TITLE	Main Turbine Major Parts Material List	DOC. No.	LGTPR-8212-1041 V-9900-4-CT9901-085-0	REV. 0

CUSTOMER	LG Engineering & Construction Corp.	COMPLETE IN WITH COVER	4 SHEETS
FINAL USER	Turkish Petroleum Refineries Corp.		
PROJECT	Tupras Izmir Refinery DHP Project	SERVICE	Recycle Compressor
JOB No.	7020	EBARA SER. No.	R0215708
ITEM No.	CT-9901	MODEL/ EQUIP.	25MB5/SRV-5DF SET 1

LG E&C LG ENGINEERING & CONSTRUCTION CORP.	TUPRAS TUPRAS IZMIR REFINERY DIESEL/KEROSENE HYDROPROCESSING PROJECT	JOB NO.:7020	UNIT : N/A
		REQ'N NO. : 7020-RQ-C-001	SH/OF
		CONTRACTOR SPEC NO. : V-9900-4 -CT9901- 085	1 / 4
		REV 0	

TO	SET	TO	SET
CUST-	R		
OMER	10 C	281-1	
813	1	811-1	1
813E		811-2	
821-1		811-3	
821-2	1		
821-4			
819			
816-1			
816-2		4	
812-1	1	3	
812-2	1	2	
850		1	
		REV.	PAGE

☐ FOR APPROVAL

AVOID DELAY
TO MAINTAIN SHIPPING PROMISE.
ONE APPROVED PRINT MUST BE RETURNED BY:

BY: DATE:

☒ FOR RECORD

ANY REQUESTED CHANGE OF THIS EQUIPMENT WILL RESULT IN:
1.CONTRACT PRICE ADJUSTMENT
2.EXTENDED SHIPPING PROMISE
AS THIS CONTRACT IS IN MANUFACTURING PROCESS.

BY: DATE: FEB-24'03

ISSUED BY

APPROVED BY H. Sasaki Feb.24'03

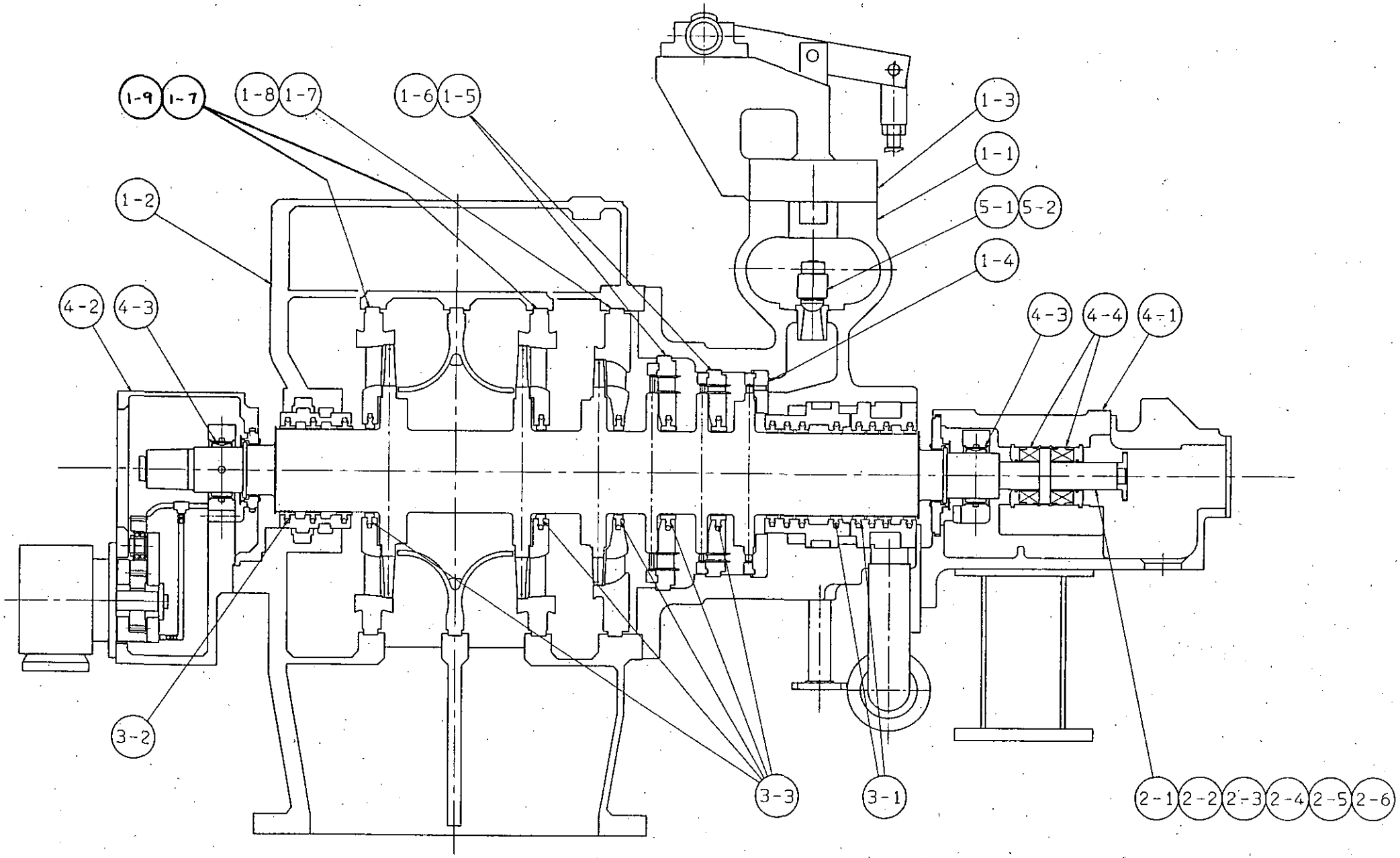
CHECKED BY

PREPARED BY H. Sasaki Feb.24'03

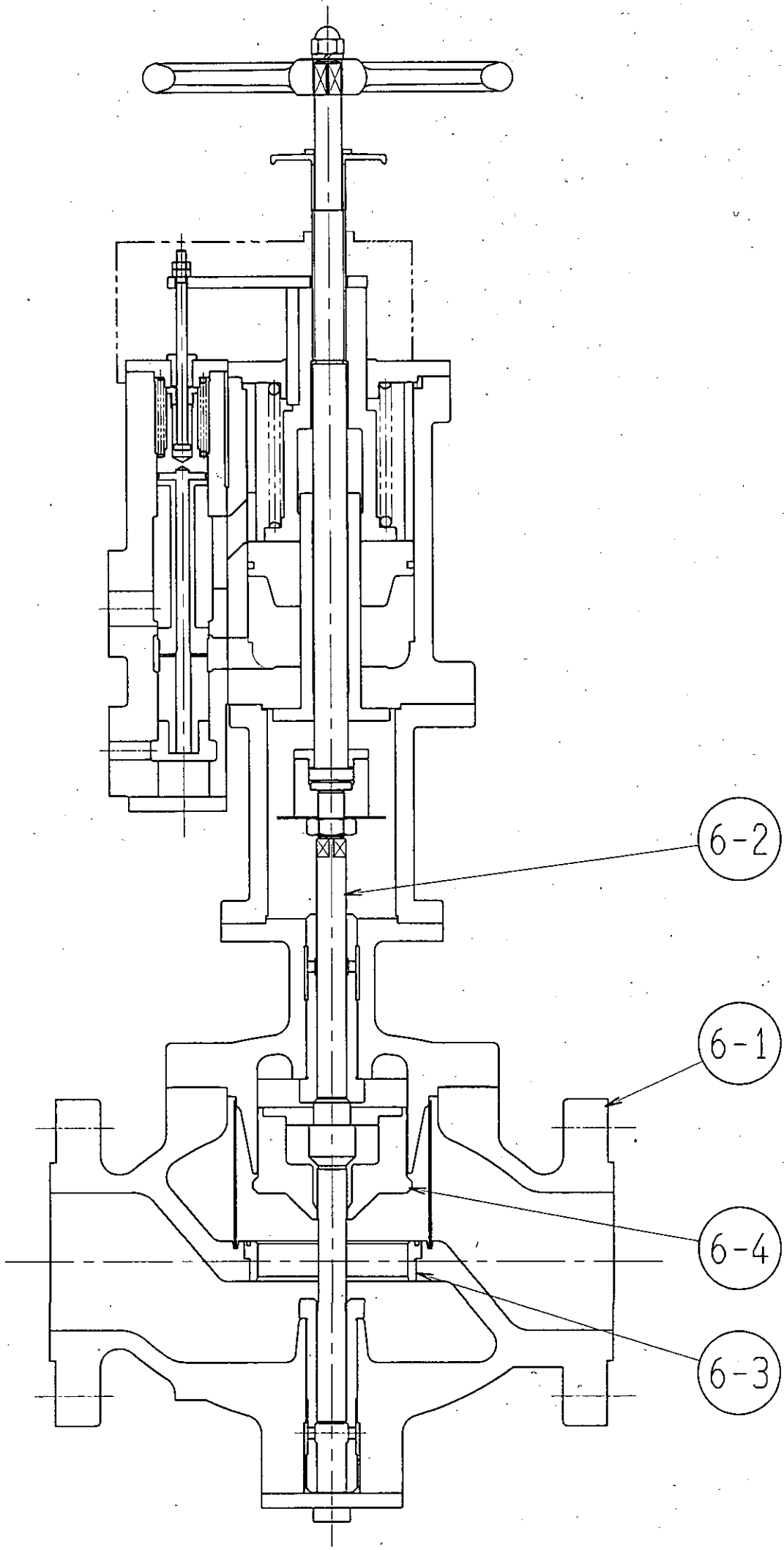
DATE	APP'D	BY

R021570803/SRV-5DF

NO.	PART NAME	MATERIAL	US EQUIV. MATERIAL	ELC. MS-NO.
CASING				
1-1	HP CASING AND STM CHEST	ASTM A217 Gr. WC6		
1-2	EXHAUST CASING	ASTM A516 Gr.60		
1-3	STEAM CHEST COVER	ASTM SA182 Gr.F11		
1-4	NOZZLE RING (1ST)	AISI 410		
1-5	DIAPHRAGMS(2nd - 3rd)	ASTM A516 Gr.60		
1-6	DIAPH. NOZZLE(2nd - 3rd)	AISI 410		
1-7	DIAPHRAGMS(4th - 5th)	ASTM A536 Gr.65-45-12		
1-8	DIAPH. NOZZLE(4th)	AISI 405		
1-9	DIAPH. NOZZLE(5th)	ASTM A743 Gr.CA6NM		
ROTOR				
2-1	SHAFT	ASTM A470 CL.4		
2-2	BLADE(1st, 2nd)	AISI 403		
2-3	BLADE(3rd)	ASTM A565 Gr.616		
2-4	BLADE(4th,5th)	12%Cr-0.12Cb Steel		
2-5	SHROUD(1st-3rd)	AISI 410		
2-6	TIE WIRE(4th - 5th)	INCONEL X-750		
SHAFT SEALS				
3-1	HP END SEALS	JIS SB410/JIS SUS 430A	ASTM A516 Gr.60/AISI430	
3-2	LP END SEALS	JIS SB410/JIS SUS 430A	ASTM A516 Gr.60/AISI430	
3-3	INTERSTAGE SEALS	JIS LBC4	ASTM B584 C93800	
BEARING AND BEARING HOUSING				
4-1	HP BEARING HOUSING	ASTM A216 Gr. WCB		
4-2	LP BEARING HOUSING	JIS SB410	ASTM A516 Gr.60	
4-3	HP,LP RADIAL BEARING METAL	ASTM C18200 / JIS WJ2	ASTM B-23AlloyNo.2	
4-4	THRUST BEARING METAL	ASTM C18200 / JIS WJ2	ASTM B-23AlloyNo.2	
CONTROL VALVES				
5-1	GOVERNOR VALVE / STEM	ASTM A565 Gr.616		
5-2	SEAT	17-4 PH (modified ASTM A705-630)		
TRIP AND THROTTLE VALVE				
6-1	BODY	ASTM A217 Gr. WC6		
6-2	STEM	JIS SUS 403	AISI 403	
6-3	SEAT	JIS SUS 403	AISI 403	
6-4	PLUG	JIS SUS 403	AISI 403	
REMARKS:				



R021570803/SRV-5DF TURBINE



T&T VALVE

CHAPTER 2

INSTALLATION – TURBINE
FOR
TUPRAS IZMIR DHP PROJECT
SERVICE: RECYCLE COMPRESSOR DRIVER
ITEM CT-9901

EBARA SERIAL NUMBER: R021570803
FRAME: SRV-5DF

Refer to the compressor instruction manual Chapter 2 Installation for following items.

1. Foundation
2. Chock Blocks
3. Grouting
4. Setting the equipment on foundation
5. Shaft alignment
6. Coupling Installation

TURBINE PIPING RECOMMENDATIONS

No part of the turbine installation is more important for successful operation than well-designed and properly installed piping. There are two definite objectives for good piping:

1. To prevent the heated piping from imposing strains on the turbine casing and, thus, affecting the alignment.
2. To so connect and drain the turbine inlet and exhaust piping that dry steam is furnished to the turbine and that water accumulation in these lines is prevented.

A stop valve is recommended in the steam piping, preferably at a convenient accessible location in the turbine room, between the steam header and the turbine inlet, to allow working on the turbine without shutting down the boiler.

The turbine casing must be protected from piping weight and piping expansion strains. The weight of piping should be carried by suitable supports. Expansion joints with limit rods or piping bends should be used adjacent to the turbine flanges. Connections between the piping flanges and turbine flanges are made without forcing the pipe line in any direction in order to make a satisfactory joint. Connections may be considered satisfactory if the connecting pipe lines, when heated to operating temperature, do not shift out of line with the turbine flanges when the bolting is withdrawn.
Refer to NEMA standards for maximum forces and moments allowable, the document "Allowable nozzle force and moment" and the drawing "Compressor unit outline".
Before piping is connected to turbine, mount at least two indicators from one coupling hub to the other coupling hub. One to measure any vertical movement, the other to measure any horizontal movement.

Then connect piping to turbine. If movement shown on any indicator exceeds 0.05 mm (0.002") loosen piping and re-fabricate, realign or adjust anchors as required.

All steam piping between the turbine and boiler or steam header must be adequately "blown down" to remove welding beads, scale, dirt, etc. During blow down, the piping should be disconnected and directed away from the turbine. Blow down should be at maximum design turbine throttle flow to obtain design steam temperature and velocity. The piping should be blown down several times, until a polished steel plate held in the stream indicates the absence of foreign material.

TURBINE STEAM SUPPLY

Steam should at all times be free from moisture. A receiver type separator with ample drains should be provided ahead of the stop valve to prevent slugs of water from entering the turbine. When a separator is not provided, a blow off valve or continuous drain should be connected to the lowest point of the steam inlet piping.

A strainer is installed internally in the T&T valve for the normal operation. But a strainer should be installed in the steam supply piping for protection against large particles of scale, welding beads, etc. during the start-up period. A strainer does not guard against abrasive matter, boiler compound or acid or alkaline substances, which may be carried over in the steam. These substances will corrode, erode, or form deposits on the steam parts, reducing efficiency and power. It is imperative that feed water treatment and boiler operation be carefully controlled to insure a supply of clean steam at all times.

STEAM LINE BLOW DOWN

All new steam piping between turbine and boiler or existing header must be adequately blown to remove welding beads, scale, dirt, broken backing rings, weld rod, etc. This includes all steam lines that can import steam into the turbine including but not limited to:

- Main Steam
- Gland Sealing Steam

Proper setup and implementation of a sound blow down procedure are normally the responsibility of the installation contractor. Ebara responsibility is normally only as a witness and to verify that placement targets are acceptable before connecting to the turbine.

Since the steam lines to the turbine can not be connected for blow down, temporary blow down piping will be required. Piping must be adequately secured prior to blow down. Piping also must be rated for steam conditions at the time of the test and discharged into an area that is properly secured and marked off.

In broad terms, blowing down the steam lines is a process which uses a cycle of heating and cooling to break free any loose particles. Pressure is built up in the boiler and a valve is opened to release this pressure though the steam lines. By the time the pressure is built up again in the boiler, the piping has usually cooled. This forms the heating and cooling cycle. The number of cycles will depend on the attention that was given to cleanliness during erection, the design of the plant piping system, and the design of the blow down system used.

Verification of the blow down is made by installing polished targets in the temporary blow down piping. The targets are usually mild steel bar with a ground finish, however key

stock material can be used. Each target can be used four times by turning the target in ninety degree increments.

The temporary blow down piping setup and size are very important. The force on a particle is proportional to the mass velocity head of the fluid; therefore the mass velocity head developed during the blowing cycle must be at least equal to that developed during full load operation. The temporary piping should not have a greater flow area than the permanent piping, so that satisfactory velocities can be maintained.

It is not possible to ascertain how many steam blows will be required to properly clean the system since too many variables are involved. Experience has shown that up to fifty total blows may be required for the main steam line and ten to twenty for the secondary lines. Normally the blow down cycle will require one to three hours. The actual steam flow through the pipe should be about fifteen to twenty minutes in duration and the piping should allowed to cool for at least two hours if insulated and one hour if not insulated.

Polished targets are to be installed after approximately ten blows on the main steam line. At this point the targets should indicate the approximate relative condition of the system. After two successive blows with no pitting observed on the targets, the blown down can be considered completed. Retain these targets for reference. Discoloration of the targets is normal. After successful completion of the blow down procedure, the temporary piping is to be removed. Reinstall any piping removed for the blow down. Test the system for leaks and piping strain.

The trip and throttle valves always contain a permanent screen to guard against the ingestion of large loose particles. In addition, many valves (out of Ebara scope) will also have a temporary screen installed around the permanent one.

NOTE

Strainers do not take the place of a properly setup and conducted blow down.

Taking proper care to insure an effective blow down procedure has been carried out will assure a successful start-up of the turbine.

TURBINE ATMOSPHERIC RELIEF VALVES

Over-pressure protection should be considered part of any good safety program. Relief valves must be supplied and installed for protecting the turbine, exhaust connections and piping.

The relief valve should be designed for full relief of maximum steam flow through the turbine without the pressures rising above the values shown in Table 2-1.

TABLE 2-1
ATMOSPHERIC RELIEF VALVE

Exhaust Relief Valve Settings

Starting Pressure:	
Condensing Turbines:	0.7 kgf/cm2G
~~Non-condensing Turbines:~~	~~10% or 0.7 kgf/cm2G above maximum operating exhaust pressure, whichever is greater.~~
Full Open Pressure:	
Condensing and Non-condensing Turbines:	Not to exceed more than 110% of the starting pressure.

The maximum operating pressures are the maximum operating pressures for which the unit was specified to operate at. These pressures should not be confused with casing construction rating. Under no circumstances should the relief valve settings exceed the casing hydro test pressure.

If a high back pressure or high extraction or admission pressure trip is furnished, the relief valve pressure should be raised 5 psig (.345 bar) and the high steam pressure trip should be set at the "start to open" pressure on Table 2-1.

TURBINE DRAINS AND LEAKOFF CONNECTIONS

Drain and leak off connections are provided as detailed on the drawing "Header piping arrangement". "Header piping arrangement" gives the locations, size and ratings of the various piping connections to be made.

Drains directed to waste should be grouped and brought to an open type collector box and piped to a common sump or sewer. All valved lines should have the valves conveniently grouped as close as possible to the collector box and all lines are better to be tagged for *identification in order to prevent miss operation.*

NOTE

All lines connected through valves should have the valves tightly closed during operation. On condensing units, these valves should normally never be opened unless the turbine casing is cold and the vacuum entirely broken. All lines connected without valves should be clear and free of back pressure at all times.

Steam piping connected to the turbine must also be provided with adequate drains, particularly at piping low points or areas where water pockets could be formed.

Consideration should be given to the location of valves to ensure operator accessibility and also the manner in which the piping will be run in order to avoid any interference with jacketing, controls, etc.

CONNECTING TURBINE TO CONDENSER

A condenser connected directly to the turbine exhaust flange, when not suspended from the flange or spring-supported, must have an expansion joint to provide the necessary flexibility for expansion. When the condenser is spring-supported or hung from the turbine exhaust flange, no expansion joint need be used, provided the maximum condenser weight under any condition is within the allowable weight, which the exhaust end is designed to support. In the latter case, the condenser load on the exhaust flange must be central. Provisions must be made in the supports for lateral expansion. All other piping connections to the condenser must be provided with suitable expansion joints.

To avoid air leaks and maintain the highest attainable vacuum, see that all joints are tight and that the shaft packing is receiving sufficient sealing steam. Suitable paint applied along the joints and around the bolts of the exhaust connection will assist in keeping them air tight.

MULTISTAGE TURBINE INSULATION & JACKETING

Insulation

Insulating a turbine greatly reduces heat loss and sound pressure levels as well as isolates hot turbine parts for personnel protection.

To insulate multistage turbines, Ebara provides a blanket type, custom fitted insulation package for field installation. The insulation package consists of:

~~Inlet steam range (More than 500℃ &less than 600℃)~~
~~Inner Jacketing: Siltex cloth 1000s, T/#8250-1000S~~
~~Insulation Cover: Silicon coated fiberglass fabric~~
~~Insulation Core: 2" to 3" thickness of Fineflex, T/#5210#100~~

Inlet steam range (More than 350℃ & less than 500℃)

Inner Jacketing:	Siltex cloth 700, T/#8250-700
Insulation Cover:	Silicon coated fiberglass fabric
Insulation Core:	45mm thickness of glass mat GE, T/#4517-GE

~~Inlet steam range (Less than 350℃)~~
~~Inner Jacketing: Glass cloth, ARG~~
~~Insulation Cover: Silicon coated fiberglass fabric~~
~~Insulation Core: 2" to 3" thickness of glass mat GE, T/#4517-GE~~

Installation

To ensure a snug fitting blanket insulation system, due to the physical irregularities of a turbine casing, it is necessary to provide several pieces of blanket material. The pieces are attached to the turbine casing with weld studs and stainless steel lashing wire.

CAUTION

When installing insulation to the turbine steam chest, ensure that the insulation do not interfere with the mechanical linkage or valve stems of the governor system.

Jacketing

To insulate multistage turbines, Ebara supplies a sheet metal jacketing that covers the turbine casing. This removable jacketing, which provides access to turbine parts for servicing, separately houses the high-temperature turbine sections. The sheet metal jacketing squares the turbine's shape for a neater appearance. Turbine jacketing is made for each turbine's specifications.

NOTE

In addition to any block/cement or blanket type insulation, Ebara recommends jacketing for all outdoor installations to protect high temperature turbine parts from the elements.

NOTE

All turbine insulation and jacketing will require fit-up and possibly some modification when finally installed on the turbine in the field. Fit-up/modification of the insulation and jacketing will be the responsibility of the customer/erecting contractor.

CHAPTER 3

OPERATION - TURBINE
FOR
TUPRAS IZMIR REFINERY DHP PROJECT
SERVICE: RECYCLE COMPRESSOR DRIVER
ITEM TC-9901

EBARA SERIAL NUMBER: R021570803
FRAME: SRV-5DF

Elliott model SRV-5DF is a multi-stage, multi-valve condensing steam turbine with a turning gear.

INTRODUCTION

The equipment should deliver design performance and long life if these instructions are carefully followed. Successful operation depends upon careful installation and initial start-up, a maintenance program that will locate troubles before they become serious and quality repair work. Start-up and shutdown procedures vary depending upon the particular design of the unit. The following general instructions are intended to be used as guidelines in establishing a start-up and shutdown procedure.

It is recommended that an Ebara Corporation Service Representative be present during initial start-up. Any questions concerning operation should be directed to the *nearest Ebara Corporation District Office.*

It is recommended that service representatives from the Turbine, Driven Machine(s), and governor manufacturers be present during initial start-up to ensure all equipment is properly installed and calibrated.

Please refer to the manuals of speed governor, overspeed trip system and actuator located in Chapter 6, Accessories, to become familiar with mentioned equipments. Particular attention should be given to the proper use of overspeed trip.

Read and study carefully the manuals and other associated handbooks pertaining to the control panel, the Trip and Throttle Valve, the oil system, and all other hardware, which interface with the turbine string.

NOTES FOR OPERATION AFTER UNPACKING

1 Remove all shipping hardware and perform any necessary adjustments after alignment but before start-up.

~~2 Preparation to remove casing (Refer to the drawing "Shipping Hardware (NWP bearing housing)")~~
~~Lower casing is supported by upper casing through split line bolting.~~
~~When upper casing is removed, lower casing must be supported.~~
~~Install alignment blocks & screws.~~
~~Tighten the 6 nuts on the horizontal tie rods.~~
~~Install items #3, #6 and #7 on the drawing "Shipping Hardware (NWP bearing housing)")~~

~~3 Washers of exhaust end bearing pedestal had been set for shipping position. After turbine unit is installed on foundation, these washers should be reversed from shipping position to operation position. Required clearance should be adjusted by shim to absorb casing thermal expansion. (Refer to drawing "Support Foot Hardware ")~~

4 Teflon (or polypropylene) seats are inserted in the journal bearing in order to move or to avoid unexpected damage of journal bearing and journal during transportation.

So, remove the seats and apply paste type gasket to the horizontal flanges. As for the detail, refer to the bearing assembly drawing in this instruction manual.

5 Confirm the caution plates attached to the equipment.

~~WARNING~~

~~Opening of turbine casing and T&T valve is necessary to remove rust preventives (that are coated inside equipments) at site. Casing and T&T valve bolts are fixed by partial torque. Accordingly, do not pressurize casing and T&T valve unless all bolts are fixed with the correct torque. As for detail refer to the document "Rust Preventive Procedure".~~

~~6 As governor (Actuator) be factory filled with lubricant containing rust preventive, it is not necessary to change lubricant before operation. Check cleanliness and oil level and replace or add clean oil if required.~~

7 Check cleanliness and the revel of lubricant that be pre-filled in the vendors' shop and replace or add clean lubricant if required. As for the applicable equipment, refer to the document "Lubricant List".

8 It is not necessary to remove rust preventive inside the turbine casing, as this coating is steam soluble once operation is started. As for detail refer to the document "Rust Preventive Procedure".

9 Review and understand the contents of instruction manuals and the other documents, issued from Ebara, of turbine train system such as the turbine, the governor, the actuator, the turning gear, the gland condenser, the sealing system, the super bolt, etc.

STEAM SUPPLY

Steam should be free from moisture and preferably superheated. A receiver type separator with ample drains should be provided ahead of the shut-off valve to prevent water from entering the turbine. When a separator is not provided, a continuous drain must be connected to the lowest point of the steam inlet piping.

A steam strainer should be installed to protect the turbine from large particles of scale, welding beads, etc. This strainer does not guard against abrasive matter, boiler compounds, acids, or alkaline substances, all of which may be carried over in the steam. These substances may corrode, erode or form deposits on the internal turbine parts, thus reducing efficiency and power. It is necessary that feed water treatment and boiler operation be carefully controlled to insure a supply of clean steam if prolonged satisfactory operation is desired.

NOTE EBARA'S GUIDELINES FOR STEAM PURITY

Ebara's recommended guidelines for steam purity limits for both start-up and operation of steam turbines are defined in the following table :

Conductivity - STARTUP		**CONTINUOUS**	
Micromhs/cm at 25°C			
	Drum	0.3	1.0
	Once through	0.2	0.5
SiO2	(ppb, max.)	20	50
Fe	(ppb, max.)	20	50
Cu	(ppb, max.)	3	10
Na + K	(ppb, max.)		
	up to 5.51 Mpa (up to 800 psig)	20	20
	5.52 to 10.00 Mpa (801 to 1450 psig)	10	10
	10.01 to 16.55 Mpa (1451 to 2400 psig)	5	5
	over 16.55 Mpa (over 2400 psig)	3	3
CL	(ppb, max.)	10	10 - 30

SAFETY PRECAUTIONS

1. Do not operate the machinery if inspection shows that the shaft or blades are excessively corroded or eroded.

2. Be sure that all valves controls, trip mechanisms and safety devices are in good operating condition.

3. Be sure that the rotor turns freely before starting.

4. If high vibration, unusual noise or rubbing is present, shut down immediately, investigate and correct the cause.

5. Be sure that all electrical and piping connections are properly made before starting the turbine string.

6. When any alarm or abnormality occurs within the equipment or system, the turbine string should be shut down, a troubleshooting investigation should begin, and repairs should be undertaken before attempting a restart.

7. Accelerate through critical speeds quickly. Do not operate the turbine string at the critical speeds.

-WARNING-

UNDER NO CIRCUMSTANCES SHOULD THE TRIP VALVE BE BLOCKED OR HELD OPEN TO RENDER THE TRIP SYSTEM INOPERATIVE. OVERRIDING THE TRIP SYSTEM AND ALLOWING THE TURBINE TO EXCEED THE RATED (NAMEPLATE) TRIP SPEED MAY RESULT IN FATAL INJURY TO PERSONNEL AND EXTENSIVE TURBINE DAMAGE. IN THE EVENT THE TRIP SYSTEM MALFUNCTIONS IMMEDIATELY SHUT DOWN THE TURBINE AND CORRECT THE CAUSE.

CAUTION

The turbine and driven machine(s) interface with other various types of equipment to form a system. Equipment that is not part of Ebara Corporation supply must be properly installed and checked out to develop a trouble-free and safe system. Failure to check out this equipment can lead to distress of the turbine and driven machine(s).

CONTROL SYSTEM DESCRIPTION

Refer to the control panel instruction manual.

Valtek Actuator

The actuator system for this application consists of a Valtek Electro-pneumatic actuator. This actuator is designed especially to receive a control signal from governor, convert this signal to pneumatic pressure signal to drive a pneumatically actuated governor valve, At the same time, sensing the control valve opening and feeding it

back to the controlling instrument or system. The actuator is calibrated at the factory for bias in the minimum fuel condition in the event of a loss of input current.

Trip and Throttle Valves

The Trip and Throttle Valve serves as the primary turbine shutdown device. The T&T Valve features a trip cylinder, which instantaneously closes the valve on loss of pressure in the oil circuit, and a manual exerciser to prevent the valve from sticking in the open position.

CAUTION

After turbine shutdown / stop, T&T Valve must be manually closed as soon as possible.
Operator must confirm that T&T valve is fully closed position until turbine start-up.

SYSTEM OPERATION

Refer to panel instruction manual and governor instruction manual.

PRIOR TO INITIAL START-UP

It is important to point out here that proper familiarity and sequencing of all the control hardware are required to ensure safe operation and to prevent possible damage to the turbine string.

The following is a recommended checklist of preparations that should be completed prior to initial start-up.

1. Remove paint, protective coatings, and foreign material from all moving parts. (Refer to "Rust prevention procedure)

NOTE

Due to internal shipping preservatives, turbine should be exhausted to atmosphere on initial start-up to prevent fouling condenser tubing, etc.

CAUTION

When exhausting to atmosphere, exhaust temperature must not exceed 121°C, AND THE RUN SHOULD BE HELD TO A MINIMUM TIME.

2. Clean the rotor shaft journals and the bearing housing oil reservoirs with clean, lint free rags. Flood the Kingsbury type thrust bearing and shaft journals with oil. (See Chapter 5, Lubrication System, for proper oil levels and lubrication requirements.) Replace bearings and bearing caps.

3. Ascertain that the lube system has been properly flushed, lube pump shaft alignments have been properly made, and that the lube piping has been properly installed.
   If foreign material exist in the oil, the bearings and the journals may have a sever damage.

4. Verify that the equipment internals and inlet piping are free of all tools, rags, and foreign material.

5. The turbine steam supply system piping should have been "blown down" to remove foreign material from the piping. Refer to the Steam Line Blow Down section of Chapter 2, Installation. Flow measuring devices should have been removed from the steam lines during "blow down". Inspect all leakoff, drain, and miscellaneous piping connections as shown on the outline and purchaser's connection drawings to insure that they are properly connected.

6. Verify that all nuts and bolts have been properly tightened.

7. Check and record shaft alignments. Also check and verify that the couplings are properly installed.

8. Check to be sure the steam strainer located in the T&T Valve is clean and properly installed.

9. ~~Verify that the extraction non-return valve and / or exhaust check valve (if installed) is properly installed and works freely.~~

10. Disconnect the coupling between the turbine and driven machine.

11. Inspect and lubricate the control linkages.

12. Inspect and check the configuration of the governor. For specific details, refer to the governor instruction manual in the panel instruction manual.

13. Verify that all magnetic pick-ups connected to the governor are properly gapped.

14. Inspect and check the configuration of the overspeed trip system. For specific details, refer to the overspeed trip system manual in the panel instruction manual.

15. Verify that all magnetic pick-ups connected to the overspeed trip system are properly gapped.

16. Verify that the magnetic pick-up cables leading from the magnetic pick-up unit to the electronic governor and electronic overspeed trip system are properly connected, and that there are no signs of broken wire along the exposed sections of the cable.

NOTE

Steps 14, 15, and 16 should be used for initial start-ups and all other start-ups after maintenance.

17. Verify that the exhaust relief valve (or atmospheric relief valve) is properly installed and operates at the proper position.

-WARNING-

THE TURBINE SHOULD NOT BE OPERATED UNLESS THE EXHAUST RELIEF VALVE (OR ATMOSPHERIC RELIEF VALVE) OR OTHER PROTECTIVE DEVICE HAS BEEN INSTALLED BETWEEN THE TURBINE EXHAUST CONNECTION AND FIRST SHUT-OFF VALVE (OR CONDENSER AS ON A CONDENSING TURBINE) AND DESIGNED FOR FULL RELIEF OF THE MAXIMUM STEAM FLOW THROUGH THE TURBINE WITHOUT EXCESSIVE EXHAUST PRESSURE.

18. Reinstall coupling spacer if both units are to be run. Check and record shaft alignment(s) between the Turbine and driven machine(s).

19. Start the buffer gas flowing into the compressor labyrinth separation seals. Refer to the Dry Gas Seal System Instructions in compressor instruction manual. Before starting the oil system, gas (N2) must be supplied to the separation seals. This supply of buffer gas is required to prevent contaminating the dry gas seals with oil.

20. Make sure the oil reservoir is filled to the proper level with clean oil.

21. Start oil system and circulate the lube oil for several hours using the main oil pump, checking for and correcting any leaks. Check the start-up feature of the auxiliary oil pump upon loss of the main oil pump. Check for cooling water flow to the turbine driver. ~~Check the emergency oil pump to be sure it is armed and functional. (If applicable)~~ Oil temperature should be at least 21°C for start-up. If not, bring the oil temperature (by heating or warming up) to at least 21°C before starting the unit.

22. Ebara oil consoles are provided with separate transfer valves and pressure equalizing lines for switching from one filter or cooler to the other. In order to maintain the standby set for immediate use, the following procedure must be followed:

    a. Open the cooler or filter vents to atmosphere.
    b. Open the valve on the pressure equalizing line.
    c. Close the vents on the cooler or filter when oil flow begins and the air is completely purged.

    ~~**NOTE**~~

    ~~If the cooler/filter vents are equipped with orifices and piped back to the reservoir, the vent valves may remain open.~~

    d. Set the transfer valve to position for the cooler or filter set to be used.
    e. Occasionally repeat Steps (a) through (d) to insure complete air venting and readiness of the alternate cooler or filter for operation.

23. Inspect and test all controls, alarms and trips. Primary attention should be directed towards the verification of the proper trip system settings; extra care must be taken to verify the settings of the overspeed trip system.

24. Inspect and test the actuator movement.

25. Check all drain valves for proper operation.

26. Before start-up, drain piping of any liquid.

CAUTION

Do not attempt start-up until all liquid is drained from piping.

27. Be sure the rotor turns freely. With the lube system operating, roll the shaft via turning gear through several revolutions before starting. Any sign of binding or rubbing should be thoroughly investigated before attempting to start the unit. Binding indicates the desirability of checking the casing shaft seals and rechecking driven machine(s) alignment. If rubbing is experienced, check internal clearances.

28. Confirm that the Turbine Turning Gear is installed and all electrical connections are properly made up. Refer to the Turning Gear Operation section of this chapter and the turning gear instruction manual in Chapter 6, Accessories.

29. Using the Gas Seal Buffer Gas package, inject the filtered process gas into the gas seals. As for the detail, refer to compressor instruction manual.

30. Refer to the Automatic Sealing Steam And Leakoff System section of this chapter for the operating procedures as required.

31. Disable all automatic controls or regulators used in the turbine control system. They should not be operated during the initial start-up phase. Use only after the general operation of the equipment has been determined to be satisfactory.

RECOMMENDED INITIAL OPERATION OF A STEAM TURBINE TRAIN

Initial operation of a new or reconditioned turbine, including flushing and adjusting the lubrication system and adjustment of control and protective mechanisms will normally be done under the supervision of an Ebara field service representative.

Starting a steam turbine that operates with high inlet pressures and temperatures should be done with care to avoid any possible damage to the machine. Since the casing was designed to contain high pressures, the walls are relatively thick and they heat (or cool) slowly. Sudden admission of high temperature steam to a cold turbine would rapidly raise the temperature of the internal surfaces exposed to the steam while the outer metal would remain at a lower temperature. This would result in thermal stresses that could be detrimental to the turbine. It should always be kept in mind that thermal gradients across the metal sections of the turbine should be minimized. Excessive repeated thermal stresses can result in cracking of the turbine shell, especially between the primary steam inlet and first stage shell area. Predominately, rapid temperature changes occur during the start-up or shutdown cycle.

Before the T&T Valve is opened, water should be drained from the steam inlet line and the line should be heated by blowing steam through the before seat drain. Droplets or slugs of water that are allowed to enter the turbine may cause severe damage. All other lines connected to the turbine should have drains so that water can be drained from the lines before the T&T Valve is opened.

Detailed instructions for routine operation adapted to the individual installation are usually prepared by the purchaser's representative responsible for plant operation. These instructions may then be submitted to Ebara Corporation for comments if desired.

CAUTION

This instruction book is based on Ebara's understanding of the system when this book was generated. Alternate governor configurations are possible, but it is the contractor's and/or user's responsibility to insure that changes are safe and proper before implementation.

Prior to loaded operation of a new or reconditioned turbine string, the turbine should be run to check for proper operation, direction of rotation, and verification of correct overspeed trip settings. These verification runs should be done with the turbine uncoupled from the driven machine(s). The recommended general operating procedures for these verification runs are as follows:

NOTE

The turbine speed is to be controlled solely with the T&T Valve until the governor and trip systems have been checked or during cold starts.

TURBINE UNCOUPLED RUN

1. Check the condition of all equipment to insure that it is ready for operation, including the axial position of the rotor if it has been disturbed since the last operation.

2. Check the oil level in the reservoir. If necessary, heat and establish a minimum oil temperature of 21°C. Start the main oil pump and check for leaks. Check the lube system operation by running the main pump and auxiliary pump separately to determine that they are functioning correctly, and that the controls and alarms are properly set. ~~Verify that the emergency oil pump is armed and functional~~.

3. Check the control oil and bearing oil pressures at all appropriate locations to verify that they are within design values. If the oil pressures are below design values, reset the control valves to obtain design pressures.

4. Check the sight flow indicators at all bearing drains to verify that all bearings are receiving oil.

5. Establish design steam supply conditions from the boiler for the start-up.

6. Warm up and drain the steam piping ahead of the turbine. Verify that any drain traps are blocked in and operational.

7. Make certain that the turbine steam chest, steam end casing, exhaust end casing, and packing cases are drained of all water that might have accumulated. Then close drain valves.

NOTE

Casing drains may be left open until the casing is warm and the steam is dry.

8. If a vacuum breaker is installed, see that it is closed.

9. ~~See that exhaust piping is free of water, exhaust valve and drains in exhaust line are open, and the atmospheric relief valve (or exhaust safety valve) will operate.~~

10. If an accumulator is installed, check its pre-charge pressure and recharge if necessary.

11. Supply control oil pressure to activate the inlet governor valve servomotor / ~~actuator, and the extraction control valve servomotor / actuator.~~

NOTE

If the control oil pressure is low, the servomotor ~~/ actuator~~ operation will be sluggish. Use the standard oil pressure at all times.

12. Supply air to the solenoid trip valve. Air pressure should be 5.0 kgf/cm2g.

13. Supply air to the inlet valve Valtek actuator I/P transducer. The air pressure should be 5.0 kgf/cm2g. Steady state consumption for each is 8.8 N-lit/min @ steady state, 311 N-lit/min @ transient condition.

14. Energize the governor ~~and apply redundant input power supply to the actuators~~.

15. Energize the Overspeed Trip System.

NOTE

If the overspeed trip system is found not to have been *configured, read overspeed trip system manual before* performing the necessary configuration.

16. Verify that all permissive start, alarm, and trip instruments are functional.

17. Verify that the control oil Pressure is established at the T&T Valve.

18. Verify that cooling water is available for the oil coolers, surface condenser and the gland condenser.

19. Verify that the steam is available at the Automatic Sealing Steam Package and gland ejector.

NOTE

The sealing steam supply must be dry to avoid serious damage to the turbine rotor. The supply line should be thoroughly blown down and should not contain any drain prior to use.

20. Start the Turning gear to start the rotor turning. Refer to the Turning Gear Operation section of this chapter for the operation details of the Turning Gear. If the driven machine is the compressor with the dry gas seal system, operator should understand that turning period reduce life of the dry gas seal contact surface. Do not operate turning gear unnecessarily. (Refer to compressor instruction manual)

NOTE

To start the turbine rolling over slowly before building up any vacuum. This has the advantage of safeguarding against a bowed shaft due to air leaking in along the shaft with the rotor at rest (particularly important when still warm from recent operation).

21. Start and operate the main condenser and scavenging ejectors according to the manufacturer's instructions.

NOTE

Many operators prefer to start the turbine rolling over slowly before building up any vacuum. This has the advantage of safeguarding against a bowed shaft due to air leaking in along the shaft with the rotor at rest (particularly important when still warm from recent operation).

CAUTION

On condensing units, do not open sealing steam valves to turbine packing glands until after the rotor has started turning.

22. Establish a 76 mmH_2O vacuum (3" H_2O vacuum) exhaust pressure. Verify that all appropriate drains are closed to aid in building the vacuum. (Drains can be slightly opened if desired vacuum is established.)

23. Start water circulating through the oil cooler and gland condenser.

NOTE

In extremely cold weather, or when using cold circulating water, it may be advisable to postpone or throttle the admission of water to the oil cooler until the unit has started turning and the oil has warmed to its minimum operating temperature. Outlet temperatures from the cooler should be maintained at 46°C (during normal operation).

24. When all auxiliary systems are operating satisfactorily and the turbine casing is drained of all water that may have accumulated, the turbine is ready to be started.

25. Close down the casing and steam chest drains. Casing drains should be left cracked open until the casing is warm and steam is dry.

26. Admit medium pressure steam to the gland condenser steam jet ejector. Maintain condenser vacuum at approximately 13.3 kPaG (0.136 kgf/ cm^2G) negative pressure.

27. Observe the unit for abnormalities, especially internal rubs or high shaft displacements, when placed on the Turning Gear.

28. Verify that the T&T Valve is closed. Verify that the trip circuit is reset so that the T&T Valve will be operative. The solenoid valve should be energized and closed, establishing the design control oil pressure at T&T valve, etc.

29 Start the turbine train control systems.

30. While the governor is open through the start sequence, manually open the T&T Valve enough to immediately start the turbine rotor turning slowly at approximately 1000 rpm. If the T&T Valve is new, please refer to the T&T valve Instructions located in Chapter 6, Accessories, prior to operating the valve for the first time.

NOTE

The Turning Gear will automatically disengage as the string speed accelerates above 30 rpm.

NOTE

Opening the T & T valve gradually should be used only on the first start up after installation, major repairs, or during cold starts. When verification of governor control and overspeed trip system is necessary and imperative. However on hot / warm starts open T&T slowly until governor takes control, then T&T may be fully opened.

NOTE

The governor and overspeed trip system are configured for a fail-safe setting. If the turbine is not started and the governor does not detect shaft speed from the magnetic speed pickups before the fail-safe time, the governor and overspeed trip system will automatically go to trip condition and shut the turbine down by closing the inlet governor valves and tripping the T&T Valve.

NOTE

Thick turbine casing walls to resist pressure heat & cool slowly.
Sudden admission of high temperature steam to a cold turbine causes high thermal stresses. Moderated steam for the initial stage of cold start-up is recommended.

31. Just before the rotor is turning at low idle speed of approximately 1000 rpm (or just confirm not zero speed), admit medium pressure steam to the turbine gland seals using the Automatic Sealing Steam and Leakoff System. In case of turbine with turning gear unit, seal steam may be admitted during train turning. Refer to the Automatic Sealing Steam and Leakoff System section in this chapter for further information.

32. Maintain sufficient vacuum to prevent blowing excessive steam from the shaft packing.

NOTE

It will require a coordinated effort to initially adjust the sealing steam valves, keeping in mind that it is better to *blow out a slight amount of steam rather than draw in* cold air along the shaft during the transition period.

CAUTION

Do not permit excessive steam vapor venting from the packing cases as this may allow water to enter the bearing cases and form sludge.

33. During any low speed operation, and until the machine comes under governor control, monitor the unit's speed closely.

-WARNING-

DO NOT LEAVE A RUNNING TURBINE UNATTENDED DURING THE START-UP PHASE.

34. Carefully observe the turbine operation as the speed is slowly increased, listening for sounds which may indicate rubs or other distress. If any difficulty is encountered, immediately shutdown the turbine, diagnose and correct the problem.

CAUTION

Sealing steam to the shaft packing must be shut off and the vacuum broken if the turbine rotor is stopped for even a very short time.

35. Initially, the steam will condense on the cold metal surfaces. This condensate should be drained from the turbine casing. Due to the small amount of steam necessary to run the turbine in the uncoupled condition, warm up time may be limited to where the steam no longer condenses and blows dry from the drains.

NOTE

Open all casing drains to verify that no water has accumulated in the system. Then close the drains.

36. Confirm that the trip mechanisms are operating properly. Close the throttle valve and reset the trip latch. Re-open the throttle valve to keep the rotor turning over slowly. Do not allow the rotor to come to rest after it has once started rolling unless there are signs of something wrong.

37. Run at approximately 1000 rpm, controlling speed by the T&T Valve, to obtain an even temperature distribution in the casing and rotor.

38. Listen for any unusual noises and feel all bearing pedestals, oil lines, etc. for any signs of abnormal heating or vibration. If undue heating, vibration, or noises are detected, slow down until it disappears. Should the disturbance persist, shut down, locate and correct the cause before attempting to start again. Heating of the bearings may be caused by insufficient clearances or lack of oil. Vibration may be due to improper shaft alignment, a bowed shaft, etc.

Disregard of the temperature equalizing run may result in a permanently bent shaft which can only be straightened by a complicated and expensive process or may cause damage to the rotor and other parts. By extending the running period at approximately 1000 rpm, a bow that is not sufficient to cause a rub will ordinarily straightened out.

39. Check all panel readings; vibration, pressures, temperatures, etc., and monitor for any abnormalities.

CAUTION

Not performing the temperature equalizing run may result in a permanently bent shaft that can only be straightened by a complicated and expensive process or may cause damage to the rotor and stationary parts. By extending the running period at 1000 rpm, a bow that is not sufficient to cause a rub will ordinarily straighten out.

40. If the turbine shows any signs of distress, use the T&T Valve to slow down and fully open the governor valve. Continue the temperature equalization run for a short time and try again. Repeat this procedure as necessary until operation is satisfactory.

41. Operate at approximately 305 to 406 mm Hg vacuum exhaust pressure until the exhaust steam temperature reaches approximately 60° to 66°C, then establish the design vacuum. A readjustment of the sealing steam and leakoff system may be required at this time.

CAUTION

Proceed with the remaining steps without delay to prevent high exhaust steam temperatures. Except for short periods of time, exhaust steam temperatures should not exceed121°C. Reduce the steam supply temperature if necessary. Do not exceed the condenser temperature limitations. ~~This turbine has water spray nozzles to cool down exhaust casing. Confirm that exhaust water spray will act not to get 120 degC exhaust temperature.~~

42. While checking the operation at 1000 rpm, operation of the turbine should be carefully observed for unusual noises, excessive vibration, or high bearing metal temperatures.

NOTE

Open all positive pressure casing drains to verify that no water has accumulated in the system. Then close the drains.

43. When the turbine is uniformly warmed up and low idle speed operation at 1000 rpm is satisfactory, open T&T valve gradually to bring the turbine speed at next idle speed of 2500 rpm which is below the critical speed band. If the turbine shows any signs of distress slow down and continue the temperature equalizing run for a short time and try again repeating the procedure, if necessary, until operation is satisfactory.

44. Once turbine operation at 2500rpm is satisfactory, the turbine is ready to be brought up in speed through the critical speed range of 3500 rpm to 5200 rpm. First critical speed of the each machine is shown below.

SRV-5DF	3997 rpm (tested)
25MB5	4721 rpm (tested)

45. To continue warm up open the T&T valve to allow the turbine to accelerate through the critical speed band of 3500 – 5200 rpm.

NOTE

Critical speeds are dependent on numerous variables. The actual critical speed and critical speed ranges may deviate slightly from the above numbers due to the actual installation. Adjustments in operating speed and critical speed range should be made accordingly based on operating expense.

46. When turbine operation at 5200rpm is satisfactory, open T&T valve gradually to bring
the turbine speed at next idle speed of 5500 rpm.

47. Open the T & T valve to allow the turbine speed to get to the rated speed 7218 rpm which is the minimum governor speed in this application.

NOTE

Should the need arise for the turbine speed to be halted for prolonged periods of time during the start-up sequence between idle and maximum continuous speed, Ebara Corporation recommends that the T&T valve be throttled back until the inlet governor valves are 100% open as indicated by the actuator. Once acceleration to normal operating speed can be reattempted, the T&T valve can be opened and the inlet governor valve will close and control speed. The speed acceleration sequence can then be restarted.

The advantage of throttling back on the T&T valve is that thermal gradients will be minimized by utilizing the full nozzle flow area.

48. Follow the step of "Cold start curve normal" shown in this chapter to get the minimum speed. Once the minimum governor speed is reached the start sequence is complete.

49. Check all operating conditions. If they are satisfactory, the turbine may be brought up in speed to the maximum governor speed of 10828 rpm.

50. Open the T&T valve only enough to check and verify governor control operation.

NOTE

To stabilize the turbine if the turbine speed at minimum governor speed of 7218 rpm, refer to the governor instruction manual.

51. After stabilization of the turbine speed if necessary, raise or lower the speed of the turbine in the governor operating speed range (Minimum and Maximum governor).

52. While checking the operation of the governor, operation of the unit should be carefully observed for unusual noises, excessive vibration, or high bearing metal temperatures.

53. Raise the turbine speed to the maximum governor speed of 10828 rpm if necessary.

TURBINE OVERSPEED TESTS

NOTE

Overspeed testing must be performed for initial installation, anytime work is done to the mechanical trip or governor, when the unit is restarted after a long shutdown or at the recommended period.

To Perform The Governor Overspeed Trip Test:

1. Ensure that all other control functions are disabled and the turbine is in Speed Control Priority.

2. Set the governor for the overspeed trip test enable mode. (Refer to the governor instruction manual for the detail manipulation procedure of the governor and overspeed trip system)

3. Raise the turbine speed until electrical overspeed trip set value of 11911 rpm. Once the speed reaches the Electrical Overspeed set point of 11911 rpm the overspeed trip system will trip the turbine.

4. Because the T & T circuit is designed to receive a trip output from overspeed trip system, close, relatch and open the T & T Valve.

NOTE

If the turbine speed is above maximum governor speed, the Speed Reference will not go above Maximum Governor Speed in trying to match the decelerating turbine speed. It will start at the maximum governor speed.

CAUTION

T&T Valve must be manually closed immediately after turbine is shutdown by loss of pressure in oil circuit.
Operator must confirm that T&T valve fully is close position before turbine re-start.

5. Repeat steps 1 through 4 to verify the overspeed Trip setting. It is recommended that at least three (3) runs be conducted to verify the Overspeed Trip setting.

NOTE

Disable the overspeed trip test at any time will cause the speed set point to ramp down the speed set point to the maximum controllable set. As for detail, refer to the governor instruction manual.

CAUTION

Do not operate the turbine more than 2% above the rated trip speed listed on the turbine nameplate.

NOTE

Verified tripped speed at the display of each of the governor and overspeed trip system.

-WARNING-

DO NOT OPERATE THE TURBINE STRING UNLESS IT IS KNOWN FOR A POSITIVE FACT THAT THE OVERSPEED MECHANISMS ARE IN PROPER WORKING CONDITION.

After the overspeed trip system, allow the speed to drop a little below normal, reset the trip & throttle valve, and bring the turbine up to normal speed.

NOTE

The T&T Valve should be backed off one-half turn in the closing direction from its wide open position to avoid binding.

Operate the turbine for approximately one hour at the maximum continuous speed of 10828 rpm. Check the bearing temperatures and turbine speed. Listen for unusual noises, vibration or rubbing. After this period, the turbine can be shut down and coupled to the driven machine.

NOTE

Check all reading of instruments and function of control of turbine system with the data shown in the instrument data sheet.

COUPLED RUN

Check all operating conditions and if satisfactory, the turbine is now in condition to be coupled with the driven machine(s) and to take the load. (Refer to the instructions applying to the driven machine(s) for loading.)
In addition to the turbine operating procedures outlined in the Turbine Uncoupled Run section of this Chapter, these additional precautions should be observed:

1. Start the Separation Seal Buffer Gas flowing into the compressor seals before supplying oil to the bearings. This will prevent oil from migrating in the gas seal cartridge from the bearing housing. Refer to the compressor instruction manual and oil system instruction manual for further details.

2. Using the Automatic Buffer System of the compressor(s) (Refer to the compressor instruction manual)

3. Verify that the permissive start, alarm, and trip instruments, not only for the turbine but also for the driven machine(s) are functional.

4. Follow the general operating procedure described in the Turbine Uncoupled Run section. Particular attention must be paid to all coupled driven machine(s) system.

NOTE

It is equally important to conduct the temperature equalization run for the turbine in the event the coupled run is delayed and this is a cold start.

5. Make speed changes gradually, monitoring the operation and condition of all units closely for any sign of distress. Follow the Turbine Start-Up Curve for the timing and duration of the speed changes.

6. Check the bearing oil discharge temperatures to verify that they are not excessive.

7. Allow the turbine to remain at minimum speed of 7218 rpm as recommended by the Turbine Start-Up Curve to heat soak the casing.

8. Check the turbine and driven machine(s) operating conditions to verify that all operating conditions are satisfactory by checking all reading of instruments and function of control of the turbine system and the driven equipment system with the data shown in the instrument data sheet.

NOTE

During a cold start, driven machine(s) load changes should be done in gradual steps to aid in minimizing turbine and driven machine(s) thermal gradients. Also, depending on the response of the steam supply system, extreme load changes may result in system pressure transients. By making gradual load changes, these transients will be minimized and the steam supply system will be able to maintain firing rates and steam pressures.

-WARNING-

DO NOT LEAVE A RUNNING TURBINE AND DRIVEN MACHINE(S) UNATTENDED WHEN IN THE INITIAL START-UP.

9. When operating conditions have been reached and there is no unexpected vibration exist, a hot alignment check should be conducted. Any necessary adjustments should be made, and the compressor and driver doweled into position.

NOTE

Step 9 is for the initial start-up and coupled run immediately after installation.

NOTE

The remote speed set control can be enabled after confirmation of couple run is satisfactory. (Refer to the panel instruction manual)

STABILIZATION OF TURBINE SPEED

To stabilize the turbine speed, refer to governor instruction manual.

HOT ALIGNMENT CHECK

A final alignment check should be made if there is any unexpected vibration exist during coupled running.

To recheck the alignment; proceed as described under Shaft Alignment in Chapter 2. Adjust alignment as required.

When hot alignment is satisfactory, the compressor and driver should be doweled as indicated on the certified outline drawing.

VIBRATION LEVELS

Designed maximum allowable unfiltered peak to peak vibration level excluding run-out * is 25 microns at machine

To determine alarm and trip limits: add 51 microns (2 mils) to the above reading for alarm and 77 microns (3 mils) for trip. (Refer to Instrument Data Sheet)

NOTE

Shaft limits are based on a reading on the shaft adjacent to a bearing and apply in the operating speed range only.

? Shafts may contain mechanical and/or electrical runout to 6.35 microns (0.25 mils). Readings must be adjusted accordingly.

During plant start-up, when frequent upsets and surging can occur, it may be necessary to exceed these limits by 25.4 to 50.8 microns (1 to 2 mils) for short periods of time. On occasion, it may be desirable to set limits that differ from the suggested settings because of past operating experience, company policy, etc.

-WARNING-

DO NOT LEAVE A RUNNING TURBINE AND/OR COMPRESSOR UNATTENDED DURING THE START-UP PHASE.

START-UP PROCEDURE – HOT / WARM (After a Shutdown Period of Less Than 1 Hours)

The main consideration on a warm start is to prevent the quenching of the hot casing metal. This can be accomplished by insuring that the steam is at least 38°C (100°F) hotter than the metal temperature. The heat leaves the casing very slowly and the rotor retains its heat the longest.

If the shutdown has been for 1 hours or less, the time from start-up to minimum governor speed can be reduced considerably. The total elapsed time could be reduced to approximately 1/2 hour in some case. (This period depends on the shutdown period.) However, no liberties should be taken in observing for abnormalities.

CAUTION

It is extremely important that the equipment be closely monitored for abnormalities during this phase of operation. Ebara Corporation strongly emphasizes that close attention be paid to vibration on a re-start. The first indication of a temporary rotor bow is usually abnormally high vibration at reduced speeds. If high vibration levels are noted, the equipment should be operated at reduced speed until the vibration levels return to normal. If this early warning is ignored, and if the equipment speed is increased, there is a very good possibility that the machine will develop a permanent rotor bow. It is therefore advisable that attention be paid to the relationship of the immediate vibration level to the speed of the unit, as well as how the vibration compares to historical levels at the same period.

In all warm-ups, regardless of the time taken to reach minimum governor speed, it is recommended that a minimum soaking period of 1/2 hour be allowed after switching to governor control.

The same basic step-by-step procedure for starting, as recommended in the Coupled Run section, may be used for a warm start.

ROUTINE OPERATION

1. Under normal operating conditions, it is desirable to make load changes as gradual as possible to permit normal casing temperature redistribution.

2. Observe all turbine, driven machine(s) and lubrication oil supply system pressures and temperatures, vibration and axial position readings, and Dry Gas Seal system conditions.

3. Record these levels at least twice every eight hours.

4. Note and record all operating conditions. Should any abnormal operating conditions occur, take appropriate corrective action.

5. Observe the general operation of the equipment for steam, oil or water leaks.

6. Once a week, exercise the T&T Valve to insure it is operative. Refer to the T&T Valve instruction manual.

CAUTION

Allowable variations from rated inlet pressures and temperatures are not to be exceeded as indicated by the guidelines set forth by NEMA shown in the Limitations, Warranty & Safety section of this instruction book.

CAUTION

Condensing turbine has exhaust flow limitation at a lower exhaust pressure than specified value in the data sheet. Condensing turbine should be operated within "Design operating region" with some allowance shown in the performance curve. In the not permitted region, the flow will not smoothly expand resulting in fluctuating rotating blade flutter.

UNIT SHUTDOWN (NOTES AND DESCRIPTION)

NOTE

There are two modes of using the Governor Shut Down. They are:

1. Normal Stop (Controlled Shutdown)
2. Trip Command (for Emergency Shut Down)

Normal Stop Procedure (Controlled Shut Down)

Shutting down the unit may require special precaution, depending upon the particular application. The following general precautions apply to all installations.

1. Reduce the driven machine(s) load.

Gradually reduce the load to zero (if possible) by reducing the speed to the minimum speed of 7218 rpm.

2. Press the "Stop" key. This will eventually close the Governor Valve and the T & T Valve.

3. Monitor the vibration levels, particularly when approaching the unit critical speeds. In the event that severe vibration is encountered when approaching the critical speed, decelerate as quickly as possible.

4. Shut down the gland condenser leakoff system before rotor comes to a stop.

5. Open the turbine casing drains once unit is entirely blocked-in. Be sure that no steam can enter the turbine from any source when idle.

CLOSE THE STOP VALVE IN THE HEADER BETWEEN THE T&T VALVE AND THE BOILERS.

After the unit has completely stopped, continue to operate the turning gear and the oil pump for several hours (minimum 10 hours) to prevent rotor warpage and overheating of bearings from a hot rotor. Continue to circulate water through the oil coolers to maintain bearing metal temperatures below 93°C (200°F).

1. Shut the compressor suction and discharge valve (if provided).

2. Open the compressor drains and drain off any liquid. (Refer to the compressor instruction manual)

3. If the unit is to be taken out of service for an extended period; follow the storage instructions in Chapter 1, General Information.

Emergency Shut Down (Trip Command)

Send the "Trip" command to ESD System.

OPERATING CHECKS

Continuous and satisfactory unit operation is dependent upon a well organized and executed preventive maintenance program. The purpose of preventive maintenance is to eliminate or confine destructive forces that cause component damage and eventual breakdown.

With proper operation and under normal conditions, the unit should require a minimum of operator attention.

Systematic preventive maintenance and inspection schedules should be set up and are desirable to insure continuous operation without excessive shutdown and repairs. The following is suggested as a guide to be used in setting these schedules:

Daily (With Unit Running):

1. Inspect for oil, water, steam and gas (if the driven machine(s) be gas compressor) leakage. If leaks cannot be corrected during operation, plan to correct at next shutdown. If sizable leaks occur, shut down the unit and correct.

2. Listen for unusual noises or rubbing. Be alert for unusual or increasing vibration levels. If noticed, shut down the unit and correct.

3. Check the oil level in the reservoir(s). If low, determine the reason for the low level and add the required amount of clean oil.

4. Observe the operation of the complete oil system:

   a. Inspect thermometers and pressure gauges for cleanliness of faces, possible breakage, and proper operation.

   b. Bearing and control oil supply pressure should be at the design value.

   c. Oil leaving the oil cooler (Bearing Supply) should be maintained at 43° to 49°C.

   d. Bearing oil discharge temperatures should normally be 60° to 79°C, but should never exceed 82°C.

   e. Bearing oil temperature rise should not be permitted to exceed 28°C.

   f. Maximum bearing metal temperature must never exceed 132°C.

   g. If oil sight flow glasses are installed, check them for cleanliness and observe oil flow and condition.

   h. If an oil filter or strainer is installed, check for excessive pressure drop. Shift and clean oil filter or strainer as necessary.

5. Maintain an accurate log of the operating and mechanical conditions recorded at regular intervals. This log will be helpful in determining when it is necessary to shut down the unit for inspection and repairs and what areas require special attention.

AUTOMATIC SEALING STEAM AND LEAKOFF SYSTEM
Refer to P & I Diagram

The automatic sealing steam and leakoff system has been designed for sealing of the condensing section of the turbine from air ingestion and to eliminate leakage of steam along the shaft ends. The system incorporates two control valves for automatic operation of the system after load has been reached.

CAUTION
Never operate seal / leak system while rotor is at a stand still. Rotor must be turning before system is operated, otherwise shaft may bow.

Prior to start-up, the block valves in the external sealing steam supply and steam supply to the gland leakoff system ejector should be closed. All other block valves should be closed.

Drain the sealing steam and ejector steam lines of all condensate.

After the unit has started rolling (50-100 rpm) open the external Sealing Steam Supply Valve and set the Sealing Steam Pressure Control Valve, to maintain 0.21 Barg (0.21 kg/cm^2G) sealing steam pressure.

Commission the turbine main condenser and vacuum system.

Commission the Gland Condenser, and Ejector, system by opening the ejector steam supply block valve and cooling water valves to the gland condenser. Maintain -0.034

Barg (-0.035 kg/cm^{2}G) leakoff pressure using the air bleed valve in the ejector suction line or by throttling the ejector steam supply.

As the unit is loaded and first stage pressure builds, the Sealing Steam Control Valve, will close and the exhaust end packing will be supplied with sealing steam from the steam end of the turbine. The Sealing Steam Bypass Control Valve should be set to maintain 0.34 Barg (0.35 kg/cm^{2}G) full-load sealing steam pressure on steam end sealing steam line.

As the unit is coasting down, the sealing steam and leakoff regulators should control and maintain proper pressures. At shutdown, valves are to be shut off and gland condenser ejector shut down before unit comes to rest.

CAUTION

It is important that when rotor is stopped the sealing steam be shut off; if not, rotor may bow.

When rotor is hot and not rotating, main condenser vacuum system and gland condenser ejector system must be shut off to eliminate air being drawn along the shaft, which can cause rotor bowing.

The gland condenser water leg must be sealed to prevent air leakage into the system through the drain.

NOTE

As the turbine sealing steam and gland leakoff system apparatus is sized for 300 percent of normal requirement (API 612 criteria), the apparatus is considerably oversized for turbines in good operating condition. Steam and water supply lines should include manual throttle capabilities to allow for flexibility in actual operation. Particular care should be taken to ensure the water seal on the gland condenser is maintained since the ejector, if operated unthrottled, may produce sufficient vacuum in the gland condenser to break the water seal.

TURNING GEAR OPERATION

CAUTION
Turbine lube system must be on and oil pressure established before the Turning Gear is operated.

The primary purpose of the Turning Gear is to minimize temporary thermal bowing of the rotor. Eliminating the potential of a thermal bow is of more importance when the unit is to be restarted after a short amount of down time. If the unit is shutdown and not placed on Turning Gear, there is a higher risk that a temporary thermal bow may occur, resulting in extended start-up time requirements beyond that specified for a cold turbine start. Plant operators must be capable of operating the turbine properly to work out a temporary thermal bow without causing damage to the turbine from seal rubs, etc.

The recommended operating time on the Turning Gear for a controlled shutdown is a minimum of 10 hours. Longer or shorter periods are acceptable provided the following guidelines are followed. Cooling water should be supplied to the oil cooler during the time he turning gear is engaged. Oil temperature to be 27 degC (80 degF).

1 hour operation prior to start-up is recommended. This will reduce rotor bowing caused by its weight.

If the driven machine is the compressor with the dry gas seal system, operator should understand that turning period reduce life of the dry gas seal contact surface. Do not operate turning gear unnecessarily. (Refer to compressor instruction manual)

Due to the slow cooling rate of the casing and rotor (the rotor retains its heat the longest), the oil pump and coolers should be left on when the unit is removed from the Turning Gear. This minimizes the potential of journal bearing damage due to the bearing contacting a hot rotor.

The primary concern when removing the unit from Turning Gear operation and shutting off the oil is that the rotor may still be hot. This heat will be conducted along the shaft to the journals and bearings. When shutting off the oil, monitor the journal bearing metal temperatures. If the bearing metal temperature is less than 93°C and remains less than 200°F for the next hour, then the oil pump may be kept shut down. If bearing metal temperatures increase to 93°C or greater, continue oil pump operation until the bearing metal temperatures remain less than 93°C with the oil pump shut down.

The Turning Gear assembly is automatically disengaged and the turbine rotate at approximately 30 RPM. To engage the gear, unlatch and pull handle out. If gear fails to mesh use "jog" (inching) button to advance the gears to position of meshing. When gears are meshed and fully engaged the micro-switch turns on the indicating light that the gear are fully engaged, and the turning gear is ready for start-up. The turning gear motor may then be started by pressing the "START" button on the panel. When turbine speed exceeds turning gear speed, gear will automatically disengage and shut off motor.

CAUTION

Always check to ensure that the Turning Gear has disengaged on start up and the motor has shut down. Conversely on shut down, always check to see that the Turning Gear motor has started and the turbine string is operating on the Turning Gear.

Caution

Do not attempt to engage turning gear until turbine rotor stop has come to a complete stop.

Note

Turbine lube system must be on and oil pressure established before turning gear will operate.

For additional descriptive information on the Turning Gear, refer to the turning gear unit manual contained in Chapter 6, Accessories.

NOTES

TABLE 3-1

TURBINE OPERATING DATA

SERIAL NUMBER/SHOP ORDER NUMBER R021570803

ITEM CT-9901

FRAME: SRV-5DF

SPEED:

Rated	10312 rpm
Maximum Continuous	10828 rpm
Governor Overspeed Trip	12019 rpm
ProTech 203 Overspeed Trip	11911 rpm
Mechanical Overspeed Trip	N/A rpm
1st Critical (Test)	3997 rpm
2nd Critical (Calculated)	18000 rpm

RATED POWER: 5300 kW

GOVERNOR: Woodward 505
Speed Range 7218 rpm to 10828 rpm

STEAM CONDITIONS:

	NORMAL CONDITIONS
Inlet Pressure	38 kgf/cm2G
Inlet Temperature	390 °C
Extraction Pressure	N/A kgf/cm2G
Extraction Temperature	N/A °C
Exhaust Pressure	81 mmHgA

	CONSTRUCTION RATING
Inlet Pressure	45.1 kgf/cm2G
Inlet Temperature	468 °C
Extraction Pressure	N/A kgf/cm2G
Extraction Temperature	N/A °C
Exhaust Pressure	1 kgf/cm2G

SEALING STEAM CONDITIONS

11.2 kg/cm2G @ 230°C)

NOTES

Cold Start Curve Normal

Tupras Izmir Refinery DHP Project Recycle Gas Driver

R021570803 SRV-5DF

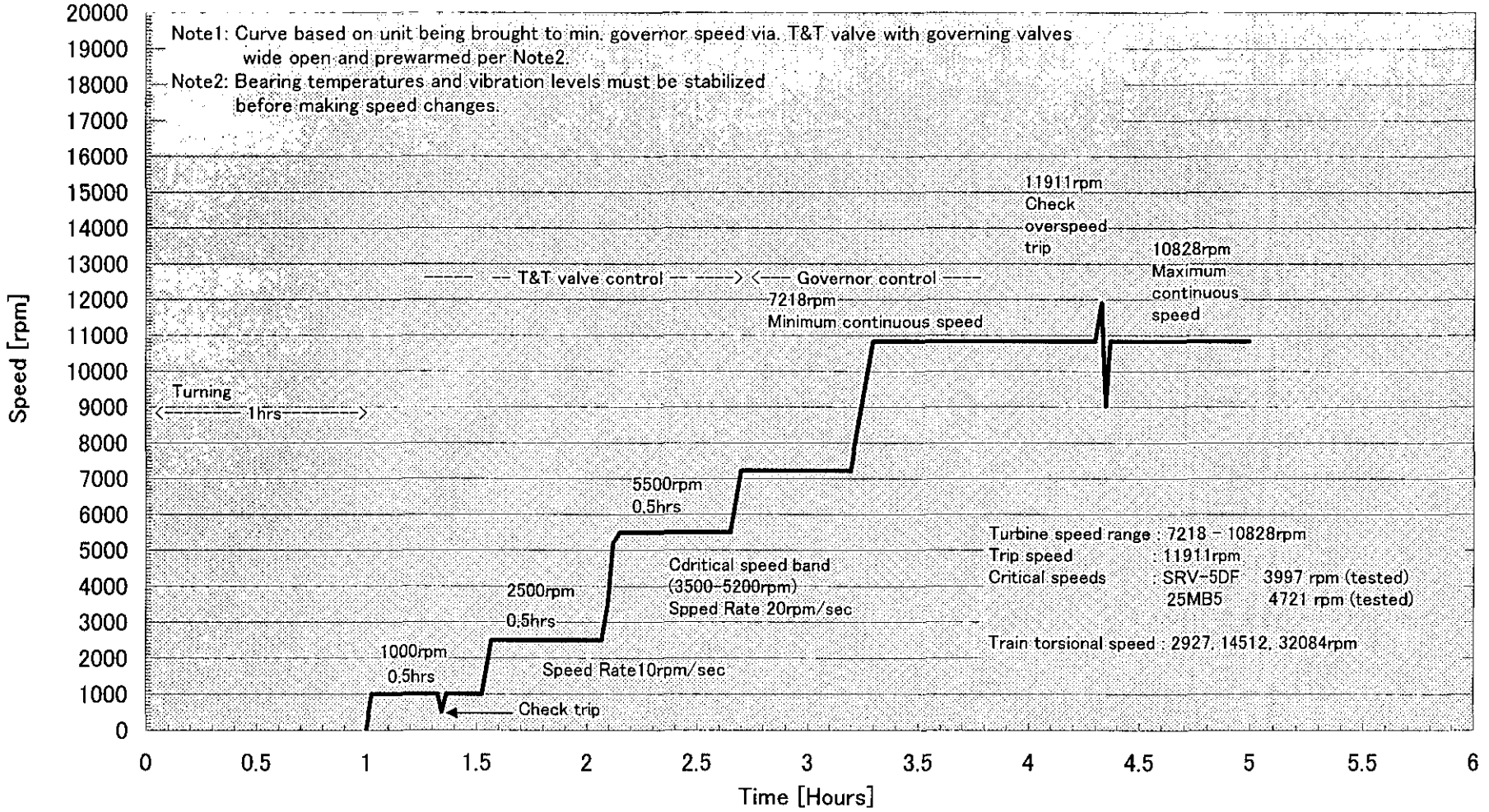


Fig 3-1

3-33

TITLE	Main Turbine Data Sheet	DOC. No.	LGTPR-813-1040 V-9900-4-CT9901-010	REV.	2

CUSTOMER	LG Engineering & Construction Corp.	COMPLETE IN WITH COVER	/ /	SHEETS
FINAL USER	Turkish Petroleum Refineries Corp.			
PROJECT	Tupras Izmir Refinery DHP Project	SERVICE	Recycle Compressor	
JOB No.	7020	EBARA SER. No.	R0215708	
ITEM No.	CT-9901	MODEL/ EQUIP.	25MB5/SRV-5DF	SET 1

FIG 3-2

LG E&C LG ENGINEERING & CONSTRUCTION CORP.	TUPRAS TUPRAS IZMIR REFINERY DIESEL/KEROSENE HYDROPROCESSING PROJECT	JOB NO.:7020	UNIT : N/A
		REQ'N NO.:7020-RQ-C-001	SH/OF
		CONTRACTOR SPEC NO.: V-9900- 4 -CT9901- 010 - 2	1 / 11
		REV 0 1 2	

TO	SET	TO	SET
CUST-	R		
OMER	10 C	281-1	
813	1	811-1	
813E	1	811-2	
821-1		811-3	
821-2	1		
821-4	1		
819			
816-1			
816-2		4	
812-1	1	3	
812-2	1	2	
850		1	

☒ FOR APPROVAL

AVOID DELAY
TO MAINTAIN SHIPPING PROMISE.
ONE APPROVED PRINT MUST BE RETURNED BY: OCT-29-'03

BY: MM DATE: OCT-15-'03

☐ FOR RECORD

ANY REQUESTED CHANGE OF THIS EQUIPMENT WILL RESULT IN:
1.CONTRACT PRICE ADJUSTMENT
2.EXTENDED SHIPPING PROMISE AS THIS CONTRACT IS IN MANUFACTURING PROCESS.

BY: DATE:

ISSUED BY

REV.	PAGE	DATE	APP'D	BY
1	ALL	OCT-15-'03	MMalan	
1	ALL	SEP-17-03	MMalan	

APPROVED BY MMalan NOV-30-02
CHECKED BY
PREPARED BY MM

ELLIOTT EBARA GROUP

PJT NO.	7020
ITEM NO.	CT-9901

SPECIAL PURPOSE STEAM TURBINE DATA SHEET

(API TYPE) PAGE 1 OF 10

PROJECT	TUPRAS IZMIR-DHP PROJECT
CLIENT	TUPRAS
LOCATION	IZMIR, TURKEY
SERVICE	Recycle Gas Compressor
NO. REQ'D	(WORKING 1 STAND-BY TOTAL 1)
PURCHASE ORDER NO.	
INQUIRY NO.	7020-RQ-C-001

DOC. NO.:	7020-MDS-CT-9901T
P&I.D NO.:	

REV.	DATE	PREP'D BY	CHK'D BY	APP'D BY
0	2002-11-20	H.Sasaki		M.Matsubara
1	2003-9-17	H.Sasaki		M.Matsubara
2	2003-10-15	M.Matsubara		M.Matsubara

APPLICABLE TO : ● PROPOSAL ○ PURCHASE ○ AS-BUILT

FOR TUPRAS UNIT

SITE IZMIR, TURKEY SERIAL NO. R021570803

SERVICE RECYCLE GAS COMPRESSOR NO REQUIRED 1 (One)

MANUFACTURER EBARA Corporation (Japan) MODEL SRV-50F DRIVEN EQUIP.ITEM NO. CT-9901

DRIVEN EQUIPMENT TYPE : ● COMPRESSOR ○ GENERATOR ○ OTHER

NOTE : INFORMATION TO BE COMPLETED BY : ○ PURCHASER ☐ MANUFACTURER ☑ PURCHASER OR MANUFACTURER

PERFORMANCE

OPERATING POINTS	SHAFT		INLET			INDUCT./EXTRACT.			EXHAUST		
☑ AS APPL.	POWER	SPEED	FLOW	PRESS	TEMP	FLOW	PRESS	TEMP	PRESS	TEMP	ENTHALPY
	kW	RPM	kg/hr	kg/cm2 G	deg-C	kg/hr	kg/cm2 G	deg-C	kg/cm2 G	deg-C	kJ/kg
RATED(1.4.27)	5300	9591	24820	38	390	-	-	-	81 mmHgA	47	2408
NORMAL(1.4.22)	4818	9591	22750	38	390	-	-	-	81 mmHgA	47	2413
MINIMUM(1.4.11)	1081	8026	6850	38	390	-	-	-	81 mmHgA	47	2586
RATED @ min steam	5300	9591	26280	36.5	350	-	-	-	81 mmHgA	47	2359

☐ STEAM RATE, kg/kW-hr (1.4.34) NORMAL 4.722 RATED 4.683 INDUCTION ○ CONTROLLED ○ UNCONTROLLED

☐ INDUCTION FLOW, kg/hr MINIMUM MAXIMUM

☐ EXTRACTION FLOW, kg/hr MINIMUM MAXIMUM EXTRACTION ○ CONTROLLED ○ UNCONTROLLED

STEAM CONDITIONS

○ INLET

NORMAL	38 kg/cm2 G	390 deg-C
MAXIMUM	41 kg/cm2 G	440 deg-C
MINIMUM	36.5 kg/cm2 G	350 deg-C

○ EXTRACTION

NORMAL	kg/cm2 G	deg-C
MAXIMUM	kg/cm2 G	deg-C
MINIMUM	kg/cm2 G	deg-C

○ EXHAUST

NORMAL	81 mmHg A	47 deg-C
MAXIMUM	mmHg A	deg-C
MINIMUM	mmHg A	deg-C

○ INDUCTION

NORMAL	kg/cm2 G	deg-C
MAXIMUM	kg/cm2 G	deg-C
MINIMUM	kg/cm2 G	deg-C

SITE AND UTILITY DATA

LOCATION :

○ INDOOR ○ HEATED ● UNDER ROOF ● OUTDOOR

● UNHEATED ○ PARTIAL SIDES ● GRADE ○ MEZZANINE

○ _____

○ WINTERIZATION REQD. ● TROPICALIZATION REQD.

○ LOW TEMPERATURE ○ CORROSIVE AGENTS

○ ELECT. AREA CLASSIFICATION : CL - GR IIC DIV Zone2

SITE DATA :

○ ELEVATION 20 m ○ BAR 1.03 kg/cm2 A

○ WINTER TEMP. -7 deg-C SUMMER TEMP 38 deg-C

○ REL.HUMIDITY % DESIGN WET BULB deg-C

○ UNUSUAL CONDITIONS : ○ DUST ○ FUMES

● OTHER Corrosive, Salt laden, Marine atmosphere with industrial pollution

UTILITY CONDITIONS :

○ AUXILIARY STEAM :	MAX	NORM	MIN
INIT. PRESSURE kg/cm2 G			
INITIAL TEMP. (deg-C)			
EXH PRESS kg/cm2 G			

INST. AIR kg/cm2 G : NOR. MIN MAX

INST. AIR DEW POINT : deg-C

○ ELECTRIC :	DRIVERS	HEATING	INST./ CONTROL	ALARM/ SHUTDOWN
VOLTS				
PHASE				
HERTZ				
KW AVAIL				

○ COOLING WATER :

TEMP. INLET : 30 deg-C MAX RETURN 42 deg-C

PRESS. NORM : 3 kg/cm2 G DESIGN : 9 / 120 kg/cm2 G / °C

MAX. RETURN PRESS. : 2 kg/cm2 G

MAX. ALLOWABLE PRE: 1 kg/cm2 G

WATER SOURCE : COOLING TOWER

VELOCITY, m/s : MIN MAX

FOULING FACTOR : 0.0004 m2 hr °C/kcal

○ UTILITY CONSUMPTION :

COOLING WATER : m^3/hr INST. AIR m^3/hr

AUX. STM : NORMAL kg/hr MAX. kg/hr

AUX. DRIVERS : ELEC. kW STEAM kW

HEATER(S) : kW OTHER :

REMARKS : 1. Mechanical Design should be 45.1 kg/cm2g, 468 °C.

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APPLICABLE SPECIFICATIONS :

API 612, SPECIAL PURPOSE STEAM TURBINES

● OTHER : UOP Standard Specification 5-16

○ VENDOR HAVING UNIT RESPONSIBILITY :

● GOVERNING SPECIFICATION, IF DIFFERENT :

To be referred to LGENC and

LGENC's approved solution shall be applied.

