



*LARGE BORE*

*TORQUE SPECIFICATIONS*

*SA*

*SERIES*

# **SERVICE BULLETIN**

**MITSUBISHI HEAVY INDUSTRIES, LTD.**  
**GENERAL MACHINERY & SPECIAL VEHICLE HEADQUARTERS**

BULLETIN No.: SA2008-048 (1/6)

GROUP: Basic engine

MODELS: S6A3, S12A2

DATE: 28 November 2008

SUBJECT: Tightening Torque for SA Series

1. Purpose

To improve reliability, method of tightening cylinder head bolts in SA series was changed from torque method to angle method. (This change will be applied starting with #25995 engine for S12A2-1 only.) Service Bulletins Nos. SA2002-010 and SA2003-069 were issued with tightening torque tables. New tightening torque tables were then prepared with change of torque values and addition of unit torque values. These new tightening torque tables are given here for use in inspection and maintenance. Tighten general bolts to specified torque within tolerances of  $\pm 10\%$ .

APPLICABLE No.:

MODIFIED No.:

DATE OF SERVICE PARTS AVAILABLE:

INTERCHANGEABILITY:

R=(NEW)  $\leftrightarrow$  (OLD)

1=Out of Supply.

S=(NEW)  $\leftrightarrow$  (OLD)

2=Yes as an assembly.

N=(NEW)  $\leftrightarrow$  (OLD)

3=Yes as a single part.

EO No.
35A0-A581



Please pass to:	DEPT. MANAGER	SECT. MANAGER	MECHANICS or CLERKS



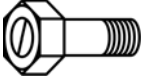

2. Description

For bolts other than general bolts, see the following data.

Tightening torque for general bolts

	Thread size Diameter × pitch (mm)	Strength classification			
		7T		10.9	
					
Metric screw thread for cars		N·m	kgf·m	N·m	kgf·m
	M8×1.25	17	1.7	30	3.1
	M10×1.25	33	3.4	60	6.1
	M12×1.25	60	6.1	108	11.0
	M14×1.5	97	9.9	176	17.9
	M16×1.5	145	14.8	262	26.7
	M18×1.5	210	21.4	378	38.5
	M20×1.5	291	29.7	524	53.4
	M22×1.5	385	39.3	694	70.8
	M24×1.5	487	49.7	878	89.5
	M27×1.5	738	75.3	1328	135.5

	Thread size Diameter × pitch (mm)	Strength classification			
		7T		10.9	
					
Metric coarse screw thread		N·m	kgf·m	N·m	kgf·m
	M10×1.5	32	3.3	58	5.9
	M12×1.75	57	5.8	102	10.4
	M14×2.0	93	9.5	167	17.0
	M16×2.0	139	14.2	251	25.6
	M18×2.5	194	19.8	350	35.7
	M20×2.5	272	27.7	489	49.9
	M22×2.5	363	37.0	653	66.6
	M24×3.0	468	47.7	843	86.0
	M27×3.0	686	70.0	1236	126.0

Tightening torque for eye bolts

Thread size Diameter × pitch (mm)	Strength classification	
	4T	
	N·m	kgf·m
M8×1.25	8±1.0	0.8±0.1
M10×1.25	15±2.0	1.5±0.2
M12×1.25	25±3.0	2.5±0.3
M14×1.5	34±4.0	3.5±0.4
M16×1.5	44±5.0	4.5±0.5
M18×1.5	74±5.0	7.5±0.5
M20×1.5	98±10.0	10.0±1.0
M24×1.5	147±15.0	15.0±1.5
M27×1.5	226±20.0	23.0±2.0

(in dry condition)

Tightening torque for union nut

Cap nut size	Nominal diameter	N·m	kgf·m
M14×1.5	63	39	4
M16×1.5	80	49	5
M20×1.5	100	78	8
M22×1.5	120	98	10
M27×1.5	150	157	16
M30×1.5	180	196	20
M30×1.5	200	196	20
M33×1.5	220	245	25
M36×1.5	254	294	30

(Tolerance of torque: ±10%, in dry condition)

Tightening torque for fuel high-pressure injection pipe

Cap nut size	N·m	kgf·m
M12×1.5	39±5	4±0.5
M14×1.5	49±5	5±0.5
M18×1.5	59±10	6±1.0

(in dry condition)

Notes:

- Tightening torque for general bolts
  - This table gives tightening torque for standard bolts and nuts.
  - These torque values apply when spring washers are used.
  - Unless specially noted, tighten general bolts to torque specified here.
- When union nuts are tightened, torsional stresses do not structurally occur in pipe that rotates together with sleeve. Above tightening torque values are thus given for reference. Union nuts can be retightened when leaks or bleeds occur.
- If high-pressure fuel injection pipe is overtightened, excessive stresses may result from rotation of sleeve together with pipe or torsion of pipe.



Model	S6A			S6A3-MTK2			Tolerance to control torque (Note 6)		Remarks
Part name (Tightening part)	Thread size Diameter × pitch (mm)	Tightening torque		Thread size Diameter × pitch (mm)	Tightening torque		Important	General	
		kgf·m	N·m		kgf·m	N·m			
Cylinder head bolt	M20×2.5	Note 4	Note 4						(Wet)
Rocker shaft bracket	M12×1.75	5±0.25	49±2.5						
Rocker arm lock nut	M12×1.25	6.5±0.65	64±6.4						
Bridge lock nut	M10×1.25	5.6±0.56	55±5.5						
Rocker cover	M12×1.25	1.3 - 1.7	13 - 17						
Main bearing cap	M24×3.0	60±3.0	588±29						(Wet), Note 2
Main bearing cap side bolt	M16×1.5	15±0.75	147±7.4						(Wet), Note 2
Oil jet	M12×1.75	3.5±0.35	34±3.4						Note 3
Timing gear case	M12×1.25	11±0.55	108±5.4						
Rear plate	M12×1.25	11±0.55	108±5.4						
Oil pan	M10×1.25	4±0.4	39±3.9						
Front mounting bracket	M18×1.5	25±1.3	245±12						
Rear mounting bracket	M16×1.5	22±1.1	216±11						
Connecting rod bearing cap	M18×1.5	Note 5	Note 5						(Wet)
Crankshaft pulley, damper	M22×1.5	40±2.0	392±20						
Flywheel	M22×1.5	55±2.8	539±27						(Wet)
Exhaust manifold	M10×1.5	5 - 6	49 - 59						
Exhaust manifold plug				M36×1.5	12±1.2	118±12			
Idler gear	M10×1.25	4±0.4	39±3.9						
Camshaft gear	M30×1.5	40±2.0	392±20						Left thread
Injection pump gear	M30×1.5	40±2.0	392±20						
Idler shaft	M12×1.25	5.5±0.28	54±2.7						
Oil pump gear	M27×1.5	30±1.5	294±15						
Oil pump idler gear				M12×1.25	7±0.7	68±6.8			
Turbocharger oil eye bolt	M10×1.25	3±0.3	29±2.9						
Water pump pulley	M24×1.5	25±2.5	245±25						
Water pump impeller	M22×1.5	20±2.0	196±20						
Injection pump				M12×1.25	11±0.55	108±5.4			
Injection pump laminate plate	M10×1.5	8.5 - 9.5	83 - 93	M12×1.25	10.5 - 11.5	103 - 113			
Injection pump bracket	M10×1.25	6.1±0.61	60±6.0						10.9 bolt
Injection pump stay (back of pump)	M14×1.5	3.5±0.35	34±3.4						Dedicated bolts with 19 width across flats
Injection pump stay (to install crankcase)	M10×1.25	6.1±0.61	60±6.0						10.9 bolt
Injection pump flywheel (nut)				M24×1.5	40±2.0	392±20			
Injection pump coupling shaft	M12×1.75	8.5 - 9.5	83 - 93	M14×1.5	17 - 18	167 - 177			
Feed pump inlet	M14×1.5	2.5 - 3.0	25 - 29						
Delivery valve holder				M30×1.5	24 - 26	235 - 255			
Gland (nozzle holder)	M12×1.25	6±0.3	59±2.9						
Nozzle holder set screw cap nut	M16×1.0	4 - 5	39 - 49						
Nozzle holder eye bolt	M10×1.0	1.5 - 2	15 - 20						
Nozzle tip retaining nut	M19×1.0	6 - 8	59 - 78						
Nozzle inlet connector	M14×1.5	7 - 8	69 - 79						



Model	S6A			S6A3-MTK2			Tolerance to control torque (Note 6)		Remarks
	Part name (Tightening part)	Thread size Diameter × pitch (mm)	Tightening torque		Thread size Diameter × pitch (mm)	Tightening torque		Important	
kgf·m			N·m	kgf·m		N·m			
Fuel rack control lever	M8×1.25	2.5±0.25	25±2.5						Tighten twice
Fuel filter air vent plug	M8×1.25	0.8 - 1.0	8 - 10						
Alternator pulley	/	/	/	M17×1.5	5±0.5	49±4.9			
Fandrive pulley (nut)	M30×1.5	40±2.0	392±19.6	/	/	/			Apply Loctite 262
Outlet pipe	M10×1.25	5 - 6	49 - 59						



Model	S12A2			Tolerance to control torque (Note 6)		Remarks
	Thread size Diameter × pitch (mm)	Tightening torque		Important	General	
		kgf·m	N·m			
Cylinder head bolt	M20×2.5	Note 4	Note 4			(Wet)
Rocker shaft bracket	M12×1.75	5±0.25	49±2.5			
Rocker arm lock nut	M12×1.25	6.5±0.65	64±6.4			
Bridge lock nut	M10×1.25	5.6±0.56	55±5.5			
Rocker cover	M12×1.25	1.3 - 1.7	13 - 17			
Main bearing cap	M24×3.0	60±3.0	588±29			(Wet), Note 2
Main bearing cap side bolt	M16×2.0	15±0.75	147±7.4			(Wet), Note 2
Timing gear case	M12×1.75	10±0.5	98±4.9			
	M16×1.5	26±1.3	255±12.8			
Rear plate	M12×1.25	10±0.5	98±4.9			
Oil pan	M10×1.5	4±0.4	39±3.9			
Front mounting bracket	M20×1.5	40±2.0	392±20			
Rear mounting bracket	M18×2.5	25±1.3	245±12			
Connecting rod bearing cap	M18×1.5	Note 5	Note 5			(Wet)
Crankshaft pulley, damper	M22×1.5	55±2.8	539±27			
Crankshaft, balance weight	M16×1.5	20±1.0	196±10			
Flywheel	M22×1.5	55±2.8	539±27			(Wet)
Exhaust manifold	M10×1.5	6 - 7	59 - 69			
Idler gear	M10×1.25	4±0.4	39±3.9			
Camshaft gear	M30×1.5	30±1.5	294±15			Left thread
Injection pump gear	M30×1.5	30±1.5	294±15			
Idler shaft	M12×1.75	5.5±0.28	54±2.7			
Oil pump gear	M27×1.5	30±1.5	294±15			
Water pump pulley	M24×1.5	25±2.5	245±25			
Water pump impeller	M22×1.5	20±2.0	196±20			
Injection pump	M10×1.5	5.9±0.3	58±2.9			
Injection pump laminate plate	M12×1.75	8.5 - 9.5	83 - 93			
Injection pump bracket	M10×1.5	5.9±0.59	58±5.8			10.9 bolt
Injection pump stay (back of pump)	M14×1.5	3.5±0.35	34±3.4			Dedicated bolts with 19 width across flats
Injection pump stay (to install crankcase)	M10×1.5	5.9±0.59	58±5.8			10.9 bolt
Injection pump coupling shaft	M12×1.75	8.5 - 9.5	83 - 93			
Feed pump inlet	M14×1.5	2.5 - 3.0	25 - 29			
Nozzle gland (nozzle holder)	M12×1.25	6±0.3	59±2.9			
Nozzle holder set screw cap nut	M16×1.0	4 - 5	39 - 49			
Nozzle holder eye bolt	M10×1.0	1.5 - 2	15 - 20			
Nozzle tip retaining nut	M19×1.0	6 - 8	59 - 78			
Nozzle inlet connector	M14×1.5	7 - 8	69 - 79			
Fuel rack control lever	M8×1.25	2.5±0.25	25±2.5			Tighten twice
Fuel filter air vent plug	M8×1.25	0.8 - 1.0	8 - 10			
Fandrive pulley (nut)	M30×1.5	45±2.3	441±22			Apply Loctite 262
Outlet pipe	M10×1.25	5 - 6	49 - 59			Strictly observe for Nos. 1 and 7 cylinders



