YANMAR SERVICE NEWS

Title	Maintenance of Con. Rod and Con. Rod Bolts [Rev.3: 6EY17, 6EY22 added]	No. ; S/N.QE5-003 Rev.3 Date ; July 2009 Revised date ; March 2014

Engine Model	ALL	Use	Marine Main & Aux.; Industrial
		Engine Nos.	————

We summarized the maintenance procedures for the con. rod and con. rod bolts of the engine models presently produced and other major models being used in the field as follows. Please have a read through this Service News since the maintenance of con. rod and con. rod bolts represent an important maintenance item in using your engine safely for a long time. In addition, apply the angle tightening method, upon your subsequent servicing opportunities, according to the procedures as described in this Service News also to the connecting rods of the engines already shipped that have been tightened by the torque tightening method. (The standard maintenance values of con. rods for both the new and old engine models are added for your reference.)

1. Time of Tightening Method Switch of Applicable Engine Models

Engine Models	Time of Angle Tightening Method Application at Plant
S165（L）	Engines produced in Sep. 1992 & thereafter
6N160, 6N165（L）	Engines produced in Sep. 1992 & thereafter
6NH160	Engines produced in Jul. 1991 & thereafter
6、8、12、16NHL	Engines produced in Jul. 1991 & thereafter
S185（L）	Engines produced in Jul. 1992 & thereafter
M200（L）	Engines produced in Jul. 1992 & thereafter
M220（L）	Engines produced in Jun. 1992 & thereafter
T240（L）	Engines produced in Dec. 1992 & thereafter
T260（L）, 12T260L	Engines produced in Oct. 1992 & thereafter
6、8Z280（L）	Engines produced in Apr. 1993 & thereafter
6、8N280（L）	Engines produced in Jun. 1992 & thereafter
6Z（L）, 12Z（L）	Engines produced in Apr. 1993 & thereafter

Angle tightening method was applied from the first unit of 6NA160.6NB165, 6N18(A)(L),6NY16 6RY,6EY17,6EY18. and 6EY22

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Approved	Checked	Drawing
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2. Angle Mark

1) Concerning S165, N165, NHL and S185, the mark is provided only at one position since the space for punching the angle mark on the con. rod is limited. Accordingly, we supplied the accessory angle gauge tool, (Fig.4).

Angle Gauge Part Number ;
For S165,6N165,NHL   : 133670-92510
             For S185   : 146613-92510

Fig. 1: Angle Mark Punched Position (showing 4 bolts)

2) Concerning M200 and upper models, the angle mark is punched on the connecting rod. Accordingly, no accessory angle gauge is supplied, (Fig.-1). (Fig.-1 shows the 4-bolt type, but identical angle mark is punched also to the 2-bolt type.)
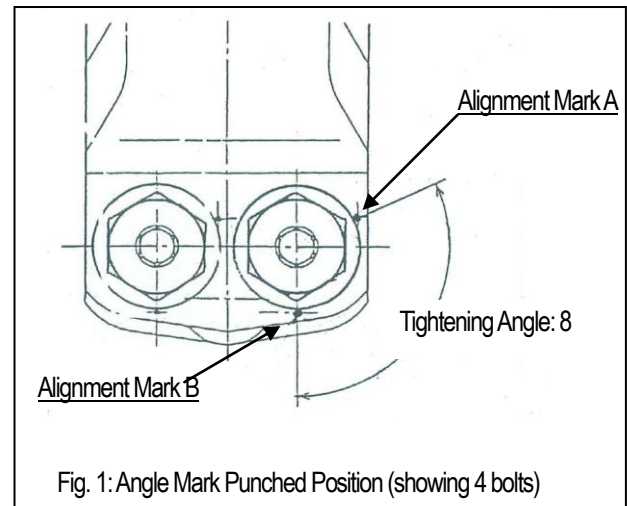
Procedures

1.Cautions

1) The alignment mark is punched respectively on the con. rod large end and the rod bolt. Check these alignment marks in advance, (Fig.-2).

2) When changing torque tightening to angle tightening, remove the con. rod from the engine and measure the inner diameter of the bearing housing, (Fig-5 & Table-2).

3) Clean the con. rod and rod bolt threads, tightening seat face and serration gear face and check for any damage.