NOISE SPECIFICATIONS :

○ APPLICABLE TO MACHINE :

SEE SPECIFICATION :

○ APPLICABLE TO NEIGHBORHOOD :

SEE SPECIFICATION :

ACOUSTICAL TREATMENT ○ YES ● NO

CONSTRUCTION FEATURES

TURBINE TYPE ○ BACK PRESSURE ● CONDENSING ○ OTHER

■ SPEEDS :

MAX CONT. 10828 RPM TRIP 11911 RPM

MAX ALLOW. 12776 RPM

■ LATERAL CRITICAL SPEEDS(DAMPED) (Preliminary)

FIRST CRITICAL	4200 - 4700 RPM	Bending MODE
SECOND CRITICAL	18000 RPM	Bending MODE
THIRD CRITICAL	RPM	MODE
FOURTH CRITICAL	RPM	MODE

■ VIBRATION 25 MICRO METER (PEAK TO PEAK)

■ TORSIONAL CRITICAL SPEEDS :

FIRST CRITICAL	2927	RPM
SECOND CRITICAL	14512	RPM
THIRD CRITICAL		RPM
FOURTH CRITICAL		RPM

○ TRAIN LATERAL ANALYSIS REQUIRED

○ UNDAMPED STIFFNESS MAP REQUIRED

○ TRAIN TORSIONAL ANALYSIS REQUIRED

■ CASINGS, NOZZLES & DIAPHRAGMS

■ MAWP(1.4.13)(2.2.3)

INLET SECT. 45.1 kg/cm2 G EXH. SECT. 1 kg/cm2 G

INDUCTION/EXTRACT. SECTION kg/cm2 G

OTHER kg/cm2 G

■ MAX OPERATING TEMPERATURE(1.4.12)(1.4.18)(2.2.2)

INLET SECTION 468 deg-C EXH. SECTION 120 deg-C

INDUCTION/EXTRACT. SECTION deg-C

OTHER deg-C

■ HYDROSTATIC TEST PRESSURE(4.3.2.1)(4.3.2.2)

HP CASING 86 kg/cm2 G MID CASING kg/cm2 G

EXHAUST CASING 1.5 kg/cm2 G OTHER kg/cm2 G

○ WELDED NOZZLE RING(2.3.1) NOZZLE RING 41.7 % ADM

DIAPH. BLADE ATTACH. : ■ INTEGRAL CAST ■ WELDED

❑ OTHER

DIAPHRAGM AXIAL LOCATION : ■ INDIVIDUALLY ❑ STACKED

CASING CONNECTIONS

CONNECTION	○ DESIGN APPROVAL REQD (2.11.3.5.4)	■ SIZE (inch)	■ FACING	○ POSITION	○ FLANGED OR STUDDED (2.4.1)	○ MATING FLG. & GASKET BY VENDOR(2.4.6.4)	❑ MAX STEAM FLOW Kg/hr	❑ MIN STEAM FLOW Kg/hr
INLET		6	ANSI 600# RF	Right Side	Flanged	No		
EXHAUST		42	Special125#, FF	Down	Flanged	by Vendor		
EXTRACTION								
INDUCTION								

PIPE CONNECTIONS ○ TAPERED ○ STRAIGHT

❑ ALLOWABLE FORCES & MOMENTS

	INLET (*)		EXHAUST (**)		EXTRAC/INDUCT	
	FORCE	MOMENT	FORCE	MOMENT	FORCE	MOMENT
	N	N-m	N	N-m	N	N-m
PARALLEL TO SHAFT						
VERTICAL						
HORZ. 90°						

(*) As per NEMA SM 23 x 1.85

(**) As per NEMA SM 23

ROTATION : (VIEWED FROM INLET END)

● CW ○ CCW VIEW → STEAM

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MATERIALS - CASINGS & APPURTENANCES :

- ■ HIGH PRESSURE CASING: ASTM A-217 Gr. WC6
- ■ MID PRESSURE CASING: N.A
- ■ EXHAUST CASING: ASTM A-516 Gr. 60
- ■ STEAM CHEST: ASTM A-217 Gr. WC6
- ■ NOZZLE RING: AISI 410
- ○ STEAM CONTAMINANTS(2.11.1.6): as per NEMA
- ○ STEAM PATH COMPONENTS<RC22(2.11.1.9)
- ○ SPECIAL LOW TEMP MATERIAL REQUIREMENTS(2.11.1.15)
- ■ DIAPHRAGM/BLADE CARRIER A-516 Gr.60 / A-536 Gr. 65-45-12 0
- ■ DIAPHRAGM NOZZLES: AISI 405 / AISI 410
- ❑ OTHER

ROTATING ELEMENTS(2.6)

SHAFT TYPE :

- ■ INTEGRAL WHEELS ❑ BUILT-UP ❑ COMBINATION
- ❑ DOUBLE EXTENDED
- ■ NO. STAGES: 5 BEARING SPAN: 2108 mm
- ■ SHAFT MATERIAL: ASTM A-470 Cl. 4
- ■ SHAFT MATERIAL UNDER SEALS(2.6.2.4) ■ INTEGRAL
- APPLIED BY : ❑ PLATING ❑ SLEEVE ❑ SPRAY
- SPRAY APPLICATION METHOD :
- BLADE(BUCKETS) : ■ MAX TIP SPEED: 400 m/s
- ■ FINAL STG. BLADE LENGTH: 114 mm MAX 114 mm

- ■ SHAFT ENDS : DIA. @ COUPLING: 114.3 mm 0
  - ○ STRAIGHT ● TAPER: 62.5 mm PER m
  - ○ KEYED ○ SINGLE ○ DOUBLE
  - ● HYDRAULIC FIT ○ INTEGRAL FLANGE
- ● FIELD BALANCING RINGS REQUIRED(2.6.1.5)
- ■ NO. 2 ■ LOCATION: 2nd,5th 0

REMARKS :

	STAGE 1	STAGE 2	STAGE 3	STAGE 4	STAGE 5-1	STAGE 5-2	STAGE
■ WHEEL MATERIAL	ASTM A-470 Cl. 4						
■ BLADE MATERIAL	12% Cr	12% Cr	12% Cr	12% Cr	12% Cr	12% Cr	
■ BLADE ROOT TYPE	Pine Tree	Saw Tooth	Saw Tooth	Pine Tree	Pine Tree	Pine Tree	0
■ CLOSURE PIECE TYPE	Piece	Blade	Blade	Piece	Piece	Piece	0
■ TIE WIRE MATERIAL	N.A	N.A	N.A	Inconel	Inconel	Inconel	0
■ SHROUD MATERIAL	12% Cr	12% Cr	12% Cr	N.A	N.A	N.A	
■ SHROUD ATTACH.	N.A	Riveted	Riveted	N.A	N.A	N.A	0
■ PITCH DIAMETER	470	470	495	552	591	591	0
■ BLADE HEIGHT	17	17	41	76	114	114	0
■ BLADE TYPE	Rateau	Rateau	Rateau	Rateau	Rateau	Rateau	
❑							
❑							

SHAFT SEALS (2.7)

	INLET		EXHAUST	
❑ SURFACE SPEED(2.7.2)		m/s		m/s
■ MAX SEAL PRESS(1.4.20)	10.2	kg/cm2 G	1.75	kg/cm2 G
■ STEAM LEAKAGE	36.5	kg/hr	71.6	kg/hr
■ AIR LEAKAGE	30.5	kg/hr	32.5	kg/hr
■ SHAFT DIA @ SEAL	231.8	mm.	231.8	mm.
❑ NO. RINGS PER SEAL				
❑ DIFF. PRESS PER SEAL		kg/cm2		kg/cm2
■ STAT. LABY. TYPE	Stepped		Stepped	
❑ ROT. LABY. TYPE	N.A		N.A	
■ MATERIAL	SS		SS	

END SEALS :

- TYPE : ● LABYRINTH(2.7.1) ○ OTHER
- MATERIAL: SS 1
- 1

INTERSTAGE SEALS : 1

- TYPE : ● LABYRINTH 0
- ○ OTHER
- MATERIAL: Copper Alloy 0
- 0

REMARKS :

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BEARING AND BEARING HOUSING (2.9)

RADIAL (2.9.1)	INLET	EXHAUST
■ TYPE	Tilting Pad	Tilting Pad
■ MANUFACTURER	Daido or Eq.	Daido or Eq.
■ LENGTH	54 mm	54 mm
■ SHAFT DIA	127 mm	127 mm
■ UNIT LOAD (ACT/ALLOW)	7 / 42 kg/cm2	7.8 / 42 kg/cm2
■ BASE MATERIAL	Cr-Cu	Cr-Cu
■ BABBITT THICKNESS	0.4 - 1.0 mm	0.4 - 1.0 mm
■ NO. PADS	5	5
■ LOAD : BTWN/ON PAD	Between	Between
■ PIVOT : CTR/OFFSET, %	CTR	CTR
❑		
❑		

THRUST (2.9.2)

	ACTIVE	INACTIVE	
❑ TYPE	Tilting Pad	Tilting Pad	
❑ MANUFACTURER	Daido or Eq.	Daido or Eq.	0
❑ UNIT LOADING (MAX)	19 kg/cm2	- kg/cm2	0
❑ UNIT LOAD (ULT.)	42 kg/cm2	42 kg/cm2	0
❑ NO. PADS	6	6	
❑ AREA	10774 mm^2	10774 mm^2	
❑ PIVOT : CTR / OFFSET, %	CTR	CTR	
❑ PAD BASE MATL.	Cr-Cu	Cr-Cu	

LUBRICATION : ● FLOODED ○ DIRECTED

THRUST COLLAR : ● INTEGRAL ○ REPLACEABLE

BEARING TEMPERATURE DEVICES :

○ THERMISTORS
- ○ TYPE ____ POS TEMP COEFF ____ NEG TEMP COEFF
- ○ TEMP SWITCH & INDICATOR BY : ____ PURCH ____ MFR

○ THERMOCOUPLES
- ○ SELECTOR SWITCH & INDICATOR BY : ____ PURCH ____ MFR

● RESISTANCE TEMP DETECTORS
- ● RESISTANCE MATL Pt ❑ 100 OHMS
- ○ SELECTOR SWITCH & INDICATOR BY : ____ PURCH ____ MFR

● LOCATION - JOURNAL BRG
- NO. ____ EA. PAD ____ EVERY OTHER PAD 2 PER BRG
- OTHER

● LOCATION - THRUST BRG
- NO. ____ EA. PAD ____ EVERY OTHER PAD 3 PER BRG
- OTHER

NO. (INACT) ____ EA. PAD ____ EVERY OTHER PAD 2 PER BRG

OTHER

○ MONITOR SUPPLIED BY : Vendor
- ○ LOCATION Safety Area ENCLOSURE
- ○ MFR. Bently Nevada ❑ MODEL 3500
- ❑ SCALE RGE 0-200 ALARM ____ ■ SET @ 132 deg - C
- ○ SHTDWN ■ SET @ 138 deg - C ○ DELAY 3 SEC

VIBRATION DETECTORS :
- ○ TYPE Non-contact ❑ MODEL 3300
- ○ MANUFACTURER Bently Nevada
- ○ NO AT EACH SHAFT BRG 2 TOTAL NO 4
- ○ OSCILLATOR-DETECTORS SUPPLIED BY Vendor
  - ○ MFR Bently Nevada ❑ MODEL 3300

MONITOR SUPPLIED BY Vendor
- ○ LOCATION Safety Area ENCLOSURE
- ○ MFR Bently Nevada ❑ MODEL 3500
- ❑ SCALE RGE 0-150 ALARM ■ SET @ 76 micro 0
- ○ SHTDWN ■ SET @ 102 micro ○ DELAY 3 SEC 0

AXIAL POSITION DETECTORS :
- ○ TYPE Non-contact ❑ MODEL 3300
- ○ MFR Bently Nevada ○ NO. REQD 2
- ○ OSCILLATOR-DEMOD. SUPPLIED BY
  - ○ MFR Bently Nevada ❑ MODEL 3300

MONITOR SUPPLIED BY Vendor
- ○ LOCATION Safety Area ENCLOSURE
- ○ MFR Bently Nevada ❑ MODEL 3500
- ❑ SCALE RGE -1,+1 mm ALARM ■ SET @ 387 micro 0
- ○ SHTDWN ■ SET @ 514 micro ○ DELAY 3 SEC 0
- ○ LOAD CELLS, NO. OF PADS 0

LUBRICATION AND CONTROL OIL SYSTEM (2.10)

REFERENCE SPECIFICATIONS : See "Oil System Data Sheets"

FURNISHED BY : ○ TURBINE MFR ❑ OTHERS
- ○ SEPARATE FOR TURBINE ONLY
- ◉ COMMON W/ DRV. EQUIPMENT & INCL (2.10.2)(2.10.5)

TURBINE MFR TO SUPPLY :
- ● CONTROL OIL OR ACCUMULATOR
- ● STAINLESS STEEL OIL SUPPLY HEADING PIPING
- ● OIL DRAIN HEADER PIPING
  - ● STAINLESS STEEL ○ CARBON STEEL
- ● SIGHT FLOW INDICATORS

OIL REQUIREMENTS :	CTRL OIL	LUBE OIL	
■ NORMAL FLOW, m^3/hr	1.8	5.4	0
■ TRANSIENT FLOW, m^3/hr	4.1	5.9	0
■ PRESSURE,kg/cm2 G	7	1	0
■ TEMPERATURE, deg-C	43 - 49	43 - 49	0
■ TOT. HEAT REJ., MJ/hr	-	37238	0
■ OIL TYPE, HC/SYN	Hyd.	Hyd.	0
■ VISCOSITY, SSU@37.8 deg-C	ISO VG32	ISO VG32	0
■ FILTRATION, MICRONS	10	10	0
❑			
❑			

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ACCESSORIES

COUPLINGS AND GUARDS (3.1.2)

NOTE : SEE ROTATING ELEMENTS-SHAFT ENDS

○ SEE ATTACHED API-671 DATA SHEET

COUPLING FURNISHED BY **Vendor**

MANUFACTURER **Eagle Industry** TYPE **Diaphragm** MODEL **100E308**

COUPLING GUARD FURNISHED BY **Vendor**

TYPE ● FULLY ENCLOSED ○ SEMI OPEN ○ OTHER

COUPLING DETAILS

❑ MAX. O.D	317.5	mm
❑ HUB WEIGHT	31.4	kg
❑ SPACER LENGTH	697.8	mm
❑ SPACER WEIGHT	17.3	kg

● VENDOR MOUNT HALF COUPLING

○ IDLING ADAPTER / SOLO MOUNT SIMULATOR REQD (3.1.4)

LUBRICATION REQUIREMENTS

○ GREASE ○ CONT. OIL LUBE ● NONE

QUANTITY PER HUB kg OR m^3/hr

MOUNTING PLATES (3.2)

BASEPLATES FURNISHED BY : **Vendor**

○ UNDER TURBINE ONLY ● OTHER (3.2.2.1) **Comp. & Turbine**

○ OPEN ● NON-SKID DECKING (3.2.2.6)

● DRIP RIM ● LEVELING PADS (3.2.2.2)

○ COLUMN MOUNTING (3.2.2.3) ○ SUB PLATES REQD (3.2.2.5)

○ LEVELING (CHOCK) BLOCKS REQD

FURNISHED BY :

SOLEPLATES FURNISHED BY :

THICKNESS mm

○ SUB PLATES REQUIRED (3.2.3.2)

○ HOLD-DOWN BOLTS FURNISHED BY

○ EPOXY PRIMER VENDOR (3.2.1.2.7)

○ ANCHOR BOLTS FURNISHED BY

GEAR UNIT

FURNISHED BY : ○ REFERENCE API 613 ○ OTHER

SEE DATA SHEETS

CONTROLS AND INSTRUMENTATION (3.4)

INSTRUMENTS AND CONTROL PANELS SHALL BE IN ACCORDANCE WITH THE FOLLOWING ATTACHED DATA SHEETS (3.4.4.1) :

○ API-614 APPENDIX B, PAGES

○ API 670 APPENDIX D, PAGES

○ PURCHASER'S DATA SHEETS

○ ANNUC. PER ISA S 18-1 OPTION

PROTECTIVE DEVICES

PROTECTIVE DEVICES (3.4.2)	EXHAUST RELIEF VALVE (2.2.3)(2.2.4)(3.4.5.7)	EXTRACT./INDUCT. RELIEF VALVE (2.2.3)(2.2.4)(3.4.5.7)	VACUUM BREAKER (3.4.2.5.4)	NON-RETURN VALVE (3.4.2.5.2)	
MOUNTING LOCATION	Condenser				
SET RELIEF PRESS.bar G	< 1				
CAPACITY, kg/hr STEAM					
VALVE MANUFACTURER					
VALVE TYPE	Water Seal				
VALVE SIZE/RATING					
FLANGE FACING	FF				
FURNISHED BY	Vendor				
QUANTITY	One(1)				

REMARKS :

ELLIOTT (EBARA GROUP)

SPECIAL PURPOSE STEAM TURBINE DATA SHEET

JOB NO.	7020	ITEM NO.	CT-9901
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		PREP. BY	H.Sasaki

○ TRIP ● TRIP & THROTTLE VALVE (3.4.2.4)

LOCATION : ● MAIN INLET ○ INDUCTION
PROVIDED BY : ● VENDOR ○ PURCHASER
❑ MANUFACTURER Ebara MODEL
❑ SIZE 6 " RATING 600 # FACING RF
❑ SIZE 6 " RATING 600 # FACING RF
❑ SIZE RATING FACING

CONSTRUCTION FEATURES :

	INLET	INDUCT.
RESET : ● MANUAL ○ HYDRAULIC	V	
TRIP : ● LOCAL(MANUAL) ● REMOTE	V	
EXERCISER : ● LOCAL(MANUAL) ○ REMOTE	V	
○ FULLY OIL OPERATED		

■ STRAINER : 3.2 (mm./MESH) 0
MATERIAL 18 % Cr
○ TEMPORARY START-UP STRAINER (MESH)
MATERIAL
■ STEM MATL 12 % Cr HARDNESS HR15N>38 ~~RC~~ 0
■ SEAT MATL 12 % Cr HARDNESS 35 - 40 RC 0
■ PACKING MATL 12 % Cr LEAK OFF 20 kg/hr 0
■ SPRING SUPPORT OF VALVE REQUIRED
● BY VENDOR ○ BY PURCHASER

CONTROL VALVES :

LOCATION	MAIN INLET	INDUCTION	INDUCTION EXTRACTION	INDUCTION EXTRACTION	NOTES
TRIP POSITION (OPEN/CLOSED)	Closed				
NUMBER OF VALVES	4				0
PROVIDED BY	Ebara				
MANUFACTURER	Ebara				
CONNECTION SIZE	6 "				
RATING	600 #				
FACING (RF, RTJ, OTHER)	RF				
ACTION (CAM, BAR, OTHER)	BAR				
STEM MATERIAL	12 % Cr				
STEM MATERIAL HARDNESS, ~~RC~~	HB 212 - 255				0
SEAT MATERIAL	17-4 PH				
SEAT MATERIAL HARDNESS ~~RC~~	HB >340				0
PACKING MATERIAL	12 % Cr				0
PACKING LEAKOFF, kg/hr	30				0

TURNING GEAR (3.9)

● TURNING GEAR REQUIRED (3.9.1)
● FURNISHED BY Vendor
○ TYPE SPEED 20 RPM
● ENGAGEMENT : ○ AUTO ● MANUAL
○ MFR NIDEC-SIMPO MODEL RXMKR-1500-1AX
○ MOUNTED BY Vendor
○ DRIVER :REF. SPEC :
TYPE : ● ELEC ○ OTHER
○ OPERATOR STATION (3.9.5) ○ LOCAL ○ REMOTE

MISCELLANEOUS

○ START-UP ASSISTANCE (2.1.7) DAYS
○ VENDOR'S REVIEW & COMMENTS ON PURCHASER'S PIPING & FOUNDATION DRAWINGS (2.1.7) 1
○ VENDOR WITNESS INITIAL ALIGNMENT (2.1.7)
○ "Y" TYPE STAINER 1
○ WATER WASHING CONNECTIONS
● STATIC CONDUCTING BRUSHES
○ TARGETS (3.2.2.2) ○ ELVELING PADS
○

INSULATION & JACKETING (3.7)

● BLANKET ○ OTHER
● JACKETING
● CARBON STEEL ○ STAINLESS STEEL
○ EXTENT

SPECIAL TOOLS (3.8)

● COUPLING RING AND PLUG GAUGE
● HYDRAULIC COUPLING MOUNTING / REMOVAL KIT
○ OTHER

ELLIOTT ENERGY GROUP

SPECIAL PURPOSE STEAM TURBINE DATA SHEET

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GOVERNOR (3.4.3)

TYPE ○ MECHANICAL ● ELECTRONIC
● SIMPLEX
○ MULTIPROCESSOR

○ NEMA CLASSIFICATION D
○ MFR Woodword MODEL 505
○ SUPPLIED BY Vendor

STEAM TURBINE TYPE

○ SINGLE VALVE SINGLE STAGE
● MULTI VALVE MULTI STAGE
○ DOUBLE AUTO EXTRACTION
○ DOUBLE AUTO EXTRACTION / INDUCTION
○ SINGLE VALVE MULTI STAGE
○ SINGLE AUTO EXTRACTION
○ SINGLE AUTO EXTRACTION / INDUCTION
○ OTHER

DRIVEN EQUIPMENT TYPE

● CENTRIFUGAL COMPRESSOR
○ SYNCHRONOUS GENERATOR
○ FAN
○ CENTRIFUGAL PUMP
○ INDUCTION GENERATOR
○ OTHER

SERVICE REQUIREMENTS

MECHANICAL DRIVE

● SPEED CONTROL BY
PROCESS PRESSURE

EXTRACTION	○ PRESSURE	○ FLOW
INDUCTION	○ PRESSURE	○ FLOW
TURBINE INLET	○ PRESSURE	○ FLOW
TURBINE EXHAUST	○ PRESSURE	○ FLOW

GENERATOR DRIVE

○ DROOP CONTROL
○ FREQ. CONTROL
○ LOAD CONTROL
○ KW CONTROL
○ KW IMPORT / EXPORT CONTROL
○ LOAD SHEDDING
○ AUTO SYNCHRONIZATION
○ AUTO VOLTAGE REGULATION
○ TURBINE INLET PRESSURE LIMITING
○ INLET PRESSURE LIMITER

MINIMUM INPUT / OUTPUT REQUIREMENTS

See Governor data sheet

DISCRETE INPUTS

○ START OR RESET
○ NORMAL STOP
○ EMERGENCY TRIP
○ RAISE TRIP
○ LOWER SPEED
○ ENABLE / DISABLE REMOTE SPEED SETPOINT
○ RAMP TO MINIMUM CONTINUOUS
○ OVERSPEED TEST ENABLE
○ ENABLE PRESSURE CONTROL
○ ENABLE ALARM CLEAR / ACKNOWLEDGE
○ REMOTE ALARM CLEAR / ACKNOWLEDGE
○ ENABLE AUTO SYNCH.
○ CASCADE RAISE / LOWER
○ OTHER

ANALOG INPUTS (4-20mA)

○ *REMOTE SET POINT*
○ PROCESS PRESSURE

○ EXTRACTION	○ PRESSURE	○ FLOW
○ KW IND. LOAD	○ PRESSURE	○ FLOW

○ KW IMPORT / EXPORT
○ OTHER

DISCRETE OUTPUTS

○ COMMON SHUTDOWN
○ COMMON ALARM
○ OVERSPEED TRIP RPM
○ REMOTE SPEED SETPOINT ENABLED
○ PRESSURE CONTROL ENABLED
○ FLOW. CONTROL ENABLED
○ EXTRACTION CONTROL ENABLED
○ INDUCTION CONTROL ENABLED
○ SPEED PICKUP ALARM
○ OTHER

ANALOG ACCESSORY OUTPUT (4-20 mA)

○ SPEED
○ SPEED SETPOINT
○ *REMOTE SPEED SETPOINT*
○ EXTRACTION PRESSURE
○ EXTRACTION PRESSURE SET POINT
○ ACTUATOR POSITION
○ PROCESS PRESSURE
○ KW
○ KW IMPORT / EXPORT

ELLIOTT EBARA GROUP

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GOVERNOR INSTALLATION REQUIREMENTS

LOCATION
- O LOCATION (AT TURBINE)
- O REMOTE (CONTROL ROOM)
- O OTHER _____

ENCLOSURE
- O GENERAL PURPOSE
- O NEMA 4
- O NEMA 4X
- O NEMA PURGE TYPE
- O EXPLOSION PROOF

MOUNTING
- O SURFACE MOUNT
- O VERTICAL RACK

POWER SOURCE	SINGLE	DUAL
120 VAC	O	O
220VAC	O	O
125VDC	O	O
24 VDC	O	O

LOCAL GOVERNOR CONTROL PANEL O REQUIRED O NOT REQUIRED

LOCATION
- O LOCATION (AT TURBINE)
- O REMOTE (CONTROL ROOM)
- O OTHER _____

ENCLOSURE
- O GENERAL PURPOSE
- O NEMA 4
- O NEMA 4X
- O EXPLOSION PROOF

OUTPUTS FROM PANEL TO GOVERNOR
- O START
- O TRIP
- O RAISE
- O LOWER
- O OVERSPEED TEST
- O RAMP TO MINIMUM CONTINUOUS
- O *REMOTE SETPOINT ENABLE / DISABLE*
- O RESET
- O OTHER _____

INPUTS TO PANEL FROM GOVERNOR
- O COMMON ALARM TRIP
- O TRIP LAMP
- O REMOTE SETPOINT ENABLE LAMP
- O SPEED SETPOINT METER
- O OTHER _____

MISCELLANEOUS GOVERNOR DETAILS

GOVERNOR ACTION ON LOSS OF REMOTE SIGNAL
- O LOCKS ON LAST VALUE
- O GOES TO MINIMUM CONTINUOUS
- O GOES TO MAXIMUM CONTINUOUS

EXTERNAL INTERFACE DEVICE TYPE :
- O PRINTER
- O CTR

FORMAT :
- O GRAPHIC DISPLAY
- O TABULAR DATA
- O TRENDING (REAL TIME)
- O HISTORICAL ARCHIVING

O DISTRIBUTIVE CONTROL SYSTEM MANUFACTURER _____ O MODEL _____

DATA TRANSMISSION
- O SERIAL DATA LINK
- O DISCRETE I/O
- O NETWORK TYPE _____

- O PROTOCOL _____
- O BAUD RATE: O 300 O 1200 O 2400 O 4800 O 9600 O 19200

MAGNETIC SPEED PICKUP

MANUFACTURER Airpax MODEL _____ INSTALLATION : O DUAL O TRIPLE O INSTALLED SPARE

GOVERNOR SPEED PICKUP (S)(3.4.3.3) ; ● NO. REQD 2 + 3 O DIRECT O 60 TOOTH WHEEL

● OTHER 2 pickups for speed governor and 3 pickups for overspeed trip device
Single common 30 tooth wheel will be used for those 5 pickups.

TURBINE MOUNTED ACCESSORIES

ACTUATOR : ● SUPPLIED BY Vendor O MANUFACTURER Valtek O MODEL _____

ACTUATOR TYPE O HYDRAULIC ● PNEUMATIC O SINGLE COIL O MULTI COIL O OTHER _____

TACHOMETER O MANUFACTURER _____ O MODEL _____ ● NO. REQD One(1)

● LOCATION(S) Local Panel ● OTHER Electric Type

0

ELLIOTT ENERGY GROUP

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OVERSPEED TRIP (3.4.2)

● FURNISHED BY Vendor

○ MFR ____ ○ MODEL ____

❑ ELECTRONIC, SET POINT 11911 RPM

○ OVERSPEED SHUTDOWN REQUIREMENTS

○ 1 OUT OF 2 ● 2 OUT OF 3 VOTING LOGIC

○ OTHER ____

○ MECHANICAL OVERSPEED SET POINT ____

❑ TYPE ____

○ NO. SPEED PICKUPS ____ 30 TOOTHWHEEL

○ OTHER ____

○ SPEED PICKUPS FURNISHED BY ____

○ SOLENOIDS SHALL : ● DE-ENERGIZE TO TRIP

○ ENERGIZE TO TRIP

○ CONTACTS SHALL BE : ○ NORMALLY OPEN

● NORMALLY CLOSED

GLAND SEALING AND VACUUM SYSTEM (3.5)

SYSTEM PER : ● APPENDIX B-1 ○ APPENDIX B-2

○ OTHER ____

○ AVAIL. HEADER PRESS. ____ kg/cm2 G TEMP ____ deg-C

○ AVAIL. SEAL STEAM SUPPLY PRESS. ____ kg/cm2 G

○ AVAIL. SEAL STEAM SUPPLY TEMP. ____ deg-C

❑ SEALING STM. PRESS. 0.21-0.35 kg/cm2 G ❑ FLOW ____ kg/hr

❑ SEALING STM. RELIEF VALVE SET PRESS. ____ kg/cm2 G

FURNISHED BY Ebara

❑ FLOW ADJUSTING VALVES, TYPE Semi-Auto

FURNISHED BY Ebara

● VACUUM SYSTEM FURNISHED BY Vendor

○ SHIP LOOSE ● SKID MOUNTED

○ OTHER ____

● GLAND CONDENSER, SEE SPEC. UOP Spec. 4-14

● STEAM EJECTOR ❑ STM. PRESS ____ kg/cm2 G

❑ STM. FLOW ____ kg/hr

○ VACUUM PUMP (3.5.2), SEE SPEC. ____

○ CONDENSATE RECEIVER

○ LOOP SEAL HEIGHT ____ m

INSPECTION AND TESTING (4.2)(4.3)

GENERAL

○ SHOP INSPECTION (4.1.4)

EXTENT : ____

INSPECTION AND MATERIAL TESTING

● FINAL ASSEMBLY RECORDS REQUIRED (4.2.1.1.e)

SPECIAL MAT'L INSP. & TESTING REQUIREMENTS

COMPONENT	MAG PART	DYE PEN	R.T	U.T	OBSVD	WIT
TRIP & T&T VALVE	V				○	○
STM CHEST	V				○	○
CASING	V				○	○
PIPING		V			○	○
ROTOR	V			V	○	○
					○	○

	OBSVD	WIT
○ HEAT STABILITY (4.2.2.3.4)	○	○
○ CLEANNESS (4.2.3.2)	○	○
○ HARDNESS (4.2.3.4)	○	○
● HYDROSTATIC TESTS (4.3.2)	○	●
○ BLADE SHAKER (STATIC)	○	○
ROTOR BALANCE ○ STANDARD (2.8.5)	○	○
● HIGH SPEED (2.8.5.4)	○	●
● FINAL SURFACE INSPECTION (4.4.3)	○	●
○ CRATING INSPECTION (4.4.3)	○	○
● SPARE ROTOR FIT	○	○
○ CASING JOINT LEAK TEST (4.3.2.7)	○	○
○ ____	○	○
○ ____	○	○
○ ____	○	○
○ ____	○	○

MECHANICAL RUNNING TEST (4.3.3)

	OBSVD	WIT
● CONTRACT ROTOR	○	●
● SPARE ROTOR	○	●
● TEST W/JOB COUPLING	○	●
○ TEST TAPE RECORD. REQ'D	○	○
○ TEST TAPE GIVEN TO PURCH.	○	○
○ TEST W/JOB L.O. CONSOLE	○	○
○ ____	○	○

OPTIONAL TESTS AND INSPECTIONS (4.3.4)

	OBSVD	WIT
○ PERFORMANCE (4.3.4.1)	○	○
○ COMPLETE UNIT (4.3.4.2)	○	○
○ TORSIONAL MEASMT'S (4.3.4.2)	○	○
AUX. EQUIPMENT (4.3.4.3)		
● TRIP/T&T VALVE	○	○
○ GLAND SEAL SYSTEM	○	○
○ GLAND VACUUM SYSTEM	○	○
○ RELIEF VALVES	○	○
○ ____	○	○
● CASING INTERNAL INSP (4.3.4.4)	○	●
● COUPLING TO SHAFT FIT (API 671)	○	○
● TURNING GEAR	○	○
ADDITIONAL TEST OR INSPECTIONS		
○ ____	○	○
○ ____	○	○
○ ____	○	○
○ ____	○	○
○ ____	○	○
○ ____	○	○
○ ____	○	○

ELLIOTT GROUP

SPECIAL PURPOSE STEAM TURBINE DATA SHEET

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MISCELLANEOUS

2002/11/20 H.Sasaki

PAINTING

- ○ MANUFACTURER'S STANDARD
- ● OTHER TGPS-N1
- ○

SHIPMENT (4.4.1)(4.4.3.10)

- ○ DOMESTIC ● EXPORT
- ● EXP BOXING REQUIRED ● OUTDOOR STORAGE OVER 6 MONTHS
- ○ WATERPROOF BOXING REQUIRED
- ● SPARE ROTOR ASSEMBLY PACKAGED FOR :
  - ● HORIZONTAL STORAGE ○ VERTICAL STORAGE

■ TURBINE	10000 kg
■ ROTOR	1000 kg
■ TURBINE UPPER HALF CASING	5000 kg
■ MAX. FOR MAINT. (IDENTIFY)	5000 kg
■ TRIP/ T&T VALVE	520 kg
❑ MISC.	kg
❑ TOTAL SHIPPING WEIGHT	kg

SPACE REQUIREMENTS : See outline drawings

	L	W	H
❑ COMPLETE UNIT :	mm	mm	mm
❑ CONTROL PANEL :	mm	mm	mm
❑ OTHER :	mm	mm	mm
❑ OTHER :	mm	mm	mm

VENDOR DWG & DATA REQUIREMENTS (5)

- ○ APPENDIX (5.3.3.1)
- ○ OTHER
- ○ PROGRESS REPORTS REQ'D (5.3.4)

FREQUENCY

REMARKS AND ADDITIONAL REQUIREMENTS

2

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0

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TITLE	Main Turbine Estimated Performance Curve	DOC. No.	LGTPR-8212-1042 V-9900-4-CT9901-011-0	REV. 0

CUSTOMER	LG Engineering & Construction Corp.	COMPLETE IN WITH COVER	3 SHEETS
FINAL USER	Turkish Petroleum Refineries Corp.		
PROJECT	Tupras Izmir Refinery DHP Project	SERVICE	Recycle Compressor
JOB No.	7020	EBARA SER. No.	R0215708
ITEM No.	CT-9901	MODEL/ EQUIP.	25MB5/SRV-5DF SET 1

FIG 3-3

LG E&C LG ENGINEERING & CONSTRUCTION CORP.	TÜPRAŞ TUPRAS IZMIR REFINERY DIESEL/KEROSENE HYDROPROCESSING PROJECT	JOB NO.:7020	UNIT : N/A
		REQ'N NO. : 7020-RQ-C-001	SH/OF
		CONTRACTOR SPEC NO. : V-9900-4 -CT9901- 011	1 / 3
		REV 0	

TO	SET	TO	SET
CUST-	R		
OMER	10 C	281-1	
813	1	811-1	
813E		811-2	
821-1		811-3	
821-2	1		
821-4	1		
819			
816-1			
816-2		4	
812-1		3	
812-2		2	
850		1	
		REV.	PAGE

☒ FOR APPROVAL

AVOID DELAY
TO MAINTAIN SHIPPING PROMISE.
ONE APPROVED PRINT MUST BE RETURNED BY: MAR-24-'03

BY: MM DATE: MAR-10-'03

☐ FOR RECORD

ANY REQUESTED CHANGE OF THIS EQUIPMENT WILL RESULT IN:
1.CONTRACT PRICE ADJUSTMENT
2.EXTENDED SHIPPING PROMISE AS THIS CONTRACT IS IN MANUFACTURING PROCESS.

BY: DATE:

ISSUED BY

APPROVED BY H. Sasaki Mar. 10 '03

CHECKED BY

PREPARED BY H. Sasaki Mar. 10 '03

CHARACTERISTIC CURVE

DATE :

ITEM NO. : **CT-9901**

EBARA SER. NO. :

PLANT OWNER : **TUPRAS**

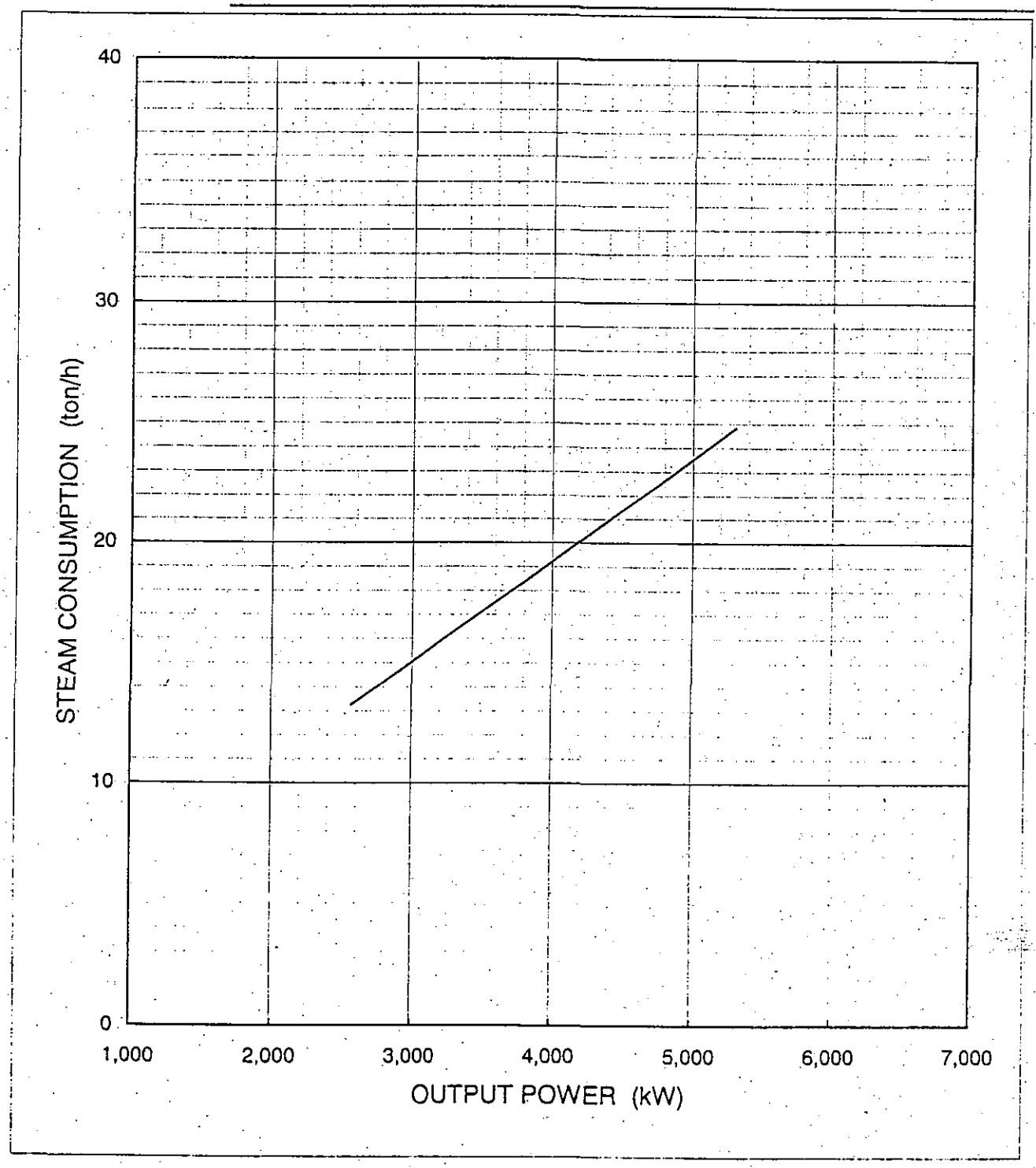
MODEL : **SRV-5DF**

UNIT : **MQD UNIONFINING PROCESS**

SPEED : **9591** rpm

STEAM CONDITION : P1 : **38.0** kg/cm2G T1 : **390** °C P2 : **81** mmHgA

REMARKS :



ISSUED BY :

APP'D BY :

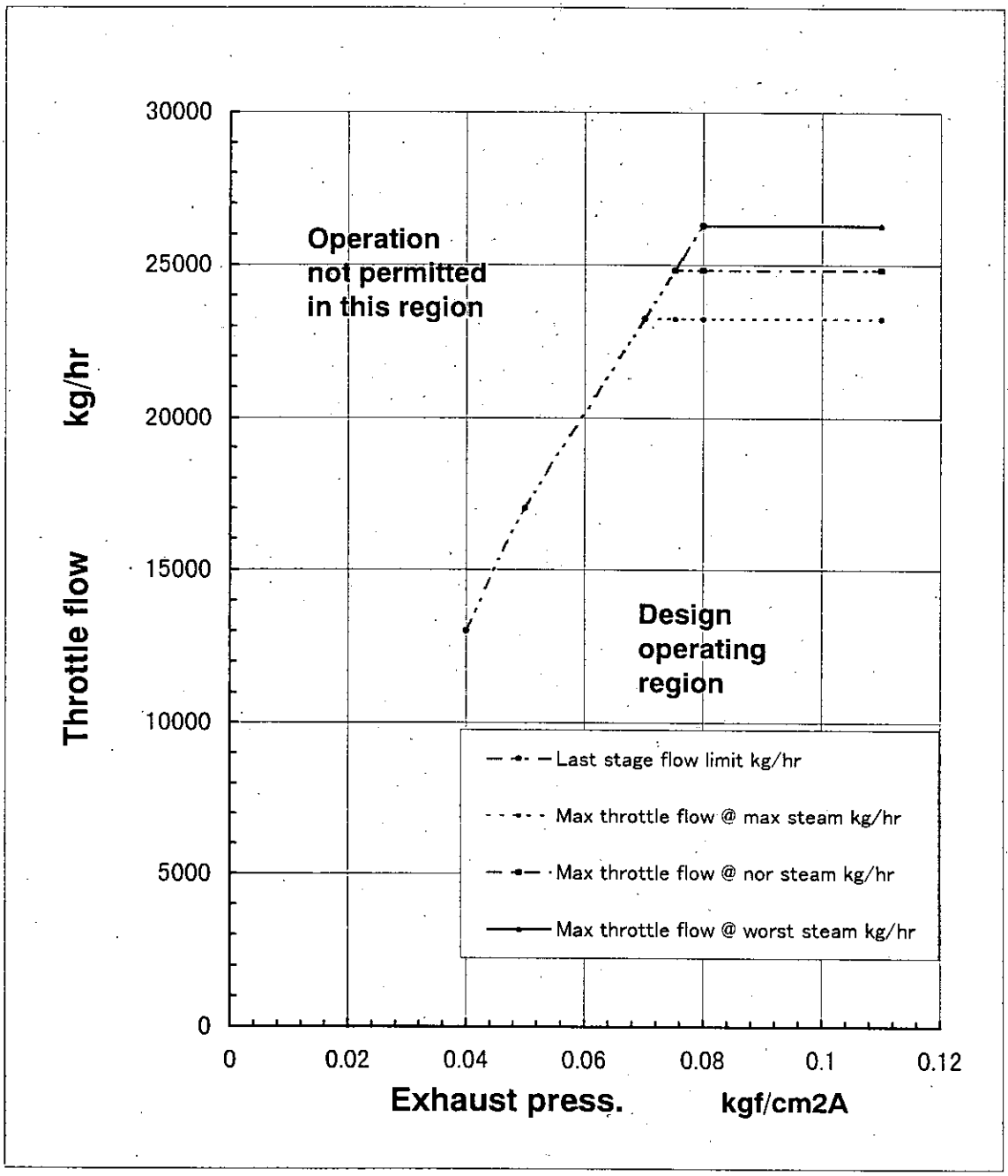
PREP'D BY :

K.TSURUMAKI

EBARA CORPORATION

Design operating limits
Steam flow vs. Turbine exhaust pressure

S.O. No.			R021570803
Model			SRV-5DF Straight
Normal steam condition			
	Inlet steam condition	Pressure	39 kgf/cm2A
		Temperature	390 degC
	Exhaust press.		0.11 kgf/cm2A
	-		0 -
	Curve drawn speed		9591 rpm
Note			
	Max throttle flow case		
	-		



by H.Sasaki 10-Mar-03

TITLE	Allowable Nozzle Forces and Moments for Main Turbine	DOC. No.	LGTPR-813-1043 V-9900-4-CT9901-018-1 REV. 1

CUSTOMER	LG Engineering & Construction Corp.	COMPLETE IN WITH COVER	4 SHEETS
FINAL USER	Turkish Petroleum Refineries Corp.		
PROJECT	Tupras Izmir Refinery DHP Project	SERVICE	Recycle Compressor
JOB No.	7020	EBARA SER. No.	R0215708
ITEM No.	CT-9901	MODEL/ EQUIP.	25MB5/SRV-5DF SET 1

LG E&C LG ENGINEERING & CONSTRUCTION CORP.	TÜPRAŞ TUPRAS IZMIR REFINERY DIESEL/KEROSENE HYDROPROCESSING PROJECT	JOB NO.:7020									UNIT : N/A	
		REQ'N NO.:7020-RQ-C-001										SH/OF
		CONTRACTOR SPEC NO.: V- 9900- 4- CT9901- 018-1										1 / 4
		REV	0	1								

TO	SET	TO	SET
CUST-	R		
OMER	10 C	281-1	
813	1	811-1	
813E		811-2	
821-1		811-3	
821-2	1		
821-4	1		
819			
816-1			
816-2		4	
812-1		3	
812-2		2	
850		1	
		REV.	

☐ FOR APPROVAL

AVOID DELAY
TO MAINTAIN SHIPPING PROMISE.
ONE APPROVED PRINT MUST BE RETURNED BY:

BY: DATE:

☒ FOR RECORD

ANY REQUESTED CHANGE OF THIS EQUIPMENT WILL RESULT IN:
1.CONTRACT PRICE ADJUSTMENT
2.EXTENDED SHIPPING PROMISE AS THIS CONTRACT IS IN MANUFACTURING PROCESS.

BY: MM DATE: SEP-4-'03

ISSUED BY EETC 813

APPROVED BY MMadsen DEC-6-'02

FINAL	Sep. 2 '03	MM	M. Tokin	CHECKED BY		
PAGE	DATE	APP'D	BY	PREPARED BY	M. Tokin	Dec. 6 '02

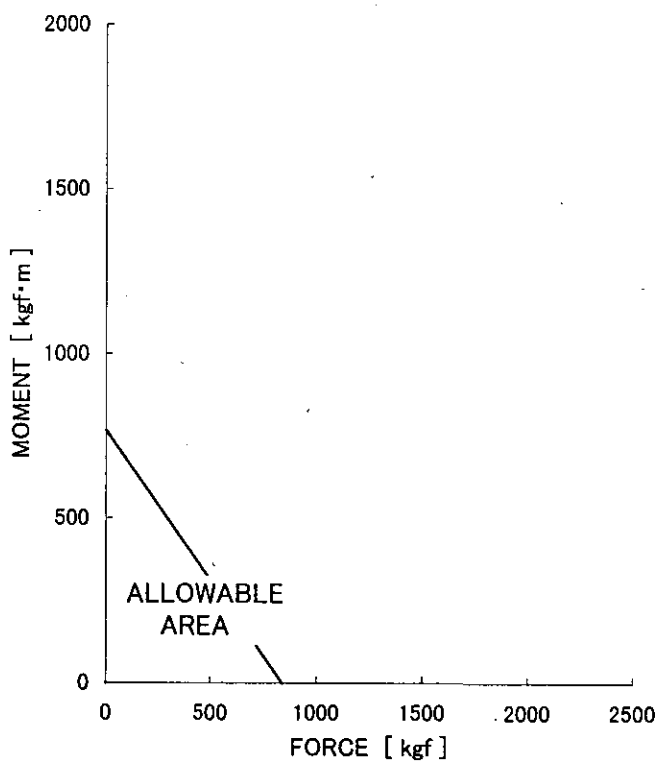
ITEM No. CT-9901 MODEL No. 25MB5/SRV-5DF

EBARA SELIAL No. R0215708 SERVIICE Recycle Compressor

ALLOWABLE EXTERNAL FORCES AND MOMENTS FOR DRIVER TURBINE

AS PER NEMA SM 23 X 1.85

NOZZLE	NOMINAL DIA. d (INCHES)	Fo (at M=0) (kgf)	Mo (at F=0) (kgf·m)	LINE TYPE
INLET	6	839	768	———



EQUATION

$$F = \frac{69.15 \times 1.85 \times D - M}{0.9147}$$

WHERE ,

F : RESULTANT FORCE (kgf)

M : RESULTANT MOMENT (kgf·m)

D : PIPE SIZE OF CONN (INCHES)

UP TO 8 INCHES ,

$D = d$

OVER 8 INCHES ,

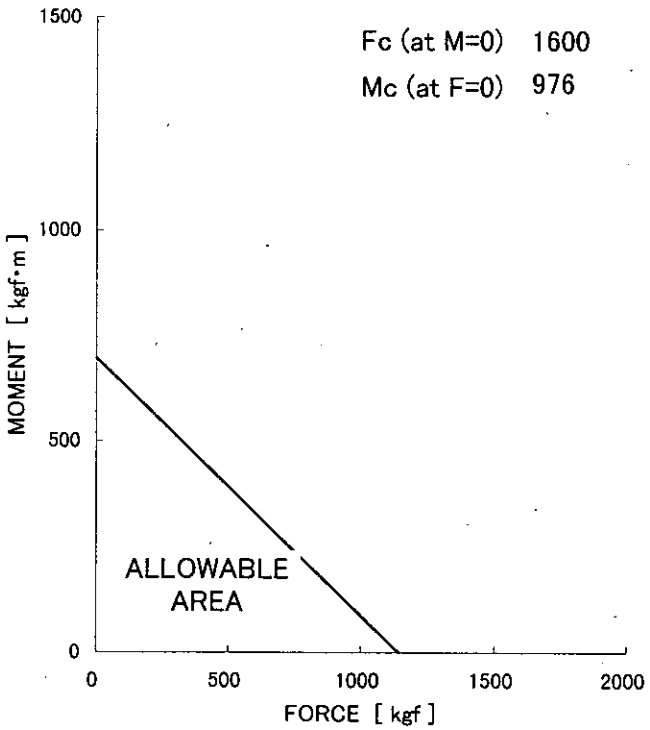
$$D = \frac{16 + d}{3}$$

ITEM No. CT-9901 MODEL No. 25MB5/SRV-5DF

EBARA SELIAL No. R0215708 SERVIICE Recycle Compressor

ALLOWABLE COMBINED RESULTANTS OF FORCE AND MOMENTS OF ALL TURBINE NOZZLE

AS PER NEMA SM 23 X 1



EQUATION

$$F = \frac{34.58 \times 1 \times Dc - M}{0.6098}$$

WHERE ,

Fc : COMBINED RESULTANT FORCE (kgf)

Mc : COMBINED RESULTANT MOMENT (kgf•m)

Dc : EQUIVALENT DIA. (INCHES)

UP TO 9 INCHES ,

Dc = EQUIV. DIA.

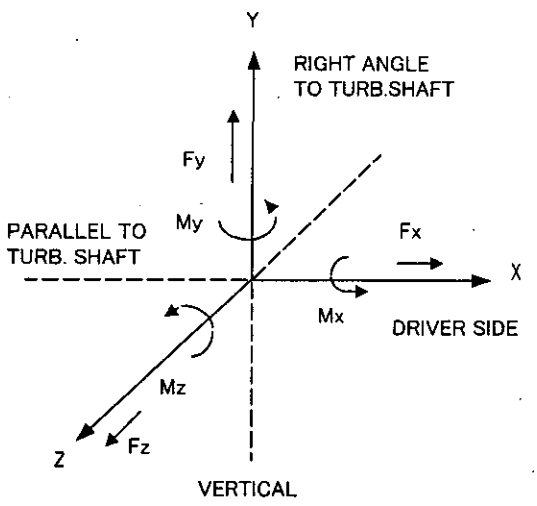
OVER 9 INCHES ,

$$Dc = \frac{18 + EQUIV.DIA}{3}$$

Dc = **20.1**

COMPONENTS OF Fc AND Mc

	ALLOWABLE VALVE	EQUATIONS F (kg) M (kg - m) Dc (INCHES)
Fcx	457	Fcx = 22.68 X 1 X Dc
Fcy	1142	Fcy = 56.70 X 1 X Dc
Fcz	914	Fcz = 45.36 X 1 X Dc
Mcx	697	Mcx = 34.58 X 1 X Dc
Mcy	348	Mcy = 17.29 X 1 X Dc
Mcz	348	Mcz = 17.29 X 1 X Dc



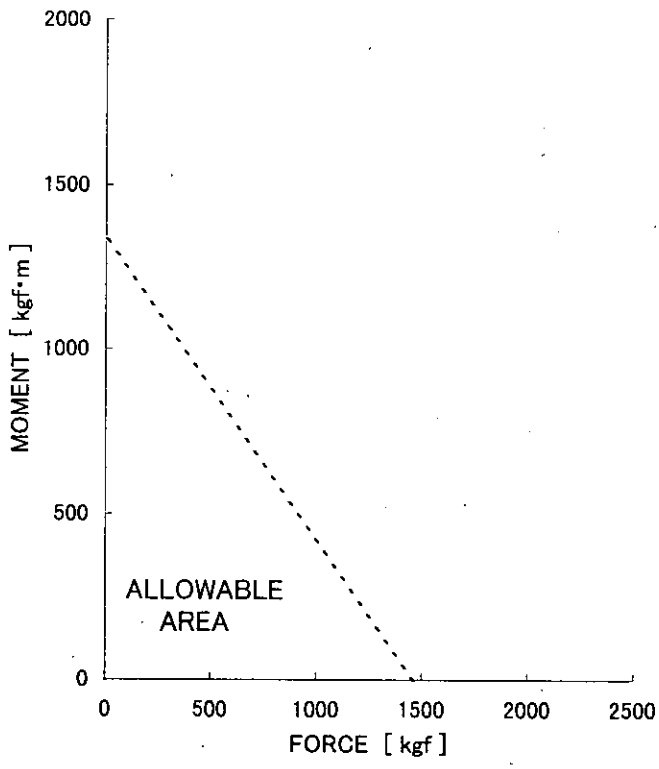
ITEM No. CT-9901 MODEL No. 25MB5/SRV-5DF

EBARA SELIAL No. R0215708 SERVIICE Recycle Compressor

ALLOWABLE EXTERNAL FORCES AND MOMENTS FOR DRIVER TURBINE

AS PER NEMA SM 23 X 1

NOZZLE	NOMINAL DIA. d (INCHES)	Fo (at M=0) (kgf)	Mo (at F=0) (kgf·m)	LINE TYPE
EXHAUST	42	1462	1337	- - - - - - - -



EQUATION

$$F = \frac{69.15 \times 1 \times D - M}{0.9147}$$

WHERE ,

F : RESULTANT FORCE (kgf)

M : RESULTANT MOMENT (kgf·m)

D : PIPE SIZE OF CONN (INCHES)

UP TO 8 INCHES ,

D = d

OVER 8 INCHES ,

$$D = \frac{16 + d}{3}$$

CHAPTER 4

MAINTENANCE - TURBINE
FOR
TUPRAS IZMIR REFINERY DHP PROJECT
SERVICE: RECYCLE COMPRESSOR DRIVER
ITEM TC-9901

EBARA SERIAL NUMBER: R021570803
FRAME: SRV-5DF

INTRODUCTION

This chapter will guide you in establishing an inspection program, covering both planning and procedures. A troubleshooting guide is included as a quick reference to possible cause and corrective action, and as an aid in developing a maintenance program. Also included are the assembly and disassembly procedures providing the essential steps in maintenance of major components of the turbine and driven machine(s). This chapter is written assuming the individuals performing the maintenance are familiar with this type of work, therefore, information provided covers the essentials only. All chapters of this manual and associated drawings must be completely reviewed and a work schedule established before starting any actual maintenance.

ROUTINE INSPECTION PROGRAM

The first requirement for satisfactory maintenance is a competent routine inspection. Some important reasons for establishing an inspection schedule are listed below.

1. Serious safety hazards may develop as a result of part failures due to corrosion, erosion, improper lubrication, and solid objects or "slugs" of liquid entering the turbine or driven machine(s).

2. Turbine train efficiency has an important influence on plant capacity. Planned maintenance will help offset eventual main and auxiliary equipment deterioration and will also help to maintain efficiency and overall plant reliability.

Emergency shutdowns can easily lead to hasty decisions by the operators and thus costly errors. Emergency shutdowns are hazardous and extremely costly in terms of lost production. While a scheduled shutdown may be coordinated with other plant requirements, unscheduled shutdowns usually upset or even stop the operation of related equipment.

Improper operation ranks equal to mechanical wear and corrosion as a cause of equipment deterioration. Improper operation includes excessive speed, lack of proper lubrication and excessive pressures and temperatures.

Inspection should be supervised by an Ebara Corporation Service Representative to gain the maximum benefit during shutdown. Ebara Corporation Service Representatives are located in Regional Service Offices throughout the country to assist in this operation. It is recommended that their training and experience be utilized since a knowledgeable inspection and analysis of operating data can uncover potential trouble that would not normally be recognized by others.

When planning an inspection, the following factors will be useful in determining what areas should be inspected most thoroughly, and what parts are most likely to require replacing.

?? Is data available to indicate past performance?

?? Is there evidence of mechanical difficulty?

?? What has been the maintenance experience over the past several years?

?? What parts indicated a need for future replacement during the last inspection?

?? Are there corrosive elements or boiler carryover in the steam supply?

A complete study of the turbine and driven machine(s) construction is essential before inspection so that a thorough understanding of the function of each part may be gained.

INSPECTION PLANNING

Proper planning for a thorough inspection requires that external inspection be made prior to the plant turnaround, during operation. This procedure includes the following:

1. Examine the foundation, base support and foundation bolts to determine if re-grouting or bolt replacement will be necessary.

2. Check for unusual noises or vibration. This is a good indication of equipment deterioration.

3. Analyze all temperatures, pressures, flows, etc., which have been recorded since the previous inspection. Proper interpretation of this data can help determine which parts will require replacement before the turbine and compressor is actually disassembled.

4. Take an inventory of all spare parts. A complete set of recommended spare parts should be in stock. If these parts are not available during the inspection, costly delays might be experienced.

5. Inspect for oil, gas or steam leakage.

INSPECTION PROCEDURE

This discussion recommends the maintenance procedures that should be followed, the inspections that should be made and the corrective action to be taken.

-STEAM TURBINE WARNING-

BEFORE INSPECTION, DEPRESSURIZE THE CASING, CLOSE AND LOCK THE INLET, EXHAUST AND ~~EXTRACTION (INDUCTION)~~ VALVES. BE SURE THE TURBINE CANNOT BE STARTED WHILE IT IS BEING WORKED ON. BE SURE TO FOLLOW GOOD SHOP PRACTICES AND SAFETY PRECAUTIONS TO PREVENT INJURY TO PERSONNEL AND/OR DAMAGE TO THE EQUIPMENT.

-COMPRESSOR WARNING-

BEFORE INSPECTION, DEPRESSURIZE THE CASING, CLOSE AND LOCK THE INLET AND DISCHARGE VALVES. ALSO, IF THE PROCESS GAS IS TOXIC OR FLAMMABLE, PURGE THE UNIT WITH AN INERT GAS. BE SURE THE COMPRESSOR CANNOT BE STARTED WHILE IT IS BEING WORKED ON. BE SURE TO FOLLOW GOOD SHOP PRACTICES AND SAFETY PRECAUTIONS TO PREVENT INJURY TO PERSONNEL AND/OR DAMAGE TO THE EQUIPMENT.

RECOMMENDED ROUTINE INSPECTION

Suggested scheduled maintenance guidelines are as follows:

Daily

1. Check all oil levels and add oil as necessary.
   Grease once per week. (Torque shaft bearing of multi-valve turbine steam chest cover, T&T valve, etc.)

   NOTE

   See the grease ooze from the torque shaft bearing and stop. If no grease is visible, then the line must be cleaned and grease replaced since it has probably dried.

   CAUTION

   Apply extreme high temperature bearing grease specified in the lubricant list.

2. Check bearing and lubricating oil temperatures.

3. Check turbine speed.

4. Check smoothness of operation; investigate sudden changes in operating conditions or unusual noises. Refer to the Troubleshooting Guide located at the end of this Chapter.

5. If daily shutdowns are made, test the trip valve by activating the manual exerciser. During this procedure the valve stem should visually be verified as moving.

Weekly

1. Exercise trip valve to prevent sticking due to deposits or corrosion if on a continuous operating schedule, all valves, including those with a hydraulic exerciser, should be exercised by partially closing the valve with the handwheel and then reopening.

Monthly

1. Sample lubricating oil and renew as necessary.

2 Check governor linkage for excessive play. Replace any worn parts.

3. Check the overspeed trip by overspeeding the turbine.

4. Refer to the document "Lubricant list" for lubricating of the turbine train system components.

Annually

The following items must be carefully inspected:

Grease points
Replace grease of torque shaft bearing of multi-valve turbine steam chest cover, T&T valve, etc. and the line.

Couplings - Diaphragm Type

Periodic inspection for the diaphragm type coupling is done during equipment shut down. Inspect the coupling for loose fasteners, keys, rigid hubs or flange adapters. Check the alignment and determine if any severe shifting has occurred in the machinery or the bearings. Check the intermediate spacer assembly for any abnormal movement. Excessive movement would indicate that a major overhaul be made to inspect the diaphragm packs for possible failure. Refer to the coupling manufacturer's instruction manual in the compressor instruction manual for further information.

The diaphragm type coupling is designed to transmit full torque at maximum misalignment and parallel offset capacities. Initial alignment of equipment should not exceed 1/4 of any combination of maximum values for angular misalignment and parallel offset.

CAUTION

Over extending or compressing of the diaphragm pack assembly beyond capacities can result in premature failure. Dynamically, a single diaphragm pack assembly is capable of moving only 1/2 of the total coupling capacity.

Journal Bearings - Spherical Seat

The journal bearing condition and clearances should be checked. Inspect for scoring, cracks, indentations, and evidence of pounding in the babbitt metal and for proper bond between the babbitt and the bearing shoes. Bearing clearances may be checked as detailed under Disassembly and Assembly Guidelines, Tilt-Shoe Journal Bearings section of this chapter.

Bearing clearance is preset at Ebara by grinding each seat, and seats are match marked to a specific counterbore in the base ring. Shoes are normally not match marked and can be interchanged or replaced without affecting clearance. In some special cases shoes are match marked and clearance is affected if shoes are interchanged or replaced. If shoes are match marked, then the complete bearing assembly must be replaced. Used bearings can be returned for reconditioning.

This bearing requires a "pinch fit" into the bearing retainer housing of 0.013 to 0.038 mm (0.0005 to 0.0015 inch). A loose fit may cause vibration.

Thrust Bearing

Before removing the thrust bearing, the axial endplay should be measured. Before disassembling the bearing retainer, the rotor float should be measured. The thrust shoes and thrust collar should be inspected for excessive wear, scoring or wiping. If any of these conditions exist, renewal should be made. When renewing the thrust bearing, replace the complete thrust bearing assembly. When the thrust bearing is replaced, the axial endplay or rotor running position and the rotor float should be checked and adjusted as required.

Rotor

Visually inspect the condition of the rotor; if damaged or corroded, return to the factory for repair and/or reconditioning.

Inspect the shaft journals and areas under the shaft seals for wear and corrosion. Remove light corrosion with crocus cloth.

Inspect oil baffles for signs of binding.

Check balance the rotor prior to installation.

Shaft Seals

Check the condition of the shaft end seals and interstate shaft seals.

Seals should be replaced if clearances are excessive or if chipped or otherwise damaged.

Lubrication System

Inspect the entire lubrication oil system. Check all relief valves, regulators, control valves, pressure switches, temperature switches, thermometers, gauges, etc., to assure proper operation.

Inspect oil coolers, filters, piping and reservoir for fouling.

Inspect the main, and auxiliary oil pumps according to manufacturer's instructions.

Test the oil for water content, acidity, suspended solids, etc. Renovate or change oil as dictated by these tests.

Refer to the oil system instruction manual for detail information.

THESE ITEMS SHOULD BE CAREFULLY INSPECTED ON THE STEAM TURBINE:

Inspect the worm and worm wheel for proper contact and wear pattern.

Overspeed Trip - Electronic

Inspect the speed sensors that correct gap exist and no wear exist. Refer to the electrical overspeed trip system manual, which is located in the panel instruction manual. The governor instruction manual is located in the panel instruction manual.

Valve Stem Packing

Inspect and renew all valve stem packing as required.

Steam Parts and Casing

Inspect nozzles and buckets for erosion (indication of entrained water in the steam) or presence of deposits (indication of boiler carryover).

Inspect the casing for indication of steam cutting or other damage to sealing surfaces.

DISASSEMBLY AND ASSEMBLY GUIDELINES - MULTISTAGE TURBINES

It is important, when performing maintenance on the turbine, to remember that it is a precision-built machine; and maintenance personnel should be familiar with this type of equipment. All parts should be handled with due care. Any jacketing, insulation, piping as well as other interference must be removed. Cleanliness is essential. All nicks and burrs should be carefully removed from each part without damaging machined surfaces. Bearings and shaft journals should be clean and well lubricated before assembly.

Assembly is essentially the reverse of disassembly. Dowels are used to facilitate assembly of the parts where it is necessary to return the parts to their original alignment. Insert dowels before tightening nuts or capscrews.

Where gaskets or O-rings were removed, do not forget to install new gaskets and O-rings. All high temperature bolting should be coated with Never-Seez or equivalent. Keys and retaining screws should be replaced in their original locations. Where washers, lockwashers, or lashing wire were used, be sure to install the same kind as originally used and at the proper location. Tanged lockwashers should have the tangs bent back into the proper position on assembly. All parts should be clean and in good condition; all carryover, carbon, and old sealing compound should be removed. Defective parts should be renewed. Oil seals and bearing housings should be sealed across the split and around the diameter with an oil resistant sealant.

The rotor should be clean and in good balance, having no excessive runout.

STEAM END BEARING HOUSING

To maintain "centerline support" during high thermal growths, the steam end bearing housing is a flexible type where vertical alignment is adjusted using factory set shims under the housing and horizontal alignment is maintained using two keys, one top and one bottom vertical centerline. The steam end bearing housing is adjusted in the factory to be concentric with the HP packing of the steam end. Likewise, the exhaust end bearing housing is set in the factory to be concentric with the LP packing. No adjustments are necessary in the field. If required, please refer to Ebara Service Representative for assistance.

Removal

1. Disconnect all piping and connections to top half steam end bearing housing.

2. Remove vertical flange bolting and dowels connecting end cover to steam end bearing housing and remove end cover.

3. Remove dowels and capscrews at bearing housing horizontal split.

4. Rig and carefully remove top half bearing housing.

To remove journal and thrust bearings, refer to journal bearing and thrust bearing maintenance.

Installation

1. Install top half steam end bearing housing using oil resistant sealant to make up horizontal and vertical joint. Caution when assembling not to damage oil baffle.

2. Insert dowels and capscrews at horizontal split of steam end bearing housing.

3. Insert dowels and capscrews at vertical split connecting end cover to steam end bearing housing.

4. Connect all piping and connections to top half steam end bearing housing.

TILT-SHOE JOURNAL BEARINGS

Two journal bearings support and radially position the rotor assembly. The journal bearings are the spherical seated tilting pad type and are positioned by the bearing retainers.

Removal

1. Remove the bearing housing top half. Refer to bearing housing removal.

2. Remove all piping, wiring, etc., inside the bearing housings. Tag for proper identification.

3. On thrust end, if required, remove the thrust bearing cap and thrust bearings to gain access to journal bearing. Refer to Thrust Bearing section.

4. Remove the top half of the bearing retainer by removing the retainer horizontal bolting.

NOTE

Care must be taken when removing the top half bearing retainer. The bearing assembly is not fixed to the retainer. When removing the top half retainer, the top half bearing assembly should remain in place on the bottom half; however, should it remain with the top half of the retainer, it must be supported to prevent its falling out. Disconnect temperature sensor leads (if supplied) and note location of shoe(s) containing temperature sensor so that it may be returned to the same location.

5. Roll out the bottom half of the base ring while supporting the shaft, taking the weight off of the bearing. Remove the bottom half of the bearing carefully to avoid dropping and damaging the shoes. Do not rest rotor on seals. While bearing(s) are removed, keep rotor supported to prevent damage to the seals.

Inspection

Inspect the bearing shoes for scoring, uneven wear, excessive wear and for cracking and flaking and for proper bonding of the babbitt and other abnormal conditions. (Refer back to Inspection section.)

Pinch Check

High speed rotating machinery bearings must generally be operated with a pinch of *0.013 to 0.038 mm (0.0005 to 0.0015 inch) diametral*: eliminating relative looseness between bearing and retainer, and between retainer and housing.

Check the pinch by using a 0.25 mm (0.010 inch) shim on the horizontal faces of the retainer. Shim should cover at least one half the surface area of the horizontal splits and positioned on both sides of the bolts to minimize retainer and/or housing distortion. Using plastigauge, about 0.38 mm (0.015 inch) thick, place one piece on top of the cage ring and two at about 45°, the full length of the bearing. Hold in place with grease and pull the housing and retainer down tight against the shims, measuring the gap with feelers to be certain the housing and retainer are tight against the shim stock. Remove the housing and retainer to determine the degree of tightness. The plastigauge should now show 0.216 to 0.241 mm (0.0085 to 0.0095 inch).

If the proper pinch is not obtained, the bearing assembly and/or bearing retainer bore may need reconditioned or replaced. Repeat pinch check to assure proper dimensions. Be sure all parts are clean. Verify proper procedure is being used.

Clearance Checks

Before doing a clearance check, the "pinch check" between the bearing assembly and the bearing retainer must be done. Refer to Pinch Check section.

The most accurate and consistent methods for determining tilt-shoe journal bearing clearances are the "Component Measurement Method" and the "Shaft Lift Method". Bearing parts and rotor journals should be measured at approximately room temperature, 21?C (70?F), to avoid errors in thermal growth.

Seat and shoe thicknesses are held within tight tolerances during manufacturing, allowing them to be randomly assembled in the bearing. Generally it is acceptable to mix odd seats and shoes, if necessary, as long as proper clearance can be maintained. In rare cases, Seat thickness may vary in a given bearing to compensate for the retainer bore being out of round. Therefore, Seat orientation should be maintained. Shoes can be moved if desirable. Wiped, pitted or badly scratched shoes should always be replaced. Shoes with a shiny spot may be relocated to a position in the bearing where the load is less, usually to the top. Oil must be removed from components when measurements are made.

The Component Measurement Method requires only the use of a micrometer. The accuracy of this method depends on the accuracy of the micrometer and one's ability to use it.

1. Measure individually the thickness of the shoes (Dimension a) with a ball end micrometer and average the readings (Dimension a average).

2. Measure individually the thickness of the seats (Dimension b) with a micrometer and average the readings (Dimension b average).

3. Measure the I.D. of the seat bearing surface (the bearing retainer or the adapter installed in the retainer) with the split lines tight (Dimension c). Measure the I.D. three ways - vertically and across the splits. All three dimensions should be very close. (If the readings are off by a significant amount, the adapter halves may be reversed or the split line shoulder bolts may have excessive clearance; in any case, this must be corrected before continuing).

4. Measure the O.D. of the shaft journal (Dimension d). The diametral clearance (D.C.) equals the retainer or adapter I.D. minus twice the average thickness of the shoes plus the seats, minus the shaft journal O.D.; i.e., D.C. = C - 2(a average + b average) - d .

The most reasonable method for determining tilt-shoe journal bearing clearances in the field is the "Shaft Lift Method". For best results, bearing parts and rotor journals should be at approximately room temperature to avoid errors due to thermal growth.

1. Assemble bearings being sure that retainer dowels are installed and capscrews are tight.

2. Mount a 0.03 mm (0.001 inch) magnetic base indicator on the retainer, zeroed on the top of the rotor as close to the bearing as possible.

3. Lift the rotor to the top of the bearing and read the vertical clearance on the indicator. The indicator should jump as the rotor is lifted. Take care not to lift the rotor beyond the bearing clearance. Whatever method is used to lift the rotor should allow small increments of movement. A hydraulic jack with a piece of wood placed between the jack and rotor is recommended. A strap and prying bar may also be used. Use of a crane should be avoided. If a crane must be used, it is a good idea to mount a second indicator on the casing or end wall zeroed on the retainer to show when the retainer is being strained. To be safe, crane lifting force should be limited to 1/2 rotor weight. This can be accomplished by putting an appropriate size hoist or come-a-long between the crane and bearing housing. The rotor weight is shown on the Rotor Assembly drawing in this Chapter and General Data Table in Chapter 1 General Information.

4. Repeat steps (2) and (3) to verify readings.

5. Mount a second indicator in the same plane as the first to read horizontal rotor movement.

6. Lift the rotor to the middle of the vertical clearance.

7. Pry the rotor from side to side. The total horizontal indicator movement gives the horizontal clearance.

8. Repeat steps (6) and (7) to verify readings.

Installation

1. Lift and temporarily support the rotor shaft only enough to install the bottom half journal bearing.

2. Remove temporary support under rotor.

3. Install the top half journal bearing.

4. Mount top half bearing retainer. Insert dowels and bolting at horizontal split. Torque bolting and secure with 1.27 mm (0.05 inch) diameter lockwire, if noted on assembly drawings.

5. Install steam end and exhaust end housings, refer to respective sections.

THRUST BEARING

Rotor Float and Rotor Axial Position

Rotor axial position and the required rotor float are determined by adjusting shims between the thrust bearing retainer rings and shim plates. The rotor float and axial position should be checked and recorded prior to disassembly of the thrust bearing. Setting the rotor to this dimension will insure that the internal clearances are properly maintained. Rotor float in excess of the original setting (Refer to Table 4-3) is an indication of thrust bearing wear. Shims may be added to compensate for this wear. A record should be kept of these shim additions and the thrust bearing assembly should be replaced when the accumulated shim additions exceeds 0.25 mm (0.010 inches).

The rotor axial position must first be set before any adjustments are made for rotor float:

1. The rotor axial position is the clearance between the nozzle ring and the first stage disk, also diaphragms to disks clearances. Refer to Table 4-3, bearing housing outboard machined vertical face or Clearance Record drawing.

2. Insert or remove shims between shim plate and base ring of active thrust bearing to maintain this rotor axial position.

NOTE

The active thrust bearing is located inboard or down-stream of the thrust disk.

Rotor thrust disk must be against the active thrust bearing when measuring for rotor axial position.

The active thrust bearing and steam end bearing housing must be completely assembled when measuring for rotor axial position.

When changing shim pack thickness, the same thickness shims must be added to or removed from both top and bottom halves of thrust bearing shim pack.

To Determine the Rotor Float:

NOTE

The thrust bearing (active and inactive sides) and steam end bearing housing must be completely assembled when reading rotor float.

1. Attach a dial indicator perpendicular to a vertical shaft face (such as the thrust disk) to detect any axial rotor movement.

2. Jack the rotor as far as possible in both axial directions several times, observing the dial indicator. The total axial movement is the rotor float.

3. If the rotor float is not within tolerance, it will be necessary to change the inactive thrust bearing shim pack thickness.

NOTE

When changing shim pack thickness, the same thickness shims must be added to or removed from both top and bottom halves of thrust bearing shim pack. Shims should be made from a non-corroding metal and free from burrs. Make shim changes to the inactive thrust bearing shim pack when adjusting for rotor float.

Removal

1. Check rotor float.

2. Remove top half steam end bearing housing. Refer to the Steam End Bearing Housing section.

3. Remove thrust shoes one at a time while rotating thrust bearing retainer ring around shaft, then remove the retainer halves, being careful not to damage the shoes or machined surfaces.

NOTE

Keep all components of the thrust bearings in the order of removal. Tagging is recommended.

4. Remove thrust bearing end covers being careful not to damage oil seals.

Inspection

Inspect the thrust bearing shoes and thrust disk for excessive wear, scoring or wiping. Inspect the equalizer blocks and thrust shoe buttons for excessive wear. If any of these conditions exist, renewal is recommended.

CAUTION

When renewing parts, replace only complete sets of thrust bearing parts. DO NOT REPLACE INDIVIDUAL THRUST BEARING PARTS, i.e., one shoe, one equalizing block, etc.

Installation

The thrust bearing assembly should be clean, free from burrs and well oiled prior to replacement. Be sure that, as the thrust assemblies are placed into position, all parts are being replaced in the same position from which they were removed. Be sure that the anti-rotation devices are properly positioned and engage with mating notches.

1. Install thrust bearing end covers, be careful not to damage oil seal rings, if supplied.

2. Install the retainer ring halves. Rotate the retainer ring around the shaft while installing the thrust shoes one at a time. Be careful not to damage the shoes or machined surfaces. Replace any internal piping, wiring, etc.

3. Recheck the rotor axial float as previously described. If the float is not within design, recheck bearing adjustments.

4. Replace top half steam end bearing housing. Refer to steam end bearing housing assembly.

5. Replace all piping, wiring, etc.

CASING DIAPHRAGMS AND NOZZLE RINGS

The diaphragms are located vertically in the casing grooves by shims at the bottom of the grooves and laterally by means of adjusting screws at the horizontal joint. The upper halves of the diaphragms are fastened in the same manner to the top half turbine casing and remain with the turbine casing when it is lifted. The diaphragms are adjusted on assembly with a mandrel to allow for rotor deflection and insure that the packing is concentric with the shaft.

Removal

1. Remove top halves of packing cases. Refer to Packing Case Removal.

2. Remove all piping, linkage, etc. connected to top half turbine casing and steam chest. If steam chest cover is to be removed, refer to steam chest section and remove steam chest cover.

3. Remove turbine case horizontal flange bolting and dowels.

4. Insert guide studs, one each side of turbine casing.

CAUTION

Rotor must be in running position while removing top half turbine casing.

5. Insert jack screws to break turbine casing joint.

6. Rig top half turbine casing so that it is parallel to bottom half and slowly lift until clear of rotor and guide pins. When casing has been removed, set it on floor, resting on wooden blocks in a level position. (This will prevent machined surface damage and casing warpage.)

7. Remove rotor. Refer to rotor section.

8. Remove set screws at horizontal split of turbine casing retaining the diaphragms (one each side) and lift out diaphragms.

NOTE

Shims at the bottom of the diaphragm grooves in turbine casing are used to adjust diaphragms vertically in turbine casing and must be replaced in the order of removal. Do not intermix.

9. Remove bottom half nozzle ring caulking band.

10. Remove cap screws and lift out bottom half nozzle ring.

11. To remove top half nozzle ring, and diaphragm, the top half turbine casing must be turned over and properly supported in a level position. Repeat steps 8, 9, and 10.

Inspection

Inspect casing diaphragms and nozzle ring for steam cuts, cracking, corrosion, erosion, and build-up from boiler carryover. Replace damaged or worn parts. Remove any build-up and thoroughly clean all sealing compounds from all joints being careful not to remove any metal or damage any parts.

Installation

1. Make up joint between nozzle ring and turbine casing using Copaltite. Install the nozzle ring, insert cap screws and tighten. Prick punch capscrews.

2. Install new nozzle ring caulking band peening entire radius to a tight fit.

3. Install bottom half diaphragms in bottom half turbine casing and top half diaphragms in top half turbine casing. Adjust diaphragms for rotor deflection and concentricity to the shaft, and then roll in diaphragm shaft seals.

4. Replace rotor. Refer to Rotor section.

5. Make up turbine casing horizontal joint by applying a thin coating of Copaltite on flange surfaces. A study of the casing will doubtless be of great value, bearing in mind that chambers and passages subjected to different pressures must be isolated from each other. This is of importance in preventing steam leakage outward or air leakage into the casing.

   The sealing compound or its equivalent is applied on the casing horizontal flange inboard of the boltholes terminating at the vertical joint of the exhaust end packing case. The diaphragms also sealed with the same sealing compounds; placed on the downstream side but adjacent to the diaphragm keys and across the downstream side of the dasing diaphragm grooves to meet the casing horizontal joint sealant.

6. Insert guide rods in bottom half turbine casing.

7. Rig top half turbine casing to be parallel to bottom half turbine casing and lower slowly over guide rods onto bottom half turbine casing. Insert horizontal flange dowels just before top half casing contacts bottom half.

8. Insert horizontal flange nuts and tighten.

9. Rotate the rotor by hand to check for possible binding or interference.

10. Connect all piping, linkage, etc. that were removed for disassembly.

LABYRINTH SEALS

Removal

1. For complete inspection of all seals, the top half of both turbine casings must be removed. Refer to the appropriate sections.

2. Remove packing anti-rotation capscrews from steam end packing, exhaust end packing and diaphragm seals.

3. Remove packing springs, if used, and roll labyrinth sections out.

NOTE

Labyrinth sections are numbered and must be kept in the order of removal. Tagging is recommended.

To Remove Packing Retainers:

4. Remove rotor. Refer to Rotor Removal.

5. Remove anti-rotation set screws at horizontal split of bottom halves packing retainers.

6. Remove spacers, if used, from each side of bottom halves of steam end packing retainer and exhaust end packing retainer.

NOTE

These spacers are fit at assembly to maintain the axial position of the labyrinth packing and must be replaced in the same location. Tagging is recommended.

7. Lift out packing retainers.

Clearance Check

The labyrinth seal clearances should be checked each time the unit is disassembled as follows:

1. Remove the top and bottom sections of the labyrinth seals.

2. Assemble the top and bottom labyrinths securely together using a clamp (such as a hose clamp). Be sure the sections mate properly. Use shims between each labyrinth section if the seals are designed with a saw cut.

3. Measure the labyrinth inner diameters with an inside micrometer.

4. Measure the shaft diameter of the corresponding labyrinth locations with an outside micrometer.

5. The difference between the measurements in Steps 3 and 4, is the labyrinth seal diametral clearance.

NOTE

If these clearances exceed the design clearances, the labyrinth seal should be renewed.

An alternate method of checking labyrinth clearances:

NOTE

When using alternate method, all labyrinth sections must be shimmed tight. The shims are inserted between the O.D. of the labyrinth section and the I.D. of their corresponding slots.

1. With bottom section of all seals installed and shimmed, lay appropriate size strips of lead wire axially on the bottom center of the seals.

2. With journal bearings mounted, install rotor.

3. Use feeler gauge to check side clearances.

4. Place lead wire axially on the top center of the rotor shaft in the seal areas.

5. Assemble top halves of inner steam end and exhaust end packing retainers.

6. Replace top half of turbine casing and steam end packing case. Tighten bolting.

7. Remove top halves steam end turbine case, inner steam end packing, and exhaust end packing. Measure the flattened areas of lead wire which was placed on the top of the rotor.

8. Remove rotor and measure the flattened areas of lead wire placed on the bottom halves of seals. These measurements will be the radial clearances.

CAUTION

The shims used to backup the seals during lead wire measurements must be removed before running the unit.

Installation

1. Roll top and bottom sections of diaphragm labyrinth into diaphragm slots, insert and fasten springs, if used.

2. Apply Copaltite in the bottom turbine casing in the radial areas which contact the steam and exhaust end packing retainer and install packing retainer.

3. Insert spacers at each side of the bottom halves of the inner steam end and exhaust end packing retainers.

NOTE

Spacers must be replaced in the same locations from which they were removed.

4. Press bottom half packing retainers firmly in turbine casing, keeping horizontal splits even on both sides with turbine casing horizontal splits.

NOTE

The bottom halves must be pressed and held firmly into place until completion of Step 5.

5. Install anti-rotation set screws at horizontal splits of packing retainer.

6. Roll top and bottom labyrinth sections into the seal slots. Replace springs, if used, and anti-rotation keys.

7. Install rotor.

8. Mount top halves of labyrinth packing and tighten bolting at horizontal splits.

9. Apply Copaltite sealant on all top half packing retainer which contacts turbine casing, and assemble turbine casing. Refer to Casing, Diaphragms and Nozzle Rings section.

ROTOR REMOVAL AND INSPECTION

1. The rotor can be removed after the bearing cases, journal bearings, thrust bearings, top half turbine case, and top halves of casing end packing retainers have been removed.

2. When lifting or handling the rotor, rope, nylon slings or sheathed cables should be used to prevent damage to the machined surfaces. The slings should be placed outside the disks but not on the shaft journals. It is advisable to use a spacer between the slings immediately above the disks to separate the slings so that they do not come in contact with the disks or buckets. Care must be taken to prevent damage to labyrinth seals.

NOTE

The rotor must be kept level relative to the casing and should be lifted vertically until it has cleared the casing.

When setting the rotor down, support it so that the weight of the rotor does not rest on the disks. The rotor should not be supported on the shaft journal surfaces. Resting points can be protected by use of soft copper or lead sheet.

3. Examine the buckets, shrouds and disk assemblies to see that they have not been chipped, cracked, eroded or otherwise damaged. Examine the shaft areas for corrosion or grooving.

4. Examine the shaft journals to see that they are not scored or worn. Mechanically clean the rotor assembly, being careful not to remove any metal or damage it in any manner.

NOTE

Some turbines with vibration sensing equipment have specially prepared shaft vibration measurement areas near the shaft journals. These areas will appear blemished and discolored, which is normal. When this is found, care must be taken during maintenance work to preserve the shaft condition in this area, otherwise the compensation provided for electrical effects will be lost. The areas should be identified and protected when cleaning or handling the rotor. The shaft vibration measurement areas are indicated on the rotor assembly drawing.

5. The rotor assembly should be indicated for concentricity, then check balanced.

OVERSPEED TRIP (Electric)

Refer to the Woodward ProTech 203 Manual for information on the electronic overspeed trip system. The manual is located in Chapter 6 - Accessories.

CAUTION

Never operate the turbine unless the trip mechanism is known to be in proper working condition. Shut down by actually overspeeding the turbine whenever possible, keeping in mind the driven equipment, and noting the tripping speed and functioning of the trip mechanism and all protective valves operated by it. Also, after an extended idle period, test the trip several times before putting the unit in service.

SPEED PICK-UP, KEYPHASOR, AXIAL, AND VIBRATION ASSEMBLY

The speed pickup assembly consists of the pickup and gear wheel mounted on the turbine shaft directly below the pickup assembly at the exhaust end of the turbine. Axial and keyphasor probes are located on the steam end bearing housing, outboard. Vibration pickups are all located immediately outboard of the bearings at 45 Degree off centerlines.

Removal

1. Disconnect any piping and connections from pickup assembly. Tag in order of removal.

2. Unscrew the speed pick-up assembly and remove as a unit from exhaust end bearing housing.

NOTE

The Speed Pick-Up gear wheel is a permanently installed part of the rotor assembly. It should not be removed under normal circumstances. If it is removed, the entire rotor assembly should be rebalanced.

3. Unscrew the axial, vibration, and keyphasor assemblies and remove them from the steam end bearing housing.

Installation

1. Mount speed pickup assembly to bearing case using oil resistant sealant.

2. Adjust clearance between speed sensor tips and gear wheel to inches 1.02 ? 0.127 mm (0.040 ? 0.005).

3. Replace the axial, vibration, and keyphasor assemblies.

4. Check the gap of the axial probe, the setting should be 1.12 ? 0.05 mm (0.044 ? 0.002 inches). Check the gap of the keyphasor probe, the setting should be 0.79 ? 0.05 mm (0.031 ? 0.002 inches). Check the gap of the vibration probe, the setting should be 1.27 ? 0.127 mm (0.050 ? 0.005 inches).

5. Connect wiring to axial and keyphasor pick-ups.

6. Replace end cover.

7. Replace all piping and wiring. The piping must be connected in the order of removal.

INLET STEAM CHEST

STEAM CHEST

Removal

1. Remove all piping and linkage connections from steam chest cover. Tag in order of removal.

2. Remove steam chest cover nuts and dowels, lifting steam chest cover as a unit.

3. To remove lifting rods, the rod ends must first be disassembled from the links.

CAUTION
The links are spring loaded. Use cap screws for assembly and disassembly of links.

4. Remove lifting rods by removing roll pins and nuts and unscrew rod end from rod.

5. To remove valves, back away set screw in nut on top of valve stem and carefully remove nut. Make sure that the threads do not gall due to burrs in the setscrew hole. The valves can then be removed from the lift bar. Tag in order of removal.

6. The valve seats are lightly shrunk in and spot welded in three places to the steam chest and are removed by grinding the weld and freezing the seat to free it from the steam chest.

Inspection

1. Inspect valves, valve stems and valve seats for steam cutting, erosion and corrosion. Replace if necessary.

2. Inspect lifting rods and rod bushings for wear. Replace if necessary.

3. Check valve gear pins and bearings for wear. Replace if necessary.

Installation

1. The valve seats are shrunk in the steam chest by freezing. The valves are then spot welded in three places to steam chest.

2. Locate valves in the proper opening order, torque nuts with 20 ft-lb maximum torque, and secure with set screws. Prick punch metal over set screws to keep them from backing out.

CAUTION

Metal must be upset over the setscrew, otherwise, the setscrew or valve stem nuts may become loose and pass through the unit causing severe damage.

3. Replace lifting rods in steam chest cover, if removed, in the reverse of disassembly. Use capscrews for assembly.

4. Make up steam chest cover joint with Copaltite and a new gasket. Be sure joint surfaces are clean before applying sealing compounds.

5. Assembly cover to steam chest. Dowels and keys are provided to insure accurate assembly.

6. Assemble and tighten the Steam Chest cover bolting.

7. Connect linkage and all piping to steam chest cover.

SPARE ROTOR FIT-IN CHECK PROCEDURE

When the spare rotor will be assembled in the turbine, adjust it's location according to the following procedures.
The axial location of rotor should be determined based on the clearance between the nozzle ring and the first stage moving buckets.
After the rotor is properly located, adjust the rotor axial float as indicated in the Instruction Manual.
The adjusting procedures are also included in the Manual.
Finally, confirm that every radial or axial clearance (of packing, bearing, etc.) is proper within the tolerance specified in the "Turbine Assembly Drawing".

If any measured clearances are off the specified criteria, correct them according to the procedures in the Instruction Manual.

NOTES

TABLE 4-1 TROUBLESHOOTING GUIDE

TROUBLE	POSSIBLE CAUSE	CORRECTIVE ACTION
1. Low lube oil pressure	1. a. Faulty lube oil pressure gage or switch.	1. a. Calibrate or replace.
	b. Low oil level.	b. Add oil.
	c. Oil pump suction plugged.	c. Clear pump suction.
	d. Leak in oil pump suction piping.	d. Tighten leaking connections, and/or place gaskets.
	e. Clogged oil filter.	e. Clean or replace oil filter cartridges.
	f. Failure of main and auxiliary oil pumps.	f. Repair or replace pumps.
	g. Operation at a very low speed without the auxiliary oil pump running. (if main oil pump is shaft driven).	g. Increase speed or operate the auxiliary oil pump to increase oil pressure.
	h. Relief valve improperly set or stuck open.	h. 1. Adjust relief valve 2. Recondition or replace relief valve.
	i. Incorrect pressure control valve setting or operation.	i. Check control valve for correct setting and operation.
	j. Oil leakage.	j. 1. Tighten flanged or threaded connections. 2. Replace defective gaskets.
	k. Bearing oil orifices missing or plugged.	k. Check to see that oil orifices are installed and are not obstructed. Refer to the lube system schematic diagram for orifice locations.
	l. Clogged or restricted oil cooler.	l. Clean or replace cooler.

TABLE 4-1 TROUBLESHOOTING GUIDE
(Continued)

TROUBLE	POSSIBLE CAUSE	CORRECTIVE ACTION
2. Excessive bearing oil drain temperature and/ or bearing wear.	2. a. Faulty temperature gage(s).	2. a. Replace temperature gage(s).
	b. Inadequate or restricted flow of lube oil to bearings.	b. 1. See #1 in "TROUBLE" column. 2. If pressure is satisfactory, check for restrictions in flow of lube oil to the affected bearings.
	c. Poor conditions of lube oil or dirt or gummy deposits in bearing.	c. 1. Change oil. 2. Inspect and clean oil strainer or filter more frequently. 3. Inspect and clean bearings. 4. Check with oil supplier to see correct oil is being used.
	d. Inadequate cooling water to lube oil cooler.	d. 1. Increase cooling water supply. 2. Check design cooling water inlet temperature.
	e. Fouled oil cooler, oil or water side.	e Clean or replace oil cooler.
	f. Wiped bearing.	f. 1. Replace journal bearings. 2. Determine and correct cause of wiped bearing.
	g. Excessive oil viscosity.	g. 1. Refer to Chapter 5 for oil requirements. 2. Check oil requirements with supplier.
	h. Vibration.	h. See Item #3.
	i. Water in lube oil.	i. See Item #5.
	j. Rough rotor shaft journal surface.	j. 1. Stone or chrome plate journal, if practical. 2. Replace shaft, if necessary.

TABLE 4-1 TROUBLESHOOTING GUIDE
(Continued)

TROUBLE	POSSIBLE CAUSE	CORRECTIVE ACTION
3. Excessive vibration. **NOTE:** **Vibration may be transmitted from the coupled machine. To localize vibration, disconnect coupling and operate driver alone. This should help to indicate whether the driver or driven machine is causing the vibration.**	3. a. Improperly assembled parts.	3. a. Shut down, dismantle, inspect and correct. If any changes are made to the rotor, the rotor should be balanced prior to operation.
	b. Loose or broken bolting.	b. Check bolting at support assemblies. Check bedplate bolting, tighten or replace.
	c. Piping strain.	c. Inspect piping arrangement and proper installation of pipe hangers, springs, or expansion joints.
	d. Sympathetic vibration.	d. Adjacent machinery can cause vibration when the unit is shutdown, or at certain speeds due to foundation or piping resonance. A detailed investigation is required in order to take corrective measures.
	e. Shaft misalignment.	e. Check shaft alignment at operating temperatures. Correct any misalignment.
	f. Dry coupling.	f. Lubricate coupling.
	g. Worn or damaged coupling.	g. Replace the coupling.
	h. Bent rotor shaft caused by uneven heating or cooling.	h. 1. Turn the rotor at low speed (500 to 1000 rpm) until vibration stops, then gradually increase speed to operating speed. If vibration occurs at higher speeds, reduce speed to a point below that where the vibration occurs. Hold speed at this point for a while, then increase speed again. If vibration continues, shut down the unit, determine and correct the cause. 2. Straighten or replace shaft.

TABLE 4-1 TROUBLESHOOTING GUIDE (Continued)

TROUBLE	POSSIBLE CAUSE	CORRECTIVE ACTION
	i. Operating in or near critical speed.	i. Operate at other than the critical speed.
	j. Build-up of deposits on rotor.	j. 1. Clean the wheels and blading. 2. Check balance.
	k. Unbalanced rotor.	k. 1. Inspect rotor for signs of rubbing. 2. Check rotor for concentricity, cleanliness, loose disks, buckets or shrouds. 3. Re-balance rotor.
	l. Damaged rotor.	l. 1. Replace or repair rotor. 2. Re-balance rotor.
	m. Excessive bearing clearance.	m. Replace bearings.
	n. Liquid "slugs" striking rotor.	n. 1. Locate and remove source of liquid. 2. Drain the casing of any accumulated liquid.
	o. Loose rotor parts (rare case).	o. Repair or replace the loose part.
4. Shaft Misalignment.	4. a. Piping Strain.	4. a. 1. Inspect for proper installation of pipe hangers, springs, and expansion joints. 2. Inspect the piping arrangements and correct as necessary.
	b. Warped foundation or bedplate.	b. 1. Check for possible settling of the foundation support. Correct footing as required. 2. Check for uneven temperatures surrounding the foundation or bedplate causing distortion.

TABLE 4-1 TROUBLESHOOTING GUIDE
(Continued)

TROUBLE	POSSIBLE CAUSE	CORRECTIVE ACTION
5. Water in lube oil.	5. a. Leak in lube oil cooler tube(s) or tube-sheet.	5. a. 1. Hydrostatically test the tubes and tube sheets for leaks and repair as necessary. Refer to manufacturer's instructions for test pressure and procedures. 2. Replace zinc protector rods (if installed) more frequently if leaks are due to electrolytic action of cooling water.
	b. Condensation in oil reservoir.	b. 1. During operation, maintain a minimum lube oil reservoir temperature of 120°F (49°C) to permit evaporation of entrained water. To avoid excessive oil vaporization does not exceed a reservoir temperature of 150°F (65°C). 2. When shutting down, stop cooling water flow to the oil coolers when bearing oil drain temperatures are equal to the lube oil cooler outlet temperature.
6. Turbine fails to start.	6. a. No steam pressure at steam inlet.	6. a. 1. Check shutoff valve(s) between the turbine and boiler to be sure they are open. 2. Check the steam strainer to see that it is not clogged. 3. Check to see if trip valve is in the open position.
	b. No steam pressure at steam chest.	b. 1. Check that the steam governor valve(s) stem(s) is not binding and sticking in the closed position. 2. Check the governor valve linkage(s) to be sure it is not binding.

TABLE 4-1 TROUBLESHOOTING GUIDE
(Continued)

TROUBLE	POSSIBLE CAUSE	CORRECTIVE ACTION
6. Turbine fails to start. (Continued)	6. c. No lube oil pressure.	6. c. The lube oil system must be pressurized to reset the low lube trip mechanisms before the turbine can be started.
	d. Faulty or improperly set low lube oil pressure mechanism(s).	d. Repair or replace faulty mechanism(s) and adjust.
	e. Rotor assembly binding.	e. Manually rotate the rotor. If binding or rubbing, dismantle and correct the cause.
	f. Steam nozzles.	f. Loss of power will usually occur before scale deposits build-up sufficiently to clog nozzles. However, if nozzles are clogged, then turbine must be dismantled to clean nozzles.
	g. ~~Governor oil level low.~~	g. ~~Add oil.~~
	h. ~~Woodward governor low lube oil shut down.~~	h. ~~Refer to Woodward governor bulletin, Chapter 6.~~
7. Turbine will not come up to speed or refuses to accept the load. **NOTE** ** Indicates when nozzle ring pressure is lower than steam inlet pressure. * Indicates when nozzle ring pressure equals or nearly equals steam inlet pressure.	7. a.** Binding or interference in governor linkage.	7. a. Correct binding or interferences. Lubricate as required.
	b.* Restricted steam flow at inlet.	b. 1. Clean or replace steam strainer. 2. Check that trip and throttle and/ or other valves between turbine and boiler are fully open.
	c.* Steam nozzles partially plugged.	c. Clean nozzles.
	d.** Steam inlet control valve(s) not fully open	d. 1. Check valve stem for possible binding. 2. Loosen or replace tight packing. 3. Check that valve(s) and linkages are operating throughout full travel

TABLE 4-1 TROUBLESHOOTING GUIDE
(Continued)

TROUBLE	POSSIBLE CAUSE	CORRECTIVE ACTION
7. Turbine will not come up to speed or refuses to accept the load. (Continued) **NOTE** ** Indicates when nozzle ring pressure is lower than steam inlet pressure. * Indicates when nozzle ring pressure equals or nearly equals steam inlet pressure.	7. e.** Improper air signal to governor (if pneumatic con trolled). f.* ~~Improper positioning of hand valves (if provided).~~ g.* Low steam supply pressure and/or temperature. h.* High steam exhaust pressure. I.* Load exceeds turbine rating.	7. e. 1. Check for proper air signal to the governor speed changer. 2. Check for air leaks in air signal line. f. ~~Refer to Table 3-1 for proper hand valve settings~~. g. Increase steam supply pressure/temperature to the design values. Refer to Table 3-1 h. Reduce exhaust pressure to design value. Refer to Table 3-1. i. Reduce load to design. Do not operate the turbine in excess of specified contract rating.
8. Excessive steam leakage past shaft-end seals.	8. a. Worn or damaged packing. b. Packing case and/or packing (labyrinth or carbon ring) not properly installed.	8. a. Replace packing. b. 1. Examine packing case for burrs, foreign matter on horizontal or vertical joints preventing proper fit Clean, if necessary. 2. Examine packing for foreign matter. 3. Examine packing springs (when used) holding segments in position. Replace weak or broken springs. 4. ~~Examine carbon ring grooves for cleanliness. Clean as required~~.

