

1 General

Onboard installation of REXPELLER unit and the intermediate shafting system shall be done in accordance with specifications in the shipyard's "Shafting system arrangement drawing" as well as in this instruction manual.

Context of this manual describes about those works which are marked with "※" in page 4.

In particular, such works as universal joint, centering and confirmation of mating marks for intermediate shafts, and tightening of bolts shall be performed according to respective instructions, to ensure performance of equipment.

Furthermore, as with the REXPELLER, consideration must be given to avoid any remainder of foreign matters in the oil tank and the piping system during "filling the system oil" and other operations, as well as thorough flushing should be done to any piping system additionally installed by the shipyard, since these foreign matters can impair normal operations of equipment.

Do not remove any item of equipment or piping arranged on the platform.

In inevitably removing them, thorough care must be taken to prevent entry of foreign matters inside the REXPELLER.

If you use any method other than those specified in this manual, our responsibility for an accident caused by it shall be exempted.

For installation of the remote control device, please refer to separately supplied booklet "Remote Control Device".

2 Request for parts fitting work during installation

Since such parts as thermometers having a danger of damage during transportation and the air breather, etc. will be removed from the REXPELLER and delivered in separate packages, you shall be requested to perform fitting work of following parts during installation.

- | | | |
|-----|----------------------------|---|
| (1) | REXPPELLER unit | : (a) Air breather···1pc./unit(Gear box part) |
| | | : (b) Oil cooler thermometer···2sets/unit |
| | | : © Micro separator···1set/unit(for the oil tank) |
| (2) | Intermediate shaft bearing | : (a) Eye bolt |
| | | : (b) Grease nipple |

Caution : About items in 2-(1), fitting places to be referred to FIG.-1.

And about items in 2-(2), fitting places to be referred to FIG.-9.

3 Storage

During storage of REXPELLER after arrival until onboard installation, care shall be used for the following points :

- (1) Store the REXPELLER unit, intermediate shaft, etc. indoor to protect them from rain water.
- (2) Store electrical equipment (W/H stand spare parts, etc.) in place avoiding direct sunshine, high temperature and high humidity.
- (3) Special care must be taken for the area to store the remote control device (W/H stand) which are most important part having built-in printed circuit board, so as to avoid direct sunshine, high temperature and high humidity.
- (4) Use thorough care to handle equipment covered with vinyl and grease-proof paper, as such equipment (parts) may be electric equipment, etc. sensible to damage.

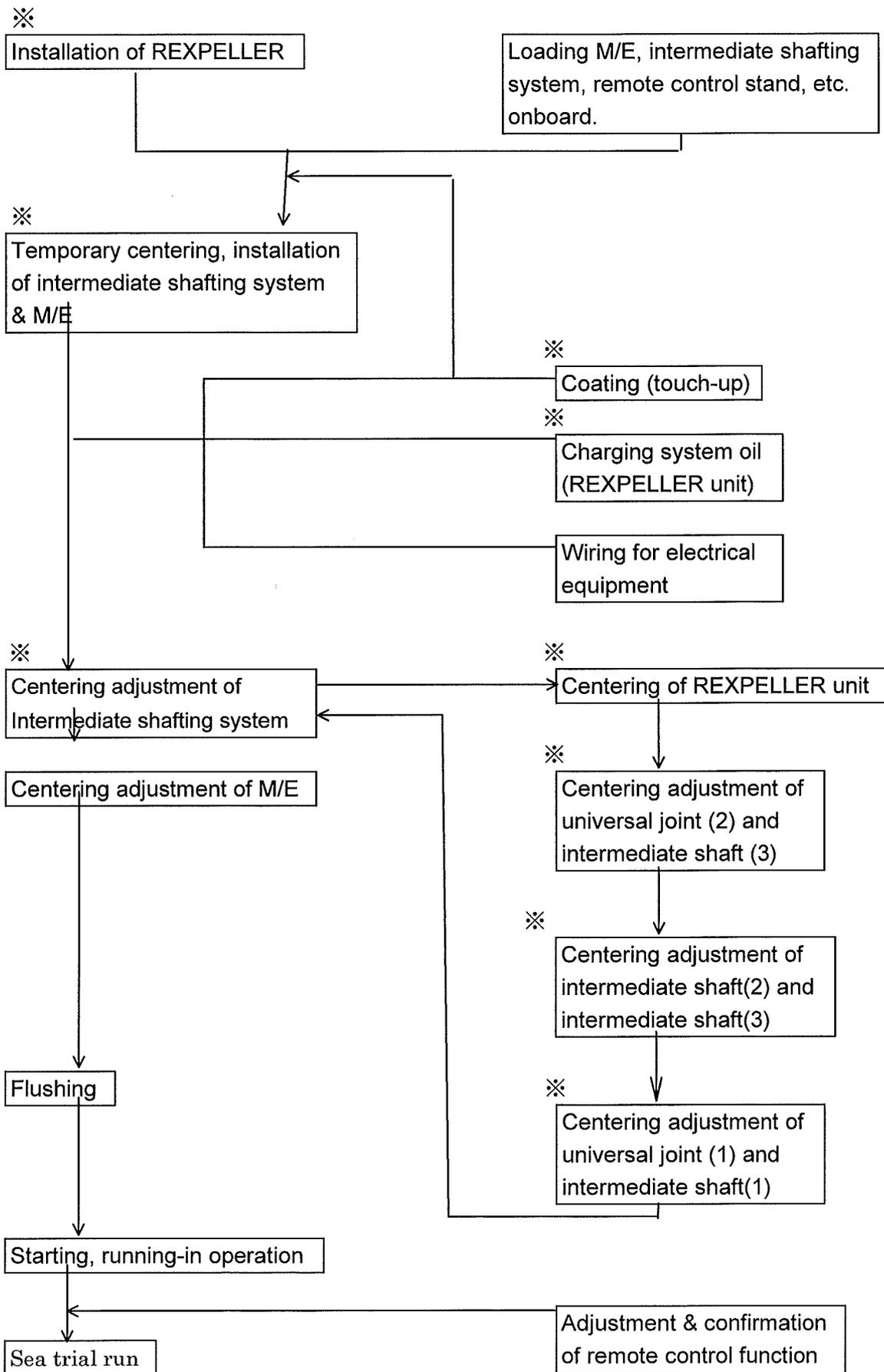
4 Lifting procedure Refer to attached FIG.2 "HOW TO CONVEY THE REXPELLER"

- (1) During lifting the REXPELLER and each item of equipment, protect them from damage due to wire ropes by applying cloth, rubber, steel sheet, etc.
In particular, solenoid valves and flow regulating valves, etc. require sufficient attention because, if any of them damaged, at least three months will be taken for obtaining and replacing it.
- (2) Use lifting holes on the platform and the gear case section to lift the REXPELLER unit.
 - *1) Hang it always at four portions for lifting.
 - *2) If the gear case section is to be used, use care to prevent paint from peeling off.
Should it peel off, correct it necessarily with touch-up.
Besides, for "Coating and color", refer to separately supplied "Technical Specification" as attached.
- (3) For other items of equipment, use eye bolts, lifting holes, etc.