4) If any damage was found, correct it with a grinder, etc.

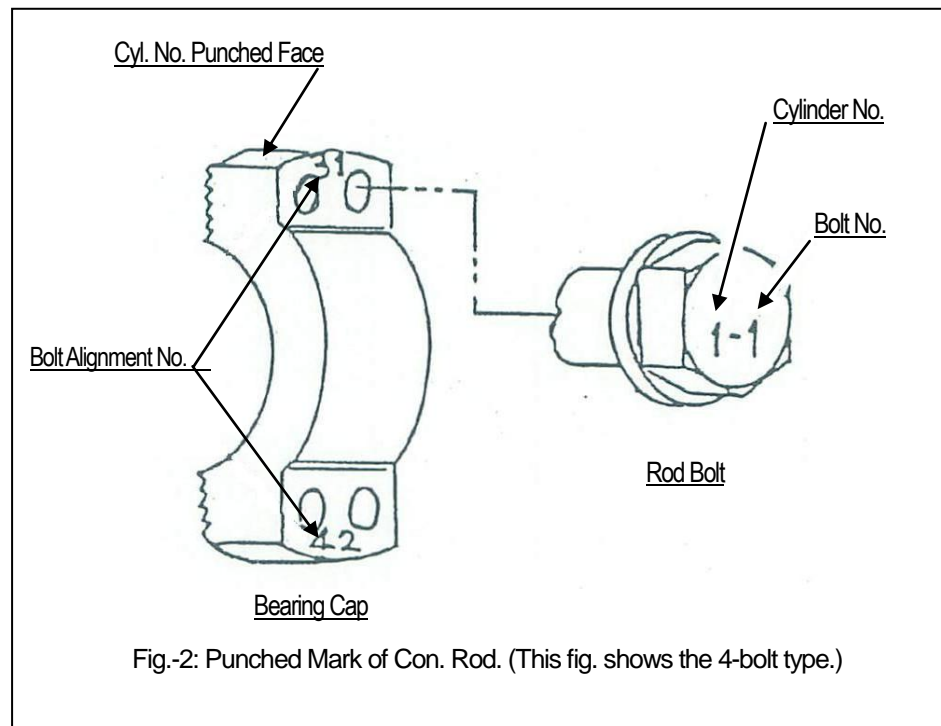Fig.-2: Punched Mark of Con. Rod. (This fig. shows the 4-bolt type.)

5) Check the cylinder number and bolt number punched on the rod bolt head and bearing cap and installed to the specified position.

6) Apply PROTEC GREASE to the rod bolt thread and tightening seat face in order not to make burrs. If PROTEC GREASE is not available, apply the seizing inhibitor (molybdenum disulfide).

7）Check that the rod bolt seat face can be screwed in up to the surface lightly by hand.

8) When the rod bolts were replaced, implement as follows:

① Fasten and loosen the rod bolt from/to its surface position to/from the specified surface angle position for about 3 times in order to break in the thread and tightening seat face fully. (Apply the seizing inhibitor to the thread and tightening seat face in advance.)

② In order to discriminate the hours of use, punch the Cyl. No., Bolt No. and Date of Replacement on the rod bolt head, (Fig-3). Example: when the bolt was replaced in March 1992, punch "2-3".

③ When punching "Point A", tighten the bolt with the torque of Point A without installing the bearing before punching Point A.

9) Tighten the rod bolts in the following order:
（See Fig.-2.）
・2-bolt type: (Bolt No.) : ①→②→①→②
・4-bolt type: (Bolt No.) : ①→④→③→②→①

2. Tighten the con. rod and bolts upon maintenance:
(Changing torque tightening to angle tightening)
【When using the angle gauge】

1) Install the cap (with not installing the bearing) to the con. rod. Apply LO agent, PROTEC GREASE to bolt thread and tightening seat face. Screw in the bolt by hand up to the surface.

2) Tighten the bolts with a torque wrench to Point A torque specified in Table-1 in the specified order.

3) Install the angle gauge to the rod bolt tightening seat face and punch Point A on the bolt tightening seat face at the specified tightening angle with the punched mark B at the bearing cap side as the reference, (Fig.-4 & Table-1).