TABLE 4-1 TROUBLESHOOTING GUIDE
(Continued)

TROUBLE	POSSIBLE CAUSE	CORRECTIVE ACTION
8. Excessive steam leakage past shaft-end seals. (Continued)	8. b. Packing case and/or packing (labyrinth ~~or carbon ring~~) not properly installed.	8. b. 5. ~~Carbon rings should be free to float axially. The outboard face of the carbon rings must seat against a true clean surface in the packing case groove~~.
	c. shaft under packing rings scored, corroded or fouled with dirt.	c. 1. Clean and polish shaft or shaft sleeves. 2. If necessary, replace shaft sleeves (if provided) or chrome plate the shaft as required.
	d. Back pressure on packing case.	d. Check for restrictions in leak-off lines and water traps.
	e. Improper vacuum on gland exhaust system (if installed).	e. Maintain the recommended vacuum on the gland exhaust system. Refer to the leak-off system schematic for the designed leak-off pressure. If this pressure cannot be maintained, check for satisfactory operation of the ejector, leaks in the leak-off piping and the gland condenser cooling water supply flow and temperature.
9. Excessive steam consumption.	9. a. Nozzle and/or turbine wheels excessively worn or damaged.	9. a. Inspect rotor and nozzle. Repair or replace defective parts.
	b. Worn or damaged shaft interstate seals.	b. Replace shaft seals.
	c. ~~Improper positioning of hand valves (if provided).~~	c. ~~Position hand valves properly. Refer to Table 3-1.~~
10. Turbine does not cool after shutdown.	10.a. Steam leakage into secured turbine.	10.a. Check trip and throttle valve or steam shut-off valve to see that it is closed tight. If valve is closed, check for valve leaks.

TABLE 4-1 TROUBLESHOOTING GUIDE
(Continued)

TROUBLE	POSSIBLE CAUSE	CORRECTIVE ACTION
10. Turbine does not cool after shutdown. (Continued)	10.a. Steam leakage into secured turbine. (Continued)	b. See that steam is not backing up into the casing from another source. c. Check exhaust valve (if non-condensing turbine) to see if it is closed tight. If closed, check for valve leaks and correct valve seating.
11. ~~Rapid wear of governor worm gear~~.	11.a. ~~Damaged or defective worm or worm wheel~~. b. ~~Misalignment between worm and worm wheel~~.	11.a. ~~Replace damaged parts~~. b. ~~Reposition the governor horizontally on the steam end bearing case to provide 0.006" to 0.008" backlash between the worm and worm wheel. Adjust the vertical position of the governor by adjusting the shim pack thickness between the governor and bearing case to give approximately 80% worm to worm wheel tooth contact. After final positioning, dowel governor to the bearing case~~.
12. Speed increases as load is decreased.	12.a. Leaky governor valve(s) or seats. b. Slow responding governor due to worn or sticking parts. c. Governor valve(s) not fully closed.	12.a. Repair and/or replace valve(s) or seats. b. Free all sticking parts such as governor linkage pivot points and valve stem(s). Replace worn parts. c. Adjust the valves and/or linkage to properly seat the valve(s).
13. Trip valve not functioning properly.	13.a. Trip improperly adjusted. b. Defective trip mechanism, springs or latches.	13.a. Test the overspeed trip regularly. Adjust the trip to actuate at the speed given in Table 3-1. b. Inspect the condition of all trip parts. Replace defective parts.

TABLE 4-2

TURBINE DESIGN CLEARANCES

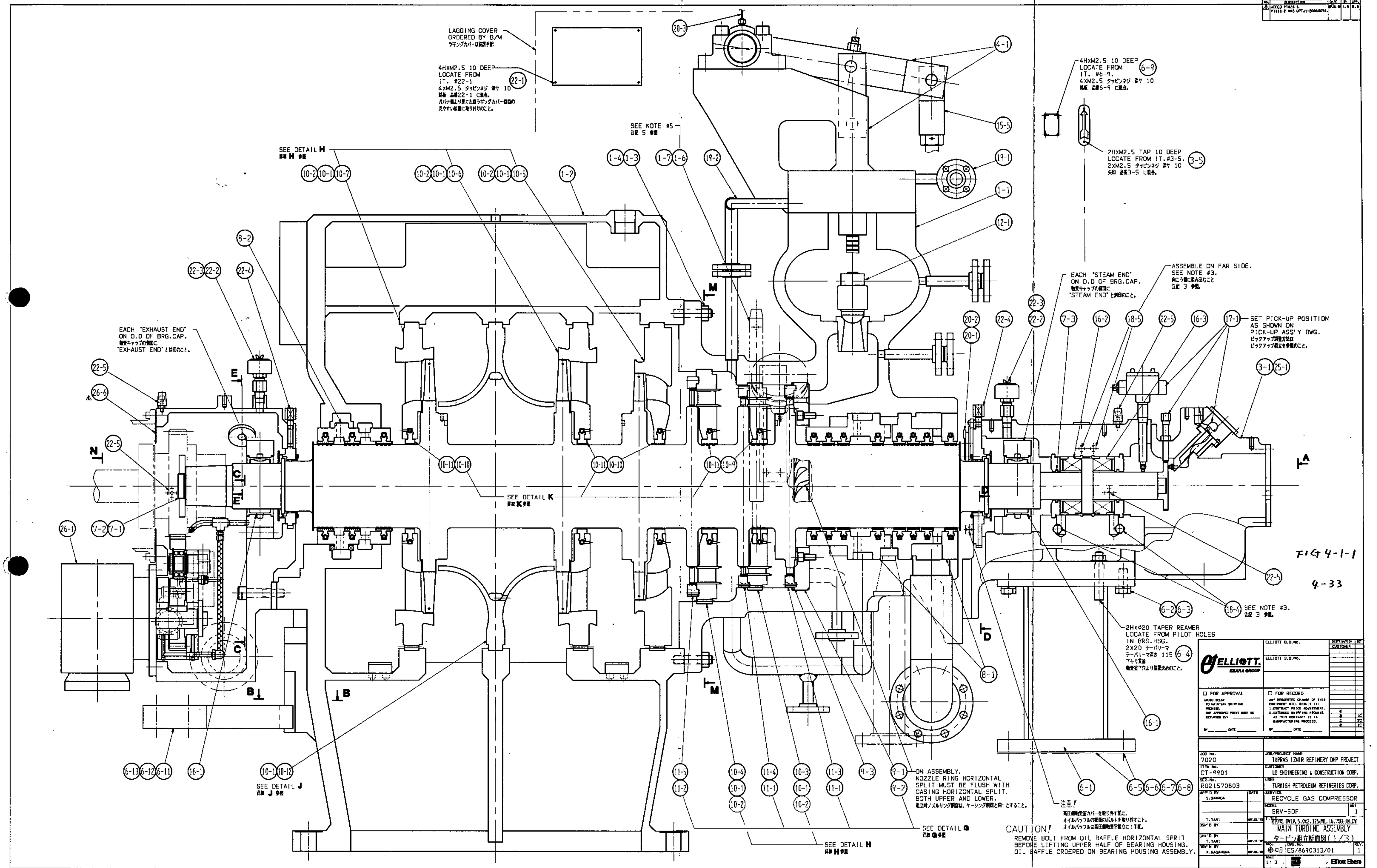
EBARA SERIAL NUMBER: R021570803

ITEM CT-9901

FRAME: SRV-5DF

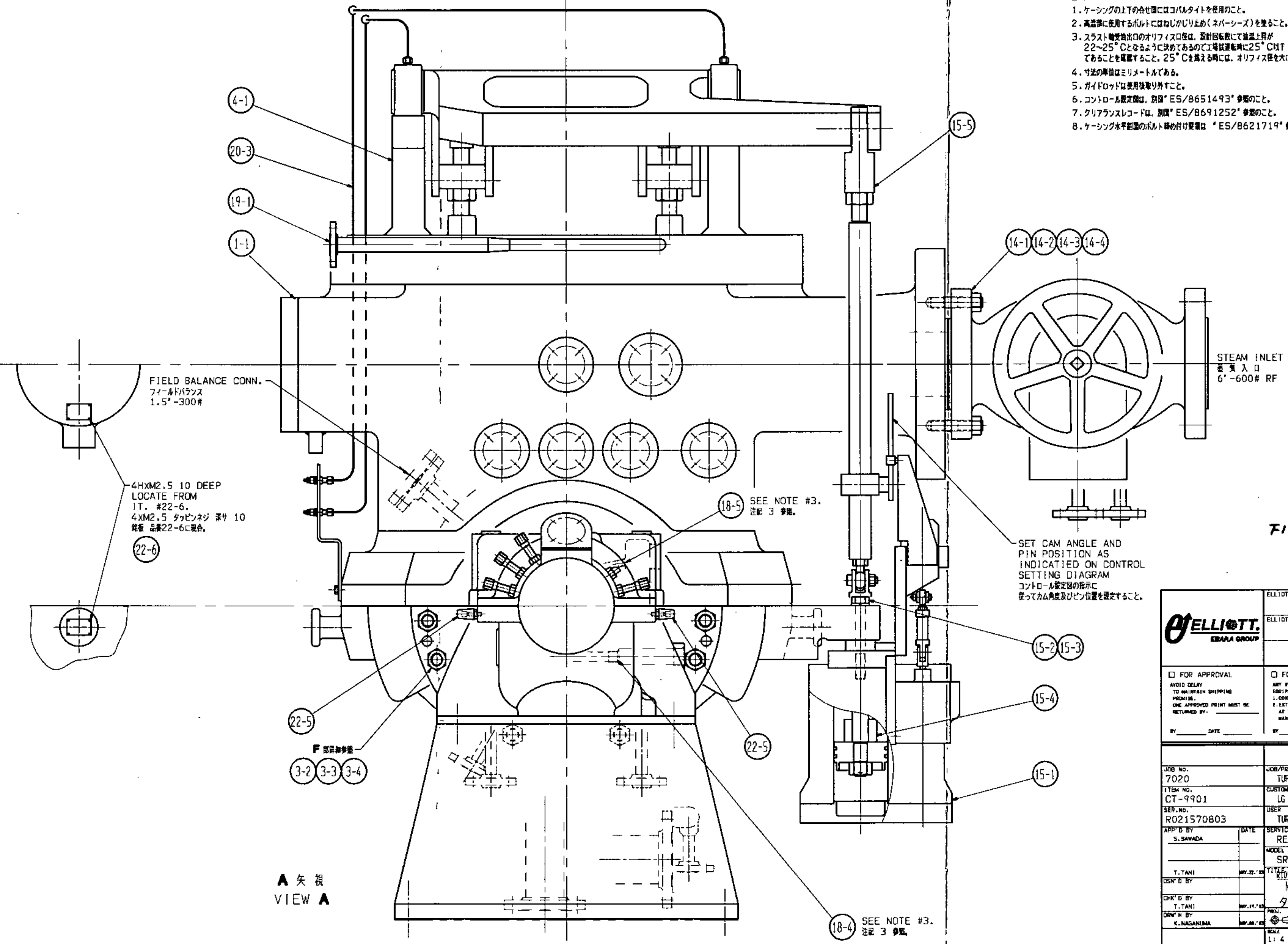
	mm Minimum	Maximum
SHAFT SEALS (RADIAL):		
Steam End	0.39	0.47
Exhaust End	0.39	0.47
Diaphragm	0.39	0.47
JOURNAL BEARINGS (DIAMETRAL):		
Steam End Journal	0.191	0.242
Exhaust End Journal	0.127	0.178
THRUST BEARING:		
Rotor Axial Float	0.23	0.30
DIAPHRAGM TO DISC (AXIAL):		
Stages 2, 3	1.35	2.11
Stages 4	6.11	6.86
Stages 5,5DF	2.93	3.69
NOZZLE RING (AXIAL):		
Stage 1	1.44	1.70
Stage		
OIL BAFFLES (RADIAL):		
Steam End	0.13	0.18
Exhaust End	0.13	0.18
COUPLING HUB PULL-UP:	3.66±0.13	

NOTES


LAGGING COVER ORDERED BY B/M
ラギングカバーは別途手配
4HxM2.5 10 DEEP LOCATE FROM IT. #22-1
4xM2.5 タッピンネジ 深サ 10
EACH "EXHAUST END" ON O.D OF BRG.CAP.
SEE DETAIL H
SEE DETAIL K
SEE DETAIL J
SEE NOTE #5
注記 5 参照
4HxM2.5 10 DEEP LOCATE FROM IT. #6-9.
4xM2.5 タッピンネジ 深サ 10
2HxM2.5 TAP 10 DEEP LOCATE FROM IT.#3-5.
2xM2.5 タッピンネジ 深サ 10
EACH "STEAM END" ON O.D OF BRG.CAP.
"STEAM END" と刻印のこと。
ASSEMBLE ON FAR SIDE. SEE NOTE #3.
SET PICK-UP POSITION AS SHOWN ON PICK-UP ASS'Y DWG.
SEE NOTE #3.
2Hxφ20 TAPER REAMER LOCATE FROM PILOT HOLES IN BRG.HSG.
ON ASSEMBLY, NOZZLE RING HORIZONTAL SPLIT MUST BE FLUSH WITH CASING HORIZONTAL SPLIT. BOTH UPPER AND LOWER.
SEE DETAIL Q
SEE DETAIL H
CAUTION!
REMOVE BOLT FROM OIL BAFFLE HORIZONTAL SPRIT BEFORE LIFTING UPPER HALF OF BEARING HOUSING. OIL BAFFLE ORDERED ON BEARING HOUSING ASSEMBLY.
FIG 4-1-1
4-33
ELLIOTT EBARA GROUP
FOR APPROVAL
FOR RECORD
JOB No. 7020
JOB/PROJECT NAME TUPRAS IZMIR REFINERY DHP PROJECT
ITEM No. CT-9901
CUSTOMER LG ENGINEERING & CONSTRUCTION CORP.
SER.No. R021570803
USER TURKISH PETROLEUM REFINERIES CORP.
APP'D BY S.SAWADA
SERVICE RECYCLE GAS COMPRESSOR
MODEL SRV-5DF
SET 1
T.TANI
TITLE R109S, DW1A, 5.0x2.125JNL, 16.75G-IN, CW
MAIN TURBINE ASSEMBLY
タービン組立断面図(1/3)
CHK'D BY T.TANI
DRW'N BY K.NAGANUMA
DWG.No. ES/8690313/01
REV. 1
SCALE 1:3
Elliott Ebara

Q'TY/1SET 1台分個数 GR5	GR4	GR3	GR2	GR1	PART NAME	部品名	NO. 番号	EBARA PARTS NO. エバラ 部品番号	DESCRIPTION 記事
				1	CASING ASSEMBLY	高圧ケーシング	1-1	E8620678-60	STEAM END
				1	CASING ASSEMBLY	排気ケーシング	1-2	E8621720-25	EXHAUST END
				40	STUD	FM24STX105	1-3	FST-H24105	
				4	STUD	FM24STX90	1-4	FST-H24090	
							1-5		
				2	GUIDE, ROD	ガイドロッド	1-6	B720386-1	STEAM END
				2	NUT	FM24N	1-7	FN-A24	STEAM END
				2	GUIDE, ROD	ガイドロッド	1-8	B845150-9	EXHAUST END
				1	BRG.HSG.ASS'Y	高圧側軸受室組立	3-1	E8641583-310	STEAM END
				6	STUD	FM30SKX115	3-2	FSK-H30115	
				6	WASHER, LOCK	ZRB-M30	3-3	ZRB-J30	
				2	PIN, DOWEL	ピン	3-4	B845906-16	
				1	ARROW ROTATION	矢 印 YA-80	3-5	YA-880	
							3-6		
				1	BRG.HSG.ASS'Y	低圧側軸受室組立	3-7	E8641787-60	EXHAUST END
				4	SCREW, CAP	BSH-M24X80	3-8	BSH-H24080	
				2	SCREW, CAP	BSHW-M24X105	3-9	BSHW-H24105	
				2	PIN, DOWEL	平行ピン	3-10	B845906-40	
				1	WIRE	WAR-1.2X5M	3-11	WAR-B1205	
				1	STM. CHEST COVER ASS'Y	蒸気室カバー組立	4-1	B654467-27	INLET
				1	SUPPORT	高圧側支持脚	6-1	B667661-5	STEAM END
				6	STUD	FM24TX55	6-2	FT-A24055	
				6	WASHER, LOCK	ZR-M24	6-3	ZR-J24	
				2	PIN, TAPER	BST-20X100	6-4	BST-H20100	
				1	SHIM	シム	6-5	E8642128-GR.1	STEAM END
				4	STUD	FM36TX75	6-6	FT-A36075	
				4	PIN, TAPER	BST-20X90	6-7	BST-H20090	
				2	SCREW, JACK	STB-M22X70	6-8	STB-A22070	
				1	CAUTION PLATE	注意書銘板	6-9	E8663085-1	FOR OIL BAFFLE
				1	SUPPORT ASS'Y	支持脚組立	6-10	E8641777-GR.3	EXHAUST END
				1	KEY PLATE	キープレート	6-11	E8622297-1	EXHAUST END
				2	PIN, TAPER	BST-16X85	6-12	BST-H16085	
				4	STUD	FM24TX95	6-13	FT-A24095	
				1	ROTOR ASS'Y	ローター組立	7-1	E8600459-40	
				1	COUPLING NUT	カップリングナット	7-2	P28F16	4.5°, CW
				1	OIL SEAL RING	オイルシールリング	7-3	A635647-40	
				1	PACKING ASS'Y	高圧側パッキン組立	8-1	E8632323-GR.1	STEAM END
				1	PACKING ASS'Y	低圧側パッキン組立	8-2	E8632325-GR.1	EXHAUST END
				1	NOZZLE RING ASS'Y	ノズルリング組立	9-1	E8611663-3	
				26	SCREW-CAP	BSH-M16X35	9-2	BSH-HA16035	
				2	CAULKING BAND	コーキンバンド	9-3	A638182-23	
				24	SCREW, SET	CS-M12X45	10-1	CS-H1245	
				5	SHIM, DIAPHRAGM	ダイヤフラム用シム	10-2	E8613027-4	
				1	DIAPHRAGM ASS'Y	ダイヤフラム組立	10-3	E8610937-101	2ND.
				1	DIAPHRAGM ASS'Y	ダイヤフラム組立	10-4	E8610938-112	3RD.
				1	DIAPHRAGM ASS'Y	ダイヤフラム組立	10-5	E8610939-6	4TH.
				1	DIAPHRAGM ASS'Y	ダイヤフラム組立	10-6	E8610940-6	5TH.
				1	DIAPHRAGM ASS'Y	ダイヤフラム組立	10-7	E8610941-6	5DF.
							10-8		
				2	SEAL DIAPHRAGM	ダイヤフラムパッキン	10-9	E8632328-10	2ND., 3RD
				3	SEAL DIAPHRAGM	ダイヤフラムパッキン	10-10	E8632329-10	4, 5TH, 5DF.
				10	SPRING	スプリング	10-11	A655312-11	
				1	DIFFUSER	ディフューザー	10-12	E8621728-8	
				24	SCREW, CAP	BSH-M6X35	11-1	BSH-HT06035	1ST., 2ND.
				8	SCREW, CAP	BSH-M10X35	11-2	BSH-HT10035	3RD.
				1	SEAL RING ASS'Y	シールリング組立	11-3	E8631592-5	1ST.
				1	SEAL RING ASS'Y	シールリング組立	11-4	E8630090-62	2ND.
				1	SEAL RING ASS'Y	シールリング組立	11-5	E8630093-65	3RD.
				1	VALVES & SEATS ASS'Y	加減弁及び弁座組立	12-1	E8651492-GR.1	INLET
				1	T&T VALVE ASS'Y	主蒸気止め弁組立	14-1	E8650051-102	6"-600#ME
				1	GASKET	ガスケットJPI.6"-600#.RF.t=4.5	14-1	GDP4-2ES5048B45	V#8596
				1	LIMIT SWTCH ASS'Y	リミットスイッチ組立	14-3	E8652223-GR.22	YAMATAKE:LSXA3K+LSZ51C
				1	SPRING SUPPORT	スプリングサポート組立	14-3	E8652143-10	
				1	SERVO MOTOR ASS'Y	サーボモーター組立	15-1	B658994-GR.3	5", VALTEK
				2	STUD	FM24TX180	15-2	FT-H24180	
				2	WASHER, LOCK	ZR-M24	15-3	ZR-J24	
				1	SPACER	スペーサー	15-4	A647024-45	
				1	LINKAGE ASS'Y	リンク組立	15-5	B710159-GR.15	
				2	JOURNAL BRG. ASS'Y	ジャーナル軸受	16-1	E8641793-17	5.0x2.125" JNL
				1	THRUST BRG. ASS'Y	スラスト軸受(負荷側)	16-2	E8641791-13	16.7SQ-IN.-ACT.
				1	THRUST BRG. ASS'Y	スラスト軸受(反負荷側)	16-3	E8641792-17	16.7SQ-IN.-INACT.
				1	PICK-UP ASS'Y	ピックアップ組立	17-1	E8671819-203	STEAM END
				2	SENSING PROBE ASS'Y	振動計ピックアップ組立	17-2	E8670045-GR.53	EXHAUST END
				1	PLATE, ORIFICE	オリフィスプレート	18-1	OPTJ1-B0060068	TAG-No.FO-616
				1	PLATE, ORIFICE	オリフィスプレート	18-2	OPTJ1-B0060110	TAG-No.FO-615 △
				2	CHAIN, SASH	くさりひも	18-3	P311Z9312	
				2	PLUG, ORIFICE	OPLN-3/4X5.6	18-4	OPLN-E06056	THR., INLET
				2	PLUG, ORIFICE	OPLN-3/8X8.1	18-5	OPLN-E03081	THR., DRAIN
				1	PIPING, VALVE LEAK	加減弁リークオフ配管	19-1	E8672899-10	OUTER
				1	PIPING, VALVE LEAK	加減弁リークオフ配管	19-2	E8677033-10	INNER

Q'TY/1SET 1台分個数 GR5	GR4	GR3	GR2	GR1	PART NAME	部品名	NO. 番号	EBARA PARTS NO. エバラ 部品番号	DESCRIPTION 記事
				1	CARBON BRUSH ASS'Y	カーボンブラシ組立A	20-1	E8631227-17	
				1	CARBON BRUSH ASS'Y	カーボンブラシ組立B	20-2	E8631227-18	
				1	LIBRICATION ARR'T	グリス配管組立	20-3	E8671759-16	
				1	NAME PLATE	要項銘板	22-1	E8662376-1	
				2	ADAPTER	アダプター	22-2	E8833074-1	
				2	AIR BREATHER	エアブリーザー	22-3	AP-06-150WEL	
				2	ORIFICE ADAPTER	オリフィスアダプター	22-4	E8643414-3	φ6.3mm
				6	ALIGNMENT TOOL	アライメントツール	22-5	P255B063	FLAT
				7	CAUTION PLATE	注意書銘板	22-6	P6200B008-1	
				4	CAUTION PLATE	注意書銘板	22-7	P6200B013-1	
				1	DETECTOR ASS'Y	RTD組立	25-1	E8671817-10	STEAM END
				1	DETECTOR ASS'Y	RTD組立	25-2	E8671818-10	EXHAUST END
				1	TURNING GEAR UNIT	ターニングギヤユニット	26-1	-	SIMPO
				4	SCREW, CAP	FM8TX35	26-2	FT-A08035	
				4	WASHER	ZM-M8	26-3	ZM-A08	
				1	SHIM	シム	26-4	-	WITH/TURNING GEAR UNIT
				1	LIMIT SWITCH ASS'Y	リミットスイッチ組立	26-5	E8652739-GR.1	YAMATAKE:LSXA3K+LSZ51C
				1	PLATE, BAFFLE	バッフルプレート	26-6	E8643425-1	t=3.0 △
				X	TURBINE ASSEMBLY	タービン組立	50	E8690313-50	



NOTES

1. APPLY PASTE TYPE GASKET(COPALTITE) TO STEAM CASING JOINTS.
2. APPLY ANTI SEIZE LUBRICANT TO THE SCREW THREADS SUBJECTED TO HIGH TEMPERATURE.
3. THRUST BRG. ORIFICE DISCHARGE SIZE MAY HAVE TO BE ADJUSTED ON TEST FLOOR TO MAINTAIN A TEMP. RISE OF 22~25°C AT DESIGN SPEED.
4. ALL DIMENSIONS ARE IN MILLIMETERS.
5. GUIDE RODS MUST BE REMOVED. GUIDE RODS TO BE SHIPPED SEPARATE.
6. FOR CONTROL SETTING DIAGRAM SEE DWG.'ES/8651493'.
7. FOR CLEARANCE RECORD SEE DWG.'ES/8691252.
8. TIGHTEN BOLTING PER SEQUENTIAL BOLTING DIAGRAM DWG. 'ES/8621719'.

注記

1. ケーシングの上下の合せ面にはコパルタイトを使用のこと。
2. 高温部に使用するボルトにはねじかじり止め(ネバーシーズ)を塗ること。
3. スラスト軸受油出口のオリフィス口径は、設計回転数にて油温上昇が22~25°Cとなるように決めてあるので工場試運転時に25°C以下であることを確認すること。25°Cを越える時には、オリフィス径を大にすること。
4. 寸法の単位はミリメートルである。
5. ガイドロッドは使用後取り外すこと。
6. コントロール設定図は、別図' ES/8651493' 参照のこと。
7. クリアランスレコードは、別図' ES/8691252' 参照のこと。
8. ケーシング水平割面のボルト締め付け要領は ' ES/8621719' 参照のこと。

FIG 4-1-2

4-34

ELLIOTT. EBARA GROUP

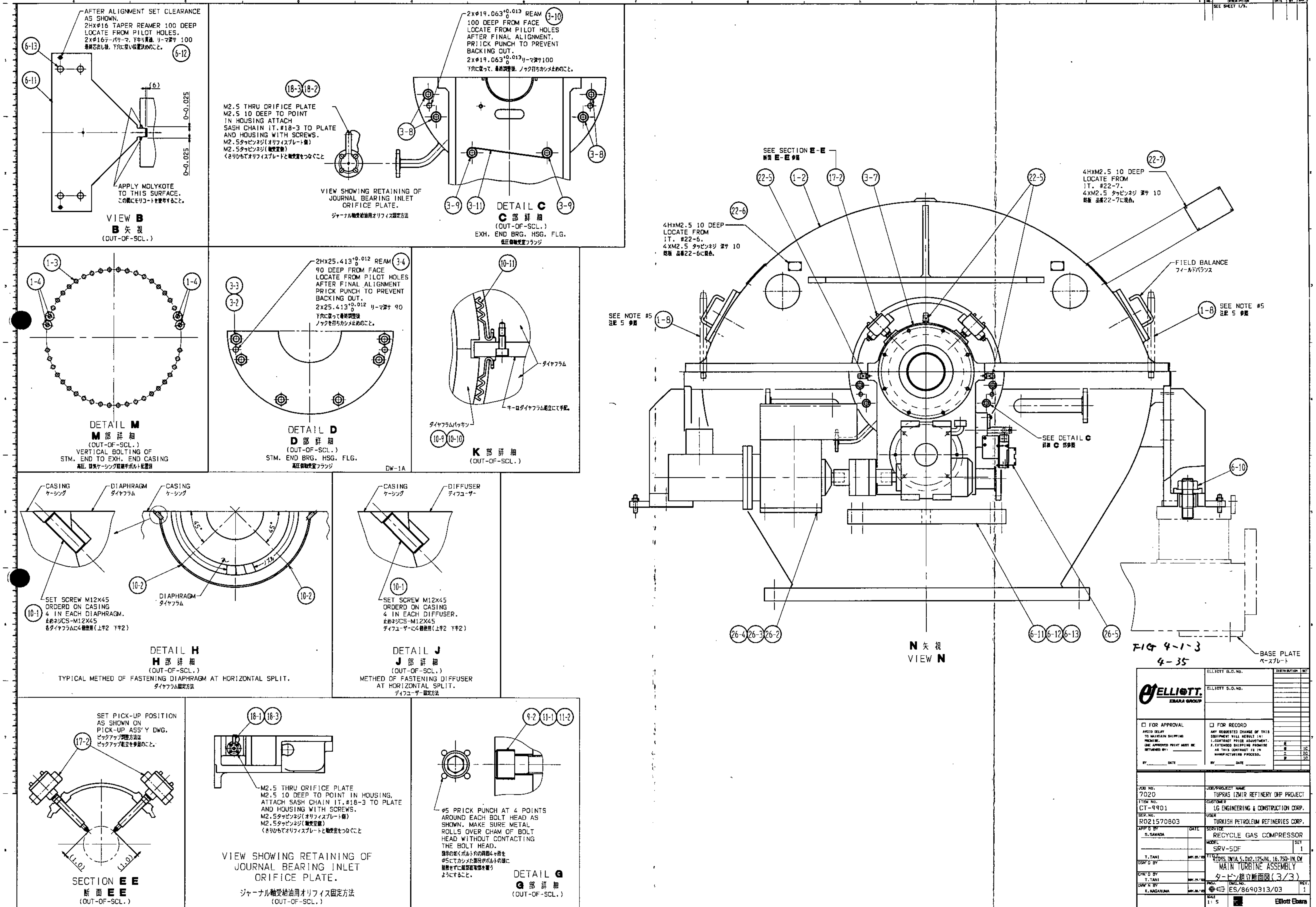
ELLIOTT G.O.NO.

ELLIOTT S.O.No.

☐ FOR APPROVAL
AVOID DELAY TO MAINTAIN SHIPPING PROMISE. ONE APPROVED PRINT MUST BE RETURNED BY: ______
BY ______ DATE ______

☐ FOR RECORD
ANY REQUESTED CHANGE OF THIS EQUIPMENT WILL RESULT IN:
1. CONTRACT PRICE ADJUSTMENT.
2. EXTENDED SHIPPING PROMISE AS THIS CONTRACT IS IN MANUFACTURING PROCESS.
BY ______ DATE ______

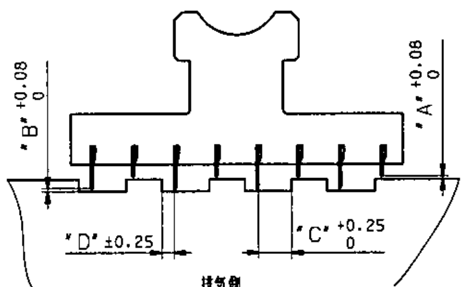
JOB NO. 7020	JOB/PROJECT NAME: TUPRAS IZMIR REFINERY DHP PROJECT
ITEM NO. CT-9901	CUSTOMER: LG ENGINEERING & CONSTRUCTION CORP.
SER.NO. R021570803	USER: TURKISH PETROLEUM REFINERIES CORP.
APP'D BY S.SAWADA; T.TANI	SERVICE: RECYCLE GAS COMPRESSOR
DSN'D BY	MODEL: SRV-5DF; SET: 1
CHK'D BY T.TANI	TITLE: R1095, DW1A, 5.0X2.125JNL, 16.7SQ-IN, CW MAIN TURBINE ASSEMBLY タービン組立断面図(2/3)
DRW'N BY K.NAGANUMA	DWG. NO. ES/8690313/02; REV. 1
SCALE 1:4	Elliott Ebara



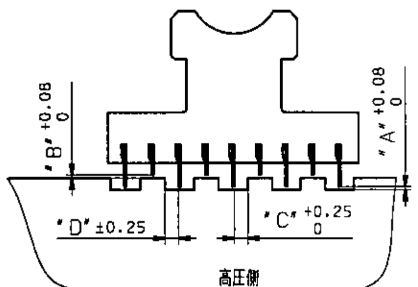
ELLIOTT. EBARA GROUP	ELLIOTT O.O. NO. / ELLIOTT S.O. NO.
☐ FOR APPROVAL — AVOID DELAY TO MAINTAIN SHIPPING PROMISE. ONE APPROVED PRINT MUST BE RETURNED BY: ___ BY ___ DATE ___	☐ FOR RECORD — ANY REQUESTED CHANGE OF THIS EQUIPMENT WILL RESULT IN: 1.CONTRACT PRICE ADJUSTMENT. 2.EXTENDED SHIPPING PROMISE AS THIS CONTRACT IS IN MANUFACTURING PROCESS. BY ___ DATE ___
JOB NO. 7020	JOB/PROJECT NAME: TUPRAS IZMIR REFINERY DHP PROJECT
ITEM NO. CT-9901	CUSTOMER: LG ENGINEERING & CONSTRUCTION CORP.
SER.NO. R021570803	USER: TURKISH PETROLEUM REFINERIES CORP.
APP'D BY S.SAWADA	SERVICE: RECYCLE GAS COMPRESSOR
T.TANI	MODEL: SRV-5DF — SET 1
DSN'D BY	TITLE: R1095.DW1A.5.DX2.125/NL.16.75D-IN.CW MAIN TURBINE ASSEMBLY タービン組立断面図(3/3)
CHK'D BY T.TANI	
DRW'N BY K.NAGANUMA	DWG.NO. ES/8690313/03 — REV. 1
SCALE 1:5	Elliott Ebara

パッキンの隙間
PACKING CLEARANCES

パッキンの隙間 / PACKING CLEARANCES			
	排気側 EXHAUST END	高圧側 STEAM END	
	設計値 DESIGN	設計値 DESIGN	
A	0.39	0.39	
B	0.39	0.39	
C	4.47	1.78	
D	1.58	1.78	

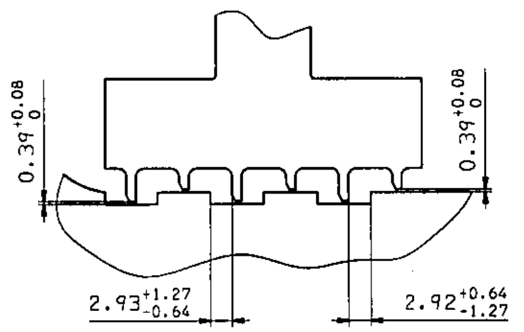


排気側 EXHAUST END

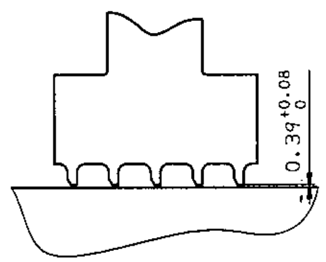


高圧側 STEAM END

蒸気の流れ
STEAM FLOW

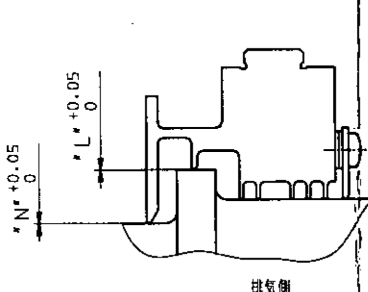


2, 3段目
STAGE 2~3RD.

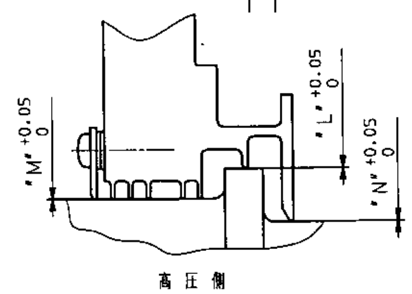


4, 5, 5DF段目
STAGE 4, 5, 5DF TH.

ダイヤフラムパッキンの隙間
DIAFRAM SEAL CLEARANCE



排気側
EXHAUST END



高圧側
STEAM END

オイルバッフルの隙間
OIL BAFFLE CLEARANCE

	排気側 EXHAUST END	高圧側 STEAM END
	設計値 DESIGN	設計値 DESIGN
L	0.13	0.15
M	0.13	0.15
N	0.13	0.16

注記
隙間を測定後、オイルバッフル下半の垂直中心線上で隙間が
0.025mm以上になるよう調整のこと。
必要な場合オイルバッフルの内径側を削ること。

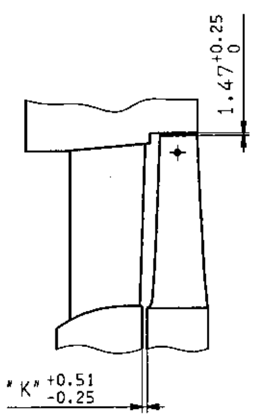
NOTES
AFTER CHECKING THESE CLEARANCES,
ADJUST OIL SEALS TO HAVE OVER 0.025mm
CLEARANCE ON BOTTOM VERTICAL ℄
STONE I.D. OF SEALS IF NECESSARY
TO OBTAIN CLEARANCE.

	ジャーナル軸受隙間(直径) / JOURNAL BRG.CLEARANCES	
	軸径/JOURNAL(φ)	隙間(直径)/CLEARANCE(φ)
	設計値/DESIGN	設計値/DESIGN
高圧側 STEAM END	$126.873^{0}_{-0.013}$	0.191~0.242
排気側 EXHAUST END	$126.937^{0}_{-0.013}$	0.127~0.178

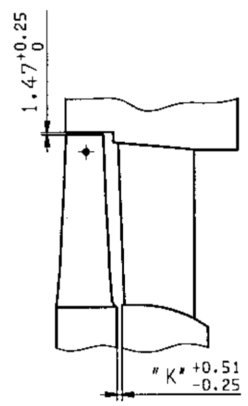
注記
1. 設計の承諾なしにクリアランスを得るため、加工してはいけない。
2. スラスト軸受を組み込んだ時のローターフロート（スラスト軸受サイズ 16.7SQ-IN）0.23~0.30

NOTES
1. NO PIECES ARE TO BE MACHINED TO SATISFY CLEARANCE RECORD WITHOUT AUTHORIZATION FROM ENGR. DEPT.
2. ROTOR FLOAT WITH THRUST BRG. IN PLACE IS 0.23 TO 0.30.

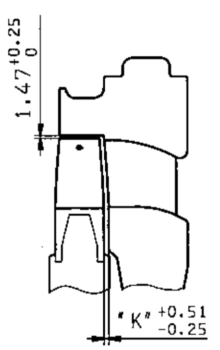
FIG 4-2
4-36



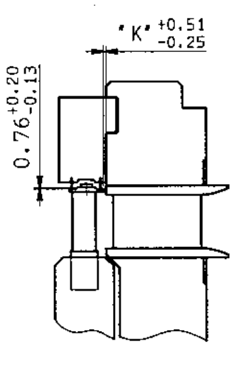
5DF段目の隙間
5DF.TH STAGE CLEARANCE
(#219/636)



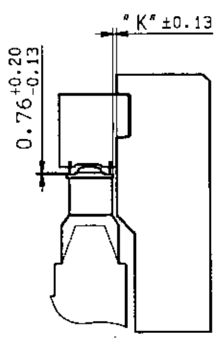
5段目の隙間
5TH STAGE CLEARANCE
(#219/636)



4段目の隙間
4TH STAGE CLEARANCE
(#25/66B)



2, 3段目の隙間
2ND., 3RD STAGE CLEARANCE
(#137/407)



1段目の隙間
1ST STAGE CLEARANCE
(#11B/401A-1)

ダイアフラムの隙間
DIAFRAM CLEARANCES

段数 STAGE	"K" 計算値 DESIGN
#1	1.57
#2	1.60
#3	1.60
#4	6.35
#5	3.18
#5DF	3.18

動翼隙間（ローターを負荷側スラスト軸受に押し付けた状態）
ROTOR RUNNING CLEARANCES WITH ROTOR DOWNSTREAM IN THRUST BEARING.

ELLIOTT EBARA GROUP	ELLIOTT G.O.NO. / ELLIOTT S.O.NO.
☐ FOR APPROVAL — AVOID DELAY TO MAINTAIN SHIPPING PROMISE. ONE APPROVED PRINT MUST BE RETURNED BY: ____ BY ____ DATE ____	☐ FOR RECORD — ANY REQUESTED CHANGE OF THIS EQUIPMENT WILL RESULT IN: 1.CONTRACT PRICE ADJUSTMENT. 2.EXTENDED SHIPPING PROMISE AS THIS CONTRACT IS IN MANUFACTURING PROCESS. BY ____ DATE ____
JOB NO. 7020	JOB/PROJECT NAME TUPRAS IZMIR REFINERY DHP PROJECT
ITEM NO. CT-9901	CUSTOMER LG ENGINEERING & CONSTRUCTION CORP.
SER.NO. R021570803	USER TURKISH PETROLEUM REFINERIES CORP.
APP'D BY S.SAWADA	SERVICE RECYCLE GAS COMPRESSOR
T.TANI MAY.19.'03	MODEL SRV-5DF — SET 1
DSN'D BY	TITLE R1095, DW1A, 5.0X2.125JNL, 16.7SQ-IN, CW クリアランスレコード CLEARANCE RECORD
CHK'D BY T.TANI MAY.19.'03	PROJ. — DWG.NO. ES/8691252 — REV. 0
DRW'N BY K.NAGANUMA MAY.08.'03	SCALE 1:NTS — Elliott Ebara

REVISIONS				
NO.	DESCRIPTION	DATE	BY	APP.

CAD登録済(SF)
PM841C

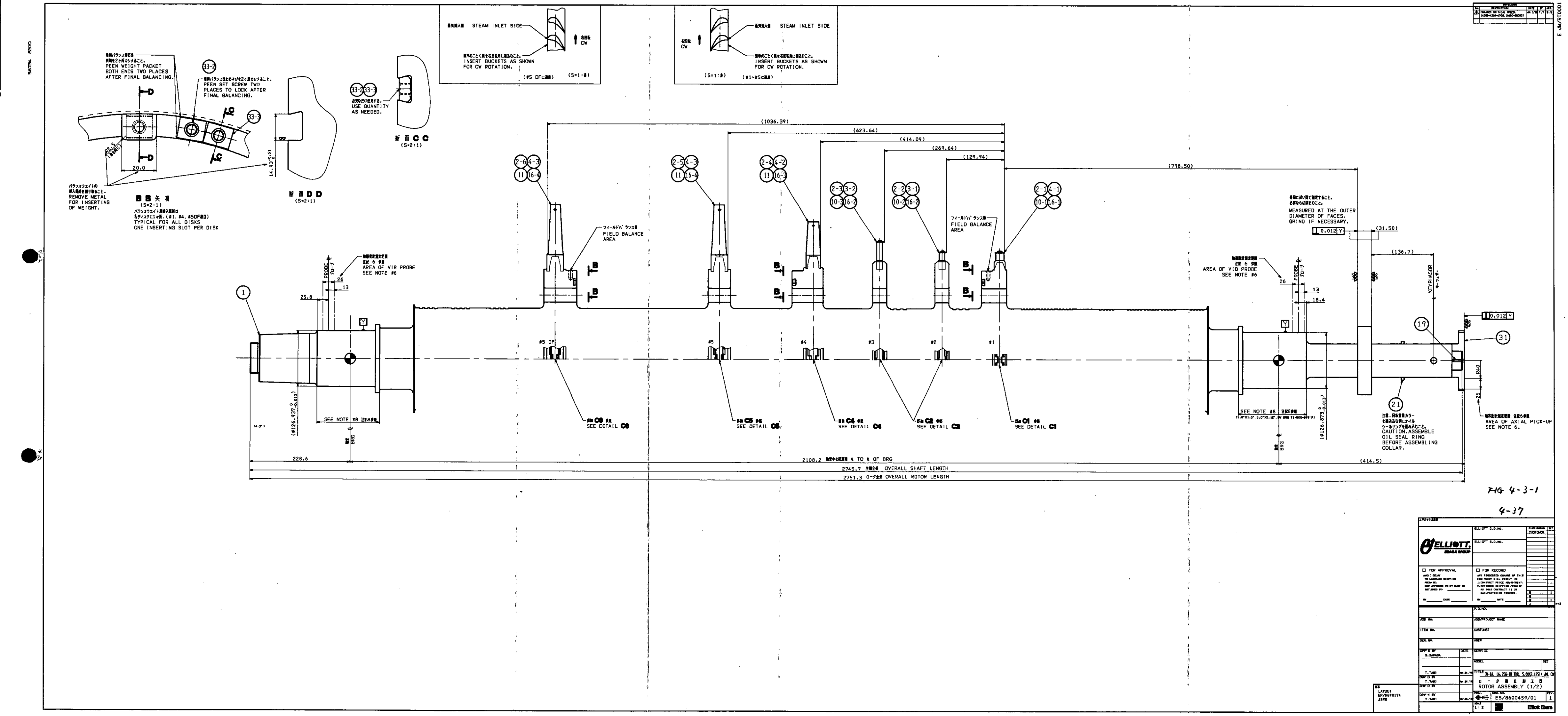


FIG 4-3-1

4-37

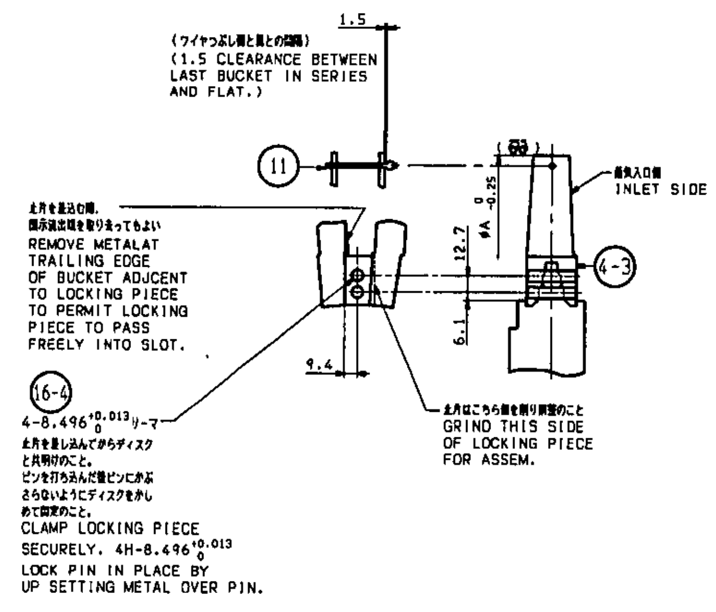
ELLIOTT ELLIOTT GROUP	ELLIOTT S.O.NO.	
ELLIOTT S.O.NO.		
☐ FOR APPROVAL	☐ FOR RECORD	
JOB NO.	JOB/PROJECT NAME	
ITEM NO.	CUSTOMER	
REF. NO.	USER	
DRWN BY S.SAHADA	DESCRIPTION	
T.TAKEI	MODEL	KIT
CHK'D BY T.TAKEI	TITLE 28-14, 16.750-18 THR, 5.000-12518 JNL CR ロータ組立加工図 ROTOR ASSEMBLY (1/2)	
APP'D BY T.TAKEI	DWG. NO. ES/8600459/01	REV. 1
	SIZE A2	SCALE 1:2

Elliot Ebara

56734 S370

E JM/RT0002

REVISIONS			
SEE SHEET 1/2			

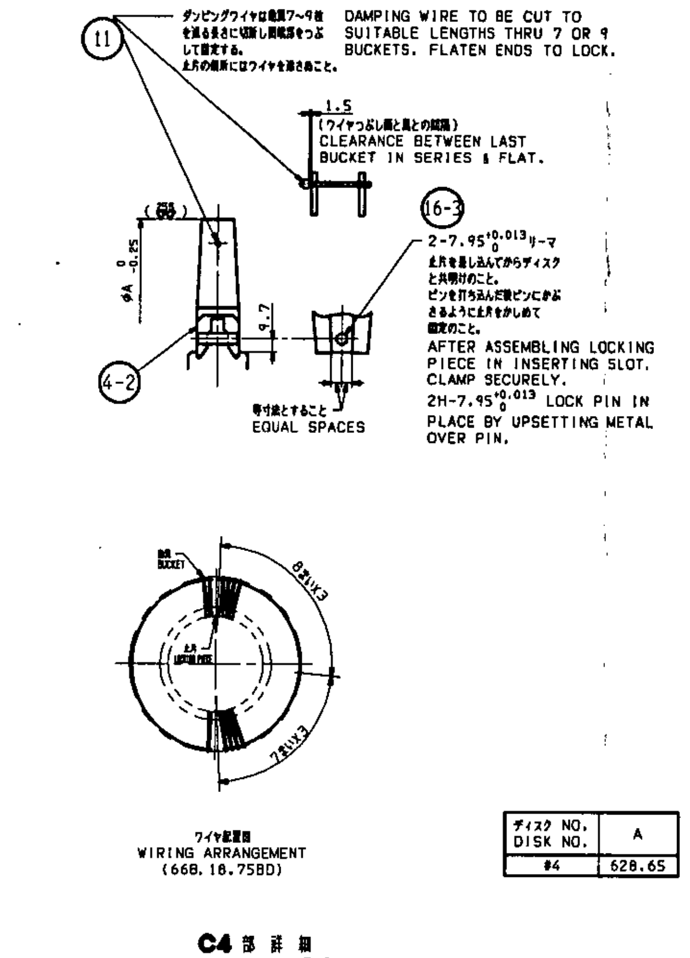


1.5
(1.5 CLEARANCE BETWEEN LAST BUCKET IN SERIES AND FLAT.)
11
INLET SIDE
4-3
12.7
6.1
9.4
φA 0 -0.25
REMOVE METALAT TRAILING EDGE OF BUCKET ADJCENT TO LOCKING PIECE TO PERMIT LOCKING PIECE TO PASS FREELY INTO SLOT.
GRIND THIS SIDE OF LOCKING PIECE FOR ASSEM.
16-4
4-8.496 +0.013 0
CLAMP LOCKING PIECE SECURELY. 4H-8.496 +0.013 0 LOCK PIN IN PLACE BY UP SETTING METAL OVER PIN.

(636, 18.75BD, W/L.P.)
LASHING WIRE TO BE CUT TO SUITABLE LENGTH. LENGTH TO GO THRU 12 GROUPS OF 6 BUCKETS. SPACE GROUPS WITH EQUAL NO. OF BUCKETS 180° OPPOSITE EACH OTHER. WIRE NOT TO SPAN LOCKING PIECE.

ディスク NO. DISK NO.	A
#5	704.85

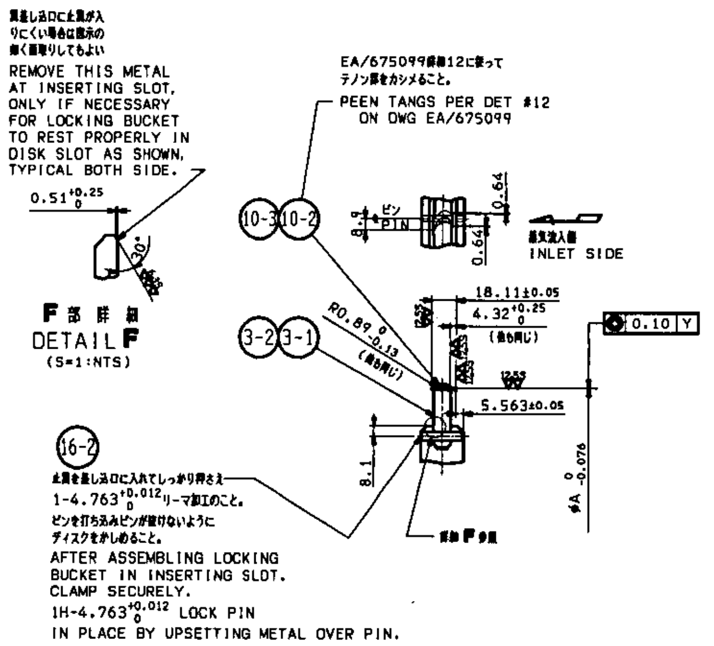
C5 部詳細 DETAIL **C5** (636翼) (BUCKET 636) CW (S=1:1)



11
DAMPING WIRE TO BE CUT TO SUITABLE LENGTHS THRU 7 OR 9 BUCKETS. FLATEN ENDS TO LOCK.
1.5
CLEARANCE BETWEEN LAST BUCKET IN SERIES & FLAT.
16-3
2-7.95 +0.013 0
AFTER ASSEMBLING LOCKING PIECE IN INSERTING SLOT, CLAMP SECURELY. 2H-7.95 +0.013 0 LOCK PIN IN PLACE BY UPSETTING METAL OVER PIN.
4-2
9.7
EQUAL SPACES
φA 0 -0.25
WIRING ARRANGEMENT (668, 18.75BD)

ディスク NO. DISK NO.	A
#4	628.65

C4 部詳細 DETAIL **C4** (668翼) (BUCKET 668) CW & CCW (S=1:1)

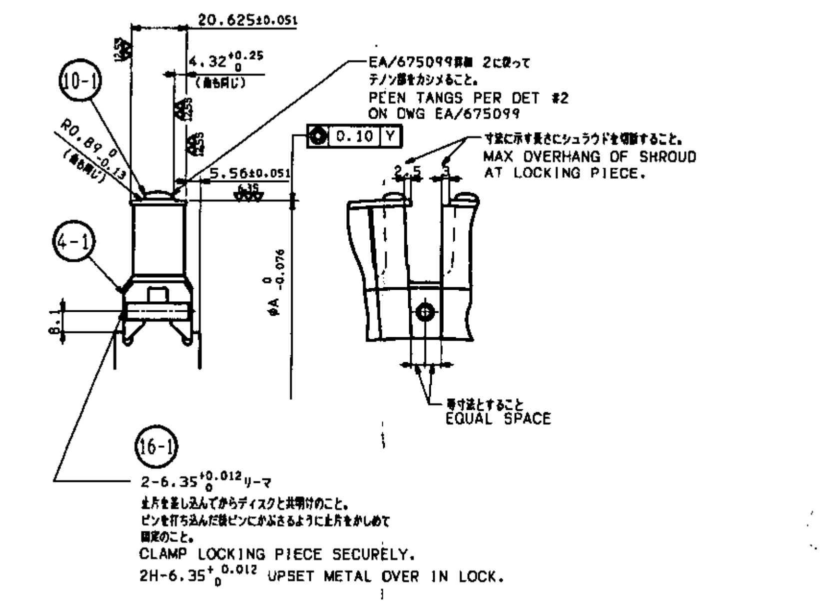


REMOVE THIS METAL AT INSERTING SLOT, ONLY IF NECESSARY FOR LOCKING BUCKET TO REST PROPERLY IN DISK SLOT AS SHOWN, TYPICAL BOTH SIDE.
0.51 +0.25 0
F 部詳細 DETAIL F (S=1:NTS)
EA/675099
PEEN TANGS PER DET #12 ON DWG EA/675099
10-3
10-2
3-2
3-1
INLET SIDE
0.64
18.11±0.05
4.32 +0.25 0
0.10 Y
5.563±0.05
8.1
R0.89
φA 0 -0.076
16-2
1-4.763 +0.012 0
AFTER ASSEMBLING LOCKING BUCKET IN INSERTING SLOT, CLAMP SECURELY. 1H-4.763 +0.012 0 LOCK PIN IN PLACE BY UPSETTING METAL OVER PIN.

(FOR SHROUD TYPE BUCKET ONLY)
AFTER TANGS ARE RIVETED, SAWCUT SHROUD TO GIVE 1.0~1.5 GAP BETWEEN SECTIONS.
(407, 14.88BD, 17.84BD, 25.34BD, 29.34BD, 33.34BD)
COMPLETED SHROUD TO BE IN SECTIONS SPANNING 8 BUCKETS. START SHROUD 4 BUCKETS FROM INSERTING SLOT.

ディスク NO. DISK NO.	A
#2	491.261
#3	538.886

C2 部詳細 DETAIL **C2** (407翼) (BUCKET 407) CW (S=1:1)

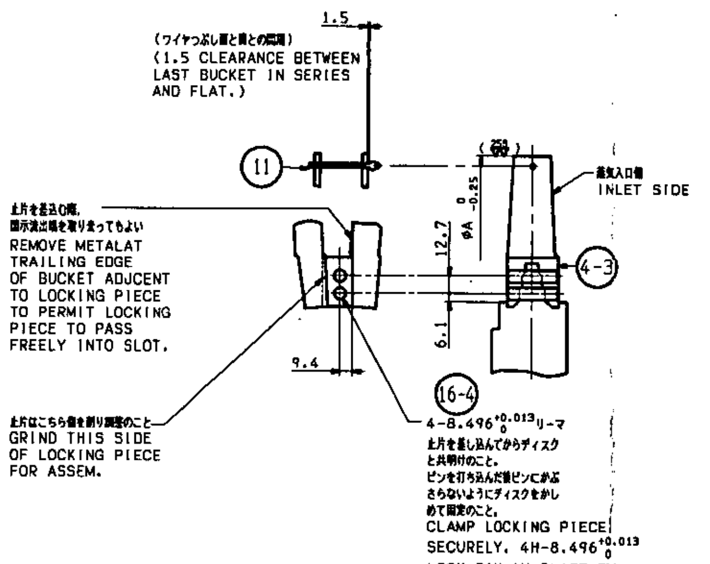


(FOR SHROUD TYPE BUCKET ONLY)
AFTER TANGS ARE RIVETED, SAWCUT SHROUD TO GIVE 1.0~1.5 GAP BETWEEN SECTIONS.
(401-A1, 51A, ALL BD, W/L.P.)
COMPLETED SHROUD TO BE IN SECTIONS SPANNING 12 TO 15 BUCKETS. START SHROUD AT INSERTING SLOT.

ディスク NO. DISK NO.	A
#1	489.204

C1 部詳細 DETAIL **C1** (401-A1翼)(BUCKET 401-A1) CW (S=1:1)

Q'TY GR2	Q'TY GR1	PART NAME	部品名	NO.	ELLIOT PARTS NO.	EBARA PARTS NO.	DESCRIPTION
	1	SHAFT	主軸	1	-	E8601602-1	
	112	BUCKET	動翼(401-A1)	2-1	-	A606954-30	#1 STAGE
	167	BUCKET	動翼(407)	2-2	-	A652378-202	#2 STAGE
	167	BUCKET	動翼(407)	2-3	-	A652378-253	#3 STAGE
	90	BUCKET	動翼(668)	2-4	-	ACS0344-39	#4 STAGE
	72	BUCKET	動翼(636)	2-5	-	E8602386-1	#5 STAGE
	72	BUCKET	動翼(636)	2-6	-	E8602387-1	#5 DF STAGE
	1	LOCKING BUCKET	止翼(407)	3-1	-	A652378-222	#2 STAGE
	1	LOCKING BUCKET	止翼(407)	3-2	-	A652378-273	#3 STAGE
	2	LOCKING PIECE	止片(401-A1)	4-1	-	A690174-1	#1 STAGE
	2	LOCKING PIECE	止片(668)	4-2	-	A681658-12	#4 STAGE
	4	LOCKING PIECE	止片(636)	4-3	-	A682323-2	#5-#5 DF
	1	SHROUD RING	シュラウドリング(401-A1)	10-1	-	A635530-32	#1 STAGE
	1	SHROUD RING	シュラウドリング(407)	10-2	-	A669732-34	#2 STAGE
	1	SHROUD RING	シュラウドリング(407)	10-3	-	A669732-45	#3 STAGE
	3	LASHING WIRE	レーシングワイヤ	11	-	E8603104-1	#4-#5 DF STAGE
	2	PIN	翼固定用ピン(401-A1)	16-1	-	A671987-1	#1 STAGE
	2	PIN	翼固定用ピン(407)	16-2	-	E8602215-19	#2-#3
	2	PIN	翼固定用ピン(668)	16-3	-	A671987-4	#4 STAGE
	8	PIN	翼固定用ピン(636)	16-4	-	A671987-71	#5-#5 DF
	1	PIN	ピン	19	-	P36L76	FOR COLLAR
	1	OIL SEAL RING	オイルシールリング	21	-	A639992-9	FOR 16.7 SQ-IN
	1	COLLAR	回転計用カラー	31	-	A711783-1	FOR SPD PICK-UP
	60	SET SCREW	止めねじ	33-2	-	P23B50	FOR BALANCE
	60	BALANCE WEIGHT	バランスウェイト	33-3	-	A720408-1	FOR BALANCE
	X	ASSEMBLY	ローター組立加工	40	-	E8600459-40	



1.5
(1.5 CLEARANCE BETWEEN LAST BUCKET IN SERIES AND FLAT.)
11
INLET SIDE
4-3
12.7
6.1
9.4
φA 0 -0.25
REMOVE METALAT TRAILING EDGE OF BUCKET ADJCENT TO LOCKING PIECE TO PERMIT LOCKING PIECE TO PASS FREELY INTO SLOT.
GRIND THIS SIDE OF LOCKING PIECE FOR ASSEM.
16-4
4-8.496 +0.013 0
CLAMP LOCKING PIECE SECURELY. 4H-8.496 +0.013 0 LOCK PIN IN PLACE BY UP SETTING METAL OVER PIN.

(636, 18.75BD, W/L.P.)
LASHING WIRE TO BE CUT TO SUITABLE LENGTH. LENGTH TO GO THRU 12 GROUPS OF 6 BUCKETS. SPACE GROUPS WITH EQUAL NO. OF BUCKETS 180° OPPOSITE EACH OTHER. WIRE NOT TO SPAN LOCKING PIECE.

ディスク NO. DISK NO.	A
#5DF	704.85

C6 部詳細 DETAIL **C6** (636翼) (BUCKET 636) (S=1:1)

5DF	636	0.25	1.02
5	636	0.25	1.02
4	668	0.12	0.76
3	407	0.25	REFER TO DETAIL C2
2	407	0.25	REFER TO DETAIL C2
1	401-A1	0.12	0.61
STAGE	BKT TYPE	MACHINING ALLOWANCE	BUCKET MAXIMUM OVERHANG LENGTH

表-5. TABLE 5. MACH.ALLOWANCE & OVERHANG LENGTH

表-1. TABLE-1. ROTOR OVER SPEED TEST SPEC.

TEST SPEED	TOLERANCE	UNIT	TESTING PERIOD	UNIT
12452	±124	min^{-1}	3	分 min.

表-2. TABLE-2. HIGH-SPEED BALANCE SPEC.

TEST SPEED (min^{-1})		ALLOWABLE VIB. LIMIT	UNIT
M.C. SPEED	10828	25.4	μm
TRIP SPEED	11911	SEE TEST PROCEDURE	μm

表-3. TABLE-3. ALLOWABLE RESIDUAL UNBALANCE (AT EACH OF THE 2 END PLANES)
PRIOR TO HIGH SPEED BALANCE, ROTOR ASSEMBLY SHOULD BE BALANCED PER THE FOLLOWING TABLE(SEE NOTES 5, 9)

BALANCING METHOD	ALLOWABLE LIMIT	UNIT
3-PLANE BALANCING	(STEAM END) * 277	g-mm
	(EXH. END) * 315	

表-4. TABLE-4. ROTOR SPECIFICATION

ITEM		DATA	UNIT
ROTOR MASS		1010	kg
SPEED RANGE		7218~10828	min^{-1}
TRIP SPEED	MECHANICAL	-	min^{-1}
	ELECTRICAL	11911±119	min^{-1}
CRITICAL SPEED (CALCULATED)	FIRST CRITICAL	4200~4700	min^{-1}
	SECOND CRITICAL	18000	min^{-1}
ALLOWABLE RUNOUT	RADIAL VIBRATION	6.35	μm
	AXIAL MOVEMENT	12.7	μm

1. START BUCKET ASSEMBLY WITH 2 BUCKETS OF EQUAL MASS, DIAMETRICALLY OPPOSITE. MAINTAIN THIS PROCEDURE THROUGHOUT. FORCE BUCKETS SOLIDLY TOGETHER USING LUBRICANT. NO SHIMS MAY BE USED, EXTRA BUCKETS ADDED, INSERTING SLOTS ENLARGED, OR BUCKETS WELDED WITHOUT AUTHORIZATION FROM PRODUCT ENGINEER.
2. MACHINING ALLOWANCE IN TABLE-5 MAY BE GROUND OFF THE NECESSARY NUMBER OF BUCKETS UNTIL THE MATERIAL OVERHANGING THE INSERTING SLOT ON EACH SIDE DOES NOT EXCEED THE VALUE IN TABLE-5.
4. PERFORM HIGH-SPEED BALANCING INDICATED PER ESM-112-23. REFER TO TABLE-2.
5. PERFORM DYNAMIC BALANCING INDICATED PER SP-209. REFER TO TABLE-3.
6. NO CHROME PLATING IN SENSING PROBE AREA. REFER TO TABLE-4.
7. PERFORM OVER SPEED TEST. REFER TO TABLE-1.
8. RESIDUAL MAGNETISM SHALL NOT EXCEED 3 GAUSS(0.0003 TESLA).
9. PRIOR TO HIGH SPEED BALANCE, ROTOR ASSEMBLY SHOULD BE BALANCE CHECKED WITH REFERENCE VALUE MARKED *.

FIG 4-3-2
4-38

ELLIOTT EBARA GROUP
□ FOR APPROVAL
□ FOR RECORD
LAYOUT EP/8690174
APP'D BY S.SAWADA
CHK'D BY T.TANI
DRWN BY T.TANI
TITLE: ROTOR ASSEMBLY (2/2)
DWG NO. ES/8600459/02 REV. 1
SCALE 1:NON
Elliott Ebara

CAD自動系(SF)

REVISIONS				
No.	DESCRIPTION	DATE	BY	APP.
7	ADDED PT#102, 121, 201, 301	APR.19,'93	M.T.	S.S
6	ADDED PT#103, 104, 122, 203~205, 303	AUG. 7,'95	K.K.T.	S.S
5	ADDED PT#206, 207, 304.	AUG.18,'95	K.K.T.	S.S
4	ADDED PT#123, 208.	MAR. 6,'96	S.I.T.	S.S
3	ADDED PT#124.	MAR.17,'96	S.I.T.	S.S
2	ADDED PT#209, 210, 105, 106, 306.	NOV. 4,'97	K.K.T.	S.S
1	ADDED PT#211, 212, 307.	FEB. 2,'98	K.N.T.	S.S
0	ADDED PT#213, 214, 308.	NOV. 2,'98	K.N.T.	S.S
-1	ADDED PT#215, 216, 309.	AUG.29,'02	K.K.T.	S.S
-2	ADDED PT#125, 217, 310.	DEC.16,'02	K.K.T.	S.S

ASSEMBLY PART NUMBERS 組立番号

NO. 番号	CONSISTS OF 構成部品	NOTE / 記事 JNL.	THR.	SPEED	ROT.	BRUSH	ALIGNMENT	OIL BUFFLE	KEY	
300	GR.1 PT#100, 101, 120, 200	5'X1.500'	40.5 SQ-IN	6	CCW	-	YES	WINDBACK	-	
301	GR.1 PT#102, 121, 201	5'X2.125'	23 SQ-IN	5	CW	YES	-	WINDBACK	-	
302	GR.1 PT#100, 101, 120, 205	5'X2.125'	40.5 SQ-IN	6	CCW	YES	-	WINDBACK	-	
303	GR.1 PT#103, 104, 120, 207	5'X1.5'	55.1 SQ-IN	5	CCW	YES	-	WINDBACK	-	
304	GR.1 PT#102, 123, 208	4'X1.6'	23 SQ-IN	6	CW	-	YES	AIR PURGE	-	
305	GR.1 PT#102, 124, 208	4'X1.6'	23 SQ-IN	6	CW	-	YES	AIR PURGE	-	
306	GR.1 PT#105, 106, 121, 210	5'X2.125'	16.7 SQ-IN	5	CW	YES	-	WINDBACK	1	
307	GR.1 PT#100, 101, 120, 211	5'X2.125'	40.5 SQ-IN	5	CCW	YES	YES	WINDBACK	-	
308	GR.1 PT#100, 101, 121, 213	5'X2.125'	40.5 SQ-IN	5	CW	YES	-	WINDBACK	-	CAST IRON(SPEED PICK-UP 3/4"LNGE
309	GR.1 PT#100, 101, 121, 215	5'X2.125'	40.5 SQ-IN	5	CW	YES	-	WINDBACK	-	CAST IRON
310	GR.1 PT#105, 106, 125, 217	5'X2.125'	16.7 SQ-IN	5	CW	YES	YES	AIR PURGE	1	
311										
312										
313										
314										
315										
316										
317										
318										
319										
320										

Q'TY/1SET 1台分個数 GR4	GR3	GR2	GR1	PART NAME 部品名		NO. 番号	EBARA PARTS NO. エバラ 部品番号	DESCRIPTION 記事
			4	FM10TX40	SCREW, CAP	1	FT-A10040	
			4	ZM-M10	WASHER	2	ZM-A10	
			4	ZR-M10	WASHER, LOCK	3	ZR-J10	
			1	シール剤	SEALANT	4	E8641583-4	
						5		
						6		
						7		
						8		
						9		
			X	軸受室小組立	GROUP OF PARTS	GR.1	E8641583-GR.1	

注記

1, A. シール面からほこり, グリース, 湿り等を除去すること。
B. 矢印で示したオイルバッフルと軸受室の面及びオイルバッフル水平割面に品番4のシール剤を塗布すること。ただし、オイルバッフル及び軸受室のエアーパージ用穴にはシール剤を塗布しないこと。
C. オイルバッフルを軸受室に組み込む前に5~10分程度おき, シール剤を硬化させること。
D. 最終組立後24時間放置し, 完全にシール剤を硬化させること。

NOTES

1. A. CLEAN SEAL SURFACES FROM DIRT, GREASE, MOISTURE & ETC.
B. APPLY THIN COAT OF IT#4, SEALANT. TO AREAS INDICATED OF SEAL & HOUSING. DO NOT PLUG HOLES IN HOUSING OR SEAL. ALSO APPLY TO OIL SEAL HORIZONTAL SPLIT.
C. CURE SEALANT FOR 5-10 MINUTES BEFORE ASSEMBLING OIL BAFFLE IN BEARING HOUSING.
D. CURE COMPLETE ASSEMBLY FOR 24 HOURS.

Q'TY 個数	PART NAME 部品名		NO. 番号	EBARA PARTS NO. エバラ 部品番号	DESCRIPTION 記事
1	エンドカバー	END COVER	100	A674503-4	40.5 SQ-IN, INACTIVE(反負荷側)
1	エンドカバー	END COVER	101	A674502-4	40.5 SQ-IN, ACTIVE(負荷側)
2	エンドカバー	END COVER	102	A680384-4	23 SQ-IN
1	エンドカバー	END COVER	103	A672275-4	55.1SQ-IN., ACTIVE
1	エンドカバー	END COVER	104	A672267-4	55.1SQ-IN., INACTIVE
1	エンドカバー	END COVER	105	A681863-4	16.7SQ-IN., ACTIVE
1	エンドカバー	END COVER	106	A681864-4	16.7SQ-IN., INACTIVE
1	オイルバッフル	OIL BAFFLE	120	E8641405-15	WINDBACK, 5.5'X6.125'X5', CCW
1	オイルバッフル	OIL BAFFLE	121	E8641405-14	WINDBACK, 5.5'X6.125'X5', CW
1	オイルバッフル	OIL BAFFLE	122	E8641286-15	AIR PURGE 5.5'X6.125'X5'
1	オイルバッフル	OIL BAFFLE	123	E8641324-15	AIR PURGE 4.5'X5.125'X4'
1	オイルバッフル	OIL BAFFLE	124	E8641666-15	AIR PURGE 4.5'X5.125'X4'(MS-8)
1	オイルバッフル	OIL BAFFLE	125	E8641454-14	AIR PURGE 5.5'X6.125'X5'

					JNL.	THR.	ROT.	SPEED	BRUSH	KEY	
1	軸受室	HOUSING, BRG.	200	E8641572-26	5'X1.5'	40.5	CCW	6	-	-	
1	軸受室	HOUSING, BRG.	201	E8641581-25	5'X2.125'	23	CW	5	-	-	
			202							-	
1	軸受室	HOUSING, BRG.	203	E8641572-25	5'X1.5'	40.5	CCW	6	YES	-	
1	軸受室	HOUSING, BRG.	204	E8641606-26	5'X2.125'	40.5	CCW	6	-	-	
1	軸受室	HOUSING, BRG.	205	E8641606-25	5'X2.125'	40.5	CCW	6	YES	-	
1	軸受室	HOUSING, BRG.	206	E8641607-26	5'X1.5'	55.1	CCW	5	-	-	
1	軸受室	HOUSING, BRG.	207	E8641607-25	5'X1.5'	55.1	CCW	5	YES	-	
1	軸受室	HOUSING, BRG.	208	E8641663-27	4'X1.6'	23	CW	6	-	-	
1	軸受室	HOUSING, BRG.	209	E8641690-27	5'X2.125'	16.7	CW	5	-	1	
1	軸受室	HOUSING, BRG.	210	E8641690-25	5'X2.125'	16.7	CW	5	YES	1	
1	軸受室	HOUSING, BRG.	211	E8641709-25	5'X2.125'	40.5	CCW	5	YES	-	
1	軸受室	HOUSING, BRG.	212	E8641709-26	5'X2.125'	40.5	CCW	5	-	-	
1	軸受室	HOUSING, BRG.	213	E8641733-25	5'X2.125'	40.5	CW	5	YES	-	CAST IRON
1	軸受室	HOUSING, BRG.	214	E8641733-26	5'X2.125'	40.5	CW	5	-	-	CAST IRON
1	軸受室	HOUSING, BRG.	215	E8641786-25	5'X2.125'	40.5	CW	5	YES	-	CAST IRON
1	軸受室	HOUSING, BRG.	216	E8641786-26	5'X2.125'	40.5	CW	5	-	-	CAST IRON
1	軸受室	HOUSING, BRG.	217	E8641690-30	5'X2.125'	16.7	CW	5	YES	1	ALIGNMENT TOOL

FIG 4-4-1
4-39

展開図

NON MECH.-TRIP

設計用注記
GR.307は新規設計には使用不可(スピードピックアップ3/4')

ELLIOTT. EBARA GROUP

ELLIOTT G.O.No.

ELLIOTT S.O.No.

DISTRIBUTION | SET

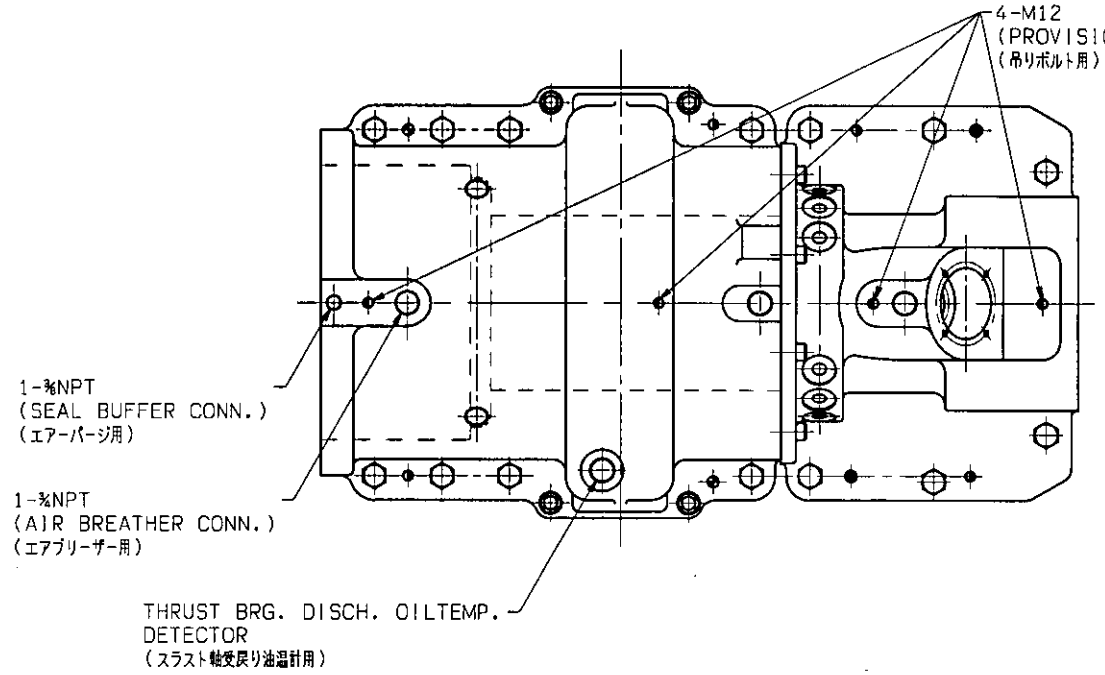
☐ FOR APPROVAL
AVOID DELAY TO MAINTAIN SHIPPING PROMISE. ONE APPROVED PRINT MUST BE RETURNED BY: _____
BY _____ DATE _____

☐ FOR RECORD
ANY REQUESTED CHANGE OF THIS EQUIPMENT WILL RESULT IN: 1.CONTRACT PRICE ADJUSTMENT. 2.EXTENDED SHIPPING PROMISE AS THIS CONTRACT IS IN MANUFACTURING PROCESS.
BY _____ DATE _____

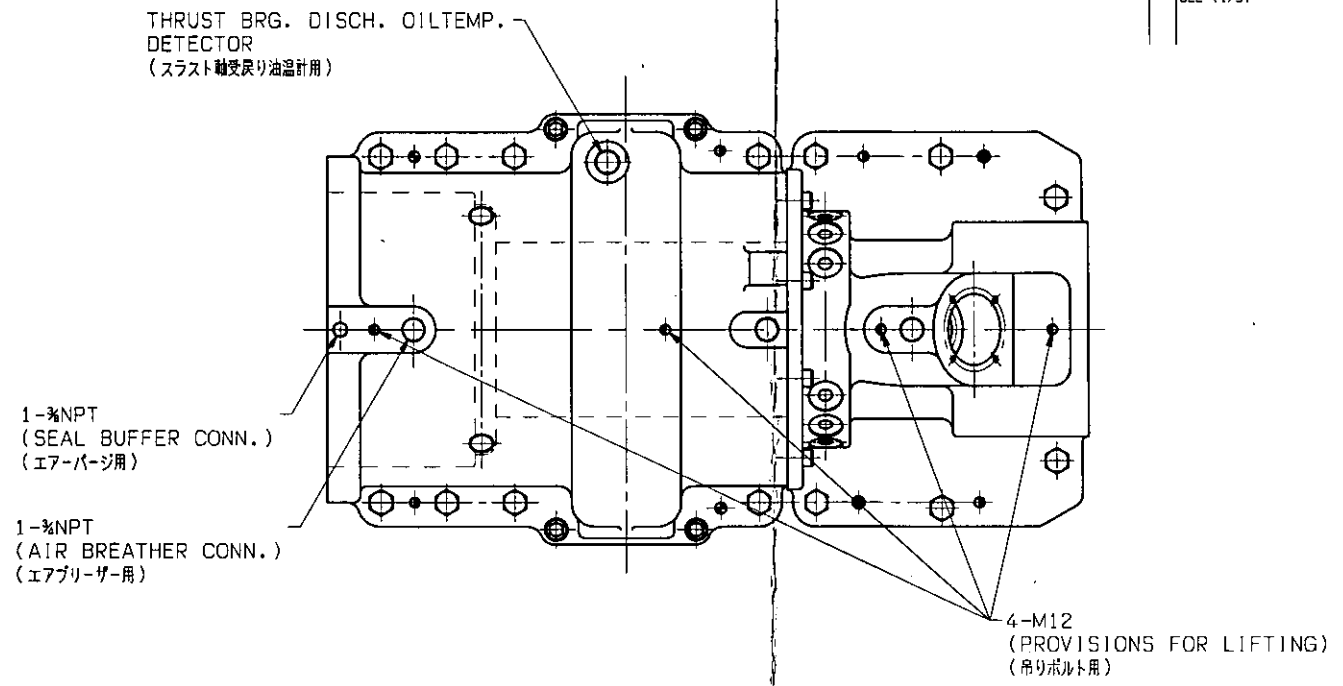
JOB No.	JOB/PROJECT NAME
ITEM No.	CUSTOMER
SER.No.	USER
APP'D BY / DATE	SERVICE
S.SAWADA Mar. 4,'98	MODEL / SET
T.TANI Mar. 4,'98	TITLE DW-1A, NON-TRIP, ELEC.GOV., FLANGED HOUSING, BRG. ASS'Y 高圧側軸受室組立(1/3)
DSN'D BY	
CHK'D BY T.TANI Mar. 4,'98	
DRW'N BY M.NISHIUCHI Mar. 3,'98	PROJ. / DWG.NO. ES/8641583/01 / REV. 5
	SCALE 1:NTS / Elliott Ebara

PM841C

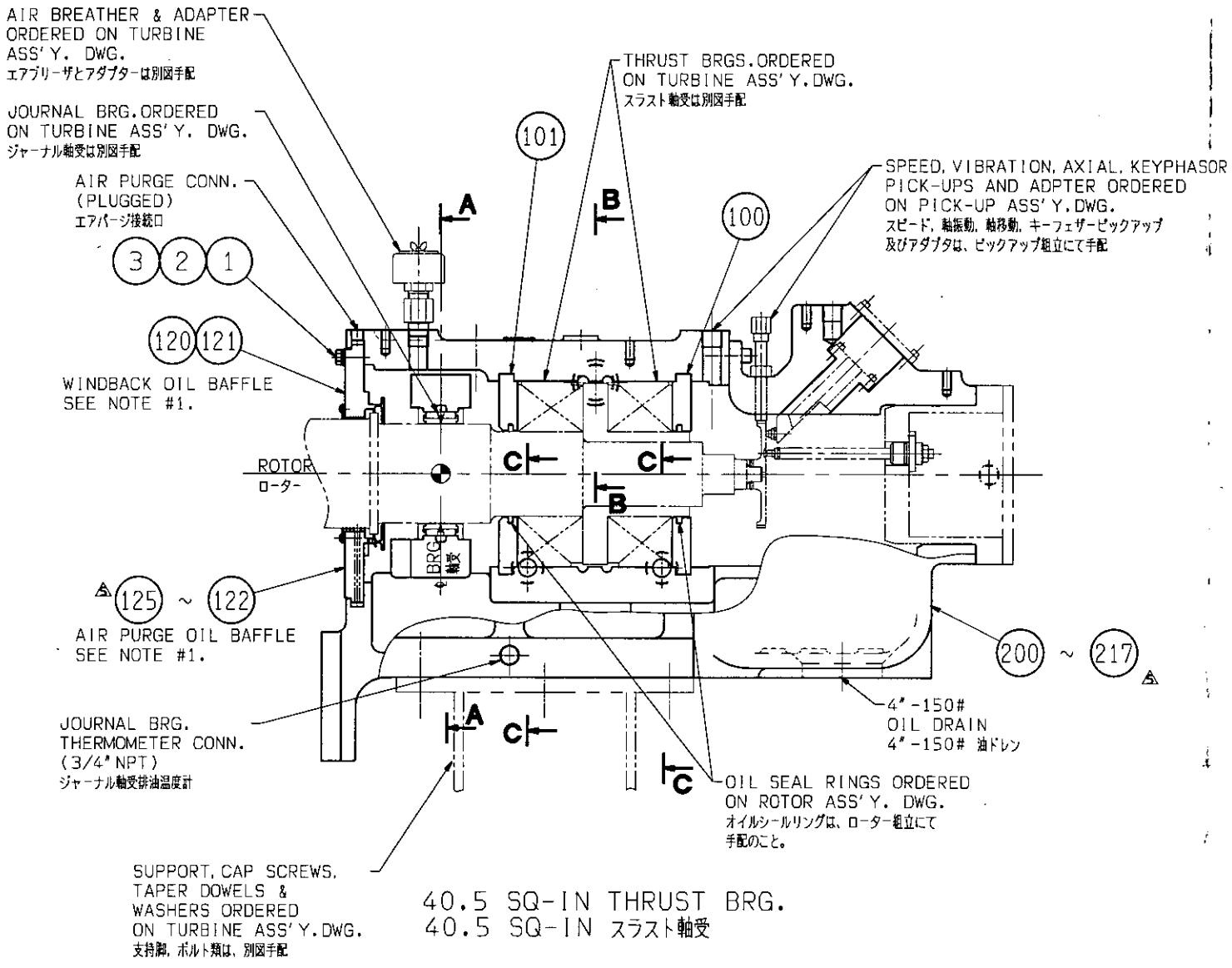
CAD合格済(SF)



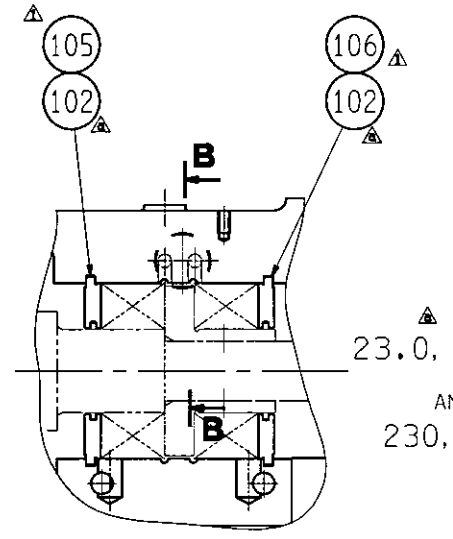
PLAN VIEW FOR CCW ROTATION
左回転用平面図



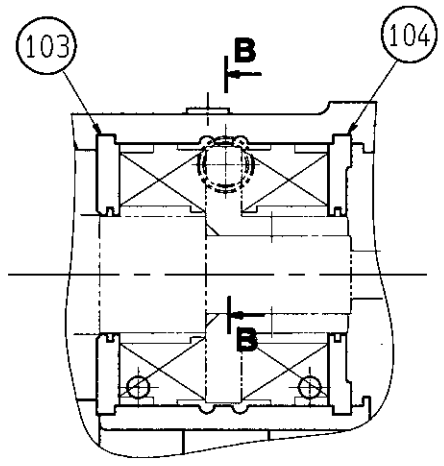
PLAN VIEW FOR CW ROTATION
右回転用平面図



40.5 SQ-IN THRUST BRG.
40.5 SQ-IN スラスト軸受



⚠ SECTION SHOWING
23.0, 16.7 SQ-IN THRUST BRG.
ALL OTHER VIEWS, NOTES
AND ETC. SAME AS 40.5 SQ-IN.
230, 16.7 SQ-IN スラスト軸受断面図
特記外は, 40.5 SQ-IN スラスト軸受に同じ



⚠ SECTION SHOWING
55.1 SQ-IN THRUST BRG.
ALL OTHER VIEWS, NOTES
AND ETC. SAME AS 40.5 SQ-IN.
55.1 SQ-IN スラスト軸受断面図
特記外は, 40.5 SQ-IN スラスト軸受に同じ

REVISIONS				
No.	DESCRIPTION	DATE	BY	APP.
	SEE (1/3)			

FIG 4-4-2
4-40

展開図

NON MECH.-TRIP

ELLIOTT. EBARA GROUP

ELLIOTT G.O.NO.

ELLIOTT S.O.NO.

DISTRIBUTION	SET
営	1
村	
建	
エ	2

☐ FOR APPROVAL
AVOID DELAY TO MAINTAIN SHIPPING PROMISE.
ONE APPROVED PRINT MUST BE RETURNED BY: _____
BY_____ DATE _____

☐ FOR RECORD
ANY REQUESTED CHANGE OF THIS EQUIPMENT WILL RESULT IN:
1. CONTRACT PRICE ADJUSTMENT.
2. EXTENDED SHIPPING PROMISE AS THIS CONTRACT IS IN MANUFACTURING PROCESS.
BY_____ DATE _____

JOB NO.

ITEM NO.

SER.NO.