- (4) During carrying in electrical equipment for the remote control device (W/H stand) on board, use care for the position of "TOP" - "BOTTOM" as well as avoid any shock given.

5 Installing procedure of REXPELLER

The installation work (procedure) may somewhat differ depending on the shipyard's working procedures and facilities, but typically shall be executed as per the following flow chart :



5-1 Installation of REXPELLER

- (1) Installation of REXPELLER, be careful so that the st'bd side unit and the port side unit may not be mistaken each other.
(Confirm this from the arrangement of hydraulic units.) · · · (See Fig-1)
- (2) Confirm attachment of "O"-ring on the hull side holddown flange surface and coat it with liquid packing · · · (See Fig.-3 "General Arrangement".)
Recommended Brand and Type of liquid packing : ThreeBond 1101
- (3) Install the REXPELLER by aligning marking lines on the platform flange surface (Fore and Stern) with marking lines on the hull.
- (4) During installing on the hull, use thorough care so that each item of equipment on the platform may not contact with the hull.
(Special consideration shall be given to protection of solenoid valves and flow regulation valves in the hydraulic units)

Note * Before loading it onboard the ship, apply touch-up on any area the paint peeled off from the side wall of the platform.

* Should any of solenoid valves and flow regulating valves fail, about three months may be required for obtaining and replacing it, so thorough care must be used for handling them.

5-2 Centering adjustment of intermediate shafting system · · · (See attached Fig.-4 "Alignment of the shafting")

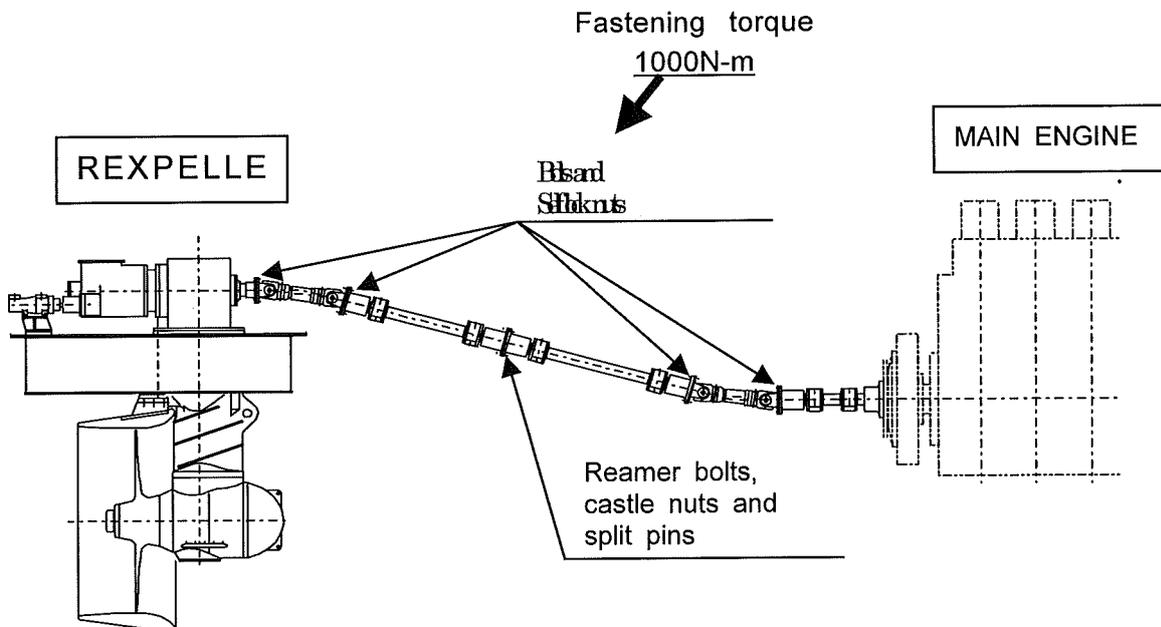
- (1) Centering of the shafting system shall be performed in the order of "REXPPELLER" – "intermediate shafting system" - "main engine" and adjusted with chock liners for the intermediate shaft bearings.
- (2) Maintain installation and centering dimensions for intermediate shafts within allowable values given in attached Fig.-4 "Alignment of the shafting".

- (3) Connection of intermediate shafts
 - a) After confirming that mating marks and flange faces are in order and cleaning the coupling faces, securely connect them with reamer bolts and non-fit bolts.
Reamer bolts don't provide for the fastening torque.
Tighten "Non-fit bolts" by the following torque.
Fastening torque : 1000 N·m
 - b) Lock the reamer bolts securely with respective split pins after tightening them by specified torque.
 - c) Coat threads in the reamer bolts with Mori-coat.

5-3 Installation of universal joint (See Fig.-5 "Installation of the universal joint")

- (1) Confirmation of distance between flanges mark
There are some confirming points, so make sure the distance between certain points in accordance with the "Fig.-5" .
- (2) Charging grease
Before the starting of main engine, following grease to be filled after installation of universal joints.

Grease : Lithium base. No.2 (Ex. SHELL Oil EP2)



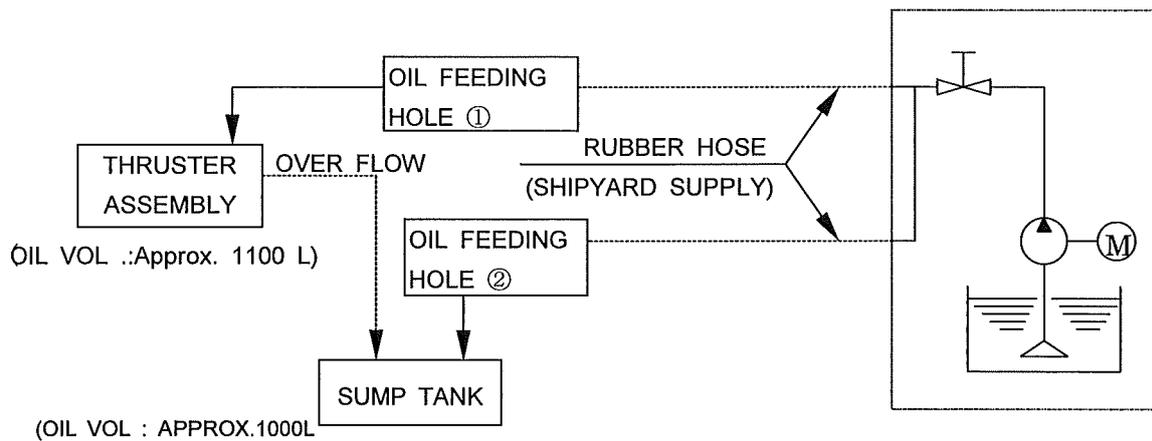
5-4 Installation of intermediate shaft bearings...(See Fig.-6 & Fig.-7 "Intermediate shaft bearing")