## Notes:

1. Apply engine oil to the bolt threads and seats of parts designated “wet”.
2. Tighten the main bearing cap bolts and main bearing cap side bolts in the following order:
  - (1) Tighten the cap bolts to the specified torque.
  - (2) Tighten the engine RH side bolts.
  - (3) Tighten the engine LH side bolts.
3. Be sure to tighten the oil jet check valve to the specified torque with a torque wrench. If tightened with any other tool, the check valve may be overtightened and may operate improperly, stopping the flow of cooling oil to the engine and causing the seizure of the pistons.
4. Tighten the cylinder head bolts by either of the methods (1) and (2) below.
  - (1) Angle method (tightening twice)
    - Short bolts
      - 1 Tighten to snug torque of  $118\pm 5.9$  N·m ( $12\pm 0.6$  kgf·m).
      - 2 Then turn to angle of  $75^\circ\pm 3^\circ$ .
      - 3 Loosen all bolts.
      - 4 Tighten again to snug torque of  $118\pm 5.9$  N·m ( $12\pm 0.6$  kgf·m).
      - 5 Turn again to angle of  $75^\circ\pm 3^\circ$ .
    - Long bolts
      - 1 Tighten to snug torque of  $196\pm 9.8$  N·m ( $20\pm 1.0$  kgf·m).
      - 2 Then turn to angle of  $60^\circ\pm 3^\circ$ .
      - 3 Loosen all bolts.
      - 4 Tighten again to snug torque of  $196\pm 9.8$  N·m ( $20\pm 1.0$  kgf·m).
      - 5 Turn again to angle of  $60^\circ\pm 3^\circ$ .
  - (2) Torque method (tightening twice)
    - 1 Tighten to snug torque of  $392\pm 20$  N·m ( $40\pm 2.0$  kgf·m).
    - 2 Loosen all bolts.
    - 3 Tighten again to snug torque of  $392\pm 20$  N·m ( $40\pm 2.0$  kgf·m).
5. Tighten the connecting rod bolts by either of the methods (1) and (2) below.
  - (1) Angle method (at assembly) (tightening twice)
    - 1 Tighten to snug torque of  $147\pm 7.4$  N·m ( $15\pm 0.75$  kgf·m).
    - 2 Then turn to angle of  $45^\circ\pm 3^\circ$ .
    - 3 Loosen all bolts.
    - 4 Tighten again to snug torque of  $147\pm 7.4$  N·m ( $15\pm 0.75$  kgf·m).
    - 5 Turn again to angle of  $45^\circ\pm 3^\circ$ .
  - (2) Torque method (at site) (tightening twice)
    - 1 Tighten to snug torque of  $343\pm 17$  N·m ( $35\pm 1.8$  kgf·m).
    - 2 Loosen all bolts.
    - 3 Tighten again to snug torque of  $343\pm 17$  N·m ( $35\pm 1.8$  kgf·m).
6. Meet the tolerances to control torque below.
  - (1) Important:  $\pm 5\%$ 
    - Angle method: Snug torque tolerances of  $\pm 5\%$  and angle tolerances of  $\pm 3^\circ$
  - (2) General:  $\pm 10\%$

*LARGE BORE*

*TORQUE SPECIFICATIONS*

*SB*

*SERIES*



# **SERVICE BULLETIN**

**MITSUBISHI HEAVY INDUSTRIES, LTD.**  
**GENERAL MACHINERY & SPECIAL VEHICLE HEADQUARTERS**

BULLETIN No.: SB2008-039 (1/8)

GROUP: Basic engine

MODELS: S6B, S6B3, S6B5

DATE: 28 November 2008

SUBJECT: Tightening Torque for SB Series

1. Purpose

Service Bulletin No. SB2001-037 was issued with tightening torque tables. New tightening torque tables were then prepared with change of existing torque values and addition of unit tightening torque values. These new tightening torque tables are given here for use in inspection and maintenance. Tighten general bolts to specified torque within tolerances of  $\pm 10\%$ .

APPLICABLE No.:

MODIFIED No.:

DATE OF SERVICE PARTS AVAILABLE:

INTERCHANGEABILITY:

R=(NEW)  $\leftrightarrow$  (OLD)

S=(NEW)  $\leftrightarrow$  (OLD)

N=(NEW)  $\leftrightarrow$  (OLD)

1=Out of Supply.

2=Yes as an assembly.

3=Yes as a single part.

EO No.
34A0-A394



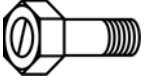

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2. Description

For bolts other than general bolts, see the following data.

Tightening torque for general bolts

	Thread size Diameter × pitch (mm)	Strength classification			
		7T		10.9	
Metric screw thread for cars					
		N·m	kgf·m	N·m	kgf·m
	M8×1.25	17	1.7	30	3.1
	M10×1.25	33	3.4	60	6.1
	M12×1.25	60	6.1	108	11.0
	M14×1.5	97	9.9	176	17.9
	M16×1.5	145	14.8	262	26.7
	M18×1.5	210	21.4	378	38.5
	M20×1.5	291	29.7	524	53.4
	M22×1.5	385	39.3	694	70.8
	M24×1.5	487	49.7	878	89.5
	M27×1.5	738	75.3	1328	135.5
Metric coarse screw thread					
		N·m	kgf·m	N·m	kgf·m
	M10×1.5	32	3.3	58	5.9
	M12×1.75	57	5.8	102	10.4
	M14×2.0	93	9.5	167	17.0
	M16×2.0	139	14.2	251	25.6
	M18×2.5	194	19.8	350	35.7
	M20×2.5	272	27.7	489	49.9
	M22×2.5	363	37.0	653	66.6
	M24×3.0	468	47.7	843	86.0
M27×3.0	686	70.0	1236	126.0	

Tightening torque for eye bolts

Thread size Diameter × pitch (mm)	Strength classification	
	4T	
	N·m	kgf·m
M8×1.25	8±1.0	0.8±0.1
M10×1.25	15±2.0	1.5±0.2
M12×1.25	25±3.0	2.5±0.3
M14×1.5	34±4.0	3.5±0.4
M16×1.5	44±5.0	4.5±0.5
M18×1.5	74±5.0	7.5±0.5
M20×1.5	98±10.0	10.0±1.0
M24×1.5	147±15.0	15.0±1.5
M27×1.5	226±20.0	23.0±2.0

(in dry condition)

Tightening torque for union nut

Cap nut size	Nominal diameter	N·m	kgf·m
M14×1.5	63	39	4
M16×1.5	80	49	5
M20×1.5	100	78	8
M22×1.5	120	98	10
M27×1.5	150	157	16
M30×1.5	180	196	20
M30×1.5	200	196	20
M33×1.5	220	245	25
M36×1.5	254	294	30

(Tolerance of torque: ±10%, in dry condition)

Tightening torque for fuel high-pressure injection pipe

Cap nut size	N·m	kgf·m
M12×1.5	39±5	4±0.5
M14×1.5	49±5	5±0.5
M18×1.5	59±10	6±1.0

(in dry condition)

Notes:

- Tightening torque for general bolts
  - This table gives tightening torque for standard bolts and nuts.
  - These torque values apply when spring washers are used.
  - Unless specially noted, tighten general bolts to torque specified here.
- When union nuts are tightened, torsional stresses do not structurally occur in pipe that rotates together with sleeve. Above tightening torque values are thus given for reference. Union nuts can be retightened when leaks or bleeds occur.
- If high-pressure fuel injection pipe is overtightened, excessive stresses may result from rotation of sleeve together with pipe or torsion of pipe.



Model	S6B			S6B3			Tolerance to control torque (Note 6)		Remarks
	Thread size Diameter × pitch (mm)	Tightening torque		Thread size Diameter × pitch (mm)	Tightening torque		Important	General	
		kgf·m	N·m		kgf·m	N·m			
Cylinder head bolt	M18×2.5	Note 4	Note 4						(Wet)
Rocker shaft bracket	M10×1.5	6±0.3	59±3.0						
Rocker arm lock nut	M10×1.25	5.6±0.6	55±5.5						
Bridge lock nut	M8×1.25	4±0.4	39±3.9						
Main bearing cap	M22×2.5	56±2.8	549±27.5						(Wet), Note 2
Main bearing cap side bolt				M16×1.5	15±0.8	147±7.4			(Wet), Note 2
Oil jet	M12×1.75	3.5±0.4	34±3.4						Note 3
Timing gear case	M12×1.75	10±0.5	98±4.9	M12×1.25	10±0.5	98±4.9			
Rear plate	M12×1.25	10±0.5	98±4.9						
				M10×1.25	6±0.3	59±3.0			
Relief valve	M30×1.5	15±1.5	147±14.7						
Oil pan	M10×1.5	4.3±0.4	42±4.2	M10×1.25	3.6±0.40	35±3.5			
Mounting bracket	M12×1.75	8±0.4	78±3.9	M12×1.25	7.6±0.4	75±3.8			
Connecting rod bearing cap	M16×1.5	Note 5	Note 5						(Wet)
	(M16×1.5)	(23±1.2)	(226±11.3)						(Wet), horizontally split connecting rods
Crankshaft pulley	M16×1.5	16±0.8	157±7.9	M22×1.5	40±2.0	392±19.6			
Flywheel	M16×1.5	27±1.4	265±13.3	M22×1.5	55±2.8	539±27.0			(Wet)
Damper	M12×1.75	6±0.3	59±3.0	M22×1.5	40±2.0	392±19.6			
Exhaust manifold	M10×1.5	7±0.7	69±6.9						
Camshaft gear	M30×1.5	30±1.5	294±14.7						(S6B: Left thread)
Injection pump gear	M24×1.5	22±1.1	216±10.8	M30×1.5	40±2.0	392±19.6			
Idler shaft gear (bolt)	M16×2.0	14±0.7	137±6.9	M16×1.5	14±0.7	137±6.9			
Idler shaft gear (nut)	M16×1.5	10±0.5	98±4.9						
Oil pump gear	M18×1.5	12±0.6	118±5.9						(Wet)
Oil pump idler gear	M12×1.25	7±0.7	69±6.9	M12×1.25	6 - 8	59 - 78			Apply Loctite 262 to threads
Oil pump cover				M10×1.25	3.4±0.3	33±3.3			(Wet)
Oil filter spacer				M30×1.5	30±3.0	294±29.4			
Turbocharger oil eye bolt	M10×1.25	3±0.3	29±2.9						
Water pump impeller	M16×1.5	10±1.0	98±9.8						
Water pump pulley				M22×1.5	16±1.6	157±15.7			
Water pump cover				M10×1.25	3.3±0.3	32±3.2			
Fan	M10×1.5	3.4±0.2	33±1.7						
Injection pump laminate plate	M10×1.5	4.5 - 5	44 - 49	M12×1.5	9 - 9.5	88 - 93			
Injection pump stay (back of pump)	M14×1.5	3.5±0.35	34±3.4						Dedicated bolts with 19 width across flats
Injection pump stay (to install crankcase)	M10×1.5	5.9±0.59	58±5.8	M10×1.25	6.1±0.61	60±6.0			10.9 bolt
Injection pump coupling shaft	M12×1.75	7.5 - 8.5	74 - 83	M12×1.5	9 - 9.5	88 - 93			Inside hexagonal (S6B, S6B3)
Nozzle gland (nozzle holder)	M10×1.25	3.7±0.2	36±1.8						



Model	S6B			S6B3			Tolerance to control torque (Note 6)		Remarks
	Thread size Diameter × pitch (mm)	Tightening torque		Thread size Diameter × pitch (mm)	Tightening torque		Important	General	
		kgf·m	N·m		kgf·m	N·m			
Nozzle holder set screw cap nut	M16×1.5	4 - 5	39 - 49	M14×1.0	4 - 5	39 - 49			
Nozzle tip retaining nut	M19×1.0	6 - 8	59 - 78	M19×0.75	6 - 8	89 - 78			
Nozzle inlet connector				M14×1.5	7 - 8	69 - 78			
Fuel rack control lever	M8×1.25	2.5±0.1	25±1.3						Tighten twice
Fuel filter air vent plug	M8×1.25	0.8 - 1	8 - 10						