JOB/PROJECT NAME

CUSTOMER

USER

APP'D BY	DATE
S.SAWADA	MAY. 4,'98
T.TANI	MAY. 4,'98
DSN'D BY	
CHK'D BY T.TANI	MAY. 4,'98
DRW'N BY M.NISHIUCHI	MAY. 3,'98

SERVICE

MODEL | SET

TITLE DW-1A, NON-TRIP, ELEC. GOV., FLANGED
HOUSING, BRG. ASS'Y
高圧側軸受室組立(2/3)

PROJ.	DWG.NO.	REV.
	ES/8641583/02	5

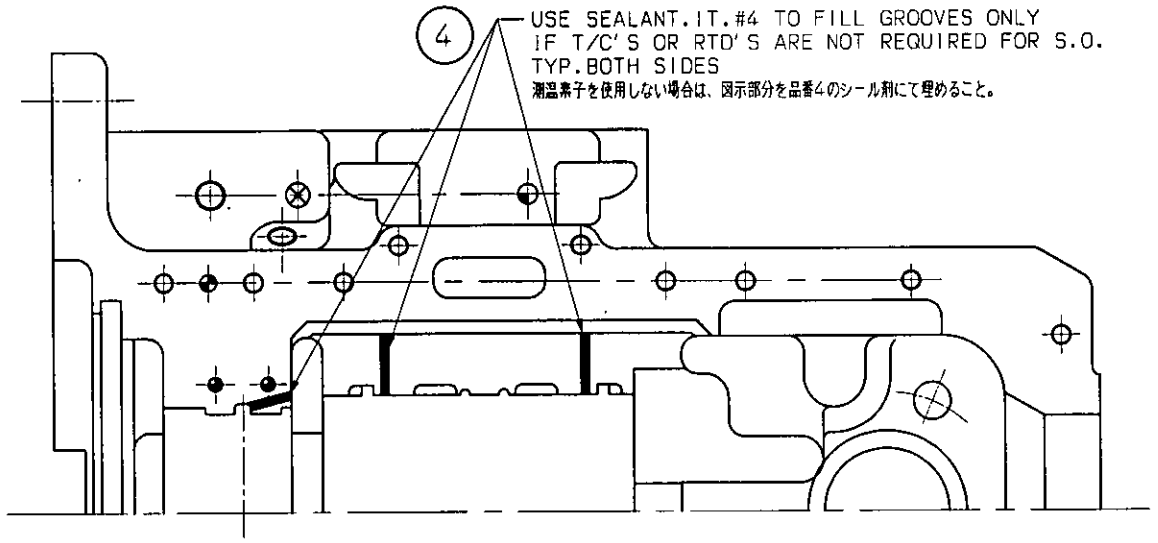
SCALE 1:4

Elliott Ebara

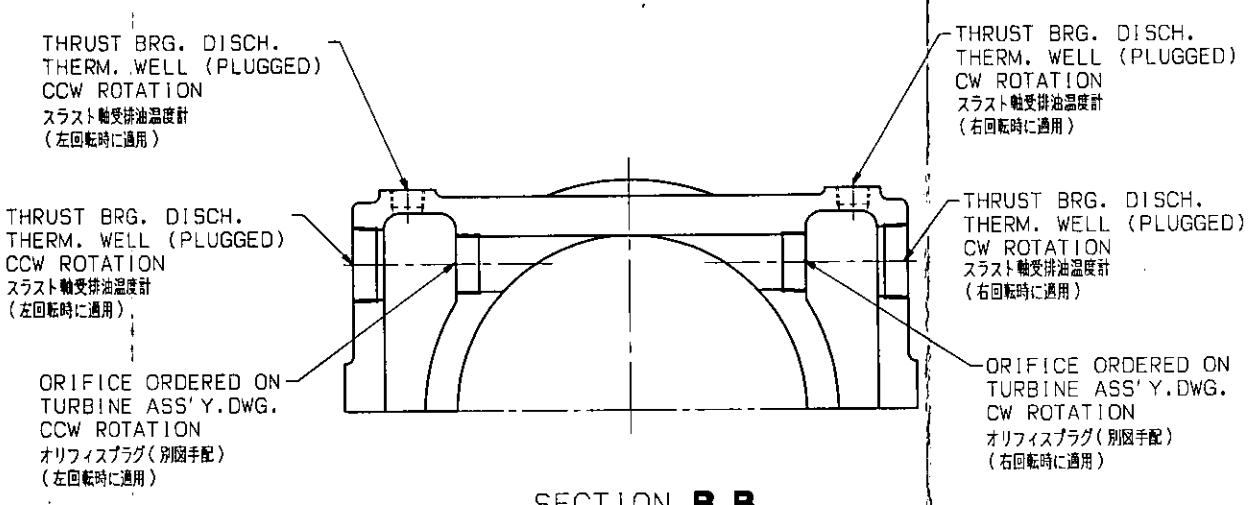
PM841C

CAD資料(SF)

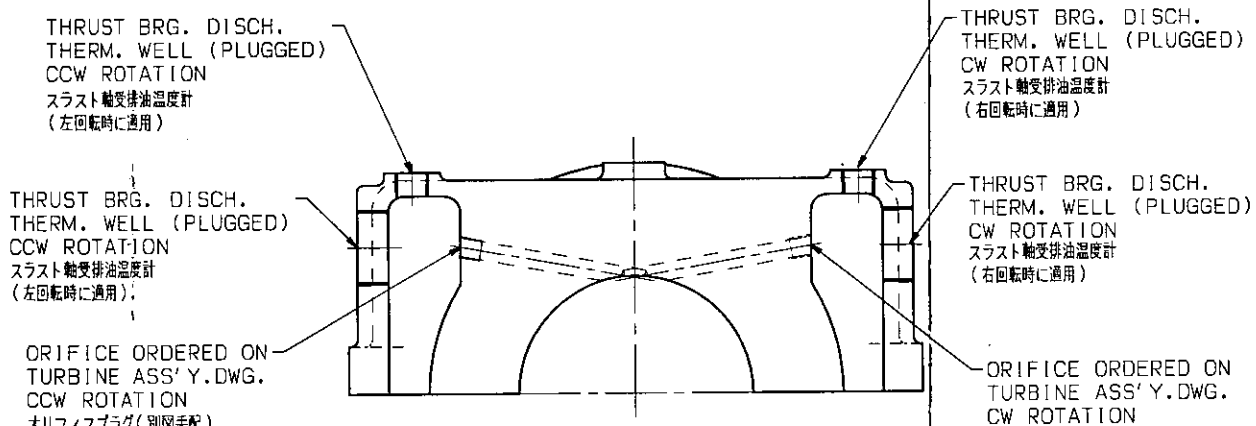
REVISIONS				
NO.	DESCRIPTION	DATE	BY	APP.
	SEE (1/3)			



VIEW SHOWING WIRE GROOVES FOR
THRUST BRG. & JOURNAL BRG.
スラスト軸受及びジャーナル軸受配線用溝詳細図



SECTION **B B**
断 面 **B B**
(40.5&55.1SQ-IN)

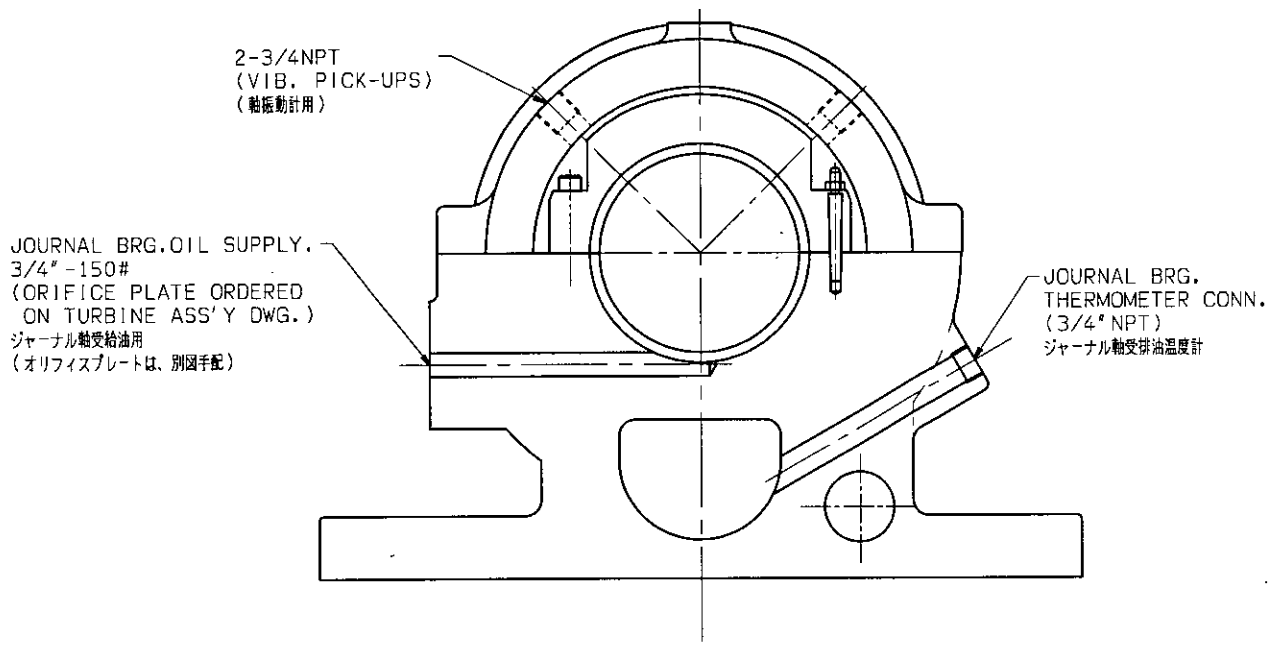


⚠ SECTION **B B**
断 面 **B B**
(23.0, 16.7SQ-IN)

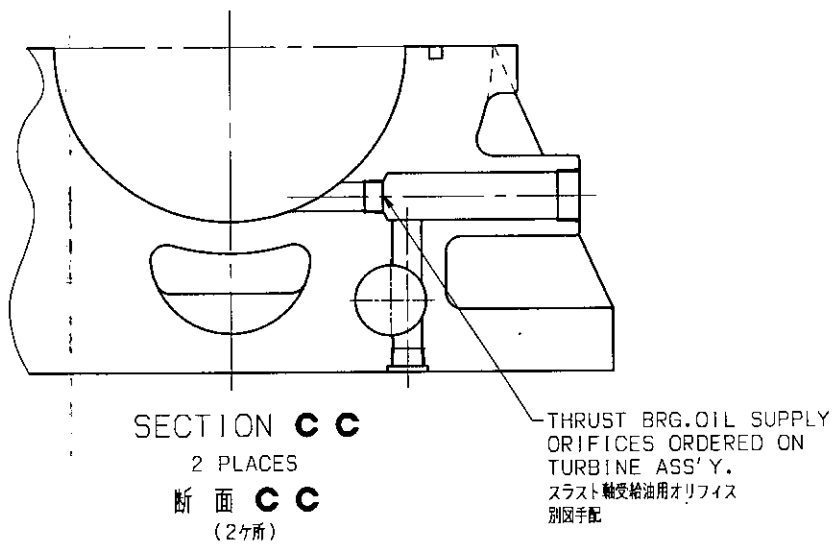
FIG 4-4-3
4-41

展 開 図

NON MECH.-TRIP



SECTION **A A**
断 面 **A A**



SECTION **C C**
2 PLACES
断 面 **C C**
(2ヶ所)

ELLIOTT G.O.NO.	
ELLIOTT S.O.NO.	

ELLIOTT EBARA GROUP

☐ FOR APPROVAL
AVOID DELAY TO MAINTAIN SHIPPING PROMISE. ONE APPROVED PRINT MUST BE RETURNED BY: _____
BY _____ DATE _____

☐ FOR RECORD
ANY REQUESTED CHANGE OF THIS EQUIPMENT WILL RESULT IN:
1. CONTRACT PRICE ADJUSTMENT.
2. EXTENDED SHIPPING PROMISE AS THIS CONTRACT IS IN MANUFACTURING PROCESS.
BY _____ DATE _____

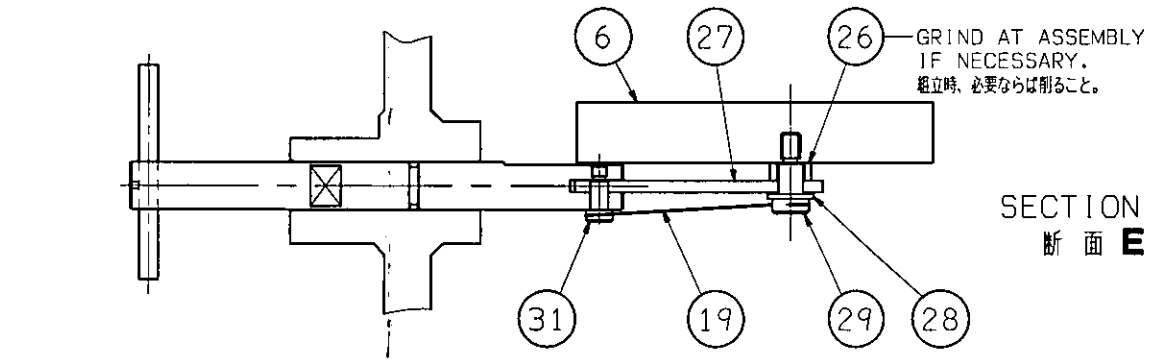
DISTRIBUTION	SET
営	1
材	
巻	
I	2

JOB NO.	JOB/PROJECT NAME
ITEM NO.	CUSTOMER
SER. NO.	USER
APP'D BY / DATE	SERVICE
S. SAWADA Mar. 4.'98	MODEL / SET
T. TANI Mar. 4.'98	TITLE DW-1A, NON-TRIP, ELEC. GOV., FLANGED
DSN'D BY	HOUSING, BRG. ASS'Y
CHK'D BY T. TANI Mar. 4.'98	高圧側軸受室組立(3/3)
DRW'N BY M. NISHIUCHI Mar. 3.'98	PROJ. / DWG. NO. ES/8641583/03 / REV. 5
	SCALE 1:3 / Elliott Ebara

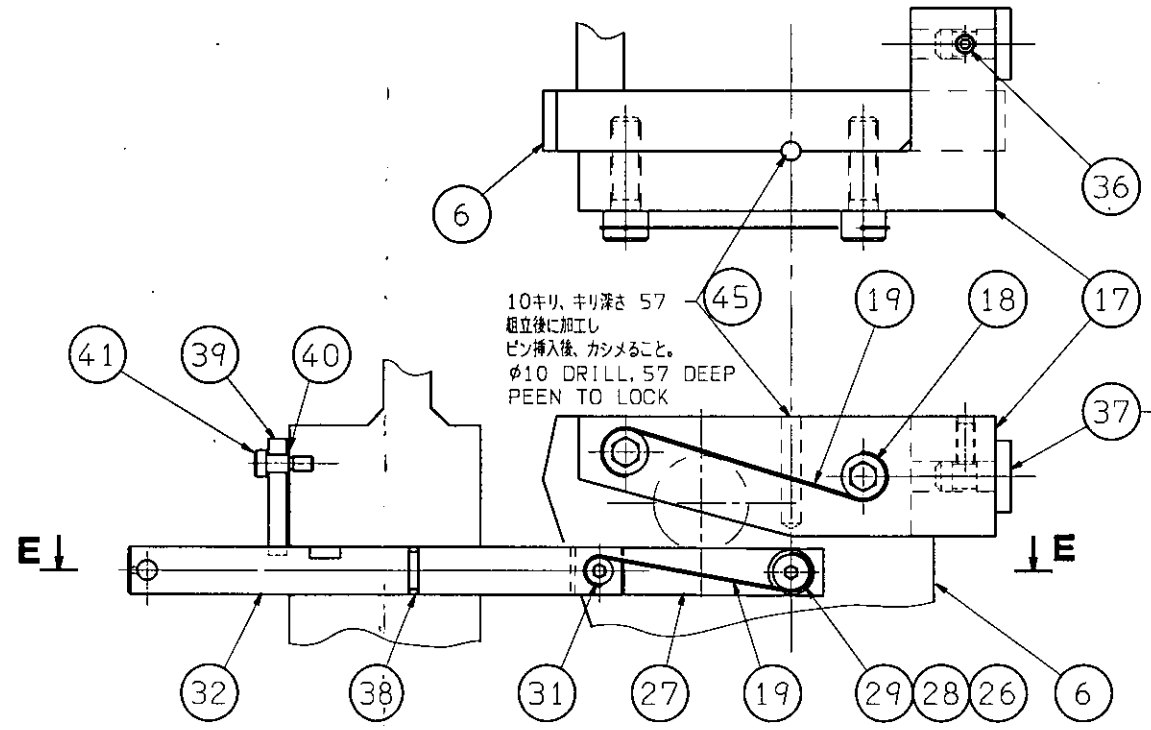
PMB41C

CAD資料(SF)

Q'TY GR4	GR3	GR2	GR1	PART NAME 部品名		NO. 番号	EBARA PARTS No. エバラ 部品番号	DESCRIPTION 記事
			1	低圧側軸受室	HOUSING, BRG	1	E8641789-15	5"X2.125"JNL,
			1	オイルバッフル	SEAL, OIL	2	E8641455-10	AIR PURGE
						3		
			1	ベアリング(内側)	BEARING, INNER	4	A682677-1	
			1	ベアリング(外側)	BEARING, OUTER	5	A682678-1	
			1	ギヤブラケット	GEAR BRACKET ASS'Y	6	E8661090-8	
			1	スラストカラー	COLLAR, THRUST	7	A676697-1	
			1	BSHW-M12X35	SCREW, CAP	8	BSHW-H12035	
			1	SCP-2.0X40	PIN, COTTER	9	SCP-J2040	
			1	中間歯車	GEAR, IDLER	10	A680846-2	
			1	複列アンギュラ玉軸受	BEARING, BALL	11	P1562L6208	
			1	RTH-80	RING, RETAINING	12	RTH-K080	
			1	駆動歯車	GEAR, DRIVING	13	A680845-2	
			1	ANR-8	NUT, LOCK	14	ANR-A08	M40X1.5P
			1	AW-8	WASHER, LOCK	15	AW-A08	
			1	キー	KEY	16	A720396-1	
			1	ストッパー	BRACKET, STOP	17	B720144-1	
			2	BSHW-M16X50	SCREW, CAP	18	BSHW-H16050	
			1	WAR-1.2X5	WIRE	19	WAR-B1205	
			1	スプレーパイプ	PIPE, SPRAY	20	A682684-2	
			1	ティー, 1/4NPT	TEE, PIPE	21	TEN-B02N5	
			.1	ニップル, 1/4NPT	NIPPLE, PIPE	22	P41Y431	
			2	ハーフユニオン	CONNECTOR, MALE	23	UHW-B10M1002N	
			1	フレキシブルホース	PIPE, FLEXIBLE	24	E8663121-1	
						25		
			1	スペーサ	SPACER	26	E8664011-1	
			1	リンク	LINK	27	A695757-1	
			1	ZM-M12	WASHER	28	ZM-A12	
			1	段付六角穴付ボルト	SCREW, SHOULDER	29	E8664006-1	
						30		
			1	段付六角穴付ボルト	SCREW, SHOULDER	31	E8664006-2	
			1	ハンドル	HANDLE	32	E8663152-5	
						33		
						34		
						35		
			1	CS-M10X22	SCREW, SET	36	CS-H1022	
			1	ピン	PIN	37	A720146-1	
			1	Oリング	O-RING	38	OAS-RD210	
			1	掛金	LATCH	39	A694669-1	
			1	ZM-M8	WASHER	40	ZM-A08	
			1	段付ボルト	SCREW, SHOULDER	41	E23W68	
						42		
						43		
						44		
			1	SSP-10X55	PIN, ROLL	45	SSP-K100055	
						46		
						47		
			1	シール剤 *	SEALANT	48	E8641787-48	
						49		
						50		
						51		
			1	ターニングギヤユニット	TURNING GEAR UNIT	52	-	SIMPO:
			4	BSH-M12X40	SCREW, CAP	53	BSH-H12040	
			4	ZRB-M12	WASHER, LOCK	54	ZRB-J12	
			2	BPNT-H12X40	PIN, DOWEL	55	BPNT-JH12040	
						56		
			1	90°エルボ1/4NPT-SCH80	90° ELBOW	57	ELN90-B02N5	NPT1/4-SCH80
			1	ニップル	NIPPLE	58	P41Y411	1/4NPT, L=51
						59		
			X	低圧側軸受室組立	GROUP OF PARTS	60	E8641787-60	



SECTION E-E
断面 E-E



VIEW D
D 矢視

NOTE
1. DO NOT ENGAGE TURNING GEAR UNTIL TURBINE ROTOR IS AT A DEAD STOP.
2. GRIND HEAD OF PIN(IT#37) TO OBTAIN 1mm BACKLASH WITH MATING GEAR ON TURBINE ROTOR.
3. MICRO-SWITCH TO INDICATE GEARS FULLY ENGAGED & DISENGAGED TO PURCHASER'S ALARM. SEE LIMIT SW ASSEMBLY DWG.
4. A. CLEAN SEALING SURFACES FROM DIRT, GREASE, MOISTURE & ETC.
   B. APPLY THIN COAT OF SEALANT.
      TO AREAS INDICATED OF SEAL & HOUSING.
      DO NOT PLUG HOLES IN HOUSING OR SEAL.
      ALSO APPLY TO OIL SEAL HORIZONAL SPLIT.
   C. CURE SEALANT FOR 5-10 MINUTES BEFORE ASSEMBLING OIL BAFFLE IN BEARING HOUSING.
   D. CURE COMPLETE ASSEMBLY FOR 24 HOURS.
5. ALL PIPING FROM THIS POINT TO BE ASSEMBLED AFTER SHOP OIL FLUSH OF OIL SYSTEM.

注記
1. ターニングギヤはタービンロータが完全に停止してからかみ合わせること。
2. ピン(品番37)の頭をタービンロータギヤのバックラッシュが1mmになる様削ること。
3. 全体組立にて手配のリミットスイッチがターニングギヤの解除、連動を指示する様に調整のこと。
   別図:リミットスイッチ組立図を参照のこと。
4. A. シール面からほこり、グリース、湿り等を除去すること。
   B. 矢印で示したオイルバッフルと軸受室の面及びオイルバッフル水平割面にシール剤を塗布すること。
      ただし、オイルバッフル及び軸受室のエアーパージ用穴にはシール剤を塗布しないこと。
   C. オイルバッフルを軸受室に組み込む前に5~10分程度おきシール剤を硬化させること。
   D. 最終組立後24時間放置し、完全にシール剤を硬化させること。
5. 全ての配管類は給油装置全ての酸洗後に取りつけること。

REVISIONS				
NO.	DESCRIPTION	DATE	BY	APP.
	FIRST USED R021508803/SRV-SDF			

FIG 4-5-1
4-42
展開図

設計用注記
1. EP/8660009より作成
2. CCW用はES/8641481参照のこと。
(ただし、ボトムキー座を削除、ストッパーピン部変更、軸受室バッフル形状など変更

ELLIOTT. EBARA GROUP

ELLIOTT G.O.No.

ELLIOTT S.O.No.

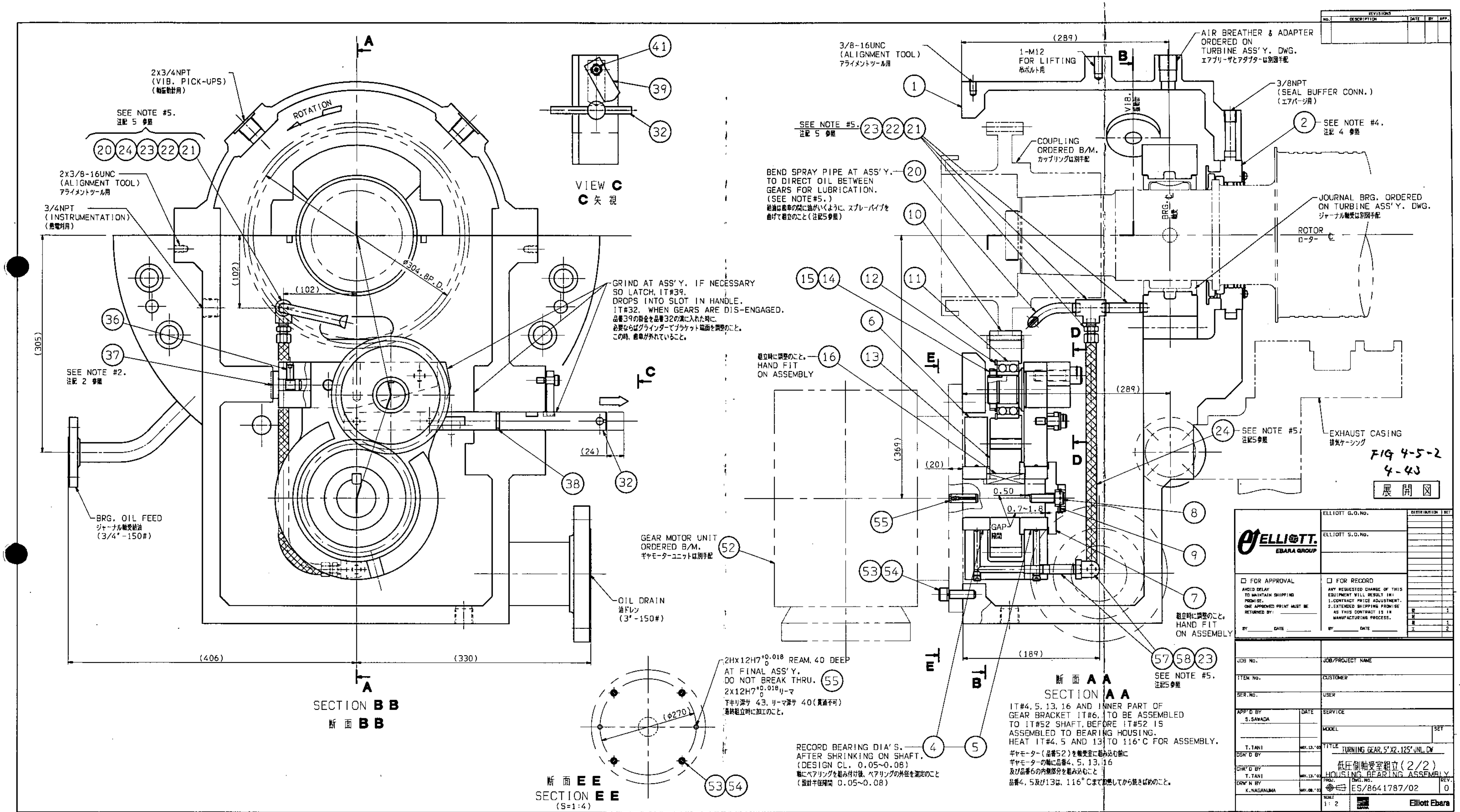
☐ FOR APPROVAL
AVOID DELAY TO MAINTAIN SHIPPING PROMISE. ONE APPROVED PRINT MUST BE RETURNED BY: _____
BY _____ DATE _____

☐ FOR RECORD
ANY REQUESTED CHANGE OF THIS EQUIPMENT WILL RESULT IN:
1. CONTRACT PRICE ADJUSTMENT.
2. EXTENDED SHIPPING PROMISE AS THIS CONTRACT IS IN MANUFACTURING PROCESS.
BY _____ DATE _____

DISTRIBUTION	SET
建	1
材	
機	
エ	2

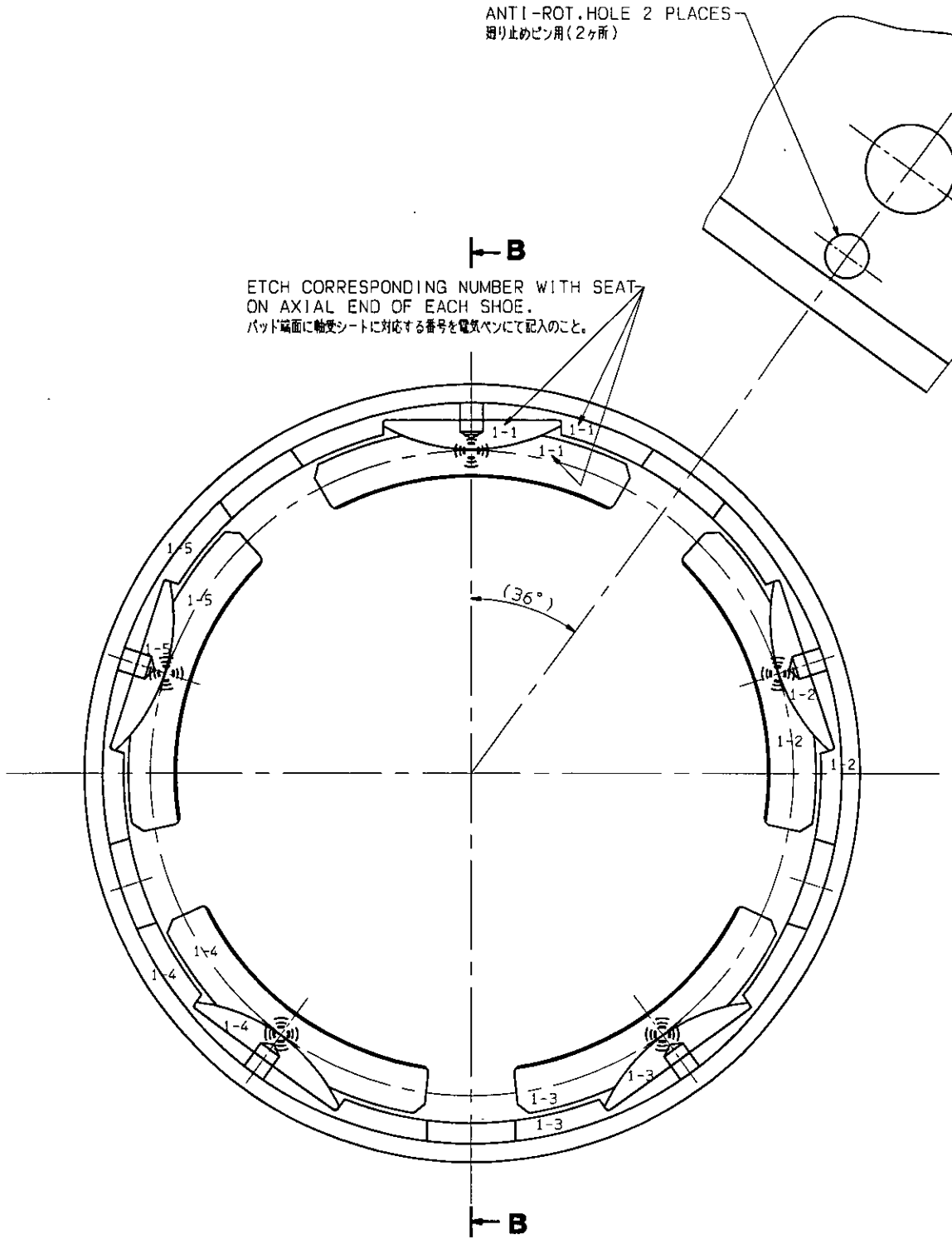
JOB NO.	JOB/PROJECT NAME
ITEM NO.	CUSTOMER
SER.NO.	USER
APP'D BY S.SAWADA	SERVICE
T.TANI MAY.13.'05	MODEL SET
DSN'D BY	TITLE TURNING GEAR, 5"X2.125"JNL, CW
CHK'D BY T.TANI MAY.13.'05	低圧側軸受室組立(1/2) HOUSING, BEARING ASSEMBLY
DRW'N BY K.NAGANUMA MAY.08.'05	PROJ. DWG.NO. ES/8641787/01 REV. 0
	SCALE 1:2 Elliott Ebara

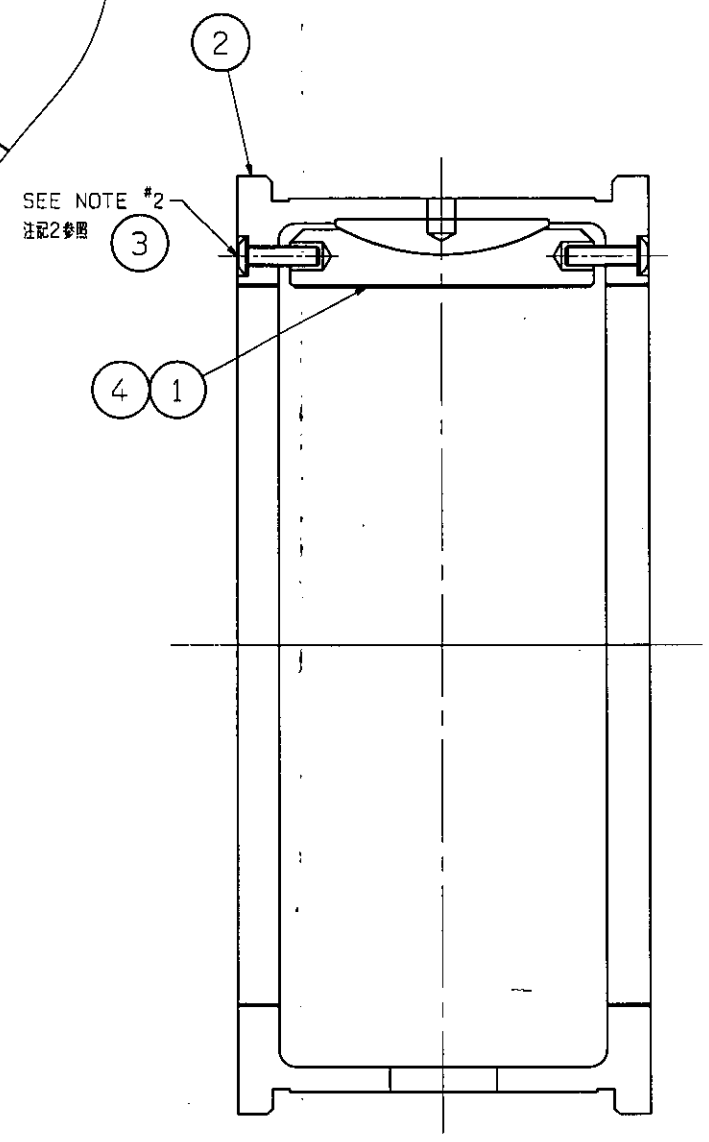
PM841C



SECTION B B
断 面 B B
SECTION A A
断 面 A A
SECTION E E
断 面 E E
(S=1:4)
VIEW C
C 矢 視
2x3/4NPT
(VIB. PICK-UPS)
(軸振動計用)
SEE NOTE #5.
注記 5 参照
ROTATION
2x3/8-16UNC
(ALIGNMENT TOOL)
アライメントツール用
3/4NPT
(INSTRUMENTATION)
(熱電対用)
SEE NOTE #2.
注記 2 参照
BRG. OIL FEED
ジャーナル軸受給油
(3/4"-150#)
OIL DRAIN
油ドレン
(3"-150#)
GRIND AT ASS'Y. IF NECESSARY
SO LATCH, IT#39.
DROPS INTO SLOT IN HANDLE.
IT#32. WHEN GEARS ARE DIS-ENGAGED.
品番39の掛金を品番32の溝に入れた時に、
必要ならばグラインダーでブラケット端面を調整のこと。
この時、歯車が外れていること。
ø304.8P.D.
(305)
(102)
(406)
(330)
(24)
GEAR MOTOR UNIT
ORDERED B/M.
ギヤモーターユニットは別手配
2HX12H7+0.018 0 REAM. 40 DEEP
AT FINAL ASS'Y.
DO NOT BREAK THRU.
2X12H7+0.018 0 リーマ
下キリ深サ 43, リーマ深サ 40(貫通不可)
最終組立時に加工のこと。
(ø270)
3/8-16UNC
(ALIGNMENT TOOL)
アライメントツール用
1-M12
FOR LIFTING
吊ボルト用
AIR BREATHER & ADAPTER
ORDERED ON
TURBINE ASS'Y. DWG.
エアブリーザとアダプターは別途手配
3/8NPT
(SEAL BUFFER CONN.)
(エアパージ用)
SEE NOTE #4.
注記 4 参照
VIB.
COUPLING
ORDERED B/M.
カップリングは別手配
BEND SPRAY PIPE AT ASS'Y.
TO DIRECT OIL BETWEEN
GEARS FOR LUBRICATION.
(SEE NOTE#5.)
給油は歯車の間に油がいくように、スプレーパイプを
曲げて組立のこと(注記5参照)
JOURNAL BRG. ORDERED
ON TURBINE ASS'Y. DWG.
ジャーナル軸受は別途手配
BRG.
ROTOR
ローター
組立時に調整のこと。
HAND FIT
ON ASSEMBLY
(289)
(369)
(20)
(189)
0.50
0.7~1.8
GAP
SEE NOTE #5.
注記5参照
EXHAUST CASING
排気ケーシング
RECORD BEARING DIA'S.
AFTER SHRINKING ON SHAFT.
(DESIGN CL. 0.05~0.08)
軸にベアリングを組み付け後、ベアリングの外径を測定のこと
(設計す隙間 0.05~0.08)
IT#4, 5, 13, 16 AND INNER PART OF
GEAR BRACKET IT#6, TO BE ASSEMBLED
TO IT#52 SHAFT, BEFORE IT#52 IS
ASSEMBLED TO BEARING HOUSING.
HEAT IT#4, 5 AND 13 TO 116°C FOR ASSEMBLY.
ギヤモーター(品番52)を軸受室に組み込む前に
ギヤモーターの軸に品番4, 5, 13, 16
及び品番6の内側部分を組み込むこと
品番4, 5及び13は、116°Cまで加熱してから焼きばめのこと。
FIG 4-5-2
4-43
展 開 図
ELLIOTT.
EBARA GROUP
ELLIOTT G.O.NO.
ELLIOTT S.O.NO.
FOR APPROVAL
FOR RECORD
JOB NO.
JOB/PROJECT NAME
ITEM NO.
CUSTOMER
SER.NO.
USER
APP'D BY S.SAWADA
SERVICE
MODEL
T.TANI
TITLE TURNING GEAR,5"X2.125"UNL.CW
低圧側軸受室組立(2/2)
HOUSING BEARING ASSEMBLY
DWG.NO. ES/8641787/02
REV. 0
SCALE 1:2
DRW'N BY K.NAGANUMA
Elliott Ebara

CAD自製済(SF)





SECTION **B B**

断 面 **B B**

NOTES:

1. BEARING DIAMETRAL ASSEMBLY CLEARANCE IS 0.127 ~ 0.178 mm WITH A RETAINER BORE OF $\phi158.687^{+0.013}_{0}$ mm AND A ROTOR JOURNAL DIAMETER OF $\phi126.937^{0}_{-0.013}$ mm.
2. USE NUT LOCK. (LOCTITE #241 OR #245) TO RETAIN CAPSCREWS (IT.'3).

注記

1. 軸受組立直径隙間 : 0.127 ~ 0.178 mm
   但し、軸受リテーナ内径 : $\phi158.687^{+0.013}_{0}$ mm
   ローター軸径 : $\phi126.937^{0}_{-0.013}$ mm
2. 品番 ③ のねじ部にはロックタイト#241又は#245を塗布の上組立のこと。

直径隙間 0.140~0.191(スペシャル)

Gr.6	Gr.5	Gr.4	Gr.3	Gr.2	Gr.1	PART NAME 部品名	NO. 番号	ELLIOTT PARTS NO エリオット部品番号	EBARA PARTS NO エバラ部品番号	DESCRIPTION 記事
G'TY/1SET 1台分個数										
						ASSEMBLY ジャーナル軸受組立	11	711005-11	A711005-11	STEEL BACKED SHOES
						ASSEMBLY ジャーナル軸受組立	10	711005-10	A711005-10	COPPER BACKED SHOES
1	1					BASE RING & SEAT ASS'Y ベースリング/シート組立	9	720402-GR5	A710402-GR5	
						SHOE PACKAGE ジャーナルパッド一組	8	711005-8	A711005-8	STEEL BACKED SHOES
						SHOE PACKAGE ジャーナルパッド一組	7	711005-7	A711005-7	COPPER BACKED SHOES
						ASSEMBLY ジャーナル軸受組立	6	711005-6	A711005-6	STEEL BACKED SHOES
						ASSEMBLY ジャーナル軸受組立	5	711005-5	A711005-5	COPPER BACKED SHOES
5		5		5		SHOE ASS'Y ジャーナルパッド組立	4	720406-5	A720406-5	
10	10			10	10	SCREW, CAP 小ねじ	3	P23R289	P23R289	#6-B2UNCX1/2"
				1	1	BASE RING & SEAT ASS'Y ベースリング/シート組立	2	720402-GR1	A720402-GR1	
	5		5		5	SHOE ASS'Y ジャーナルパッド組立	1	720406-4	A720406-4	

FIG 4-6
4-44

展 開 図

REDUCED CLEARANCE

ELLIOTT EBARA GROUP

ELLIOTT G.O.No.

ELLIOTT S.O.No.

DISTRIBUTION	SET
CUSTOMER	
	1
153	
154-1	
154-5	1C
祝	1C
検	1C
工	2C

☐ FOR APPROVAL
AVOID DELAY TO MAINTAIN SHIPPING PROMISE.
ONE APPROVED PRINT MUST BE RETURNED BY: _____
BY _____ DATE _____

☐ FOR RECORD
ANY REQUESTED CHANGE OF THIS EQUIPMENT WILL RESULT IN:
1.CONTRACT PRICE ADJUSTMENT.
2.EXTENDED SHIPPING PROMISE AS THIS CONTRACT IS IN MANUFACTURING PROCESS.
BY _____ DATE _____

JOB NO.	JOB/PROJECT NAME
ITEM NO.	CUSTOMER
SER.No.	USER
APP'D BY / DATE	SERVICE
S.TOMATSU Oct.29.'98	MODEL / SET
DSN'D BY S.TOMATSU Oct.29.'98	TITLE φ5X2.12(5PAD)SPHERICAL SEAT ジャーナル軸受組立図 JOUNAL BEARING ASSEMBLY
CHK'D BY I.AOYAMA Oct.19.'98	PROJ. / DWG.NO. EA/711005 / REV. 0
DRW'N BY M.ONODERA Oct.10.'98	SCALE 1:1.5

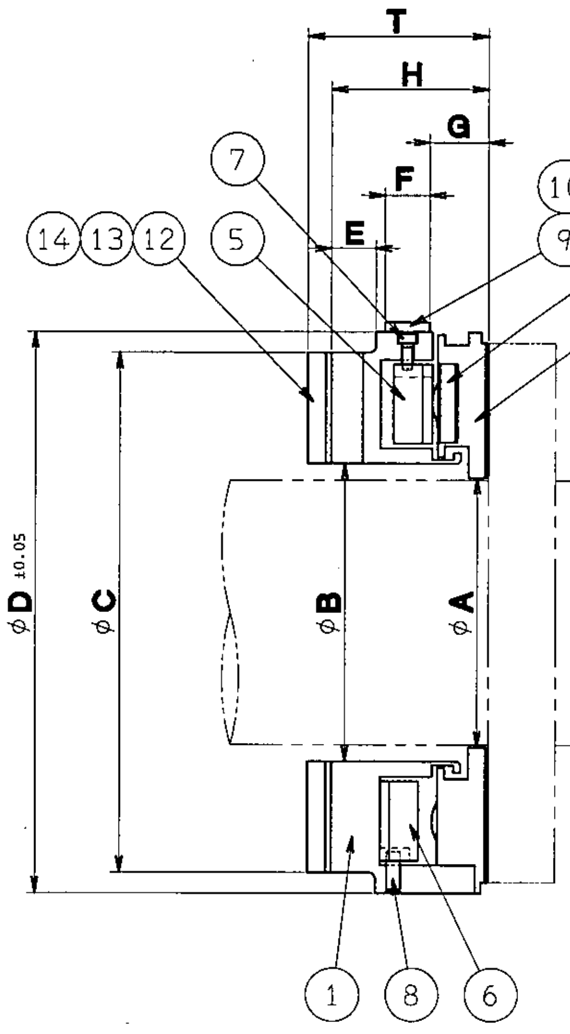
Elliott Ebara

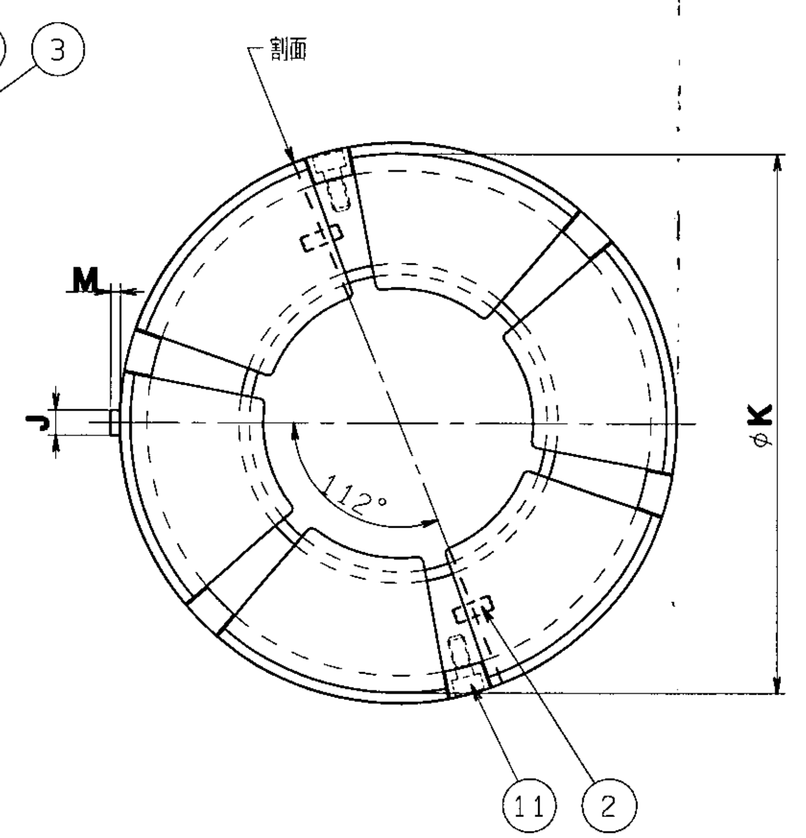
PM841C

CAD登録済(SF)

軸受サイズ (INCHES)	4	5	6	7	8	9	10-1/2	12	13-1/2	15	17
スラスト軸受組立部品番号(2組/台)	E1562G708-1	E1562G709-1	E1562G710-1	E1562G711-1	E1562G712-1	E1562G713-1	E1562G714-1	E1562G715-1	E1562G716-1	E1562G717-1	E1562G718-1
スラスト面積(SQ-IN)	7.5	11.6	16.7	23	29.9	37.8	51.5	66.8	84.8	104.7	134.4
φA	55.6	69.8	84.1	96.8	111.1	125.4	146.0	168.3	188.9	209.5	238.1
φB	55.6	69.8	84.1	96.8	111.1	125.4	146.0	168.3	188.9	209.5	238.1
φC	104.8	128.6	149.2	174.6	196.8	222.2	260.3	293.7	330.2	368.3	419.1
φD	110.87	136.27	161.67	187.07	212.47	237.87	279.02	317.12	355.22	393.32	447.29
E	10	10	14	16	19	19	24	25	32	35	38
F	9.5	12.7	15.9	15.9	17.5	19.0	22.2	25.4	31.7	34.9	38.1
G	15.9	17.5	19.0	22.2	25.4	28.6	30.2	33.3	38.1	39.7	44.4
H	36.51±0.40	44.45±0.40	50.80±0.40	57.15±0.40	65.09±0.40	69.85±0.79	79.37±0.79	88.90±0.79	101.60±0.79	111.12±0.79	127.00±0.79
J	6.35	7.94	9.52	9.52	11.11	11.11	12.70	14.29	15.87	17.46	19.05
φK	101.6	127.0	152.4	177.8	203.2	228.6	266.7	304.8	342.9	381.0	431.8
M	3.2	4.0	4.8	4.8	4.8	4.8	5.6	5.6	6.3	7.9	7.9
T	43±0.51	51±0.51	59±0.58	67±0.58	75±0.58	83±0.97	92±0.99	102±0.94	114±0.94	124±0.94	140±0.94
予備品用スラストメタル組立部品番号	E1562G558-1	E1562G559-1	E1562G560-1	E1562G561-1	E1562G562-1	E1562G563-1	E1562G564-1	E1562G565-1	E1562G566-1	E1562G567-1	E1562G568-1

← 本体用手配品 (スラスト軸受組立部品番号)
← 予備品用手配品 (予備品用スラストメタル組立部品番号)





Gr.3	Gr.2	Gr.1	番号	部品名	材料
╳			17	予備品用スラストメタル組立	—
6	╳		16	スラストメタル組立	—
		╳	15	スラスト軸受組立	—
		1	14	六角穴付ボルト	SCM435
		1	13	シム一組	304
		1	12	シム押え	SS41
		2	11	六角穴付ボルト	SCM435
		1	10	六角穴付ボルト	SCM435
		1	9	キー	S45C
		6	8	スプリングピン	S45C
		6	7	六角穴付ボルト	S45C
		6	6	下部イコライザブロック	SCM435
		6	5	上部イコライザブロック	SCM435
	1	6	4	ピボット	SK5Q
	1	6	3	スラストメタル	ASTM C18200,WJ2
		2	2	ジョイントピン	S45C
		1	1	ベースリング	S45C

注記
1. ねじは全てユニファイねじのこと。
2. 大同メタル工業製又は同等品使用のこと。

FIG 4-7
4-45

展開図

設計	検図	製図	承認	名称	尺度
戸松 91.5.23	岡田 91.5.24	戸松 91.5.23	山口 91.5.24	OVER BORE, COPPER BACKED / スラスト軸受組立	1:NTS

ES/E1562G13/1 REV.

株式会社 荏原製作所

荏原製図規格変更 2003.4.1より実施

PM872C

CAD登録済(SF)

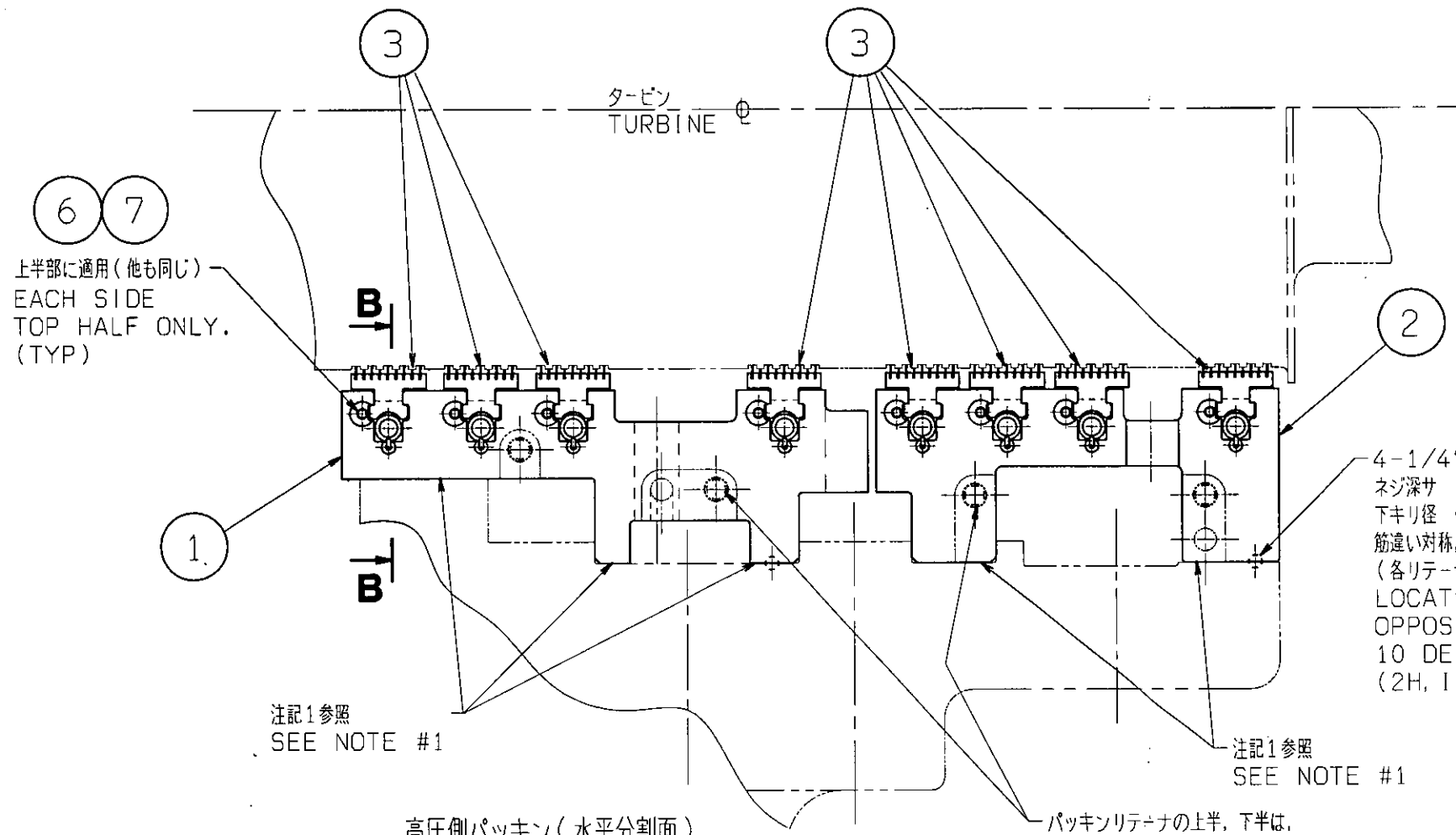
REVISIONS				
No.	DESCRIPTION	DATE	BY	APP.
	FIRST USED R021570803/SRV-5DF			

注記

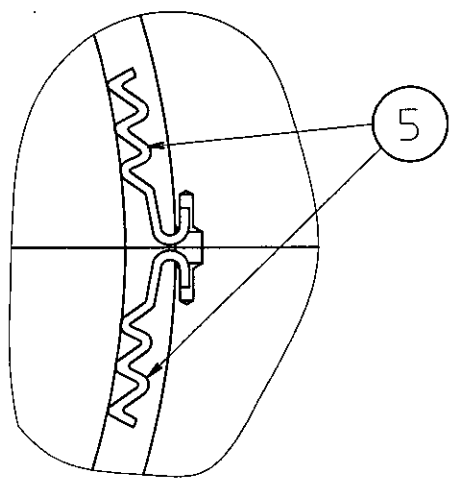
1．図示位置に、コパルタイトを全周に塗布すること。

NOTE

1. AT SURFACES INDICATED, USE COPALTITE MATERIAL SPEC. #412 ALL AROUND.



高圧側パッキン(水平分割面)
STEAM END PACKING,
AT HORIZONTAL SPLIT



SECTION **B B**

SECTION SHOWING METHOD OF ASSEMBLY OF PACKING & SPRINGS. (TYP.)

断 面 **B B**

パッキンとスプリングの組立方法
(他の断面もこれと同じ)
(S=1:1)

GR5	GR4	GR3	GR2	GR1		PART NAME 部品名		NO. 番号	EBARA PARTS NO エバラ部品番号	DESCRIPTION 記事
Q'TY/1SET 1台分個数										
						GROUP OF PARTS	パッキン組立	GR.1	E8632323-GR.1	
								9		
				4		SET SCREW	止めねじ	8	P23A52	
				16		SCREW, CAP	六角穴付ボタンネジ	7	E23R23	
				16		WASHER, PLATE	回り止め座金	6	E8633023-2	
				16		SPRING	スプリング	5	A655313-11	
								4		
				8		RING, PACKING	パッキンリング	3	E8632324-10	-530
				1		RETAINER, PACKING	パッキンリテーナ	2	E8631643-7	-530
				1		RETAINER, PACKING	パッキンリテーナ	1	E8631642-7	-530

FIG 4-8
4-46

展開図

設計用注記
1. クリアランス 0.39mm

ELLIOTT G.O.No.

ELLIOTT S.O.No.

ELLIOTT EBARA GROUP

☐ FOR APPROVAL
AVOID DELAY
TO MAINTAIN SHIPPING
PROMISE.
ONE APPROVED PRINT MUST BE
RETURNED BY: _____
BY _____ DATE _____

☐ FOR RECORD
ANY REQUESTED CHANGE OF THIS
EQUIPMENT WILL RESULT IN:
1. CONTRACT PRICE ADJUSTMENT.
2. EXTENDED SHIPPING PROMISE
AS THIS CONTRACT IS IN
MANUFACTURING PROCESS.
BY _____ DATE _____

DISTRIBUTION	SET
密	1
材	
検	
工	2

JOB No.

JOB/PROJECT NAME

ITEM No.

CUSTOMER

SER. No.

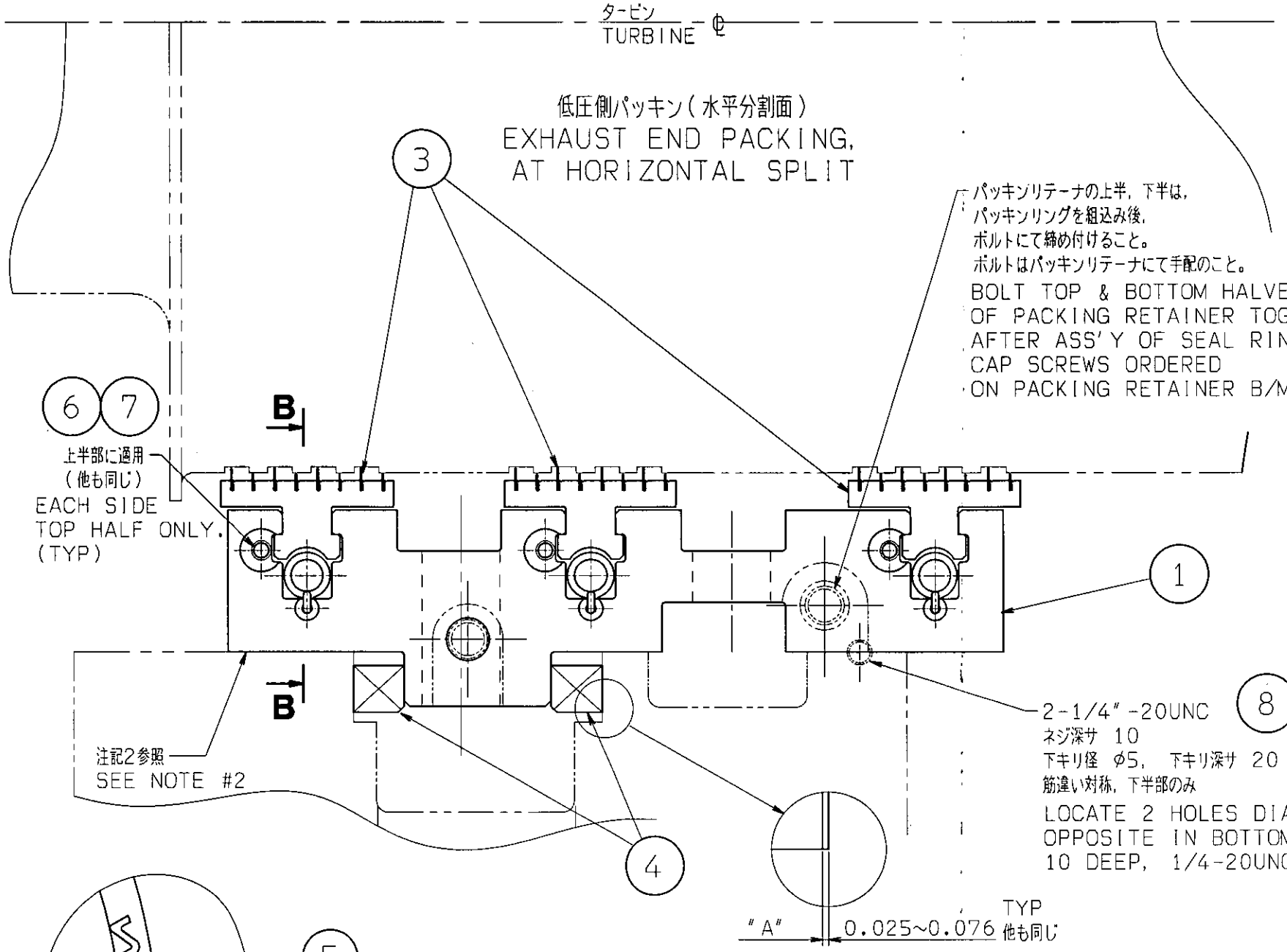
USER

APP'D BY S.SAWADA	DATE	SERVICE
		MODEL / SET
T.TANI	MAR.20.'03	TITLE R109S, 0.14" PITCH, φ9.125" SHAFT
DSN'D BY		パッキン組立(高圧側) PACKING ASSEMBLY(STM.END)
CHK'D BY T.TANI	MAR.20.'03	PROJ. / DWG.No. ES/8632323 / REV. 0
DRW'N BY K.NAGANUMA	MAR.11.'03	SCALE 1:2 / EBARA Elliott Ebara

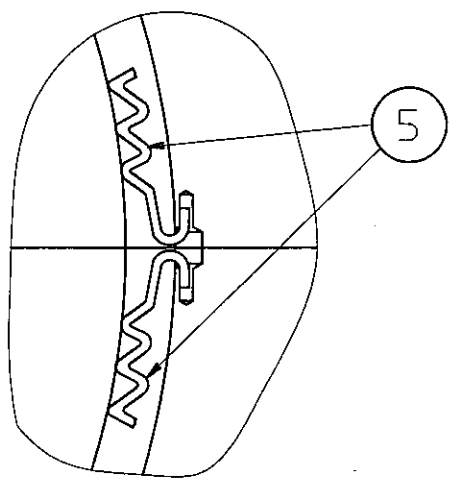
PM842C

CAD登録済(SF)

REVISIONS				
NO.	DESCRIPTION	DATE	BY	APP.
	FIRST USED R021570803/SRV-5DF			



DETAIL CLEARANCE
隙 間 拡 大 図
(S=20:1)



SECTION **B B**
SECTION SHOWING METHOD OF
ASSEMBLY OF PACKING & SPRINGS.(TYP.)
断 面 **B B**
パッキンとスプリングの組立方法
(他の断面もこれと同じ)
(S=1:1)

					GROUP OF PARTS	パッキン組立	GR.1	E8632325-GR.1	
							9		
				2	SET SCREW	止めねじ	8	P23A52	
				6	SCREW, CAP	六角穴付ボタンネジ	7	E23R23	
				6	WASHER, PLATE	回り止め座金	6	E8633023-2	
				6	SPRING	スプリング	5	A655313-11	
				2	SPACER RING	スペーサーリング	4	A635650-42	
				3	RING, PACKING	パッキンリング	3	E8632330-10	-530
							2		
				1	RETAINER, PACKING	パッキンリテーナ	1	E8631644-7	-530
GR5	GR4	GR3	GR2	GR1	PART NAME 部品名		NO. 番号	EBARA PARTS NO エバラ部品番号	DESCRIPTION 記事
Q'TY/1SET 1台分個数									

注 記
1. ラビリンス片が, 軸の溝に対し, クリアランス記録に示したスキマとなる様に
リテーナー及びパッキンリングを位置決めのこと。
その後, 図示のスキマが得られる様スペーサリングを "A" 寸法に加工すること。
スペーサリングは下半部分のみに入る。
2. 図示位置に、コパルタイトを全周に塗布すること。

NOTE.
1. LOCATE RETAINER & PACKING RING SEGMENTS
WITH PACKING RING STRIPS LOCATED
IN GROOVES AS PER CLEARANCES ON CLEARANCE
RECORD DWG. THEN FIND MICROMETER DIM."A"
ALLOWING FOR CLEARANCE AS SHOW.
MACHINE THE SPACER RING TO THESE DIMS.
SPACER RINGS IN BOTTOM HALF ONLY.
2. AT SURFACES INDICATED, USE COPALTITE
MATERIAL SPEC.#412 ALL AROUND.

FIG 4-9
4-47

展 開 図

設計用注記
1. クリアランス 0.39mm

ELLIOTT
EBARA GROUP

ELLIOTT G.O.No.
ELLIOTT S.O.No.

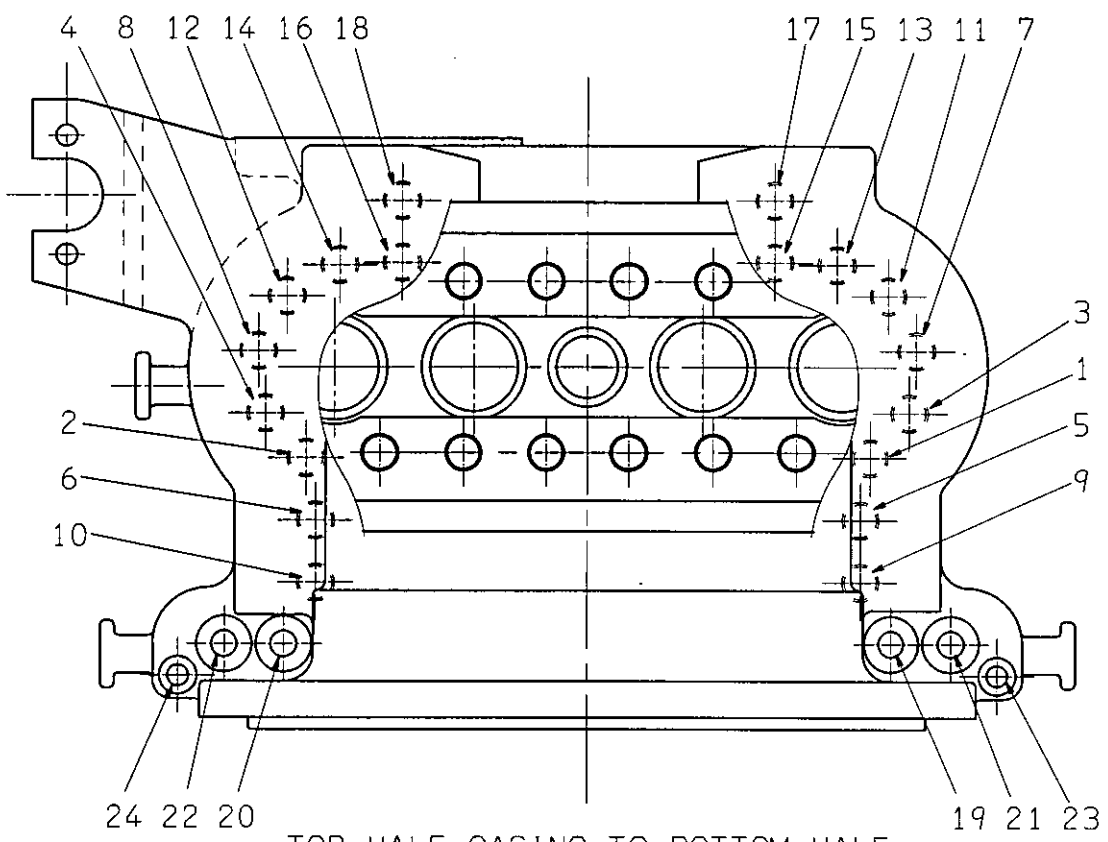
DISTRIBUTION	SET
控	1
材検工	2

☐ FOR APPROVAL
AVOID DELAY
TO MAINTAIN SHIPPING
PROMISE.
ONE APPROVED PRINT MUST BE
RETURNED BY: _____
BY _____ DATE _____

☐ FOR RECORD
ANY REQUESTED CHANGE OF THIS
EQUIPMENT WILL RESULT IN:
1. CONTRACT PRICE ADJUSTMENT.
2. EXTENDED SHIPPING PROMISE
AS THIS CONTRACT IS IN
MANUFACTURING PROCESS.
BY _____ DATE _____

JOB No.	JOB/PROJECT NAME
ITEM No.	CUSTOMER
SER.No.	USER
APP'D BY S.SAWADA DATE	SERVICE
	MODEL SET
T.TANI MAR.20.'03	TITLE 42"DF, 0.219"PITCH, φ9.125"SHAFT パッキン組立(低圧側) PACKING ASSEMBLY(EXH.END)
DSN'D BY	
CHK'D BY T.TANI MAR.20.'03	
DRW'N BY K.NAGANUMA MAR.11.'03	PROJ. DWG.NO. ES/8632325 REV. 0
	SCALE 1:2 EBARA Elliott Ebara

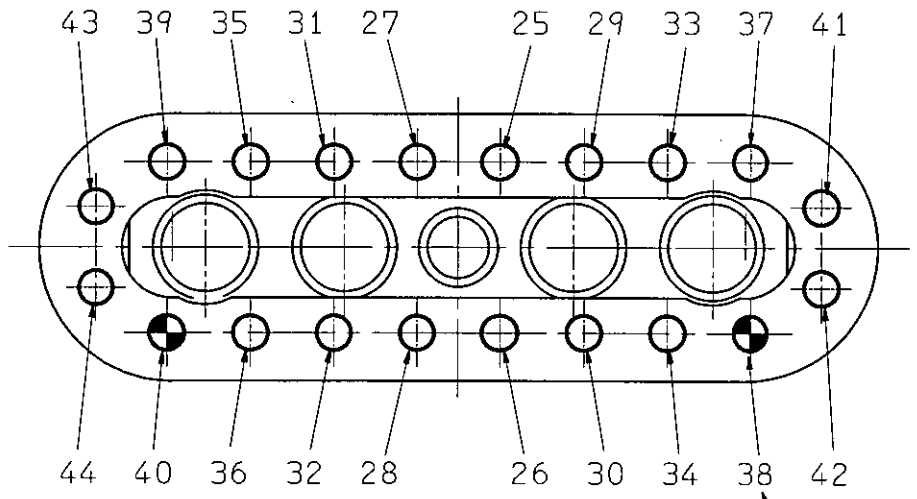
PM842C



TOP HALF CASING TO BOTTOM HALF
上部ケーシング水平割面

NOTE
1. SEALING COMPOUND(COPALTITE) TO BE APPLIED ON BOTH FLANGE SURFACES NEAR THE BORE. DO NOT ALLOW COMPOUND TO TOUCH ANY THREADED SURFACES.
2. APPLY THREAD LUBRICANT TO ALL THREADS. ASSEMBLE ALL STUDS, WASHERS & NUTS AND TIGHTEN WITH TABULATED INITIAL TORQUE. TIGHTENING TO BE DONE IN NUMERICAL ORDER ACCORDING TO TABULATED VALUES.
3. FINAL TIGHTENING TO BE DONE WITH STUD HEATERS (WHERE NEEDED) BY ONE OF THE FOLLOWING METHODS. THIGHTENING TO BE DONE BY PAIRS IN NUMERICAL ORDER ACCORDING TO THE DIAGRAM.
   1) ANGLE OF TURN FIGURE 1.
      THIS IS A MEASURE OF THE NUT ROTATION.THE FLANGE SHOULD BE SCRIBED AT ZERO DEGREES AND THE ANGLE THEN MEASURED COUNTER CLOCKWISE AROUND THE NUT. THE NUT SHOULD BE SCRIBED AT THIS ANGLE AND THEN TIGHTENED UNTIL THE SCRIBE MARKS LINE UP.
   2) CIRCUMFERENTIAL LENGTH OF NUT TURN FIGURE 1.
      THIS IS A LINEAR MEASURE OF THE ANGLE OF TURN.
      THE FLANGE SHOULD BE SCRIBED AT ZERO AND THE DISTANCE MEASURED COUNTER-CLOCKWISE AROUND THE OUTSIDE BARREL OF THE NUT.
      THE NUT SHOULD BE SCRIBED AT THIS DISTANCE AND THEN TIGHTENED UNTIL THE SCRIBE MARKS LINE UP.
   3) ELONGATION OF STUD
      THIS VALUE IS GIVEN FOR REFERENCE ONLY.
   4) COLD TORQUE
      THIS VALUE IS GIVEN FOR USE WITH TORQUE WRENCHES.
4. HEATER NOTES:
   A. BEFORE INSERTING HEATERS INTO STUDS, CHECK HEATERS FOR MOISTURE WITH MEGOHM METER. MINIMUM READING SHOULD BE 1/2 MEGOHM OR 500000 OHMS. IF READING IS LESS THAN 1/2 MEGOHM FOLLOW THIS DRY-OUT PROCEDURE.
      1) HEAT THE STUD HEATER IN AN OVEN AT APPROX.150° C UNTIL METER READING REACHES AT LEAST THE 1/2 MEGOHM LEVEL.
   B. AFTER STUD AND HEATER ASSEMBLY, THE HEATERS MAY ALSO BE CHECKED FOR MOISTURE WITH A MEGOHM METER. IF THE READING IS LESS THAN 1/2 MEGOHM, THE HEATERS MAY BE DRIED OUT AS FOLLOWS.
      1) HEAT THE STUD HEATER AT 1/2 DESIGN VOLTAGE (3 OR 4 HEATERS MAY BE WIRED IN SERIES) UNTIL THE METER READING REACHES THE 1/2 MEGOHM LEVEL.
   C. MAKE CERTAIN THAT THE CORRECT STUDS ARE USED WITH THE PROPER HEATER (PLACING A HEATER IN AN OVERSIZED HOLE WILL BURN IT OUT). SEE TABULATION.
   D. KEEP DIRT AND OTHER CONTAMINANTS, SUCH AS FELPRO OFF LENGTH OF HEATER INCLUDING TIP WHERE WIRES ARE CONNECTED TO PREVENT HEATER FROM SHORTING OUT. HEATER GREASE, MTL.SPEC.-470, IS USED ONLY ON LENGTH OF HEATER.

注記
1. フランジ面には，シール剤（コパルタイト）を塗布すること。
   但し，コパルタイトは，固着力が強いので，ねじ部に塗らぬ様注意すること。
2. 全てのねじ部には，潤滑剤を塗布すること。
   全てのボルト，座金，ナットを取付け，表で示された初期トルクで締付けること。
   但し，締付順序は締付順序番号に従うこと。
3. スタッドヒーターを用いる場合の最終締付法は，必要な部分には，次の方法のいずれかによること。
   締付けは，締付順番に従って2本1組で，行なうこと。
   1) 回転角による方法（図1参照）
      ナットの回転角を計る方法である。フランジに0度の位置をケガいておき，その位置から反時計方向にナット外周に沿って，表中の角度を計り，その位置にケガキ線をいれること。
      次に 両者のケガキ線が，一致するようナットを締め込むこと。
   2) 円周長さによる方法（図1参照）
      ナットの回転角を線長にて計る方法である。フランジに0度の位置をケガいておき，その位置から反時計方向にナット外周に沿って，表中の円周長さを計り，その位置にケガキ線をいれること。
      次に 両者のケガキ線が，一致するようナットを締め込むこと。
   3) ボルト伸び
      この値は参考用
   4) 冷間締付トルク
      トルクレンチを使用して，締付を行なう際のトルク値
4. ボルトヒーターに関する注意。
   A. ヒーターを挿入する前に，ヒーター表面の湿分をメグオーム計でチェックし，500000Ω以下の場合は，下記に従ってかわかすこと。
      1) ヒーターを加熱炉等に入れ約150° Cに加熱し，500000Ω以上になるまで加熱をくり返す。
   B. ヒーターはボルトに挿入した後でもう一度，メグオーム計でチェックをし，500000Ω以下の場合は下記に従ってかわかすこと。
      1) ヒーターを3~4個直列に結線し，常用の半分の電圧で加熱し，500000Ω以上になるまで続ける。
   C. 各ボルトに適合したヒーターを使用すること。
      （誤って他のボルトに挿入すると断線の可能性がある。）
      ヒーターの形状は表を参照のこと。
   D. ヒーターの結線部近くは，十分に汚れを取りショートせぬ様 注意すること。
      MS-470のヒーターグリースを 組立時 使用のこと。



STEAM CHEST COVER TO TOP HALF CASING
蒸気室カバー

TABLE-1 表1

TIGHTENING ORDER NO. 締付順序番号	STUD/SCREW PART NO. ボルト部品番号	STUD/SCREW SIZE ボルト寸法	ANGLE OF TURN, (DEGREE) ナット回転角度 $^{+3^\circ}_{0}$	CIRCUMFERE-NTIAL LENGTH 円周長さ $^{+1.5}_{0}$	ELONGATION (mm) ボルトの伸び	COLD TORQUE (kN-m) ボルト締付トルク	HEATER PART NO.FRE. ボルトヒーター部品番号	INITIAL TORQUE (kN-m) 初期締付トルク	SUPER BOLT JACK BOLT HEX SIZE スーパボルト用ジャッキボルト二面幅	SUPER BOLT JACK BOLT SIZE スーパボルト用ジャッキボルトサイズ	SUPER BOLT JACK BOLT No. スーパボルト用ジャッキボルト個数	SUPER BOLT JACK BOLT TORQUE (N-m) スーパボルト用ジャッキボルト締付トルク	MATERIAL 材料 BOLT ボルト	MATERIAL 材料 NUT ナット
1 ~ 18	B647938-2	M50X3X267	68°	45.1	0.38	6.24/6.87	E8681057-3	0.68	-	-	-	-	A193B16	A193B16
19 ~ 22	FST-H30120X3	M30X3X120	-	-	-	1.27/1.39	-	-	-	-	-	-	JIS SCM435Q	S45C-N
23, 24	FST-H24105	M24X105	-	-	-	0.62/0.68	-	-	-	-	-	-	JIS SCM435Q	S45C-N
25 ~ 37 39, 41~44	B647938-11	M50X3X259	64°	42.5	0.36	6.24/6.87	E8681057-4	0.68	-	-	-	-	A193B16	A193B16
38 , 40	B647938-11	M50X3X259	-	-	-	-	-	-	9	M10	16	48.8/51.2	A193B16	A193B16

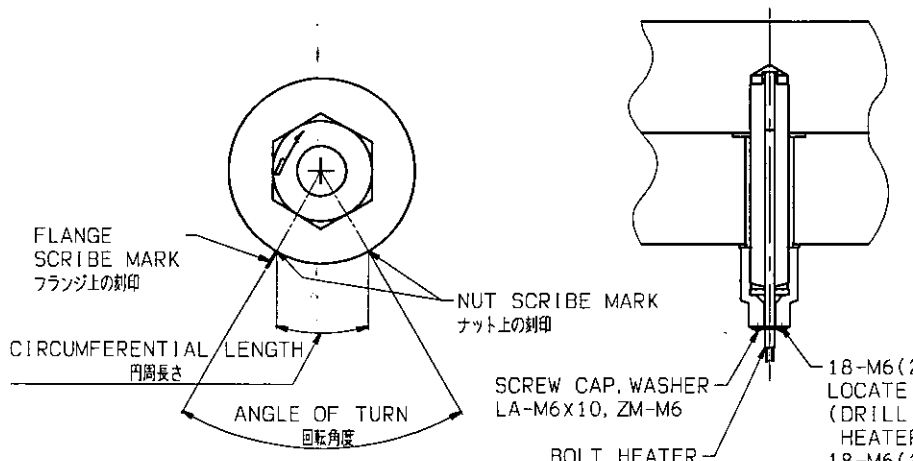


FIGURE 1
第 1 図

STUD HEATER ASSEMBLY
ボルトヒーター組立

注記
1. 図番 ES/8621719/02 を併せ参照のこと。

REVISIONS				
No.	DESCRIPTION	DATE	BY	APP.
	R001500104, SGV-7DFCT削減			

FIG4-10-1
4-48

BOLTHEATER 220V

ELLIOTT. EBARA GROUP

ELLIOTT G.O.NO.
ELLIOTT S.O.NO.

DISTRIBUTION: CUSTOMER

☐ FOR APPROVAL
AVOID DELAY TO MAINTAIN SHIPPING PROMISE. ONE APPROVED PRINT MUST BE RETURNED BY: _____
BY _____ DATE _____

☐ FOR RECORD
ANY REQUESTED CHANGE OF THIS EQUIPMENT WILL RESULT IN:
1. CONTRACT PRICE ADJUSTMENT.
2. EXTENDED SHIPPING PROMISE AS THIS CONTRACT IS IN MANUFACTURING PROCESS.
BY _____ DATE _____

JOB NO.	JOB/PROJECT NAME
ITEM NO.	CUSTOMER
SER.NO.	USER
APP'D BY S.SAWADA DATE	SERVICE
T.TANI APR.04.'03	MODEL SET
DSN'D BY	TITLE R109S, DW1A, 6"-600# SEQUENTIAL BOLTING DIAGRAM ケーシングボルト締付要領図（1/2）
CHK'D BY T.TANI APR.04.'03	PROJ. DWG.NO. ES/8621719/01 REV. 0
DRW'N BY K.NAGANUMA MAR.28.'03	SCALE 1:6 Elliott Ebara

PM841C

CAD登録(SF)

SUPERBOLT INSTALLATION PROCEDURE

NOTES:BEFORE TIGHTENING

1. DETERMINE THE TARGET JACKBOLT TORQUE FROM THE TABLE-1.
   THE JACKBOLT TORQUE VALUE STAMPED ON THE TENSIONER IS A STANDARD VALUE
   FOR THAT PART AND MAY NOT BE APPROPRIATE FOR YOUR APPLICATION.
2. IF USING AIR IMPACT. SELECT A TOOL WITH OUTPUT OF 90%-100% OF THE
   TARGET TORQUE."AIR IMPACT TOOL SELECTION"(90 PSI AIR PRESSURE)
   - UP TO 50 FT-LBS: A HIGH QUALITY 3/8" IMPACT OR RIGHT ANGLE AIR PATCHET.
   - 50-100 FT-LBS: A1/2" IMPACT AT A REDUCED PRESSURE OR SETTING.
     (BE CAREFUL NOT TO OVERTIGHEN).
   - 100-160 FT-LBS: A HIGH QUALITY 1/2" IMPACT SHOULD ACHIEVE NEAR 160 FT-LBS.
   - 160-200 FT-LBS: USE 1/2" IMPACT FOR MOST OF THE WORK SINCE THEY ARE
     EASIER TO USE.MOVE TO THE 3/4" IMPACT IF NECESSARY.
   - OVER 200 FT-LBS: FOR THESE HIGH TORQUES. A 3/4" IMPACT IS REQUIRED.

   THE JACKBOLT TORQUE ACTUALLY ACHIEVED BY AN AIR IMPACT WRENCH IS USUALLY
   MUCH LESS (30%-50%)THAN ITS RATED OUTPUT.ALSO. FOR MAXIMUM POWER. USE
   THE LARGEST AIR LINE AND FITTING. AN IMPACT CAN HAVE 10-25% MORE OUTPUT
   WITH A 3/8"VS. 1/4" AIR FITTING.
   TO VERIFY THE TORQUE OUTPUT OF AIR IMPACT, TIGHTEN THE JACKBOLT UNTIL THE
   SOCKET STOPS AND CHECK THE JACKBOLT WITH A TORQUE WRENCH (A TORQUE WRENCH
   WITH A DIRECT READING DIAL IS EASIEST TO USE).
3. MAKE SURE THE JACKBOLT TIPS ARE FLUSH (OR RECESSED) WITH BOTTOM OF NUT BODY.
   LUBRICATE MAIN THREAD OF JACK BOLT, STUD AND WASHER WITH OF SUPERBOLT(JL-G)
   LUBRICANT AND SLIDE WASHER ONTO STUD.

NOTES: TIGHTENING SEQUENCE

- STEP :1 SPIN THE TENSIONER(NUTBODY) DOWN ON THE MAIN THREAD UNTIL IT SEATS AGAINST THE WASHER. BACK OFF THE TENSIONER TO CREATE ABOUT 1.6 TO 3.2mm GAP BETWEEN NUT BODY AND WASHER.
- STEP :2 AT ABOUT 50% TARGET TORQUE. TIGHTEN THE JACKBOLTS IN A STAR PATTERN ON ALL STUDS.
- STEP :3 AT 100% TARGET TORQUE, TIGHTEN THE JACKBOLTS IN A CIRCULAR PATTERN ON ALL STUDS.
  SEQUENTIAL ORDER OF BOLTING IS SHOWN IN ES/8621719/01.
- STEP :4 REPEAT "STEP 3"UNTIL ALL JACKBOLTS ARE STABILIZAD (LESS THAN 20° ROTATION). THIS USUALLY REQUIRES 1-2 ADDITIONAL PASSES.

SUPERBOLT REMOVAL PROCEDURE

CAUTION ! REMOVAL REQUIRES STRICT PROCEDURES. JACKBOLTS MUST BE UNLOADED GRADUALLY. IF MOST OF THE JACKBOLTS ARE FULLY UNLOADED PREMATURELY.THE REMAINING JACKBOLTS WILL CARRY THE ENTIRE LOAD AND WILL BE HARD TO TURN.WITH EXTREME ABUSE, A JACKBOLT TIP CAN DEFORM MAKING REMOVAL DIFFICULT.

SERVICE OVER 120°C

ABOVE 120°C THE PETROLEUM BASE OF THE LUBRICANT BURNS OFF.
OIL THE TENSIONER TO REDUCE REMOVAL EFFORT.

- STEP :1 AS THE EQUIPMENT IS COOLING DOWN (AROUND 150°C), APPLY HYDRAULIC OIL TO JACKBOLTS, WASHER & MAIN THREAD.SYNTHETIC OIL CAN BE USED FOR REMOVAL AT HIGHER TEMPERATURES.
- STEP :2 USING A CIRCULAR PATTERN, "CRACK"EACH JACKBOLT ONLY ENOUGH TO ENSURE MOVEMENT.DO NOT TURN BEYOND BREAK LOOSE POINT.DO NOT BEGIN TO UNLOAD ANY GIVEN STUD BEFORE ALL JACKBOLTS ON ALL STUDS HAVE BEEN "CRACKED"
- STEP :3 FOLLOW REMOVAL PROCEDURES FOR SERVICE UNDER 120°C.
  SEQUENTIAL ORDER OF CRACKING IS SHOWN IN ES/8621719/01.

SERVICE UNDER 120°C

SPRAY JACKBOLTS WITH PENETRATING OIL OR HYDRAULIC OIL PRIOR TO START ESPECIALLY IF PRODUCT IS RUSTED.

- STEP :1 LOOSEN EACH JACKBOLT 1/4 TURN FOLLOWING A CIRCULAR PATTERN AROUND THE TENSIONER(1 ROUND ONLY). AS YOU MOVE AROUND AND GET BACK TO THE FIRST JACKBOLT, IT WILL BE TIGHT AGAIN. DO THIS FOR ALL STUDS ON THE JOINT PRIOR TO THE NEXT STEP.
- STEP :2 REPEAT A SECOND ROUND THE SAME AS ABOVE FOR ALL STUDS.
- STEP :3 REPEAT A THIRO ROUND THE SAME AS ABOVE FOR ALL STUDS.
- STEP :4 CONTINUE UNTIL JACKBOLTS ARE LOOSE.REMOVE CLEAN AND RELUBRICATE THE JACKBOLTS WITH LUBRICANT.

NOTE : USUALLY, AFTER THE THIRD ROUND, AN AIR IMPACT CAN BE USED TO REMOVE THE JACKBOLTS. DO NOT USE AN AIR IMPACT FOR THE FIRST THREE ROUNDS. FOR LONG STUDS OR TIE RODS, MORE THAN THREE ROUNDS MAY BE REQUIRED BEFORE USING THE IMPACT TOOLS.

5. スーパボルトに関する注意。

スーパーボルト取りつけ手順

取付け前

1. ジャックボルトの締付けトルクを表1より決める。
   メインナットに刻印されているジャックボルトの締付けトルクは標準値なので、
   表1の値と相違する場合があるので留意のこと。(図面中の表が優先)
2. エアインパクトレンチを使用する場合は、規定トルク値の90~100%の容量のインパクトレンチを選定すること。(エアインパクトレンチのレイティングの記載)
   エアインパクトレンチで出せる実際のトルク値は、レンチの定格値より小さい(30~50%)ので最大トルクを出す為に極力サイズの大きい空気ラインとフィッティングを採用すること。
   3/8"のフィッティングを使用したインパクトレンチは、1/4"の場合と比べて~10~20%出力が大きくなる。
   エアインパクトレンチでジャックボルトをソケットが回らなくなるまで締付けた後、
   トルクレンチでトルクの測定を行い、エアインパクトレンチの検定を行うこと。
   (直読式ダイアル針付きトルクレンチを使用すれば容易である。)
3. ジャックボルトのネジ先面がメインナットの底面と同一面にある(又は引っ込んでいる)ことを確認する。
   ボルト(スタッド)のネジ部及びワッシャに潤滑油(スーパーボルト社 JL-G)を塗布しワッシャーを取り付ける。
   ジャックボルトネジ部、先端部にも潤滑油を塗布すること。

取付け方法

- ステップ : 1 メインナットをボルト(スタッド)に取付け、ワッシャーに当たるまで締付ける。
  メインナットの下面とワッシャーの間に1.6~3.2mmの隙間が出来るようにメインナットを逆回転する。(緩める)
- ステップ : 2 対角線上にあるジャックボルトを順次、締付けトルクの50%で締付ける。(図1)
  全てのボルト(スタッド)のジャックボルトに対して施行のこと。
  ボルト(スタッド)の締付け順序は、ES/8621719/01による。
- ステップ : 3 円周方向にジャックボルトをトルクレンチで、締付けトルクの100%で締付ける。(図2)
  全てのボルト(スタッド)のジャックボルトに対して施行のこと。
  ボルト(スタッド)の締付け順序は、ES/8621719/01による。
- ステップ : 4 3の手順を全てのジャックボルトの締付け量が安定するまで(ジャックボルトの回転角が20°以下になるまで)繰り返すこと。通常は1~2回の繰り返しが必要である。

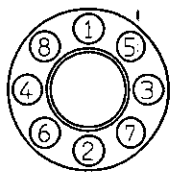


図1

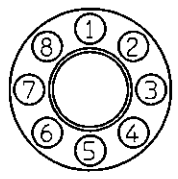


図2

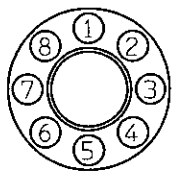


図3

注記
1. 図番 ES/8621719/01 を併せ参照のこと。

REVISIONS				
No.	DESCRIPTION	DATE	BY	APP.
	1/2修整			

スーパーボルト取外し手順

注 意! 取り外しにあたっては必ず本図に従って作業を行うこと。
ジャックボルトは少しずつゆっくりと緩めること。
早まって特定のジャックボルトだけを完全に緩めると、残りの緩めていないジャックボルトに荷重がかかり、緩めることが難しくなる。最悪の場合はジャックボルト先端が変形し、メインナットからジャックボルトが取り外せなくなる。

スーパーボルト取外し手順 (120°C以上でご使用の場合)

120C°以上では潤滑油の油分は蒸発しているので、メインナットに潤滑油を塗布すること。

- ステップ : 1 機器がおよそ150C°まで冷却されてから全てのジャックボルト、ワッシャー、ボルト(スタッド)に油圧用油を塗布する。合成油を使用してもよい。
- ステップ : 2 円周方向周りにジャックボルトが固着していないことを確認する為に少し緩める(クラックさせる)。
  完全に緩めないように留意のこと。また、全てのボルト(スタッド)に取付いているジャックボルトをクラックするまでは、どのボルト(スタッド)も緩めないこと。
  ジャックボルトのクラックを行う際の順序は、ES/8621719/01による。
- ステップ : 3 以降は、120C° 以下の場合の手順による。

スーパーボルト取外し手順 (120°C以下でご使用の場合)

作業前にジャックボルトに潤滑油又は油圧作動油を塗布する。

- ステップ : 1 各々のジャックボルトを周方向に1/4回転だけ緩め方向に戻す。(図3)
  メインナットに取付いているジャックボルトを全て1/4回転戻し終えた時点で、
  ジャックボルトが再度戻しにくくなっているかもしれないが、そのまま次のメインナットのジャックボルトを1/4回転緩めること。全てのボルト(スタッド)のジャックボルトを1/4回転戻すこと。
  ボルトの緩める順序は、ES/8621719/01による。
- ステップ : 2 全てのボルト(スタッド)のジャックボルトを1/4回転戻した後、二回目の1/4回転戻し作業を行う。
  ボルトの緩める順序は、ES/8621719/01による。
- ステップ : 3 全てのボルト(スタッド)のジャックボルトを1/4回転戻した後、三回目の1/4回転戻し作業を行う。
  ボルトの緩める順序は、ES/8621719/01による。
- ステップ : 4 すべてのジャックボルトが吸むまで上記の作業を行う。ボルトの緩める順序は、ES/8621719/01による。
  緩んだ後は、ジャックボルトを取り外し潤滑油を塗布する。

注記:通常は三回程度、戻し作業を繰り返せばジャックボルトは緩むことが多く、エアインパクトレンチが使用出来る。
最初の三巡目まではエアインパクトレンチを使用しないこと。長いスタッドやタイロッドの場合は、
以上の作業を三巡以上繰り返す必要がある。

FIG 4-10-2
4-49

ELLIOTT. EBARA GROUP

ELLIOTT G.O.NO:	
ELLIOTT S.O.No.	