- (1) A holddown installation base for the intermediate shaft bearing should be fabricated in a solid construction with thorough consideration to prevent vibration.
- (2) Since the intermediate shaft bearing is to be delivered in a condition it is attached to respective intermediate shaft, do not remove shipping fixtures when loading the intermediate shaft onboard, until completion of temporary installation of the shafting system so that the felt seal (-6) and V-ring (-8) in the bearing may not be damaged. (Seals for the intermediate shaft bearings are made in an end-face construction by means of felt seals and V-rings.)
- (3) The intermediate shaft bearings are to be installed, the thrust bearings at first, then the radial bearing.
Besides, set the V-rings according to the following :
 - a) Dimensions L1 and L2, between "Lower & Upper Housings"(-1),(-2), and "V-ring" (-9) , are to be set within 10.5 ± 0.1 mm.
- (4) After completing centering of intermediate shaft bearings, machine knock pins between "intermediate shaft bearings," & "chock liner" - "bearing carrier".
- (5) Procedure to fasten the installation bolt
The bolt to be securely screwed with sufficient torque. However, screw size is comparatively small so that the calculated fastening torque is to be used as "FOR REFERENCE" depending on our experience.
Therefore, the following calculated fastening torque to be informed as "FOR REFERENCE".
Fastening torque (M33) = about 423 N·m (FOR REFERENCE)
- (6) The intermediate shaft bearing casing is constructed in a split type, so that it can be split in halves, in case of disassembling the bearing, the operating space is needed in terms of carrying the intermediate shaft.
During this operation, use care thoroughly to prevent any damage to the V-ring (-8). In addition, coat the mating faces with liquid packing at reassembling.

6. Filling the system oil

- (1) Within one or two days after arrival of the REXPELLER or prior to launching of the ship, charge the oil specified by the ship owner into the REXPELLER unit and the oil tank, etc. for internal preservation.

Refer to the following diagram for oil charge (Oil level must be confirmed by the oil level gauge mounted on the platform)



- (2) Filling the thruster assembly

- 1 Demount the gear box top cover.

NOTE : Take care so that the foreign matter does not enter Gear Box.

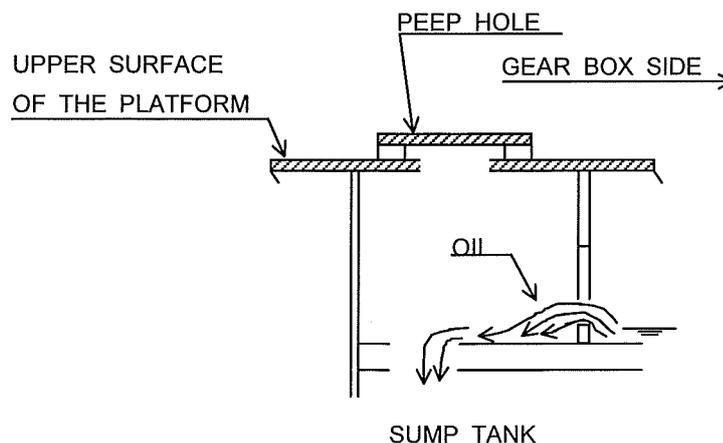
- 2 Demount the air vent blind flange.

- 3 Demount the blind flange on the platform to check the oil quantity in the sump tank.

NOTE : Take care so that the foreign matter does not enter Gear Box.

- 4 Feed oil to Gear Box through the top hole until oil flows over the rib in Platform. (See the following drawing.)

- 5 Set the gear box top cover and air vent blind flange.



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(3) Filling the sump tanks

- 1 From oil inlet part of the air breather mounted on the platform, system oil to be supplied along with checking the oil level by the oil level gauge mounted on the platform. Its level to be kept at the upper marking line or equivalent.
- 2 Then, to be checked that the float switch's terminal "C-A" indicates "ON" condition electrically.
- 3 Correctly, air breather's cover and oil level gauge to be remounted.

(4) Recommended system oil(Zinc-type anti-wear hydraulic oil is to be used.)
ISO VG 100 equivalent hydraulic oil. (See below table.)

Oil maker	Oil brand	Remarks
Shell	TELLUS OIL 100	
ESSO	NUTO HP100	
MOBIL	MOBIL DTE OIL 18M	
CASTROL	Hyspin AWH-M100	
Japan Energy	HYDLUX 100	Japanese
NISSEKI	SUPER HYLAND 100	Japanese
IDEMITSU	DAPHNE SUPER HYDRO 100	Japanese
COSMO	COSMO HYDRO AW 100	Japanese

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Coating and color (Example)

