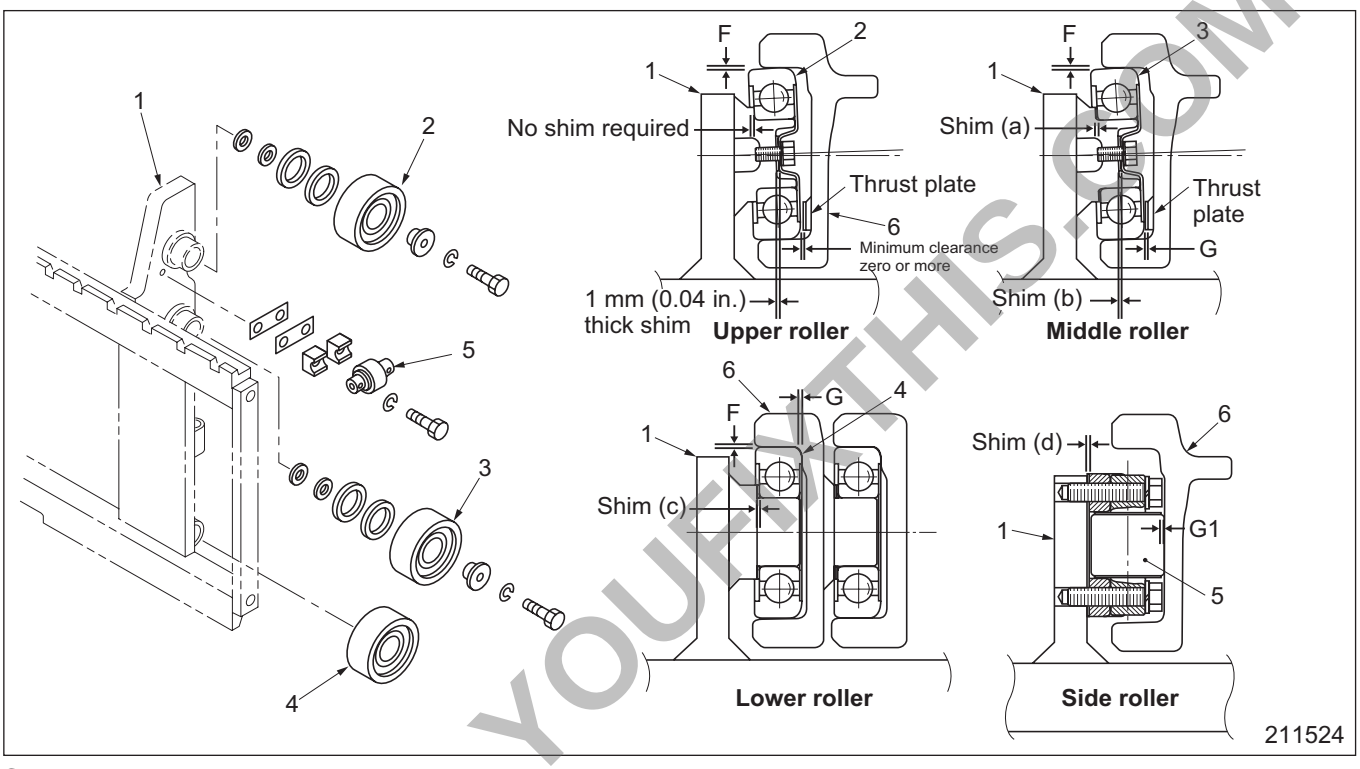
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Reassembly

Follow the disassembly sequence in reverse. Be careful with the followings.

Suggestions for Reassembly

1. Installing lift bracket rollers



Sequence

1 Lift bracket
2 Lift bracket upper rollers
3 Lift bracket middle rollers
4 Lift bracket lower rollers
5 Side rollers
6 Inner mast

The lift bracket has three main roller bearings at one side and a side roller at both sides as shown.

Clearances F, G and G1, must be maintained between these rollers and thrust surface of the inner mast for smooth operation.

- Clearance G

Clearance between roller side surface and inner mast thrust surface (right-to-left-play).

Clearance G is used for determining the correct amount of shims at the bearing seat.

Move lift bracket to the top of the inner mast and press the bracket to either the leftmost or rightmost position. Take measurements of clearance G between the side surface of roller and inner mast.

Note: It is not necessary to adjust the lift bracket upper roller with shims.

Adjust the clearance to the specification with shims (a) and (b) for middle roller and with shim (c) for the lower roller.

Clearance G	0.1 to 0.5 mm (0.004 to 0.020 in.)

- Clearance F

Clearance between roller circumference and inner mast thrust surface (back-to-front play):

Clearance F is used for determining the proper size of the rollers.

Select appropriate diameter rollers so that the clearance meets the specification. Make sure the rollers rotate smoothly when installed.