DISTRIBUTION

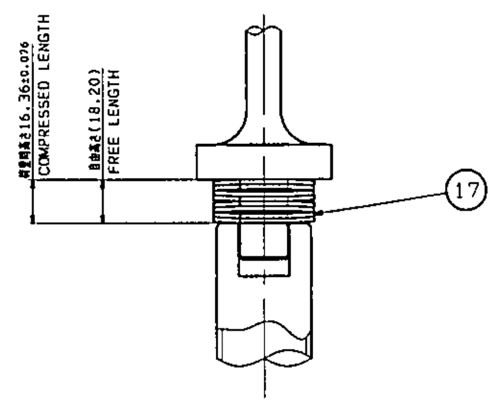
	SET
客	1
社	
最	
工	2

☐ FOR APPROVAL
AVOID DELAY TO MAINTAIN SHIPPING PROMISE. ONE APPROVED PRINT MUST BE RETURNED BY: _____
BY _____ DATE _____

☐ FOR RECORD
ANY REQUESTED CHANGE OF THIS EQUIPMENT WILL RESULT IN:
1.CONTRACT PRICE ADJUSTMENT.
2.EXTENDED SHIPPING PROMISE AS THIS CONTRACT IS IN MANUFACTURING PROCESS.
BY _____ DATE _____

JOB NO.	JOB/PROJECT NAME
ITEM NO.	CUSTOMER
SER.No.	USER
APP'D BY S.SAWADA	SERVICE
T.TANI APR.04.'03	MODEL SET
DSN'D BY	TITLE R109S, DW1A, 6"-600# SEQUENTIAL BOLTING DIAGRAM ケーシングボルト締付要領図(2/2)
CHK'D BY T.TANI APR.04.'03	PROJ. DWG.NO. ES/8621719/02 REV. 0
DRW'N BY K.NAGANUMA MAR.20.'03	SCALE 1:NOT EBARA Elliott Ebara

PM841C



DETAIL **B**
(S=1:1)
ASSEMBLE 8 PARALLEL SPRING DISCS
AS SHOWN, TYP.2 PLACES

B 部 詳 細
(S=1:1)
8個の皿バネを図のように組立のこと(2ヶ所)

CAUTION!
AT NO TIME SHOULD ASSEMBLY BE SETTING
WITH WEIGHT OF COVER ON LIFT RODS.

注意!
リフトロッドにカバーの重量をかけてはならない

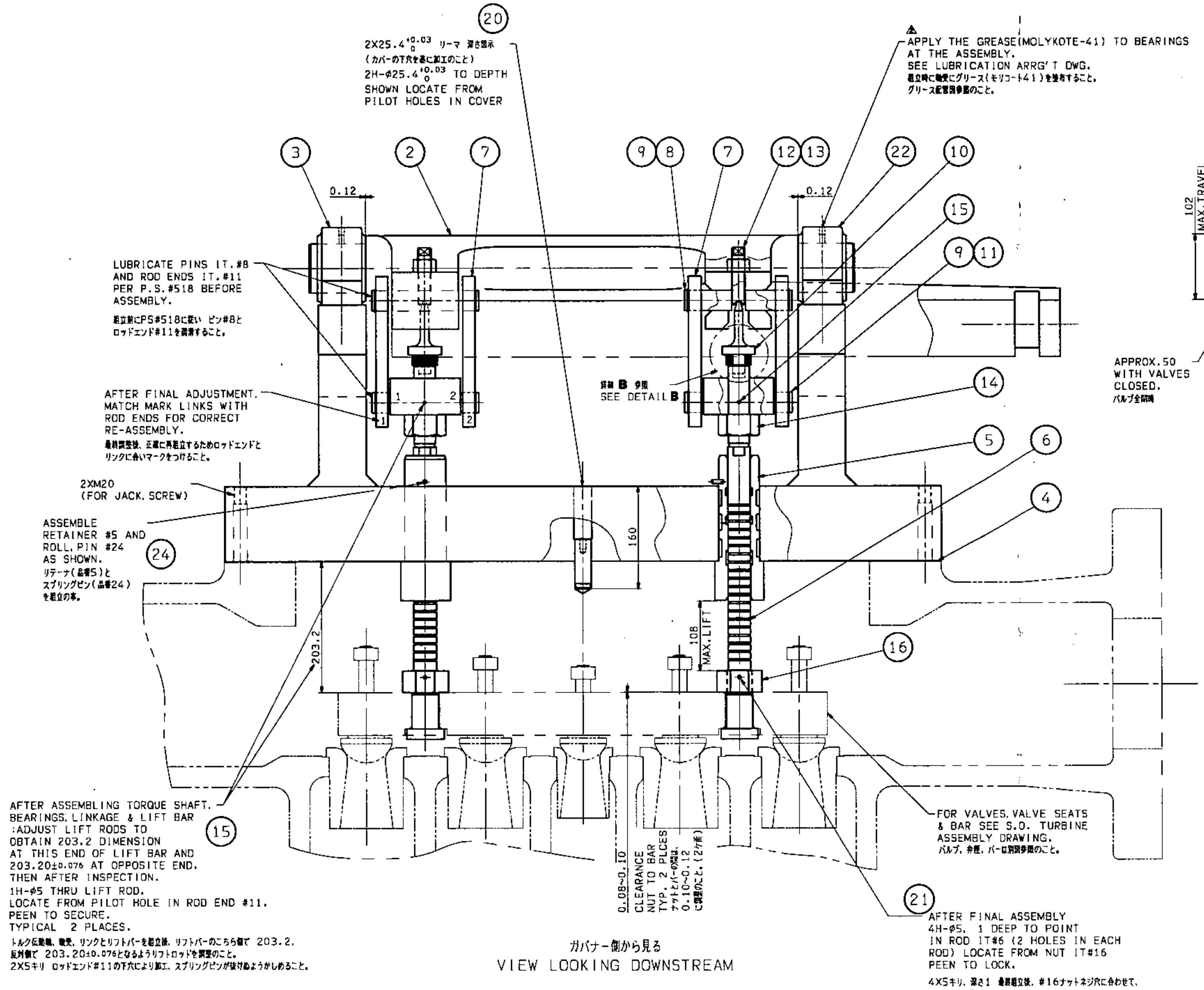
NOTE:
1.USE ANTI-GALLING COMPOUND ON ALL THREADS.

注記
1.全てのネジ部には、ネジかじり止めを塗布すること。

O'TY 個数						PART NAME 部品名		NO. 番号	ELLIOTT PARTS NO. エリオット 部品番号	EBARA PARTS NO. エバラ 部品番号	DESCRIPTION 記事
GR6	GR5	GR4	GR3	GR2	GR1						
					1	COVER	蒸気室カバー	1	654355-1	B654355-6	NO INTERM.LEAK-OFF
		1	1	1	1	TORQUE SHAFT	トルク伝導軸	2	-	B668038-1	
		1	1	1	1	BEARING	ベアリング	3	-	B676731-1	
					1	GASKET	ガスケット	4	-	B677071-1	
		2	2	2	2	RETAINER	リテーナー	5	-	A677662-2	
		2	2	2	2	ROD	リフトロッド	6	-	B677663-1	
		4	4	4	4	LINK	リンク	7	-	A682695-1	
		2	2	2	2	PIN, LINK	リンクピン	8	-	B682696-1	
		8	8	8	8	RETAINER RING	RTW-32	9	P27E36	RTW-K032	
		2	2	2	2	PIN, SPRING	スプリングピン	10	-	A696536-1	
		2	2	2	2	ROD END	ロッドエンド	11	-	B682697-1	
		2	2	2	2	SEAT, SPRING PIN	スプリングピンシート	12	-	B682899-1	
		2	2	2	2	NUT	FM20N(ヘビーナット)	13	-	FHN-A20	
		2	2	2	2	NUT	FM33X3N(ヘビーナット)	14	-	FHN-H33X2	
		2	2	2	2	PIN, ROLL	SSP-5X65	15	P36T274	SSP-K050065	
		2	2	2	2	NUT	ナット	16	-	B683176-1	
		16	16	16	16	SPRING DISC	さらバネ	17	-	A680498-1	
		4	4	4	4	SCREW, CAP	BSH-M24X125	18	P23T3329	BSH-H24125	
		4	4	4	4	PIN, TAPER DOWEL	BST-10X50	19	P36K287	BST-H10050	
		2	2	2	2	PIN, DOWEL	平行ピン	20	-	B682699-1	
		4	4	4	4	SCREW, SET	止めネジ	21	P23K456	E23K456	
		1	1	1	1	BEARING	ベアリング	22	-	B676731-2	
		2				PIN, LINK	リンクピン	23	720524-1	-	
		2	2	2	2	PIN, ROLL	SSP-6X16	24	P36T8808	SSP-K060016	
					X	ASSEMBLY	蒸気室カバー組立	25	-	B654467-25	UP TO 750°F
		1		1		COVER	蒸気室カバー	26	654146-1	B654146-6	NO INTERM.LEAK-OFF
				X		ASSEMBLY	蒸気室カバー組立	27	-	B654467-27	ABOVE 750°F
			1			COVER	蒸気室カバー	28	655352-1	-	SPECIAL
			1			RETAINER	リテーナー	29	711487-1	-	SPECIAL
			X			ASSEMBLY	蒸気室カバー組立	30	654467-30	-	SPECIAL
								31	-		
		X				ASSEMBLY	蒸気室カバー組立	32	654467-32	-	SPECIAL
								33			
								34			
								35			

REVISIONS

NO.	DESCRIPTION	DATE	BY	APP.
1	CHANGED ITEM NO21 P/N WAS E23K452		T.T	S.S
2	ADDED NOTE.			



ガバナー側から見る
VIEW LOOKING DOWNSTREAM

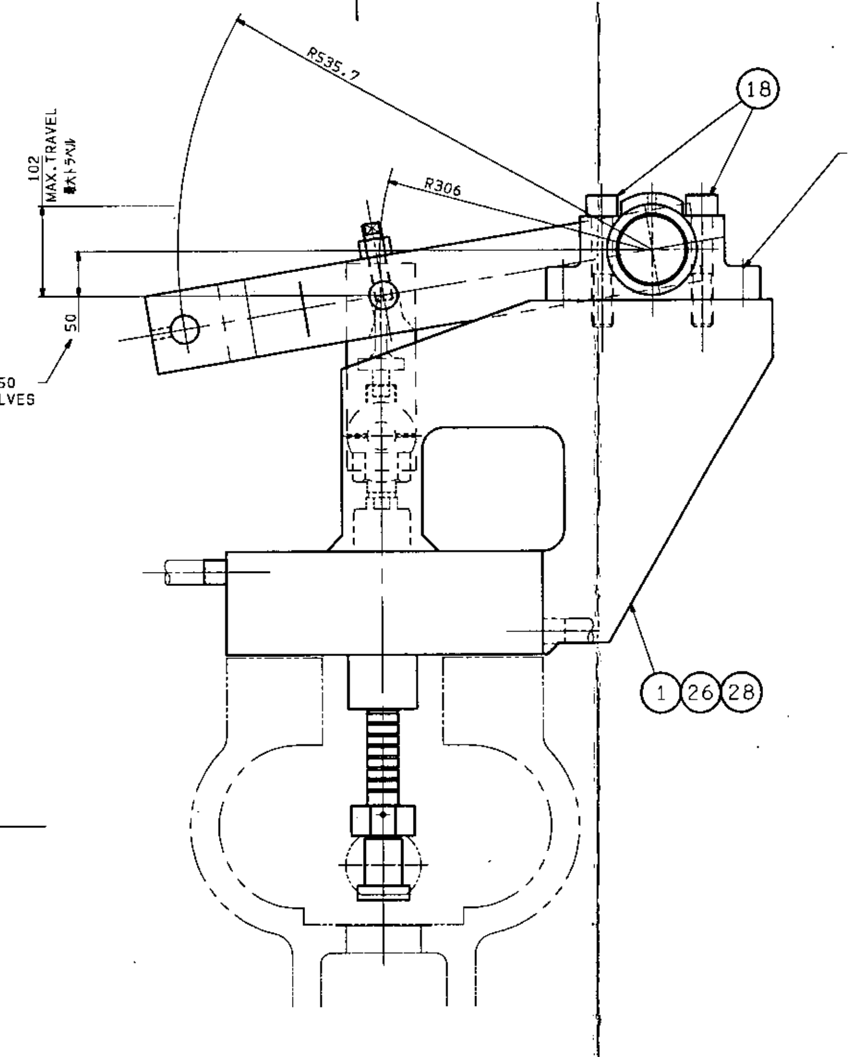


FIG 4-11
4-50

展 開 図

ELLIOTT DWG NO.
W-654467 REV.2C

ELLIOTT. EBARA GROUP

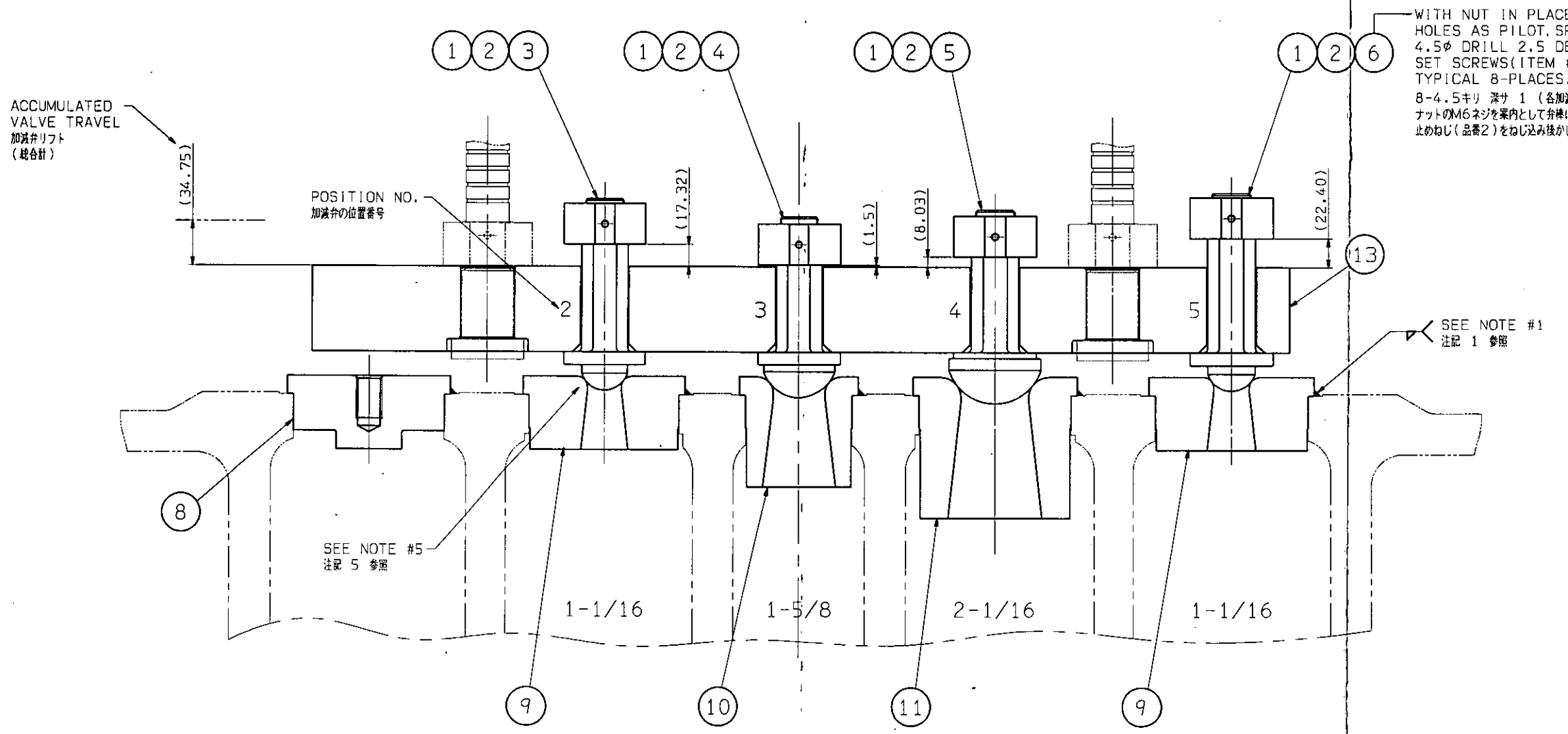
☐ FOR APPROVAL
AVOID DELAY TO MAINTAIN SHIPPING PROMISE. ONE APPROVED PRINT MUST BE RETURNED BY: ______
BY ______ DATE ______

☐ FOR RECORD
ANY REQUESTED CHANGE OF THIS EQUIPMENT WILL RESULT IN:
1.CONTRACT PRICE ADJUSTMENT.
2.EXTENDED SHIPPING PROMISE AS THIS CONTRACT IS IN MANUFACTURING PROCESS.
BY ______ DATE ______

ELLIOTT G.O.NO.	
ELLIOTT S.O.NO.	
JOB NO.	JOB/PROJECT NAME
ITEM NO.	CUSTOMER
SER.NO.	USER
APP'D BY: S.sawada, T.TANI	SERVICE
DSN'D BY	MODEL / SET
CHK'D BY: m.nishiuchi	TITLE: G109S, SG.VALVE STEM 蒸気室カバー組立図 STEAM CHEST COVER ASS'Y
DRW'N BY: K.NAGANUMA	DWG.NO. EA/654467 REV. 2
	SCALE 1:3 Elliott Ebara

CAD使用(SF)

REVISIONS				
NO.	DESCRIPTION	DATE	BY	APP.



VIEW LOOKING DOWNSTREAM
蒸気上流側より見た図

NOTES
1. AFTER ASSEMBLING VALVE SEATS IN CHEST, WELD PER PS-977A.
2. AFTER WELDING SEATS AND BEFORE ASSEMBLING VALVES IN BAR, CHECK VALVE-MATING SEAT CONTACTS. IF NECESSARY LAP VALVES TO MATING SEATS TO OBTAIN 100% CONTACT. (APPROXIMATELY A 1.5mm WIDE BAND AROUND THE SEATING DIAMETER.)
3. PRE-HEAT VALVE SEAT BORES IN STEAM END CASING TO 204°C. FOR ASSEMBLING VALVE SEATS IN CASING.
4. DO NOT EXCEED 27.1 N-m TORQUE WHEN ASSEMBLING NUT, ITEM NO.1 .
5. VALVE CLOSURE CHECK: AFTER VALVE TO SEAT CONTACT IS ESTABLISHED, MEASURE DIMENSION FROM TOP OF VALVE (POINT WHERE VALVE CONTACTS UNDERSIDE OF BAR) TO TOP OF STEAM CHEST HORIZ. FLANGE FOR ALL VALVES. ALL VALVES TO FLANGE DIM'S ARE TO BE WITHIN ±0.25mm. IF NECESSARY, BACKFACE VALVE DISK.

注 記
1. 蒸気室に弁座を取付け後, PS-977Aに従って弁座固定用溶接を行うこと。
2. 弁座溶接後, 加減弁をリフトバーに組み込む前に, 加減弁と弁座の当りをチェックすること。100%の当りを得るのに, 必要に応じ加減弁をラッピングすること。(シート面に巾約1.5mmの当りが必要)
3. ケーシングに弁座を組込む為にケーシングの弁座穴を204°Cで前もって熱しておくこと。
4. 品番1のナットの締付トルクは, 27.1 N-mを越えないこと。
5. 加減弁全閉チェック: 加減弁と弁座の当りが得られてから全ての加減弁背面(リフトバーの下端と当る面)からケーシング蒸気室フランジ上面までの寸法を計測のこと。全ての寸法が±0.25mm以下であること。もし, これを越えている場合には, 加減弁背面を削ってあわせること。

GR5	GR4	GR3	GR2	GR1		GROUP OF PARTS	加減弁&弁座組立	GR.1	E8651492-GR1	
								14		
					1	LIFT BAR	リフトバー	13	E8652727-1	
								12		
					1	VALVE SEAT	弁座(2-1/16)	11	A669747-9	4.625" BORE
					1	VALVE SEAT	弁座(1-5/8)	10	A669787-8	3.25" BORE
					2	VALVE SEAT	弁座(1-1/16)	9	A669747-4	4.625" BORE
					1	VALVE PLUG	閉止板	8	B711526-4	4.625" BORE
								7		
					1	VALVE	加減弁(1-1/16)	6	E8652726-2	1.44sq-in.
					1	VALVE	加減弁(2-1/16)	5	E8652603-3	1.44sq-in.
					1	VALVE	加減弁(1-5/8)	4	E8652681-4	1.44sq-in.
					1	VALVE	加減弁(1-1/16)	3	E8652726-1	1.44sq-in.
					8	SET SCREW	止めねじ	2	E23K456-1	
					4	NUT	特殊ナット	1	B720377-1	
GR5	GR4	GR3	GR2	GR1		PART NAME 部品名		NO. 番号	EBARA PARTS No. エバラ部品番号	DESCRIPTION 記事
Q'TY/1SET					1台分個数					

FIG 4-12
4-51

ELLIOTT. EBARA GROUP

ELLIOTT G.O.No.

ELLIOTT S.O.No.

DISTRIBUTION	SET
按	1
好	
量	
エ	2

☐ FOR APPROVAL
AVOID DELAY TO MAINTAIN SHIPPING PROMISE. ONE APPROVED PRINT MUST BE RETURNED BY: _____
BY _____ DATE _____

☐ FOR RECORD
ANY REQUESTED CHANGE OF THIS EQUIPMENT WILL RESULT IN: 1. CONTRACT PRICE ADJUSTMENT. 2. EXTENDED SHIPPING PROMISE AS THIS CONTRACT IS IN MANUFACTURING PROCESS.
BY _____ DATE _____

JOB NO. 7020	JOB/PROJECT NAME TUPRAS IZMIR REFINERY DHP PROJECT
ITEM NO. CT-9901	CUSTOMER LG ENGINEERING & CONSTRUCTION CORP.
SER.NO. R021570803	USER TURKISH PETROLEUM REFINERIES CORP.
APP'D BY S.SAWADA — DATE	SERVICE RECYCLE GAS COMPRESSOR
T.TANI JAN.10.'03	MODEL SRV-5DF — SET 1
DSN'D BY	TITLE R109S, CW VALVES & SEATS 加減弁及び弁座
CHK'D BY T.TANI JAN.10.'03	PROJ. — DWG.NO. ES/8651492 — REV. 0
DRW'N BY K.NAGANUMA DEC.26.'02	SCALE 1 : 2

Elliott Ebara

PM841C

Q'TY/1SET 1台分個数																	PART NAME 部品名		NO. 番号	ELLIOTT PARTS NO. エリオット 部品番号	EBARA PARTS NO. エバラ 部品番号	DESCRIPTION 記事	
GR17	GR16	GR15	GR14	GR13	GR12	GR11	GR10	GR9	GR8	GR7	GR6	GR5	GR4	GR3	GR2	GR1							
																1	ROD	ロッド	1	—	B683310-2		
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	NUT	FM36X1.5N	2	—	FN-B36X1.5		
1	1			1	1				1	1			1		1	1	ROD END	ロッドエンド	3	—	B695772-1		
1	1			1	1				1	1			1	1	1	1	PIN PIN	ピン	4	—	A695608-1		
1	1			1	1				1	1			1	1	1	1	SCREW, SET	CS-M10X25	5	—	CS-H1025		
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	PIN, ROLL	SSP-5x32	6	—	SSP-K050032		
															1		ROD	ロッド	7	—	B683310-4		
								1						1			ROD	ロッド	8	—	B683310-3		
																X	GROUP OF PARTS	リンク組立	GR1	—	B710159-GR.1	S=1086	
															X		GROUP OF PARTS	リンク組立	GR2	—	B710159-GR.2	S=1245	
						1		1						1			ROD END	ロッドエンド	9	—	B683179-1		
														X			GROUP OF PARTS	リンク組立	GR3	—	B710159-GR.3	S=1161	
													1				ROD	ロッド	10	—	B683310-6		
													X				GROUP OF PARTS	リンク組立	GR4	—	B710159-GR.4	S=1143	
												1					ROD	ロッド	11	—	B683310-7		
											1	1					ROD END	ロッドエンド	12	—	B696599-2		
		1	1				1				1	1					PIN	ピン	13	—	B695796-1		
		1	1				1				1	1					SCREW, SET	CS-M12X20	14	—	CS-H1220		
												X					GROUP OF PARTS	リンク組立	GR5	—	B710159-GR.5	S=1586	⚠
											1						ROD	ロッド	15	—	B683310-9		
										1							ROD	ロッド	16	—	B683310-13		
											X						GROUP OF PARTS	リンク組立	GR6	—	B710159-GR.6	S=1442	
									1								ROD	ロッド	17	—	B683310-14		
									X	X							GROUP OF PARTS	リンク組立	GR7	—	B710159-GR.7	S=1246	
									X								GROUP OF PARTS	リンク組立	GR8	—	B710159-GR.8	S=1106	
						1		1									PIN	ピン	18	—	B695565-1		
						2		2									RETAINING RING	リテーナ	19	—	P27E26		
								X									GROUP OF PARTS	リンク組立	GR9	—	B710159-GR.9	S=1161	
2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	PIN, ROLL	SSP-5x50	20	—	SSP-K050050		⚠
		1	1				1										ROD END	ロッドエンド	21	—	B696599-1		
							1										ROD	ロッド	22	—	B683310-15		
							X										GROUP OF PARTS	リンク組立	GR10	—	B710159-GR.10	S=1173	
						1											ROD	ロッド	23	—	B683310-16		
						X											GROUP OF PARTS	リンク組立	GR11	—	B710159-GR.11	S=869	
					1												ROD	ロッド	24	—	B683310-18		
					X												GROUP OF PARTS	リンク組立	GR12	—	B710159-GR.12	S=1221	
				1													ROD	ロッド	25	—	B683310-20		⚠
				X													GROUP OF PARTS	リンク組立	GR13	—	B710159-GR.13	S=1202	⚠
	1		1														ROD	ロッド	26	—	B683310-21		⚠
			X														GROUP OF PARTS	リンク組立	GR14	—	B710159-GR.14	S=1194	⚠
		1															ROD	ロッド	27	—	B683310-23		⚠
		X															GROUP OF PARTS	リンク組立	GR15	—	B710159-GR.15	S=1073	⚠
																	GROUP OF PARTS	リンク組立	GR16	—	B710159-GR.16	S=1207	⚠
	1																ROD	ロッド	28	—	B683310-25		⚠
	X																GROUP OF PARTS	リンク組立	GR17	—	B710159-GR.17	S=1233	⚠
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	PIN, ROLL	SSP-6x65	29	—	SSP-K060065		⚠

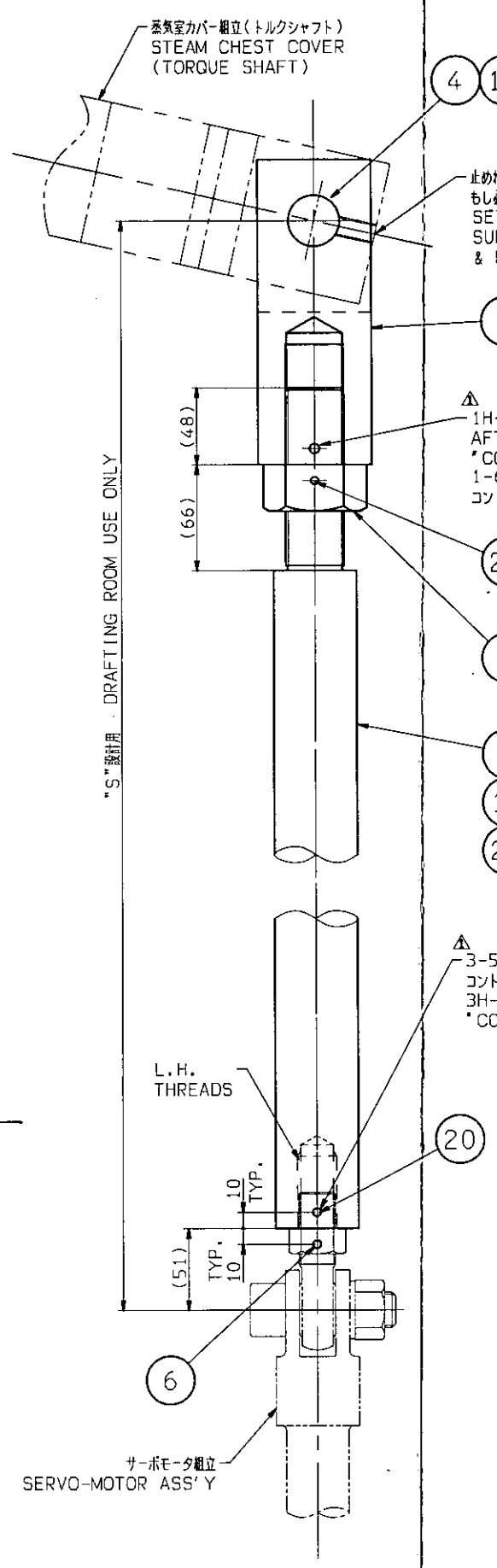


FIG 4-13
4-52

展開図

EL元図 X-710159 REV.3A

REVISIONS				
NO.	DESCRIPTION	DATE	BY	APP.
⚠	GR.5 'S' WAS 1586. REMOVE VALVE OPEN ARROW AND NOTES. IN PARTS LIST AT IT.#20 QTY WAS 3. ADDED AT GR.25~29, GR.13~17.	NOV. 5.'91	K.N T.T	S.S

ELLIOTT. EBARA GROUP

ELLIOTT S.O.No.

ELLIOTT S.O.No.

☐ FOR APPROVAL
AVOID DELAY TO MAINTAIN SHIPPING PROMISE. ONE APPROVED PRINT MUST BE RETURNED BY: _____
BY _____ DATE _____

☐ FOR RECORD
ANY REQUESTED CHANGE OF THIS EQUIPMENT WILL RESULT IN:
1. CONTRACT PRICE ADJUSTMENT.
2. EXTENDED SHIPPING PROMISE AS THIS CONTRACT IS IN MANUFACTURING PROCESS.
BY _____ DATE _____

DISTRIBUTION	SET
原	1
社	1
客	1
エ	3

JOB NO.

ITEM NO.

SER.No.

JOB/PROJECT NAME

CUSTOMER

USER

APP'D BY	DATE
S.SAWADA	NOV. 6.'91
S.SASAKI	NOV. 8.'91
DSN'D BY K.NAGANUMA	NOV. 8.'91
CHK'D BY K.NAGANUMA	OCT.30.'91
DRW'N BY H.KAWADA	OCT.25.'91

SERVICE

MODEL SET

TITLE FEMAIL END TORQUE SHAFT
リンク組立
LINKAGE ASSEMBLY

PROJ. DWG.NO. EA/710159 REV. 1

SCALE 1:2

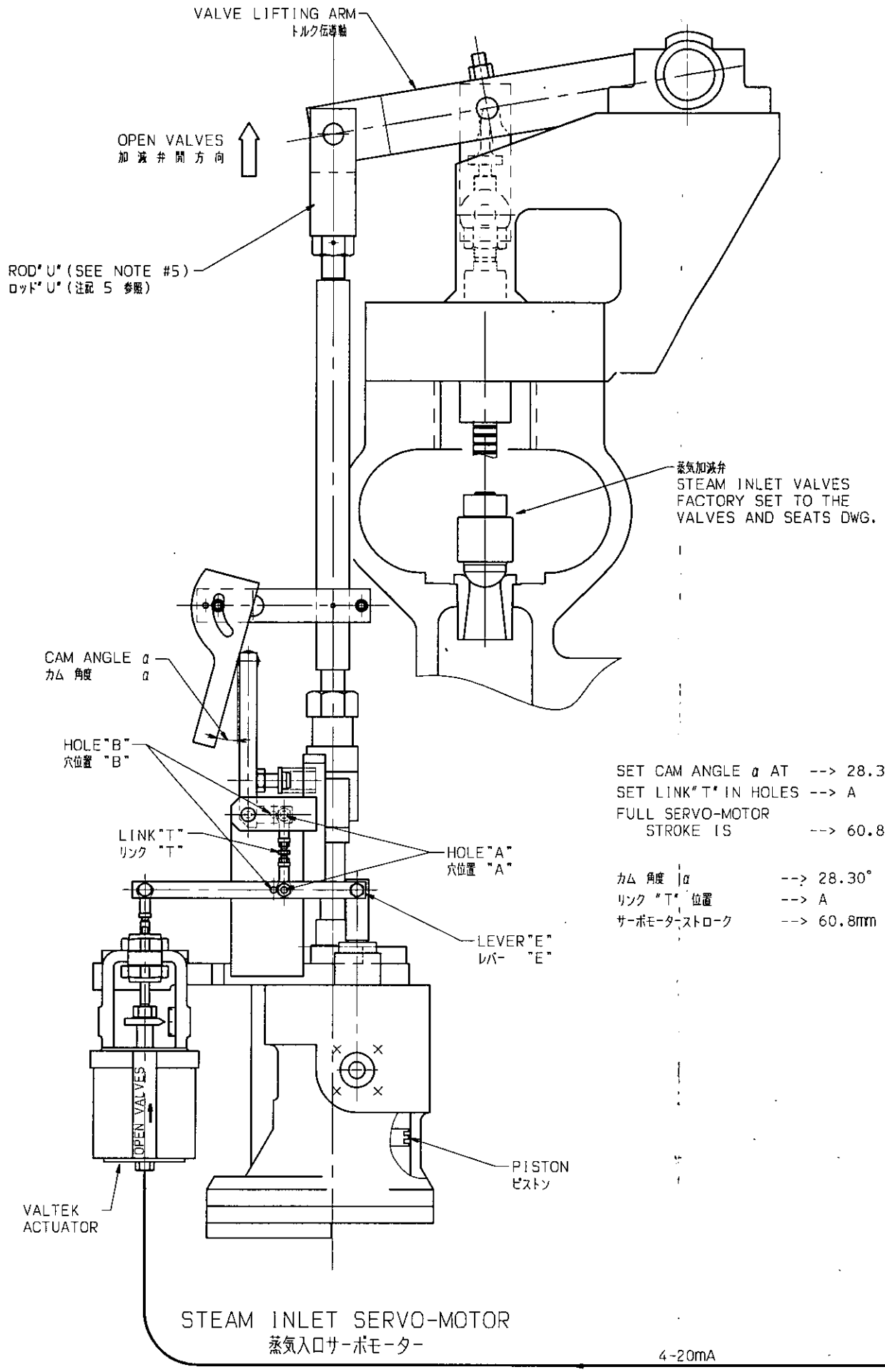
Elliott Ebara

CAD設計(SF)

PM841C

CAD作成済(SF)

REVISIONS				
No.	DESCRIPTION	DATE	BY	APP.



SET CAM ANGLE α AT --> 28.30°
SET LINK"T" IN HOLES --> A
FULL SERVO-MOTOR
STROKE IS --> 60.8mm

カム 角度 α --> 28.30°
リンク "T" 位置 --> A
サーボモーターストローク --> 60.8mm

WG505

STEAM INLET SERVO-MOTOR
蒸気入口サーボモーター

4-20mA

NOTES:
1. VALTEK ACTUATOR SHOULD BE FULLY RETRACTED WITH A 4 mA SIGNAL AND EXTENDED APPROX. 25mm WITH A 20 mA SIGNAL.
2. ADJUST LINK "T" SO THAT VALVES JUST BEGIN TO OPEN WITH AN INPUT SIGNAL SLIGHTLY GREATER THAN 4 mA.
3. ADJUST CAM IF NECESSARY TO OBTAIN FULL STROKE WITH 20mA SIGNAL TO ACTUATOR.
4. FOR STEAM INLET VALVES INFORMATION, SEE VALVES & SEATS DRAWING ORDERED ON TURBINE ASSEMBLY.
5. ADJUST ROD"U" SO PISTON IS 6mm IN FROM TOUCHING BOTTOM OF SERVO-MOTOR WHEN STEAM VALVES ARE SEATED.

注 記
1. VALTEKアクチュエーター出力軸は、4mA の電気信号を受けた時最も縮んだ位置となり、20mA の電気信号で25mm伸びた位置にくること。この範囲でサーボモーターが全ストローク動くこと。
2. 信号が、4mA をわずかに越えた時に、加減弁が開き始めるようリンク"T"を調節すること。
3. 電気信号が、20mA となった時、加減弁が全開となるよう、カム角度を調節すること。
4. 蒸気加減弁の設定については、「弁及び弁座組立図」を参照すること。
5. 加減弁を全閉にした時にピストンがサーボモーターの底より6mmの位置にくるよう、ロッド"U"を使用して調整すること。

FIG 4-14
4-53

ELLIOTT EBARA GROUP

ELLIOTT G.O.NO.	DISTRIBUTION	SET
ELLIOTT S.O.NO.		

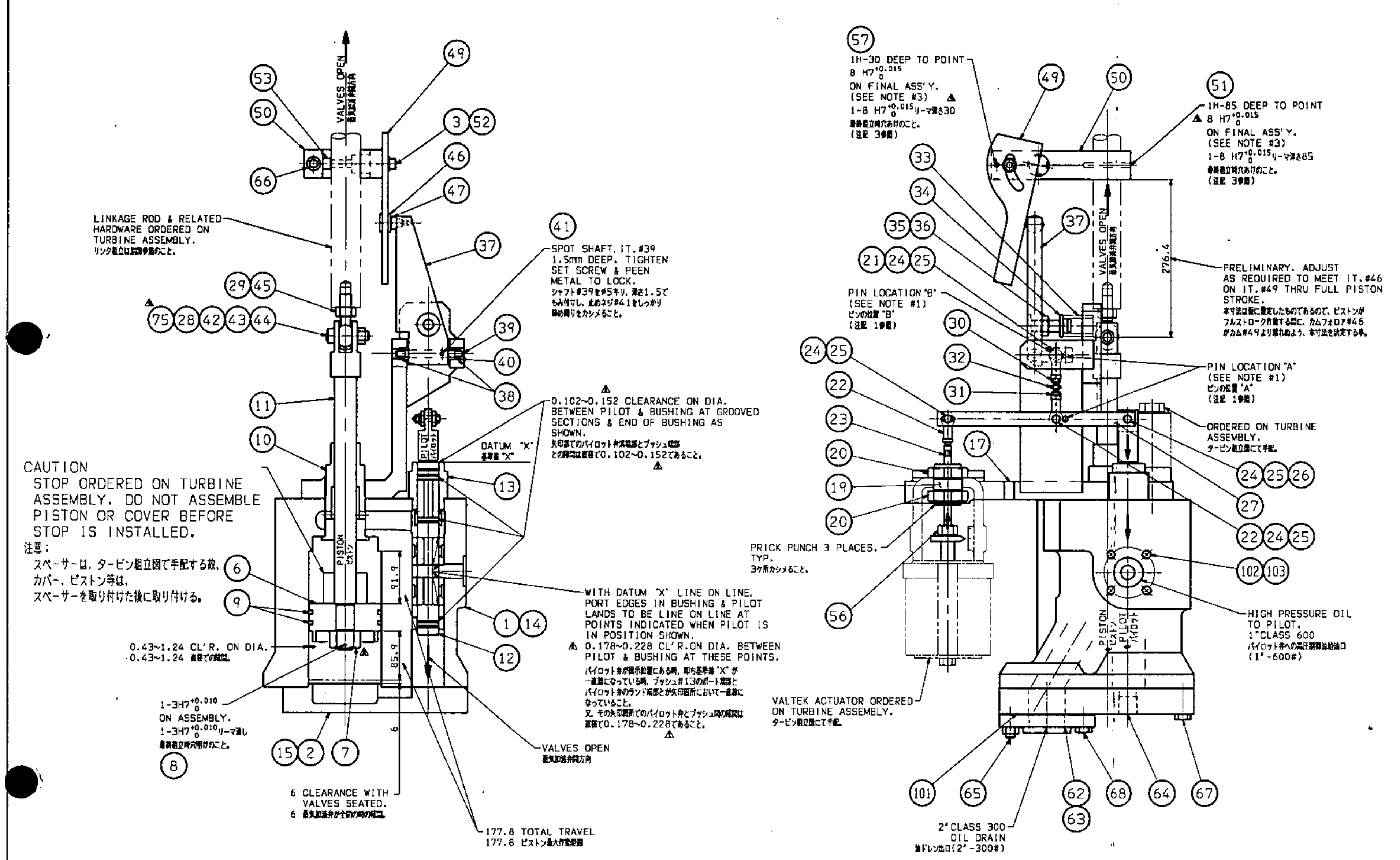
☐ FOR APPROVAL
AVOID DELAY TO MAINTAIN SHIPPING PROMISE. ONE APPROVED PRINT MUST BE RETURNED BY: _____
BY _____ DATE _____

☐ FOR RECORD
ANY REQUESTED CHANGE OF THIS EQUIPMENT WILL RESULT IN:
1. CONTRACT PRICE ADJUSTMENT.
2. EXTENDED SHIPPING PROMISE AS THIS CONTRACT IS IN MANUFACTURING PROCESS.
BY _____ DATE _____

JOB NO.	7020
ITEM NO.	CT-9901
SER.NO.	R021570803
APP'D BY	S.SAWADA
DATE	
DSN'D BY	T.TANI MAR.27.'03
CHK'D BY	T.TANI MAR.27.'03
DRW'N BY	K.NAGANUMA MAR.21.'03
JOB/PROJECT NAME	TUPRAS IZMIR REFINERY DHP PROJECT
CUSTOMER	LG ENGINEERING & CONSTRUCTION CORP.
USER	TURKISH PETROLEUM REFINERIES CORP.
SERVICE	RECYCLE GAS COMPRESSOR
MODEL	SRV-5DF
SET	1
TITLE	R109S, VALTEK CONTROL SETTING DIAGRAM コントロール設定図
PROJ.	
DWG.NO.	ES/8651493
REV.	0
SCALE	1:NOT

Elliott Ebara

PM841C



NOTES
1. SELECT PROPER LOCATION "A" OR "B" TO MATCH PISTON TRAVEL AND ADJUST ROD IT.#32 SO THAT CAM FOLLOWER CONTACTS CAM.
2. SEE TURBINE ASS'Y. OR CONTROL SETTING DWG. FOR FINAL LINKAGE ADJUSTMENT PROCEDURES.
3. AFTER TESTING LINKAGE FOR DESIGN CONDITIONS LOCK CAM WITH ROLL PIN IT.#57 AND LOCK BRACKET WITH ROLL PIN IT.#51.

注 記
1. ピストン行程量に応じてレバー#27及びブラケット#37の位置"A"、"B"を選択し、ロッド#32を調整すること。カムフォロアーがカムから離れないようにすること。
2. リンク調整手順については、コントロール設定図を参照のこと。
3. リンク装置の調整後、カム#49をスプリングピン#57で、ブラケット#50をスプリングピン#51で、それぞれ固定すること。

Q'TY/1SET GR4	GR3	GR2	GR1	PART NAME	部品名	NO.	ELLIOTT PARTS NO.	EBARA PARTS NO.	DESCRIPTION
	1		1	CYLINDER, OIL	オイルシリンダー	1	-	B651630-6	
	1		1	COVER	カバー	2	-	B668373-1	
1	1	1	1	SCREW, CAP	BSH-M12X35	3	-	BSH-H12035	
						4			
						5			
1	1	1	1	PISTON	ピストン	6	-	A676925-1	
1	1	1	1	NUT	FM30N(ヘビーナット) ▲	7	-	FHN-A30 ▲	
1	1	1	1	PIN, ROLL	スプリングピン	8	-	SSP-K030045	
2	2	2	2	RING, PISTON	ピストンリング	9	-	P27R122	
1	1	1	1	BUSHING	ブッシュ	10	-	A680501-1	
1	1	1	1	ROD, PISTON	ピストンロッド	11	-	B677116-1	
1	1	1	1	VALVE, PILOT	パイロットバルブ	12	-	B673301-1	
1	1	1	1	BUSHING	ブッシュ	13	-	A672234-1	
1		1		CYLINDER, OIL	オイルシリンダー	14	-	B651630-7	
1		1		COVER	カバー	15	-	B668373-2	125AARH
						16	-		
1	1	1	1	BRACKET	ブラケット	17	-	B677246-1	
						18	-		
1	1	1	1	CONNECTOR	継手	19	-	B682893-1	
2	2	2	2	NUT, LOCK	ロックナット	20	-	ANR-A08	
1	1	1	1	BEARING, ROD END	ロッドエンド	21	-	P1562R313	
2	2	2	2	BEARING, ROD END	ロッドエンド	22	-	P1562R333	
1	1	1	1	ROD	ロッド	23	-	A682895-1	
4	4	4	4	NUT	ナット	24	-	P14J19	
4	4	4	4	BOLT, FITTED	段付ボルト	25	-	E8653237-26	
2	2	2	2	BUSHING	ブッシュ	26	-	A646101-8	
2	2	2	2	LEVER	レバー	27	-	A682900-1	
1	1			BEARING, ROD END	ロッドエンド	28	-	P1562R248	
1	1			NUT	FU⅜-14UNF-N(左)	29	-	FNU-B07X14L	
1	1	1	1	NUT	FU⅜-24UNF-N(右)	30	-	FNU-B03X24	
1	1	1	1	NUT	FU⅜-24UNF-N(左)	31	-	FNU-B03X24L	
1	1	1	1	ROD	ロッド	32	-	A682902-1	
1	1	1	1	SPRING	バネ	33	-	A646684-1	
1	1	1	1	SEAT, SPRING	スプリングシート	34	-	B695769-1	
1	1	1	1	SCREW, SET	CS-M20X65	35	-	CS-H2065	
1	1	1	1	NUT, JAM	FM20LN	36	-	FLN-A20	
1	1	1	1	BRACKET	ブラケット	37	-	B677117-5	
2	2	2	2	BEARING, SPHERICAL	スフェリカルベアリング	38	-	P1562R833	
1	1	1	1	SHAFT	シャフト	39	-	A694772-1	
1	1	1	1	RING, RETAINING	C型止め輪	40	-	P27J20	
1	1	1	1	SCREW, SET	CS-M6X8	41	-	CS-H0608	
		1	1	BEARING, ROD END	ロッドエンド	42	-	P1562R137	
1	1	1	1	SCREW, SHOULDER	段付ボルト	43	-	E23W163	
1	1	1	1	NUT	FM16N	44	-	FN-A16	
		1	1	NUT	FU⅜-16UNF-N(左)	45	-	FNU-B06X16L	
1	1	1	1	BEARING	カムフォロアー	46	-	P1562R688	
1	1	1	1	SPACER	スペーサ	47	-	A694774-1	
						48			
1	1	1	1	CAM	カム	49	-	B680905-5	
1	1	1	1	BRACKET	ブラケット	50	-	B674550-1	
1	1	1	1	PIN, ROLL	スプリングピン	51	-	SSP-K080080	▲
1	1	1	1	WASHER	座金	52	-	ZM-A12	
1	1	1	1	SCREW, CAP	BSH-M12X65	53	-	BSH-H12065	
						54			
						55			
1	1	1	1	NUT	FU½-20UNF-N	56	-	FNU-B04X20	
1	1	1	1	PIN, ROLL	スプリングピン	57	-	SSP-K080025	
						58			
						59			
						60			
						61			
▲ 1		1		FLANGE	特殊フランジ	62	-	EB653542-1 ▲	125AARH
	1		1	FLANGE	PFLS(C300)-016B-RF0	63	-	PFLS2-EA016BR0	
1	1	1	1	PLUG, PIPE	PLGN-1	64	-	PLGN-E08	
4	4	4	4	STUD	FM16SKX110	65	-	FSK-H16110	
1	1	1	1	SCREW, CAP	BSH-M16X40	66	-	BSH-H16040	
10	10	10	10	BOLT	FM16TX65	67	-	FT-H16065	
4	4	4	4	BOLT	FM16TX45	68	-	FT-H16045	
						69			
						70			
						71			
						72			
						73			
						74			
▲ 1	1	1	1	WASHER, LOCK	バネ座金 ZR-M16	75	-	ZR-J16	
						76			
						77			
			X	GROUP OF PARTS	組立	GR.1	-	B658994-GR.1	
		X		GROUP OF PARTS	組立	GR.2	-	B658994-GR.2	W/125AARH FLGS.
	X			GROUP OF PARTS	組立	GR.3	-	B658994-GR.3	
X				GROUP OF PARTS	組立	GR.4	-	B658994-GR.4	W/125AARH FLGS.
1	1			GASKET	渦巻ガスケット JPI 2"-300#, RF, 13.0	101	-	GV6501P2-016BR30	V#6501
1	1			GASKET	渦巻ガスケット JPI 1"-600#, RF, 14.5	102	-	GAP4-2L008B45	V#8590
4	4			BOLT	FM16Tx40	103	-	FT-HB16040	
						104			
						105			

OBSOLETE FOR ALL WORK SUPERSEDED BY GROUPS 3, 4.

4

設計用注記
品番101~103(油配管用部品)をエリオット元図に追加する。

FIG 4-15
4-55

展開図

ELX番 R-658994 REV.2

ELLIOTT EBARA GROUP

FOR APPROVAL

FOR RECORD

TITLE: REVERSE ACTING VALTEK ACTUATOR
5" サーボモータ組立
5" SERVO MOTOR ASSEMBLY

DWG NO. EA/658994 REV. 3

SCALE 1:3

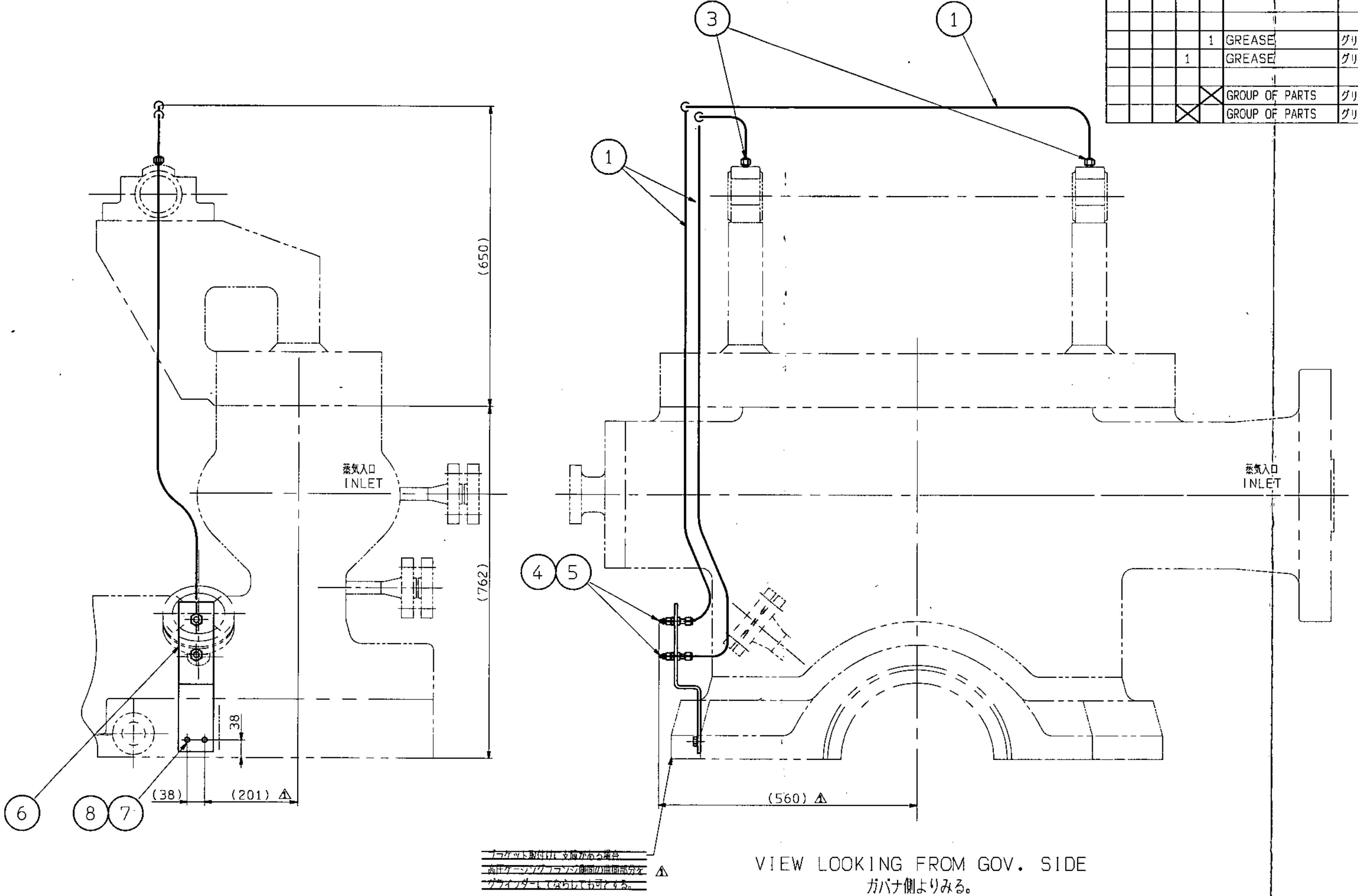
Elliott Ebara

CAD登録済(SF)

No.	DESCRIPTION	DATE	BY	APP.
⚠	CHANGED BRACKE POSITION.	SEP.19.'00	K.N.T.T.	S.S

REVISIONS

Q'TY/1SET 1台分個数 GR5	GR4	GR3	GR2	GR1	PART NAME	部品名	NO. 番号	EBARA PARTS NO. エバラ 部品番号	DESCRIPTION 記事
			1	1	TUBING	チューブ φ6X1.0t	1	E8671759-1	
							2		
			2	2	CONNECTOR, MALE	ハーフユニオン φ6X1.0t, ⅛NPT	3	UHW-C06M1001N	
			2	2	CONNECTOR, BULKHEAD	バルクヘッドコネクタ(メス), φ6xNPT1/8	4	E48J697	
			2	2	FITTING HYDRAULIC	グリースニップル NPT1/8	5	E8674027-4	1/8NPT
			1	1	BRACKET	ブラケット	6	E8672397-1	
			2	2	SCREW, CAP	FM10TX20	7	FT-A10020	
			2	2	WASHER, LOCK	ZR-M10	8	ZR-J10	
							9		
							9		
							10		
							11		
				1	GREASE	グリース	12	E8671759-12	SILICONE
			1		GREASE	グリース	13	E8671759-13	MOLYKOTE HP-500
							14		
			X		GROUP OF PARTS	グリース配管組立	15	E8671759-15	
				X	GROUP OF PARTS	グリース配管組立	16	E8671759-16	



VIEW LOOKING FROM GOV. SIDE
ガバナ側よりみる。

社内注記
グリース配管施工図は ES/8670084を参照のこと。
品番6のブラケットのみ変更

FIG 4-16
4-56

展開図

設計用注記
1. 部品はグリース配管施工図 ES/8670084にて手配のこと。
（本図は展開指示書によらず、出図すること）
2. ブラケット位置は工場要求により変更(Rev.1)。
通常はこの位置には取付け不可能なので注意のこと(吊耳に干渉するため)

ELLIOTT EBARA GROUP

ELLIOTT G.O.NO.
ELLIOTT S.O.NO.
DISTRIBUTION SET

☐ FOR APPROVAL
AVOID DELAY TO MAINTAIN SHIPPING PROMISE. ONE APPROVED PRINT MUST BE RETURNED BY: ______
BY ______ DATE ______

☐ FOR RECORD
ANY REQUESTED CHANGE OF THIS EQUIPMENT WILL RESULT IN: 1. CONTRACT PRICE ADJUSTMENT. 2. EXTENDED SHIPPING PROMISE AS THIS CONTRACT IS IN MANUFACTURING PROCESS.
BY ______ DATE ______

JOB NO. | JOB/PROJECT NAME
ITEM NO. | CUSTOMER
SER.NO. | USER
APP'D BY S.SAWADA | DATE APR.6.'00 | SERVICE
MODEL | SET
T.TANI APR.6.'00
DSN'D BY
TITLE R109S, FIELD BALANCE LUBRICATION ARRANGEMENT. グリース配管図
CHK'D BY T.TANI APR.6.'00
DRW'N BY K.NAGANUMA MAR.25.'00
PROJ. | DWG.NO. ES/8671759 | REV. 1
SCALE 1:5
Elliott Ebara

PM841C

CAD制図(SF)

NOTES

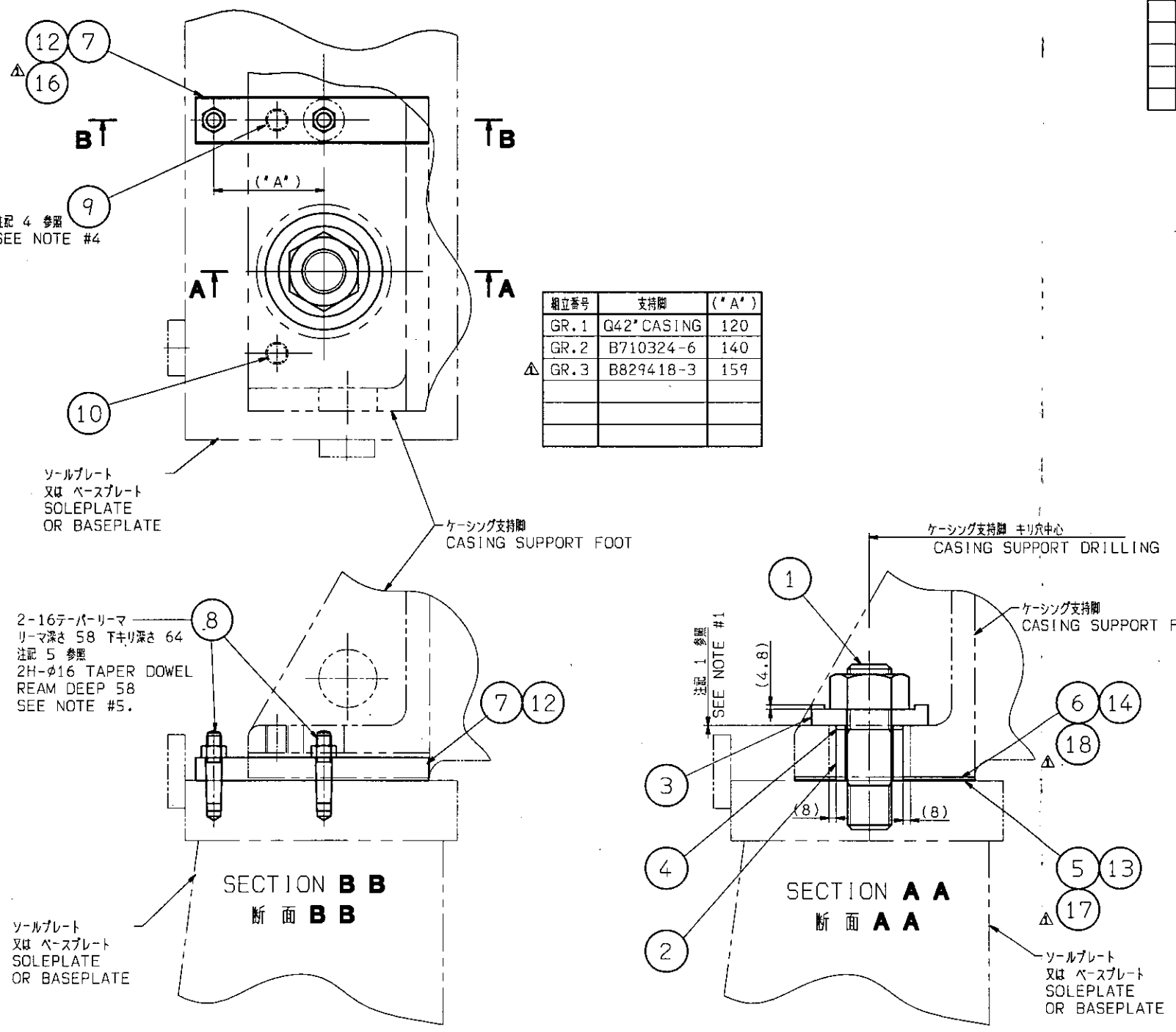
1. SHIM(PT#4) MUST BE FIT TO OBTAIN 0.15~0.10mm CLEARANCE WHEN NUT IS TIGHT AFTER ASSEMBLY IN POSITION SHOWN.
2. FOR BASEPLATE MOUNTED JOBS.
   2-a) REVERSE SPACER WASHER(PT#3) SO THAT COUNTERBORE IS IN OPPOSITE POSITION FOR SHIPMENT.
   2-b) FOR FINAL FIELD INSTALLATION, SPACER WASHER(PT#3) IS TO BE IN POSITION SHOWN.
3. FOR SOLEPLATE MOUNTED JOBS.
   3-a) FOR FINAL FIELD INSTALLATION, EACH PART IS TO BE IN POSITION SHOWN.
4. USE JACKSCREW IN THIS TAPPED HOLE FOR CLAMPING KEY WHEN DRILLING AND REAMING FOR TAPER DOWEL.
5. KEYS SHOLD BE FITTED & DOWELED AS SHOWN AFTER FINAL COUPLING ALIGNMENT IN THE FIELD. TWO(2) TAPER DOWEL ON EACH FOOT KEY.
6. ALL DIMENSIONS ARE IN MILLIMETERS.

注記

1. 組立時に、本図通り組立てナット締付後スペーサ座金(品番3)とケーシング支持脚の隙間が、0.15~0.10mmとなる様にシム(品番4)にて調整のこと。
2. ベースプレート使用の場合
   2-a) 出荷時はスペーサ座金(品番3)の座グリ面が反対側になるように裏返し、ナット締付のこと。
   2-b) 現地の最終組立時のスペーサ座金(品番3)は図示通りとすること。
3. ソールプレート使用の場合
   3-a) 現地の最終組立は図示通りとすること。
4. テーパノックのキリ穴及びリーマ加工時に、キーを固定するため押しボルトを使用のこと。
5. 現地にてカップリングの最終アライメント施行後、図示通りキーにテーパノックを打ち込むこと。
   テーパノックは1つのキーに2本のこと。
6. 寸法の単位はミリメートルです。

Q'TY/1SET 1台分個数 GR6	GR5	GR4	GR3	GR2	GR1	PART NAME 部品名		NO. 番号	EBARA PARTS NO. エバラ 部品番号	DESCRIPTION 記事
			4	4	4	FM48SKX180	STUD	1	FSK-A48180	
			4	4	4	スペーサー	SPACER	2	E8643033-1	
			4	4	4	スペーサ座金	SPACER WASHER	3	B891126-1	
			4	4	4	調整シムセット	SHIM, ADJUSTING	4	E8643158-7	
					1	調整シムセット	SHIM, ADJUSTING	5	E8642423-10	
					1	テフロンシート	SHEET, TEFLON	6	E8642424-10	
					2	キー	KEY	7	E8643416-1	(A847789-4)
			4	4	4	BST-16X45	PIN, DOWEL	8	BST-H16045	
			2	2	2	STB-M24X65	SCREW, JACK	9	STB-A24065	
			4	4	4	STB-M24X95	SCREW, JACK	10	STB-A24095	
					X	支持脚組立	GROUP OF PARTS	11	E8641777-GR.1	
				2		キー	KEY	12	E8643416-2	(A847789-1)
				1		調整シムセット	SHIM, ADJUSTING	13	E8642173-14	
		-		1		テフロンシート	SHEET, TEFLON	14	E8642174-10	
				X		支持脚組立	GROUP OF PARTS	15	E8641777-GR.2	
			2			キー	KEY	16	E8643157-1	
			1			調整シムセット	SHIM, ADJUSTING	17	E8642173-11	
			1			テフロンシート	SHEET, TEFLON	18	E8643160-3	
			X			支持脚組立	GROUP OF PARTS	19	E8641777-GR.3	
								20		
								21		
								22		
								23		
								24		
								25		

REVISIONS NO.	DESCRIPTION	DATE	BY	APP.
	FIRST USED R001600302/2SNV-B			
⚠1	ADDED GR.3. & 16~19. (R001600302/2SNV-B)	'02.1.29	K.W.T.	S.S



組立番号	支持脚	('A')
GR.1	Q42"CASING	120
GR.2	B710324-6	140
⚠ GR.3	B829418-3	159

FIG 4-17
4-57

展開図

設計用注記
本図はES/8641247 Rev.2(旧版)を参考にノックピン長さを変更して作成。
支持脚取付ボルトピッチ=3についてはES/8641775参照

ELLIOTT EBARA GROUP

ELLIOTT G.O.No.

ELLIOTT S.O.No.

DISTRIBUTION | SET
材 | 4
機 | 3
工 | 2
管 | 1

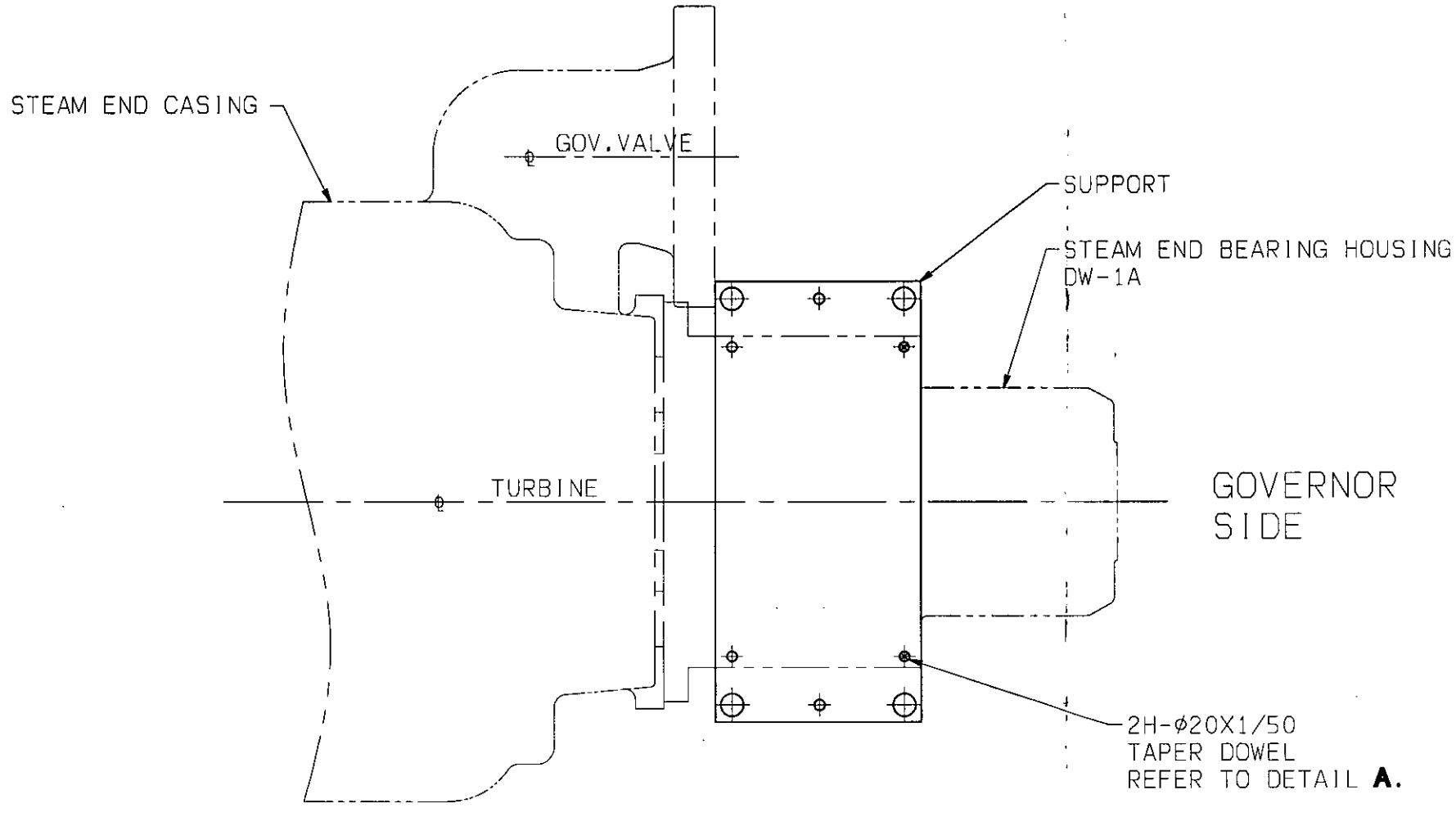
☐ FOR APPROVAL
AVOID DELAY TO MAINTAIN SHIPPING PROMISE. ONE APPROVED PRINT MUST BE RETURNED BY: _____
BY _____ DATE _____

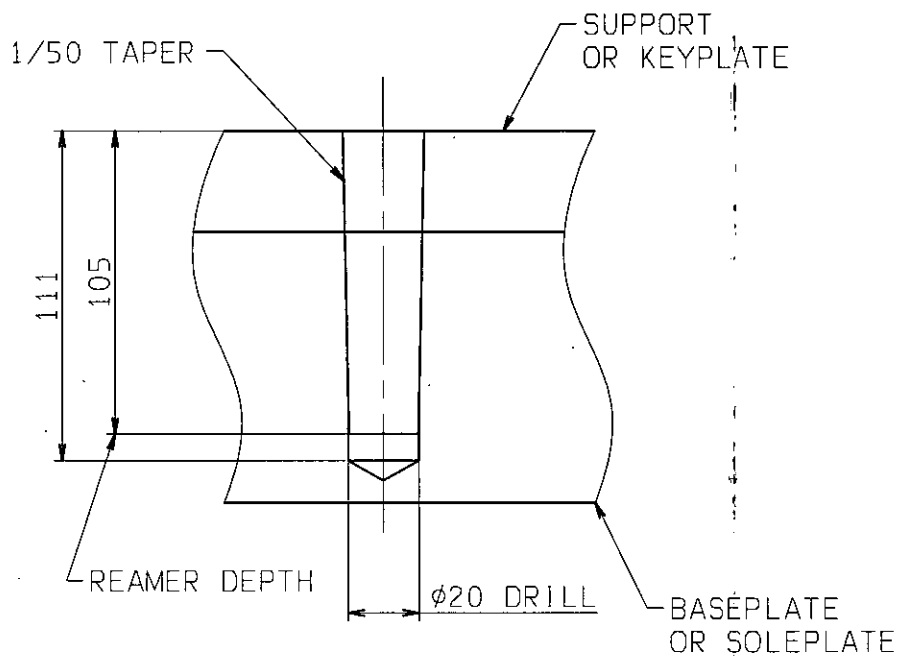
☐ FOR RECORD
ANY REQUESTED CHANGE OF THIS EQUIPMENT WILL RESULT IN:
1. CONTRACT PRICE ADJUSTMENT.
2. EXTENDED SHIPPING PROMISE AS THIS CONTRACT IS IN MANUFACTURING PROCESS.
BY _____ DATE _____

JOB NO.	JOB/PROJECT NAME
ITEM NO.	CUSTOMER
SER.NO.	USER
APP'D BY S.SAWADA JAN.30.'02	SERVICE
T.TANI JAN.29.'02	MODEL / SET
DSN'D BY	TITLE: EXH.END SUPPORT FOOT HARDWARE 支持脚組立
CHK'D BY T.TANI JAN.29.'02	PROJ. / DWG.NO. ES/8641777 / REV. 1
DRW'N BY K.NAGANUMA JAN.24.'02	SCALE 1:3 / Elliott Ebara

PM841C

CAD登録済(SF)





DETAIL **A**
(S=1:NTS)

REVISIONS				
No.	DESCRIPTION	DATE	BY	APP.

FIG 4-18
4-58

ELLIOTT
EBARA GROUP

ELLIOTT G.O.NO.

ELLIOTT S.O.NO.

DISTRIBUTION	SET

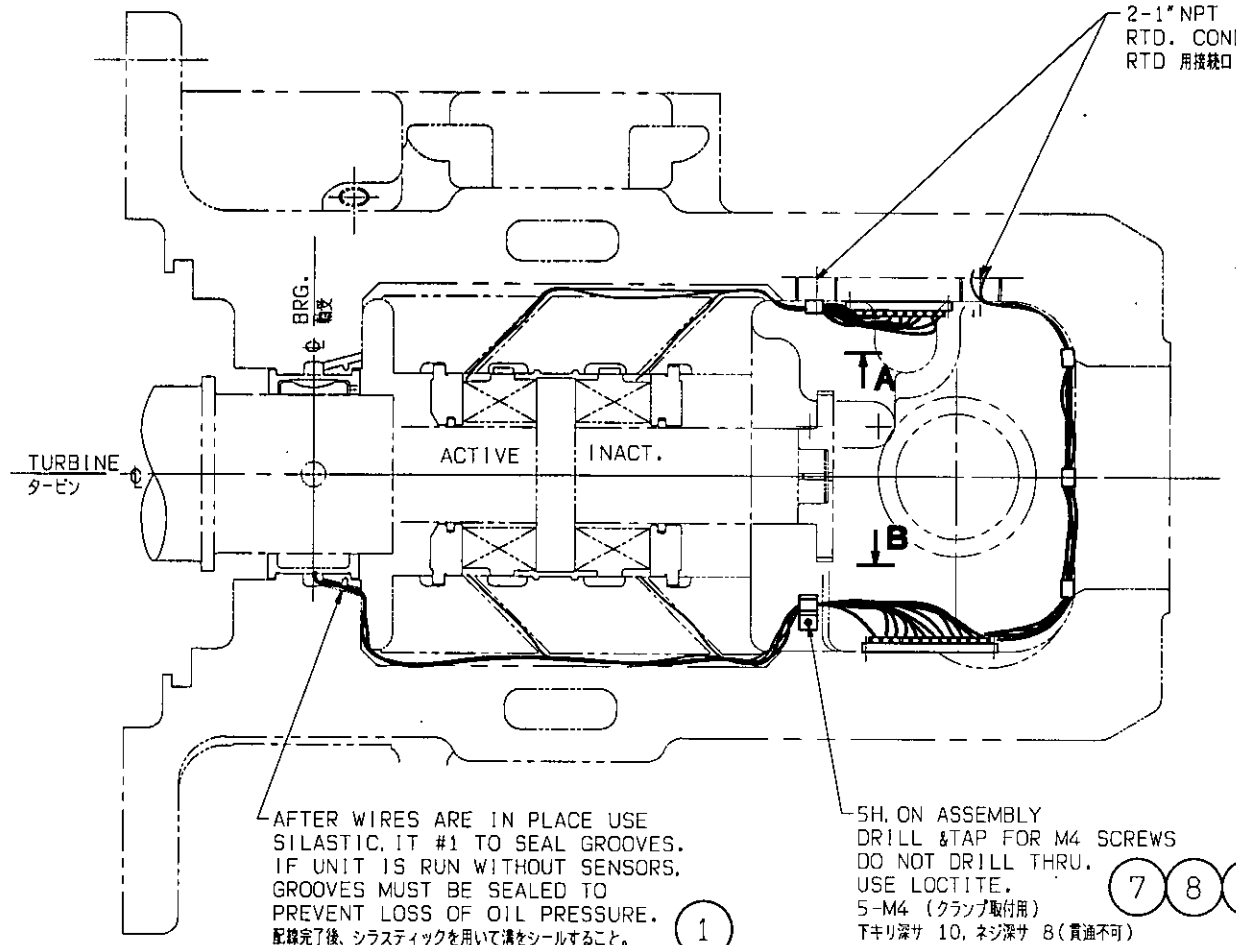
☐ FOR APPROVAL
AVOID DELAY
TO MAINTAIN SHIPPING
PROMISE.
ONE APPROVED PRINT MUST BE
RETURNED BY: _____
BY _____ DATE _____

☐ FOR RECORD
ANY REQUESTED CHANGE OF THIS
EQUIPMENT WILL RESULT IN:
1.CONTRACT PRICE ADJUSTMENT.
2.EXTENDED SHIPPING PROMISE
AS THIS CONTRACT IS IN
MANUFACTURING PROCESS.
BY _____ DATE _____

JOB NO.		JOB/PROJECT NAME	
ITEM NO.		CUSTOMER	
SER.NO.		USER	
APP'D BY	DATE	SERVICE	
S.SAWADA	Oct.26.'95	MODEL	SET 1
DSN'D BY S.SAWADA	Oct.26.'95	TITLE DW-1A DOWEL PIN ARRANGEMENT	
CHK'D BY		PROJ.	DWG.NO. ES/8682136 REV. 0
DRW'N BY T.MITO	Oct.25.'95	SCALE 1:8	Elliott Ebara

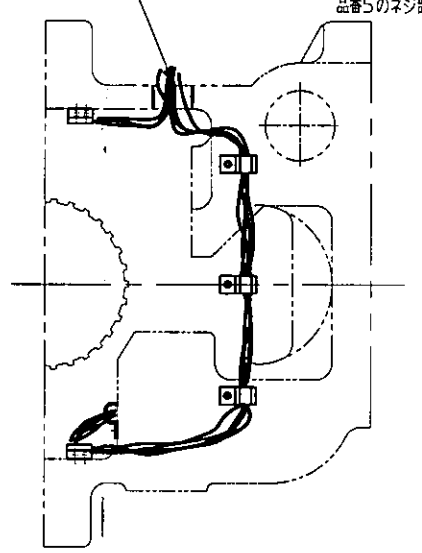
PM842C

CAD作成済(SF)

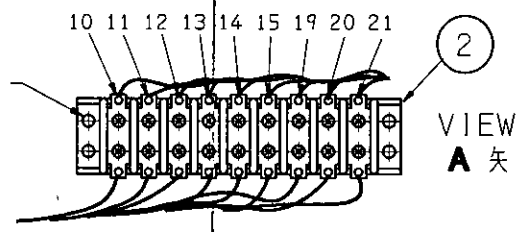


AFTER WIRES ARE IN PLACE USE SILASTIC, IT #1 TO SEAL GROOVES. IF UNIT IS RUN WITHOUT SENSORS, GROOVES MUST BE SEALED TO PREVENT LOSS OF OIL PRESSURE. ①
配線完了後、シラスティックを用いて溝をシールすること。
配線をせずに運転をする場合には、油圧低下を防ぐために溝をシールしておくこと。

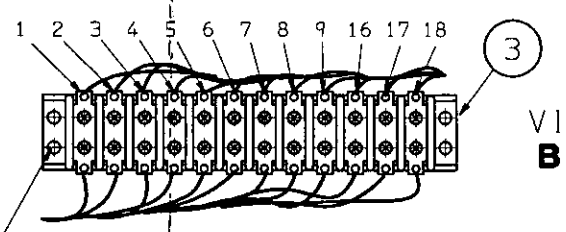
5H. ON ASSEMBLY DRILL &TAP FOR M4 SCREWS DO NOT DRILL THRU. USE LOCTITE. 7 8 9
5-M4 (クランプ取付用)
下キリ深サ 10, ネジ深サ 8(貫通不可)
配線時, 現合にて穴あけのこと。



4 5 6
4H. ON ASSEMBLY DRILL&TAP 10DEEP, FOR M3 SCREWS LOCATE FROM TERMINAL BLOCK. USE LOCTITE.
4-M3, 下キリ深サ 10, ネジ深サ 7
ネジ位置はターミナルブロックに現合のこと。
品番5のネジ部にはロックタイトを塗ること。

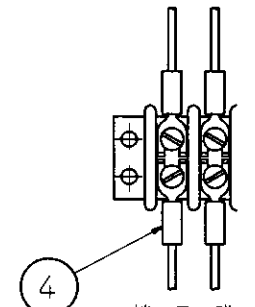


VIEW A
A 矢 視



VIEW B
B 矢 視

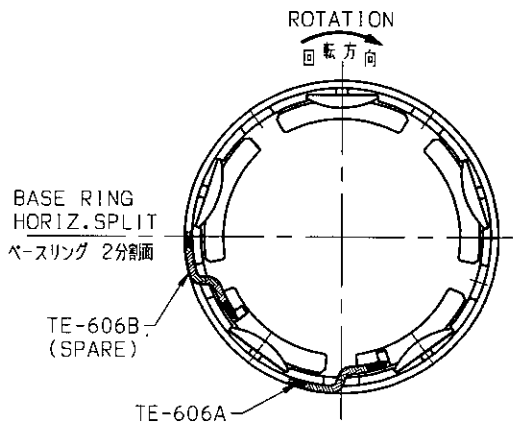
4H. ON ASSEMBLY DRILL&TAP 10DEEP, FOR M3 SCREWS LOCATE FROM TERMINAL BLOCK. USE LOCTITE.
4-M3, 下キリ深サ 10, ネジ深サ 7
ネジ位置はターミナルブロックに現合のこと。
品番5のネジ部にはロックタイトを塗ること。
4 5 6



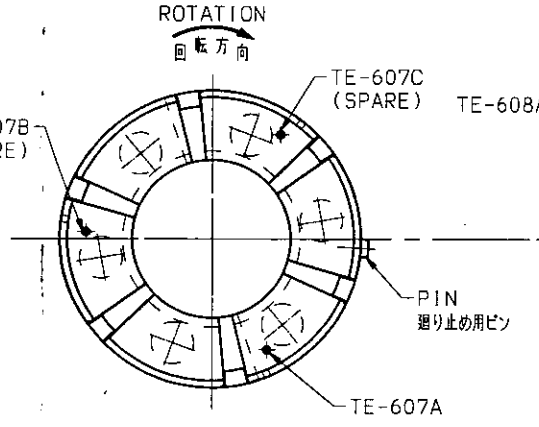
端 子 詳 細
DETAIL OF TERMINAL

FIG 4-19
4-59

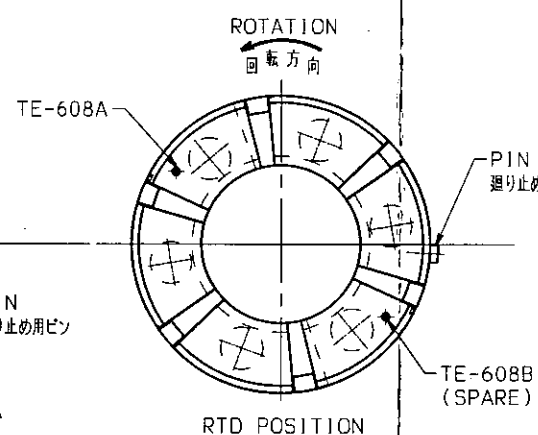
設計用注記
RTD P2557D328ST, P2557D328
(Pt, 3-wire, Single)



RTD POSITION
JOURNAL BRG.
(VIEWED FROM GOV.END)
ジャーナル軸受
(ガバナ側より見る)



RTD POSITION
ACTIVE SIDE
(FACING THRUST SURFACE)
負荷側(スラスト表面より見る)



RTD POSITION
INACTIVE SIDE
(FACING THRUST SURFACE)
反負荷側(スラスト表面より見る)

TERMINAL BLOCK CONNECTION
ターミナル端子への接続

TERMINAL NO. 端子番号	WIRE COLOUR リード線の色	TAG NO. タグ番号	POSITION 測定対象
1	赤 RED	TE-606A	JOURNAL BEARING ジャーナル軸受高圧側
2	白 WHITE		
3	白 WHITE		
4	赤 RED	TE-606B (SPARE)	
5	白 WHITE		
6	白 WHITE		
7	赤 RED	TE-607A	THRUST BEARING (ACTIVE) スラスト軸受(負荷側)
8	白 WHITE		
9	白 WHITE		
10	赤 RED	TE-607B (SPARE)	
11	白 WHITE		
12	白 WHITE		
13	赤 RED	TE-607C (SPARE)	
14	白 WHITE		
15	白 WHITE		
16	赤 RED	TE-608A	THRUST BREARING (INACTIVE) スラスト軸受(反負荷側)
17	白 WHITE		
18	白 WHITE		
19	赤 RED	TE-608B (SPARE)	
20	白 WHITE		
21	白 WHITE		

GR5	GR4	GR3	GR2	GR1	PART NAME 部品名		NO. 番号	ELLIOTT PARTS NO エリオット部品番号	EBARA PARTS NO エバラ部品番号	DESCRIPTION 記事
G'TY/1SET 1台分個数										
					GROUP OF PARTS	高圧側配線	10	—	E8671817-10	
				5	SCREW, SELF TAP	LA-M4X8	9	—	LA-A0408	
				5	CLAMP	クランプ	8	—	P80G250	
				5	WASHER	ZRE-M4	7	—	ZRE-K04	
				8	WASHER	ZRE-M3	6	—	ZRE-K03	
				8	SCREW, SELF TAP	LA-M3X12	5	—	LA-A0312	
				42	TERMINAL	ターミナル	4	—	E8643298-10	
				1	BLOCK, TERMINAL	ターミナルブロック	3	—	E8643298-6	12 TERM
				1	BLOCK, TERMINAL	ターミナルブロック	2	—	E8643298-12	9 TERM
				1	SILASTIC	シラスティック	1	—	E8671817-1	

ELLIOTT. EBARA GROUP

ELLIOTT G.O.No.
ELLIOTT S.O.No.

☐ FOR APPROVAL
AVOID DELAY TO MAINTAIN SHIPPING PROMISE. ONE APPROVED PRINT MUST BE RETURNED BY: _____
BY _____ DATE _____

☐ FOR RECORD
ANY REQUESTED CHANGE OF THIS EQUIPMENT WILL RESULT IN:
1.CONTRACT PRICE ADJUSTMENT.
2.EXTENDED SHIPPING PROMISE AS THIS CONTRACT IS IN MANUFACTURING PROCESS.
BY _____ DATE _____

DISTRIBUTION	SET
材	
鋳	1
鍛	1
I	1

JOB NO. 7020
ITEM NO. CT-9901
SER.NO. R021570803

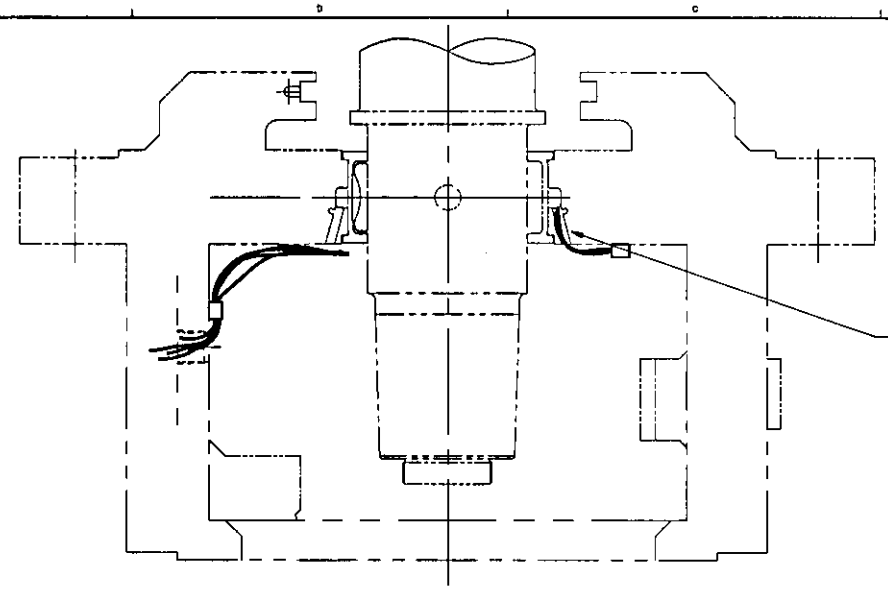
APP'D BY	DATE
S.SAWADA	
T.TANI	MAR.28.'02
DSN'D BY	
CHK'D BY T.TANI	MAR.28.'03
DRW'N BY K.NAGANUMA	MAR.20.'03

JOB/PROJECT NAME: TUPRAS IZMIR REFINERY DHP PROJECT
CUSTOMER: LG ENGINEERING & CONSTRUCTION CORP.
USER: TURKISH PETROLEUM REFINERIES CORP.
SERVICE: RECYCLE GAS COMPRESSOR
MODEL: SRV-5DF SET 1
TITLE: DW-1A, 16.75Q-IN, 5X2.125', CW
RTD配線図 (高圧側軸受室)
DETECTOR ASSEMBLY
PROJ. DWG.NO. ES/8671817 REV. 0
SCALE 1:NTS
EBARA Elliott Ebara

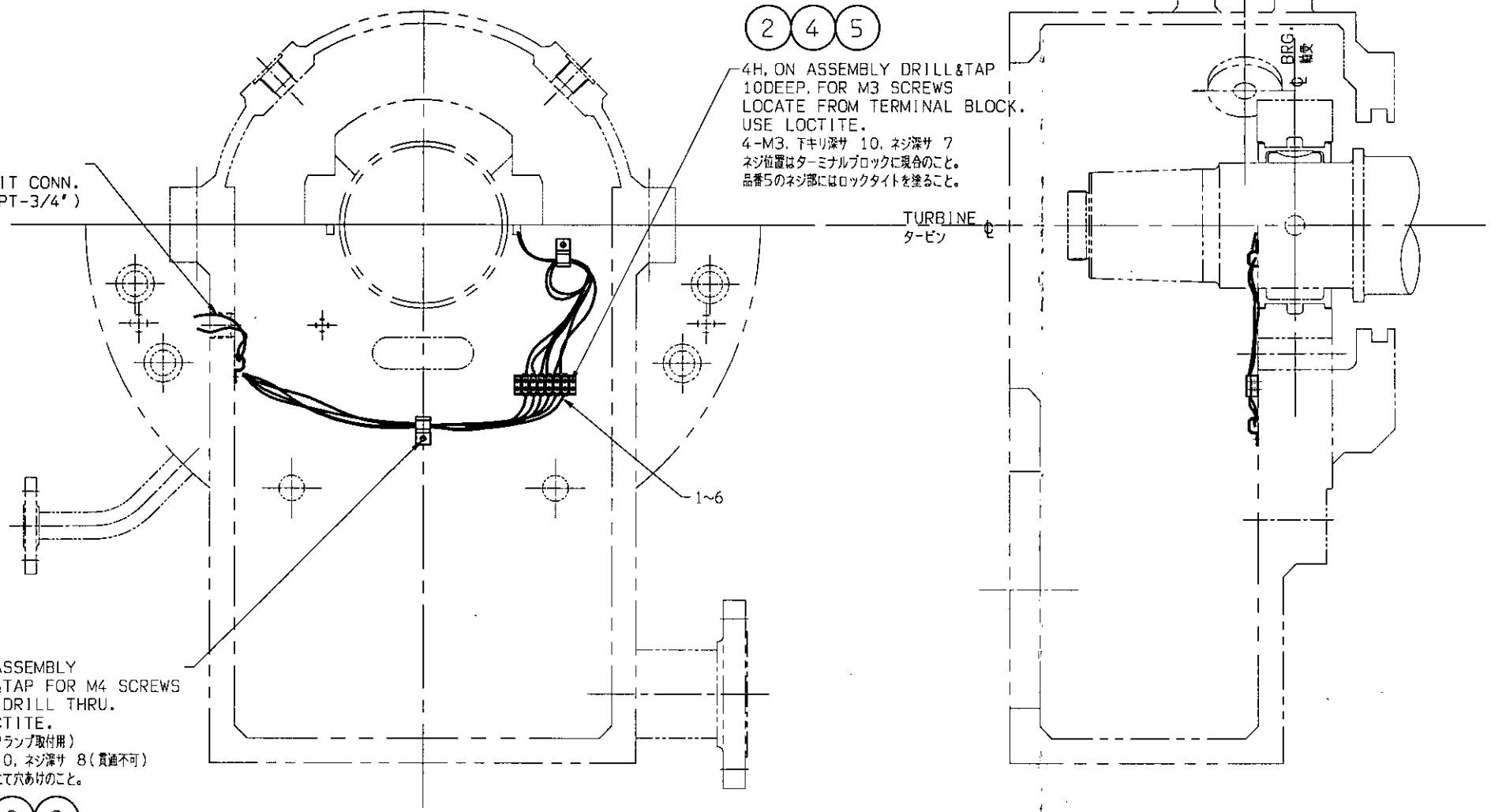
PM841C

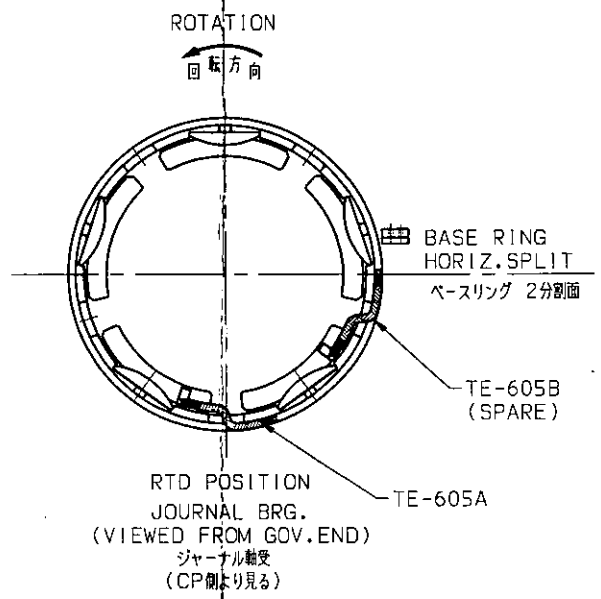
CAD作成済(SF)

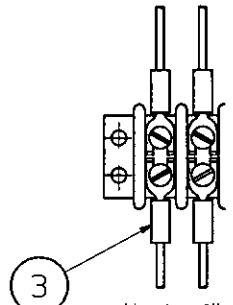
REVISIONS				
NO.	DESCRIPTION	DATE	BY	APP.