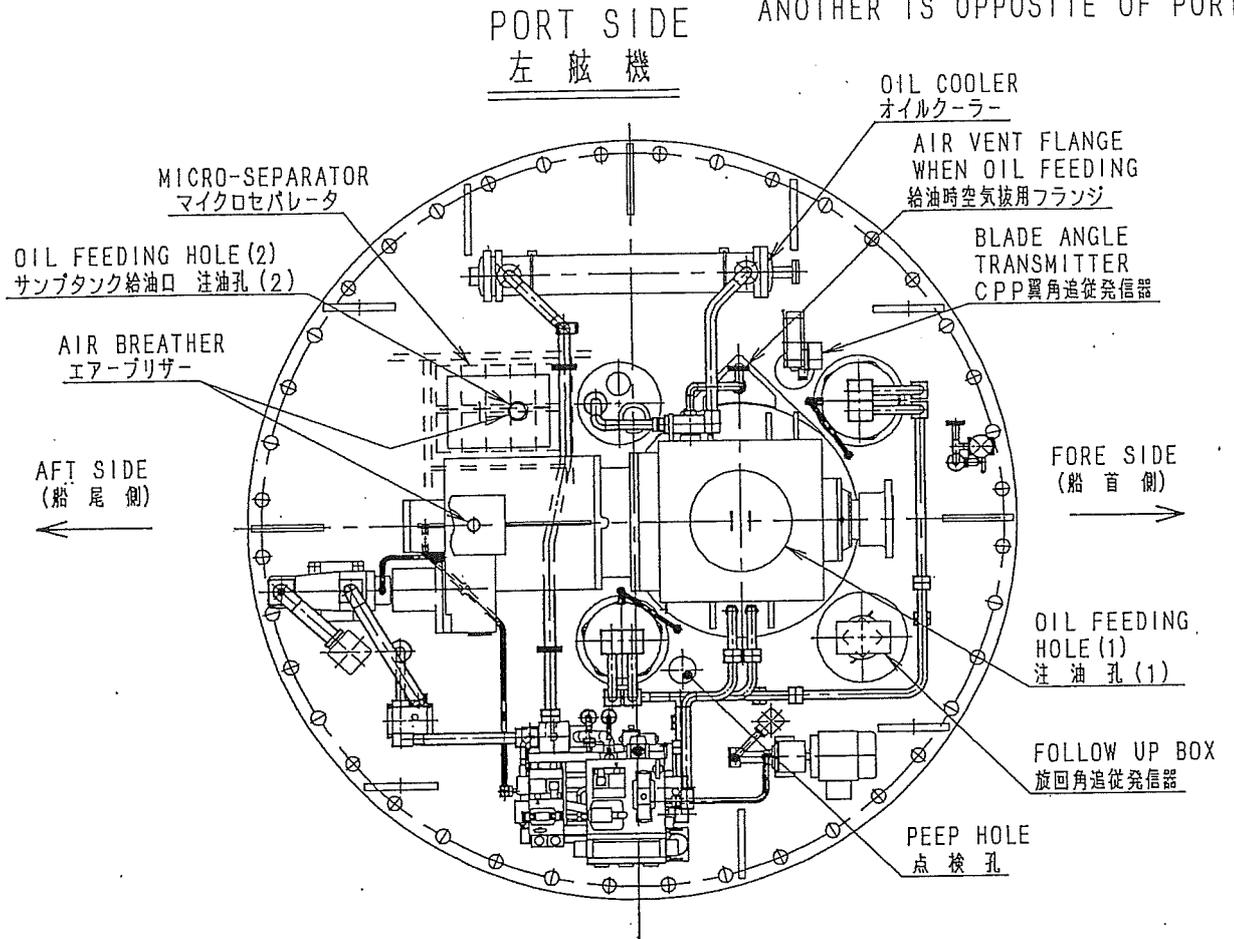
	Coated area	Ground coating	Finish coating
1	Surface exposed to sea water (Duct, Gear case, Outer surface of Platform, etc.)	Intersield 300 Bronze Approx. 150 micron	Other coatings are coated by shipyard
		Intersield 300 Aluminum Approx. 150 micron	
	Machineries in the hull (Hydraulic unit, Gear box, Upper surface of platform, Plummer block, etc.)	Interguard 300 Light gray Approx. 75 micron)	
		LZI PRIMER Red Approx. 35 x 2 coats	EVAMARINE Munsel No. 2.5G7/2 Approx. 40 micron x 2 coats
2	Intermediate shaft	-----	Coated with oil skin
3	Control stand	Maker's standard	Maker's standard Munsel No.: N1.0

Paint maker :

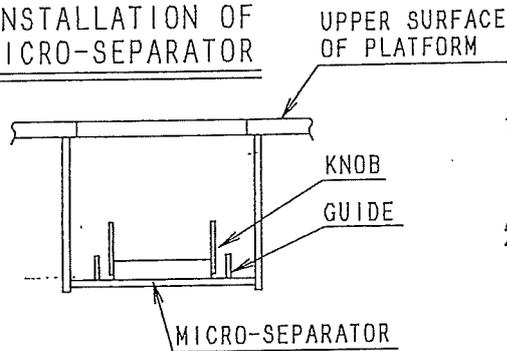
- Item 1 International
- Item 2 CHUGOKU MARINE PAINTS, LTD.
- Item 3 Maker's Standard

Fig-1

CAUTION:
THIS SHOWS PORT REPELLER,
ANOTHER IS OPPOSITE OF PORT.



INSTALLATION OF MICRO-SEPARATOR



1. INSTALL THE MICRO-SEPARATOR WITH CARRYING BY KNOB AND REFERING TO ABOVE FIG.
2. DON'T REMOVE THE KNOB FROM MICRO-SEPARATOR AFTER INSTALLATION.

For Reference

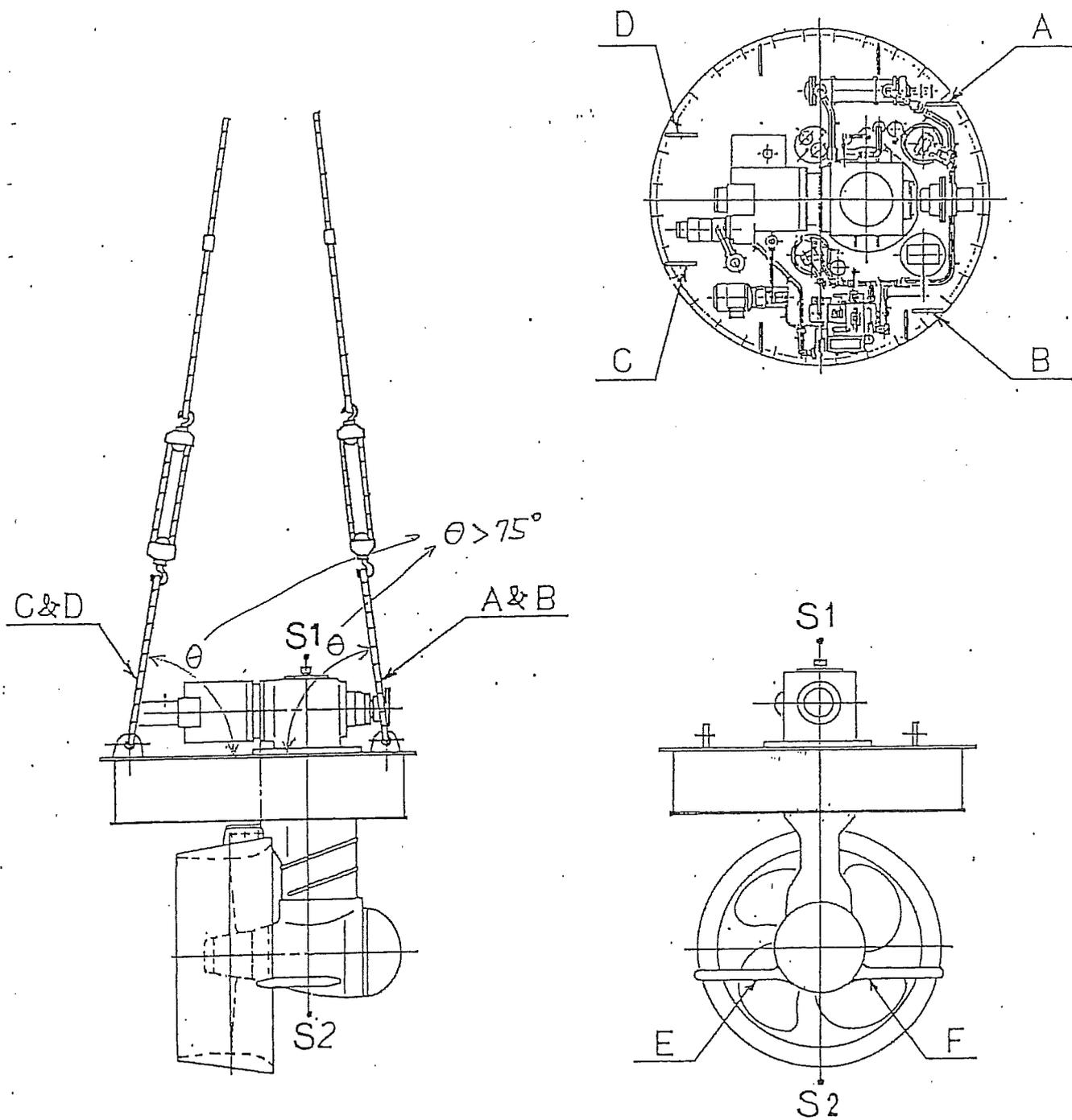
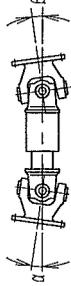