Clearance F	1.0 mm (0.04 in.) or less

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7. Installing hydraulic lines

General precautions

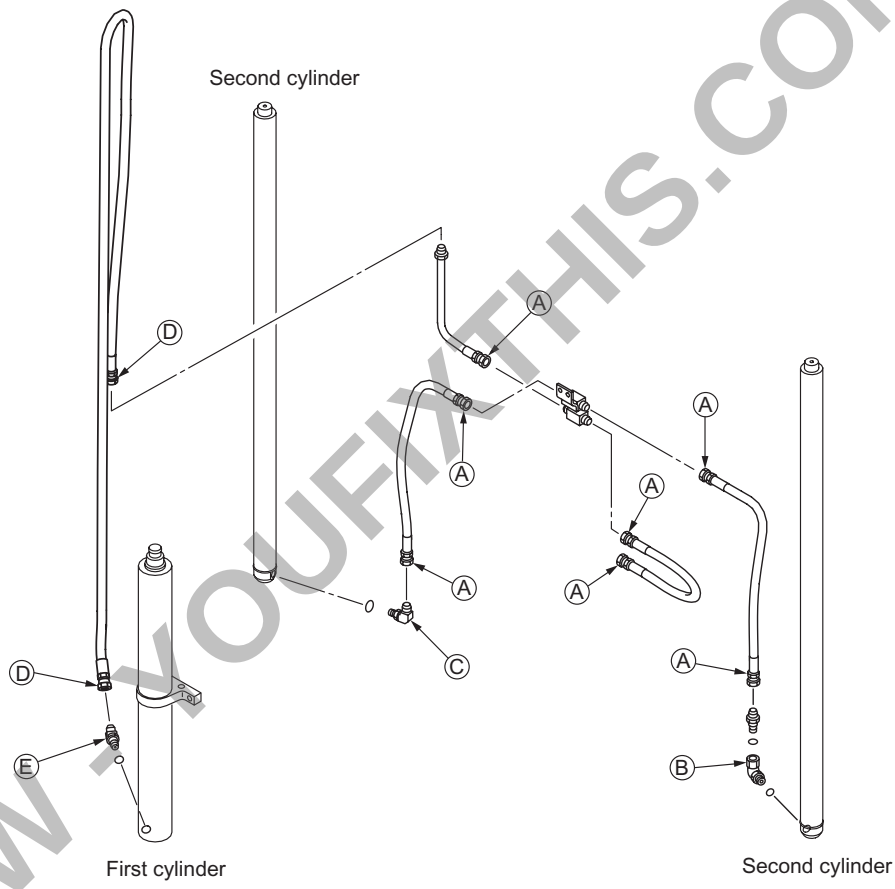
- Use care not to let abrasive dust or dirt to enter the hydraulic system.
- Apply a film of oil to O-rings before installation.
- For assembling Elbow Connector (a fitting with straight threads and O-ring seal) indicated by Ⓒ, follow the procedure "Installation of a fitting with straight threads and O-Ring seal" shown below.

Simplex Mast

Tightening torques

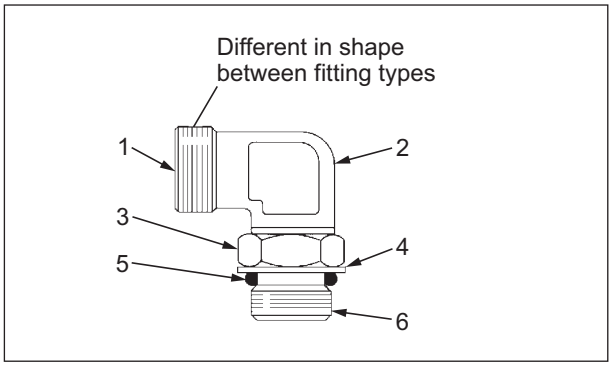
Unit: N·m (kgf·m) [lbf·ft]

Nut Ⓐ	58.8 ± 5.9 (6.0 ± 0.6) [43.4 ± 4.3]
Nut Ⓑ	58.8 ± 5.9 (6.0 ± 0.6) [43.4 ± 4.3]
Nut Ⓒ	58.8 ± 5.9 (6.0 ± 0.6) [43.4 ± 4.3]
Nut Ⓓ	58.8 ± 5.9 (6.0 ± 0.6) [43.4 ± 4.3]
Nut Ⓔ	58.8 ± 5.9 (6.0 ± 0.6) [43.4 ± 4.3]



Installation of a fitting with straight threads and O-ring seal

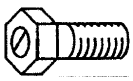
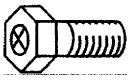
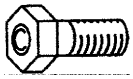
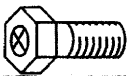
(1) Apply grease or hydraulic oil to O-ring and O-ring seat in the housing side.
(2) Turn lock nut 3 to move it as close to fitting body 2 as possible. Place washer 4 and O-ring seal 5 against the lock nut.
(3) Tighten the fitting by hand. Once O-ring 5 is placed in the position of housing and washer 4 comes in contact with the surface of housing, turn it back to adjust the mounting direction. Never loose more than 1 turn.
(4) Tighten lock nut 3 to the specified torque.