Model	S6B5			Tolerance to control torque (Note 6)		Remarks
	Part name (Tightening part)	Thread size Diameter × pitch (mm)	Tightening torque		Important	
kgf·m			N·m			
Cylinder head bolt	M18×2.5	Note 4	Note 4			(Wet)
Rocker case	M12×1.25	6±0.3	59±3.0			
Rocker shaft	M12×1.25	11±0.6	108±5.4			
Rocker arm lock nut	M12×1.25	6.5±0.7	64±6.4			
Bridge lock nut	M8×1.25	4±0.4	39±3.9			
Main bearing cap	M22×2.5	56±2.8	549±27.5			(Wet), Note 2
Main bearing cap side bolt	M16×1.5	15±0.8	147±7.4			(Wet), Note 2
Oil jet	M12×1.75	3.5±0.4	34±3.4			Note 3
Timing gear case	M12×1.25	10±0.5	98±4.9			
Rear plate	M12×1.25	10±0.5	98±4.9			
	M10×1.25	6±0.3	59±3.0			
Oil pan	M10×1.25	3.6±0.4	35±3.5			
Mounting bracket	M12×1.25	7.6±0.4	75±3.8			
Connecting rod bearing cap	M16×1.5	Note 5	Note 5			(Wet), horizontally split connecting rods
Crankshaft pulley	M22×1.5	40±2.0	392±19.6			
Flywheel	M22×1.5	55±2.8	539±27.0			(Wet)
Damper	M22×1.5	40±2.0	392±19.6			
Exhaust manifold	M10×1.5	7±0.7	69±6.9			
Camshaft gear	M30×1.5	30±1.5	294±14.7			
Injection pump gear	M30×1.5	40±2.0	392±19.6			
Idler shaft gear (bolt)	M16×1.5	14±0.7	137±6.9			
Idler shaft gear (nut)	M16×1.5	10±0.5	98±4.9			
Oil pump idler gear	M12×1.25	6 - 8	59 - 78			Apply Loctite 262 to threads
Oil pump cover	M10×1.25	3.4±0.3	33±3.3			(Wet)
Oil filter spacer	M30×1.5	30±3.0	294±29.4			
Turbocharger oil eye bolt	Fix with two standard bolts					
Water pump pulley	M22×1.5	16±1.6	157±15.7			
Water pump cover	M10×1.25	3.3±0.3	32±3.2			
Injection pump	M12×1.25	11±0.6	108±5.4			
Injection pump laminate plate	M12×1.25	10.5 - 11.5	103 - 113			
Injection pump stay (back of pump)	M14×1.5	3.5±0.35	34±3.4			Dedicated bolts with 19 width across flats
Injection pump stay (to install crankcase)	M10×1.25	6.1±0.61	60±6.0			10.9 bolt
Injection pump flywheel (nut)	M24×1.5	40±2.0	392±19.6			
Injection pump coupling shaft	M14×1.5	17 - 18	167 - 177			
Delivery valve holder	M30×1.5	24 - 26	235 - 255			
Barrel mounting bolt (injection pump)	M12×1.25	8.0 - 8.5	78 - 83			
Rack fallout prevention set screw (injection pump)	M8×1.25	2.1±0.2	21±2.1			
Timer cover	M188×1.5	48±2.4	470±23.5			
Camshaft fixing nut (timer)	M24×1.5	40±2.0	392±19.6			(Wet)



Model	S6B5			Tolerance to control torque (Note 6)		Remarks
	Thread size Diameter × pitch (mm)	Tightening torque		Important	General	
kgf·m		N·m				
Plug (timer)	M56×2.0	28±1.4	274±13.7			
Nozzle gland (nozzle holder)	M10×1.25	2±0.1	20±1.0			
Nozzle gland (stud)	M12×1.25	5±0.3	49±2.5			
Nozzle holder set screw cap nut	M14×1.00	4 - 5	39 - 49			
Nozzle tip retaining nut	M19×0.75	6 - 8	59 - 78			
Nozzle inlet connector	M14×1.5	7 - 8	69 - 78			
Fuel rack control lever	M8×1.25	2.5±0.1	25±1.3			Tighten twice
Fuel filter air vent plug	M8×1.25	0.8 - 1.0	8 - 10			



## Notes:

1. Apply engine oil to the bolt threads and seats of parts designated “wet”.
2. Tighten the main bearing cap bolts and main bearing cap side bolts in the following order:
  - (1) Tighten the cap bolts to the specified torque.
  - (2) Tighten the engine RH side bolts.
  - (3) Tighten the engine LH side bolts.
3. Be sure to tighten the oil jet check valve to the specified torque with a torque wrench. If tightened with any other tool, the check valve may be overtightened and may operate improperly, stopping the flow of cooling oil to the engine and causing the seizure of the pistons.
4. Tighten the cylinder head bolts by the methods (1) and (2) below for S6B and S6B3 and by the methods (3) and (4) below for S6B5.

Please reference MHI SERVICE BULLETIN number SB2010-009

located at the end of the S6B section of this manual.

This service bulletin supersedes all service manuals and all previous service bulletins.



5. Tighten the connecting rod bolts by either of the methods (1) and (2) below.

**S6B and S6B3**

(1) Angle method (at assembly)

Tighten to snug torque of  $147 \pm 7.4$  N·m ( $15 \pm 0.8$  kgf·m), and turn to angle of  $45^\circ \pm 3^\circ$ . Repeat this procedure twice.

(2) Torque method (at site)

Tighten twice to snug torque of  $274 \pm 13.7$  N·m ( $28 \pm 1.4$  kgf·m).

**S6B5**

Strengthened type (current), 34A19-06190

(1) Angle method (at assembly)

Tighten to snug torque of  $186 \pm 9.3$  N·m ( $19 \pm 0.9$  kgf·m), and turn to angle of  $45^\circ \pm 3^\circ$ . Repeat this procedure twice.

(2) Torque method (at site)

Tighten twice to snug torque of  $314 \pm 15.7$  N·m ( $32 \pm 1.6$  kgf·m).

Standard (not current), 34A19-40190

(1) Angle method (at assembly)

Tighten to snug torque of  $147 \pm 7.4$  N·m ( $15 \pm 0.8$  kgf·m), and turn to angle of  $45^\circ \pm 3^\circ$ . Repeat this procedure twice.

(2) Torque method (at site)

Tighten twice to snug torque of  $274 \pm 13.7$  N·m ( $28 \pm 1.4$  kgf·m).

6. Meet the tolerances to control torque below.

(1) Important:  $\pm 5\%$

Angle method: Snug torque tolerances of  $\pm 5\%$  and angle tolerances of  $\pm 3^\circ$

(2) General:  $\pm 10\%$



# **SERVICE BULLETIN**

BULLETIN No.: SB2010-009 (1/2)

GROUP: Cylinder head

MODELS: S6B,S6B3,S6B5

DATE: August 2010

**MITSUBISHI HEAVY INDUSTRIES, LTD.**  
**GENERAL MACHINERY & SPECIAL VEHICLE HEADQUARTERS**

SUBJECT: Change in cylinder head bolt tightening method

1. Purpose

There are two tightening methods of cylinder head bolts, the torque method and the angle controlled method. The torque method, which had been used in production assembly process, has been changed to the angle method.

Also, the angle controlled method for head gasket which requires preset, has been revised.

Relevant service bulletin Nos. SB98-030 and SB2008-039

Relevant service manual: S6B Pub. No. 99679-10070

Relevant service manual: S6B3 Pub. No. 99679-10080

2. New and current parts

APPLICABLE No.:

MODIFIED No.:

DATE OF SERVICE PARTS AVAILABLE:

INTERCHANGEABILITY:

R=(NEW) ⇄ (OLD)

1=Out of Supply.

S=(NEW) ⇄ (OLD)

2=Yes as an assembly.

N=(NEW) ⇄ (OLD)

3=Yes as a single part.

EO No.

34A0-A468

Please pass to:	DEPT. MANAGER	SECT. MANAGER	MECHANICS or CLERKS



### 3. Description

Angle controlled method of cylinder head bolt

(NEW)

For S6B and S6B3

When preset type head gasket is used.

(Part number 36201-52100 and subsequent part numbers)

Short bolt

1. Tighten the bolt to a snug torque of  $98 \pm 4.9\text{N}\cdot\text{m}$  ( $10 \pm 0.5\text{kgf}\cdot\text{m}$ ).
2. Turn the bolt to an angle of  $75^\circ \pm 3^\circ$
3. Loosen the bolt.
4. Tighten the bolt to a snug torque of  $98 \pm 4.9\text{N}\cdot\text{m}$  ( $10 \pm 0.5\text{kgf}\cdot\text{m}$ ). (Second time)
5. Turn the bolt to an angle of  $75^\circ \pm 3^\circ$

Long bolt

1. Tighten the bolt to a snug torque of  $98 \pm 4.9\text{N}\cdot\text{m}$  ( $10 \pm 0.5\text{kgf}\cdot\text{m}$ ).
2. Turn the bolt to an angle of  $105^\circ \pm 3^\circ$
3. Loosen the bolt.
4. Tighten the bolt to a snug torque of  $98 \pm 4.9\text{N}\cdot\text{m}$  ( $10 \pm 0.5\text{kgf}\cdot\text{m}$ ). (Second time)
5. Turn the bolt to an angle of  $105^\circ \pm 3^\circ$

For S6B5

The tightening method for S6B5 is the same as the one for short bolt above.

(OLD)

For S6B and S6B3

When preset type head gasket is used.

(Part number 36201-52100 and subsequent part numbers)

Short bolt

1. Tighten the bolt to a snug torque of  $108 \pm 5.4\text{N}\cdot\text{m}$  ( $11 \pm 0.6\text{kgf}\cdot\text{m}$ ).
2. Turn the bolt to an angle of  $60^\circ \pm 3^\circ$
3. Loosen the bolt.
4. Tighten the bolt to a snug torque of  $108 \pm 5.4\text{N}\cdot\text{m}$  ( $11 \pm 0.6\text{kgf}\cdot\text{m}$ ). (Second time)
5. Turn the bolt to an angle of  $60^\circ \pm 3^\circ$

Long bolt

1. Tighten the bolt to a snug torque of  $147 \pm 7.4\text{N}\cdot\text{m}$  ( $15 \pm 0.8\text{kgf}\cdot\text{m}$ ).
2. Turn the bolt to an angle of  $60^\circ \pm 3^\circ$
3. Loosen the bolt.
4. Tighten the bolt to a snug torque of  $147 \pm 7.4\text{N}\cdot\text{m}$  ( $15 \pm 0.8\text{kgf}\cdot\text{m}$ ). (Second time)
5. Turn the bolt to an angle of  $60^\circ \pm 3^\circ$

For S6B5

The tightening method for S6B5 is the same as the one for short bolt above.

*LARGE BORE*

*TORQUE SPECIFICATIONS*

*SH*

*SERIES*

# **SERVICE BULLETIN**

**MITSUBISHI HEAVY INDUSTRIES, LTD.**  
**GENERAL MACHINERY & SPECIAL VEHICLE HEADQUARTERS**

BULLETIN No.: SH2008-038 (1/5)

GROUP: Basic engine

MODELS: S12H, S6H

DATE: 28 November 2008

SUBJECT: Tightening Torque for SH Series

1. Purpose

To improve reliability, method of tightening cylinder head bolts in SH series was changed from torque method to angle method. Service Bulletin No. SH2001-024 was issued with tightening torque tables. New tightening torque tables were then prepared with change of torque values and addition of unit torque values. These new tightening torque tables are given here for use in inspection and maintenance. Tighten general bolts to specified torque within tolerances of  $\pm 10\%$ .

APPLICABLE No.:

MODIFIED No.:

DATE OF SERVICE PARTS AVAILABLE:

INTERCHANGEABILITY:

R=(NEW)  $\leftrightarrow$  (OLD)

S=(NEW)  $\leftrightarrow$  (OLD)

N=(NEW)  $\leftrightarrow$  (OLD)

1=Out of Supply.

2=Yes as an assembly.

3=Yes as a single part.

EO No.
35C0-A162



Please pass to:	DEPT. MANAGER	SECT. MANAGER	MECHANICS or CLERKS



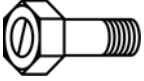

2. Description

For bolts other than general bolts, see the following data.