FIG-2

HOW TO CONVEY THE REPELLER

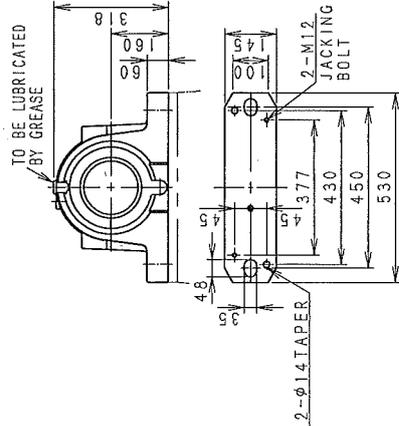
レックスペラ吊上げ要領

DETAIL OF UNIVERSAL JOINT



a	b
FORE I. 1.871.1.187	
AFT I. 1.871.1.187	

DETAIL OF PLUMMER BLOCK
(SCALE 1/15)



THE FOLLOWING TO BE PREPARED BY SHIPYARD
1) WORKING OF φ20 TAPER HOLES

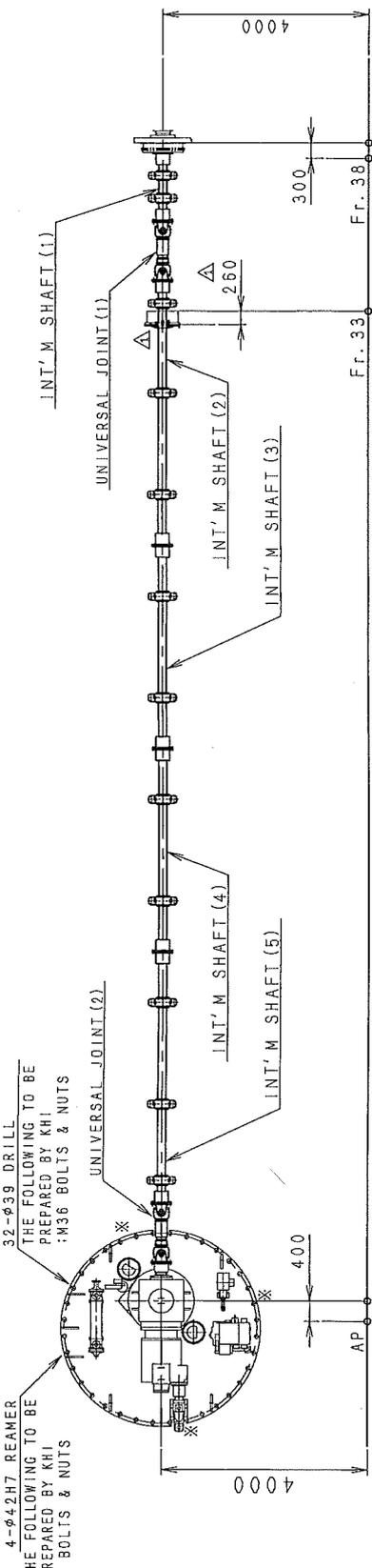
THE FOLLOWING TO BE PREPARED BY KHI
1) M30 BOLT & DOUBLE NUT
2) φ14 TAPER PIN

REMARKS :

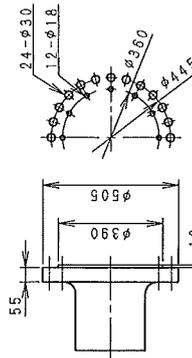
1. DIMENSIONS WITH * MARKS ARE CALCULATED BY KHI AND INDICATED THE ACTUAL LENGTH, NOT PROJECTED ONES.
2. INCLINING ANGLE OF UNIVERSAL JOINTS TO BE LESS THAN 6 DEGREES FOR EACH FWD. AND AFT. JOINT.
3. IT TO BE RECOMMENDED THAT THE UNIVERSAL JOINT AND THE INTERMEDIATE SHAFT ARE PROTECTED WITH COVER FOR SAFETY.
4. WHEN THE REPELLER IS LIFTED AND/OR INSTALLED, FOUR (4) LIFTING BRACKETS TO BE USED.

図面承認
R1: Revised for designer's comment.
June 14, 2007 H.F.
R2: Weight of REPELLER Installation was changed by owner.
Oct. 24, 2007 H.A.H.F.1.3

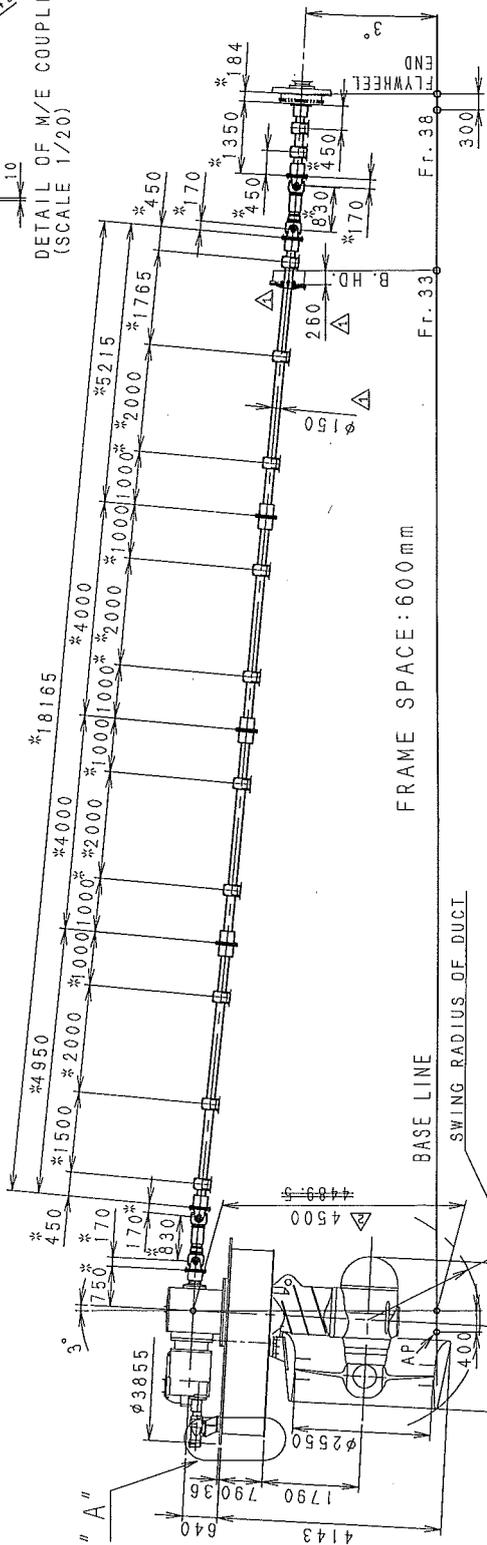
RULE	SHIP-YARD	SHIP NO.	DELIVERY CUST.
APPROVED	KAWASAKI HEAVY INDUSTRIES LTD. MACHINERY DIV. MARINE MACHINERY DEPT.		
CHECKED	WORK NO.	TYPE	KST-220ZC/A
DRAWN	KAWASAKI REPELLER		
DATE	GENERAL ARRANGEMENT		
2007.05.31	SCALE	DWG. NO.	RA-300-991R2
	1/100		CONF