Elbow body assembly

1 End of fitting body (connects to tube)
2 Fitting body
3 Locknut
4 Backup washer
5 O-ring seal
6 End of fitting that goes into other part

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	Nominal Size		Pitch		With Spring Washer 101656								
													
	mm	in.	mm	in.	N·m	kgf·m	lbf·ft	N·m	kgf·m	lbf·ft	N·m	kgf·m	lbf·ft
	10	0.39	1.5	0.06	33.3	3.4	24.6	43.1	4.4	31.8	67.7	6.9	49.9
	12	0.47	1.75	0.07	58.8	6.0	43.4	76.5	7.8	56.4	115.7	11.8	85.3
	14	0.55	2	0.08	96.4	9.8	70.9	124.5	12.7	91.9	182.4	18.6	134.5
	16	0.63	2	0.08	147.1	15.0	108.5	191.2	19.5	141.0	274.6	28.0	202.5
	18	0.71	2.5	0.10	203.0	20.7	149.7	264.8	27.0	195.3	383.4	39.1	282.8
	20	0.79	2.5	0.10	286.4	29.2	211.2	371.7	37.9	274.1	536.4	54.7	395.6
	22	0.87	2.5	0.10	383.4	39.1	282.8	499.2	50.9	368.2	715.9	73.0	528.0
	24	0.95	3	0.12	492.3	50.2	363.1	640.4	65.3	472.3	924.8	94.3	682.1
	27	1.06	3	0.12	724.7	73.9	534.5	942.2	96.1	695.1	1350.4	137.7	996.0
	30	1.18	3.5	0.14	969.9	98.9	715.3	1259.2	128.4	928.7	1843.7	188.0	1359.8
	33	1.30	3.5	0.14	1328.8	135.5	980.1	1727.0	176.1	1273.7	2477.2	252.6	1827.1
	36	1.42	4	0.16	1676.0	170.9	1236.1	2180.0	222.3	1607.9	3199.9	326.3	2360.1
	39	1.54	4	0.16	2219.2	226.3	1636.8	2884.1	294.1	2127.2	4118.8	420.0	3037.9
	42	1.65	4.5	0.18	2754.7	280.9	2031.8	3581.4	365.2	2641.5	5137.7	523.9	3789.4
Metric fine thread	Nominal Size		Pitch		With Spring Washer 101656								
													
	10	0.39	1.5	0.06	39.2	4.0	28.9	51.0	5.2	37.6	79.4	8.1	58.6
	12	0.47	1.75	0.07	69.6	7.1	51.4	90.2	9.2	66.5	135.3	13.8	99.8
	14	0.55	2	0.08	112.8	11.5	83.2	146.1	14.9	107.8	215.7	22.0	159.1
	16	0.63	2	0.08	172.6	17.6	127.3	224.6	22.9	165.6	323.6	33.0	238.7
	18	0.71	2.5	0.10	239.3	24.4	176.5	311.9	31.8	230.0	451.1	46.0	332.7
	20	0.79	2.5	0.10	336.4	34.3	248.1	437.4	44.6	322.6	630.6	64.3	465.1
	22	0.87	2.5	0.10	392.3	40.0	289.3	587.4	59.9	433.3	842.4	85.9	621.3
	24	0.95	3	0.12	578.6	59.0	426.7	753.2	76.8	555.5	1088.5	111.0	802.9
	27	1.06	3	0.12	852.2	86.9	628.5	1108.2	113.0	817.3	1588.7	162.0	1171.7
	30	1.18	3.5	0.14	1140.5	116.3	841.2	1481.8	151.1	1092.9	2168.3	221.1	1599.2
	33	1.30	3.5	0.14	1563.2	159.4	1153.0	2031.9	207.2	1498.7	2915.5	297.3	2150.4
	36	1.42	4	0.16	1972.1	201.1	1454.6	2564.4	261.5	1891.4	3765.8	384.0	2777.5
	39	1.54	4	0.16	2610.5	266.2	1925.4	3393.1	346.0	2502.6	4845.5	494.1	3573.8
	42	1.65	4.5	0.18	3241.1	330.5	2390.5	4212.9	429.6	3107.3	6044.8	616.4	4458.4

Remarks: 1. The tolerance on these torques is ±10%.

2. These torques are for “dry” condition.

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