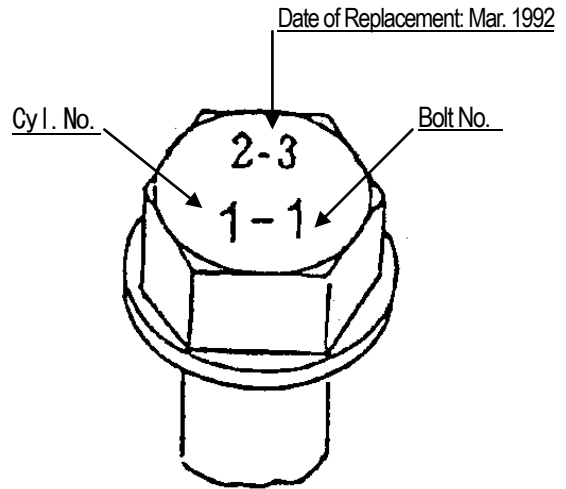4) Tighten the bolts up to Point B in the specified tightening order.

Date of Replacement: Mar. 1992
Cyl. No.
Bolt No.

Fig.3: Punching Marks on Bolt Head

Rod bolt
Bearing cap
Punch A
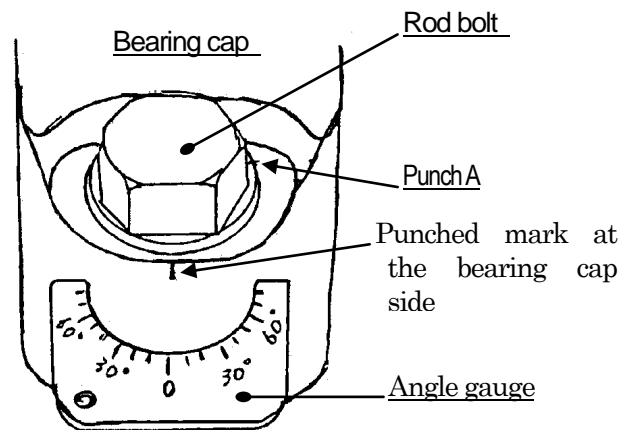Punched mark at the bearing cap side
Angle gauge

Fig.-4: 4 Point Punching with Angle Gauge

Changing Torque Tightening to Angle Tightening

Implement the identical procedure as above for changing the torque tightening to angle tightening of the con. rod also as to the engine already shipped.

When changing the torque tightening to angle tightening, the angle gauge is required for M200(L) engine and upper models. (Ref. Talbe-0).

Install the angle gauge to the bearing cap of the con. rod and punch Point A on the bolt seat face of the bearing cap, shown in Fig.-1, with Point B as the reference. Then, tighten the rod bolt with the torque of Point A, shown in Talbe-1, by a torque wrench, align to Point A of the bearing cap, and punch on the rod bolt seat face. Tighten the bolts up to Point B according to the tightening order of the bolts.

Table-0: Angle Gauge Part No. for Respective Engine Model

Model	Part No.	Engine Model	Part No.	Engine Model	Part No.
M200	141616-92510	T240	134673-92490	Z280(Φ44)	153636-92490
M220		T260	151636-92490	(Φ41)	153623-92490

[When Using the Punched Mark on Bearing Cap]

1) Tighten the bolts with a torque wrench with the tightening torque of Point A shown in Table-1, (with not installing the bearing), in the specified tightening order.

2) When Point A on the bearing cap and the punched mark on the rod bolt tightening seat face does not align, record the deviation distance.

Table-1: Tightening Angle of Respective Engine Model (Prepared: March 2013)