① AFTER WIRES ARE IN PLACE USE SILASTIC. IT #1 TO SEAL GROOVES. IF UNIT IS RUN WITHOUT SENSORS, GROOVES MUST BE SEALED TO, PREVENT LOSS OF OIL PRESSURE.
配線完了後、シラスティックを用いて溝をシールすること。
配線をせずに運転をする場合には、油圧低下を防ぐために溝をシールしておくこと。







端子詳細
DETAIL OF TERMINAL

FIG 4-20
4-60

設計用注記
RTD P2557D328ST (Pt, 3-wire, Single)
P2557D328

TERMINAL BLOCK CONNECTION ターミナル端子への接続			
TERMINAL NO. 端子番号	WIRE COLOUR リード線の色	TAG NO. タグ番号	POSITION 測定対象
1	赤 RED	TE-605A	JOURNAL BEARING ジャーナル軸受高圧側
2	白 WHITE		
3	白 WHITE		
4	赤 RED	TE-605B (SPARE)	
5	白 WHITE		
6	白 WHITE		

GR5	GR4	GR3	GR2	GR1	PART NAME 部品名		NO. 番号	ELLIOTT PARTS NO エリオット部品番号	EBARA PARTS NO エバラ部品番号	DESCRIPTION 記事
Q'TY/1SET				1台分個数						
				☒	GROUP OF PARTS	高圧側配線	10	—	E8671818-10	
				3	SCREW, SELF TAP	LA-M4X8	9	—	LA-A0408	
				3	CLAMP	クランプ	8	—	P80G250	
				3	WASHER	ZRE-M4	7	—	ZRE-K04	
							6			
				4	WASHER	ZRE-M3	5	—	ZRE-K03	
				4	SCREW, SELF TAP	LA-M3X12	4	—	LA-A0312	
				12	TERMINAL	ターミナル	3	—	E8643298-10	
				1	BLOCK, TERMINAL	ターミナルブロック	2	—	E8643298-3	6 TERM
				1	SILASTIC	シラスティック	1	—	E8671818-1	

ELLIOTT EBARA GROUP

ELLIOTT G.O.No.
ELLIOTT S.O.No.

☐ FOR APPROVAL
AVOID DELAY TO MAINTAIN SHIPPING PROMISE. ONE APPROVED PRINT MUST BE RETURNED BY: _____
BY _____ DATE _____

☐ FOR RECORD
ANY REQUESTED CHANGE OF THIS EQUIPMENT WILL RESULT IN:
1. CONTRACT PRICE ADJUSTMENT.
2. EXTENDED SHIPPING PROMISE AS THIS CONTRACT IS IN MANUFACTURING PROCESS.
BY _____ DATE _____

DISTRIBUTION	SET
対	
米	1
欧	1
エ	1

JOB No. 7020	JOB/PROJECT NAME TUPRAS IZMIR REFINERY DHP PROJECT
ITEM No. CT-9901	CUSTOMER LG ENGINEERING & CONSTRUCTION CORP.
SER.No. R021570803	USER TURKISH PETROLEUM REFINERIES CORP.
APP'D BY S.SAWADA — DATE	SERVICE RECYCLE GAS COMPRESSOR
	MODEL SRV-5DF — SET 1
T.TANI — MAR.26,'03	TITLE DF42"+TURBINE GEAR UNIT, CW RTD配線図 (低圧側軸受室) DETECTOR ASSEMBLY
DSN'D BY	
CHK'D BY T.TANI — MAR.28,'03	
DRW'N BY K.NAGANUMA — MAR.20,'03	PROJ. — DWG.NO. ES/8671818 — REV. 0
	SCALE 1:NTS — Elliott Ebara

PM841C

CAD資料(SF)

REVISIONS				
NO.	DESCRIPTION	DATE	BY	APP.
	FIRST USE R021570803/SRV-50F			

ASSEMBLY PART NUMBERS 組立番号

NO. 番号	CONSTITUTION 構成部品	REFERENCE /参考 SPEED	AXIAL	KEY	VIB.	
200	GR1 & 100, 103	2	2	1	2	
201	GR2 & 100, 103	3	2	1	2	
202	GR3 & 100, 103	4	2	1	2	
203	GR4 & 100, 103	5	2	1	2	DW-1A, 5' JNL.
204	GR5 & 100, 103	6	2	1	2	
205	GR6 & 100, 103	7	2	1	2	
206	GR1 & 100, 104	2	2	1	2	
207	GR2 & 100, 104	3	2	1	2	
208	GR3 & 100, 104	4	2	1	2	DW-1A, 6' JNL.
209	GR4 & 100, 104	5	2	1	2	
210	GR5 & 100, 104	6	2	1	2	
211	GR6 & 100, 104	7	2	1	2	
212	GR1 & 101, 105	2	2	1	2	
213	GR2 & 101, 105	3	2	1	2	
214	GR3 & 101, 105	4	2	1	2	NCW-A, 7' JNL.
215	GR4 & 101, 105	5	2	1	2	
216	GR5 & 101, 105	6	2	1	2	
217	GR6 & 101, 105	7	2	1	2	
218	GR1 & 101, 106	2	2	1	2	
219	GR2 & 101, 106	3	2	1	2	
220	GR3 & 101, 106	4	2	1	2	NCW-A, 6' JNL.
221	GR4 & 101, 106	5	2	1	2	
222	GR5 & 101, 106	6	2	1	2	
223	GR6 & 101, 106	7	2	1	2	
224						
225						

Q'TY 個数	PART NAME 部品名		NO. 番号	EBARA PARTS NO. エバラ 部品番号	DESCRIPTION 記事
1	KEYPHAZOR ASS'Y	キーフェザー組立	100	E8670045-GR.58	DW-1A
1	KEYPHAZOR ASS'Y	キーフェザー組立	101	E8670045-GR.56	NCW-A
			102		
2	GROUP OF PARTS	軸振動計組立	103	E8670045-GR.26	DW-1A, 5' JNL.
2	GROUP OF PARTS	軸振動計組立	104	E8670045-GR.35	DW-1A, 6' JNL.
2	GROUP OF PARTS	軸振動計組立	105	E8670045-GR.34	NCW-A, 7' JNL.
2	GROUP OF PARTS	軸振動計組立	106	E8670045-GR.11	NCW-A, 6' JNL.
			107		
			108		
			109		

Q'TY/1SET 1台分個数 GR8	GR7	GR6	GR5	GR4	GR3	GR2	GR1	PART NAME 部品名		NO. 番号	ELLIOTT PARTS NO. エリオット 部品番号	EBARA PARTS NO. エバラ 部品番号	DESCRIPTION 記事
		1	1	1	1	1	1	COVER	カバー	1	-	A696262-1	
		1	1	1	1	1	1	GASKET	ガスケット	2	-	B696263-1	
		4	4	4	4	4	4	SCREW, CAP	BSH-M6x20	3	-	BSH-H06020	
										4			
		1	1	1	1	1	1	COVER, END	エンドカバー	5	-	E8653654-3	
		6	6	6	6	6	6	SCREW, CAP	BSH-M10x25	6	-	BSH-H10025	
										7			
		1	1	1	1	1	1	HOLDER	ホルダー	8	-	B681746-3	AXIAL X 2
		2	2	2	2	2	2	NUT	FM6LN	9	-	FLN-A06	
		2	2	2	2	2	2	SCREW, SET	CS-M6x30	10	-	CS-H0630	
		4	4	4	4	4	4	SCREW, CAP	BSH-M6x25	11	-	BSH-H06025	
										12			
		7	6	5	4	3	2	PICK-UP, SPEED	回転計ピックアップ	13	P8405D102	-	
		2	2	2	2	2	2	PROBE	プローブ	14	-	-	AXIAL(3/8'-24UNF)
		2	2	2	2	2	2	NUT, LOCK	ロックナット	15	-	A695982-1	
										16			
										17			
							X	GROUP OF PARTS	ピックアップ組立	GR1	-	E8671819-GR1	SPEEDx2, AXIALx2
						X		GROUP OF PARTS	ピックアップ組立	GR2	-	E8671819-GR2	SPEEDx3, AXIALx2
					X			GROUP OF PARTS	ピックアップ組立	GR3	-	E8671819-GR3	SPEEDx4, AXIALx2
				X				GROUP OF PARTS	ピックアップ組立	GR4	-	E8671819-GR4	SPEEDx5, AXIALx2
			X					GROUP OF PARTS	ピックアップ組立	GR5	-	E8671819-GR5	SPEEDx6, AXIALx2
		X						GROUP OF PARTS	ピックアップ組立	GR6	-	E8671819-GR6	SPEEDx7, AXIALx2

FIG 4-21-1
4-61
展開図

注記
1. 図番 ES/8671819/02 と併せ参照のこと

INSTRUCTIONS FOR SETTING AXIAL PICK-UP GAP BEFORE START-UP.

AFTER BRG. HSG. TOP HALF AND PICK-UP COVER HAVE BEEN BOLTED AND DOWELED IN PLACE AND ROTOR HAS BEEN POSITIONED AGAINST THRUST "B" AS SHOWN, SET AXIAL PICK-UP AS FOLLOWS:

1. ASSEMBLE THE PICK-UP TO THE HOLDER AS SHOWN (APPROX.14mm) SO THAT AT LEAST (2) THREADS EXTEND OVER THE NUT.
2. USE EXTREME CAUTION TO PREVENT DAMAGING THE TIP OF THE SENSING HEAD AND CAREFULLY SLIDE THE HOLDER INTO THE HOLE OF THE PICK-UP COVER UNTIL THE TIP OF THE SENSING HEAD TOUCHES THE COLLAR ON THE SHAFT. WHEN THE SENSING HEAD IS AGAINST THE COLLAR THERE WILL BE A GAP AT "C".
3. WIRE THE PICK-UP PROBE WITH PROXIMITOR AND POWER SOURCE.
4. MEASURE THE OUTPUT VOLTAGE FROM PROXIMITOR.
5. REALIGN THE HOLDER IT#8 BY SETSCREWS IT#10, TO GET 7.5±1V OF OUTPUT VOLTAGE.
6. TIGHTEN DOWN THE CAPSCREWS ITEMS IT#11, TO SECURE THE HOLDER TO THE GOVERNOR COVER. THEN LOCK THE SETSCREWS WITH NUTS IT#9.

FOR REPLACING AXIAL PICK-UP IN THE FIELD.

1. REMOVE AXIAL PROBE COVER.
2. DISCONNECT THE AXIAL PROBE CABLE FROM THE CONNECTOR CABLE.
3. REMOVE THE CAPSCREWS FROM THE HOLDER. (DO NOT DISTURB THE SETSCREWS) THE HOLDER MAY BE REMOVED AS A UNIT.
4. CHECK THE MICROMETER DIMENSION FROM THE TIP OF THE SENSING HEAD TO THE FACE OF THE HOLDER.ASSEMBLE THE NEW SENSING HEAD TO THE SAME MICROMETER DIMENSION AND RESEAL THE OUTLET ENTRANCE.REASSEMBLE THE HOLDER TO THE ORIGINAL POSITTION AND TIGHTEN DOWN THE CAPSCREWS.
5. CHECK OUTPUT VOLTAGE.

TO CHANGE EXISTING GAP SETTING IN THE FIELD

1. TO INCREASE OR DECREASE THE GAP BETWEEN THE SENSING HEAD AND THE COLLAR BY 0.025mm, THE GAP AT "C" MUST BE INCREASED OR DECREASED BY 0.036mm.
2. CHECK OUTPUT VOLTAGE.

軸移動計ピックアップの設定方法 （運転前）

軸受室を組み込みローターを図示の如く、スラスト軸受"B"側に押し付けた後次の手段で軸移動計をセットする。

1. 図に示す如く、ロックナットからねじ山が少なくとも 2山(約14mm)出る様にピックアップをホルダーに組み付ける。
2. ピックアップの先端をを傷付けないように、最大限の注意を払って、ホルダーをピックアップカバーの先端が軸のカラーに触れる所までピックアップカバーの穴に差し込むこと。先端が、カラーに触れたとき、"C"にはギャップができる。
3. プローブをプロシキミッター及び電源に接続する。
4. プロキシミッターからの出力電圧を計測する。
5. セットスクリュウ(品番10)を使用し、出力電圧7.5±1Vになる位置にホルダー(品番8) を調整する。
6. ボルト(品番11)を締め、ナット(品番9)でセットスクリュウ(品番10)をロックすること。

現地での軸移動計ピックアップの交換方法

1. ピックアップカバーを取外す。
2. コネクターケーブルからピックアップケーブル取り外す。
3. ホルダーからボルトを取り外す。(止めネジをゆるめてはならない)ホルダーは一体にて取外すことができる。
4. マイクロメーターにてピックアップ先端からホルダーの面までの寸法を計測する。ケーブル取り出し口からシーラントを取り除きピックアップを取り外す。新しいピックアップを元の寸法と同じになる様に組み付け、ケーブル取り出し口を元のようにシールする。次にホルダーを元の位置に組み込みボルトを締める。
5. 出力電圧を確認すること。

現地でのギャップの設定を変更する方法

1. "C"部のギャップを0.036mm増減すれば、ピックアップとカラーのギャップは0.025mmだけ増減する。
2. 出力電圧を確認すること。

ELLIOTT EBARA GROUP

ELLIOTT G.O.NO.

ELLIOTT S.O.NO.

☐ FOR APPROVAL
AVOID DELAY TO MAINTAIN SHIPPING PROMISE. ONE APPROVED PRINT MUST BE RETURNED BY: _____
BY _____ DATE _____

☐ FOR RECORD
ANY REQUESTED CHANGE OF THIS EQUIPMENT WILL RESULT IN:
1. CONTRACT PRICE ADJUSTMENT.
2. EXTENDED SHIPPING PROMISE AS THIS CONTRACT IS IN MANUFACTURING PROCESS.
BY _____ DATE _____

DISTRIBUTION	SET
材	1
鋳	
工	2
塗	1

JOB NO.

ITEM NO.

SER.NO.

JOB/PROJECT NAME

CUSTOMER

USER

APP'D BY	DATE
S.SAWADA	JAN.31.'03
DSN'D BY T.TANI	JAN.30.'03
CHK'D BY T.TANI	JAN.30.'03
DRW'N BY K.NAGANUMA	JAN.16.'03

SERVICE

MODEL | SET

TITLE DW-1A, NCW-A BRG.HSG., ELECT.GOV.
PICK-UP ASSEMBLY
ピックアップ組立 (1/2)

PROJ. | DWG.NO. ES/8671819/01 | REV. 0

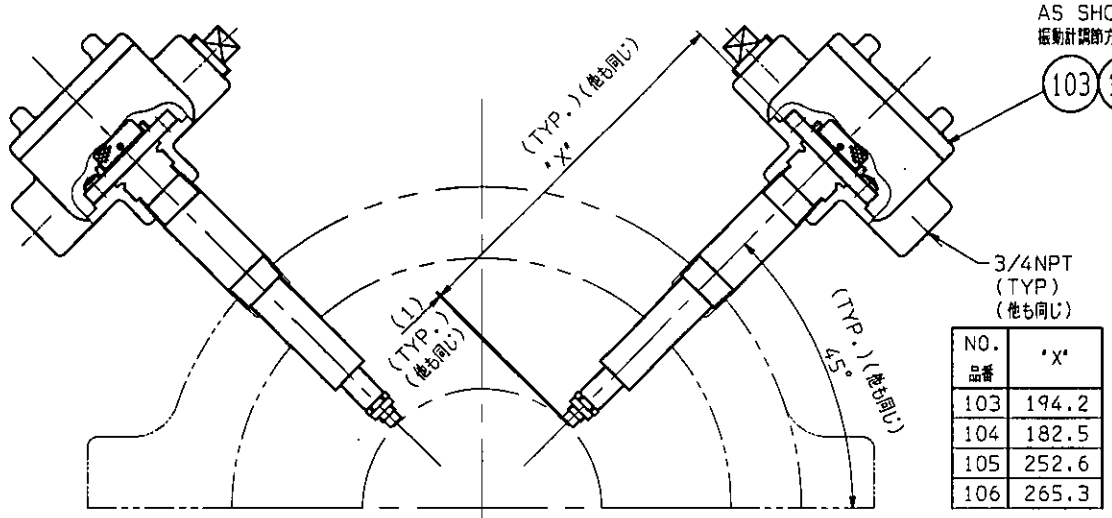
SCALE 1:NTS

Elliott Ebara

PM841C

CAD各縮尺(SF)

REVISIONS				
NO.	DESCRIPTION	DATE	BY	APP.



SET PICK-UP POSITION
AS SHOWN ON PICK-UP ASS'Y DWG.
振動計調節方法はピックアップ組立を参照のと

103 104 105 106

3/4NPT
(TYP)
(他も同じ)

NO. 品番	"X"
103	194.2
104	182.5
105	252.6
106	265.3

断面 **B B**
SECTION **B B**

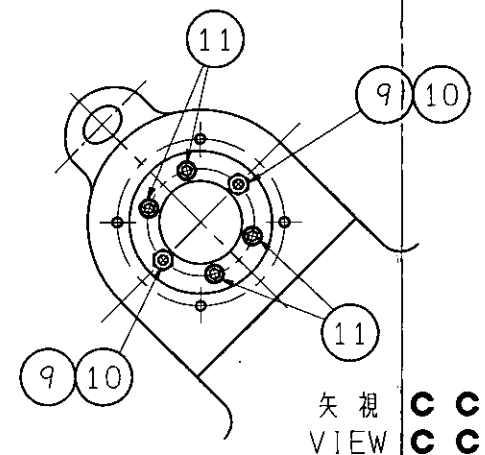
VIBRATION PICK-UP ASSEMBLY
軸振動計

NO. 品番	"X"
100	212.5
101	302.5

SET PICK-UP POSITION
AS SHOWN ON PICK-UP ASS'Y DWG.
キーフェザーピックアップ調整方法はピックアップ組立を参照のと

100 101

キーフェザー
KEYPHAZOR



矢視 **C C**
VIEW **C C**

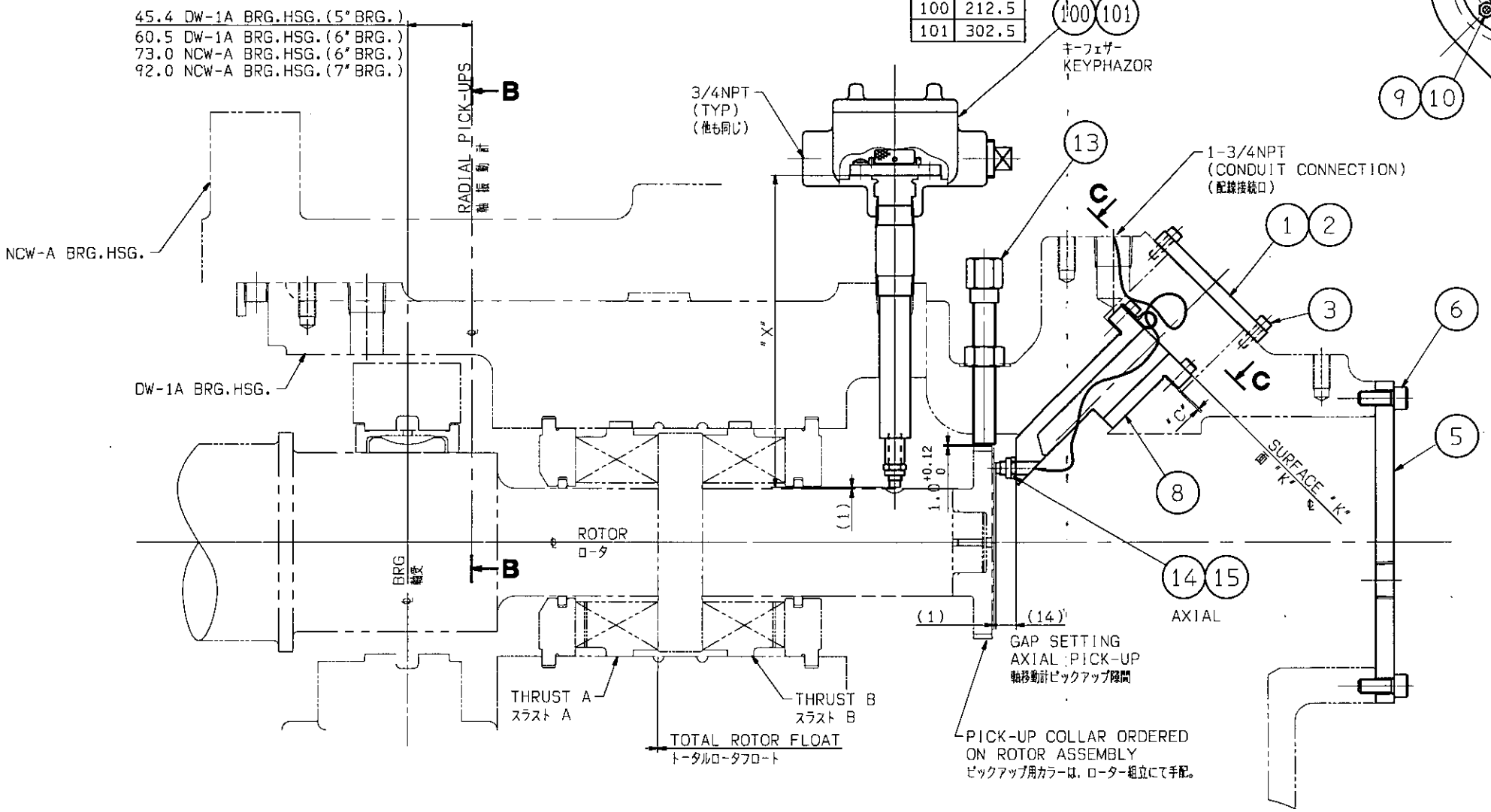


FIG 4-21-2
4-62
展開図

注記
1. 図番 ES/8671819/01 と併せ参照のこと

ELLIOTT. EBARA GROUP

ELLIOTT G.O.No.

ELLIOTT S.O.No.

DISTRIBUTION | SET

☐ FOR APPROVAL
AVOID DELAY TO MAINTAIN SHIPPING PROMISE. ONE APPROVED PRINT MUST BE RETURNED BY: _____
BY _____ DATE _____

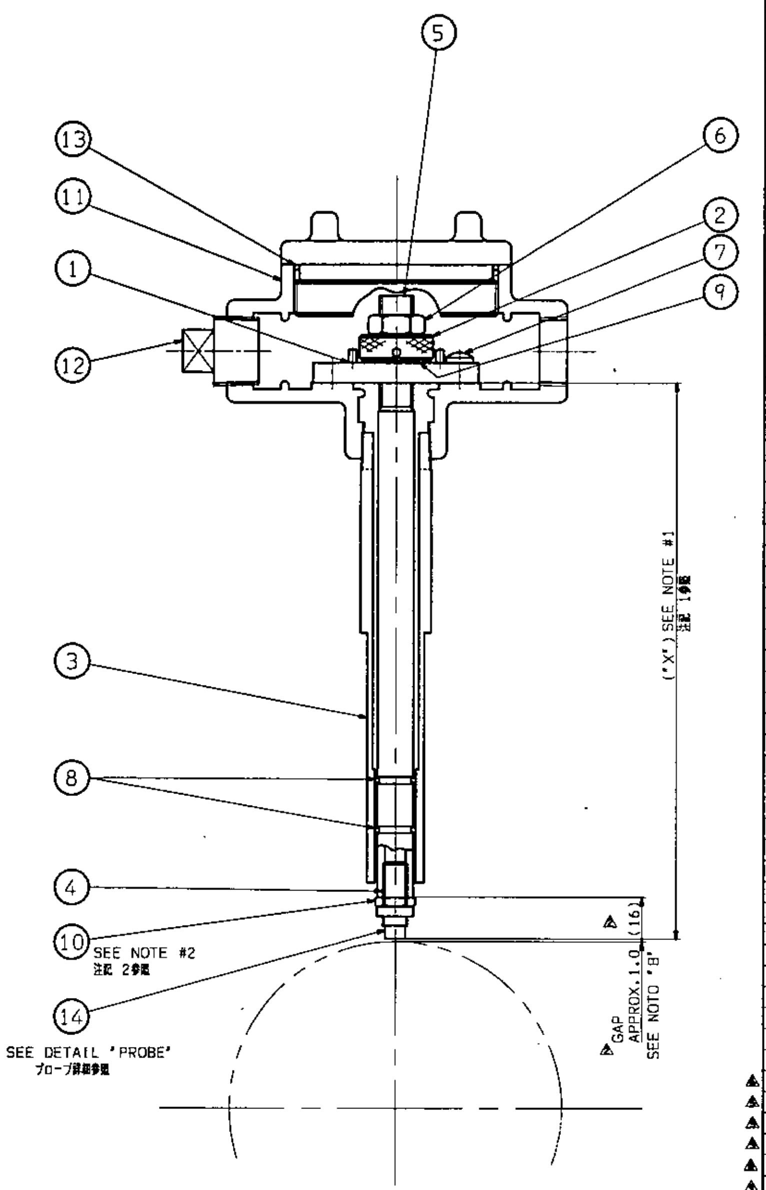
☐ FOR RECORD
ANY REQUESTED CHANGE OF THIS EQUIPMENT WILL RESULT IN: 1.CONTRACT PRICE ADJUSTMENT. 2.EXTENDED SHIPPING PROMISE AS THIS CONTRACT IS IN MANUFACTURING PROCESS.
BY _____ DATE _____

材 1
重 2
下 1

JOB NO.	JOB/PROJECT NAME
ITEM NO.	CUSTOMER
SER.No.	USER
APP'D BY S.SAWADA DATE JAN.31.'03	SERVICE
DSN'D BY T.TANI JAN.30.'03	MODEL / SET
CHK'D BY T.TANI JAN.30.'03	TITLE DW-1A, NCW-A BRG HSG., ELECT.GOV. PICK-UP ASSEMBLY ピックアップ組立 (2/2)
DRW'N BY K.NAGANUMA JAN.16.'03	PROJ. / DWG.NO. ES/8671819/02 / REV. 0
	SCALE 1:2 / Elliott Ebara

PM841C

REVISIONS				
No.	DESCRIPTION	DATE	BY	APP.
	REDRAWN BY CAD ADDED GR.38	[illegible]	S.B	M.K
△	ADDED GR39. PT#3 OF GR.25, 26 & 27 WERE A674619-137. PT#5 OF GR.25 WAS E8672247-13. PT#5 OF GR.26 & 27 WERE A881301-13.	[illegible]	T.M S.S	M.K M.K
	ADDED GR40, 41, 42.	[illegible]	A.T.	M.K
	ADDED GR43	[illegible]	K.M	S.S
	ADDED GR44	[illegible]	M.H	S.S
	ADDED GR45 & GR46	[illegible]	M.H	S.S
	ADDED GR47, 48, 49.	[illegible]	[illegible]	M.K
△	CHENGE NOTE. CHENGE DIM. 1.14→1.0, ADD NOTE	[illegible]	[illegible]	S.S
	ADDED GR50.	[illegible]	[illegible]	S.S
	ADDED GR51.	[illegible]	[illegible]	S.S
	ADDED GR52.	[illegible]	[illegible]	M.K
	ADDED GR53. (#T10950-04)	[illegible]	[illegible]	[illegible]
	ADDED GR54. (PV03114-03)	[illegible]	[illegible]	S.S
	ADDED GR55. (PV01900-03)	[illegible]	[illegible]	S.S
△	CHEANGED PT#5 OF GR.55 WAS A881301-26	[illegible]	T.T	S.S
△	ADDED GR56. (P9901300003)	[illegible]	[illegible]	S.S
△	ADDED GR57 & GR58. (P99009530021) ADDED PROBE 330101-00-08-05-02-02	[illegible]	[illegible]	S.S
△	ADDED GR59. (P9901290005)	[illegible]	T.T	S.S
△	CHANGED PT#5 OF GR.59 WAS A881301-25. (P9901290005)	[illegible]	T.T	S.S
△	ADDED GR60. (P9901290005)	[illegible]	T.T	S.S
△	ADDED GR61. (P001367101)	[illegible]	T.T	S.S

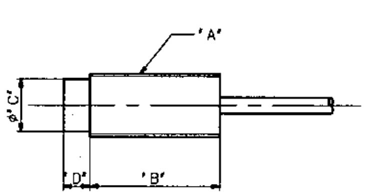


PROBE プローブ	"O" RING "O"リング	PLUG プラグ	OUTLET TERMINAL 端子箱	LOCKNUT ロックナット	LOCKWASHER EXT. TOOTH 歯付座金(外歯)	"O" RING "O"リング	MACHINE SCREW ビス	LOCKNUT ロックナット	HOLDER ホルダー	BUSHING ネジブッシュ	ADAPTER アダプター	WASHER ワッシャー	BUSHPLATE ブッシュプレート	ASSEMBLY 組立	DESCRIPTION 概要	"X" REF DETG. DEPT "X"参考寸法(mm)
⑭	⑬	⑫	⑪	⑩	⑨	⑧	⑦	⑥	⑤	④	③	②	①			
別手配(下表参照)	1	1	1	1	1	2	2	1	1	1	1	1	1			
14-2	DAS-RB232	E8832002-4	E8832002-3	S01-10	ZREU-K04	OP-RB0112	LA-A0612	FNU-A04X20	E8672247-13	-	A674619-3	B891578-3	B892153-3	E8670045-GR1	EW5A, EW6A STM. END. VIB. (3.75")	188.5
14-3				A695982-1					A881301-13	-	-3			-GR2	EW5A, EW6A STM. END. VIB. (3.75")	188.5
14-1				S01-9					A881301-13	E8673014-2	-3			-GR3	EW5A, EW6A STM. END. VIB. (3.75")	188.5
14-2				S01-10					E8672247-15	-	-18			-GR4	DW-1A STM. END. VIB. (3.75")	208.6
14-3				A695982-1					A881301-15	-	-18			-GR5	DW-1A STM. END. VIB. (3.75, 4")	208.6
14-1				S01-9					A881301-15	E8673014-2	-18			-GR6	DW-1A STM. END. VIB. (3.75")	208.6
14-2				S01-10					E8672247-10	-	-25			-GR7	AXAIL OR KEYPHAZOR	169.9
14-3				A695982-1					A881301-10	-	-25			-GR8	AXAIL OR KEYPHAZOR	169.9
14-1				S01-9					A881301-10	E8673014-2	-25			-GR9	AXAIL OR KEYPHAZOR	169.9
14-2				S01-10					E8672247-24	-	-156			-GR10	NCW STM. END. VIB. (6.0")	255.8
14-3				A695982-1					A881301-24	-	-156			-GR11	NCW STM. END. VIB. (6.0")	255.8
14-1				S01-9					A881301-24	E8673014-2	-156			-GR12	NCW STM. END. VIB. (6.0")	255.8
14-2				S01-10					E8672247-6	-	-106			-GR13	EXH. END. VIB. (3.75")	141.3
14-3				A695982-1					A881301-6	-	-106			-GR14	EXH. END. VIB. (3.75")	141.3
14-1				S01-9					A881301-6	E8673014-2	-106			-GR15	EXH. END. VIB. (3.75")	141.3
14-2				S01-10					E8672247-2	-	-107			-GR16	AXAIL OR KEYPHAZOR	122.1
14-3				A695982-1					A881301-2	-	-107			-GR17	AXAIL OR KEYPHAZOR	122.1
14-1				S01-9					A881301-2	E8673014-2	-107			-GR18	AXAIL OR KEYPHAZOR	122.1
14-2				S01-10					E8672247-35	-	-142			-GR19	AXAIL OR KEYPHAZOR	322.3
14-3				A695982-1					A881301-35	-	-142			-GR20	AXAIL OR KEYPHAZOR	322.3
14-1				S01-9					A881301-35	E8673014-2	-142			-GR21	AXAIL OR KEYPHAZOR	322.3
14-2				S01-10					E8672247-20	-	-112			-GR22	AXAIL OR KEYPHAZOR	233.4
14-3				A695982-1					A881301-20	-	-112			-GR23	AXAIL OR KEYPHAZOR	233.4
14-1				S01-9					A881301-20	E8673014-2	-112			-GR24	AXAIL OR KEYPHAZOR	233.4
14-2				S01-10					E8672247-14	-	-3			-GR25	DW1A, VIB., (φ5.0")	194.7 △
14-3				A695982-1					A881301-14	-	-3			-GR26	DW1A, VIB., (φ5.0")	194.7 △
14-1				S01-9					A881301-14	E8673014-2	-3			-GR27	DW1A, VIB., (φ5.0")	194.7 △
14-2				S01-10					E8672247-11	-	-126			-GR28	EW, VIB., (φ5.0")	172.6
14-3				A695982-1					A881301-11	-	-126			-GR29	EW, VIB., (φ5.0")	172.6
14-1				S01-9					A881301-11	E8673014-2	-126			-GR30	EW, VIB., (φ5.0")	172.6
14-2				S01-10					E8672247-3	-	-125			-GR31	EXH., VIB., (φ5.0")	131.5
14-3				A695982-1					A881301-4	-	-125			-GR32	EXH., VIB., (φ5.0")	131.5
14-1				S01-9					A881301-4	E8673014-2	-125			-GR33	EXH., VIB., (φ5.0")	131.5
14-3				A695982-1					A881301-23	-	-56			-GR34	NCW. STM. END. VIB. (7.0")	249.7
14-3									A881301-11	-	-34			-GR35	DW1A, VIB., (φ6.0")	178.9
14-3									A881301-18	-	-14			-GR36	60" EXH. CSGN BRG. HSG. (6.0")	223.2
14-3									A881301-17	-	-6			-GR37	DD-BRG. HSG STM. END. VIB. (5.0")	211.6
14-3									A881301-18	-	-6			-GR38	EW-5A KEY-PHAZOR (RADIAL)	220.1
14-3									A881301-20	-	A674619-6			-GR39	EW-5A SPEED PICK-UP	230.8
14-3									A881301-13	-	E8671123-139			-GR40	AXAIL OR KEYPHAZOR	188.5
14-3									A881301-19	-	E8671123-92			-GR41	EW-6A BOTTOM CONN. SPEED PICK-UP	229.3
14-3									A881301-26	-	E8671123-47			-GR42	AXAIL OR KEYPHAZOR	273.1
14-3									A881301-10	-	A674619-11			-GR43	DD, KEYPHAZOR	176.2
14-3									A881301-35	-	E8672501-7			-GR44	EW-5A SPEED PICK-UP	328.6
14-3									A881301-13	-	A674619-3			-GR45	EW, VIB., (φ4.0")	187.4
14-3									A881301-7	-	A674619-106			-GR46	EXH., VIB., (φ4.0")	148.5
14-3									A881301-33	-	A674619-160			-GR47	NWP, VIB. (φ8.0")	298.5
14-3									A881301-13	-	A674619-33			-GR48	EXH., VIB., (φ6.0")	183.9
14-3									A881301-21	-	A674619-129			-GR49	EXH., VIB., (φ9.0")	251.0
14-3									A881301-26	-	A674619-66			-GR50	NWP, VIB. (φ7.0")	275.7
14-3									A881301-14	-	A674619-59			-GR51	DW-1A SPEED PICK-UP	195
14-3									A881301-23	-	A674619-161			-GR52	N72" EXH., VIB. (φ9.0")	263.7
14-3									A881301-16	-	A674619-28			-GR53	EXH. END. VIB. WITH TURNING (5.0")	204.4
14-3									A881301-29	-	A674619-42			-GR54	NWP, VIB. (φ6.0")	290.7
14-3	DAS-RB232	E8832002-4	E8832002-3	A695982-1	ZREU-K04	OP-RB0112	LA-A0612	FNU-A04X20	A881301-22	-	A674619-93	B891578-3	B892153-3	E8670045-GR55	N72" EXH., VIB. (φ7.0")	240.5
△ 14-3	DAS-RB232	E8832002-4	E8832002-3	A695982-1	ZREU-K04	OP-RB0112	LA-A0612	FNU-A04X20	A881301-31	-	A674619-194	B891578-3	B892153-3	E8670045-GR56	NWP. 112.5sq-In., KEY	295
△ 14-3	DAS-RB232	E8832002-4	E8832002-3	A695982-1	ZREU-K04	OP-RB0112	LA-A0612	FNU-A04X20	A881301-16	-	A674619-168	B891578-3	B892153-3	E8670045-GR57	EXH. END. VIB. WELD. HGN. (φ6.0")	213.8
△ 14-3	DAS-RB232	E8832002-4	E8832002-3	A695982-1	ZREU-K04	OP-RB0112	LA-A0612	FNU-A04X20	A881301-17	-	A674619-196	B891578-3	B892153-3	E8670045-GR58	DW1A. 40.5sq-In., KEY	220.7
△ 14-3	DAS-RB232	E8832002-4	E8832002-3	A695982-1	ZREU-K04	OP-RB0112	LA-A0612	FNU-A04X20	A881301-21	-	A674619-5	B891578-3	B892153-3	E8670045-GR59	EXH., 8" JNL., VIB.	240.3 △
△ 14-3	DAS-RB232	E8832002-4	E8832002-3	A695982-1	ZREU-K04	OP-RB0112	LA-A0612	FNU-A04X20	A881301-33	-	A674619-74	B891578-3	B892153-3	E8670045-GR60	NWP. KEY. (φ8.0") NCD1620	312.0
△ 14-3	DAS-RB232	E8832002-4	E8832002-3	A695982-1	ZREU-K04	OP-RB0112	LA-A0612	FNU-A04X20	A881301-26	-	A674619-131	B891578-3	B892153-3	E8670045-GR61	N72" EXH., VIB. (φ8.0")	272.3

← HP SIDE (GR25–GR27)

← LP. SIDE (GR53)

DETAIL "PROBE"
プローブ詳細



NO. 品番	A	B	C	D	TYPE 型式
14-1	M6X0.75	30	5	6	東京電業 TD505
14-2	M10×1	30	8	8	東京電業 TD508
		20.3	7.6	5	BENTLY NEVADA CA22811-00-03-05-02
14-3	¾-24UNF	20.3	7.6	5	BENTLY NEVADA A21504-00-08-05-02 BENTLY NEVADA A300-00-00-08-18-07 BENTLY NEVADA 330101-00-08-05-02-02 △

NOTE

1. STAMP THE ACTUAL DIMENTION "X" ON BUSH PLATE ITEM #1.
MARK & ASSEMBLE IN UNIT AS PER SP-531 & PET-D-3000.
2. NUT FURNISHED WITH PROBE REPLACED BY LOCK NUT ITEM #10.

注記

1. 品番1のブッシュプレートに"X"寸法の実測値を刻印すること。
組立についてはSP-531 PET-D-3000参照のこと。
2. 品番10のナットはプローブに付属しているナットと交換して取付ること。
3. ブッシュプレートの刻印は刻印要領図を参照のこと。

△ NOTE "A"

PROBE REPLACEMENT WHILE RUNNING

TO REPLACE A PROBE, REMOVE THE SCREWS WHICH HOLD THE BUSH PLATE TO THE BOTTOM OF ITS HOUSING AND CAREFULLY REMOVE THE PROBE HOLDER ASSEMBLY. ONCE THE ASSEMBLY IS OUT, THE OLD PROBE CAN BE REMOVED AND A NEW PROBE INSTALLED.
PLACE THE ADJUSTING WASHER IN ITS MID ARC POSITION AND ADJUST THE PROBE TO THE STAMPED "X" DIMENSION ON THE BUSH PLATE AND LOCK IT IN PLACE WITH THE PROBE LOCK NUT. CARE SHOULD BE TAKEN TO MEASURE THE "X" DISTANCE AS ACCURATELY AS POSSIBLE. THE PROBE ASSEMBLY CAN THEN BE INSTALLED IN ITS HOUSING, VERY CAREFULLY INSERTING IT INTO THE MACHINE. AFTER INSTALLATION THIS ADJUSTMENT CAN BE CHECKED ELECTRICALLY WITH A VOLT METER AS PREVIOUSLY DESCRIBED IN INSTRUCTION BOOK.

注記 "A"

回転機稼働中のプローブ交換

1. 取付板のビスを外し、端子箱よりホルダー組立を引き抜く。
2. 旧プローブと新プローブを交換する。
3. 調整ワッシャーのポインタを取付板の基点に合わせる。
4. プローブ固定ナットを使用して、取付板に刻印してある"X"寸法と合致するようにホルダー長さを調整する。
5. ホルダー組立をそのまま端子箱へ挿入する。

△ NOTE "B"

INITIAL INSTLLATION WITH MACHINE AT REST
1. SCREW THE PROBE INTO HOLDER WITH 16mm PROTRUSION.
2. SCREW THE PROBE HOLDER INTO THE BUSH PLATE AS FAR AS POSSBLE.
3. INSERT THE HOLDER ASSEMBLY INTO THE MACHINE OR TERMINAL OUTLET.
4. WIRE THE PROBE, PROXIMITOR AND POWER SOURCE.
5. MEASURE THE OUTPUT VOLTAGE OF PROXIMITOR.
6. TURN THE PROBE HOLDER CLOCKWISE UNTIL 7.5±1V OF OUTPUT VOLTAGE.
APPROX. 1.0mm GAP BETWEEN PROBE AND SHAFT IS OBTAINED BY 7.5V OUTPUT.
7. MARK SET POSITION ON BUSH PLATE CORRESPONDING WITH POINTER OF WASHER.
8. REMOVE THE HOLDER ASSEMBLY, AND ACCURATELY MEASURE "X" DIMENSION AND STAMP BUSH PLATE WITH THE "X".
9. REASSEMBLE THE HOLDER AND READJUST IT WITH FOR PREVIOUSLY MEASURED "X" DIMENSION, AND LOCKNUTS IN PLACE.
10. REPLACE THE HOLDER ASSEMBLY INTO THE MACHINE OR TERMINAL OUTLET AND CHECK OUTPUT VOLTAGE.

△ 注記 "B"

タービン停止中のホルダー設定要領
1. プローブをホルダーより 16mm突き出した位置に調整する。
2. ブッシュプレートにホルダーを可能な限りねじ込む。
3. ホルダー組立をタービン又は端子箱に組込む。
4. プローブをプロキシミッター及び電源に接続する。
5. プロキシミッターからの出力電圧を計測する。
6. ホルダーを出力電圧 7.5±1V になる位置までねじ込む。
7. ワッシャーのポインターに相当する位置をブッシュプレート上にマーキングする。
8. ホルダー組立を抜き出し、"X"寸法を実測し刻印する。
9. ホルダーを組込み"X"寸法になるよう調整後固定する。
10. ホルダー組立を取付け、出力電圧の確認を行う。

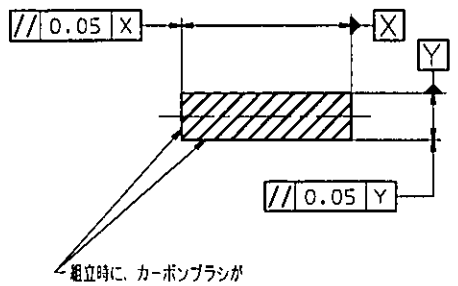
展開図

FIG 4-22
4-63

ELLIOTT. EBARA GROUP	ELLIOTT G.O.NO.	DISTRIBUTION	SET
	ELLIOTT S.O.NO.		
☐ FOR APPROVAL AVOID DELAY TO MAINTAIN SHIPPING PROMISE. ONE APPROVED PRINT MUST BE RETURNED BY: ____ BY ____ DATE ____	☐ FOR RECORD ANY REQUESTED CHANGE OF THIS EQUIPMENT WILL RESULT IN: 1. CONTRACT PRICE ADJUSTMENT. 2. EXTENDED SHIPPING PROMISE AS THIS CONTRACT IS IN MANUFACTURING PROCESS. BY ____ DATE ____		1 1 2
JOB NO.	JOB/PROJECT NAME		
ITEM NO.	CUSTOMER		
SER. NO.	USER		
APP'D BY M. KAWASAKI — DATE 1-19-'89	SERVICE		
	MODEL	SET	
DSN'D BY S. SAWADA — 1-19-'89	TITLE SENSING PROBE ASS'Y 振動計ピックアップ組立		
CHK'D BY			
DRW'N BY Y. KOMURO — 11-[illegible]-'88	PROJ.	DWG. NO. ES/8670045	REV. 9
	SCALE 1:NTS	Elliott Ebara	

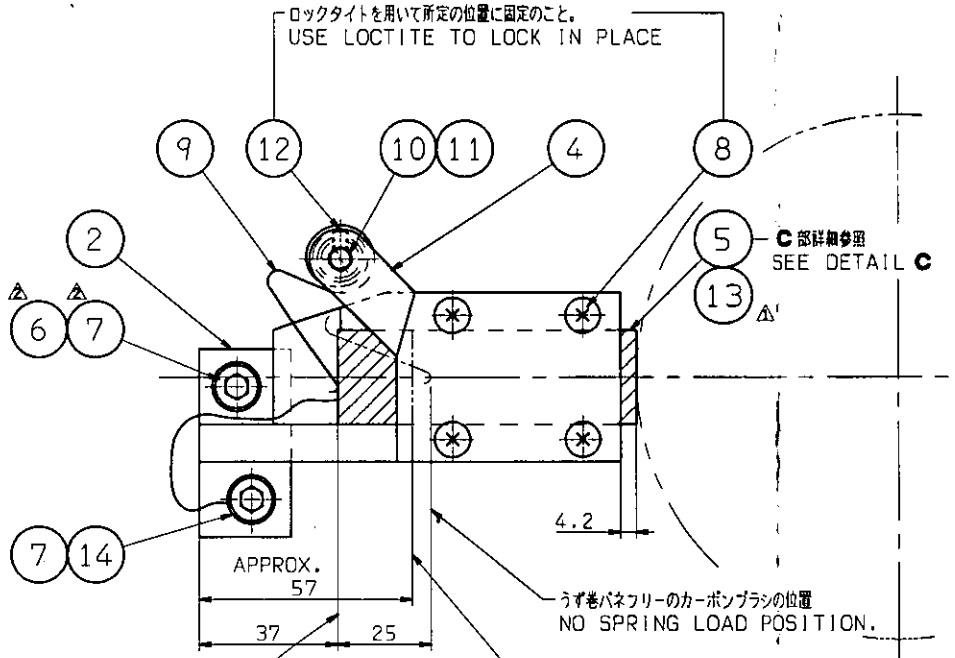
CAD登録(SF)

REVISIONS				
NO.	DESCRIPTION	DATE	BY	APP.
1	CHANGE PART NO. E8634003-1, 2 WAS S916-1, 2 E8633037-1, 2 WAS S910-1, 2 SCP-B1212 WAS S916-3 S923-1 WAS E8634004-1 ADD PT#13, 17, 18.	4-7-'92	K.N M.J	S.S
2	CHANGED PT#6, #7. PT#6 WAS BSH-B06016 PT#7 WAS ZRB-J06	AUG.25'95	H.M T.T	S.S
3	ADDED PT#14 CHANGED PT#6 QTY 2→1	NOV.25,'96	K.U.T.	S.S



組立時に、カーボンブラシが
ホルダーにすきまなく合うように
これらの表面を対辺に平行に削り、
カーボンブラシが自由に動くことを確認のこと。
ON ASSEMBY, GRIND
THESE SURFACES OF
CARBON BRUSH IN PARALLEL
TO FIT CARBON BRUSH IN
HOLDER WITHOUT CLEARANCE
AND CONFIRM THAT CARBON
BRUSH MOVES SHOOTH AND FREELY.

C 部 詳 細
DETAIL **C**
(S=1:2)



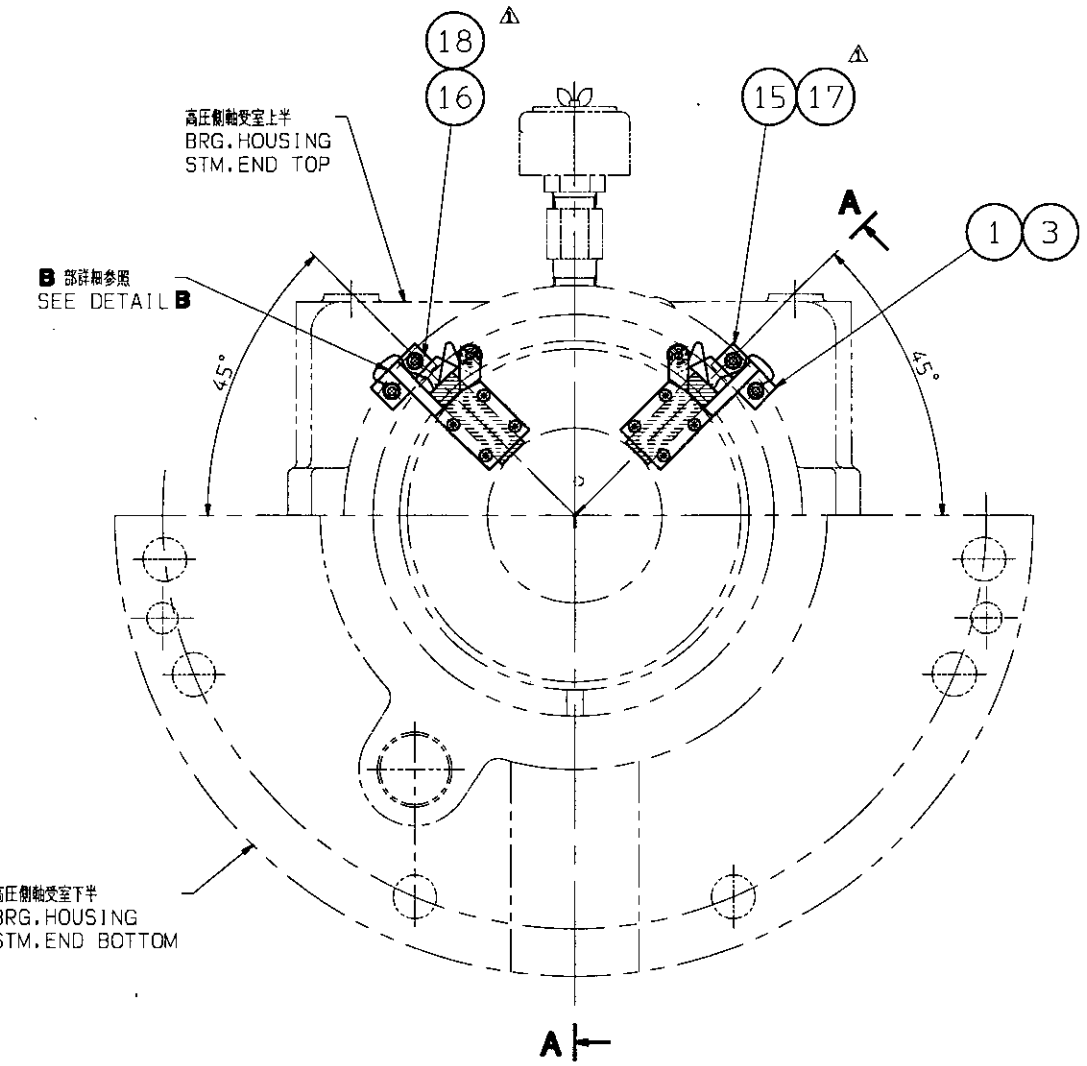
B 部 詳 細
DETAIL **B**
(S=1:1)

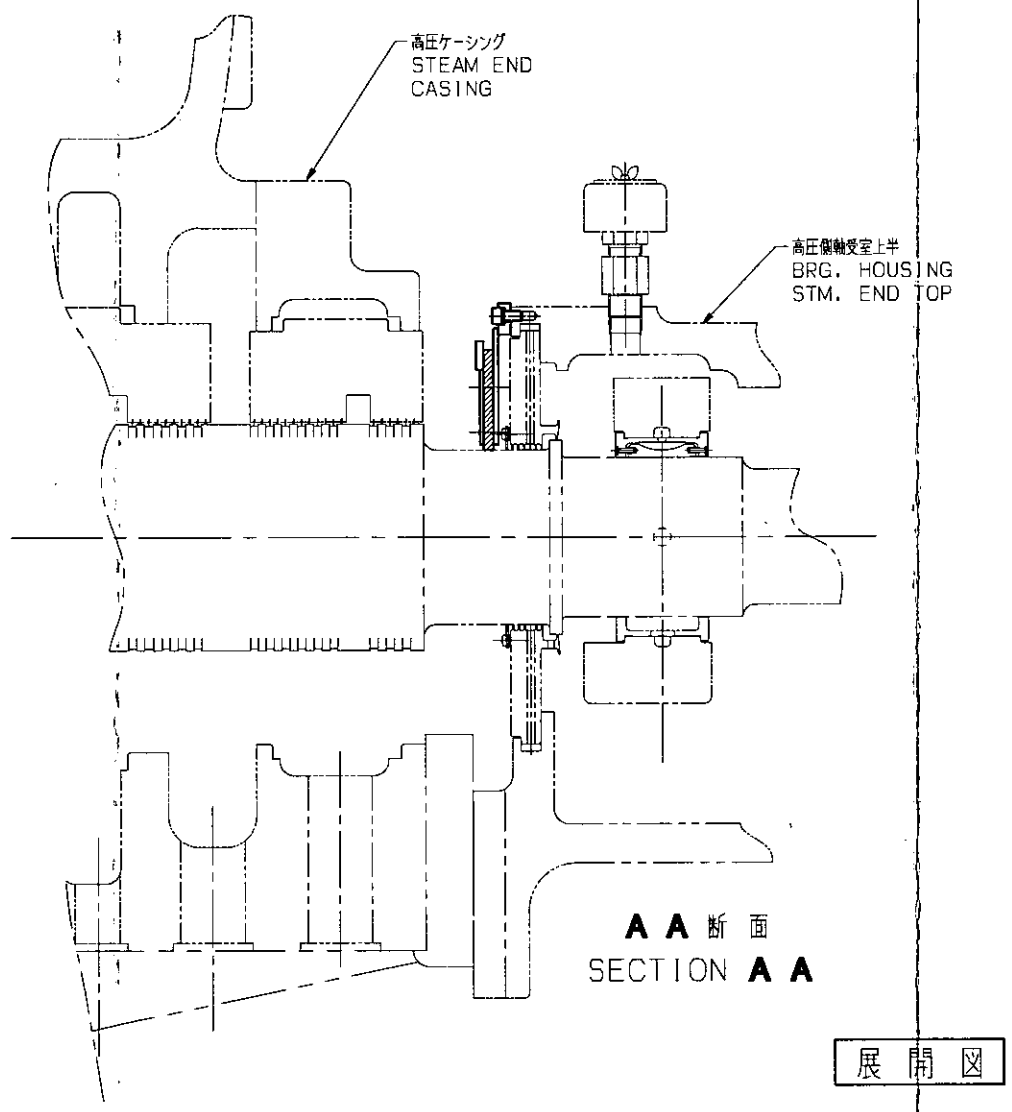
GR4	GR3	GR2	GR1	PART NAME 部品名		NO. 番号	ELLIOTT PARTS NO エリオット部品番号	EBARA PARTS NO エバラ部品番号	DESCRIPTION 記事	
	1		1	BRACKET	カーボンブラシホルダーA	1	-	E8633032-1		
1		1		BRACKET	カーボンブラシホルダーB	2	-	E8633032-2		
	1		1	HOLDER, CARBON	カーボンブラシホルダーカバーA	3	-	E8633019-1		
1		1		HOLDER, CARBON	カーボンブラシホルダーカバーB	4	-	E8633019-2		
		1	1	CARBON BRUSH	カーボンブラシ	5	-	E8634003-1		⚠1
1	1	1	1	SCREW, CAP	BSH-M8X16	6	-	BSH-B08016		⚠2
2	2	2	2	SPRING, WASHER	ZRB-M8	7	-	ZRB-J08		⚠2
4	4	4	4	SCREW, SET	LB-M4X12	8	-	LB-A0412		
1	1	1	1	SPRING	うず巻バネ	9	-	E8633037-1		⚠1
1	1	1	1	PIN	巻芯	10	-	E8633037-2		⚠1
1	1	1	1	COTTER PIN	SCP-1.2X20	11	-	SCP-B1220		⚠1
1	1	1	1	SCREW, SET	止メネジ	12	-	E8634004-1		⚠1
1	1			CARBON BRUSH	カーボンブラシ	13	-	E8634003-2		⚠1
1	1	1	1	SCREW, CAP	BSH-M8X20	14	-	BSH-B08020		⚠2
			X	CARBON BRUSH ASS'Y	カーボンブラシ組立A	15	-	E8631227-15		
		X		CARBON BRUSH ASS'Y	カーボンブラシ組立B	16	-	E8631227-16		
	X			CARBON BRUSH ASS'Y	カーボンブラシ組立C	17	-	E8631227-17	銅合金使用不可 NO COPPER ALLOY	⚠1
X				CARBON BRUSH ASS'Y	カーボンブラシ組立D	18	-	E8631227-18	銅合金使用不可 NO COPPER ALLOY	⚠1

注記
1. うず巻バネ⑨の芯部は品番⑩のスロット部に差し込み、
品番⑪の割りピンにて抜け止めとする。
2. うず巻バネ⑨は品番⑩の巻芯を固定し、最大荷重時より
最小荷重時まで変位したとき、折り曲げ部が品番③④の
カーボンブラシホルダーカバーに接触しないこと。

FIG 4-23
4-64

NOTE
1. CENTER OF SPRING ⑨ IS INSERTED
INTO THE SLOT OF PIN ⑩
AND FIXED BY COTTER PIN ⑪.
2. SPRING ⑨ SHOULD NOT TOUCH HOLDER
③④ AT ANY POSITION OF CARBON BRUSH ⑤.
SUCH AS FULL SPRING LOAD POSITION
OR NO SPRING LOAD POSITION,
AFTER FIXED BY COTTER PIN.





A A 断 面
SECTION **A A**

展 開 図

ELLIOTT. EBARA GROUP

ELLIOTT G.O.No.

ELLIOTT S.O.No.

☐ FOR APPROVAL
AVOID DELAY
TO MAINTAIN SHIPPING
PROMISE.
ONE APPROVED PRINT MUST BE
RETURNED BY: _____
BY _____ DATE _____

☐ FOR RECORD
ANY REQUESTED CHANGE OF THIS
EQUIPMENT WILL RESULT IN:
1. CONTRACT PRICE ADJUSTMENT.
2. EXTENDED SHIPPING PROMISE
AS THIS CONTRACT IS IN
MANUFACTURING PROCESS.
BY _____ DATE _____

DISTRIBUTION	SET
客先	1
社内	1
業務	1
T.	3

JOB NO.

ITEM NO.

SER.No.

JOB/PROJECT NAME

CUSTOMER

USER

SERVICE

MODEL | SET

APP'D BY	DATE
S. SAWADA	5-22-'92
A. TODA	5-21-'92
DSN'D BY K. NAGANUMA	5-21-'92
CHK'D BY	
DRW'N BY K. WATANABE	5-19-'92

TITLE DW-1A, エアパージ, 5" UNL.
カーボンブラシ組立
CARBON BRUSH ASSEMBLY

PROJ. | DWG.NO. ES/8631227 | REV. 3

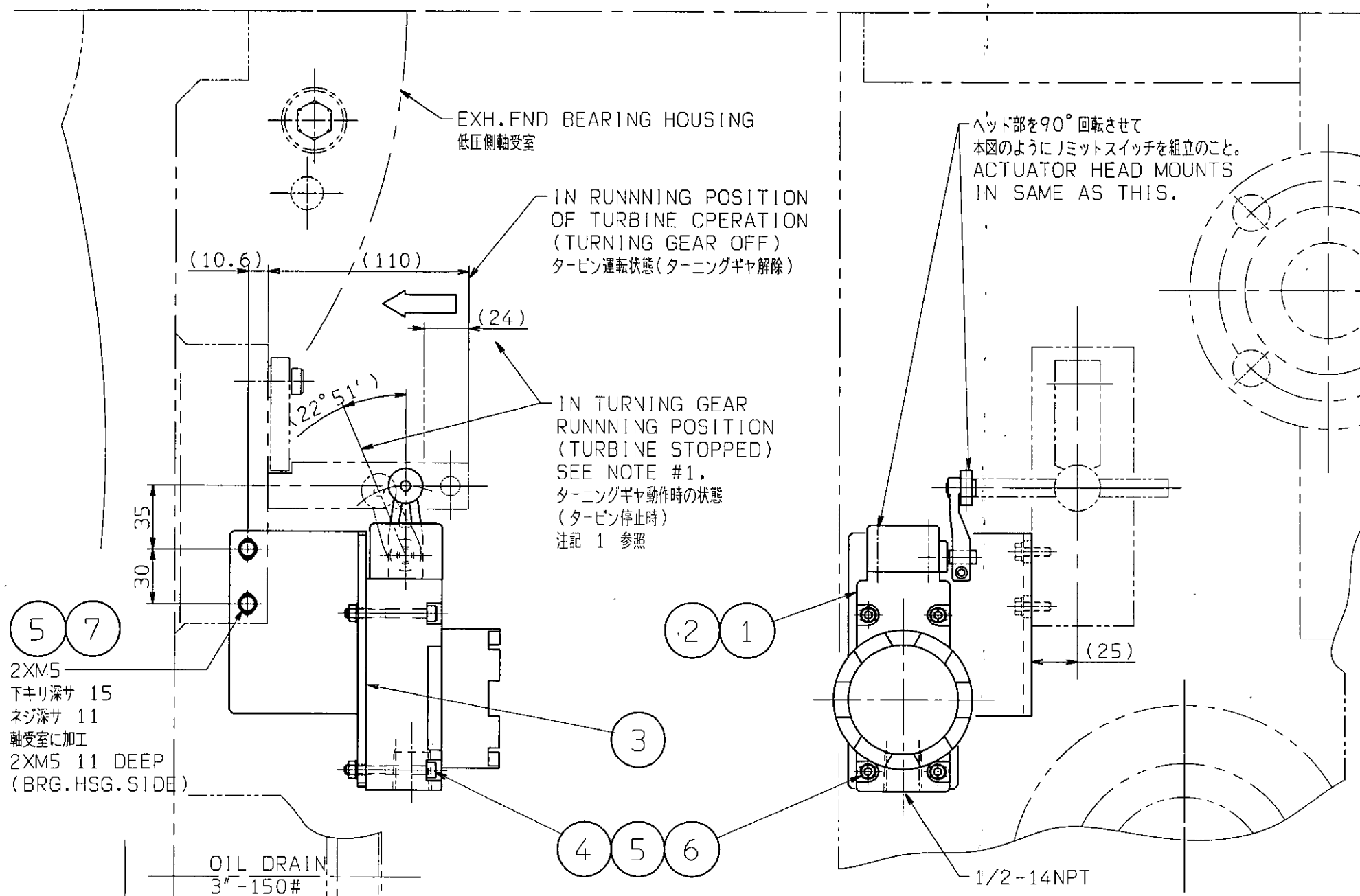
SCALE 1:3

Elliott Ebara

PM841C

CAD登録済(SF)

REVISIONS				
No.	DESCRIPTION	DATE	BY	APP.
	FIRST USED R021570803/SRV-5DF.			



VEIW OF COUPLING END
カップリング側より見る

NOTE
1.CONFIRM THAT LIMIT SWITCH IS
"ON" POSITION
IN TURNING GEAR RUNNING CONDITION.

注記
1.ターニングギヤ動作時にリミットスイッチが"ON"になること。

FIG 4-24
4-65

展 開 図

		GROUP OF PARTS	リミットスイッチ組立	10		E8652739-GR.1	
				9			
				8			
	2	SCREW, CAP	FM5TX16	7		FT-A05016	
	4	NUT	FM5N	6		FN-A05	
	6	WASHER, PLATE	ZM-M5	5		ZM-A05	
	4	SCREW, CAP	BSH-M5X45	4		BSH-H05045	
	1	BRACKET	ブラケット	3		E8663153-1	
	1	LEVER, LIMIT SWITCH	レバー	2		-	YAMATAKE:LSZ51C
	1	LIMIT SWITCH	リミットスイッチ	1		-	YAMATAKE:LSXA3K
Gr.2	Gr.1	PART NAME		NO.	ELLIOTT PARTS NO	EBARA PARTS NO	DESCRIPTION
Q'TY/個数		部 品 名		番号	エリオット 部 品 番 号	エバラ 部 品 番 号	記 事

ELLIOTT EBARA GROUP

ELLIOTT G.O.No.		DISTRIBUTION	SET
		CUSTOMER	
ELLIOTT S.O.No.		検	
		工	2
		材	
		図	1

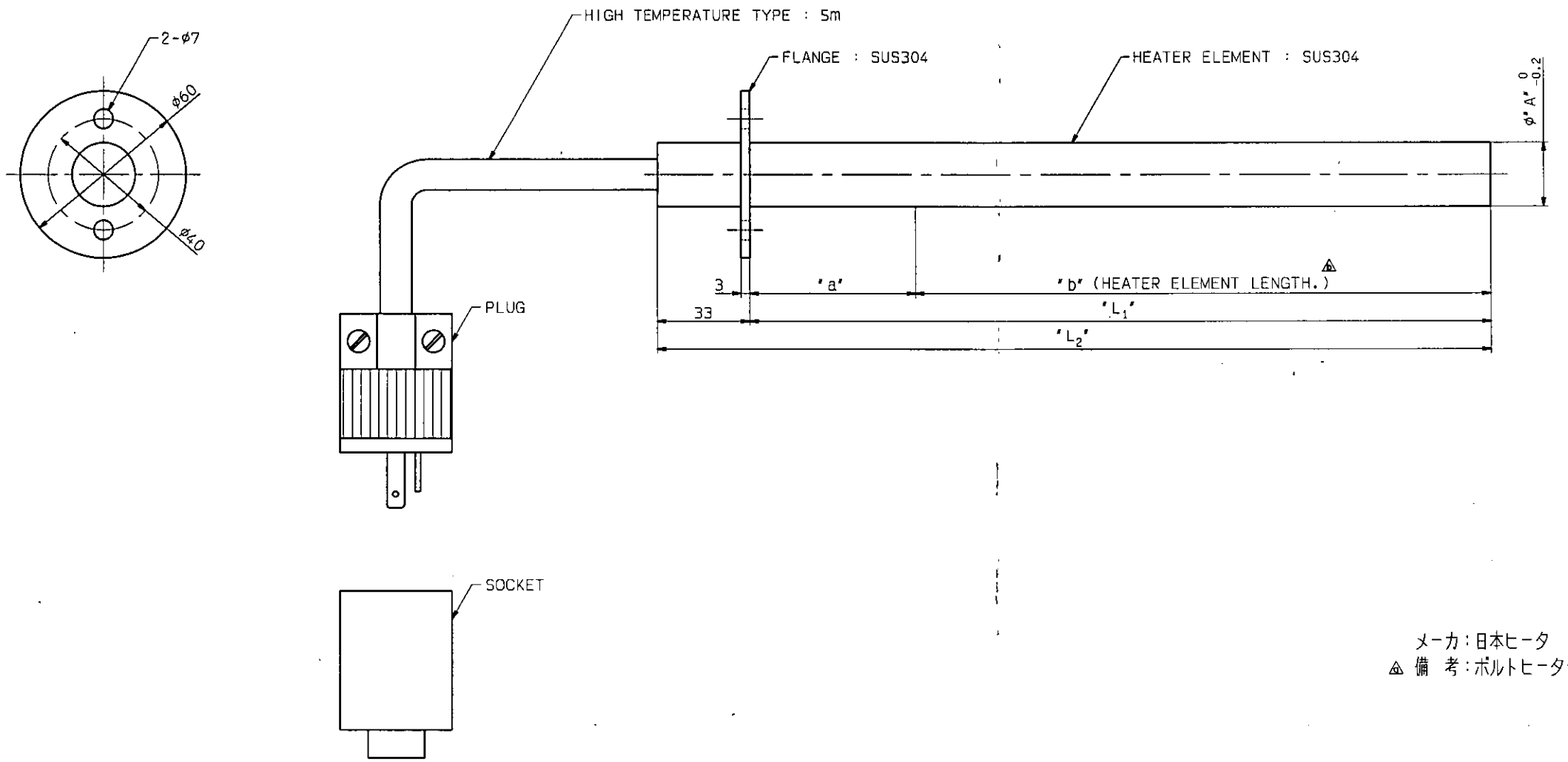
☐ FOR APPROVAL
AVOID DELAY
TO MAINTAIN SHIPPING
PROMISE,
ONE APPROVED PRINT MUST BE
RETURNED BY: _____
BY _____ DATE _____

☐ FOR RECORD
ANY REQUESTED CHANGE OF THIS
EQUIPMENT WILL RESULT IN:
1.CONTRACT PRICE ADJUSTMENT.
2.EXTENDED SHIPPING PROMISE
AS THIS CONTRACT IS IN
MANUFACTURING PROCESS.
BY _____ DATE _____

JOB No.		JOB/PROJECT NAME	
ITEM No.		CUSTOMER	
SER.No.		USER	
APP'D BY S.SAWADA	DATE	SERVICE	
		MODEL	SET
T.TANI	MAY.07.'03	TITLE 42" DF-EXH., WITH TURNING LIMIT SWTCH ASS'Y リミットスイッチ組立	
DSN'D BY			
CHK'D BY T.TANI	MAY.07.'03		
DRW'N BY K.NAGANUMA	APL.23.'03	PROJ.	DWG.NO. ES/8662739 REV. 0
		SCALE 1:2	Elliott Ebara

PM842C

CAD製図(SF)



REVISIONS				
NO.	DESCRIPTION	DATE	BY	APP.
⚠5	ADDED PT#5.	JAN.-10-'96	K.F.	S.S
⚠6	ADDED PT#6~8. ADDED NOTE.	JAN.-10-'96	D.Y. K.F.	S.S
⚠9	ADDED PT#9.	SEP.-13-'96	K.F.	S.S
⚠10	ADDED PT#10~12.	SEP.16,'96	D.Y.	S.S.
⚠11	CHANGED PARTS NO.	SEP.27,'96	K.F.	S.S.
⚠13	ADDED PT#13.	JUL. 4,'96	H.S	S.S
⚠14	ADDED PT#14~16.	DEC.25,'96	K.W.T.	S.S
⚠17	ADDED PT#17 & NOTE.	OCT. 8,'97	K.W.T.	S.S
⚠18	ADDED PT#18.	OCT.14,'97	T.W.T.	S.S
⚠19	ADDED PT#19.	AUG.18,'98	K.T.T.	S.S
⚠20	ADDED PT#20.#21.	OCT.19,'98	K.T.T.	S.S
⚠22	ADDED PT#22.	DEC.27,'00	K.T.T.	S.S
⚠23	ADDED PT#23.#24 (R001500003)	JAN.30,'02	K.T.T.	S.S
⚠25	ADDED PT#25(R001600302/2SNV-01	MAR.05,'02	K.T.T.	S.S

区分 407
BMコード T740

メーカ：日本ヒータ
⚠ 備　考：ボルトヒーターは、プラグ及び相ソケット付きとする

FIG. 4-25
4-66

展開図

		PART NAME 部品名	NO. 番号	EBARA PARTS NO. エバラ 部品番号	POWER SOURCE 電源 (V)	WATT DENSITY ワット密度 (W/cm²)	CAPACITY 容量 (W)	"L2"	"L1"	φ"A"	"a"	"b"	HOLE FOR HEATER 特殊ボルト穴サイズ	DESCRIPTION 記事
⚠		BOLT HEATER FOR M50X3X267L	25	E8681057-25	120	12		284	251	15.5	57	194	φ16.0H7	
⚠		BOLT HEATER FOR M50X3X267L	24	E8681057-24	230	12		284	251	15.5	57	194	φ16.0H7	
⚠		BOLT HEATER FOR M50X3X259L	23	E8681057-23	230	12		276	243	15.5	57	186	φ16.0H7	
⚠		BOLT HEATER FOR M50X3X259L	22	E8681057-22	200	12		276	243	15.5	57	186	φ16.0H7	
⚠		BOLT HEATER FOR M76X3X370L	21	E8681057-21	240	12		381	348	22.5	73	275	φ23.0H7	
⚠		BOLT HEATER FOR M50X3X259L	20	E8681057-20	240	12		276	243	15.5	57	186	φ16.0H7	
⚠		BOLT HEATER FOR M50X3X267L	19	E8681057-19	127	12		284	251	15.5	57	194	φ16.0H7	
⚠		BOLT HEATER FOR M76X3X370L	18	E8681057-18	220	12		381	348	22.5	73	275	φ23.0H7	
⚠		BOLT HEATER FOR M50X3X267L	17	E8681057-17	200	12		284	251	15.5	57	194	φ16.0H7	
⚠		BOLT HEATER FOR M50X3X259L	16	E8681057-16	120	12		276	243	15.5	57	186	φ16.0H7	
⚠		BOLT HEATER FOR M64X3X343L	15	E8681057-15	120	12		350	317	15.5	60	257	φ16.0H7	
⚠		BOLT HEATER FOR M76X3X370L	14	E8681057-14	120	12		381	348	22.5	73	275	φ23.0H7	
⚠		BOLT HEATER FOR M50X3X381L	13	E8681057-13	110	12		335	302	15.5	57	245	φ16.0H7	
⚠⚠		BOLT HEATER FOR M64X3X343L	12	E8681057-12	110	12		322	289	15.5	41	248	φ16.0H7	
⚠⚠		BOLT HEATER FOR M64X3X292L	11	E8681057-11	110	12		271	238	15.5	41	197	φ16.0H7	
⚠⚠		BOLT HEATER FOR M76X3X415L	10	E8681057-10	110	12		395	362	22.5	51	311	φ23.0H7	
⚠		BOLT HEATER FOR M50X3X267L	9	E8681057-9	110	12		284	251	15.5	57	194	$\phi16.0^{+0.2}_{0}$	
⚠		BOLT HEATER FOR M64X3X343L	8	E8681057-8	240	12		322	289	15.5	41	248	φ16.0H7	
⚠		BOLT HEATER FOR M64X3X292L	7	E8681057-7	240	12		271	238	15.5	41	197	φ16.0H7	
⚠		BOLT HEATER FOR M76X3X415L	6	E8681057-6	240	12		395	362	22.5	51	311	φ23.0H7	
⚠		BOLT HEATER FOR M50X3X267L	5	E8681057-5	240	12		284	251	15.5	57	194	$\phi16.0^{+0.2}_{0}$	
		BOLT HEATER FOR M50X3X259L	4	E8681057-4	220	12		276	243	15.5	57	186	$\phi16.0^{+0.2}_{0}$	
		BOLT HEATER FOR M50X3X267L	3	E8681057-3	220	12		284	251	15.5	57	194	$\phi16.0^{+0.2}_{0}$	
		BOLT HEATER FOR M64X3X343L	2	E8681057-2	220	12		350	317	15.5	60	257	$\phi16.0^{+0.2}_{0}$	
		BOLT HEATER FOR M76X3X364L	1	E8681057-1	220	12		372	339	22	73	266	$\phi22.5^{+0.2}_{0}$	

⚠ 設計用注記
ボルトヒーター手配数はボルト全数の20%程度で最低は予備を含んで5本とする。
STM-CA-504 ボルトヒーター手配上の注意点(2002年2月7日発行)より

ELLIOTT EBARA GROUP

ELLIOTT G.O.NO.
ELLIOTT S.O.NO.

DISTRIBUTION / SET
材 4
基
工 2
設 1

☐ FOR APPROVAL
AVOID DELAY TO MAINTAIN SHIPPING PROMISE.
ONE APPROVED PRINT MUST BE RETURNED BY: _____
BY _____ DATE _____

☐ FOR RECORD
ANY REQUESTED CHANGE OF THIS EQUIPMENT WILL RESULT IN:
1.CONTRACT PRICE ADJUSTMENT.
2.EXTENDED SHIPPING PROMISE AS THIS CONTRACT IS IN MANUFACTURING PROCESS.
BY _____ DATE _____

JOB NO.	JOB/PROJECT NAME
ITEM NO.	CUSTOMER
SER.NO.	USER
APP'D BY / DATE	SERVICE
S.SAWADA 12-1-'92	MODEL / SET
H.SASAKI 12-1-'92	TITLE: BOLT HEATER ボルトヒータ
DSN'D BY T.MITO 11-30-'92	
CHK'D BY	
DRW'N BY T.MITO 11-30-'92	PROJ. / DWG.NO. ES/8681057 / REV. 5
	SCALE 1:NTS / Elliott Ebara

PM841C

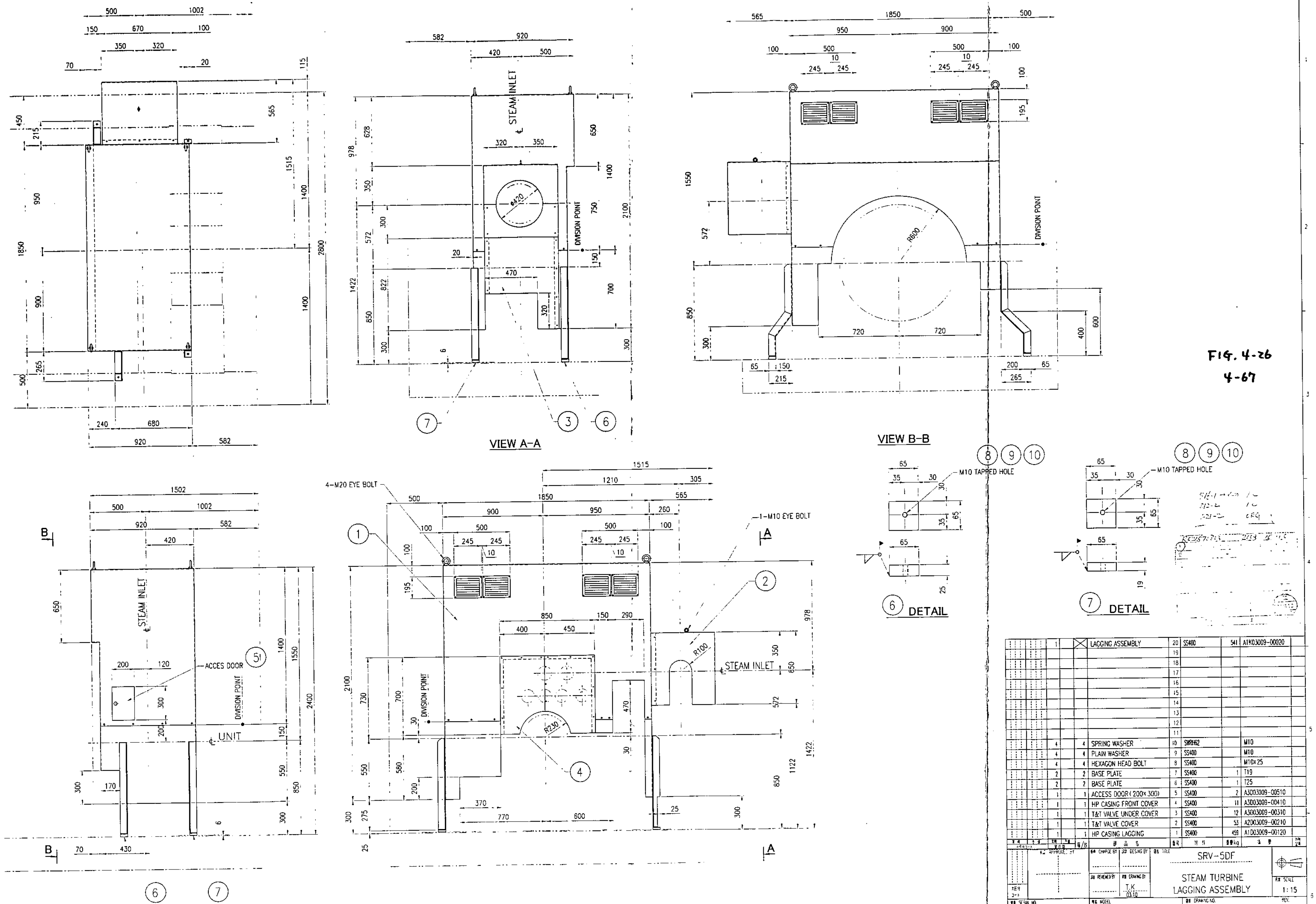


FIG. 4-26
4-67

1	LAGGING ASSEMBLY	20	SS400	541	A1K03009-00020
		19			
		18			
		17			
		16			
		15			
		14			
		13			
		12			
		11			
4	SPRING WASHER	10	SWRH62		M10
4	PLAIN WASHER	9	SS400		M10
4	HEXAGON HEAD BOLT	8	SS400		M10x25
2	BASE PLATE	7	SS400	1	T19
2	BASE PLATE	6	SS400	1	T25
1	ACCESS DOOR (200x300)	5	SS400	2	A3D03009-00510
1	HP CASING FRONT COVER	4	SS400	11	A3D03009-00410
1	T&T VALVE UNDER COVER	3	SS400	12	A3D03009-00310
1	T&T VALVE COVER	2	SS400	53	A2D03009-00210
1	HP CASING LAGGING	1	SS400	459	A1D03009-00120

SRV-5DF
STEAM TURBINE
LAGGING ASSEMBLY
T.K 03.10
1:15
R021570803
SRV-5DF
A1K03009
株式会社 荒磯製作所

TITLE	Special Tool List for Main Turbine	DOC. No.	LGTPR-813-1023 V-9900-4-CT9901-102-0 REV. 0

CUSTOMER	LG Engineering & Construction Corp.	COMPLETE IN WITH COVER	5 SHEETS
FINAL USER	Turkish Petroleum Refineries Corp.		
PROJECT	Tupras Izmir Refinery DHP Project	SERVICE	Recycle Compressor
JOB No.	7020	EBARA SER. No.	R0215708
ITEM No.	CT-9901	MODEL/ EQUIP.	25MB5/SRV-5DF SET 1

LG E&C LG ENGINEERING & CONSTRUCTION CORP.	TÜPRAŞ TUPRAS IZMIR REFINERY DIESEL/KEROSENE HYDROPROCESSING PROJECT	JOB NO.:7020	UNIT : N/A
		REQ'N NO. : 7020-RQ-C-001	SH/OF
		CONTRACTOR SPEC NO. : V-9900-4-CT9901-102	/
		REV 0	

TO	SET	TO	SET
CUST-OMER	10 C	281-1	
813	1	811-1	
813E		811-2	1
821-1		811-3	
821-2	1		
821-4			
819			
816-1			
816-2	1	4	
812-1		3	
812-2		2	
850		1	
		REV.	PAGE DATE APP'D BY

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BY: DATE: OCT-17-'03

ISSUED BY

APPROVED BY OCT-17-03

CHECKED BY

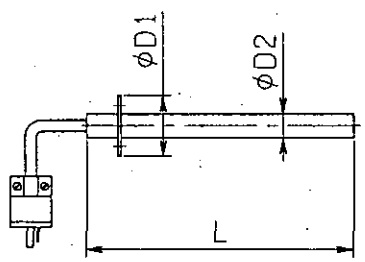
PREPARED BY Oct. 17, '03

Special Tool List for ~~GT~~ TC-9901

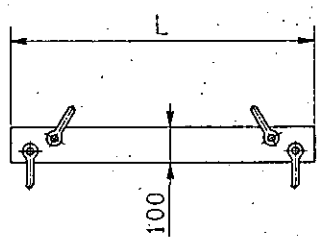
Customer : *LG Engineering & Construction Corp.*
User : *Turkish Petroleum Refineries Corp.*
Project : *Tupras Izmir Refinery DHP Project*

No.	Part Name	Part No.	Sketch No.	Outline Dimension (mm) D1	D2	L	Q'ty	Item No. TC-9901 / Serial No. R0215708 / Use for SRV-5DF
1	Bolt Heater for M50x3x267L	E8681057-3	1	60	15.5	284	8	Use
2	Bolt Heater for M50x3x259L	E8681057-4		150	17.3	276	8	Use
3	Rotor Lifting Tool	E8682175-3	2	-	-	700	1	Use
4	Lifting Bolt	IB-A10	3	M10	41	60	2	Use
5		IB-A12		M12	50	73	2	Use
6		IB-A16		M16	60	87	2	Use
7	Jack Screw	STB-A20150	4	M20	37	163	2	Use
8	Guide Bolt	B720386-1	5	M24	-	654	2	Use
9		B845150-9		M24	29	457	2	Use

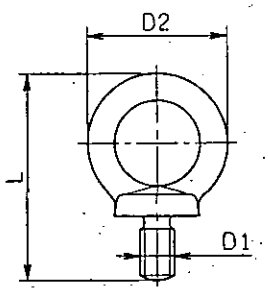
SKETCH #1



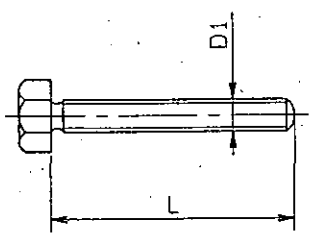
SKETCH #2
ROTOR LIFTING TOOL



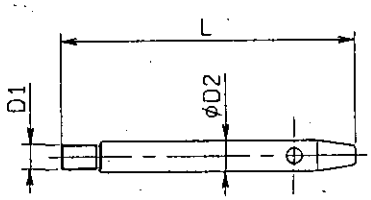
SKETCH #3
LIFTING BOLT



SKETCH #4
JACKSCREW



SKETCH #5
GUIDE BOLT



GRAHAM CORPORATION
ACCESSORY LIST

ACCESSORIES LISTED ARE FURNISHED BY GRAHAM CORPORATION AND THE QUANTITIES SHOWN ARE PER UNIT.