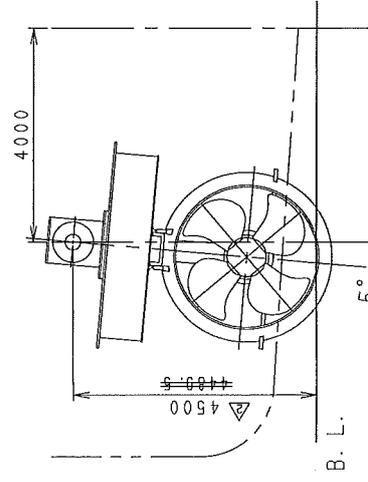
φ OF HULL



DETAIL OF M/E COUPLING
(SCALE 1/20)



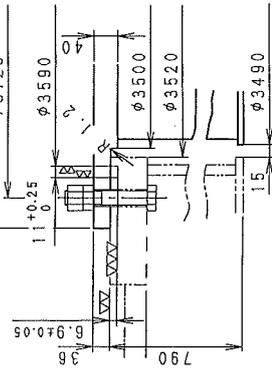
FRAME SPACE : 600mm



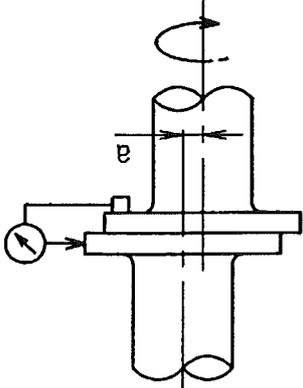
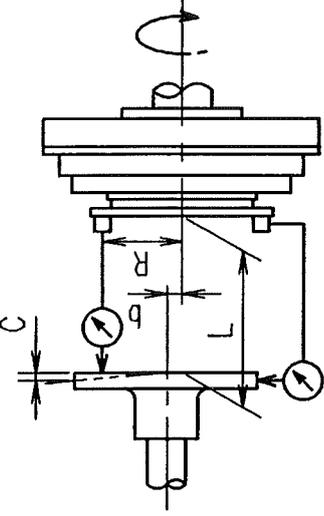
4-φ2H7 REAMER
THE FOLLOWING TO BE PREPARED BY KHI
BOLTS & NUTS

32-φ39 DRILL
THE FOLLOWING TO BE PREPARED BY KHI
M36 BOLTS & NUTS

DETAIL A
(NOT SCALE)

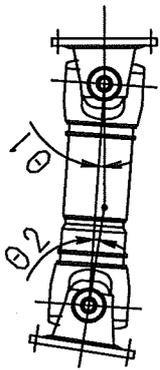
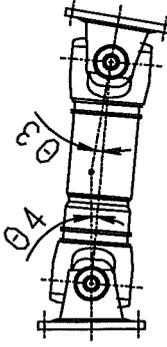


1) φ40" RING TO BE PREPARED BY KHI
2) MAKING GROOVE IN HULL STRUCTURE TO BE PREPARED BY SHIPYARD

No	PROCEDURE	確認要領	PLAN	ACTUAL
<p>INTERMEDIATE SHAFTS No.2 and No.3</p> <p>FLEXIBLE COUPLING BETWEEN INTERMEDIATE SHAFT AND MAIN ENGINE TO BE REFERRED TO MANUAL OF FLEXIBLE COUPLING</p>	<p>第2中間軸と第3中間軸の結合部</p>  <p>弾性継手部 (弾性継手メーカーの取説による。)</p> 	<p>PLAN</p> <p>a ≤ 0.03</p> <p>PLAN</p> <p>b</p> <p>c</p> <p>L</p>	<p>ACTUAL</p> <p>P</p> <p>S</p> <p>ACTUAL</p> <p>P</p> <p>S</p>	

ALIGNMENT OF THE SHAFTING

FIG.- 4

No	PROCEDURE	確認要領	PLAN		ACTUAL	
			PLAN	PORT	ACTUAL	STB'D
	<p>DISTANCE $\ell_1, \ell_2, \ell_3, \ell_4$ TO BE CONFIRMED AS FOLLOWS.</p> <p>CAUTION:</p> <p>1) INSTALL THE UNIVERSAL JOINTS AS WRITTEN IN THE RIGHT DRAWING.</p> <p>2) DO NOT USE MOLYKOTE OR ANY OTHER GREASE ON THE INSTALLATION BOLTS AND NUTS.</p> <p>3) TIGHTENING TORQUE 1000 N·M (BY USING TORQUE WRENCH)</p> <p>4) CHECK THE FIXING BOLTS AND CARRY OUT RE-TIGHTENING AFTER SEA TRIAL</p> <p>PROCEDURE:</p> <p>1) TO BE CONFIRMED THE INSTALLATION POSITION OF THE ENGINE, INTERMEDIATE SHAFTS, AND REPELLER BY THE DISTANCE OF EACH FLANGE. (BY USING TOOL AS FIG.6.)</p>	<p>1) ユニバーサルジョイント</p> <p>●船首側 FORE SIDE</p>  <p>●船尾側 AFT SIDE</p>  <p>注1) ユニバーサルジョイントはメススプラインが主機側になるよう取付けて下さい。 注2) ボルトの取付け時には、モリコート等のフリースは塗布しないで下さい。 注3) ボルトの締付けにはトルクレンチを使用し、締付けトルクは1000N・mとします。 注4) 海上運転後にボルトの再締付けを行い、再確認して下さい。</p> <p>(1) FIG.6 に示す芯出し工具を使用し、主機関、中間軸、レックスペラの各フランジ間距離を確認して下さい。</p>	<p>FORE SIDE UNIVERSAL JOINT 船側ユニバーサルジョイント</p> <p>ℓ_1 585.1 ~585.6</p> <p>ℓ_2 585.1 ~585.6</p> <p>θ_1 1.19°</p> <p>θ_2 1.19°</p> <p>AFT SIDE UNIVERSAL JOINT 艀側ユニバーサルジョイント</p> <p>ℓ_3 585.1 ~585.6</p> <p>ℓ_4 585.1 ~585.6</p> <p>θ_3 1.19°</p> <p>θ_4 1.19°</p>			