Tightening torque for general bolts

	Thread size Diameter × pitch (mm)	Strength classification			
		7T		10.9	
					
Metric screw thread for cars		N·m	kgf·m	N·m	kgf·m
	M8×1.25	17	1.7	30	3.1
	M10×1.25	33	3.4	60	6.1
	M12×1.25	60	6.1	108	11.0
	M14×1.5	97	9.9	176	17.9
	M16×1.5	145	14.8	262	26.7
	M18×1.5	210	21.4	378	38.5
	M20×1.5	291	29.7	524	53.4
	M22×1.5	385	39.3	694	70.8
	M24×1.5	487	49.7	878	89.5
	M27×1.5	738	75.3	1328	135.5

	Thread size Diameter × pitch (mm)	Strength classification			
		7T		10.9	
					
Metric coarse screw thread		N·m	kgf·m	N·m	kgf·m
	M10×1.5	32	3.3	58	5.9
	M12×1.75	57	5.8	102	10.4
	M14×2.0	93	9.5	167	17.0
	M16×2.0	139	14.2	251	25.6
	M18×2.5	194	19.8	350	35.7
	M20×2.5	272	27.7	489	49.9
	M22×2.5	363	37.0	653	66.6
	M24×3.0	468	47.7	843	86.0
	M27×3.0	686	70.0	1236	126.0

Tightening torque for eye bolts

Thread size Diameter × pitch (mm)	Strength classification	
	4T	
	N·m	kgf·m
M8×1.25	8±1.0	0.8±0.1
M10×1.25	15±2.0	1.5±0.2
M12×1.25	25±3.0	2.5±0.3
M14×1.5	34±4.0	3.5±0.4
M16×1.5	44±5.0	4.5±0.5
M18×1.5	74±5.0	7.5±0.5
M20×1.5	98±10.0	10.0±1.0
M24×1.5	147±15.0	15.0±1.5
M27×1.5	226±20.0	23.0±2.0

(in dry condition)

Tightening torque for union nut

Cap nut size	Nominal diameter	N·m	kgf·m
M14×1.5	63	39	4
M16×1.5	80	49	5
M20×1.5	100	78	8
M22×1.5	120	98	10
M27×1.5	150	157	16
M30×1.5	180	196	20
M30×1.5	200	196	20
M33×1.5	220	245	25
M36×1.5	254	294	30

(Tolerance of torque: ±10%, in dry condition)

Tightening torque for fuel high-pressure injection pipe

Cap nut size	N·m	kgf·m
M12×1.5	39±5	4±0.5
M14×1.5	49±5	5±0.5
M18×1.5	59±10	6±1.0

(in dry condition)

Notes:

1. Tightening torque for general bolts
  - 1-1. This table gives tightening torque for standard bolts and nuts.
  - 1-2. These torque values apply when spring washers are used.
  - 1-3. Unless specially noted, tighten general bolts to torque specified here.
  
2. When union nuts are tightened, torsional stresses do not structurally occur in pipe that rotates together with sleeve. Above tightening torque values are thus given for reference. Union nuts can be retightened when leaks or bleeds occur.
  
3. If high-pressure fuel injection pipe is overtightened, excessive stresses may result from rotation of sleeve together with pipe or torsion of pipe.



Model	S12H			S6H-MTK			Tolerance to control torque (Note 6)		Remarks
	Thread size Diameter × pitch (mm)	Tightening torque		Thread size Diameter × pitch (mm)	Tightening torque		Important	General	
		kgf·m	N·m		kgf·m	N·m			
Cylinder head bolt	M22×2.5	Note 4	Note 4						(Wet)
Rocker case	M12×1.25	11±0.55	108±5.4						
	M10×1.25	6±0.3	60±3.0						
Rocker shaft	M16×2.0	17±0.85	167±8.4						
Rocker arm lock nut	M12×1.25	6.5±0.33	64±3.2						
Bridge lock nut	M10×1.25	5.6±0.28	55±2.8						
Camshaft gear	M14×1.5	18±0.9	176±8.8						
Camshaft thrust plate	M12×1.25	11±0.55	108±5.4						
Cam follower shaft	M12×1.25	9±0.45	88±4.4						
Adapter	M12×1.25	8±0.4	78±3.9						
Main bearing cap	M22×2.5	50±2.5	490±24.5	M24×3.0	60±3.00	588±29.4			(Wet), Note 2
Main bearing cap side bolt	M16×1.5	15±0.75	147±7.4						(Wet), Note 2
Front hanger				M12×1.25	11±1.1	108±10.8			
Rear hanger	M16×1.5	26±2.6	245±24.5	M12×1.25	11±1.1	108±10.8			
				M14×1.5	18±1.8	176±17.6			
Oil jet	M12×1.75	3.5±0.18	34±1.7						Note 3
Timing gear case	M12×1.25	10±0.5	98±4.9	M12×1.25	11±0.55	108±5.4			Fixed to crankcase
	M12×1.25	7±0.35	69±3.5						Fix with rear plate and nut
	M16×1.5	26±1.3	245±12.3						
Rear plate	M12×1.25	11±0.55	108±5.4						
Oil pan	M10×1.25	4±0.40	39±3.9						
Front mounting bracket	M20×1.5	40±2.0	392±19.6	M18×1.5	25±1.3	245±12.3			
Rear mounting bracket	M18×2.5	30±1.50	294±14.7	M16×1.5	22±1.1	216±10.8			
Connecting rod bearing cap	M18×1.5	Note 5	Note 5						(Wet)
Balance weight	M16×1.5	20±1.0	196±19.8						(Wet)
Flywheel	M22×1.5	60±3.0	588±29.4	M22×1.5	55±2.75	539±27.0			(Wet)
Viscous damper	M22×1.5	50±2.5	490±24.5						
Rear idler shaft	M12×1.25	11±0.55	108±5.4						
Rear idler shaft thrust plate	M10×1.25	6.1±0.31	60±3.0						
Front gear case	M12×1.25	10±1.0	98±9.8	M12×1.25	11±1.1	108±10.8			Fixed to crankcase
	M12×1.25	7±0.7	69±6.9						Fix with rear plate and nut
	M16×1.5	26±2.6	255±25.5						
Front plate	M12×1.25	11±1.1	108±10.8						
Front idler shaft	M12×1.25	11±0.55	108±5.4						
Front idler shaft thrust plate	M16×1.5	22±1.1	216±10.8	M10×1.25	6.1±0.31	60±3.0			
Exhaust manifold	M10×1.5	5 - 6	49 - 59						
Oil pump	M10×1.25	6±0.6	59±5.9						
Oil pump idler gear (nut)				M12×1.25	7±0.7	69±6.9			
Turbocharger oiling	M10×1.5	3±0.15	29±1.45						Eye bolt type
	M10×1.5	5.9±0.30	59±3.0						Flange fixing type



Model	S12H			S6H-MTK			Tolerance to control torque (Note 6)		Remarks
Part name (Tightening part)	Thread size Diameter × pitch (mm)	Tightening torque		Thread size Diameter × pitch (mm)	Tightening torque		Important	General	
		kgf·m	N·m		kgf·m	N·m			
Water pump	M12×1.25	11±1.1	108±10.8	M12×1.25	7±0.7	69±6.9			
Water pump shaft pulley (nut)	M30×1.5	40±2.0	392±20	M24×1.5	25±1.25	245±12.3			
Fan pulley (cap nut)	M30×1.5	40±4.0	392±3.9						
Unit injector gland (nut)	M14×1.5	10±0.5	98±4.9						
	M16×1.5	Note 6	Note 6						(Wet)
Unit injector gland stud	M16×2.0	13±0.65	127±6.35						Apply Loctite to cylinder head stud bolts
Fuel main pipe	M10×1.25	1.5±0.15	15±1.5						Eye bolt
Fuel main pipe check valve	M14×1.5	3.5±0.4	34±4.0						Eye bolt type
Fuel main pipe check valve head nut	M12×1.25	5.7±0.6	56±6.0						
Priming pump and fuel filter	M14×1.5	2.0 - 2.5	20 - 25						Eye bolt
Priming pump	M16×1.5	3.5±0.35	34±3.4						Eye bolt
Trochoid pump piping	M20×1.5	6±0.6	59±5.9	M16×1.5	3.5±0.35	34±3.4			Eye bolt
Fuel rack control lever	M8×1.25	2.5±0.25	25±2.5						Tighten twice
Fuel filter air vent plug	M8×1.25	0.8 - 1.0	8 - 10						Not used for ordinary air venting
Governor drive case	M12×1.25	11±1.1	108±10.8						
Starter (nut)	M12×1.25	6±0.60	59±5.9						
Trochoid pump	M8×1.25	2.0 - 2.2	20 - 22						



## Notes:

1. Apply engine oil to the bolt threads and seats of parts designated “wet”.
2. Tighten the main bearing cap bolts and main bearing cap side bolts in the following order:
  - (1) Tighten the cap bolts to the specified torque.
  - (2) Tighten the engine RH side bolts.
  - (3) Tighten the engine LH side bolts.
3. Be sure to tighten the oil jet check valve to the specified torque with a torque wrench. If tightened with any other tool, the check valve may be overtightened and may operate improperly, stopping the flow of cooling oil to the engine and causing the seizure of the pistons.
4. Tighten the cylinder head bolts by either of the methods (1) and (2) below.
  - (1) Angle method (at assembly) (tightening twice)
    - 1 Tighten to snug torque of  $294 \pm 15$  N·m ( $30 \pm 1.5$  kgf·m).
    - 2 Then turn to angle of  $65^\circ \pm 3^\circ$ .
    - 3 Loosen all bolts.
    - 4 Tighten again to snug torque of  $294 \pm 15$  N·m ( $30 \pm 1.5$  kgf·m).
    - 5 Turn again to angle of  $65^\circ \pm 3^\circ$ .
  - (2) Torque method (at site) (tightening twice)
    - 1 Tighten to snug torque of  $539 \pm 27$  N·m ( $55 \pm 2.8$  kgf·m).
    - 2 Loosen all bolts.
    - 3 Tighten again to snug torque of  $539 \pm 27$  N·m ( $55 \pm 2.8$  kgf·m).
5. Tighten the connecting rod bolts by either of the methods (1) and (2) below.
  - (1) Angle method (at assembly) (tightening twice)
    - 1 Tighten to snug torque of  $147 \pm 7.4$  N·m ( $15 \pm 0.75$  kgf·m).
    - 2 Then turn to angle of  $45^\circ \pm 3^\circ$ .
    - 3 Loosen all bolts.
    - 4 Tighten again to snug torque of  $147 \pm 7.4$  N·m ( $15 \pm 0.75$  kgf·m).
    - 5 Turn again to angle of  $45^\circ \pm 3^\circ$ .
  - (2) Torque method (at site) (tightening twice)
    - 1 Tighten to snug torque of  $343 \pm 17$  N·m ( $35 \pm 1.8$  kgf·m).
    - 2 Loosen all bolts.
    - 3 Tighten again to snug torque of  $343 \pm 17$  N·m ( $35 \pm 1.8$  kgf·m).
6. Tighten the unit injector gland mounting nuts in the following order.  
 $176 \pm 9$  N·m ( $18 \pm 0.9$  kgf·m)     $0$  N·m ( $0$  kgf·m)     $127 \pm 6.4$  N·m ( $13 \pm 0.7$  kgf·m)
7. Meet the tolerances to control torque below.
  - (1) Important:  $\pm 5\%$   
Angle method: Snug torque tolerances of  $\pm 5\%$  and angle tolerances of  $\pm 3^\circ$
  - (2) General:  $\pm 10\%$



*LARGE BORE*

*TORQUE SPECIFICATIONS*

*SR*

*SERIES*

# **SERVICE BULLETIN**

**MITSUBISHI HEAVY INDUSTRIES, LTD.**  
**GENERAL MACHINERY & SPECIAL VEHICLE HEADQUARTERS**

BULLETIN No.: SR2008-109 (1/12)

GROUP: Basic engine

MODELS: S6R, S6R2, S12R, S16R,  
S16R-S

DATE: 28 November 2008

SUBJECT: Tightening Torque for SR Series

1. Purpose

To improve reliability, method of tightening cylinder head bolts in SR series was changed from torque method to angle method. Service Bulletin No. SA2001-160 was issued with tightening torque tables. New tightening torque tables were then prepared with change of torque values and addition of unit torque values. These new tightening torque tables are given here for use in inspection and maintenance. Tighten general bolts to specified torque within tolerances of  $\pm 10\%$ .

APPLICABLE No.:

MODIFIED No.:

DATE OF SERVICE PARTS AVAILABLE:

INTERCHANGEABILITY:

R=(NEW)  $\leftrightarrow$  (OLD)

1=Out of Supply.

S=(NEW)  $\leftrightarrow$  (OLD)

2=Yes as an assembly.

N=(NEW)  $\leftrightarrow$  (OLD)

3=Yes as a single part.

EO No.
3750-B551



Please pass to:	DEPT. MANAGER	SECT. MANAGER	MECHANICS or CLERKS



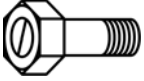

2. Description

For bolts other than general bolts, see the following data.