ITEM	ACCESSORY	QTY	MANUFACTURER	DESCRIPTION	REV	BM PART#
1	TUBE EXPANDER (SURFACE CONDENSER)	1	POWERMASTER	Model G-823 R9 FOR 3/4"-14 BWG TUBES		2695
2	TUBE END FACER (SURFACE CONDENSER)	1	POWERMASTER	MODEL NO: TEF-750 FOR 3/4"-14 BWG TUBES		2725
3	TUBE GUIDE	1	POWERMASTER	MODEL NO: BTG-6 FOR 3/4"-14 BWG		2745
4	TUBE DRIFT TOOL (SURFACE CONDENSER)	1	POWERMASTER	MODEL NO: TD750-14-01 FOR 3/4"-14 BWG TUBES		2765
5	HAND TUBE PULLER (SURFACE CONDENSER)	1	POWERMASTER	MODEL NO: JSP-750-14 FOR 3/4"-14 BWG TUBES		2785
6	LONG REACH EXPANDER FOR *INTER/ AFTER CONDENSER* DIVISION PLATE	1	POWERMASTER	Model 1225-38-6-S FOR 3/4"-14 BWG TUBES	1	2715
7					1	
8					1	
9					1	
10					1	
11					1	

DWG NO. A-55145-506

JOB: 03-53282 M

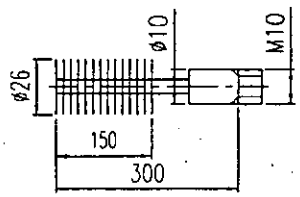
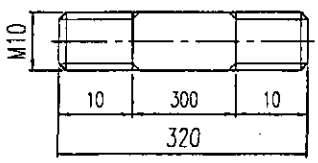
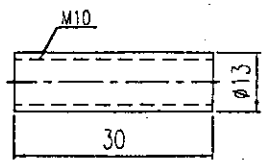
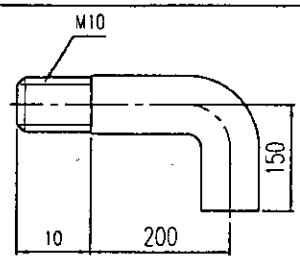
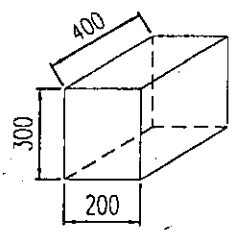
P.2

SPECIAL TOOL

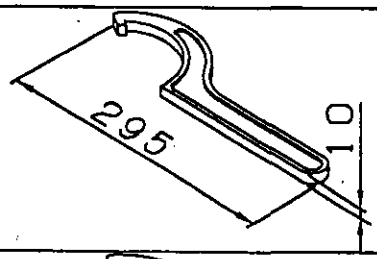
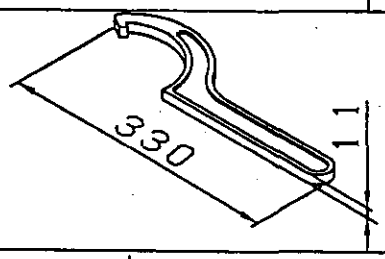
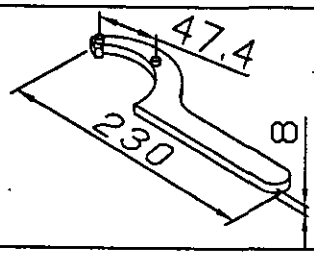
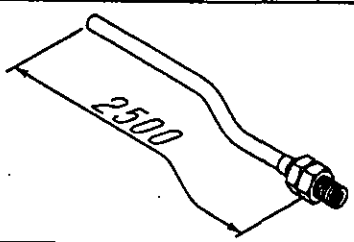
PAGE : 1 OF 1

TUPRAS IZMIR DHP PJT. ITEM NAME : 4.4M^{2}GLAND CONDENSER

MANUFACTURED BY : DONG HWA ENTEC NO. OF SET : 1 SET

SERIAL NO.	PARTICULARS	MATERIAL	NO. OF SUPPLY	SKETCH	REMARKS
1	BRUSH	NYLON & SS400	1		
1-1	BAR	SS400	4		
1-2	JOINT	SS400	5		
1-3	L-TYPE HANDLE	SS400	1		
1-4	TOOL BOX	SS400	1		

SPECIAL TOOL LIST FOR TS140-10~60 ACCUMULATOR
特殊工具リスト CG TYPE アキュムレータ

NO. 番号	NAME 名称	SKETCH 略名 図	Q'TY 数量	PART NAME 関係部品名	REMARKS 備考
1	HOOK SPANNER フックスパナ		1	LOCK NUT (OIL PORT SIDE) ロックナット (オイルポート側)	98-110
2	HOOK SPANNER フックスパナ		1	LOCK NUT (GAS PORT SIDE) ロックナット (ガスポート側)	105-115 (FK-13)
3	PLUG SPANNER プラグスパナ		1	PLUG BODY プラグ ボディ	58/65S (小)
4	PULL HOSE プルホース		1	VALVE STEM (BLADDER) バルブステム (ブラダ)	PH-120
5					

TAG NO. : CT-9901D1
EBARA SERIAL NO. : R021570803
EQUIP. NAME: TUPRAS Izmir DHP Project
CUSTOMER: LGE
CONSUMER: TUPRAS

K8180

NAKAMURA KOKI CO., LTD.
中村工機株式会社

List No. 台帳No.	—	Document No. 書類No.	TTS14010GE⚠1	
Rev. 改訂来歴	Matters 事項	Designed 作成	Checked 審査	Approved 承認
⚠1	—	6/24 '03 R. Em.	7/11/03 K. E	7/11/03 K. E

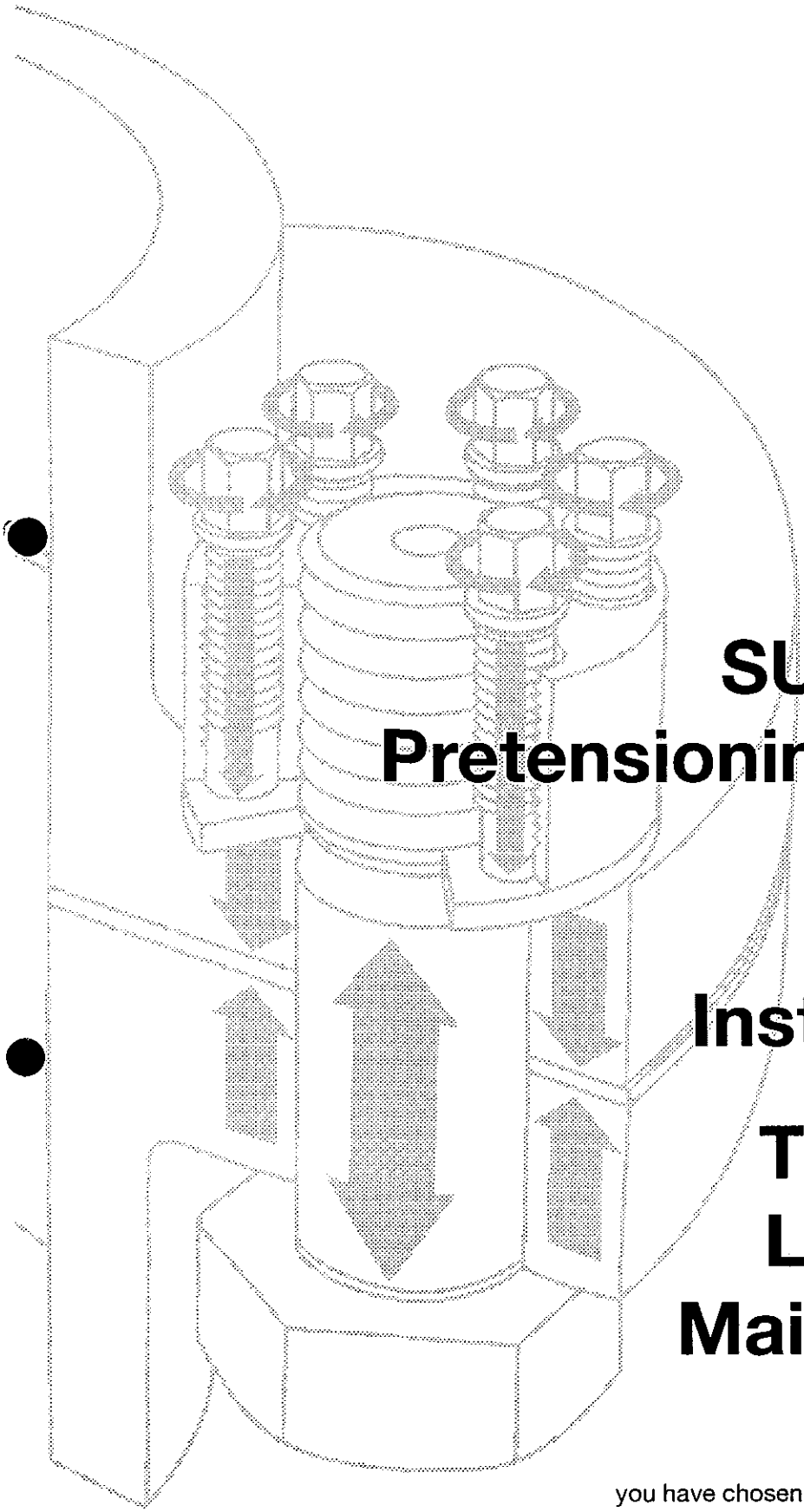
CHAPTER 5 - LUBRICATION

PLEASE REFER TO LUBRICATION SYSTEM (FILE NO. 2).

P&S Tensioning Systems Ltd.
Rickenstrasse 55
CH-8735 St. Gallenkappel
Switzerland

Tel. +41-(0)55-284 64 64
Fax +41-(0)55-284 64 69

Internet: http://www.p-s.ch
e-mail: info@p-s.ch



SUPERBOLT®
Pretensioning Systems

Instruction for

Tightening –
Loosening –
Maintenance –

With SUPERBOLT Tensioners
you have chosen a technologically superior product.
It is purely mechanical and, therefore, very safe.

The following simple steps will help you with your application.
Thereby you increase safety, speed and service life.

GB

1. Tightening procedure

1.1 Check:

Which jackbolt torque?

M = 100% of recommended torque, see
- your internal directives
- P&S cerficate
- P&S data sheet

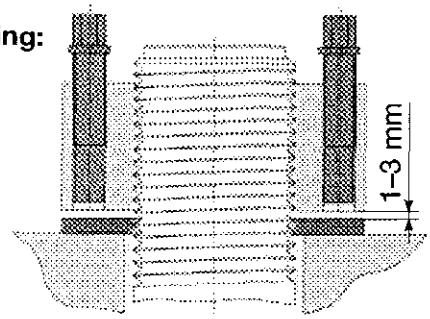
Attention: The engraved jackbolt torque is the maximum value typically allowed and can be unsuitable for your application.

1.2 Which tools?
- suitable torque wrench
- matching socket, heavy duty line
- lubricant

1.3 Prepartion:
- Clean main thread and contact areas and lubricate well with suitable anti-seize lubricant.
- Make certain that the jackbolts on the SUPERBOLT tensioner do not protrude beyond the load surface and are well lubricated. If neccessary, relubricate with the recommended SUPERBOLT lubricant (see cerficate).
- Firmly tighten tensioner by hand, if neccessary by using a screwdriver stuck between the jackbolts or the like.
- *Afterwards turn back approx. 1/2 turn. Depending on size the gap will be approx.* 1 to 3 mm wide.
- The actual tightening occurs in a few steps:

1.4 Tightening:

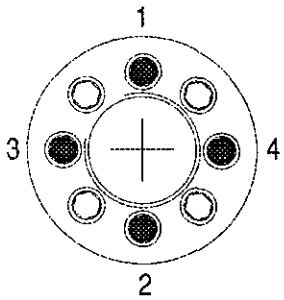
Step 1:



Tighten 4 jackbolts by hand or using a small wrench to center the main thread and to eliminate backlash. Tighten bolts crosswise.

Step 2:

Step 3:

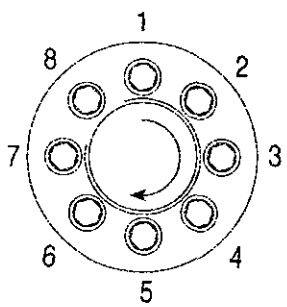


Now tighten these 4 jackbolts crosswise with 50% of the recommended jackbolt torque.

Tighten the same 4 jackbolts crosswise with 100%.

Step 4:

Step 5:



Now change to circular tightening and tighten all jackbolts with 100% of the recommended jackbolt torque.

Repeat step 4 until all jackbolts are equally tightened (less than 20° remaining movement). Normally 2 to 3 passes are sufficient, with long bolts accordingly more.

Power tools can save time, see item 3.3.

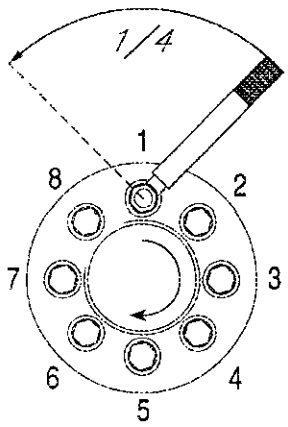
2. Loosening procedure

Attention: Loosening requires an exact procedure. The jackbolts must be unloaded stepwise! Under no circumstances unload single screws completely. The remaining screws would have to carry the entire load and, therefore, would be difficult to loosen. In extreme cases the jackbolts could mushroom and make loosening impossible!

2.1 Usage at normal temperatures (under 100° C)

Preparation: Before loosening apply penetrating oil, especially with any rust formation.

Step 1:



Starting with N° 1 loosen every jackbolt in a circular pattern approx. 1/4 turn (breaking loose is sufficient). After the first round jackbolt N° 1 will be tightened again, however, on a lower level of loading.
Note: Should several tensioners be loosened, i.e. on a flange, perform step 1 on all tensioners before moving to step 2.

Step 2:

In a 2nd round repeat step 1, again on all tensioners.

Step 3:

Repeat step 1 in a 3rd round.

Step 4:

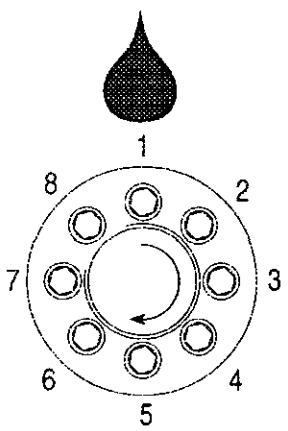
Relieve jackbolts completely. Now the tensioner can be removed by hand.

Note: Long screws expand more and, therefore, may require one or two passes more.
Attention: Before re-using follow maintenance instructions!

2.2 Usage at high temperatures (over 100° C)

Preparation: At higher temperatures the petroleum base of the lubricant evaporates, thereby increasing the effort for loosening.

Step 1:



If possible, already apply penetrating oil during cooling of the installation (at approx. 150° C). At even higher temperatures use synthetic oil.

Step 2:

Starting with N° 1 break loose each jackbolt of one tensioner in a circular pattern.
Note: Do not loosen beyond break loose point, *and break loose all jackbolts of all tensioners of* a joint first.

Step 3:

The actual loosening occurs according to the procedure described under item 2.1 (normal case), beginning with step 1.

Note: For high temperature applications bolts with bores are often used. Through the use of heating rods the loosening of SUPERBOLT tensioners can be substancially facilitated. Five minutes of heating are already sufficient to accelerate loosening.

3. Lubrication and tools

3.1 Lubricant

Jackbolts: The jackbolts are delivered pre-lubricated and are ready for use. Refer to the cerficate for the lubricant. For jackbolts use only SUPERBOLT lubricants or substitutes permitted by P&S.

Hardened washers: For the upper side (contact with jackbolts) use the correct SUPERBOLT lubricant. For the bottom side you may use any suitable anti-seize lubricant.

Main thread: Any suitable anti-seize lubricant including SUPERBOLT lubricants may be used. Apply with brush or spray.

3.2 Sockets

For tightening the jackbolts only high quality tools in good working order should be used. Heavy duty sockets for use with impact tools are best suited. Worn sockets are dangerous and should be disposed of.

3.3 Power tools

Air impact tools have prooven to be most suitable, however, with SUPERBOLT jackbolts they reach only 30–50% of their rated output (lack of displacement). Therefore, the largest possible air lines and couplings (i.e. hydraulic couplings from Stäubli) should be used. Because of the high forces and for repeated usages only heavy duty products should be chosen (i.e. Ingersoll Rand, Dino Paoli, Atlas Copco). Verifying the torque output of an air impact tool is easy: Tighten until tool stalls, then measure the torque with a torque wrench (preferably with electronic gauge).

For regulating the tightening torque simply install a service unit directly in front of the air impact tool (filter, controller, oiler). Adjust the pressure at the controller and, thereby, the power of the air impact tool. Tighten a SUPERBOLT jackbolt to the desired torque with a torque wrench. Then, apply the air impact tool and increase the pressure until the jackbolt starts turning again. Check the controller if the pressure decreases when starting the air impact. This indicates an unwanted pressure drop in the air duct. Therefore, use generously dimensioned air ducts! For regular usage of air impact tools the use of a control unit pays off (available upon request).

When tightening air impact tools are especially suited for steps 2 through 5 and should be adjusted to approx. 90 to 100% of the rated torque.

Note: Because of the lower accuracy of power tools, the last tightening round should always be manually performed with a precision torque wrench.

Note: During loosening caution is mandatory: Use normal air impact tools only for step 4 (complete loosening), **but never for steps 1 through 3!**
A special air impact tool for loosening SUPERBOLT tensioners is newly available from P&S: It turns only 1/4 of a turn, and is applicable for steps 1 through 3 .

Notes for the use of air impact tools:
- Network pressure min. 6.5 bar
- up to 70 Nm 3/8" impact tool or air ratchet
- 70–130 Nm 1/2" impact tool, derated (**Attention:** Do not overshoot!)
- 130–200 Nm 1/2" impact tool
- 200–270 Nm 1/2" impact tool (handy) or 3/4"
- over 270 Nm 3/4" impact tool

4. Maintenance

4.1 *Regular checks*

SUPERBOLT tensioners do not loose their preload force even after several years in service provided that they are correctly tightened. During revisons (after several years) the preload force should be checked nevertheless. Use a torque wrench adjusted to 100% of the permitted jackbolt torque according to the cerficate or your installation procedure.

Should some jackbolts unexpectedly have lost some of the preload force the following procedure is recommended:

- Unload tensioner slightly by loosening the jackbolts according to loosening procedure. However, only 1 turn! Thus, the nut remains tensioned.
- Now retension according to tightening procedure - step 5, meaning:
  Tighten in circular pattern with full jackbolt torque, until all jackbolts are tightened.

4.2 Preventive maintenance

i.e. for removal for maintenance purposes:

- Relieve according to loosening procedure.
- Clean thread and end of the SUPERBOLT jackbolts and treat with lubricant according to cerficate. Do not use molybdenum sulfide (MoS_2) unless expressly specified in the cerficate.
- SUPERBOLT hardened washer may be re-used despite indentations simply by turning over. Depressions of a few 1/100 mm are normal.
- Retighten according to tightening procedure.

4.3 If you encounter problems

Jackbolts cannot be loosened:

- Try to free at least one jackbolt.
- Remove, lubricate well and tighten with 110% of the recommended jackbolt torque.
- The two neighboring jackbolts should become free.
- Remove also, lubricate and tighten with 110%.
- Again the next two jackbolts should become free.
- And so on.
- Afterwards relieve all jackbolts according to loosening procedure.

Hardened washers are damaged i.e. after a long time in service:

- Exchange against original SUPERBOLT hardened washers.

Jackbolts are damaged or missing:

- Exchange against original SUPERBOLT jackbolts.
  Do not use commercially available screws because they are not suitable for such high loads.

Other problems:

- Please contact your supplier or directly P&S Tensioning Systems Ltd.

5. General notes

5.1 Tensioners with only 4 or 6 jackbolts

Tightening – Step 1: Tighten all jackbolts by hand crosswise.
Step 2: Tighten 2 opposite jackbolts with 50% of recommended torque.
Step 3: Tighten 2 other opposite jackbolts with 100%.
Step 4: Tighten jackbolts in circular pattern with 100% until they are tightend.

5.2 Tightening of long tie rods

To accelerate tightening of long tie rods it pays off to perform step 4 with increased jackbolt torque (approx. 110–125%).
Attention: In final rounds always check jackbolt torque by hand with 100% to prevent overloading.

5.3 Gaskets with large elastic displacements

It does not matter if some jackbolts (or tensioners on the circumference) become loose during tensioning. This is normal, because in the beginning only those bolts carry loads that are being tightened. Do not spin down loose tensioners, otherwise there will be problems later during loosing. Preferably adjust jackbolts with power tools.

5.4 Tensioning large flanges or joints

For tensioning large flanges/joints preferably work with 2 men 180° apart or 4 men 90° apart.

5.5 Usage of spacers

Tensioners should be positioned on the outer end of a bolt. This protects the main thread. It can be tensioned easier (no extensions neccessary) and the expansion is improved. Place suitable spacer or several heavy washers under the hardened washer. Thereby you can bridge over areas that have been damaged by other tightening techniques.

5.6 Retensioning for high temperature applications

If tensioned properly it should not become neccessary to retension SUPERBOLT tensioners. *If regular retensioning should nonetheless become necessary, please inform us so that we* can re-examine the joint.

5.7 Recutting of the bolt threads

Recutting of the bolt threads can become neccessary on bolts that have deformed during years of service, especially at higher temperatures. Likewise on bolts of earlier manufacture that were manufactured with other tolerances.

5.8 Installation tools

Apart from a variety of standard tools for tensioning of SUPERBOLT tensioners simple special tools are available, which facilate the installation of large nuts or bolts.

5.9 Protective caps

Protective caps from vinyl, steel or stainless steel are available to protect the tensioners for different applications. Filled with grease they offer good potection against rust at normal temperatures.

---

6. Consultation and exclusion of liability

For further information on possible uses, applications and maintenance of SUPERBOLT pretensioning systems please contact your supplier or directly P&S Tensioning Systems Ltd. P&S excludes all liability for unsuitable product selection, improper use as well as damage resulting from disregarding our instructions and directives. Changes due to technical progress are reserved.

SUPERBOLT®
P.O. Box 683 • Carnegie, PA 15106
Ph: (412) 279-1149 • Fax: (412) 279-1165
1-800-345-BOLT (2658) in the U.S.

Installation Procedure

(excludes piston end, crosshead, mill motor, & bearing lock nuts)

BEFORE TIGHTENING

Determine the target jackbolt torque from the installation sheet shipped with the product, or by calling Superbolt.

Note: The jackbolt torque value stamped on the tensioner is a standard value for that part and may not be correct for your application.

If using air impacts: Select a tool with output of about 100% - 110% of the target torque. See "Air Impact Tool Selection" on back.

Preparation: 1) Confirm jackbolts are lubricated with correct Superbolt lubricant (JL-G or JL-M). New product is pre-lubricated at the factory. 2) Make sure the jackbolt tips are flush (or recessed) with bottom of nut body. 3) Lubricate thread of main stud. 4) Slide hardened washer onto the stud. 5) Lubricate the washer face or jackbolt tips with correct Superbolt lubricant (JL-G or JL-M).

For flanges: To speed up installation, use two workers at 180° apart, following the OEM pattern for tightening.

TIGHTENING SEQUENCE

STEP 1: Spin the tensioner onto the main thread until it seats against the washer. You may want to back off the tensioner slightly as mentioned in Helpful Tip #3.

STEP 2: Tighten (4) jackbolts at 90° apart (12:00, 6:00, 9:00, and 3:00) on all studs with a partial torque (30 - 70%). This serves to seat the flange. If using an impact, use a reduced setting or lightly pulse the trigger at the full setting.

STEP 3: At 100% target torque, tighten the same (4) jackbolts on all studs.

STEP 4: At 100% target torque, tighten all jackbolts in a circular pattern. Do this for all studs (1 round only). See Helpful Tip #7 about using up to 120% torque.

STEP 5: Repeat "STEP 4" until all jackbolts are "stabilized" (less than 10° rotation). This usually requires 2-4 additional passes. If using air tools, switch to a torque wrench when socket rotation is small. Use the torque wrench to stabilize at the target torque.

Note: *Product with 4 or 6 jackbolts- use a star pattern for all steps.*

Removal Procedure

Note: For stubborn removal, please call for alternate procedure

CAUTION! Removal requires strict procedures! Jackbolts must be unloaded gradually. If some jackbolts are fully unloaded prematurely, the remaining jackbolts will carry the entire load and may be hard to turn. With extreme abuse, a jackbolt tip can deform making removal difficult.

SERVICE UNDER 250°F

Preparation: Spray jackbolts with penetrating oil or hydraulic oil prior to start (especially if product is in corrosive environment).

STEP 1: Loosen each jackbolt 1/8 turn following a circular pattern around the tensioner (1 round only). As you move around and get back to the 1st jackbolt, it will be tight again. Do this for all studs on the joint prior to the next step.

STEP 2: Repeat a 2nd round as above for all studs, loosening each jackbolt 1/4 turn in a circular pattern.

STEP 3: Continue loosening 1/4 turn for 3rd and successive rounds until all jackbolts are loose.

Note: *Usually after the 3rd or 4th round, an impact can be used to completely extract the jackbolts, one by one. For long bolts or tie rods, additional rounds may be required before removing the jackbolts with an impact tool.*

STEP 4: Remove, clean, and relubricate the jackbolts prior to next use with correct Superbolt lubricant (JL-G or JL-M).

SERVICE OVER 250°F

Preparation: Above 300°F the petroleum base of the lubricant burns off. Oil per "STEP 1" below to reduce the removal torque.

STEP 1: As the equipment is cooling down (around 300°F), apply hydraulic oil to the jackbolts and washer and let sit for several hours. Thoroughly "wet-down" all components and re-apply during equipment cool down period. If the tensioner is inverted, squirt oil in the gap between the nut body and the washer. Synthetic oil can be used for oiling above 300°F.

STEP 2: Wait for tensioners to cool below 200°F. Using a circular pattern, "crack" each jackbolt only enough to ensure movement. Do not turn beyond the break loose point. Do this for all studs.

STEP 3: Now begin with "STEP 1" of the procedure for service under 250°F.

Note: *Heating Rods can be used to reduce the removal torque required.*

APPROVAL DRAWING

CUSTOMER : EBARA Corporation.

END USER :

P L A N T : R021570803

ORDER No. :

YKV CORPORATION

REV NO.	DATE	REVISED CONTENTS	DRAWN BY
3			
2			
1			

APPROVED BY	CHECKED BY	DRAWN BY	MFR NO.
'03. 4. 3	'03. 4. 3	'03. 4. 3	VTR031341
K. Kaji	S. Takahashi	M. Chiba	

CONTROL VALVES SPECIFICATION (MISCELLANEOUS USE)	SHOP ORDER No.	SEC.	LOOP	ITEM
	R031341	01	001	01
CUSTOMER : EBARA Corporation.	SERIAL No. 031341-01-01			
END USER :	SPEC No. R021570803			
PLANT :	SO No.			

NO	ITM	DESCRIPTION / PARTS NUMBER	MATERIAL	QTY

<LINER DOBLLE ACTING CYLINDER>

- SPECIFICATION -

1	SIZE	: 25sq.in	10	SPRING	: SINGLE
2	SET PRESS	5.0(kgf/cm2)	11	SUP PRESS	: Nor 5.0(Kg/cm2,G)
3	AMB TEMP	Max60degC/Min0degC	12	HAND WHEEL	: NON
4	AIR FAIL	: STEM RETRACT (SPRING SETTING DIRECTING)			
5	STROKE	: 1.00 INCH	13	MOUNTING ORIENTATION : ③	
6	SPUD	: 2.00		ATTACHED DWG : NO. CD-LN025-041	
7	STEM SCREW	: 1/2-20UNF (WITH STEM CLAMP)	14	QTY	1set
8	POSITION	: MODEL Beta I/P (NT3000 Explosion Type) : Input Signal 4-20 mA DC : SIG. INCR. TO STEM EXTEND	15	AIR PIPING AND FITTING MAT'L : STAINLESS STEEL	
9	AIR SET	: MODEL AW3000-N02BG3-R-X490-YA : CUSTOMER AIR CONN. : NPT 1/4			

NOTE: *NAME PL: STROKE, SUP PRESS(5.0Kg/cm2,G), SERIAL NO. AND DATE ARE STAMPED ON A LINEAR PLATE.

*PRESS GAUGE UNI : Kg/cm2,G

*HAZARDOUS LOCATION APPROVALS : Class 1, Div.2 (1) Groups B,C,D

*PIPING DIAGRAM No.PD-CLKN-101-04

DATED	変更欄	DRAWN

DRAWN	SM	SE	ACCEPTED	CHECKED	ORDERED
	YKV 03.3.28 山内		管理 03.4.-1 仕検	YKV 03.4.01 安彦	YKV 03.4.-1 下田

SD NO.	
008	
MFR No.	VTR031341-01

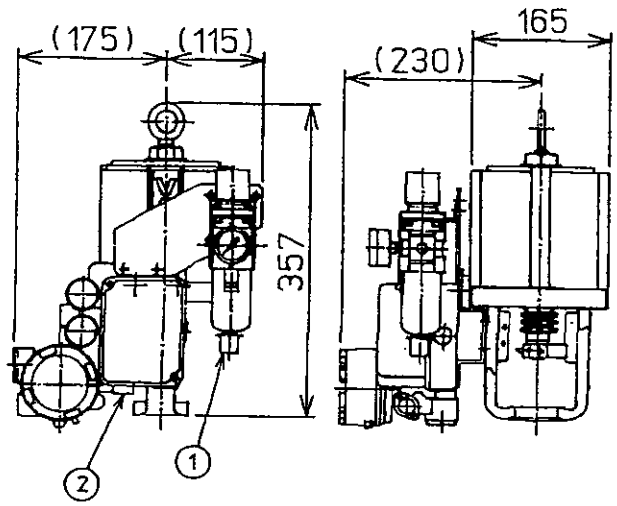
WS 21F0A3

YKV corporation

UNIT : mm
( ) : APPROX.

<STD.>

①



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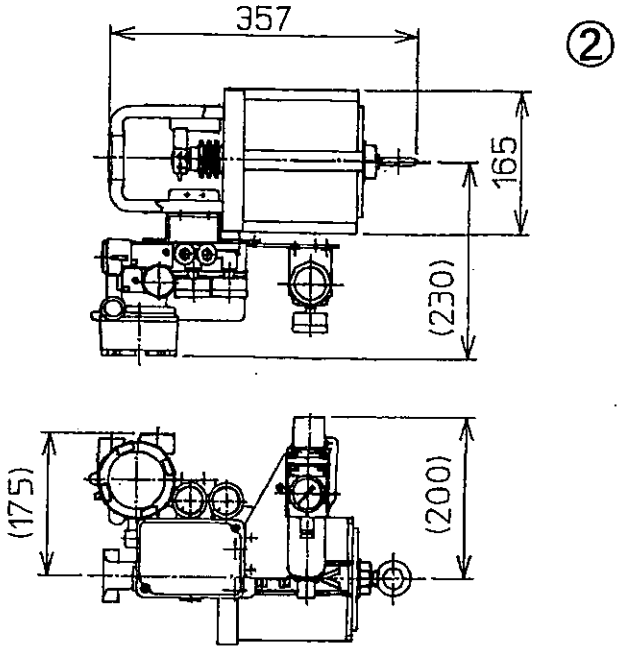

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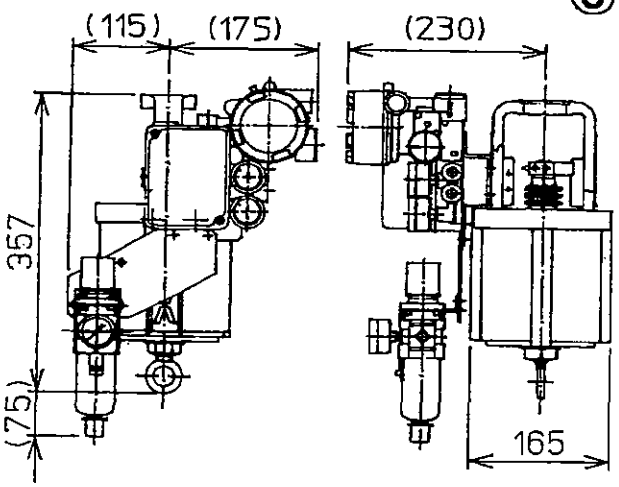
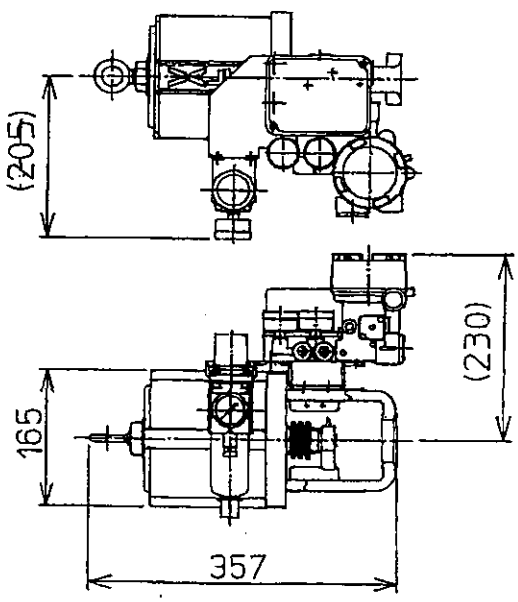


MV

④



B.E66

ACCESSORY TYPE

① AIR SET : AW3000

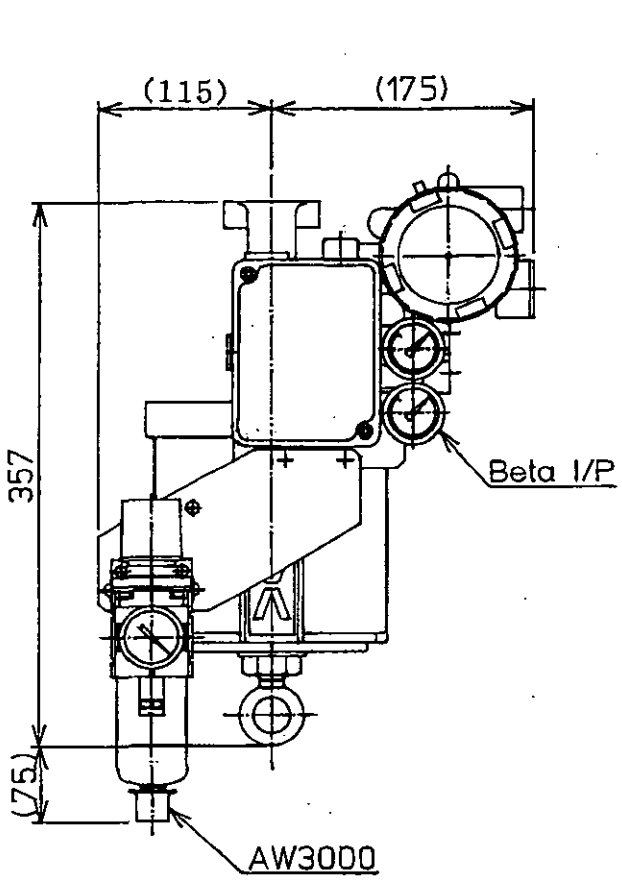
② POSITIOER : Beta I/P

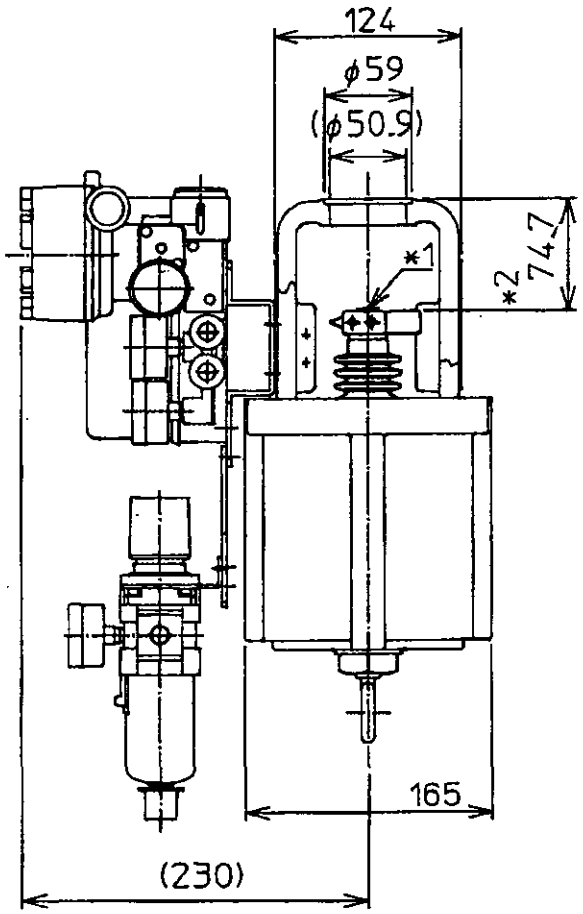
	- -		DR. Kato	SECT. ENG	25sq(2.00SPUD)ACTUATOR MOUNTING ORIENTATION
	- -		CH. K. Yamagata		
	- -		APP. K. Tasaka	1998-10-19	NO. CD-LN025-041 PAGE OF
	- -				
MICRO	- -				

ε A4 2/7

VKV

UNIT : mm
( ) : APPROX.





*1 : 1/2-20UNF(Female) 1.0 Full Treads
*2 : Actuator stem shown in extended position

ACTUATOR SIZE : 25sq.in.(2.00SPUD)
STROKE : 1 INCH
AIR FAIL : STEM RETRACT
SIGNAL INCREASED : STEM EXTEND

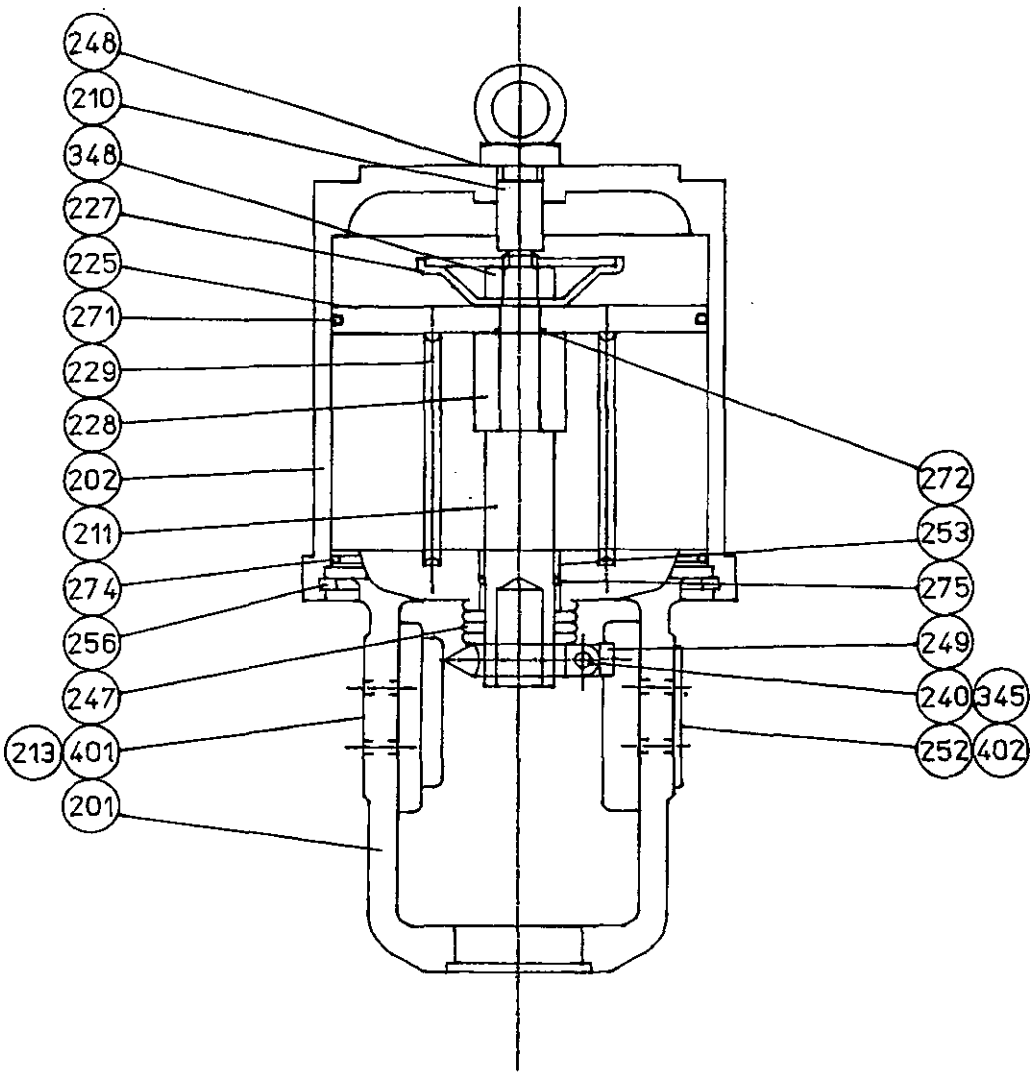
DR. H.Saito	SECT. ENG	25sq(2.00SPUD) ACTUATOR MOUNTING DRAWING	
CH. K.Yamagata			
APP. K.Yamada	1998-10-2	NO. CD-LN025-039	PAGE OF

SIZE A4
MICRO

YKV

Form YKV 10A-3

LN-C1002E-00



			DR. S. Ushida	SECT. ENG.	BILL OF MATERIAL AFO, S/SPRING
			CH. S. Ushida		NO.
			APP.	1997-6-13	PAGE OF
MICRO					

SIZE A4

4/7

Yokogawa Kitz Valtek

Form YKV 10A-3

	L25ASNXX 4A00T300

ITEM	DESCRIPTION	QTY	PART NUMBER	MATERIAL
201	YOKE	1	17665.300.040	DUCTILE IRON FCD-S
202	CYLINDER	1	16681.609.008	CAST ALUMINUM AC4C
210	ADJUSTING SCREW 1.0"	1	01285.029.002	CARBON STEEL SS400
211	ACTUATOR STEM(1/2-20)	1	01134.159.000	STAINLESS STEEL SUS403
213	STROKE PLATE 1.0"	1	01251.151.000	STAINLESS STEEL SUS304
225	PISTON	1	01004.601.003	ALUMINUM A6061
227	SPRING BUTTON	1	03860.029.176	CARBON STEEL SPCD
228	STEM SPACER	1	01009.604.000	ALUMINUM A5056
229	SPRING	1	15264.999.000	SPRING STEEL SUP6
240	STEM CLAMP BOLT(3/8-16)	1	02491.010.002	CARBON STEEL SS400
247	STEM BELLOWS	1	15498.652.000	RUBBER, NEOPRENE
248	ADJUST SCREW GASKET	1	01501.655.000	RUBBER, NEOPRENE
249	STEM CLAMP	1	CA11.C101.70	STAINLESS STEEL SCS13
	WITH TAKEOFF ARM	1		STAINLESS STEEL SUS304
252	NAME PLATE	1		STAINLESS STEEL SUS304
253	ACTUATOR STEM BUSHING	2	17665.431.000	BRONZE, OILITE
256	CYLINDER RETAINING RING	1	16680.029.014	CARBON STEEL SS400
270	O-RING SET	1	C841.1101.10	RUBBER BUNA N
271	PISTON O-RING	1	01114.650.000	
272	PISTON STEM O-RING	1	01112.650.000	
274	YOKE O-RING	1	01114.650.000	
275	ACTUATOR STEM O-RING	1	01113.650.000	
345	STEM CLAMP LOCKNUT(3/8)	1	03834.013.002	CARBON STEEL SS400
348	ACTUATOR STEM LOCKNUT	1	01120.013.002	CARBON STEEL SS400
401	STROKE PLATE SCREW	2	01118.012.002	CARBON STEEL, SWCH12
402	NAME PLATE SCREW	2	07516.195.000	STAINLESS STEEL SUS304

3	- -		DR. S.Ushirib	SECT. ENG	25 ACTUATOR SUB ASS'Y BILL OF MATERIAL 2.00SPUD. S/SPRING. 1.0" ST. 1/2-20
2	- -		CH. S.Ushirib		
1	- -		AP. O.Asai	1997-06-13	

YKV

1/9

DWG. NO. Ⓐ AW3000-(N)02-03(B)G(-N,R)-X490-YA

ORDER SPECIFICATION CODE

AW3000- [ ] [ ] [ ] [G] - [ ] -X490- [YA]

THREAD TYPE	
※	Rc
N	NPT

PORT SIZE	
02	1/4
03	3/8

ACCESSORY	
B	BRACKET
G	PRESSURE GAUGE

OPTIONS	
※	————
N	NON-RELIEVING
R	FLOW DIRECTION:RIGHT TO LEFT

ACCESSORY	
YA	MPa,kgf/cm² PRESSURE GAUGE

THE ※ MARK INDICATES NIL, AND NEED NOT TO BE FILLD IN.

WHEN SPECIFYING MORE THAN ONE OPTION, PLEASE LIST THEN ALPHABETICALLY.

COMBINATION OF ACCESSORY: G, BG

COMBINATION OF OPTIONS: ※, N, R, NR

SPECIFICATIONS

PROOF PRESS.	1.5 MPa(15.3 kgf/cm²)	
MAX.WORKING PRESS.	1.0 MPa(10.2 kgf/cm²)	
SET PRESS.	0.05~0.85MPa(0.51~8.7kgf/cm²)	
WORKING FLUID	AIR	
AMBIENT TEMP.AND WORKING FLUID TEMP.	-5~60°C(SHOULD BE NO FREEZING)	
RATED FILTRATION	5 μm	
PORT SIZE	2-A	

SMC CORPORATION TOKYO JAPAN OCT 25 2002 DEVELOPMENT SECTION

CAUTIONS CONCERNING SPECIFICATIONS,ASSEMBLY, AND INSPECTION OF CUSTOM-MADE PRODUCTS

※DIFFERENCE FROM THE STANDARD TYPE, (AW3000-(N)02-03(B)G(-N,R))

1.PARTS IN THE TITLE COLUMN DIFFER FROM STANDARD.

2.MATERIAL OF BONNET AND CASE IS METAL.

3.NO SET NUT WILL BE ATTACHED IF BRACKET IS NOT ATTACHED.

4.PRESSURE GAUGE IS DIFFERENT.(G36-S10-(N)01)

5.CATIONS FOR MANUFACTURING

5-1)THE UNIT OF PRESSURE ON NAME PLATE SHOULD BE DISPLAYD BY "MPa" ONLY.

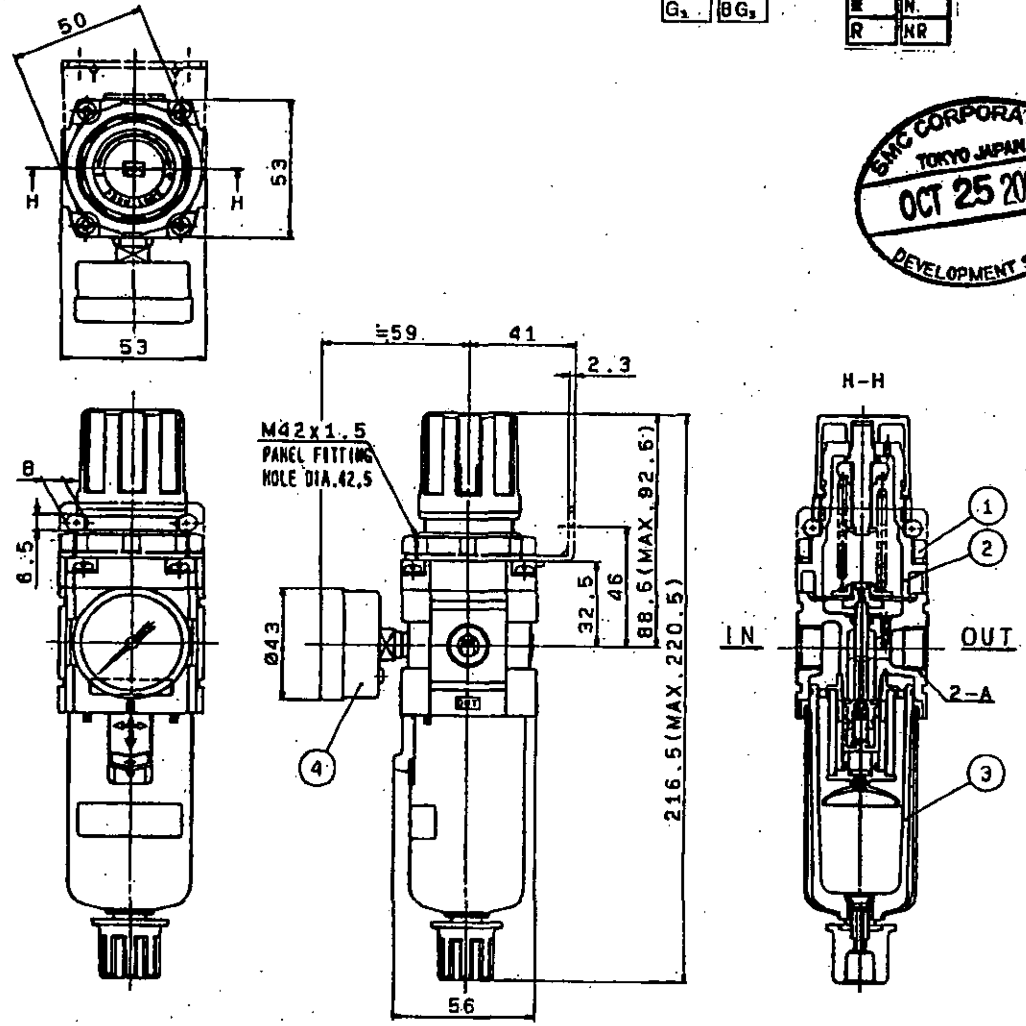


FIG.1.PORT SIZE

DWG.NO.	A	GAUGE PORT SIZE
AW3000-02-03(B)G(-N,R)-X490-YA	Rc1/4~3/8	Rc1/8
AW3000-N02-03(B)G(-N,R)-X490-YA	NPT1/4~3/8	NPT1/8

ITEM	PART NO	PART NAME	MATERIAL	QTY	REMARKS
4	G36-S10-(N)01	PRESSURE GAUGE	————	1	MPa,kgf/cm²
3	C300F-2	BOWL ASSEMBLY	————	1	BOWL MATERIAL: ALUMINIUM DIE CASTING
2	1315521	BONNET	ALUMINIUM DIE CASTING	1	
1	131532	SET NUT	ZINC DIE CASTING	1	

	DESCRIPTION	DATE	REV NO
4	THE UNIT:kgf/cm² IS ADDED, NOTE IS ADDED		

DRAWN / DESIGNED T.SHINTANI DATE OCT.13.'99 / CHECKED K.Akiyama DATE Oct.15.'01 / APPROVED DATE Oct.17.'01

SCALE 1:√2

DRAWING NAME: FILTER REGULATOR

DRAWING NO: Ⓐ AW3000-(N)02-03(B)G(-N,R)-X490-YA

REVISION 2

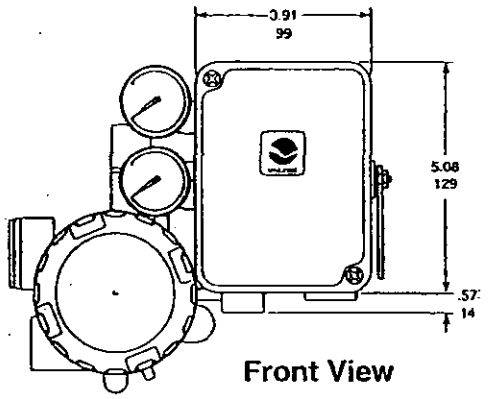
SMC CORPORATION

AW3000-X0795

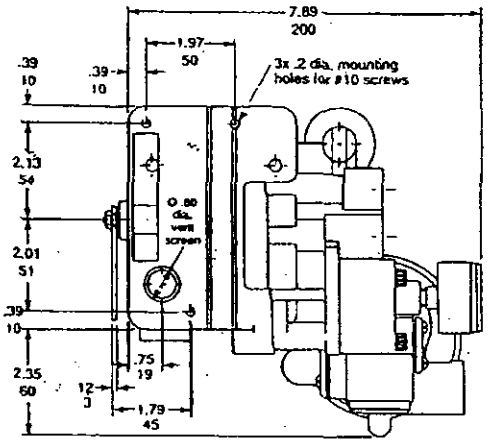
FINISH / PAINT / PACKING / MATERIAL / MATERIAL SIZE

Beta Positioner
Dimensions with Electro-pneumatic (I/P) Module

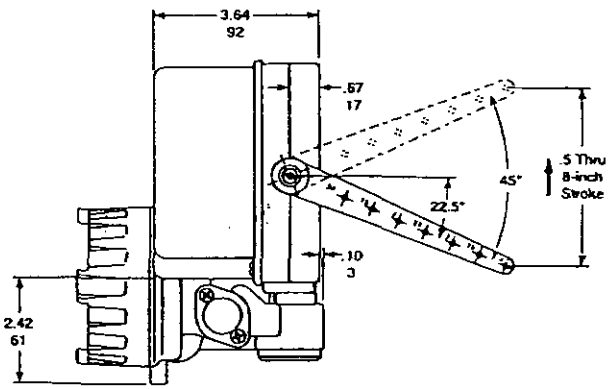
(inches / mm)



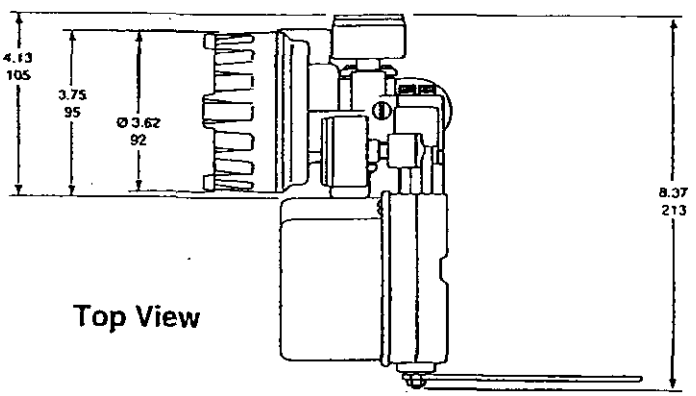
Front View



Back View



Side View



Top View

	- -	DR. M. Tsuchi	SECT.		
	- -	CH.			
	- -	APP. K. Yazawa	1995-2-9	NO. ZDD-A003	PAGE OF
	- -				
MICRO	- -				

SIZE A4

T/T

YKV Yokogawa Kitz Valtek

Form YKV 10A-3

VALTEK INTERNATIONAL

2

Installation, Operation, Maintenance Instructions

Spring Cylinder Linear Actuators

GENERAL INFORMATION

The following instructions are designed to assist in installing, troubleshooting, and servicing Valtek® spring cylinder actuators. Product users and maintenance personnel should thoroughly review this bulletin prior to installing, operating, or disassembling the actuator. Separate installation, operation, maintenance instructions cover additional features (such as handwheels, limit stops, fail-safe systems, limit switches, etc.).

This publication does not contain information on Valtek positioners. Refer to the appropriate installation operation and maintenance instructions for installing, maintaining, troubleshooting, calibrating, and operating Valtek positioners.

To avoid possible injury to personnel or damage to valve parts, WARNING and CAUTION notes must be strictly adhered to. Modifying this product, substituting non-factory or inferior parts, or using maintenance procedures other than outlined could drastically affect performance, void product warranties and be hazardous to personnel and equipment.

WARNING: Standard industry safety practices must be adhered to when working on this, or any process control product. Specifically, personal protective and lifting devices must be used as warranted.

Spare Parts

Valtek International recommends quality, factory-built parts be used when servicing Valtek valves. In the USA phone 1 800 99 Spare for the spare parts information.

Unpacking

While unpacking the actuator, check the packing list against the materials received. Lists describing the actuator and accessories are included in each shipping container.

1. When lifting the actuator from the shipping container, position the lifting straps and hoist to avoid damage to the tubing and mounted accessories. Actuators provided with a lifting ring can be lifted by that ring. On larger actuators (size 300 and larger), do not attach a lifting ring; instead, use lifting straps through the yoke legs.

   WARNING: When lifting an actuator with lifting straps through the yoke legs, be aware that the center of gravity may be above the lifting point. Therefore, support must be given to prevent the actuator from rotating. Failure to do so can cause serious injury to personnel or damage to nearby equipment.

2. In the event of shipping damage, contact your shipper immediately.
3. Should any problem arise, contact your Valtek representative.

Installation

Prior to installation, make sure adequate overhead clearance for the actuator is provided to allow for proper removal from the valve body and for proper maintenance. Refer to Table 1:

NOTE: If the actuator is attached to a valve body assembly, see Instalation, Operation, Maintenance Instructions 1 for overhead clearances.

Table 1:
Overhead Clearance for Disassembly

Actuator Size	Minimum Clearance
25	6 inches (152 mm)
50	8 inches (203 mm)
100,200,300 400,500,600	9 inches (229 mm)

1. Connect the air supply and instrument signal air lines to the two appropriately marked connections on the positioner. Since both the cylinder and positioner are suitable for 150 psi (10.3 Bar) air supply, an air regulator should not be used unless the supply exceeds 150 psi (10.3 Bar).

   NOTE: In some cases, the air supply must be limited to 100 psi (6.9 Bar) rather than 150 psi (10.3 Bar); a sticker found near the upper air port on the cylinder will indicate this.

   WARNING: Do not exceed recommended supply pressure. Injury to personnel or damage to *equipment can result.*

2. Installation of an air filter on the supply line is recommended.
3. Using a soap solution, make sure all air connections are free of leaks.

MAINTENANCE

At least once every six months, check for proper operation by following the preventative maintenance steps outlined below. These steps can be performed while the actuator is in service and, in some cases, without interrupting service. If an internal problem is suspected with the actuator, refer to the "Disassembly and Reassembly" section.

1. Examine the actuator for damage caused by corrosive fumes and process drippings.
2. Clean the actuator and repaint any areas of severe oxidation.
3. If possible, stroke actuator and check for smooth, full-stroke operation.

   WARNING: Keep hands, hair, clothing, etc. away from all moving parts while operating the actuator. Failure to do so can cause serious injury.

4. Make sure positioner mounting bolts, linkage and stem clamp are securely fastened.
5. Insure all accessories, brackets and associated bolting are securely fastened.
6. If possible, remove air supply and observe actuator for correct fail-safe action.
7. Check rubber bellows for wear.
8. Spray soap solution around the cylinder retaining ring, the adjusting screw and the lower actuator stem bushing to check for air leaks through the O-rings and gasket.
9. Clean any dirt or foreign material from the actuator stem.
10. If an air filter is supplied, check and replace cartridge as necessary.

DISASSEMBLY AND REASSEMBLY

Disassembling the Actuator

To disassemble the cylinder actuator, refer to Figures 1 thru 5:

1. Shut off air supply. If actuator is installed on a Valtek valve remove it per Installation, Operation, Maintenance Instructions 1.

   WARNING: Depressurize the line to atmospheric pressure and drain all fluids before working on the actuator. Failure to do so can cause serious injury.

2. Disconnect all tubing. Remove stem clamp and stem bellows from the actuator stem.
3. Relieve spring compression completely by removing the adjusting screw. Remove adjusting screw gasket from adjusting screw.

   CAUTION: Do not use a screwdriver, bar, etc. to turn the adjusting screw; instead, use a wrench on the flats of the screw.

   WARNING: Spring compression must be relieved before further disassembly. If not relieved, the cylinder could fly off the yoke when removing the cylinder retaining ring, causing serious personal injury.

4. Remove the cylinder retaining ring from the groove at the base of the cylinder by using two screwdrivers. Insert one screwdriver in slot found in the ring and pry the ring from the groove. Use the other screwdriver to help work the ring out of the cylinder groove.
5. Pull the cylinder off the yoke and piston. Some O-ring resistance may be felt.

   WARNING: Do not use air pressure to remove the cylinder. This could cause the cylinder to fly off the yoke which can result in serious personal injury.

6. For heavy-duty spring designs using a spring cap (see Figure 4), remove the spring cap and cap O-ring from the cylinder.
7. For air-to-retract configurations, remove the spring(s) and spring button for cleaning and inspection (see Figures 1, 3 and 5). Remove the actuator

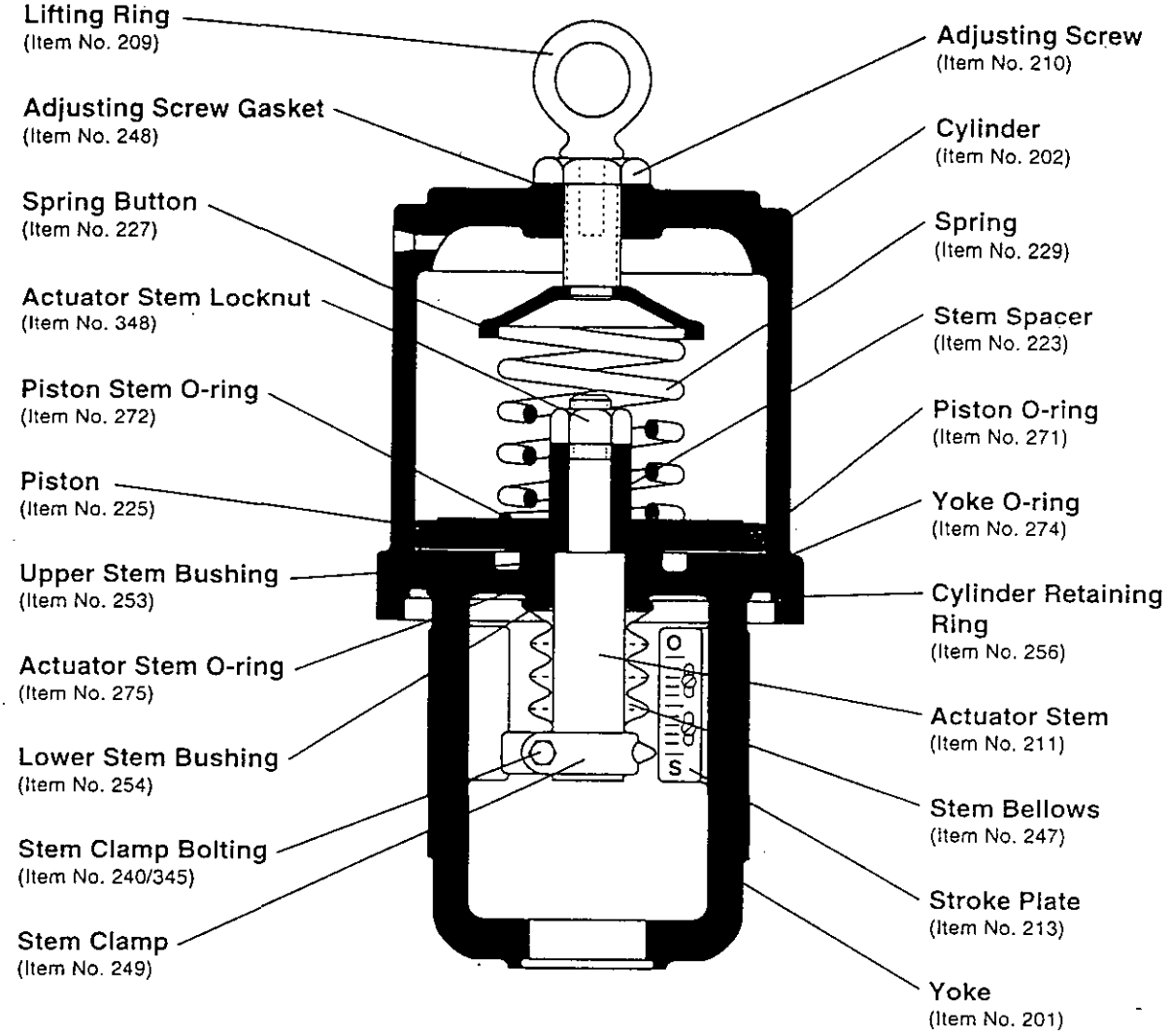


Figure 1: Air-to-retract Cylinder Actuator

NOTE: Item numbers correspond directly to actuator's bill of material. Refer to it for specific part numbers.

stem locknut and slide the piston and stem spacer off the actuator stem. With heavy-duty spring designs, the spring guide should also be removed.

NOTE: The dual, heavy-duty spring configuration (Figure 3) has two springs, one inside the other. Remove both springs during this step.

For air-to-extend configurations, slowly loosen and remove the actuator stem locknut being certain the piston follows stem locknut up the actuator stem and does not bind on the actuator stem. Remove the actuator stem locknut, spring button, piston, spring and stem spacer.

WARNING: Be certain the spring force is completely relieved before removing actuator stem locknut; otherwise, personal injury may occur.

8. Remove the piston O-ring, piston stem O-ring and yoke O-ring.
9. Remove the actuator stem O-ring.
   NOTE: The upper and lower stem bushings are pressed into the yoke. It is not necessary to remove the bushings to replace the actuator stem O-ring.
10. If stem bushings are worn or damaged, use an appropriately sized press to push the bushings out of the yoke.

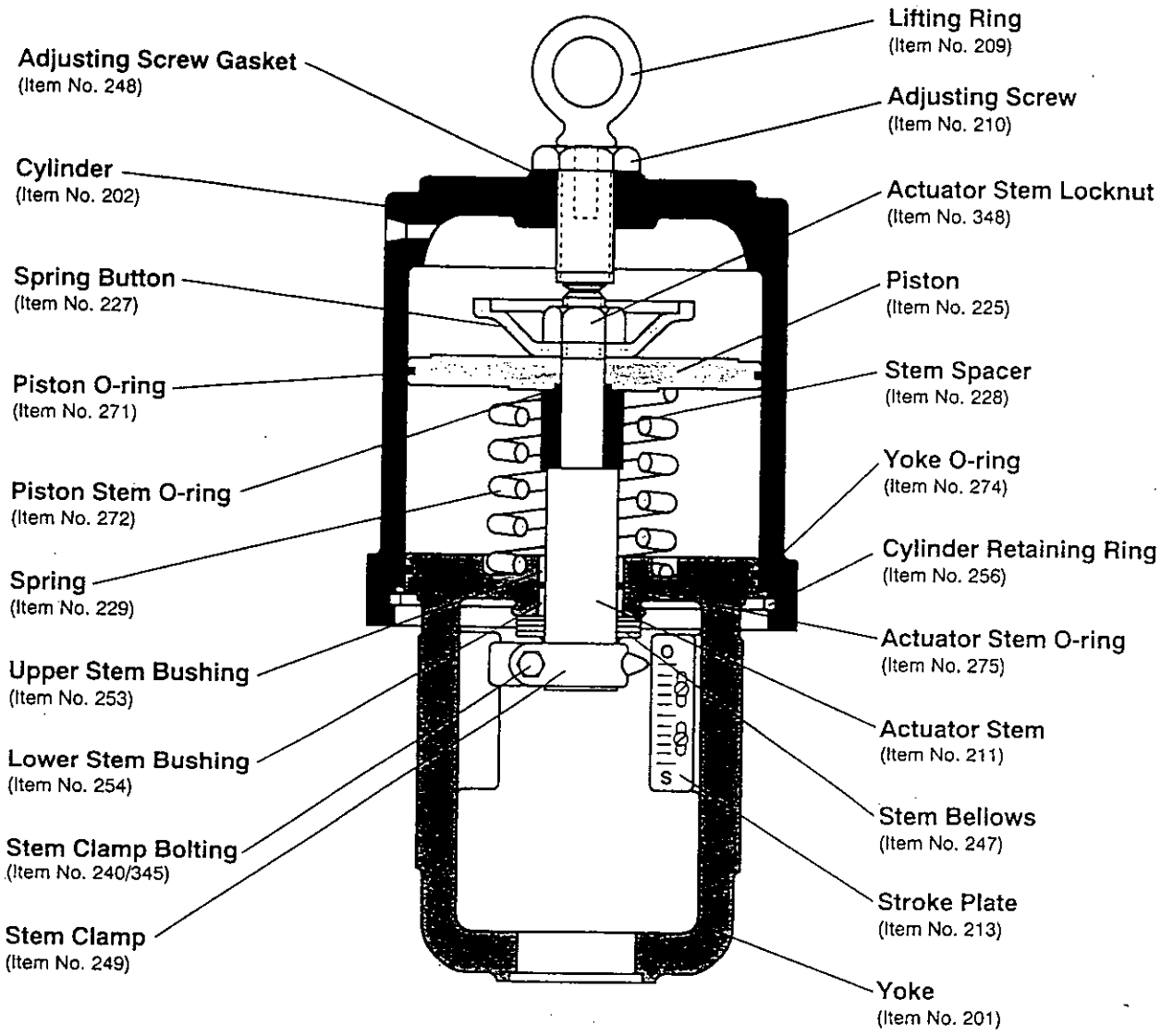


Figure 2: Air-to-extend Cylinder Actuator

NOTE: Item numbers correspond directly to actuator's bill of material. Refer to it for specific part numbers.

Reassembling the Actuator

To reassemble the cylinder actuator, refer to Figures 1 thru 5:

1. All O-rings should be replaced and the new ones lubricated. Most O-rings should be lubricated with a silicone lubricant (Dow Corning 55M or equivalent). (Silicone O-rings must be lubricated with Magnalube-G lubricant or equivalent. Do not use a silicone lubricant on silicone O-rings.)
2. Make sure all internal parts are thoroughly cleaned before beginning assembly. Lubricate cylinder wall with the silicone lubricant.
3. If the stem bushings have been removed, lubricate the outside of the replacement bushings. Press a new lower stem bushing into the actuator stem bore in the yoke until it bottoms out. Press the upper stem bushing into the bore until it is flush with the top of the yoke (refer to Figures 1 or 2).
4. Replace the actuator stem O-ring and yoke O-ring.
5. Reassemble the piston, piston stem O-ring, and stem spacer on the actuator stem according to the proper air-action (refer to either Figure 1 or 2). Replace the piston O-ring. Air-to-extend configurations require the spring button to be stored under the actuator stem locknut. Tighten the locknut firmly.

   NOTE: *With heavy-duty spring designs, the spring guide must be first inserted under the actuator stem locknut (see Figures 3 and 4).*

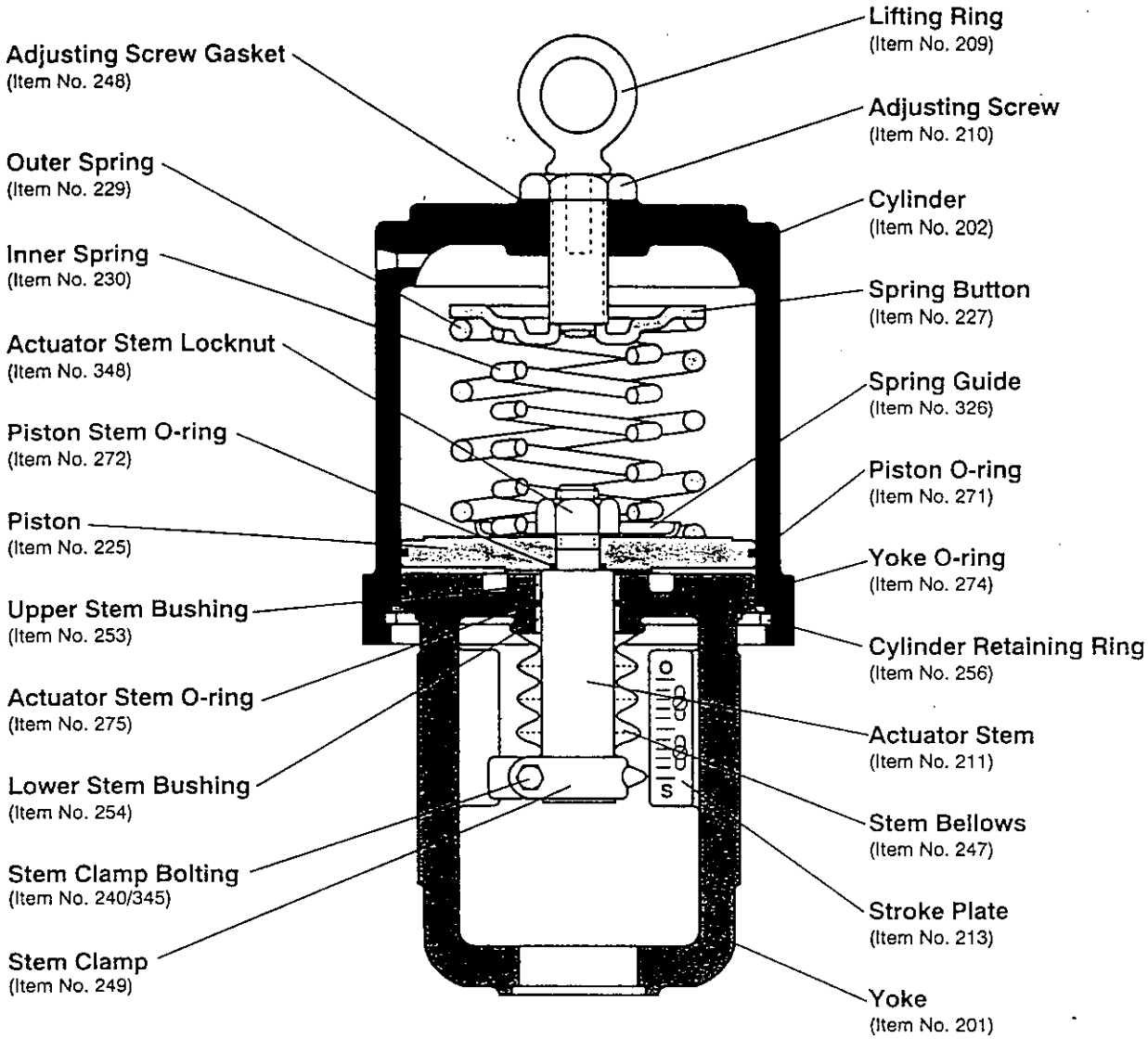


Figure 3: Dual-spring Cylinder Actuator

NOTE: Item numbers correspond directly to actuator's bill of material. Refer to it for specific part numbers.

6. For air-to-extend configurations, place the spring under the piston and insert the actuator stem through the yoke, being careful not to pinch the actuator stem O-ring or gall the stem and stem bushings. For air-to-retract configurations, insert the actuator stem through the yoke and place the spring(s) and spring button above the piston.

7. For heavy-duty spring designs using spring caps, replace the cap O-ring and install the spring cap in the cylinder (see Figure 4).

8. Install the cylinder, making sure the yoke is pushed deeply enough into the cylinder to allow the cylinder retaining ring to be installed. Care should be taken not to scar or cut the piston and yoke O-rings.

9. Reinsert the cylinder retaining ring by feeding it in a little at a time until it snaps in place. Using a hammer and drift punch, tap the retaining ring lightly in the groove to insure it is properly seated.

   WARNING: Cylinder retaining ring must be solidly in place or cylinder may fly off when pressurized, causing personal injury. Be careful not to pinch or cut fingers on the square edges of the retaining ring during installation.

10. Using a new adjusting screw gasket, reinstall the adjusting screw.

    NOTE: On air-to-retract configurations, make sure the hole in the spring button is directly centered under the adjusting screw hole in the cylinder.

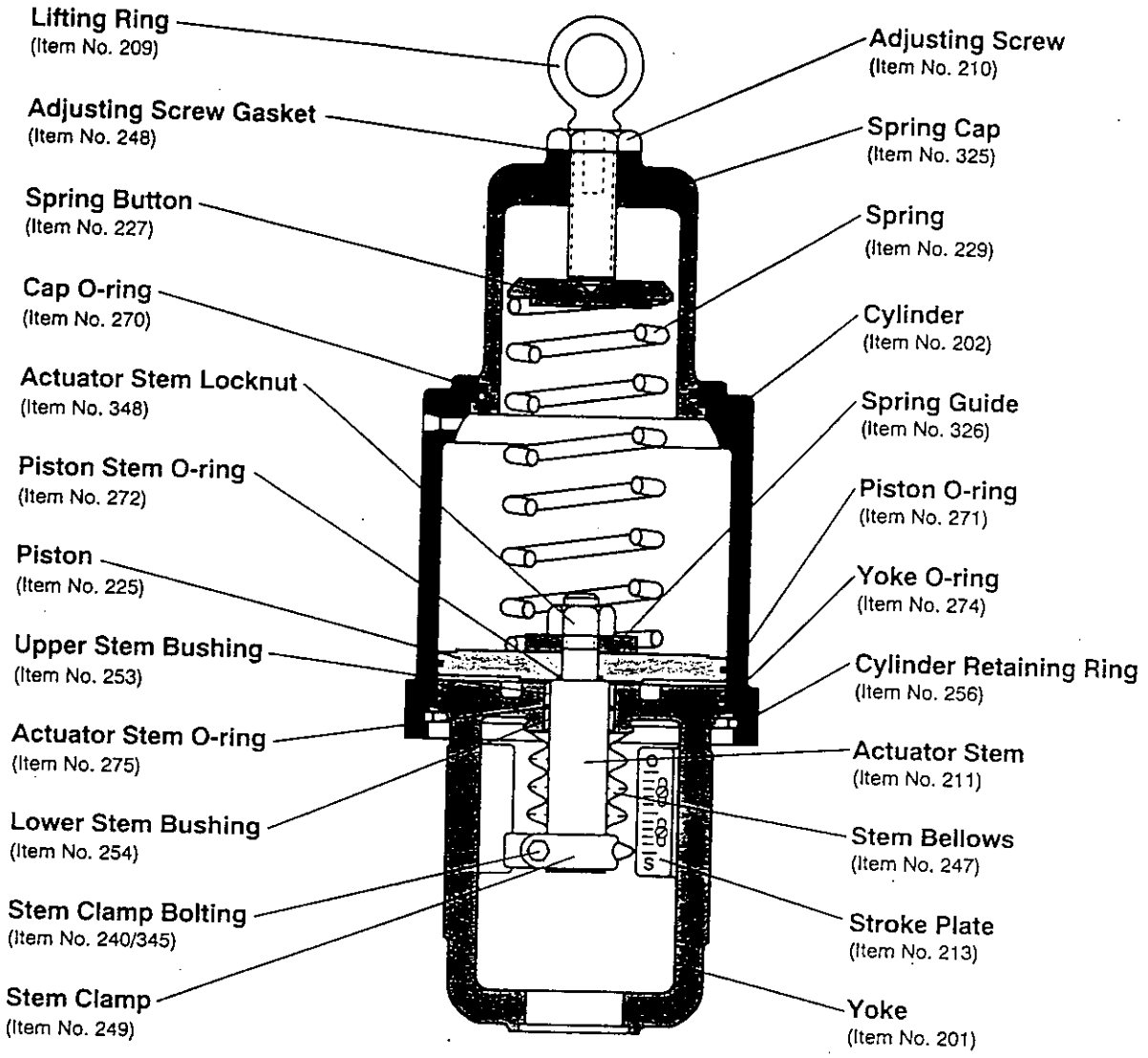


Figure 4: Cap-spring Cylinder Actuator

NOTE: Item numbers correspond directly to actuator's bill of material. Refer to it for specific part numbers.

11. Tighten the adjusting screw only enough to provide an air seal with the gasket. Do not overtighten.
12. Reinstall the stem bellows and stem clamp.

    NOTE: When installing the stem clamp, make sure the stem clamp bolting is perpendicular to one of the slots machined into the actuator stem. This assures maximum clamping strength.
13. Apply air over the piston. With the stem clamp adjusted to point at the "closed" position of the stroke indicator plate, tighten the stem clamp bolting.

    NOTE: If the actuator is installed on a Valtek valve, refer to the Maintenance Instructions 1 for correct plug stem thread engagement.
14. Reconnect tubing, supply and signal lines.

Reversing the Air-action

To change the air action from air-to-retract to air-to extend, or vice versa, refer to Figures 1, 2 or 5:

NOTE: Heavy-duty spring actuators are not reversible.

1. Disassemble the actuator according to the "Disassembling the Actuator" section.
2. For air-to-retract action, Reassemble the actuator with the stem spacer and spring button over the piston.
3. For air-to-extend action, reassemble with spring and stem spacer below the piston and with the spring button stored above the piston.
4. Reassemble the actuator according to the "Reassembling the Actuator" section.
5. The positioner must also be reversed. See the appropriate positioner maintenance instructions.

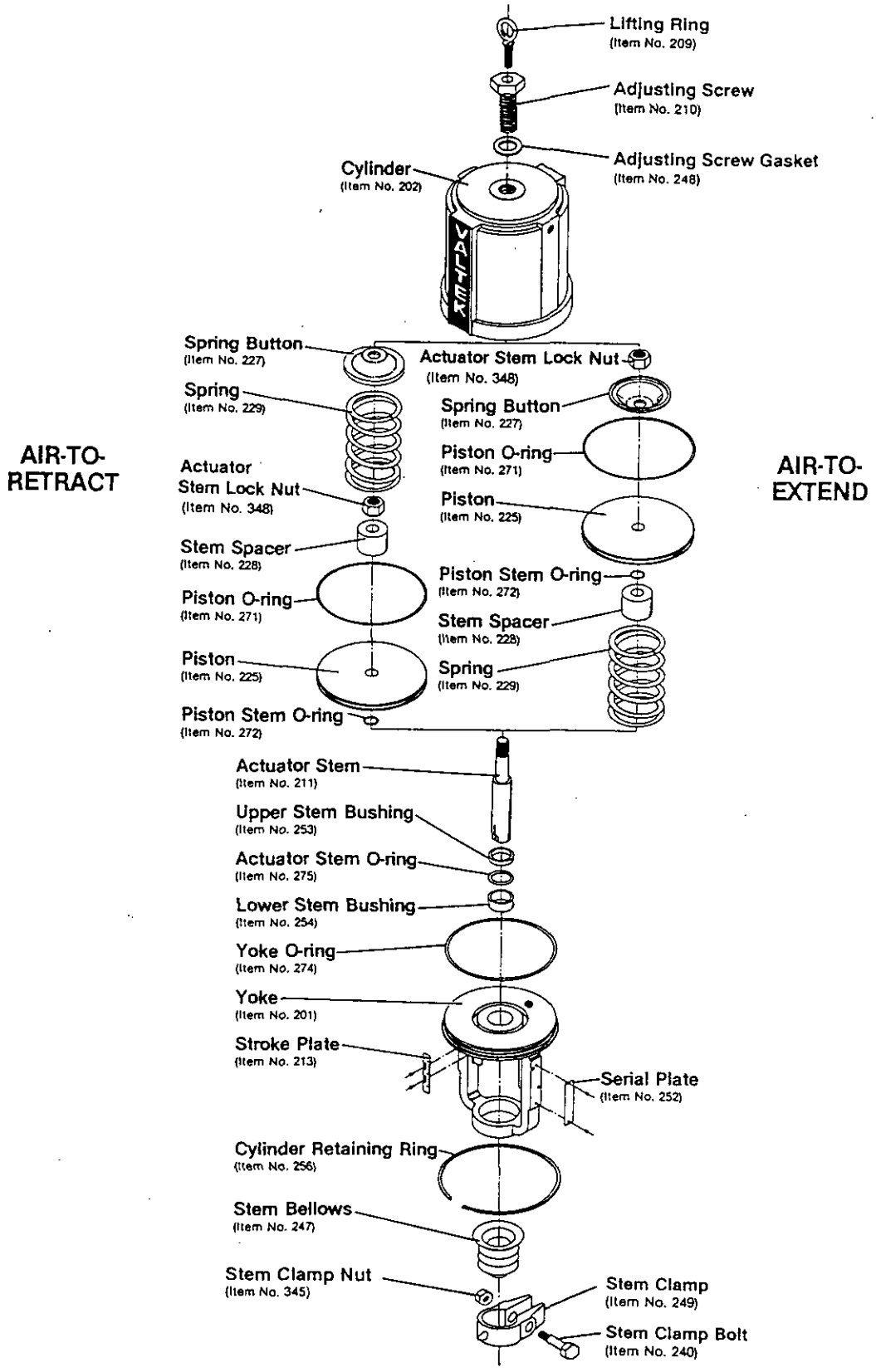


Figure 5: Exploded View, Spring Cylinder Actuator

NOTE: Item numbers correspond directly to actuator's bill of material. Refer to it for specific part numbers.

Troubleshooting

Problem	Probable Cause	Corrective Action
High air consumption or leakage	1. Leaks in the air supply or instrument signal system	1. Tighten connections and replace any leaking lines
	2. Malfunctioning positioner	2. Refer to appropriate positioner maintenance bulletin
	3. Leaks through O-rings or adjusting screw gasket	3. Replace O-rings or gasket
Actuator does not move to fail position upon loss of air supply pressure	1. Air pressure in cylinder not venting because of faulty positioner	1. Refer to appropriate positioner maintenance bulletin
	2. Spring failure	2. Replace spring
	3. Internal valve problem	3. Refer to valve's maintenance bulletin
Jerky or sticking stem travel	1. Insufficient air supply pressure	1. Check air supply and any filters or regulators; check for leaking O-rings
	2. Unlubricated cylinder wall	2. Lubricate cylinder wall with silicone lubricant
	3. Worn or damaged stem bushings	3. Check actuator stem for damage; replace actuator stem, O-ring, and stem bushings, if necessary
	4. Improperly assembled spring	4. Disassemble actuator and check cylinder and piston for damage; reassemble actuator correctly
	5. Internal valve problem	5. Refer to valve's maintenance instructions

Valtek is dedicated to providing accurate, detailed and current installation, operation and maintenance instructions to the users of its products. If incorrect, unclear, or incomplete material is discovered, please contact Valtek Corporate Communication, Box 2200, Springville, Utah 84663-0903; Phone 801 489 8611; Fax 801 489 3719.

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VALTEK INTERNATIONAL

24

Installation, Operation, Maintenance Instructions

Beta Positioner

General Information

This bulletin contains instructions for installing, calibrating, troubleshooting, and performing maintenance as required for the Valtek® Beta Positioner mounted on control valves.

Specific instructions are also given for the Valtek IP 2000 series module. This module has been distributed since August 1992 and is characterized by a 3½-inch diameter base, a pressure gauge and the words "Valtek Incorporated" printed on the inside circuit board.

Instructions for maintaining and calibrating the I/P module distributed prior to mid-1992, and characterized with a 2½-inch base and grey or white electronic box inside, are contained in Installation, Operation, Maintenance Instructions 24a.

Product users and maintenance personnel should read thoroughly and follow exactly the instructions contained in this bulletin prior to operation of the positioner. If there is any question concerning this bulletin, call your Valtek representative.

To avoid possible injury to personnel or damage to equipment, WARNING and CAUTION notes must be strictly adhered to. Modifying this product, substituting non-factory or inferior parts, or using maintenance procedures other than outlined could drastically affect performance, be hazardous to personnel and equipment, and may void existing warranties.

NOTE: *Numbers in parenthesis correspond to the part item numbers in Figures 16 or 17.*

Rev. 12/93 Valtek No. 49035

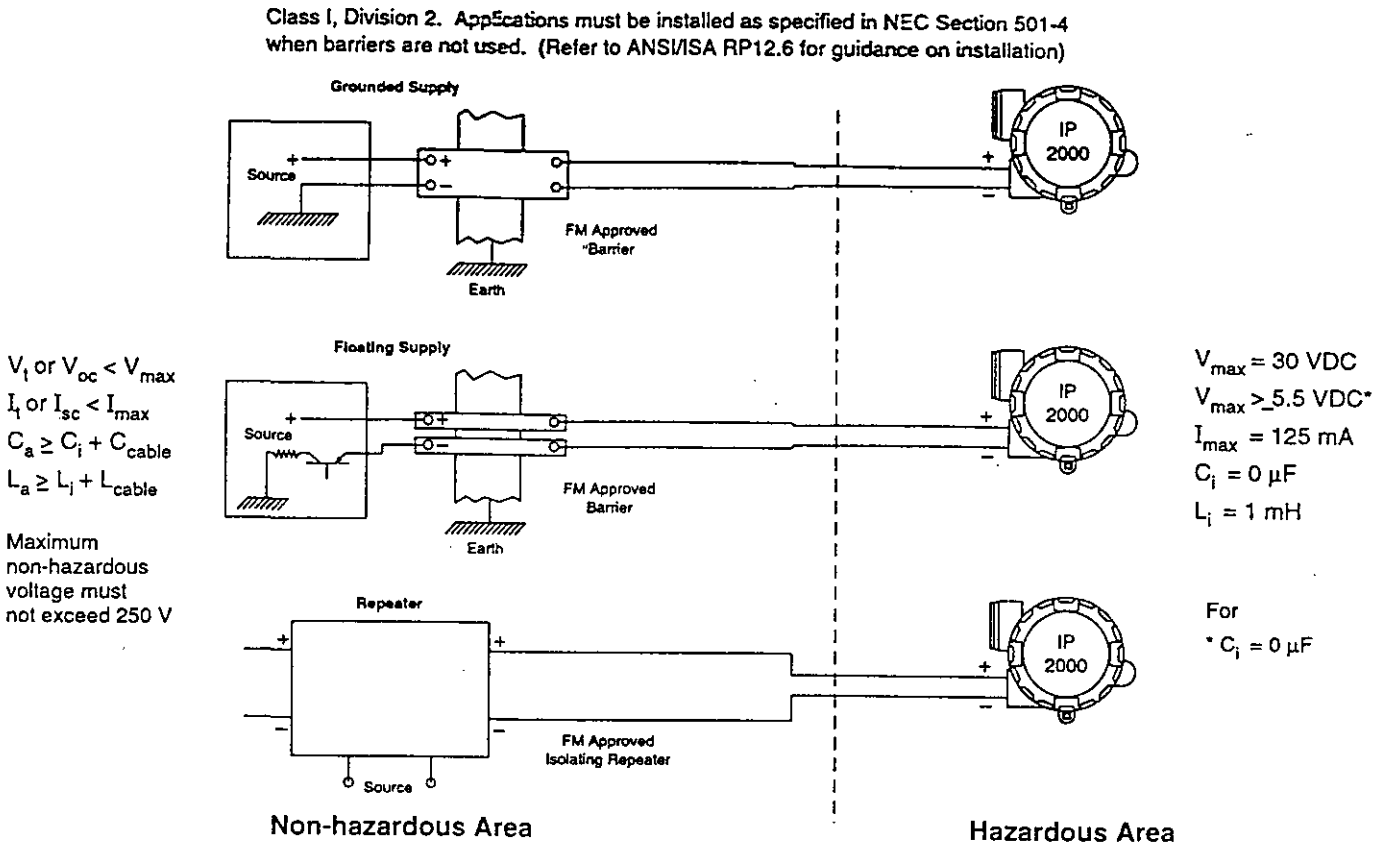

Figure 1: Intrinsically Safe Installation Schematic

Beta Positioner Overview

The Valtek Beta Positioner is available with either a pneumatic (P/P) module for air control signals or an electro-pneumatic (I/P) module for milliampere electrical control signals. It is double-acting, capable of supplying air to either side of the actuator piston while exhausting the other side to the atmosphere. The unit is adjustable to two and three-way split range without special feedback springs. Because of its interchangeability with the Beta pneumatic, system 80 pneumatic and electro-pneumatic positioners, the Beta Positioner can be mounted on either Valtek linear or rotary actuators without modification to the actuator.

The Beta Positioner with I/P module is intrinsically safe for class I, division I, groups A, B, C, and D; class II, groups E, F, and G, when installed with the appropriate energy limiting safety barriers. See Figure 1. It is also explosion proof in class I, division I, groups B, C, and D; class II, groups E, F, and G. Ratings are certified by Factory Mutual and the Canadian Standard Association. Since the positioner is insensitive to supply pressure changes and can handle supply pressures from 30 to 150 psi a supply regulator is usually not required; however, an air filter is highly recommended.

NOTE: The air supply should conform to ISA Standard S7.3 (a dew point at least 18°F below ambient temperature, particle size below 5 microns, oil content not to exceed 1 part per million).

Positioner Operation

The Beta Positioner is a force-balanced instrument. Figure 2 shows a Beta Positioner, with either a pneumatic or electro-pneumatic (I/P) module, installed on a double-acting actuator for air-to-open action. Positioning is based on a balance of two forces; one proportional to the instrument signal and the other proportional to the stem position.

With the I/P model, the current signal is first converted to a 3-15 psi air signal. For the pneumatic model, the 3-15 psi signal is passed directly into the positioner. The pressure signal acts upon the diaphragms in the instrument signal capsule creating a downward force. The motion of the actuator stem is transmitted to the top end of the feedback spring through the follower arm and cams. As a result, tension in the feedback spring will vary as the stem position changes.