INSTALLATION OF UNIVERSAL JOINT

FIG.5

PROCEDURE

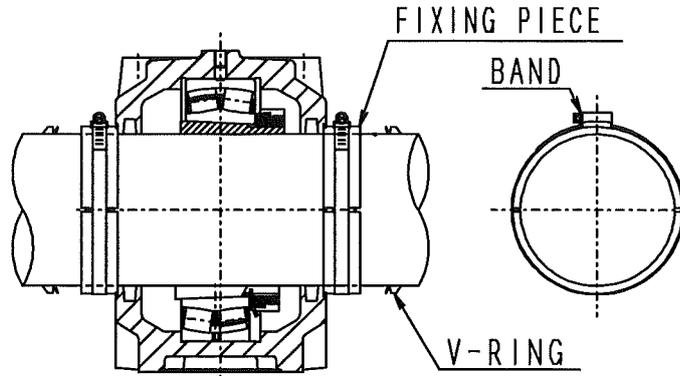
確認要領

CAUTION.
STORE THE FIXING
TOOLS, FIXING PIECE
AND BAND INTO THE
SPECIAL TOOL BOX
AFTER COMPLETION OF
INSTALLING.

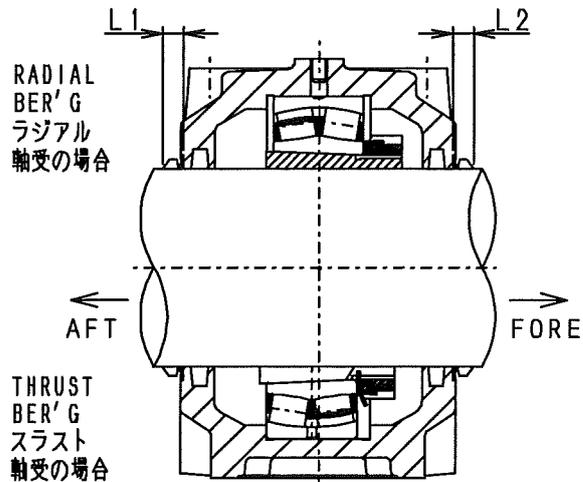
MEASURE "L₁" & "L₂"
DISTANCE IN ORDER TO
CONFIRM V-RING
INSTALLATION.

AFTER ADJUSTING THE
ABOVE ITEM, TIGHTEN
THE BOLT AND FIT THE
TAPER PIN FOR BEARING
HOUSING.

注) 固定要具 (固定片、管バンド) は用済み後
レックスペラの要具箱に格納して下さい。



Vリングの取り付け状態を確認するため、
L₁ & L₂寸法を計測して下さい。



中間軸軸受取付ボルトの締付および回り止め
確認、並びに位置決めピンの装着

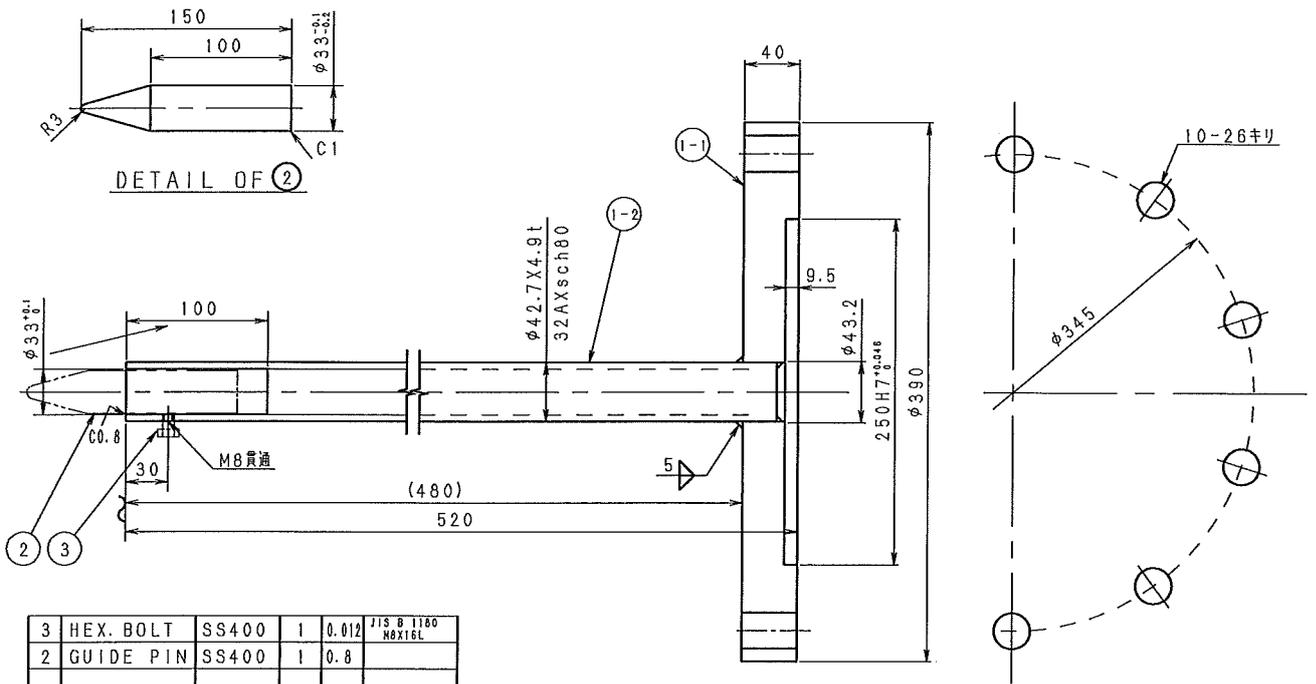
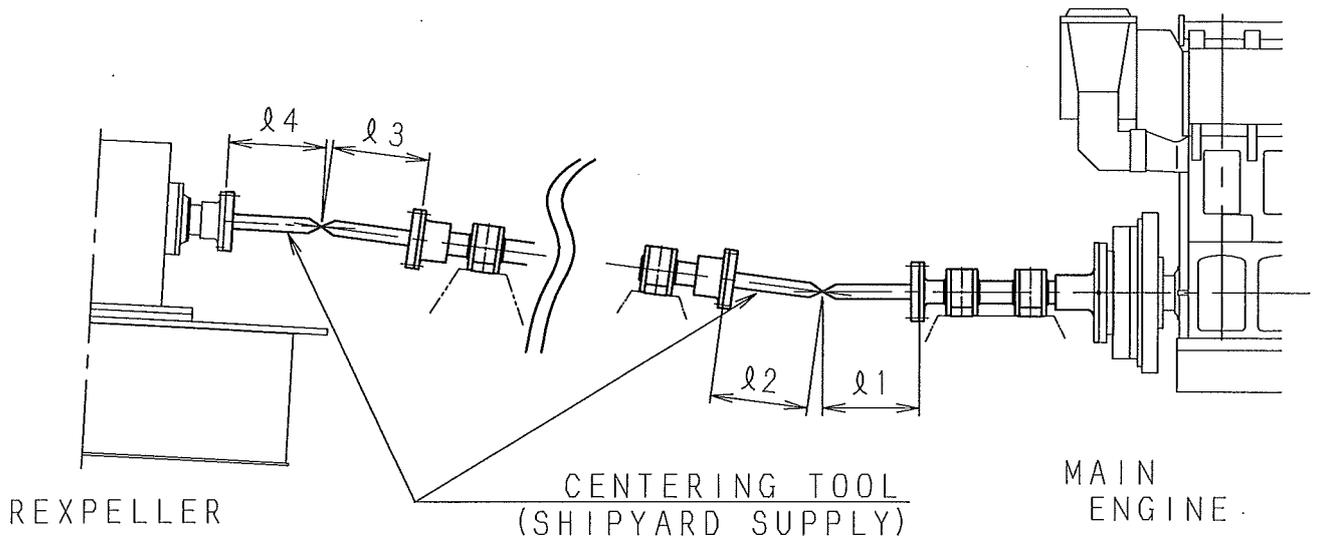
STANDARD