No.	Engine Model		Bolt Shank Dia. (mm)	Point "A" Torque (Kgf-m)	Tightening Angle (°) (Point A ⇒ B)	Serration Angle (°)
1	6A(L) Series					60
2	6R(L) Series		**Apply the conventional torque tightening to the old models. (Refer to the operation manual.)**			Flat
3	6M(L) Series					90
4	6U(L) Series					60
5	6G(L) Series					90
6	T220(L) Series		25.5	Tightening torque : 109kgf-m		90
			23	Tightening torque : 85kgf-m		60
			24.5、25.5	Tightening torque : 95kgf-m		
7	S165 (L)	New	19	5	85	90
		Old	Apply conventional torque tightening. (Tightening torque : 50kgf-m)			60
8	N160, N165		20	5	80	90
9	6NA160, 6NB165		19	5	90	90
10	6,12,16SHL	New	19	5	85	90
		Old	Apply conventional torque tightening (Tightening torque : 50kgf-m)			60
11	6,8NHL		19	5	90	90
	12,16NHL		19	5	90	90
12	S185 (L)		20.5	Tightening torque : 65kgf-m		60
				5	85	90
13	M200 (L)	New	21	5	100	90
		Old	Apply conventional torque tightening (Tightening torque : 75kgf-m)			60
14	M220 (L)	New	24.5	5	92	90
		Old	Apply conventional torque tightening (Tightening torque : 95kgf-m)			60
15	T240 (L)	New	19	5	120	90
		Old		25	60	60
16	T260 (L) 12T260L	New	21	5	100	90
		Old		25	60	60
17	Z280 (L) 8Z280(L)	Old	21	25	65	60
		Old	23	25	$76(80\text{kgf-m}^{+5}_{0})$	90
		New	24	5	140	90
18	6、8Z(L) 12、16 Z(L)	New	25	5	95	90
		Old	Apply conventional torque tightening (Tightening torque : 6&12Z:75kgf-m)(8&16Z: 85kgf-m)			60
19	6N18		21.5	5	120	90
20	6,8N21		25	Hydraulic pressure tightening		90
21	6N260		29	Hydraulic pressure tightening		90
22	6N280		24	5	115	90
23	6,8N330		31	Hydraulic pressure tightening		Flat
24	6NY16(A)(L)		18	5	95~105	90
25	6RY17		20	5	100	90
26	6EY17		22	5	110	90
27	6EY18		21.5	5	120	90
28	6EY22(L)		29	Hydraulic pressure tightening		90
29	6/8EY26(L)		29	Hydraulic pressure tightening		90

[Caution]
① Apply conventional torque tightening to 165(L), M200(L) and 6Z(L)/12ZL with 60° serration angle.
② Concering the old con. rod of Z280(L)/8Z280(L), when the shank diameter of con. rod bolt is Φ21, change it to the Φ23 con. rod bolt (Part #153623-23212) upon replacement.
In this case, tighten the bolts with the tightening torque as specified in Table-1.   However, when the serration angle is 60°, tighten the bolts with the same tightening angle and torque as in Φ21.
③ When using the rod bolts with the shank diameter other than specified above, apply the conventional torque tightening according to the instructions of the operation manual.

3) Tighten the bolts according to the punched marks on the rod bolt seat face in two stages: (First time: Intermediate point between Points A~B; Second time: From intermediate point to Point B). Include the deviation distance at Point A for tightening bolt at Point B.

Tightening Bolts with the Use of Punched Mark on Bearing Cap upon Bolt Replacement
1) Tighten bolts with "Point A" torque shown in Table-1 by a torque wrench according to the tightening order specified, (with not installing the bearing).

2) Align to Point A of the bearing cap and punch the mark on the rod bolt seat face.

3) Tighten the punched mark on the rod bolt seat face up to Point B of the bearing cap.

4. Measurement of Con. Rod Large Eng Inner Diameter

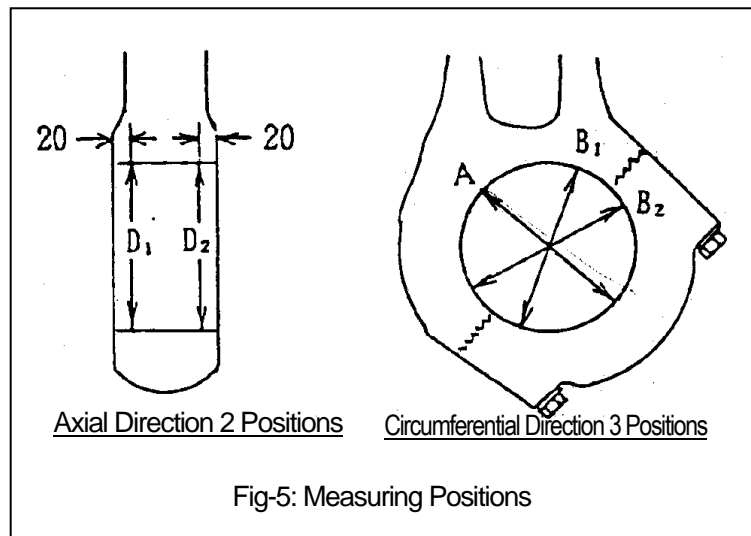1) Measurement Position (Fig.-5)