Tightening torque for general bolts

	Thread size Diameter × pitch (mm)	Strength classification			
		7T		10.9	
					
Metric screw thread for cars		N·m	kgf·m	N·m	kgf·m
	M8×1.25	17	1.7	30	3.1
	M10×1.25	33	3.4	60	6.1
	M12×1.25	60	6.1	108	11.0
	M14×1.5	97	9.9	176	17.9
	M16×1.5	145	14.8	262	26.7
	M18×1.5	210	21.4	378	38.5
	M20×1.5	291	29.7	524	53.4
	M22×1.5	385	39.3	694	70.8
	M24×1.5	487	49.7	878	89.5
	M27×1.5	738	75.3	1328	135.5

	Thread size Diameter × pitch (mm)	Strength classification			
		7T		10.9	
					
Metric coarse screw thread		N·m	kgf·m	N·m	kgf·m
	M10×1.5	32	3.3	58	5.9
	M12×1.75	57	5.8	102	10.4
	M14×2.0	93	9.5	167	17.0
	M16×2.0	139	14.2	251	25.6
	M18×2.5	194	19.8	350	35.7
	M20×2.5	272	27.7	489	49.9
	M22×2.5	363	37.0	653	66.6
	M24×3.0	468	47.7	843	86.0
	M27×3.0	686	70.0	1236	126.0

Tightening torque for eye bolts

Thread size Diameter × pitch (mm)	Strength classification	
	4T	
	N·m	kgf·m
M8×1.25	8±1.0	0.8±0.1
M10×1.25	15±2.0	1.5±0.2
M12×1.25	25±3.0	2.5±0.3
M14×1.5	34±4.0	3.5±0.4
M16×1.5	44±5.0	4.5±0.5
M18×1.5	74±5.0	7.5±0.5
M20×1.5	98±10.0	10.0±1.0
M24×1.5	147±15.0	15.0±1.5
M27×1.5	226±20.0	23.0±2.0

(in dry condition)

Tightening torque for union nut

Cap nut size	Nominal diameter	N·m	kgf·m
M14×1.5	63	39	4
M16×1.5	80	49	5
M20×1.5	100	78	8
M22×1.5	120	98	10
M27×1.5	150	157	16
M30×1.5	180	196	20
M30×1.5	200	196	20
M33×1.5	220	245	25
M36×1.5	254	294	30

(Tolerance of torque: ±10%, in dry condition)

Tightening torque for fuel high-pressure injection pipe

Cap nut size	N·m	kgf·m
M12×1.5	39±5	4±0.5
M14×1.5	49±5	5±0.5
M18×1.5	59±10	6±1.0

(in dry condition)

Notes:

1. Tightening torque for general bolts
  - 1-1. This table gives tightening torque for standard bolts and nuts.
  - 1-2. These torque values apply when spring washers are used.
  - 1-3. Unless specially noted, tighten general bolts to torque specified here.
  
2. When union nuts are tightened, torsional stresses do not structurally occur in pipe that rotates together with sleeve. Above tightening torque values are thus given for reference. Union nuts can be retightened when leaks or bleeds occur.
  
3. If high-pressure fuel injection pipe is overtightened, excessive stresses may result from rotation of sleeve together with pipe or torsion of pipe.



Model	S6R, S6R2			S12R			Tolerance to control torque (Note 6)		Remarks
	Thread size Diameter × pitch (mm)	Tightening torque		Thread size Diameter × pitch (mm)	Tightening torque		Important	General	
		kgf·m	N·m		kgf·m	N·m			
Cylinder head bolt	M22×2.5	Note 4	Note 4						(Wet)
Cylinder head nozzle gland (stud)	M14×2.0	7 - 8	69 - 78						Apply Loctite 272 to stud bolts
Rocker case	M12×1.25	11±0.55	108±5.4						
Rocker shaft	M14×2.0	15±0.75	147±7.4						
Rocker arm lock nut	M12×1.25	6.5±0.33	64±3.2						
Bridge lock nut	M10×1.25	5.6±0.28	55±2.8						
Camshaft gear (rear)	M14×1.5	17.9±0.90	176±8.8	/	/	/			12T bolt (black) + hard washer
	(M12×1.25)	(13±0.65)	(127±6.4)	M12×1.25	13±0.65	127±6.4			12T bolt (black) + hard washer
	(M12×1.25)	(11±0.55)	(108±5.4)	(M12×1.25)	(11±0.55)	(108±5.4)			10T bolt (gold) + hard washer
Camshaft thrust plate	M12×1.25	6±0.60	59±5.9						
Main bearing cap	M22×2.5	50±2.50	490±24.5	M24×3.0	60±3.00	588±29.4			(Wet), Note 2
Main bearing cap side bolt	/	/	/	M20×2.5	40±2.00	392±19.6			(Wet), Note 2
Hanger	M12×1.25	11±0.55	108±5.4	M20×1.5	40±2.00	392±19.6			
	/	/	/	M16×1.5	22±1.10	216±10.8			
Oil jet check valve	M12×1.75	3.5±0.18	34±1.7						Note 3
Timing gear case	M16×1.5	26±1.30	255±12.8						Hard washer used
	(M16×1.5)	(22±1.10)	(216±10.8)						Spring washer used
Rear plate	M12×1.25	11±0.55	108±5.4						Hard washer for S6R and flange bolt for SRV
	/	/	/	M16×1.5	26±1.3	255±12.8			Hard washer used
	/	/	/	(M16×1.5)	22±1.10	(216±10.8)			Spring washer used
Oil pan	M12×1.25	6±0.60	59±5.9						
Front mounting bracket	M12×1.25	11±0.55	108±5.4	M20×1.5	40±2.00	392±19.6			
	/	/	/	M20×1.5	25±1.25	245±12.3			Lower front bolts (STD SR: RH alone)
Rear mounting bracket	M16×1.5	22±1.10	216±10.8	M20×1.5	40±2.00	392±19.6			
Connecting rod bearing cap	M22×1.5	Note 5	Note 5						(Wet)
Balance weight	/	/	/	M22×1.5	50±2.50	490±24.5			(Wet)
Flywheel	M22×1.5	55±2.75	539±27.0	M22×1.5	60±3.00	588±29.4			(Wet)
Ring gear	/	/	/	M10×1.25	3.4±0.17	33±1.7			
Viscous damper	M22×1.5	50±2.50	490±24.5						



Model	S6R, S6R2			S12R			Tolerance to control torque (Note 6)		Remarks
Part name (Tightening part)	Thread size Diameter × pitch (mm)	Tightening torque		Thread size Diameter × pitch (mm)	Tightening torque		Important	General	
		kgf·m	N·m		kgf·m	N·m			
Rear timing idler gear	/	/	/	(M12×1.25)	(11±0.55)	(108±5.4)			Separate gear type
Rear idler shaft	M12×1.25	11±0.55	108±5.4	M20×1.5	40±2.00	392±19.6			Apply Molykote
	/	/	/	(M16×1.5)	(26±1.3)	(255±12.8)			Apply Molykote
Rear idler shaft (nut)	/	/	/	(M16×1.5)	(22±1.1)	(216±10.8)			
	/	/	/	M18×1.5	20±1.00	196±9.8			
Rear idler shaft thrust plate	/	/	/	(M14×1.5)	(15±0.75)	(147±7.4)			
	M10×1.25	6.1±0.31	60±3.0	/	/	/			Spring washer Hard washer
Front gear case	/	/	/	M12×1.25	6±0.30	59±3.0			
	/	/	/	M16×1.5	26±1.3	255±12.8			Hard washer used
	/	/	/	M16×1.5	22±1.10	216±10.8			Spring washer used
Front plate	/	/	/	M12×1.25	6±0.60	59±5.9			
Front idler shaft	/	/	/	M12×1.25	11±1.1	108±10.8			
Front idler shaft thrust plate	/	/	/	M10×1.25	6.1±0.31	60±3.0			
Air duct clamp	/	/	/	M6×1.0	0.5±0.05	4.9±0.49			T bolt type: -2
Exhaust manifold V-clamp nut	M6×1.0	0.9±0.05	9±0.45						S12R-2 is 20 N·m (2 kgf·m)
Exhaust manifold mounting bolt	/	/	/	M10×1.5	10±0.50	98±4.9			
Turbocharger mounting bolt	M12×1.25	11±0.55	108±5.4						ASTM A453 equivalent
Compressor wheel (nut)	Note 8, 9, 10, and 11								
Oil pump and water pump mount plate	/	/	/	M12×1.25	6±0.60	59±5.9			
Bearing cover	/	/	/	M12×1.25	11±1.1	108±10.8			
Injection pump drive case	M12×1.25	11±0.55	108±5.4						
Injection pump gear (nut)	M30×1.5	50±2.50	490±24.5						SCM435H, with identification mark
		(40±2.00)	(392±19.6)						S43C, without identification mark
Injection pump coupling shaft	/	/	/	M14×1.5	17 - 18	167 - 177			Tighten slit portion
Oil pump	M12×1.25	11±1.1	108±10.8						
Oil pump idler gear (nut)	M12×1.25	7±0.35	69±3.5	/	/	/			Apply Loctite 262 to threads
Oil pump cover	/	/	/	M10×1.25	3.4±0.34	33±3.3			
Water pump	M12×1.25	6±0.60	59±5.9	M12×1.25	11±1.10	108±10.8			
Water pump shaft pulley (nut)	M24×1.5	25±1.25	245±12.3	M30×1.5	40±2.00	392±19.6			For alternator drive



Model	S6R, S6R2			S12R			Tolerance to control torque (Note 6)		Remarks
Part name (Tightening part)	Thread size Diameter × pitch (mm)	Tightening torque		Thread size Diameter × pitch (mm)	Tightening torque		Important	General	
		kgf·m	N·m		kgf·m	N·m			
Fandrive camshaft gear (front)	M14×1.5	17.9±0.90	176±8.8	/	/	/			12T bolt (black) + hard washer
	(M12×1.25)	(13±0.65)	(127±6.4)	/	/	/			12T bolt (black) + hard washer
	(M12×1.25)	(11±0.55)	(108±5.4)	/	/	/			10T bolt (gold) + hard washer
Fandrive gear (nut)	M30×1.5	40±2.0	392±19.6	/	/	/			
Fan plate	M12×1.25	11±1.1	108±10.8	/	/	/			
Fandrive case	/	/	/	M12×1.25	11±1.10	108±10.8			
Fandrive coupling (nut)	/	/	/	M30×1.5	40±2.00	392±19.6			
Fandrive hub	/	/	/	M12×1.25	11±0.55	108±5.4			
Fandrive idler shaft	/	/	/	M12×1.25	6±0.60	59±5.9			
Air cooler	M12×1.25	11±1.10	108±10.8	M10×1.25	4.5±0.45	44±4.4			
Injection pump bracket	M12×1.25	11±0.55	108±5.4						
Injection pump	M12×1.25	11±0.55	108±5.4						
Injection pump laminate plate	M14×1.5	11.5 - 12.5	113 - 123	/	/	/			Applicable to S6R2-MTK3, etc. Tighten twice
	M12×1.25	10.5 - 11.5	103 - 113						10T bolt (10T stamped) + washer-faced nut
	(M12×1.25)	(8.5 - 9.5)	(83 - 93)						Bolt without identification mark + ordinary nut
Injection pump flywheel (nut)	M24×1.5	40±2.0	392±19.6						
Injection pump coupling shaft	M14×1.5	17 - 18	167 - 177						
Plunger assembly	M12×1.25	8 - 8.5	78 - 83						
Delivery valve holder	M30×1.5	24 - 26	235 - 255						
Nozzle gland (nut)	M14×1.5	10±0.5	98±4.9						
Nozzle tip retaining nut	M28×1.5	18 - 20	177 - 196						Nozzle assembly (SR STD) for T- shaped nozzle tip
Nozzle holder cap nut	M14×1.5	7 - 8	69 - 78						
Nozzle holder set screw	M10×1.5	3.5 - 4.5	34 - 44						
Nozzle inlet connector	M16×1.5	6.5 - 7.5	64 - 74						
Injection pipe (nozzle side, pump side)	M18×1.5	5 - 7	49 - 69						
Fuel rack control lever	M8×1.25	2.5±0.13	25±1.25						Tighten twice



Model	S6R, S6R2			S12R			Tolerance to control torque (Note 6)		Remarks
	Thread size Diameter × pitch (mm)	Tightening torque		Thread size Diameter × pitch (mm)	Tightening torque		Important	General	
kgf·m		N·m	kgf·m		N·m				
Fuel filter air vent plug	M8×1.25	0.8 - 1.0	8 - 10						
Governor drive case	M12×1.25	11±0.55	108±5.4						
Starter	M12×1.25	6±0.60	59±5.9						