L1 10.5±0.1

L2 10.5±0.1

AFT SIDE

FORE SIDE



3	HEX. BOLT	SS400	1	0.012	JIS B 1180 M8X16L
2	GUIDE PIN	SS400	1	0.8	
-2	PIPE	STPG370	1	3.0	32AXsch80
-1	FLANGE	SS400	1	21.8	
1	CENTERING TOOL		1	25.0	
No	PARTS	MATERIAL	SET	WEIGHT (kg)	

CENTERING TOOL
FOR REFERENCE

FIG. 7



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Kawasaki Heavy Industries, Ltd.

Intermediate Bearing Assembly Procedure

(Preparation)

Before starting installation work, the following instructions should be carefully read.

Ensure that the environment is clean.

Check the dimensional and form accuracy of the shaft seating.

Set the bearing ①, lock nut ②, adapter sleeve ③, Felt-seal ⑥, V-ring seal ⑦, into intermediate shaft.

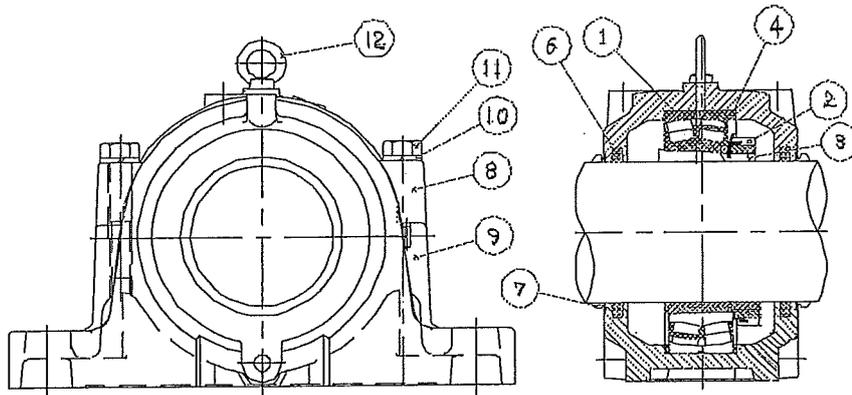


Fig-1

(Bearing mounting procedure)

1. Set the bearing on adapter sleeve to specified position on the shaft. For tightening the bearing, use the lock nut, which is to be so fastened that the radial clearance is 0.080 mm to 0.110 mm less than the initial radial clearance.

(Measurement of the clearance is to be done under gradual fastening.) (See Fig.-2)

Residual clearance after tightening of bearing : $\delta = 0.060$ mm minimum (Target : 0.070 to 0.080 mm)

- Measuring item :
- (1) Initial radial clearance
 - (2) Reduction of radial clearance
 - (3) Residual clearance

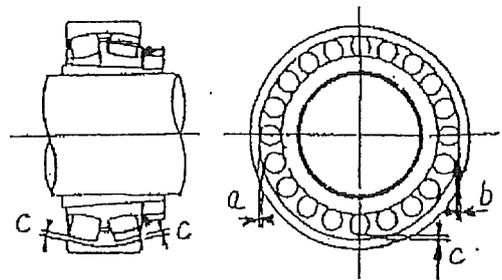


Fig-2



SKF Japan Ltd.

(Assemble procechure)

1. Set the lower housing ⑨ on the base, and tighten the attachment bolts. And set the felt seal into the groove of the housing.
2. Set the shaft with bearing and spacer ring into lower housing.

Caution : For fixed housing, **One** spacer ring ④ (width:10 mm) must be used.

3. Fill the bearing & housing with grease.
4. Set the upper housing ⑧ which the felt seal has inserted into groove on the lower housing. Tighten the cap bolts for fix the each housing.
5. Slide the V-ring seal ⑦ on the surface of shaft, and make the lip of V-ring seal contact with the face of housing.



SKF Japan Ltd.

(Grease lubrication)

Bearing 23034CCK/W33 with adapter sleeve and SN 3034 Housing.

1. The mass of grease required to fill the empty, unswept space

In bearing : 100% (Approx. 390 g)

In housing : 30 – 50 % (Approx. 610 – 1000 g)

2. The amount of grease for relubrication

$$G_p = 0.005 * D * B = 87.1 \text{ g}$$

3. Relubricating intervals

The diagram (General Catalogue P155, Maintenance Handbook P228) shows relubricating interval, expressed in hours of operation, for oxidation-resistant lithium grease of good quality. It can be used for bearings on horizontal shafts in stationary machines under normal working conditions.

(Example : $d = 170\text{mm}$, Speed = 700 rpm, $t_r = \text{approx.} 1800 \text{ hours}$)

- Relubrication procedure;

- ① If the relubrication interval is shorter than 6 months, then it is recommended that the grease fill in the bearing arrangement be replenished (topped up) at intervals corresponding to 0.5 ; the complete grease fill should be replaced after three replenishments, at the latest.
- ② When relubrication intervals are longer than 6 months it is recommended that all used grease be removed from the bearing arrangement and replaced by fresh grease.

4. Replenishment method

The grease nipple on the housing should be used for the replenishment of grease. It is also necessary to open the exit hole for the grease at replenishment so that excessive amounts will not collect in the space surrounding the bearing.