Circumferential Direction

A   : at 90° position to serration

B1/B2   : at 15° position to serration

Axial Direction

D1/D2 : at 20mm inside from both end face

Axial Direction 2 Positions   Circumferential Direction 3 Positions

Fig-5: Measuring Positions

2) Judgment of Measurement Data

Decide the inner diameter by the following formula based on the measurement data:

Calculation of Inner Diaz.

Dimension A : Use the actual measurement value.

Dimension B : $\dfrac{B1 + B2}{2}$

Table-2: Use Limit of Bearing Housing Inner Diameter Tolerance (Unit : mm)

No.	Engine Model		Inner Dimension AB($B_1 \cdot B_2$)		Tolerance as Produced of Inner Dia. at the Left	Max. Allowable Value of Roundness (A-B)
			Min. Dia.	Max. Dia.		
1	6A(L) Series		φ133−0.03	φ133+0.05	0～+0.025	0.05
2	6R(L) Series		φ124−0.02	φ124+0.06	0～+0.026	
3	6M(L) Series		φ148−0.03	φ148+0.05	0～+0.026	0.06
4	6U(L) Series		φ170−0.04	φ170+0.06	0～+0.025	0.08
5	6G(L) Series		φ202−0.05	φ202+0.07	0～+0.029	0.10
6	T220 (L)		φ180-0.05	φ180+0.05	0～+0.025	0.08
7	S165 (L)		φ122−0.02	φ122+0.06	0～+0.025	0.05
8	N160, N165		φ132−0.03	φ132+0.05	0～+0.025	
9	6NA160, 6NB165		φ122−0.02	φ122+0.06	0～+0.025	
10	6,12,16SHL		φ122−0.02	φ122+0.06	0～+0.025	
11	6/8NHL		φ122−0.02	φ122+0.06	0～+0.025	
	12/16NHL		φ132−0.03	φ132+0.05	0～+0.025	
12	S185 (L)		φ148−0.03	φ148+0.05	0～+0.025	0.06
13	M200 (L)		φ160−0.03	φ160+0.06	0～+0.025	0.07
14	M220 (L)		φ180−0.04	φ180+0.06	0～+0.025	0.08
15	T240 (L)		φ190−0.05	φ190+0.07	0～+0.029	
16	T260 (L) 12T260L		φ205−0.05	φ205+0.07	0～+0.029	0.10
17	Z280 (L) 8Z280(L)		φ225−0.05	φ225+0.07	0～+0.029	
18	6,8,12,16 Z (L)		φ235−0.05	φ235+0.07	0～+0.029	
19	6N18		φ153−0.03	φ153+0.06	0～+0.025	0.07
20	6/8N21		φ178−0.04	φ178+0.06	0～+0.025	0.08
21	6N260		φ220−0.05	φ220+0.07	0～+0.029	0.10
22	6/8N280		φ235−0.05	φ235+0.07	0～+0.029	
23	6/8N330	Main	φ292−0.06	φ292+0.08	0～+0.032	0.12
		Aux./Ind.	φ272−0.06	φ272+0.08	0～+0.032	
24	6NY16(A)(L)		φ122−0.02	φ122+0.06	0～+0.025	0.05
25	6RY17		φ132−0.03	φ132+0.05	0～+0.025	0.05
26	6EY17		φ137−0.03	φ137+0.05	0～+0.025	0.05
27	6EY18		φ153−0.03	φ153+0.05	0～+0.025	0.07
28	6EY22(L)		φ190−0.05	φ190+0.07	0～+0.029	0.08
29	6/8EY26(L)		φ230−0.05	φ230+0.07	0～+0.029	0.10

注) No.1～5 hold to the final revised models only.