Model	S16R			S16R-S			Tolerance to control torque (Note 6)		Remarks	
	Part name (Tightening part)	Thread size Diameter × pitch (mm)	Tightening torque		Thread size Diameter × pitch (mm)	Tightening torque		Important		General
			kgf·m	N·m		kgf·m	N·m			
Cylinder head bolt	M22×2.5	Note 4	Note 4						(Wet)	
Cylinder head nozzle gland (stud)	M14×2.0	7 - 8	69 - 78						Apply Loctite 272 to stud bolts	
Rocker case	M12×1.25	11±0.55	108±5.4							
Rocker shaft	M14×2.0	15±0.75	147±7.4							
Rocker arm lock nut	M12×1.25	6.5±0.33	64±3.2							
Bridge lock nut	M10×1.25	5.6±0.28	55±2.8							
Camshaft gear (rear)	M12×1.25	13±0.65	127±6.4						12T bolt (black) + hard washer	
	(M12×1.25)	(11±0.55)	(108±5.4)						10T bolt (gold) + hard washer	
Camshaft thrust plate	M12×1.25	6±0.60	59±5.9							
Main bearing cap	M24×3.0	60±3.0	588±29.4						(Wet), Note 2	
Main bearing cap side bolt	M20×2.5	40±2.00	392±19.6						(Wet), Note 2	
Hanger	M20×1.5	40±2.00	392±19.6							
	M16×1.5	22±1.10	216±10.8							
Oil jet check valve	M12×1.75	3.5±0.18	34±1.7						Note 3	
Timing gear case	M16×1.5	26±1.30	255±12.8	M16×1.5	22±1.10	216±10.8			Hard washer used	
	(M16×1.5)	(22±1.10)	(216±10.8)	(M16×1.5)	(18±0.9)	(176±8.8)			Spring washer used	
Under plate	M16×1.5	26±1.3	255±12.8	/	/	/			Crankcase to underplate	
	(M20×1.5)	(30±1.5)	(294±14.7)	/	/	/				
Rear plate	M12×1.25	11±0.55	108±5.4						Hard washer for S6R and flange bolt for SRV	
	M16×1.5	26±1.3	255±12.8	M16×1.5	22±1.10	216±10.8			Hard washer used	
	/	/	/	(M16×1.5)	(18±0.9)	(176±8.8)			Spring washer used	
Oil pan	M12×1.25	6±0.60	59±5.9							
Front mounting bracket	M20×1.5	40±2.00	392±19.6						Lower front bolts (STD SR: RH alone, Rainbow: Both RH and HL), shallow female threads	
	M20×1.5	25±1.25	245±12.3							
Center mounting bracket	M20×1.5	40±2.0	392±19.6							
Rear mounting bracket	M20×1.5	40±2.0	392±19.6	M20×1.5	20±1.0	196±9.8				
Cushion rubber	/	/	/	M14×1.5	10±0.5	98±4.9				
Connecting rod bearing cap	M22×1.5	Note 5	Note 5						(Wet)	
Balance weight	M22×1.5	50±2.50	490±24.5						(Wet)	
Flywheel	M22×1.5	60±3.0	588±29.4						(Wet)	





Model	S16R			S16R-S			Tolerance to control torque (Note 6)		Remarks
Part name (Tightening part)	Thread size Diameter × pitch (mm)	Tightening torque		Thread size Diameter × pitch (mm)	Tightening torque		Important	General	
		kgf·m	N·m		kgf·m	N·m			
Ring gear	M10×1.25	3.4±0.17	33±1.7						
Viscous damper	M22×1.5	50±2.50	490±24.5						
Rear timing idler gear	(M12×1.25)	(11±0.55)	(108±5.4)						Separate gear type
Rear idler shaft	M20×1.5	40±2.00	392±19.6						Apply Molykote
	(M16×1.5)	26±1.3	255±12.8						Apply Molykote
	(M16×1.5)	(22±1.10)	(216±10.8)						
Rear idler shaft (nut)	(M18×1.5)	20±1.00	196±9.8						
	(M14×1.5)	15±0.75	(147±7.4)						
Rear idler shaft retainer				M10×1.25	6±0.3	59±3.0			
Front gear case	M12×1.25	6±0.30	59±3.0						
	M16×1.5	26±1.3	255±12.8	M16×1.5	18±0.9	177±8.9			Hard washer used
	(M16×1.5)	(22±1.10)	(216±10.8)						Spring washer used
Front plate	M12×1.25	6±0.60	59±5.9						
Front idler shaft	M12×1.25	11±1.1	108±10.8						
Front idler shaft thrust plate	M10×1.25	6.1±0.31	60±3.0						
Air duct clamp	M6×1.0	0.5±0.05	4.9±0.49						T bolt type: -2
Exhaust manifold V-clamp nut	M6×1.0	0.9±0.05	9±0.45	M8×1.25	2±0.1	20±1.0			S16R-2 is 19.6 N·m (2 kgf·m)
Exhaust manifold mounting bolt	M10×1.5	10±0.5	98±4.9						
Turbocharger mounting bolt	M12×1.25	11±0.55	108±5.4						ASTMA453 equivalent
Exhaust pipe V-clamp	1/4-28UNF	0.9±0.045	9±0.45						
Compressor wheel (nut)	Notes 8, 9, 10, and 11			M11×1 (Non-spiral lock)	Note 5	Note 5			
Oil pump and water pump mount plate	M12×1.25	6±0.60	59±5.9						
Bearing cover	M12×1.25	11±1.1	108±10.8						
Injection pump drive case	M12×1.25	11±0.55	108±5.4						
Injection pump gear (nut)	M30×1.5	50±2.50	490±24.5						SCM435H, with identification mark
	M30×1.5	(40±2.50)	(392±19.6)						S43C, without identification mark
Injection pump coupling shaft	M14×1.5	17 - 18	167 - 177						Tighten slit portion
Oil pump	M12×1.25	11±1.1	108±10.8						
Oil pump cover	M10×1.25	3.4±0.34	33±3.3						
Water pump	M12×1.25	11±1.10	108±10.8	M12×1.25	11±0.55	108±5.4			



Model	S16R			S16R-S			Tolerance to control torque (Note 6)		Remarks
	Part name (Tightening part)	Thread size Diameter × pitch (mm)	Tightening torque		Thread size Diameter × pitch (mm)	Tightening torque		Important	
kgf·m			N·m	kgf·m		N·m			
Water pump shaft pulley (nut)	M30×1.5	40±2.00	392±19.6						For alternator drive
Sea water pump gear (nut)				M27×1.5	20±1.00	196±9.8			
Sea water pump impeller (nut)				M16×1.5	10±0.5	98±4.9			
Fandrive shaft gear (nut)	M30×1.5	40±2.00	392±19.6						
Fandrive case	M12×1.25	11±1.10	108±10.8						
Fandrive coupling (nut)	M30×1.5	40±2.00	392±19.6						
Fandrive hub	M12×1.25	11±0.55	108±5.4						
Fandrive idler shaft	M12×1.25	6±0.60	59±5.9						
Air cooler	M10×1.25	4.5±0.45	44±4.4						
Injection pump bracket	M12×1.25	11±0.55	108±5.4						
Injection pump	M12×1.25	11±0.55	108±5.4	M12×1.25	8±0.4	78±3.9			
Injection pump laminate plate	M12×1.25	10.5 - 11.5	103 - 113						10T bolt (10T stamped) + washer-faced nut
	(M12×1.25)	(8.5 - 9.5)	(83 - 93)						Bolt without identification mark + ordinary nut
Injection pump flywheel (nut)	M24×1.5	40±2.0	392±19.6						
Injection pump coupling shaft	M14×1.5	17 - 18	167 - 177						
Plunger assembly	M12×1.25	8 - 8.5	78 - 83						
Delivery valve holder	M30×1.5	24 - 26	235 - 255						
Nozzle gland (nut)	M14×1.5	10±0.5	98±4.9						
Nozzle tip retaining nut	M28×1.5	18 - 20	177 - 196						Nozzle assembly (SR STD) for T-shaped nozzle tip
Nozzle holder cap nut	M14×1.5	7 - 8	69 - 78						
Nozzle holder set screw	M10×1.5	3.5 - 4.5	34 - 44						
Nozzle inlet connector	M16×1.5	6.5 - 7.5	64 - 74						
Injection pipe (nozzle side, pump side)	M18×1.5	5 - 7	49 - 69						
Fuel rack control lever	M8×1.25	2.5±0.13	25±1.25						Tighten twice
Fuel filter air vent plug	M8×1.25	0.8±1.0	8 - 10						
Governor drive case	M12×1.25	11±0.55	108±5.4						
Starter	M12×1.25	6±0.60	59±5.9						
Heat exchanger				M14×1.5	8±0.4	78±3.9			
Vulkan coupling (flywheel side)				M12×1.25	11±0.55	108±5.4			
Vulkan coupling (intermediate rubber)				M10×1.5	3.5±0.18	34±1.7			Specified by Hitachi Nico
Vulkan coupling (marine gear side)				M12×1.75	10.2±0.51	100±5.0			Specified by Hitachi Nico



## Notes:

1. Apply engine oil to the bolt threads and seats of parts designated “wet”
2. Tighten the main bearing cap bolts and main bearing cap side bolts in the following order:
  - (1) Tighten the cap bolts to the specified torque.
  - (2) Tighten the engine RH side bolts.
  - (3) Tighten the engine LH side bolts.
3. Be sure to tighten the oil jet check valve to the specified torque with a torque wrench. If tightened with any other tool, the check valve may be overtightened and may operate improperly, stopping the flow of cooling oil to the engine and causing the seizure of the pistons.
4. Tighten the cylinder head bolts by either of the methods (1) and (2) below.
  - (1) Angle method (converted torque control value: 450 to 650 N·m) (tightening twice)
    - 1 Tighten to snug torque of  $294 \pm 14.7$  N·m ( $30 \pm 1.5$  kgf·m).
    - 2 Then turn to angle of  $65^\circ \pm 3^\circ$ .
    - 3 Loosen all bolts.
    - 4 Tighten again to snug torque of  $294 \pm 14.7$  N·m ( $30 \pm 1.5$  kgf·m).
    - 5 Turn again to angle of  $65^\circ \pm 3^\circ$ .
  - (2) Torque method (tightening twice)
    - 1 Tighten to snug torque of  $539 \pm 27$  N·m ( $55 \pm 2.75$  kgf·m).
    - 2 Loosen all bolts.
    - 3 Tighten again to snug torque of  $539 \pm 27$  N·m ( $55 \pm 2.75$  kgf·m).
5. Tighten the connecting rod bolts ~~by either of the two methods (1) and (2) below.~~
  - ~~5-1. Connecting rods after increase in stiffness~~
    - ~~(1) Angle method (at assembly) (tightening twice)~~
      - ~~Upper bolts (short bolts)~~
        - ~~1 Tighten to snug torque of  $245 \pm 12.3$  N·m ( $25 \pm 1.25$  kgf·m).~~
        - ~~2 Then turn to angle of  $60^\circ \pm 3^\circ$ .~~
        - ~~3 Loosen all bolts.~~

**Connecting Rod Torque**

See next page for updated specifications

- ~~(2) Torque method (at site) (tightening twice)~~
  - ~~Tighten both upper and lower bolts as described below:~~
    - ~~1 Tighten to snug torque of  $637 \pm 31.9$  N·m ( $65 \pm 3.25$  kgf·m).~~
    - ~~2 Loosen all bolts.~~
    - ~~3 Tighten again to snug torque of  $637 \pm 31.9$  N·m ( $65 \pm 3.25$  kgf·m).~~

# **SR Series**

## **Connecting Rod Torque Specifications**

### **Weight Rank ( M )**

**470 ft. lbs / 637 N-m**

### **Weight Rank ( A,B,C,D,E,F,G )**

**380 ft. lbs / 539 N-m**

**Tighten both bolts in several steps until desired torque is achieved. At this point it is required that both bolts be loosened and retorqued to the appropriate specification a second time. Failure to do so may lead to a catastrophic failure.**



~~5-2. Connecting rods before increase in stiffness~~

~~(1) Angle method (at assembly) (tightening twice)~~

~~1 Tighten to snug torque of  $245 \pm 12.3$  N·m ( $25 \pm 1.25$  kgf·m).~~

~~2 Then turn to angle of  $60^\circ \pm 3^\circ$ .~~

~~3 Loosen all bolts.~~

~~4 Tighten again to snug torque of  $245 \pm 12.3$  N·m ( $25 \pm 1.25$  kgf·m).~~

~~5 Turn again to angle of  $60^\circ \pm 3^\circ$ .~~

~~(2) Torque method (at site) (tightening twice)~~

~~1 Tighten to snug torque of  $539 \pm 27.0$  N·m ( $55 \pm 2.75$  kgf·m).~~

~~2 Loosen all bolts.~~

~~3 Tighten again to snug torque of  $539 \pm 27.0$  N·m ( $55 \pm 2.75$  kgf·m).~~

6. Meet the tolerances to control torque below.

(1) Important:  $\pm 5\%$

Angle method: Snug torque tolerances of  $\pm 5\%$  and angle tolerances of  $\pm 3\%$

(2) General:  $\pm 10\%$

7. Tighten the S16R-S compressor wheel nuts as described below.

7-1. New fabrication

(1) Clean the threads of oil.