＜Caution＞
① In addition to the need of the inner diameter being within the min. ~ max. values, the clearance between the crank pin and the pin bearing must be within the use limit range.　If the inner dia. value approximated to the min. or max. value, measure the inner diameter with assembling the bearing, (Table-3).
② If the value deviates from the min. or max. value, correct the inner diameter.　(Correct it as near as possible to the tolerance as produced.)

Prepared: March 2013

Table-3: Standard Inner Dia with Installing Bearing and Use Range of Clearance   Unit：mm

		Standard Inner Dia with Installing Bearing		Crank pin – Bearing Clearance	
		Inner Dia.	Inner Dia. Tolerance	Use Range (Note ②)	Standard Clearance
1	6A(L) Series	φ125	+0.080～+0.141	0.08～0.22	0.08～0.166
2	6R(L) Series	φ118	+0.062～+0.114	0.062～0.22	0.062～0.149
3	6M(L) Series	φ138	+0.050～+0.116	0.05～0.25	0.05～0.15
4	6U(L) Series	φ160	+0.100～+0.165	0.1～0.25	0.10～0.19
5	6G(L) Series	φ190	+0.14～+0.209	0.14～0.35	0.14～0.238
6	T220 (L)	φ170	+0.12～+0.185	0.12～0.25	0.12～0.215
7	S165 (L)	φ115	+0.052～+0.117	0.052 ～ 0.180	0.052 ～ 0.139
8	N160、N165	φ125	+0.100～+0.165	0.100 ～ 0.230	0.100 ～ 0.190
9	6NA160, 6NB165	φ115	+0.072～+0.137	0.072 ～ 0.200	0.072 ～ 0.200
10	6,12,16SHL	φ115	+0.052～+0.117	0.052 ～ 0.180	0.052 ～ 0.139
11	6・8NHL	φ115	+0.072～+0.137	0.072 ～ 0.200	0.072 ～ 0.200
	12・16NHL	φ125	+0.100～+0.165	0.100 ～ 0.230	0.100 ～ 0.190
12	S185 (L)	φ140	+0.080～+0.145	0.080 ～ 0.220	0.080 ～ 0.170
13	M200 (L)	φ152	+0.080～+0.145	0.080 ～ 0.220	0.080 ～ 0.170
14	M220 (L)	φ170	+0.120～+0.185	0.120 ～ 0.250	0.120 ～ 0.210
15	T240 (L)	φ180	+0.120～+0.189	0.120 ～ 0.300	0.120 ～ 0.214
16	T260 (L) 12T260L	φ195	+0.140～+0.209	0.140 ～ 0.350	0.140 ～ 0.238
17	Z280 (L) 8Z280(L)	φ215	+0.160～+0229	0.160 ～ 0.350	0.160 ～ 0.258
18	6・8・12・16Z(L)	φ225	+0.160～+0.229	0.160 ～ 0.350	0.160 ～ 0.258
19	6N18	φ145	+0.080～+0.145	0.080 ～ 0.250	0.080 ～ 0.170
20	6,8N21	φ170	+0.120～+0.185	0.120 ～ 0.250	0.120 ～ 0.210
21	6N260	φ210	+0.180～+0.249	0.180 ～ 0.350	0.180 ～ 0.279
22	6N280	φ225	+0.200～+0.269	0.200 ～ 0.350	0.200 ～ 0.299
23	6,8N330	φ280	+0.240～+0.312	0.240 ～ 0.400	0.240 ～ 0.342
		φ260	+0.240～+0.312	0.240 ～ 0.400	0.240 ～ 0.342
24	6NY16(A)(L)	φ115	+0.064～+0.129	0.064 ～ 0.200	0.064 ～ 0.151
25	6RY17	φ125	+0.100～+0.165	0.100 ～ 0.200	0.100 ～ 0.190
26	6EY17	φ130	+0.100～+0.165	0.100 ～ 0.220	0.100 ～ 0.190
27	6EY18	φ145	+0.080～+0.145	0.080 ～ 0.250	0.080 ～ 0.170
28	6EY22(L)	φ180	+0.140～+0.209	0.140 ～ 0.300	0.140 ～ 0.234
29	6/8EY26(L)	φ220	+0.180～+0.249	0.180 ～ 0.300	0.180 ～ 0.279

＜Caution＞
　①The inner dia. roundness with installing the bearing is identical to that without the bearing installation.

　②When the overlay of the crankpin bearing has worn over 30% of the bearing face, replace the crankpin bearing, irrespective of the use limit of the clearance, in order to protect the crankshaft.

Excessive distortion of the con. rod large end can cause seizure or protrusion of crankshaft.
Consult the large end repair to Yanmar Engineering or your sales company.

4.Judgment of Bearing Housing Inner Dia. (Correction Standard)

1) Smaller Diameter of Whole Circumference
   When the inner diameter of the whole circumference lowered the use limit value, correct the inner diameter by honing, etc. to within the standard dimensional tolerance range.

2) In the Case of Elliptical Diameter
   Even when the dimension toward A and B directions represented an elliptical shape, the inner diameter can be used continuously as far as the dimension of each part and roundness remain within the use limit.   However, measure the inner diameter with installing the bearing and check that the clearance to the crankpin remains within the use limit range, (Table-3).

6. Check and Repair of Serration
   When the con. rod was disassembled, check the serration with Color Check, etc. that there is no cracking.   If any cracking was found, repair as follows depending on the length of cracking.

1)S165(L),6 -16NHL,6N160/6N165:
   If the crack size is under 10mm in length and 1.0mm in depth, remove the crack with the use of a pencil grinder to prevent the progress of cracking.

2)S185(L),M200(L),M220(L):
   If the crack size is under 10mm in length and 1.5mm in depth, remove the crack with the use of a pencil grinder to prevent the progress of cracking.

3)T240(L),T260(L),/12T26L,Z280(L)/8Z280(L),6N260(L),N280(L), 6Z(L),12ZL:
   If the crack size is under 10mm in length and 2.0mm in depth, remove the crack with the use of a pencil grinder to prevent the progress of cracking.

4) If the size of crack exceeds the values above, replace the con. rod.

   【Caution】
    The depth of crack is not necessarily identical for all distance.
    Instead of judging from the crack depth on the end face, turn around the con. rod to check the depth of the crack.
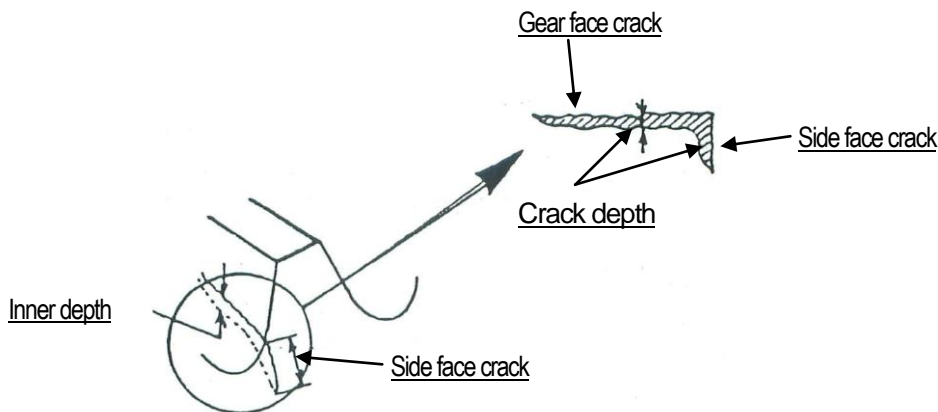
7.Caution Upon Installing Con. Rod to Engine

1) Apply PROTEC GREASE or seizing inhibitor to the tightening seat face and thread of bolt and install the bolt to the cap.

2) Tighten the bolts in the bolt tightening order as follows:
 ・Tightening for the 1st time: up to the contact of the bolt's seat face (Point A).
 ・Tightening for the 2nd time: up to the intermediate angle between Points A and B.
 ・Tightening for the3rd time: up to Point B (final tightening)

3) Checking after Assembly
   After completing installation to the engine, check the side motion of the con. rod and check that the clearance of the bearing is normal.

8. Periodic Inspection

1) Check every year or every 6,000 hours that bolts were not loosened excessively.   Re-tighten if necessary.

2) Whenever the con. rod was disassembled, check the bolt tightening by the angle tightening method.

3) Irrespective of the state of the con. rod bolts, replace the bolts every 20,000 hours.