(2) Tighten to torque of  $1 \pm 0.05$  kgf·m and loosen (nothing applied to threads).

(3) Apply Loctite 962.

(4) Tighten again to torque of  $1 \pm 0.05$  kgf·m.

(5) Tighten further to angle of  $80^\circ \pm 3^\circ$ .

7-2. Overhaul

(1) Clean the threads of oil.

(2) Apply Molykote to the threads and seats of the nuts.

(3) Tighten to torque of  $1 \pm 0.05$  kgf·m and loosen.

(4) Tighten again to torque of  $1 \pm 0.05$  kgf·m.

(5) Tighten further to angle of  $80^\circ \pm 3^\circ$ .

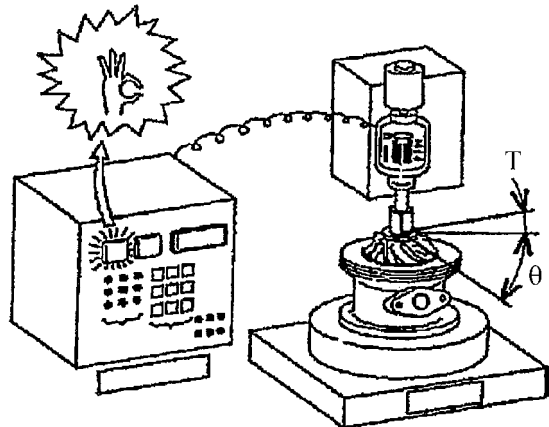


Nut assembling procedures

8. This standard shows two procedures for assembling the turbocharger lock nuts on the shaft and T/W assembly bolts. Perform this assembly task accurately. Otherwise the shaft may bend or break, prompting a serious complaint.

9. Procedure (Molykote application)

- (1) Install the compressor wheel onto the shaft. Never allow Molykote to adhere to the compressor wheel rear surface that comes into contact with the sleeve.
- (2) Apply Molykote to the lock nut threads or shaft threads. Or apply Molykote to the shaft threads. When the lock nut is tightened, its seat must be coated with Molykote.
- (3) Tighten the lock nut as described below (see Tables 1 and 2).
  - (a) Tighten the lock nut to the torque T1 and then loosen it.
  - (b) Tighten the lock nut to the torque T2.
  - (c) Turn the lock nut by the angle  $\theta 1$ .
  - (d) Apply the torque T3 to the lock nut in the loosening direction.
  - (e) Turn the lock nut by the angle  $\theta 2$  in the loosening direction.



10. Procedure (Loctite application)

- (1) Install the compressor wheel onto the shaft.
- (2) Tighten the lock nut as described below (see Tables 1 and 2).
  - (a) Clean the lock nut threads and shaft threads of oil.
  - (b) Tighten the lock nut to the torque T1 and then loosen it.
  - (c) Apply Loctite 962T to the lock nut threads or shaft threads.
  - (d) Tighten the lock nut to the torque T2.
  - (e) Turn the lock nut by the angle  $\theta 1$ .
  - (f) Apply the torque T3 to the lock nut in the loosening direction.
  - (g) Turn the lock nut by the angle  $\theta 2$  in the loosening direction.

11. Precautions

- (1) When loosening or tightening the lock nut, do not apply a bending or pushing load to the shaft.
- (2) Do not repeat the procedure on the same lock nut more than ten times.
- (3) Never use the lock nut when its seat is dented, burred or otherwise unsatisfactory.

Table 1. Torque and angle values for torque and angle methods (metric and unified standard threads).

Model	T1 N·m (kgf·m)	T2 N·m (kgf·m)	$\theta 1$ (deg)	T3 N·m (kgf·m)	$\theta 2$ (deg)
TD09	9.8 (1)	9.8 (1)	80±3		
TD10	9.8 (1)	9.8 (1)	80±3		
TD13	9.8 (1)	9.8 (1)	80±3		
TD15	See Table 2				

Table 2. Torque and angle values for torque and angle methods (spiral lock threads).

Model	T1 N·m (kgf·m)	T2 N·m (kgf·m)	$\theta 1$ (deg)	T3 N·m (kgf·m)	$\theta 2$ (deg)
TD09					
TD10					
TD13	45 (5)	14.7 (1.5)	80±3		
TD15	68.6 (7)	9.8 (1)	80±3		

*LARGE BORE*

*TORQUE SPECIFICATIONS*

*SN*

*SERIES*

# SERVICE BULLETIN

**RESTRICTED**

**MITSUBISHI HEAVY INDUSTRIES, LTD.**  
**SAGAMIHARA MACHINERY WORKS**

**BULLETIN No.:** SN2002-002 (1/4)

**GROUP:** General

**MODELS:** S6N, S12N, S16N, S12N-2



**SUBJECT:** Tightening torque for SN series

**DATE:** May, 2002



**1. Purpose**

The tightening torque list of general bolts and special bolts for SN series was prepared. It should be used at maintenance. The tolerance of torque value for main bolts shall be  $\pm 10\%$ .

**Tightening torque of general bolts**

	Thread size Diameter x pitch(mm)	Strength classification			
		7T		10.9	
					
Metric screw thread for cars		N·m	kgf·m	N·m	kgf·m
	M8x1.25	17	1.7	30	3.1
	M10x1.25	33	3.4	60	6.1
	M12x1.25	60	6.1	108	11.0
	M14x1.5	97	9.9	176	17.9
	M16x1.5	145	14.8	262	26.7
	M18x1.5	210	21.4	378	38.5
	M20x1.5	291	29.7	524	53.4
	M22x1.5	385	39.3	694	70.8
	M24x1.5	487	49.7	878	89.5
	M27x1.5	738	75.3	1328	135.5

	Thread size Diameter x pitch(mm)	Strength classification			
		7T		10.9	
					
Metric screw thread		N·m	kgf·m	N·m	kgf·m
	M10x1.5	32	3.3	58	5.9
	M12x1.75	57	5.8	102	10.4
	M14x2	93	9.5	167	17.0
	M16x2	139	14.2	251	25.6
	M18x2.5	194	19.8	350	35.7
	M20x2.5	272	27.7	489	49.9
	M22x2.5	363	37.0	653	66.6
	M24x3	468	47.7	843	86.0
	M27x3	686	70.0	1236	126.0

(Tolerance of torque:  $\pm 10\%$ , in dry condition)

**Tightening torque for eye bolt**

Thread size Diameter x pitch(mm)	Strength classification	
	4T	
	N·m	kgf·m
M8x1.25	8 $\pm$ 1	0.8 $\pm$ 0.1
M10x1.25	15 $\pm$ 2	1.5 $\pm$ 0.2
M12x1.25	25 $\pm$ 3	2.5 $\pm$ 0.3
M14x1.5	34 $\pm$ 4	3.5 $\pm$ 0.4
M16x1.5	44 $\pm$ 5	4.5 $\pm$ 0.5
M18x1.5	74 $\pm$ 5	7.5 $\pm$ 0.5
M20x1.5	98 $\pm$ 10	10.0 $\pm$ 1.0
M24x1.5	147 $\pm$ 15	15.0 $\pm$ 1.5
M27x1.5	226 $\pm$ 20	23.0 $\pm$ 2.0

(in dry condition)

**Tightening torque for union nut**

Nominal diameter	Cap nut size	N·m	kgf·m
63	M14x1.5	39	4
80	M16x1.5	49	5
100	M20x1.5	78	8
120	M22x1.5	98	10
150	M27x1.5	157	16
180	M30x1.5	196	20
200	M30x1.5	196	20
220	M33x1.5	245	25
254	M36x1.5	294	30

(in dry condition)

**Tightening torque for pressure fuel injection pipe**

Cap nut size	N·m	kgf·m
M12x1.5	39 $\pm$ 5	4 $\pm$ 0.5
M14x1.5	49 $\pm$ 5	5 $\pm$ 0.5
M18x1.5	59 $\pm$ 1	6 $\pm$ 1.0

(in dry condition)

**APPLICABLE No.:** Initial serial number-up

**MODIFIED No.:**

**DATE OF SERVICE PARTS AVAILABLE:**

**INTERCHANGEABILITY:**

R=(NEW) $\leftrightarrow$ (OLD)

S=(NEW) $\leftrightarrow$ (OLD)

N=(NEW) $\leftrightarrow$ (OLD)

1=Out of Supply.

2=Yes as an assembly.

3=Yes as a single part.

E0 No.

3710-2061

Please pass to :	DEPT. MANAGER	SECT. MANAGER	MECHANICS or CLERKS





2. Description

Model  Fittings	S6N			S12N			Remarks
	Thread size Diameter x pitch (mm)	Tightening torque		Thread size Diameter x pitch (mm)	Tightening torque		
		kgf·m	N·m		kgf·m	N·m	
Cylinder head bolt	M20x2.5	38	372	←	←	←	(wet)
Rocker shaft bracket	M14x2.0	8	78	←	←	←	
Rocker arm lock nut	M12x1.25	6.5	64	←	←	←	
Bridge lock nut	M10x1.25	5.6	55	←	←	←	
Main bearing cap	M22x2.5	50	490				(wet)
Timing gear case	M16x2.0	15	147	M16x1.5	15.8	155	
	M12x1.75	5	49	←	6	59	
Oil pan	M10x1.5	3	29	M12x1.75	5	49	
Front mounting bracket	M20x1.5	40	392	←	48	470	
Center mounting bracket							
Rear mounting bracket	M16x2.0	18	177	M20x1.5	30	294	
Connecting rod bearing cap	M20x1.5	40	392	←	←	←	(wet) Note 2
Balance weight	M20x1.5	40	392				
Crankshaft pulley damper	M16x1.5	18	177	M22x1.5	30	294	
Flywheel	M22x1.5	55	539	←	60	588	(wet)
Idler gear	M10x1.25	3	29	←	←	←	
Camshaft gear	M42x1.5	60	588	←	←	←	
Injection pump gear	M30x1.5	40	392	←	←	←	
Idler shaft	M12x1.75	5.5	54	←	←	←	
Oil pump gear	M22x1.5	25	245	M27x1.5	30	294	
Water pump pulley (nut)	M20x1.5	20	196				
Water pump gear				M20x1.5	20	196	
Water pump impeller	M22x1.5	20	196	←	←	←	
Injection pump coupling	M12x1.75	8.5-9.5	83-93	←	←	←	
Injection pump coupling shaft	M12x1.75	7.5-8.5	74-83	←	8.5-9.5	83-93	
Injection pump flywheel (nut)							
Laminate plate							
Nozzle holder connector	M16x1.5	7	69	←	6.5-9.5	64-74	
Gland (nozzle holder)	M14x1.5	10	98	←	←	←	
Nozzle holder set screw cap nut	M14x1.5	5	49	←	4-5	39-49	
Nozzle tip retaining nut	M28x1.5	18-20	176-196	←	←	←	
Fuel rack control lever	M8x1.25	2.5	25	←	←	←	Double tightening
Fuel filter bleeder plug	M8x1.25	0.8-1.0	8-10	←	←	←	



Model	S16N			S12N-2			
Fittings	Thread size Diameter x pitch (mm)	Tightening torque		Thread size Diameter x pitch (mm)	Tightening torque		Remarks
		kgf·m	N·m		kgf·m	N·m	
Cylinder head bolt	M20x2.5	38	372	←	←	←	(wet)
Rocker shaft bracket	M14x2.0	8	78	←	←	←	
Rocker arm lock nut	M12x1.25	6.5	64	←	←	←	
Bridge lock nut	M10x1.25	5.6	55	←	←	←	
Main bearing cap	M22x2.5	50	490				(wet)
Timing gear case	M16x1.5	15.8	155	←	←	←	
	M12x1.75	6	59	←	←	←	
Oil pan	M12x1.75	5	49	←	←	←	
Front mounting bracket	M20x1.5	48	470	←	←	←	
Center mounting bracket							
Rear mounting bracket	M20x1.5	30	294	M20x2.5	30	294	
Connecting rod bearing cap	M20x1.5	40	392	←	←	←	(wet) Note 2
Balance weight							
Crankshaft pulley damper	M22x1.5	30	294	←	←	←	
Flywheel	M22x1.5	60	588	←	←	←	(wet)
Idler gear	M10x1.25	3	29	←	←	←	
Camshaft gear	M42x1.5	60	588	←	←	←	
Injection pump gear	M30x1.5	40	392	←	←	←	
Idler shaft	M12x1.75	5.5	54	←	6	59	
Oil pump gear	M27x1.5	30	294	←	←	←	
Water pump pulley (nut)							
Water pump gear	M20x1.5	20	196	←	←	←	
Water pump impeller	M22x1.5	20	196	←	←	←	
Injection pump coupling	M12x1.75	8.5-9.5	83-93	M14x1.5	17-18	167-177	
Injection pump coupling shaft	M12x1.75	8.5-9.5	83-93				
Injection pump flywheel (nut)				M24x1.5	40	392	
Laminate plate				M12x1.25 (M12x1.25)	10.5-11.5 (8.5-9.5)	103-113 (83-93)	In case of using 10T bolt and washer based nut In case of using bolt without identification and general nut
Nozzle holder connector	M16x1.5	6.5-7.5	64-74	←	7	69	
Gland (nozzle holder)	M14x1.5	10	98	←	←	←	
Nozzle holder set screw cap nut	M14x1.5	4-5	39-49	←	←	←	
Nozzle tip retaining nut	M28x1.5	18-20	176-196	←	←	←	
Fuel lack control lever	M8x1.25	2.5	25	←	←	←	Double tightening
Fuel filter bleeder plug	M8x1.25	0.8-1.0	8-10	←	←	←	



- NOTES:
1. The parts specified (wet) shall be applied engine oil on the thread part and the bearing surface of bolt.
  2. The connecting rod bolt shall be double tightened.

*LARGE BORE*

*TORQUE SPECIFICATIONS*

*SU*

*SERIES*

# SERVICE BULLETIN

**RESTRICTED**

**MITSUBISHI HEAVY INDUSTRIES, LTD.**

**GENERAL MACHINERY & SPECIAL VEHICLE HEADQUARTERS**

BULLETIN No.: SU2003-021 (1/5)

GROUP: Engine

MODELS: S6U, S6U2, S8U

SUBJECT: Tightening torque for SU series

DATE: October, 2003

## 1. Purpose

The tightening torque list of general bolts and special bolts for SU series was prepared for check and maintenance. The tolerance of torque value for main bolts should be  $\pm 10\%$ .

## 2. New and old parts

APPLICABLE No.:

MODIFIED No.:

DATE OF SERVICE PARTS AVAILABLE:

INTERCHANGEABILITY:

R=(NEW) $\leftrightarrow$ (OLD)  
1=Out of Supply.

S=(NEW)  $\leftrightarrow$  ~~X~~(OLD)  
2=Yes as an assembly.

N=(NEW)  $\leftrightarrow$  ~~X~~ (OLD)  
3=Yes as a single part.

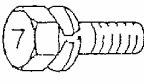
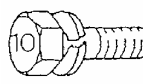
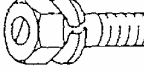
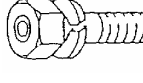
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Please pass to :	DEPT. MANAGER	SECT. MANAGER	MECHANICS or CLERKS



3. Description

Tightening torque of general bolts

	Thread size Diameter x pitch(mm)	Width across flat	Strength classification			
			7T		10.9	
			N· m	kgf· m	N· m	kgf· m
Metric screw thread for cars						
	M8x1.25	12	17	1.7	30	3.1
	M10x1.25	14	33	3.4	60	6.1
	M12x1.25	17	60	6.1	108	11.0
	M14x1.5	22	97	9.9	176	17.9
	M16x1.5	24	145	14.8	262	26.7
	M18x1.5	27	210	21.4	378	38.5
	M20x1.5	30	291	29.7	524	53.4
	M22x1.5	32	385	39.3	694	70.8
	M24x1.5	36	487	49.7	878	89.5
	M27x1.5	41	738	75.3	132.8	135.5
Metric coarse screw thread						
			N· m	kgf· m	N· m	kgf· m
	M10x1.5	14	32	3.3	58	5.9
	M12x1.75	17	57	5.8	102	10.4
	M14x2	22	93	9.5	167	17.0
	M16x2	24	139	14.2	251	25.6
	M18x2.5	27	194	19.8	350	35.7
	M20x2.5	30	272	27.7	489	49.9
	M22x2.5	32	363	37.0	653	66.6
M24x3	36	468	47.7	843	86.0	
M27x3	41	686	70.0	1236	126.0	

(Tolerance of torque: ±10%, in dry condition)

Tightening torque for eye bolt

Thread size Diameter x pitch(mm)	Width across flat	Strength classification 4T	
		N· m	kgf· m
M8x1.25	12	8±1	0.8±0.1
M10x1.25	14	15±2	1.5±0.2
M12x1.25	17	25±3	2.5±0.3
M14x1.5	22	34±4	3.5±0.4
M16x1.5	24	44±5	4.5±0.5
M18x1.5	27	74±5	7.5±0.5
M20x1.5	30	95±10	10.0±1.0
M24x1.5	36	147±15	15.0±1.5
M27x1.5	41	226±20	23.0±2.0

(in dry condition)

- Note
- (a): The above lists are the tightening torque list of general bolts and nuts.
  - (b): These values shows the case used the spring washer.
  - (c): This table shows the standard value and the tolerance should be ±10%
  - (d) Tightening should be performed in accordance with this table unless otherwise specified.
  - (e) The oil should not be applied to the thread and bearing surface (in dry condition).

Tightening torque for eye bolt

Nominal diameter	Cup nut size	Width across flat	N· m	kgf· m
63	M14x1.5	19	36	4
80	M16x1.5	22	49	5
100	M20x1.5	27	78	8
120	M22x1.5	30	98	10
150	M27x1.5	32	157	16
180	M30x1.5	36	196	20
200	M30x1.5	36	196	20
220	M33x1.5	41	245	25
254	M36x1.5	41	294	30

(in dry condition)

Tightening torque for fuel high pressure injection pipe

Cap nut size	N· m	kgf· m
M18x1.5	59±1	8±1.0
M22x1.5	88±1	9±1.0

(in dry condition)

Tightening with hydraulic jack

Parts	Thread size Diameter x pitch(mm)	Pressure of hydraulic jack		Remarks
		MPa	Kgf/cm <sup>2</sup>	
Nut to tighten cylinder head	33x1.5	58.8	600	Note 1
Nut to tighten main bearing cup	42x1.5	63.7	650	Note 2

Note1: The MOLY LG GREASE No.2 (JYUKOU LUBRICANT Co., Ltd.) or the equivalent grease should be applied to the thread.

The hydraulic jack 41091-04000 should be used.

Note 2: The MOLY LG GREASE No.2 (JYUKOU LUBRICANT Co., Ltd.) or the equivalent grease should be applied to the thread.

The hydraulic jack 41091-03500 should be used.



## Tightening torque of main bolt

Parts	Thread size Diameter x pitch (mm)	Width across flat	Tightening torque		Remarks	
			N·m	kgf·m		
Stud to install cylinder head (screw side)	M33x3.5	---	196	20	Note (3)	
Locker shaft set screw	M10x1.5	5	29.4	3	Bolt with hexagon hole	
Locker shaft set screw nut	M10x1.5	17	57.8	5.9		
Bolt to hold rocker bracket	M18x2.5	24	235	24		
Nut to hold nozzle sleeve	M52x2.0	---	147	15	Applied engine oil to thread	
Nut to hold nozzle retainer	M18x1.5	27	196	20	Applied engine oil to thread	
Crankcase main bearing cap side bolt	M30x3.5	46	883	90	Note (3)	
Stud to install main bearing cap (screw side)	M42x4.5	---	245	25	Note (3)	
Bolt to install timing gear case	M12x1.75	17	59	6		
Bolt to install piston body crown	M14x1.5	19	59	6	Note (1)	
Bolt to install mounting bracket	M24x3.0	36	490	50		
Bolt to install connecting rod cap	M22x1.5	27	245	25	Note (2)	
Crankshaft oil hole screw	M22x1.5	12	118	12	The LOCKTITE 271 or the equivalent should be applied to the bolt thread. (bolt with hexagon hole)	
Bolt to install flywheel	M22x1.5	32	618	63	Note (4)	
Bolt to install flywheel ring gear	M10x1.5	14	58	5.9		
Bolt to install vibration damper	M22x1.5	32	618	63	Note (4)	
Stud nut to connect cam shaft	M10x1.25	14	68.6	7		
Bolt to install camshaft gear	M16x1.5	24	145	14.8		
Bolt to install idler shaft thrust plate	M12x1.25	10	98	10	Bolt with hexagon hole	
Nut to install oil pump gear	S6U (1000 min <sup>-1</sup> -up)	M27x1.5	---	196	20	
	S6U (-900min <sup>-1</sup> )	M30x1.5	46	294	30	
	S6U2, S8U					
Bolt to install oil pan	M12x1.75	17	57	5.8		
Nut to install water pump gear	M36x1.5	55	392	40	Note (3)	
Water pump gear	Old type water pump (Shaft diameter dia 30)	M27x1.5		343 N·m	35 kgf·m	
	New type water pump (Shaft diameter dia 40)	M36x1.5		392 N·m	40 kgf·m	
Water pump impeller	Old type water pump (Shaft diameter dia 30)	M16x1.5		176 N·m	18 kgf·m	
	New type water pump (Shaft diameter dia 40)	M20x1.5	32	196 N·m	20 kgf·m	
Nut to install water pump impeller	M20x1.5	32	196	20	As for the left thread, the periphery of nut is with the V groove. The THREEBOND 1215 or the equivalent should be applied to both sides of washer.	
Nut to install intercooler side cover	M12x1.25	17	60	6.1		



Parts	Thread size Diameter x pitch (mm)	Width across flat	Tightening torque		Remarks	
			N· m	kgf· m		
Bolt to hold starting valve retaining cap	M12x1.75	17	57	5.8	The bolt should be tightened to be the gap of height between the left and the right cap should be 0.5mm at max.	
Bolt to hold starting valve spring	M8x1.25	12	29.4±2.0	3.0±0.2		
Bolt to hold safety valve	M12x1.75	17	57	5.8	The bolt should be tightened to be the gap of height between the left and the right flange should be 0.5mm at max.	
Nut to hold safety valve spring	M27x3.0	36	294	30		
Nozzle tip retaining nut	M28x1.5	27	98-127	10-13	Note (5)	
Nozzle holder set screw nut	M14x1.0	22	39-49	4-5		
Nozzle holder set screw cap nut	M14x1.0	22	29-39	3-4		
Nozzle holder fuel inlet connector	M16x1.5	19	88-98	9-10		
Oil filter center bolt	M16x2.0	24	78-88	8-9		
Fuel filter center bolt	M16x1.5	24	58.8-68.6	6-7		
Fuel filter element			19.6	2	Primary filter	
Bolt to fix distributor valve (in case of fixed bolt)			76.6	7.8		
Nut to install magnetic pick-up			68±13.6	6.9±1.4		
Bolt to hold indicator valve cap	M12x1.75	17	57	5.8	The bolt should be tightened to be the gap of height between the left and the right cap should be 0.5mm at max.	
Bolt to hold injection pump	M14x2.0		167±17	17.0±1.7		
Injection pump	Bolt to install delivery valve	M14x2.0	22	78-98	8-10	The MOLY LG GREASE No. 2 or the equivalent should be applied to the bolt thread. The engine oil should be applied to the baring surface.
	Deflector bolt	M14x1.5	6	20-29	2-3	The LOCKTITE 222 or the equivalent should be applied to the bolt thread. (bolt with hexagon hole)
	Bolt to install control rack	M8x1.25	6	13-15	1.3-1.5	The LOCKTITE 242 or the equivalent should be applied to the bolt thread. (bolt with hexagon hole)
Nut to install governor drive gear	M24x1.5	---	147	15		

- Note (1) Double tightening. The MOLY LG GREASE No. 2 (JYUKOU LUBRICANT Co., Ltd.) or the equivalent should be applied to the bolt thread.
- (2) After the bolt is tightened by the turn-of-nut method at the snag torque 245 N· m (25kgf·m), it should be tightened with the small con-rod for the big end rigidity at 90degree ±5degree turn angle and the big con-rod for the big end rigidity at 105 degree ± 5 degree turn angle.
- (3) The MOLY LG GREASE No.2 (JYUKOU LUBRICANT Co., Ltd.) or the equivalent should be applied to the thread of bolt.





- (4) The MOLY LG GREASE No.2 (JYUKOU LUBRICANT Co., Ltd.) or the equivalent should be applied to the thread of bolt and the bearing surface.
- (5) The MOLY LG GREASE No.2 (JYUKOU LUBRICANT Co., Ltd.) or the equivalent should be applied to the thread of retaining nut and the shoulder of nozzle tip.
- (6) The oil should not be applied to the thread and the bearing surface unless otherwise specified. (in dry condition)