When these opposing forces balance exactly, the system will be in equilibrium and the stem will be in the position called for by the instrument signal. If these opposing forces are not in balance, the balance beam will move up

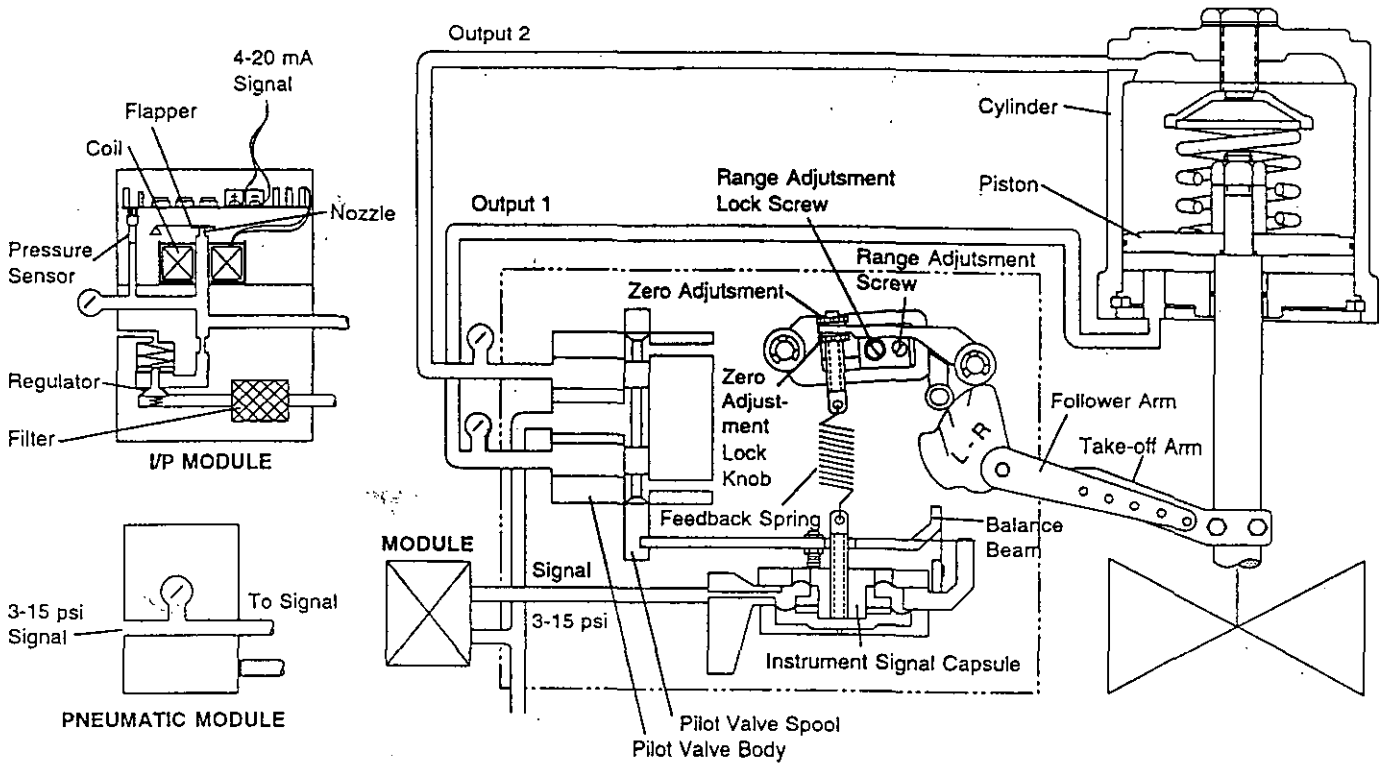

Figure 2: Positioner Schematic for Air-to-Open (Retract)

(or down) and, by means of the spool valve, will change the output pressures and flow rate. This will cause the piston to move until the tension on the feedback spring equalizes with the instrument signal pressure.

The detailed sequence of positioner operations are as follows: An increase in the instrument signal forces the instrument signal capsule and balance beam downward. This motion of the balance beam also pulls the pilot valve spool downward from its equilibrium position. This opens the pilot valve ports, supplying air to port 1 and exhausting air from port 2. This causes the actuator piston to move upward.

This upward motion of the piston is transmitted back to the positioner through the feedback linkage and cam resulting in the spring being stretched proportionally to the valve position. The piston continues to stroke upward *until the force in the feedback spring increases sufficiently* to counter the force generated by the instrument signal capsule. At this point, the balance beam and spool begin to return to their equilibrium position. As the valve spool ports start to close, the air flow rate to the actuator is decreased.

After the piston has reached the required position, the feedback spring tension force will equal the force generated in the instrument signal capsule. The balance beam and instrument signal capsule will remain in their equilibrium positions with no air flowing to the actuator until a change in the instrument signal is made.

A decrease in the instrument signal reverses the described actions causing a proportional downward movement of the actuator piston and stem.

I/P Module Operation

The I/P module receives a 30-150 psi air supply pressure from the Beta positioner and converts it to a 3-15 psi output signal. This signal is proportional to a 4-20 mA input signal or a 10-50 mA input signal depending on the model used.

The supply pressure from the Beta Positioner is filtered as it passes through a field-replaceable, coalescing filter element in the module. Next it passes through an internal pressure regulator that regulates it to approximately 22 psi. The air then goes through an orifice that restricts the *flow and air consumption.*

The air is further controlled to 3-15 psi using a spring-diaphragm flapper that is attracted by an electromagnet to a nozzle. A temperature compensated piezoresistive pressure sensor mounted on a circuit board senses the I/P output pressure. The pressure sensor and circuitry create a feedback loop, which determines how much current to send to the electromagnet for a desired pressure output. The electromagnet in the feedback loop varies the nozzle-flapper spacing, which regulates the I/P output pressure to 3-15 psi proportional to the 4-20 (or 10-50 mA) input signal.

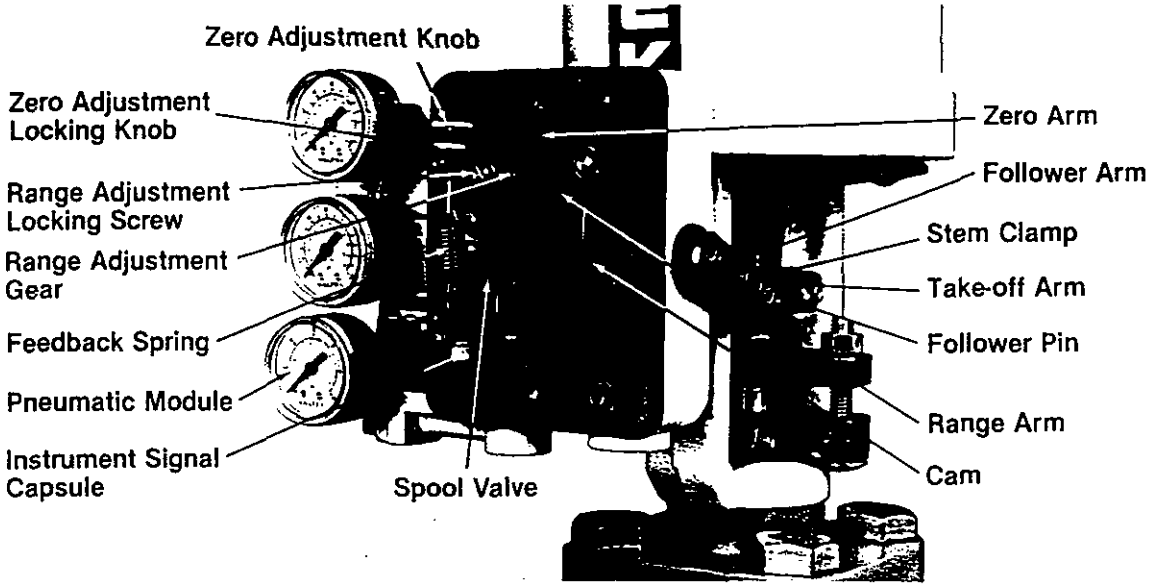

Figure 3: Beta Positioner with Pneumatic Module

Installation

The installation section of this bulletin details how to install the positioner on linear and rotary actuators. Reversing the air action on linear and rotary actuators is also covered along with an explanation of how to convert the positioner from an I/P to pneumatic or pneumatic to I/P control signal.

Installing Positioner on Linear Actuators

Information for installing or retrofitting the Beta Positioner on all sizes of linear actuators follows:

NOTE: *When retrofitting the Beta Positioner to an actuator equipped with a Moore or comparable positioner, remove the existing positioner, bracket, stem clamp, and associated bolting. If retrofitting to an actuator equipped with a Valtek Beta pneumatic or system 80 positioner, the same bracket, stem clamp, and bolting can be used.*

1. Place the new stem clamp (if applicable) onto the actuator stem with the boss on the right side as illustrated in Figures 3 and 6.
2. Mount the positioner bracket to the yoke leg which has the stroke indicator plate attached to it and in the correct position as shown in Figure 4.
3. If not welded to the stem clamp, bolt the take-off arm to the stem clamp so that the arm curves upward (toward the cylinder). The holes in the follower arm should line up with the slots in the take-off arm (again refer to Figures 3 or 6).
4. Referring to Figure 5, install the cam, cam shaft and follower arm for the proper air action. For air-to-open action, the cam should be installed with the letters L-R facing toward the cam shaft and the return spring

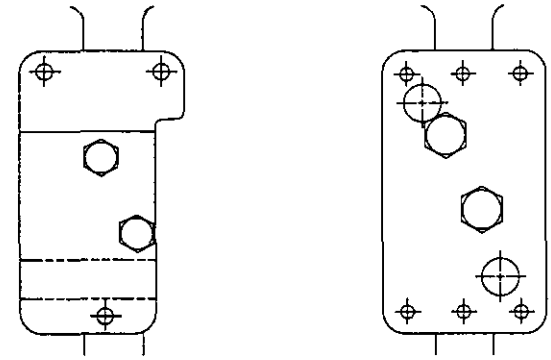

Figure 4: Mounting Bracket

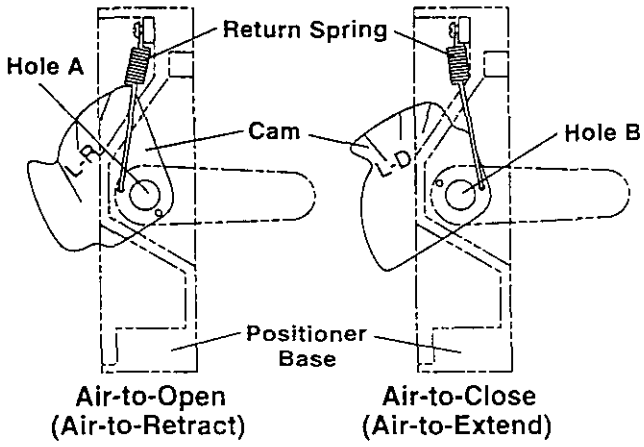

Figure 5: Return Spring / Cam Mounting
(viewed from positioner's right side)

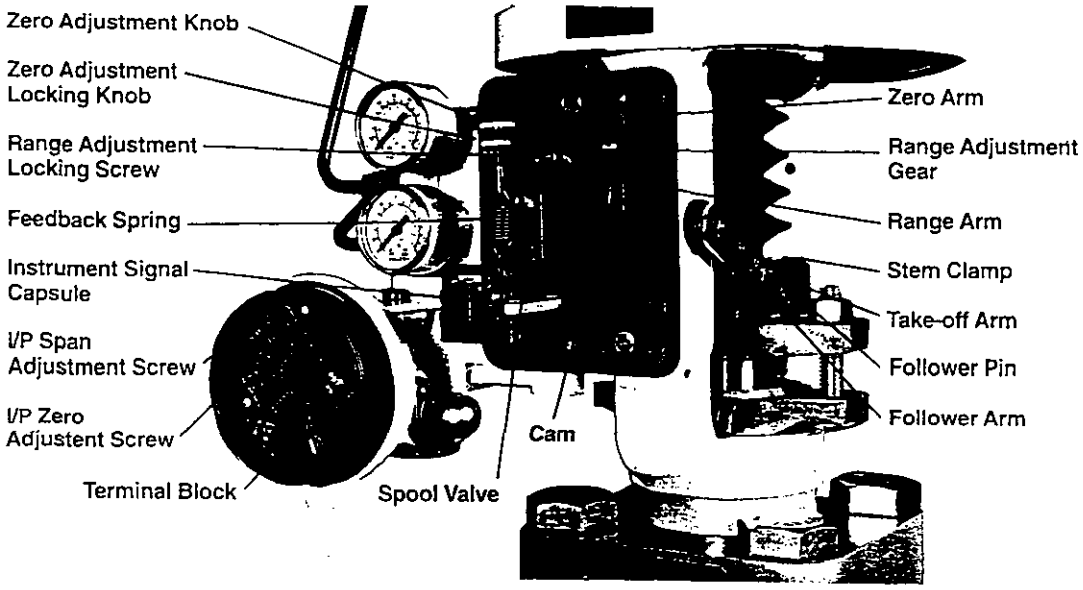

Figure 6: Beta Positioner with I/P Module

should be fed into hole "A." For air-to-close action, the L-D side of the cam should face toward the cam shaft and the return spring should be fed into hole "B."

5. Insert the rubber boot on the outside of the cam shaft. Feed the appropriate stroke follower arm onto the cam shaft boss with the hole markings facing outward. Fasten securely with the lock washer and nut.
6. Mount positioner on bracket. Connect follower arm and take-off arm together with follower pin. Connection must allow free movement of the follower arm.

   CAUTION: Be certain to lubricate the follower pin and take-off arm where contact is made to prevent premature wear. A light industrial grease is recommended. Failure to do so can cause premature wear, resulting in equipment failure and possible personal injury.
7. For air-to-open (air-to-retract) air action, tube "output 1" to the bottom and "output 2" to the top of the cylinder. For air-to-close (air-to-extend) action, tube "output 2" to the bottom and "output 1" to the top of the cylinder.
8. Attach air supply and instrument tubing, using 1/4-inch NPT tubing connections.

   CAUTION: A 3-15 psi instrument signal is recommended on the pneumatic module. High air pressure may damage the module; the module is limited to 30 psi.

Reversing Air Action on Linear Actuators

Reversing the air-action of the positioner is simple. No additional parts are required, although the tubing will need to be rerouted on the linear actuator.

To reverse the air-action on all sizes of linear actuators:

1. Using Installation, Operation, Maintenance Instructions 2, reverse the air-action of the actuator.
2. Disengage the return spring from the cam and remove the cam from the cam shaft.
3. Reverse the cam, return spring, and tubing for the desired air-action by referring to steps 4-8 in the "Installing Positioner on Linear Actuators" section of this bulletin.

Installing Positioner on Rotary Actuators

Proceed as follows when installing the Beta positioner on all sizes of rotary actuators if the cam and follower arm are not already installed, otherwise refer directly to step 7.

1. Remove the feedback spring and rotate the zero adjustment arm out of the way. Remove the snap ring from the range adjustment arm post and remove the range adjustment arm.
2. With the desired cam (see Table 1) and its identification letter facing towards the cam shaft, slide the cam (56) onto the end of the cam shaft having the shorter shoulder (57). (Refer to Table 1 to determine desired cam characteristic). Fasten with the star lock washer (26) and nut (25).
3. Insert the follower arm (58) into the back recess of the positioner with part identification number facing out. Slide the cam shaft through the inner bearing and then slip the flatted hole of the follower arm over the longer stepped shoulder of the cam shaft.
4. Place a small amount of threadlocking compound (Loctite #222 or equivalent) to the threaded portion of the cam shaft nut (59). Slide the cam shaft nut (59) through the outer bearing and screw it onto the cam shaft (57). Tighten the cam shaft together firmly so

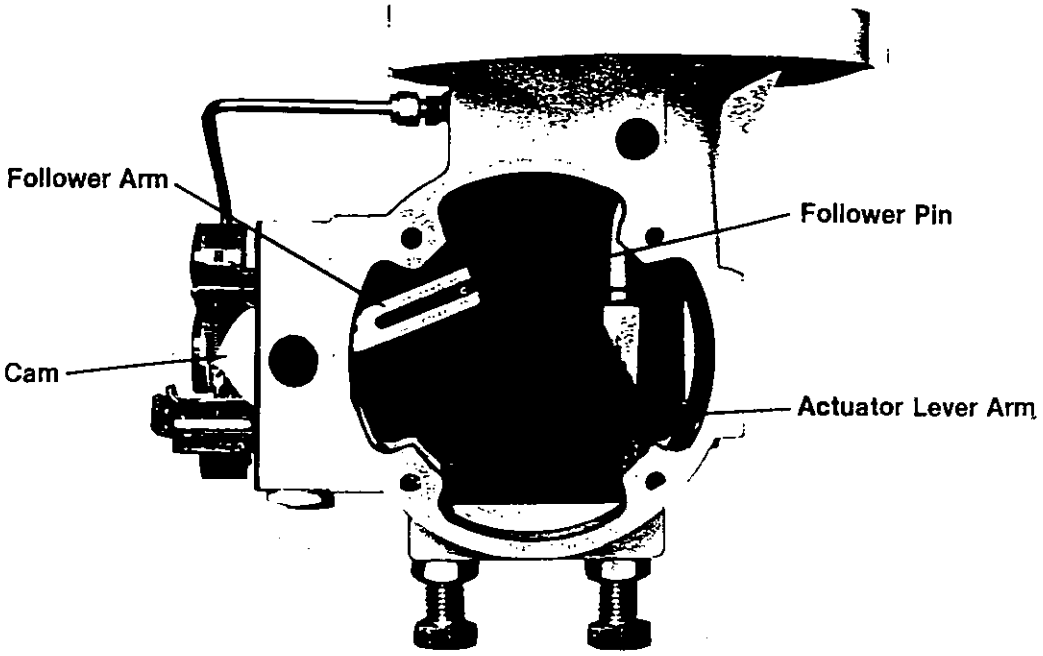

Figure 7: Beta Positioner Installation on Rotary Actuator

that the follower arm (58) is securely clamped. Also, make sure the cam (56) is tightly secured to the cam shaft. Check to be sure there is no slippage. Apply a small amount of grease to the bent end of the return spring (18) and feed it through the hole in the cam. Loop the other end of the return spring over the screw (19) and screw it into the positioner base.

NOTE: *Screw head will not bottom out.*

5. Replace the range adjustment arm (13) and its snap ring (8).
6. Rotate the zero adjustment arm (22) back into place and reinstall the feedback spring (34).

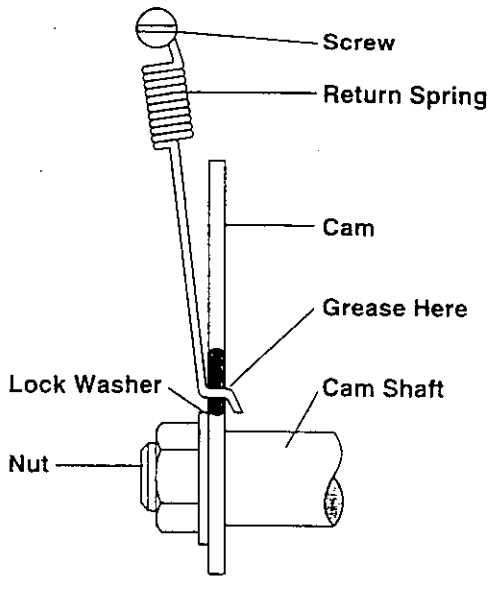

Figure 8: Installation for Cam Return Spring

Table I:
Rotary Actuator Cam Characteristic Chart

Cam No.	Fail Action	Characteristic (1)	
		Equal Percent	Linear
46467	Air-to-Open	B	C
	Air-to-Close	C	B

(1) Letters are the markings stamped on either side of the cam.

7. Insert the follower pin into the hole in the actuator lever arm and drive it firmly into place with a hammer (see Figure 7).
8. Apply grease to the sliding surfaces of the follower arm (58) before mounting the positioner to the transfer case. When mounting the positioner to the transfer case, make sure to guide the follower arm so the pin slides in the slot on the follower arm (see Figure 7). Fasten the positioner to the transfer case with the three mounting screws. Push up on the cam to verify that the pin is riding in the follower arm slot or remove the transfer case cover plate to inspect.

CAUTION: Failure to replace the coverplate before operating the actuator will cause damage to the shaft since the coverplate houses a shaft support bearing.

Depending on the positioner cam side selected, the rotation of the valve shaft may be linear or equal percent when compared to the instrument signal to the positioner. Figures 12 through 15 show the shaft rotation versus instrument signal of a valve (Valdisk or ShearStream). These graphs should be used when visually checking the valve shaft rotation versus positioner signal relationship.

Reversing Air-Action on Rotary Actuators

Reversing the action on rotary actuators is achieved by mounting the yoke to the opposite side of the transfer case. Refer to Installation, Operation, Maintenance Instructions 10, Valdisk Control Valves; Installation, Operation, Maintenance Instructions 27, ShearStream Control Valves for details; or Installation, Operation, Maintenance Instructions 31, Rotary Actuators.

Converting Positioner Input Signal

Converting a Beta positioner's input signal from an I/P to pneumatic or pneumatic to I/P control signal is accomplished by unbolting the existing input signal module and replacing it with the other (either an I/P module or a pneumatic module). The part numbers for these modules are found in the "Ordering Information" section of this bulletin.

Calibration

Procedures for calibrating both rotary and linear actuators are the same.

Valtek positioners mounted on valves are calibrated at the factory; however, due to shipping and handling, it may be necessary to check the calibration before operating the valve. There are three feedback springs available for use in the Beta Positioner, depending on the valve stroke and split range required. The silver spring (standard) is used with standard stroke actuators and provides 1, 2, or 3-way split ranges (3-15, 3-9, 9-15, 3-7, 7-11, or 11-15 psi with the pneumatic module, or ranges of 4-20, 4-12, 12-20, 4-9.3, 9.3-14.6. 14.6-20 mA with the I/P module). A red spring is used with short stroke actuators (1/2-inch on 25 or 50 square-inch actuators, 3/4 and 1-inch strokes on 100 square-inch actuators) and provides 1, 2, or 3-way split ranges. A green spring provides a 4-way split range on standard stroke actuators.

WARNING: When stroking the actuator during calibration, be sure to keep hands, hair, and clothing away from moving parts. Failure to do so can cause serious personal injury.

Calibrating Positioner Zero and Span

For Calibration, refer to Figure 6, and proceed as follows:

1. For standard ranges (3-15 psi, 4-20 mA), loosen the zero adjustment locking knob and adjust the zero adjustment knob until the valve begins to stroke at just over the desired zero point (usually 3 psi pneumatic, 4 mA electrical).
2. Loosen range adjustment locking screw about 1/8 turn.
3. With a screwdriver, turn the range adjusting gear so that the valve is at full stroke at just under the desired maximum range point (usually 15 psi pneumatic, 20 mA electrical).
4. Return to minimum signal (usually 3 psi pneumatic, 4 mA electrical) and check the zero. Repeat steps 1 - 4 if necessary.
5. Tighten the range adjustment locking knob.
6. Tighten the zero adjustment locking knob.

Calibrating I/P Module Zero and Span Settings

Valtek positioners mounted on valves are calibrated at the factory; however, due to shipping and handling, it may be necessary to check the calibration before operating the valve. Normal calibration of the Beta Positioner should be done with the adjustments as described in the "Calibrating Positioner Zero and Span" section of these instructions. The zero and span of the I/P module are set to close tolerances at the factory and normally do not need readjustment.

If required, the I/P module can be recalibrated either while mounted on the Beta Positioner or while mounted on a calibration manifold. Calibration manifolds are available from the factory (part #97370). To calibrate the I/P module zero and span settings, refer to Figure 9 and proceed as follows.

NOTE: *Although calibration can be accomplished using the output pressure gauge on the I/P module, its accuracy is ±3 percent. It is recommended that the standard gauge be removed for calibration and that more accurate calibration equipment of ±0.1 percent of span be used. The pressure gauge port is 1/8-inch NPT.*

1. Connect the I/P module to the 30 to 150 psi supply pressure.
2. Remove the I/P module housing cover.

   WARNING: Be certain power to the I/P module is disconnected before removing the housing cover in explosive atmospheres; otherwise personal injury may occur.
3. Before adjusting the zero and span, be certain the MPC feature is disabled. Refer to step 7 in the "Adjusting the Minimum Pressure Cutoff Feature" section.
4. Connect a current source to the terminal block on the circuit board.

   NOTE: *The zero and span adjustments are multi-turn potentiometers (pots) that have no stops on the ends of their travel; however, they have a slip clutch to prevent damage from over-adjustment. The pots also make a clicking noise when they have reached the limits of their adjustment.*
5. Apply a 4.0 mA signal to the input. Locate and adjust the zero trim pot to achieve a 3.0 psi output. The output will increase with clockwise rotation of the

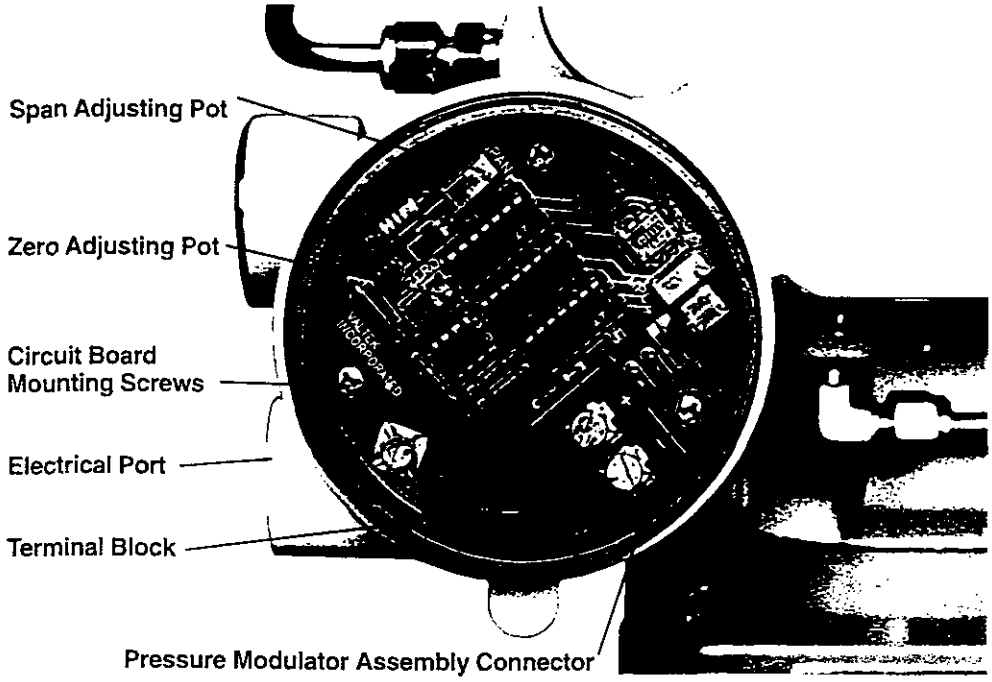

Figure 9: I/P Module Circuit Board (housing cover removed)

zero trim pot. If calibrating an I/P module with a 10-50 mA input signal, apply a 10.0 mA signal to the input.

6. Increase the input signal to 20.0 mA (50 mA for 10-50 mA units). Locate and adjust the span trim pot to achieve a 15.0 psi output. The output will increase with clockwise rotation of the span.
7. Recheck the zero setting by repeating step 5. The span adjustment may affect the zero setting.
8. Repeat steps 5, 6, and 7 until the proper adjustments are obtained.

Adjusting the Minimum Pressure Cutoff Feature

The Beta positioner with I/P module has a "Minimum Pressure Cutoff" feature, which allows the user to set the positioner so when the input signal falls below a user-adjustable current the pressure output falls rapidly to approximately 1.7 psi, causing the valve to close. This feature is generally used when the service requires a tight shutoff or to prevent throttling near the valve seat. To adjust this feature, refer to Figure 9 and perform the following steps:

NOTE: The following procedure should only be followed if the minimum pressure cutoff feature is to be used.

NOTE: The zero and span settings of both the positioner and I/P module should be verified to be accurate before the minimum pressure cutoff feature is enabled and adjusted. Instructions for setting the zero and span settings are described elsewhere in this bulletin.

1. Connect the I/P module to the 30 to 150 psi air supply pressure.
2. Remove the I/P module housing cover.
   WARNING: Be certain power to the I/P module is disconnected before removing the housing cover in explosive atmospheres; otherwise personal injury may occur.
3. Connect an adjustable current source to the terminal block on the circuit board. Apply the desired input signal to the positioner at which the output pressure is to fall to approximately 1.7 psi. This signal can range from the factory setting of 3.7 to 8 mA.
4. Turn the minimum pressure cutoff pot clockwise until the output pressure drops off.
5. Fine tune the pressure drop-off point by increasing the input signal and then decreasing it through the desired shut-off signal. Observe the signal value at which the pressure drops off. If the pressure drops off at a lower mA signal than desired, turn the MPC pot slightly counterclockwise. If the pressure drops off at a higher signal than desired, turn the tight shut-off screw slightly clockwise.
6. Repeat step 5 until the pressure drops off at the desired input signal.
7. To disable the MPC feature turn the minimum pressure cutoff pot (marked "MPC") 20 turns counterclockwise or until it makes a clicking noise.
   NOTE: For earlier models with the removable jumper (marked "J1"), leave the jumper connected and set the MPC pot to 3.7 mA.

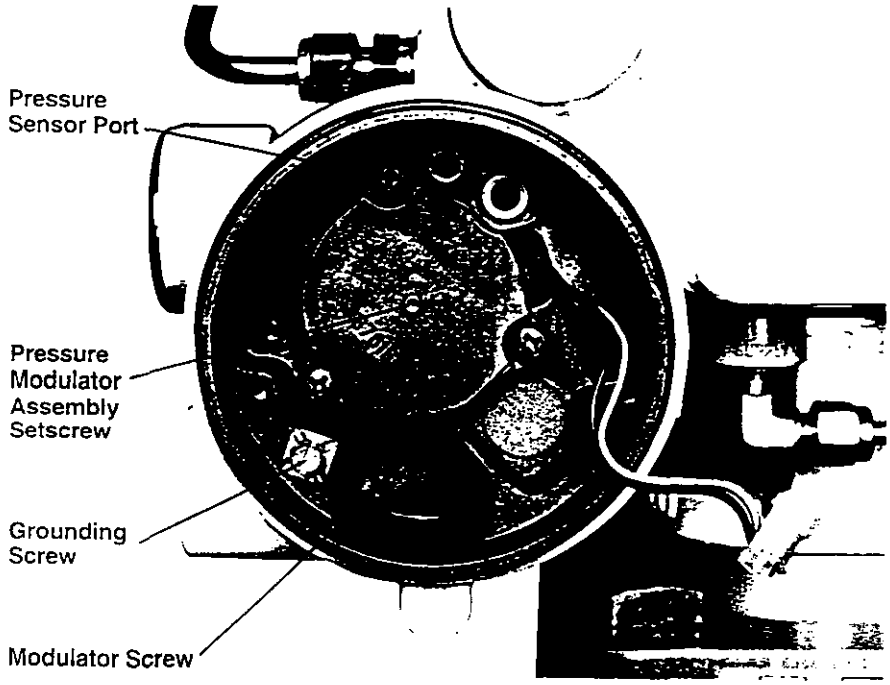

Figure 10: I/P Module Pressure Regulator (circuit board removed)

Adjusting I/P Module Pressure Regulator Output

The setpoint of the internal pressure regulator is set at the factory and normally does not need to be adjusted. However, if it is necessary to check or adjust the pressure regulator, refer to Figure 10 and proceed as follows.

1. Disconnect the air supply pressure to the positioner (or I/P module).
2. Detach the vent cover (14) and unscrew the vent element (15).
3. Plug the vent port with a ⅛-inch NPT plug, being certain the plug is air-tight.
4. Plug the electrical port with a ½-inch NPT plug, being certain the electrical port is air-tight.
5. Be certain the housing cover (1) is screwed on air-tight.
6. Reconnect or turn on the supply pressure to the I/P module.
7. Observe the pressure indicated by the pressure gauge on the I/P module. With the ports plugged and cover on, the indicated pressure is the setpoint of the internal pressure regulator. Its value should be 22 psi (±1 psi). If the setpoint is within this range it needs no further adjustment, continue to step 9. If it is not within this range, proceed to step 8.
8. Remove the pressure regulator setscrew (30). Apply a drop of threadlocking compound (Loctite #222 or equivalent) to the setscrew. Install and turn the setscrew clockwise until the pressure indicated by the I/P module pressure gauge on the I/P module is 22 psi (±1 psi).
9. Disconnect the air supply pressure to the positioner (or I/P module).
10. Remove the ⅛-inch NPT plug from the vent port and reinstall the vent element (15) and the regulator vent cover (14) into the I/P module housing.
11. Remove the ½-inch NPT plug from electrical port.
12. Reconnect the air supply pressure to the positioner.

Adjusting I/P Module Pressure Modulator

The pressure modulator is adjusted at the factory and normally does not need to be adjusted; however, if adjustment is necessary refer to Figures 10 and 11, and proceed as follows.

NOTE: *Although the pressure modulator can be adjusted using the standard output pressure gauge on the I/P module, its accuracy is ±3 percent. It is recommended that the module gauge be removed for calibration and a more accurate calibration equipment of ±0.1 percent of span be used or use a manifold block with an accurate pressure sensor. The pressure gauge port is ⅛-inch NPT.*

1. Remove the I/P module housing cover (1).

   WARNING: Be certain power to the I/P module is disconnected before removing the housing cover in explosive atmospheres; otherwise personal injury may occur.

2. Disconnect the pressure modulator electrical connector from the circuit board.

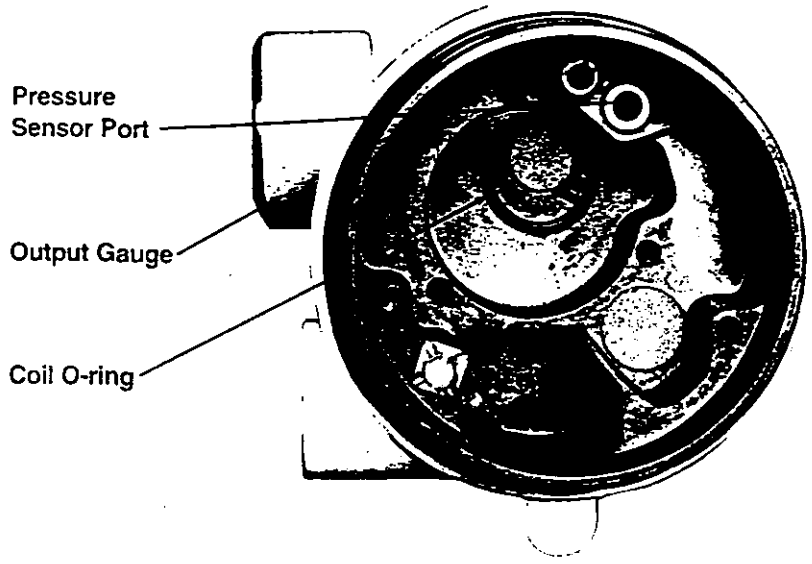

Figure 11: I/P Module with Circuit Board and Pressure Modulator Removed

3. Apply supply air pressure to the I/P module and observe the pressure indicated by the I/P module pressure gauge. If the indicated pressure is 1.75 ±0.10 psi the pressure modulator is adjusted correctly; *reconnect the pressure modulator electrical* connector to the jumper and reinstall the housing cover. If the indicated pressure is not 1.75 ±.10 psi, turn off the supply pressure and proceed to step 4.
4. Remove the three screws (3) holding the circuit board in place, and carefully, pull the circuit board straight out of the housing. A pressure sensor is attached to the underside of the circuit board that fits into a port in the housing. Be careful not to damage the pressure sensor while removing the circuit board.
5. Securely plug the pressure sensor port with a .188 inch diameter rod. Be careful not to damage the coil O-ring (10) in the pressure sensor port.

   WARNING: This rod may be ejected from the port with high pressures. Use care to prevent personal injury.

   If the O-ring is damaged it must be replaced using a small screwdriver to pull it out.
6. Connect the air supply pressure to the positioner.
7. Remove the "Factory Calibrated" sticker from off the pressure modulator cover (7). Turn the setscrew (5) clockwise until the pressure indicated on the pressure gauge on the I/P module is 1.75 ±0.10 psi. This is the correct pressure modulator adjustment.
8. Disconnect the air supply pressure to the positioner.
9. Remove the rod plugging the pressure sensor port.
10. Reinstall the circuit board by engaging the pressure sensor tube and pressing it straight into the housing. Be careful not to damage the O-ring with the pressure sensor. Apply threadlocking compound, replace and tighten the three screws holding the circuit board in place.
11. Reconnect the pressure modulator electrical connector to the circuit board.
12. Reinstall the housing cover and reconnect the air supply pressure.
13. Check the span and zero calibration.

MAINTENANCE

Beta Positioner Maintenance

General maintenance procedures for the Beta positioner on both rotary and linear actuators are the same. At least once every six months, check positioner for proper operation by following the maintenance steps outlined below.

1. Maintain a clean air supply, free of dust, oil, and water. It is recommended that an air filter be used to ensure a clean air supply to the positioner. Check and maintain the air filter at least every six months.

   NOTE: *The air supply should conform to ISA Standard S7.3 (a dew point at least 18° F below ambient temperature, particle size below 5 microns, oil content not to exceed 1 part per million).*
2. Make sure all arms and levers move freely.
3. Check for and tighten any loose parts.
4. Be sure there are no leaks in the air supply.
5. Check and maintain the coalescing filter element in the I/P module every six months.
6. Refer to the "Troubleshooting" section of this bulletin in case of problems.

Removal and Repair of Pilot Valve

To remove or repair the positioner pilot valve, refer to Figure 6 or 7 and proceed as follows.

1. Loosen the zero adjustment locking knob (23) and zero adjusting knob (20). Disconnect the feedback spring (34) from the zero screw (24). Remove the feedback spring from the positioner assembly. Rotate the zero arm (22) out of the way before removing the snap ring (8) holding the range adjustment arm (13) to the base assembly (7). Remove the range adjustment arm.
2. Remove the two screws (53) holding the pilot valve to the base. Remove the pilot valve from the positioner (be careful not to damage the pilot valve or balance beam). Slide the pilot valve (40) from the spool valve body (52) and check it for dirt build-up or sticking. To operate properly, the spool should slide freely and fall through by its own weight when held vertically. Clean both the pilot valve spool and body with a degreasing solvent. When clean, insert the spool back into the body and move it back and forth to ensure that it slides freely for proper operation. If the spool doesn't slide freely, reclean or replace it.

   CAUTION: Do not apply oil or grease to the spool. It will adversely affect the performance of the positioner.

Removal and Repair of Instrument Capsule Assembly

To remove and repair the instrument capsule assembly, refer to the appropriate figure, 6 or 7, and proceed as follows.

NOTE: If the instrument capsule assembly is damaged, the entire instrument capsule assembly with the balance beam is available as a spare part and can be replaced as a unit. It can also be disassembled and only the soft goods replaced.

1. To replace the entire instrument capsule assembly, first remove the pilot valve as described in steps 1 and 2 in the preceding section. Then remove the two screws fastening it to the base. Make sure the new instrument capsule O-ring (48) is installed in the base of the instrument capsule assembly. Install the two mounting screws (35) and tighten. Reinstall the pilot valve as described in step 7.
2. If you wish to disassemble the instrument capsule and replace the diaphragms, then proceed as follows: Remove the pilot valve as described in steps 1 and 2 of the preceding section. Remove the instrument capsule assembly from the positioner base by removing two screws (35). Remove the nut (38) from the top of the balance beam. Remove the four screws (36, 37) that attach the balance beam to the assembly (41) of the instrument capsule body. Then remove the balance beam assembly (41).
3. Remove the four screws (39) holding the upper diaphragm retaining plate (42) to the instrument capsule assembly. Remove the upper diaphragm retaining plate (42) and the lower diaphragm retaining plate (50) from the assembly. Carefully push the diaphragm assembly (49) through the hole and out the bottom of the instrument capsule base. Examine the instrument diaphragm assembly for wear or failure and replace if necessary. When replacing the diaphragm assembly, remove and save the feedback screw (51) from this assembly.
4. Reattach the feedback screw (51) to the new instrument diaphragm assembly by applying a small amount of threadlocking compound (Loctite #222 or equivalent) to the threads. Twist the feedback screw (51) into the instrument diaphragm assembly until it is approximately flush with the bottom of the diaphragm assembly. However, make sure it doesn't protrude through.
5. Carefully fold up the corners of the smaller diaphragm on the diaphragm assembly (49) and carefully work it through the hole in the instrument capsule base (43). Rotate the diaphragm assembly so the small tapped hole in the diaphragm assembly hub is oriented downward closest to the mounting base. Install the lower diaphragm retaining plate (50) and the upper diaphragm retaining plate (42) over the diaphragm making sure that all the diaphragm corners are lying flat. Install and securely tighten the four screws (39). Apply a small amount of Loctite #222 to the shorter threaded portion of the spring and stud assembly (45, 46, 47) and screw it into the diaphragm center hub until the spring coil bottoms out against the center hub. Thread nut (44) onto the longer portion of the stud assembly until it bottoms out against the top of the coil spring (46).
6. Reinstall the balance beam assembly with four screws (36,37) with a small amount of Loctite #222 or equivalent applied to each screw. Also use the flat washers under the two widely spaced screws. Be careful not to bend the thin flexures on the balance beam. With the bottom nut (44) threaded down against the top of the spring coil, install the top nut (38) and tighten it firmly, attaching the balance beam to the diaphragm assembly. Install a new O-ring (48) in the instrument capsule base. Install the two mounting screws (35) and fasten the assembly securely to the positioner base (7).
7. To reinstall the pilot valve, replace the three pilot valve O-rings (54). Compress the leaf spring on the end of the balance beam and carefully engage the notched end of spool with the beam spring. Slide spool carefully until it is aligned with its mounting holes and fasten securely with two screws (53).
8. Return range arm to the base and secure with the snap ring (8). Reinstall the feedback spring with one

end engaging the feedback screw and the other end engaging the zero screw. Then calibrate the positioner according to "Calibration" section of this bulletin.

I/P MODULE MAINTENANCE

Service and Replacement of I/P Orifice

To service or replace the I/P module orifice, refer to Figures 9 and 17, and proceed as follows.

1. Disconnect the air supply pressure to the positioner.
2. Remove the orifice screw (34) from the module housing (1). Examine the O-rings (32, 33) on the orifice screw for wear. Replace if necessary.
3. Examine the orifice for blockage. If blocked, dislodge the blockage by inserting a small wire, less than .014-inch diameter, through the orifice. Be careful not to make the orifice larger during cleaning; otherwise positioner performance will be effected. Blow the orifice clean with air and then reassemble into housing. *If orifice is damaged it must be replaced.*
4. Tightly replace cleaned or new orifice body into housing.
5. Reconnect the air supply pressure to the positioner.

Service and Replacement of I/P Filter

The coalescing filter element in the I/P module should be checked every six months and replaced when necessary. To check or replace the filter proceed as follows:

1. Disconnect the air supply pressure to the positioner.
2. Remove the filter cover screw (16) from the housing (1), being careful not to damage the O-ring (17).
3. Remove the filter element (18) from the housing and examine it. If the filter is plugged or dirty replace it with *a new one.*
4. Reinstall the filter after first cleaning the sealing surfaces. Install the filter in the housing, and tightly fasten on the filter cover.
5. Reconnect the air supply pressure to the positioner.

Disassembly and Reassembly of I/P Pressure Regulator

To disassemble and reassemble the I/P module pressure regulator, refer to Figures 10 and 11, and proceed as follows.

1. Disconnect the air supply pressure to the positioner.
2. Remove the spring preload setscrew (30) from the pressure regulator cover (28).

   WARNING: *The pressure regulator has an internal* spring that is preloaded. Removing the setscrew relieves this preload. This must be done before the pressure regulator cover is removed; otherwise personal injury may occur.

3. Remove the pressure gauge (31).
4. Remove the pressure regulator cover (28) by evenly removing its two mounting screws (29). The pressure regulator preload will be further reduced as these screws are removed.
5. Remove the regulator spring button (27) and the regulator spring (26).
6. Remove the regulator piston (25), its O-ring (24), and the poppet seat (23) by gently pulling on the raised lip of the piston with needlenose pliers. Remove the poppet seat from the piston. **Do not pull on the protruding black stem.**
7. Using a $^{7}/_{16}$-inch socket wrench, remove the poppet guide (22), its O-ring (21), the regulator poppet (20), and the poppet spring (19).
8. Before reassembly, clean the regulator cavity and check for galling and wear. Replace or clean the necessary parts before reassembly.
9. To reassemble, place the poppet spring (19) into the housing cavity. Place the poppet guide O-ring (21) on the poppet guide (22) and insert the regulator poppet (20) through the bottom of the guide screw. Apply threadlocking compound (Loctite #414 or equivalent) and thread the guide screw into the housing using a $^{7}/_{16}$-inch socket. Be careful not to overtighten the guide screw. (A maximum torque of 4 to 5 inch-lbs is sufficient.) Make sure the poppet is free to move up and down and has spring load.
10. Assemble the poppet seat (23) into the regulator piston (25). *Apply a small amount of O-ring grease* to the bore and wipe out all excess. A very thin film is all that is required since excessive grease may plug the orifice, making the I/P module inoperable. Assemble the O-ring on the piston and gently push the piston into the bore.
11. Place the regulator spring (25) on the piston, and place the spring button (27) on the spring. Place a small amount of threadlocking compound on the regulator cover screws (29) and tightly secure the pressure regulator cover (28).
12. Place a small amount of threadlocking compound on the threads of the pressure gauge (31) and tightly thread it into the housing.
13. Adjust the setpoint of the pressure regulator by following the instructions as outlined in the "Adjusting Pressure Regulator Output" section of this bulletin.
14. Reconnect the air supply to the positioner.

Removal and Replacement of I/P Pressure Modulator

To remove or replace the I/P pressure modulator, refer to Figures 10, 11 and 17, and proceed as follows.

1. Disconnect the air supply pressure and input signal to the positioner.

2. Remove the I/P module housing cover (1).

   WARNING: Be certain power to the I/P module is disconnected before removing the housing cover in explosive atmospheres; otherwise personal injury may occur.

3. Disconnect the input signal wires from the terminal block on the circuit board (4). Disconnect the pressure modulator electrical connector from the circuit board.
4. Remove the three circuit board mounting screws (3) and carefully pull the circuit board straight out. There is a pressure sensor attached to the underside of the circuit board that fits in a port in the housing. Be careful not to damage the pressure sensor as the circuit board is removed.
5. Remove the "Factory Calibrated" sticker and the modulator setscrew (5) from the top of the pressure modulator assembly (7).
6. Remove the three modulator screws (6) and the pressure modulator assembly (7). Remove the O-ring (10) from the housing.
7. To reassemble, replace the O-ring (10) and pressure modulator assembly (7).
8. Apply a small amount of threadlocking compound to the modulator screws (6), and start all threads. Apply hand pressure to the center of the pressure modulator cover, shifting it slightly to ensure it is centered. While maintaining this pressure, thread the screws in evenly until seated; torque to 12 inch-lbs.
9. Next, readjust the modulator. Although the modulator can be adjusted using the I/P module output pressure gauge (31), its accuracy is ±3 percent. It is recommended that the standard gauge be removed for calibration and that a more accurate calibration gauge of ±0.1 percent of span be used. The pressure gauge port is ⅛-inch NPT.
10. Plug the pressure sensor port with a .188 inch diameter rod, being careful not to damage the O-ring (35) in the pressure sensor port.
11. Connect the air supply pressure to the positioner.
12. Thread the modulator setscrew (5) into the cover until it is approximately 50 percent engaged. Apply a small drop of threadlocking compound to the setscrew (5) and allow the compound to partially cure. Turn the setscrew into the pressure modulator cover until the pressure indicated on the pressure gauge on the I/P module is 1.75 ±0.10 psi. This is the correct adjustment.
13. Turn off the air supply pressure.
14. Remove the rod plugging the pressure sensor port.
15. Reinstall the circuit board being careful to engage the pressure sensor tube squarely as it's pushed in. Secure circuit board in place with the three mounting screws.
16. Reconnect the pressure modulator electrical connector to the connection on the circuit board and the electrical signal wiring to the terminal block, noting polarity connections.
17. Reinstall the I/P housing cover and reconnect the air supply pressure and electrical signal.

Removal and Replacement of I/P Vent

To remove and replace the I/P module vent, refer to Figures 9 and 17, and proceed as follows.

1. Disconnect the air supply pressure to the positioner.
2. Remove the vent cover (14) by first removing the two vent screws (13).
3. Remove and inspect the vent breather element (15).
4. To reassemble the vent assembly, thread the new vent element into the unit and replace the cover. Replace and tighten the vent screws (13).
5. Reconnect the air supply pressure to the positioner.

Removal and Replacement of I/P Circuit Board

To remove or replace the I/P module circuit board, refer to Figures 9 and 17, and proceed as follows.

1. Disconnect the air supply pressure and electrical input signal to the positioner.
2. Remove the module housing cover (1).

   WARNING: Be certain power to the I/P module is disconnected before removing the housing cover in explosive atmospheres; otherwise personal injury may occur.

3. Disconnect the input signal wires from the terminal block on the circuit board (4). Disconnect the pressure modulator electrical connector from the circuit board.
4. Remove the three circuit board mounting screws (6) and pull the circuit board straight out. There is a pressure sensor attached to the underside of the circuit board that fits in a port in the housing. Be careful not to damage the pressure sensor as the circuit board is removed.
5. Install existing, or replace with a new, circuit board by aligning the pressure sensor with the port in the module housing and carefully pressing the board squarely in place. Do not damage the pressure sensor O-ring. Reinstall the three circuit board mounting screws using threadlocking compound.
6. Reconnect the pressure modulator electrical connector to the circuit board and the input signal wires to the terminal block noting polarity.
7. Reinstall the housing cover. Reconnect the air supply pressure.

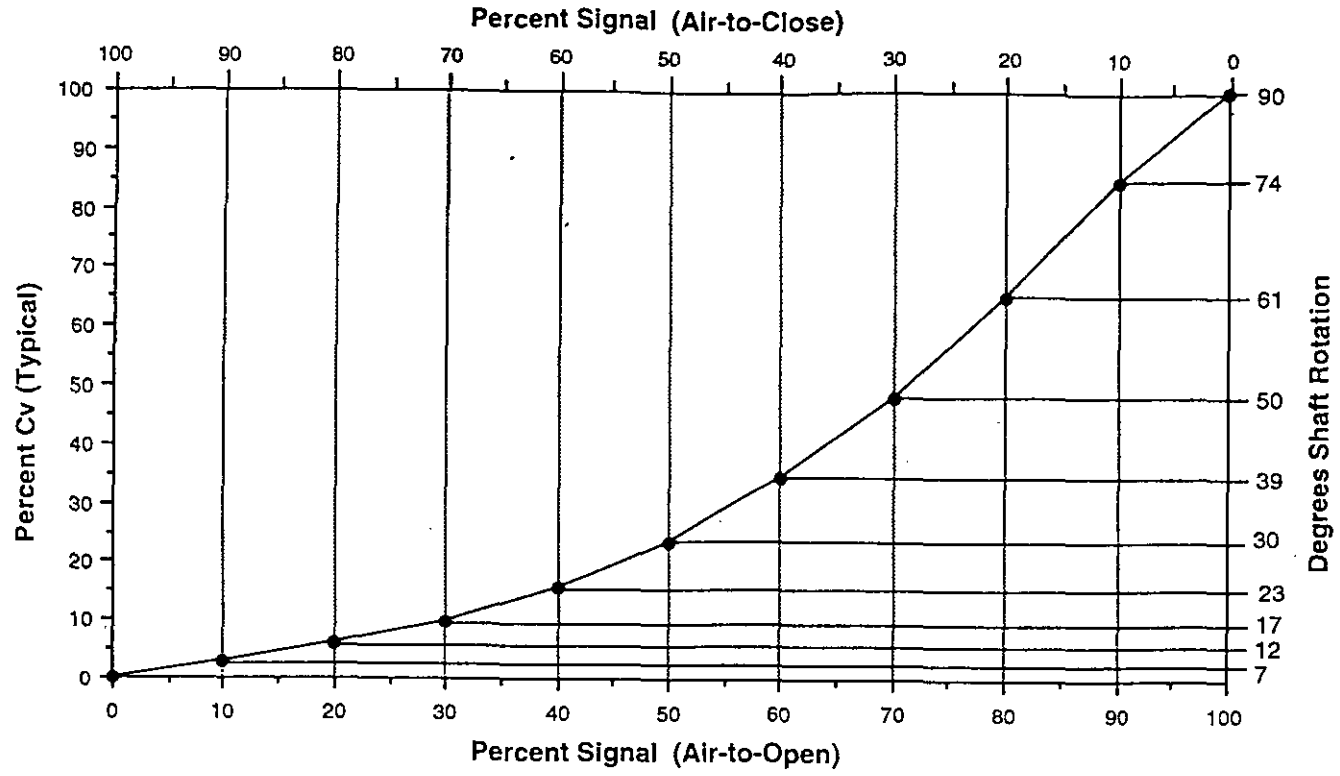

Figure 12: Valdisk – Equal Percent Flow Characteristic
(Shaft Rotation vs. Instrument Signal)

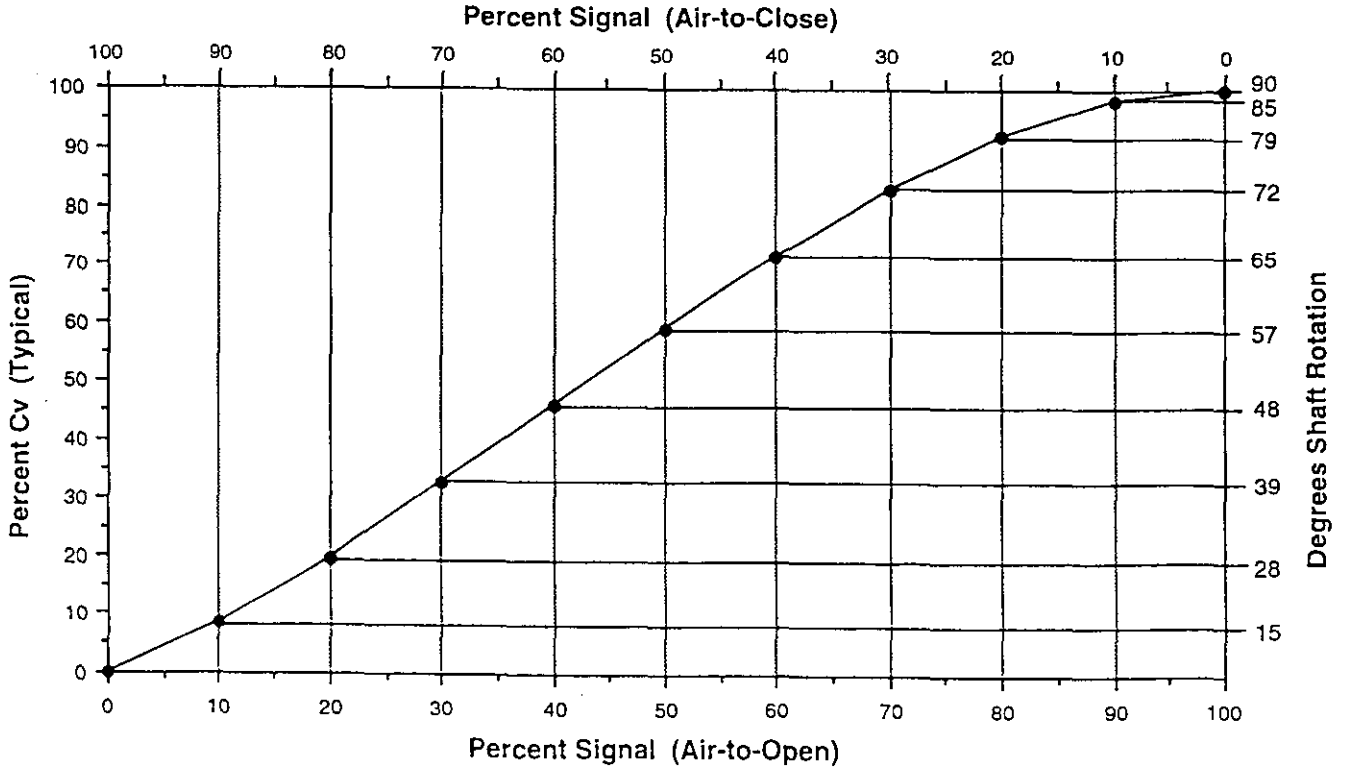

Figure 13: Valdisk – Linear Flow Characteristic
(Shaft Rotation vs. Instrument Signal)

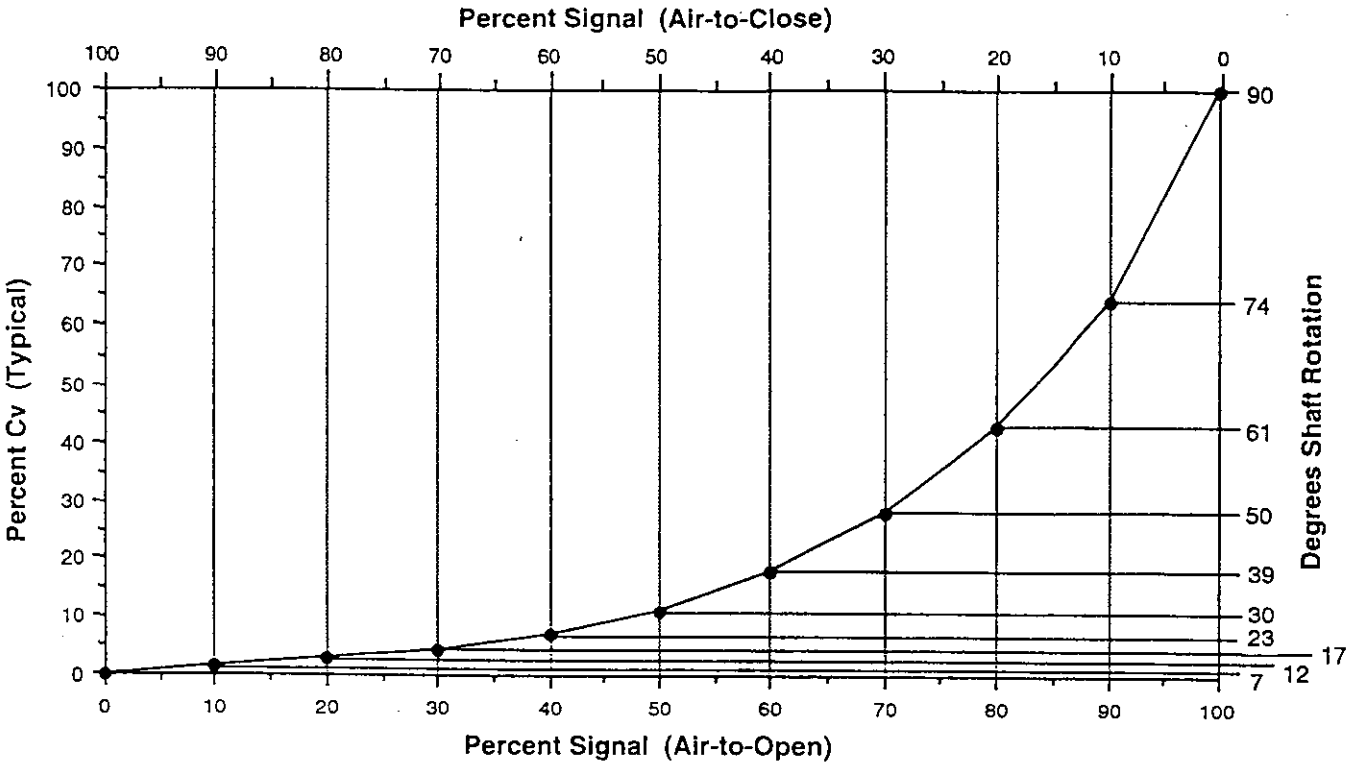

Figure 14: ShearStream – Equal Percent Flow Characteristic
(Shaft Rotation vs. Instrument Signal)

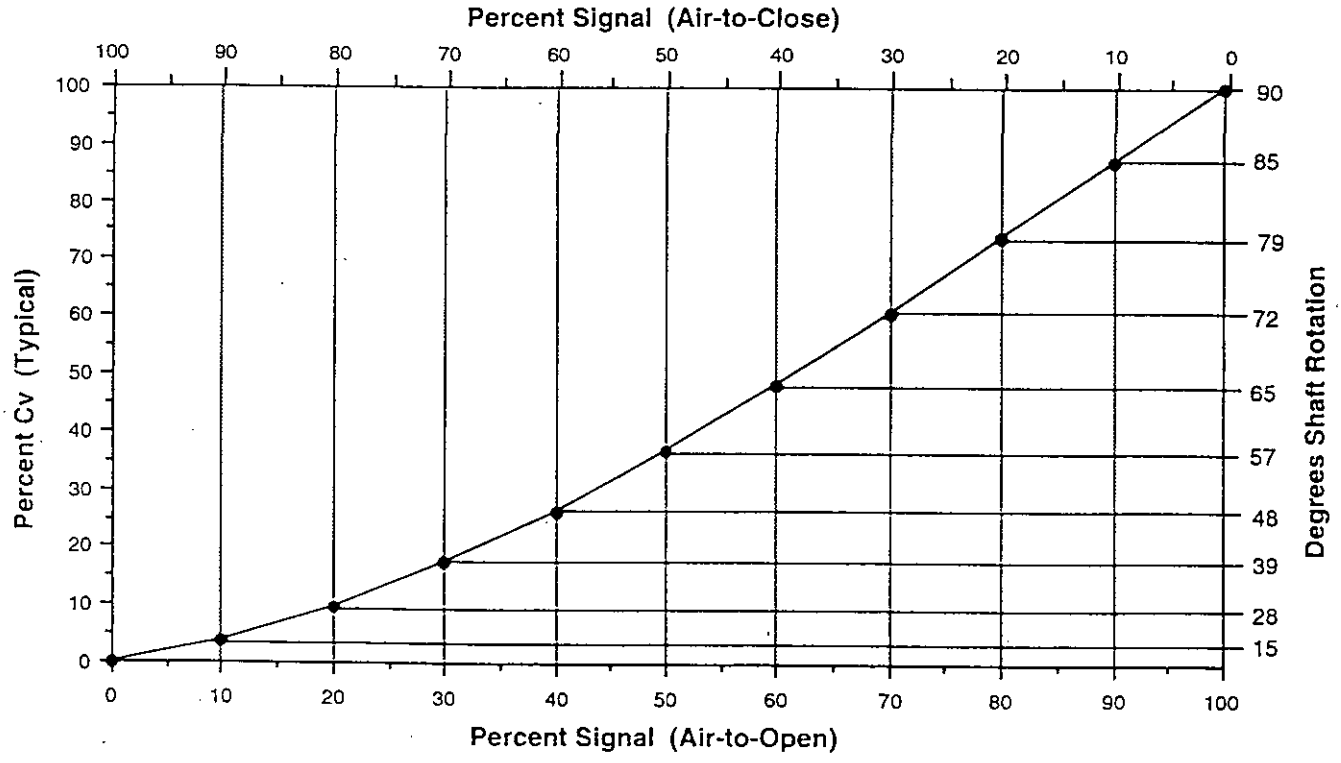

Figure 15: ShearStream – Linear Flow Characteristic
(Shaft Rotation vs. Instrument Signal)

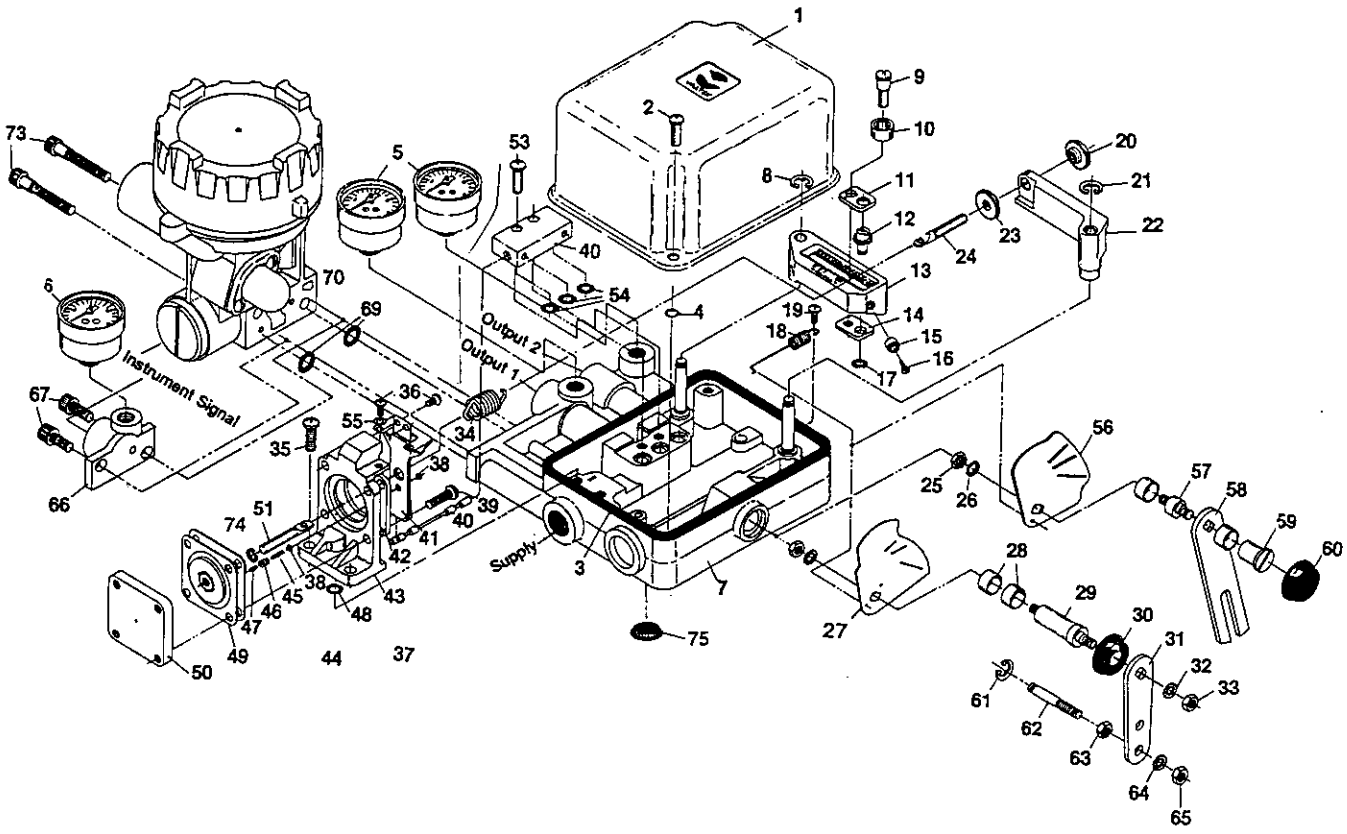

Figure 16: Beta Positioner – Exploded View

Positioner Parts List*

1. cover
2. screw
3. gasket
4. O-ring
5. pressure gauge 0-150 psi
6. pressure gauge 0-30 psi
7. base assembly
8. snap ring
9. range lock screw
10. bushing
11. front range plate
12. range adjustment gear
13. range adjustment arm
14. rear range plate
15. bearing
16. screw
17. snap ring
18. return spring
19. screw
20. zero adjustment knob
21. snap ring
22. zero arm
23. zero adjustment lock knob
24. zero screw
25. nut
26. lock washer
27. cam, linear
28. bushing, linear
29. cam shaft, linear
30. boot, linear
31. follower arm
32. lock washer
33. nut
34. feedback spring
35. screw
36. screw
38. nut
39. screw
40. pilot valve assembly
41. balance beam assembly
42. upper diaphragm retaining plate
43. instrument capsule body
45. stud
46. spring
47. stud
48. instrument capsule O-ring
49. instrument diaphragm assembly
50. lower diaphragm retaining plate
51. feedback screw
53. screw
54. spool valve O-rings
55. washer
56. cam, rotary
57. cam shaft, rotary
58. follower arm, rotary
59. cam shaft nut, rotary
60. cap, rotary
61. snap rings
62. follower pin
63. nut
64. lock washer
65. nut
66. pneumatic adapter
67. bolt, socket head
69. O-ring
70. I/P module assembly (see Figure 17)
73. bolt, socket head
74. snap ring
75. vent screen

* *All of the above parts are in stock, and can be purchased in any one of 24 spare parts kits. For selecting and ordering the appropriate kit or a new positioner, contact your Valtek representative or the factory.*

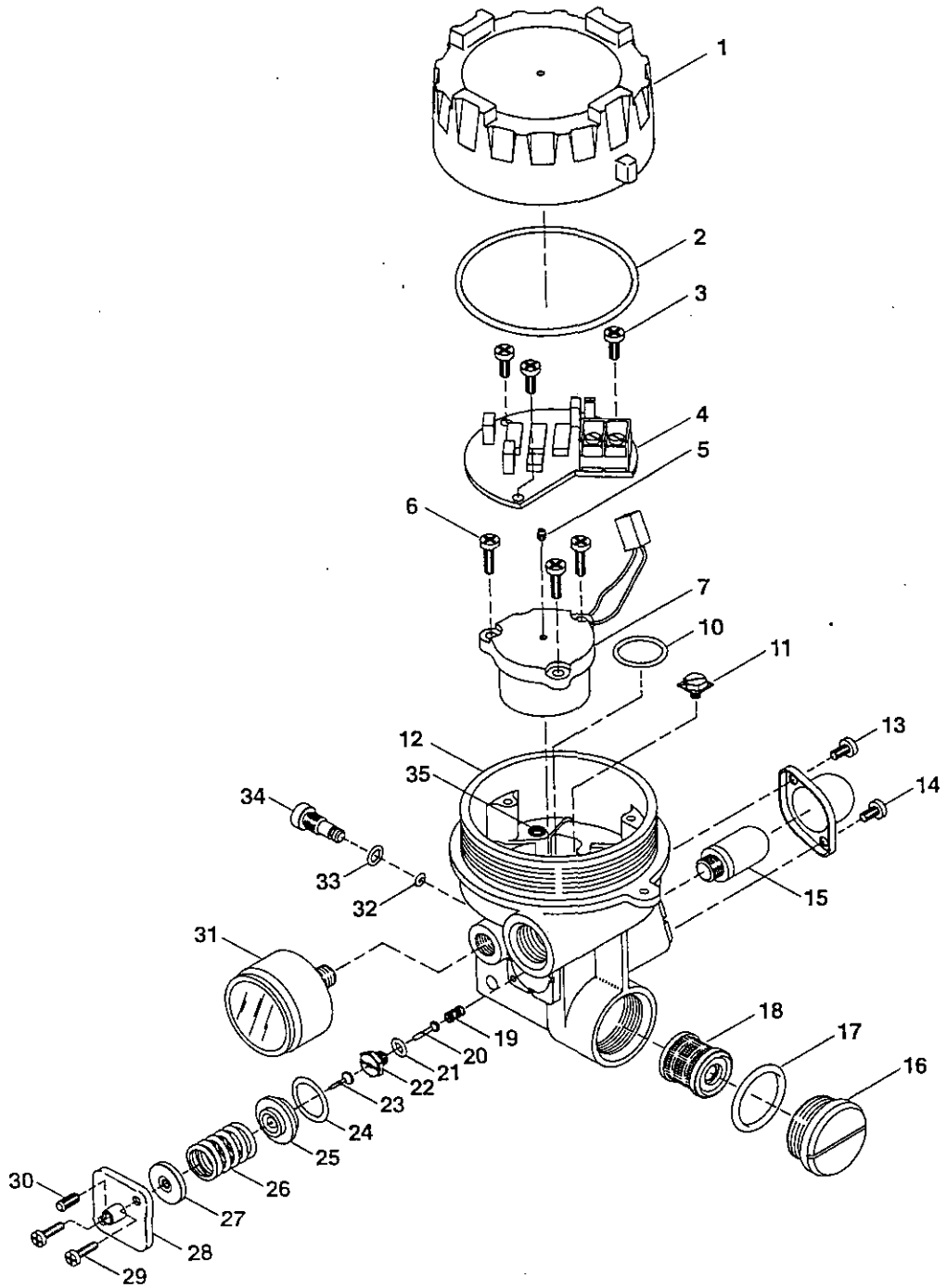

Figure 17: I/P Module – Exploded View

I/P Module Parts List

1. I/P housing cover
2. housing cover O-ring
3. circuit board mounting screws
4. circuit board
5. modulator setscrew
6. modulator screw
7. pressure modulator assembly
10. coil O-ring
11. grounding screw
12. I/P housing
13. vent cover screw
14. vent cover
15. vent element
16. filter cover screw
17. filter cover O-ring
18. filter element
19. poppet spring
20. regulator poppet
21. poppet guide O-ring
22. regulator poppet guide
23. poppet seat
24. regulator O-ring
25. regulator piston
26. regulator spring
27. regulator spring button
28. regulator cover
29. regulator screw
30. regulator setscrew
31. pressure gauge (0-30 psi)
32. orifice O-ring
33. orifice screw O-ring
34. orifice screw
35. sensor O-ring

Beta Positioner Troubleshooting

Failure	Probable Cause	Corrective Action
Valve won't stroke, no excessive air is exhausting from positioner	1. Tubing to wrong ports	1. Retube to correct ports (see "Installation" section)
	2. Cam action reversed	2. Refer to installation section and reverse cam
	3. Lever arm stuck	3. Work with stuck arm until it freely turns
	4. Pilot spool stuck	4. Work spool by hand until it freely moves, or remove spool and spool valve body and clean thoroughly; replace if necessary
	5. I/P module filter plugged	5. Remove I/P module and replace filter
	6. I/P module failure	6. Replace I/P module
	7. I/P mounting bolts loose	7. Tighten mounting bolts
Actuator goes to full signal position, regardless of signal	1. Broken feedback spring	1. Replace feedback spring
	2. Linkage is disconnected, stuck or missing parts	2. Check and tighten all bolts and nuts in linkage, make sure linkage doesn't stick.
	3. Pilot spool stuck	3. Work spool by hand until it freely moves, or remove spool and spool valve body and clean thoroughly; replace if necessary. Do not apply grease to spool valve.
	4. I/P module orifice plugged	4. Return I/P module to factory for service
Calibration shifts	1. Loose positioner mounting	1. Remove cover and check three screws holding positioner to bracket, check two bolts holding bracket to yoke
	2. Loose linkage	2. Tighten all nuts and bolts on linkage
	3. Loose zero adjustment locking knob	3. Tighten zero adjustment locking knob or range adjustment locking knob adjustment after calibrating knob
	4. Worn arms or pins	4. Replace arms or pins, and apply grease
	5. I/P mounting bolts loose	5. Tighten mounting bolts
Excessive air consumption (other than normal exhaust)	1. Air leakage from O-rings	1. Remove spool valve; Check O-rings and replace if necessary
	2. Air leakage from tubing	2. Tighten or replace tubing fittings
	3. Leaky cylinder piston O-rings	3. Replace O-rings in cylinder
Actuator strokes very slowly in one direction only	1. Connection between capsule and beam improperly adjusted	1. Retighten balance beam to diaphragm assembly with nut bottomed out against coil of spring (See step 6 in "Removal & Repair of Instrument Capsule Assembly")
	2. Tubing to cylinder is restricted	2. Locate faulty tube and replace it
	3. I/P module filter plugged	3. Remove I/P module and replace filter
Erratic operation	1. Dirt build-up inside spool valve	1. Disassemble; clean spool and body; add air filter to air supply; if air filter exists, replace cartridge
	2. Bent spool	2. Replace spool and valve block
	3. Broken linkage or positioner parts	3. Replace broken parts

I/P Module Troubleshooting

Failure	Probable Cause	Corrective Action
Transducer output pressure is zero, no excessive air being exhausted	1. Supply pressure is low 2. Pressure regulator piston not properly seated 3. Housing passage plugged 4. Improper calibration of zero and span settings 5. Circuit board is defective	1. Set supply pressure to recommended value 2. Disassemble pressure regulator piston and re-assemble, taking care to seat piston per procedure 3. Disassemble unit and clear passage. 4. Recalibrate I/P module zero and span settings 5. Replace circuit board; do not attempt to repair or replace individual components
Excessive air consumption	1. Air leakage from input port 2. Air leakage from filter cover 3. Air leakage from pressure gauge 4. Air leakage from orifice	1. Tighten port mounting screws. Be certain correct O-rings are in place. 2. Tighten cover. Replace O-ring, if necessary 3. Remove gauge, clean threads and apply hydraulic sealant to threads and replace 4. Tighten orifice screw, replace O-rings if necessary
Transducer goes to full output pressure regardless of signal	1. Nozzle is clogged 2. Modulator setscrew is improperly adjusted 3. Flapper is bent or dirty	1. Replace pressure modulator assembly 2. Recalibrate modulator setscrew; see "modulator calibration" procedure 3. Replace pressure modulator assembly
Transducer output doesn't reach 15 psi, regardless of signal	1. Defective pressure modulator 2. Low air supply pressure 3. Zero and Span improperly set on circuit board 4. Orifice is clogged 5. Air leakage from ports 6. Circuit board is defective	1. Replace pressure modulator assembly 2. Set supply pressure to recommended value 3. Recalibrate I/P module zero and span settings on circuit board 4. Remove orifice and clean or replace 5. Tighten all port mounting screws 6. Replace circuit board; do not attempt to replace individual board components
Low output with a signal above 4.0 mA	1. Minimum pressure cutoff jumper is enabled 2. Zero and span out of calibration	1. Disable minimum pressure cutoff jumper 2. Recalibrate zero and span settings
Transducer output is 1 – 2 psi, regardless of signal	1. No power to unit 2. Minimum pressure cutoff jumper is enabled 3. Pressure modulator assembly not connected to circuit board	1. Connect power to input leads 2. Disable minimum pressure cutoff jumper; adjust feature per instructions 3. Connect pressure modulator assembly to circuit board
Erratic operation	1. Leads to circuit board are reversed 2. Circuit board leads are loose 3. Orifice is clogged 4. Pressure modulator assembly is defective 5. Housing passage way is clogged 6. Pressure modulator is miscalibrated 7. Circuit board is defective	1. Connect power correctly to the positive (+) and negative (-) terminals 2. tighten circuit board leads 3. Remove orifice screw and clean or replace 4. Replace pressure modulator assembly 5. Disassemble I/P module and clear all passageways 6. Recalibrate pressure modulator, see "Adjusting I/P Module Pressure Modulator" 7. Replace circuit board
At 4mA signal, device will not return to 3 psi	1. Zero current output pressure set incorrectly	1. Recalibrate pressure modulator

Ordering Information

The following information is provided to order a new Beta positioner or to adapt an existing positioner from one application to another.

Linear Actuators

When ordering a positioner for a linear actuator, select two part numbers; one each from Tables 2 and 3.

Table 2 – Positioner Model with 3-15 psi or 4-20 mA span for Linear Actuators(1)

	Air Action	P/P Module	IP 2000 Module	
			Int. Safe	Exp. Proof
Std. Stroke	Air-to-Open(2)	63934	97632	96734
	Air-to-Close	63935	96733	96735
Short Stroke	Air-to-Open(2)	63936	97602	97604
	Air-to-Close	63937	97603	97605

(1) Can be split ranged 2:1 or 3:1 without additional parts. Also available are positioner models with 6-30 psi or 10-50 mA span and the same split ranges.

(2) The cam can be turned over in the field for opposite air action.

Table 3: Linear Actuator Follower Arms

Actuator Size	Stroke (in.)	Spud (in.)	Follower Arm Kit
25	1/4	2.00	55895*(3)
25	3/8	2.00	55895*
25	1/2	2.00	48624(3)
25	3/4 - 1 1/2	2.00	48624
50	1/2 - 1 1/2	2.00	48624(3)
50	1/2 - 2 1/2	2.62	56098(3)
50	3	2.62	48625
100	3/4 - 3	2.62 - 2.88	48625(3)
100	3/4 - 4	3.38 - 4.75	48626(3)
100	5 - 8	3.38 - 4.75	48627

* Requires the use of stem clamp number 55679

(3) Use short-stroke positioners with: 25 sq. in. actuator, 1/4, 1/2-inch stroke; 50 sq. in. actuator, 1/2-inch stroke; and 100/200 sq. in. actuator, 3/4, 1-inch stroke. See Section 1.

Rotary Actuators

When ordering a positioner for a rotary actuator, select two part numbers; one from Table 4 and one from Table 5 which includes part numbers for the follower arm.

Table 4 – Positioner Model with 3-15 psi or 4-20 mA span for Rotary Actuators(1)

Actuator Size	Installed Cam(4)	Pneumatic Module	I/P Module	
			Int. Safe	Exp. Proof
25	B	63940	97606	97608
50				
100	C	63941	97607	97609

(1) Can be split ranged 2:1 or 3:1 without additional parts. Also available are positioner models: with 6-30 psi or 10-50 mA span and the same split ranges, or models with 4-way split range.

(4) The cam can be turned over in the field to the opposite side "B" or "C". To select the correct positioner model choose either "B" or "C" from the "Cam Characteristic" chart below.

Table 5: Follower Arms for Rotary Actuators

Actuator Size (Square-inches)	Follower Arm Part Number
25	42817
50	42816
100	41418

When installed on a rotary valve, the signal vs. C_v relationship can be equal percentage or linear, based on air action as well as cam characteristics. See Table 1.

Three kits are available to convert of the Beta positioner control signal from either pneumatic to I/P, or from I/P to pneumatic.

Conversion Kit	Number
Pneumatic to Intrinsically Safe IP 2000	97901
Pneumatic to Explosion-proof IP 2000	97900
I/P to Pneumatic	41694

Valtek International is represented by factory-trained manufacturer representatives throughout the world.

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Valtek Beaumont – Beaumont, TX 77705
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Valtek Corpus Christi – Corpus Christi, TX 78408
Phone 512 289 6911 Fax 512 289 6917
Valtek Houston – Deer Park, TX 77536
Phone 713 479 9500 Fax 713 479 8511
Valtek Philadelphia – Boothwyn, PA 19061
Phone 610 497 8600 Fax 610 497 8680
Valtek Controls Ltd. – Edmonton, Alberta T6P 1K6
Phone 403 449 4850 Fax 403 449 4851
Valtek Australia Pty. Ltd. – Scoresby, Victoria 3179
Phone 3 764 8522 Fax 3 764 0013
Valtek Engineering Ltd. – Pershore, England WR10 2BZ
Phone 386 554 551 Fax 386 554 968
Kämmer Valves Inc. – Pittsburgh, PA 15205
Phone 412 787 8803 Fax 412 787 1944
Kämmer Ventile GmbH – Essen, Germany
Phone 201 29407 0 Fax 201 29407 62
Valtek-Sereg Vannes S.A. – Paris, France
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Valtek Sulamericana Ltda. – Sao Paulo 09940, Brazil
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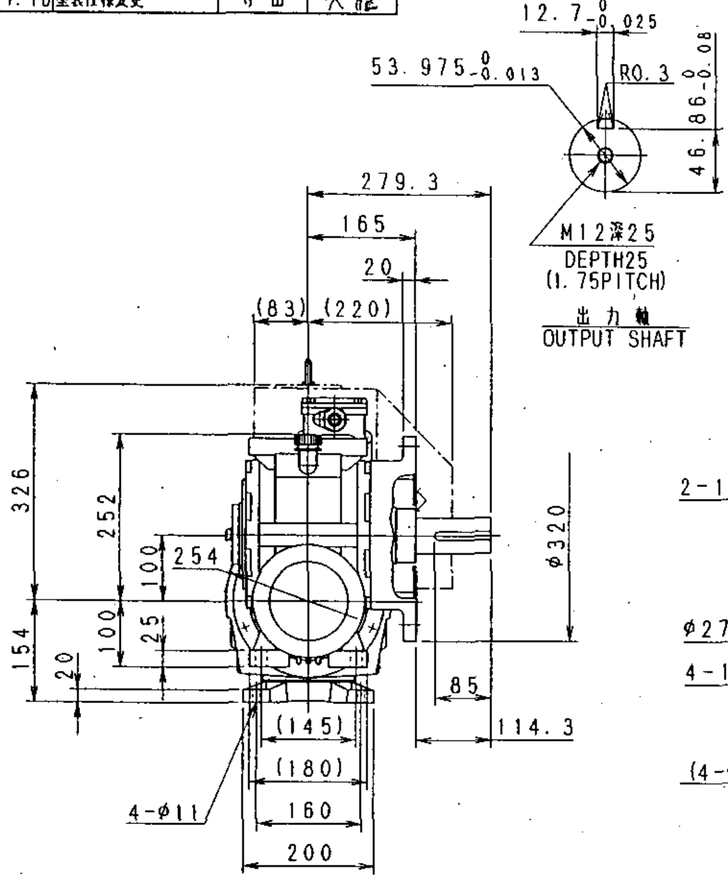
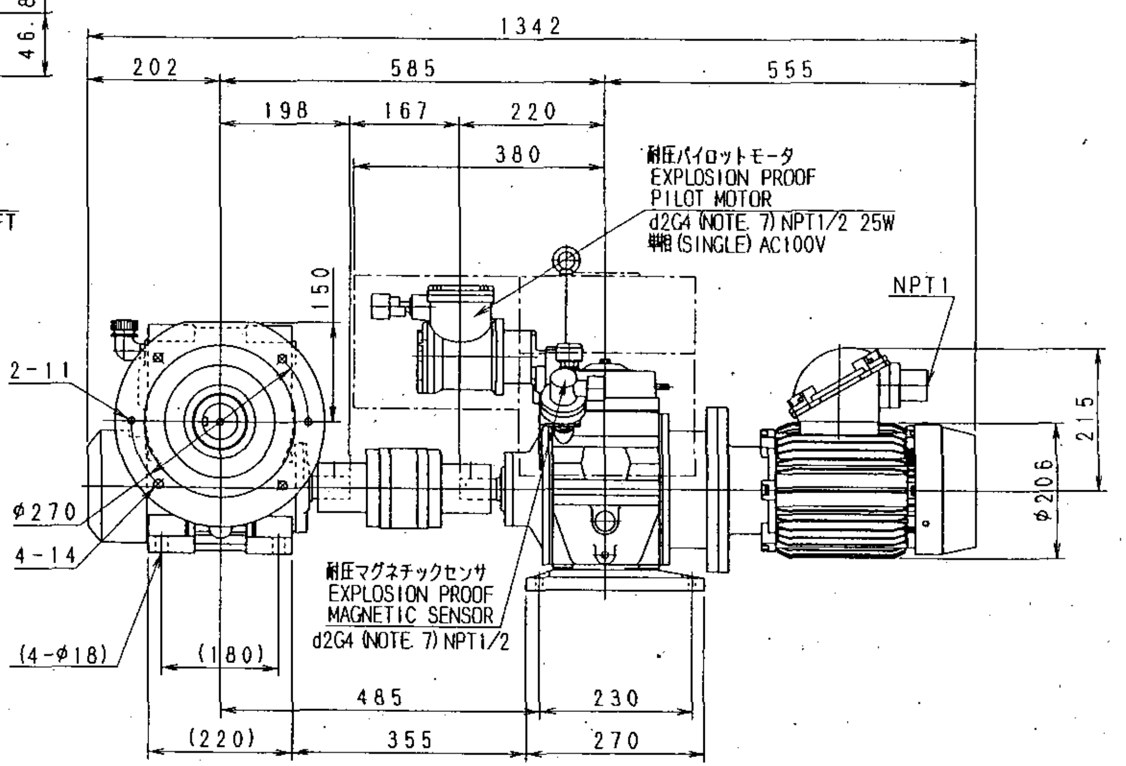
改訂 REV. MARK	年月日 DATE	記事 CONTENTS	担当 REVISED BY	承認 APPROVED BY
1	2003. 6. 17	合フランジ φ7→φ11他	寺田	天龍
2	2003. 6. 20	NOTE. 7追記	寺田	天龍
3	2003. 7. 18	塗装仕様変更	寺田	天龍

1. TERMINAL BOX IS DIAL PLATE SIDE.
2. PILOT MOTOR IS OUTPUT SHAFT SIDE. WITH HAND WHEEL (φ65) & FOOD FOR PM&MGS
3. NAME PLATE: RIGHT SIDE. (FROM MOTOR VIEW)
4. NEME PLATE, DIAL PLATE, BOLTS: STAINLESS STEAL. (PORTIONS, REQUIRED OF DURABILITY AND STRENGTH, ARE EXEMPTED)
5. WITH WORM GEAR (HEDCON: CHB-A100 K-L 20), COUPLING (GERWAH CK500/73), COUPLER, SPECIALLY OUTPUT SHAFT, STOPPER COLLAR & BREATHER CAP.
6. WITH SHIM FOR CENTER HEIGHT ADJUSTMENT.
7. d2G4 (EX" d" IIC T4 equivalent)





1. 端子箱は目盛板側取付
2. パイロットモータは出力軸側取付 (変速ハンドル (φ65) 付属、PM・MGS屋外フード付)
3. 目盛板は右側取付 (モートル側より見て)
4. 銘板、目盛板、ボルト類はSUS製 (但し強度必要部は除く)
5. ウォーム減速機 (HEDCON CHB-A100 K-L 20) カップリング (ガーワCK500/73)、合フランジ、特出力軸、抜け止めカラー、エアブリーザ付
6. 変速機ベース高さ調整用シム付属
7. 防爆構造: d2G4 (EX" d" IIC T4 equivalent)

Elliott EbaraTurbomachinery Corp. 様

仕様表 SPEC.

モートル仕様 SPECIFICATION FOR COMBINED MOTOR

メーカ MFR.	出力 OUTPUT	定格 RATING
東芝	1.5 kW	S1
相数 PHASE	極数 POLES	電圧 VOLTS
3	4	380
周波数 Hz	回転速度 rpm	絶縁 INS. CLASS
50	1500	F
保護方式 PROTECTION	防爆構造 EXP. PROOF SYMBOL	
IP55	d2G4 (NOTE. 7)	

塗装色 PAINT	MUNSELL (マンセル) 7.5B3/4 (本体) 10B5/3 (ウォーム減速機)
ハンドル回り数 HANDWHEEL REVOLUTION	—
総質量 MASS	TOTAL 235 kg

変速部 TRACTION SECTION	減速部 REDUCTION SECTION
回転速度 rpm / 変速比 RATIO: (100:1)	回転速度 rpm / 減速比 RATIO: 0. 43~42. 7 (1/19. 5)
油名・油量 OIL & QUANTITY: TDオイル10 1.8 ℓ TRACTION DRIVE OIL TD-10	油名・油量 OIL & QUANTITY: 昭和シェル・チベラオイル SB (220EP) SHELL: TIVELA OIL SB (220EP) 1.5 ℓ

第三角法 3RD ANGLE PROJECTION	承認 APPROVED BY: R. TENRYU
尺度 SCALE: FREE	検図 CHECKED BY: K. KITAURA
単位 UNITS: mm	製図 DRAWN BY: A. TERADA
年月日 DATE: MAY. 20. 2003	

名称 TITLE: リングコーン無段変速機外形図 DIMENSIONS FOR RINGCONE TRACTION DRIVES

機種形番 MODEL: EXPLOSION PROOF OUTDOOR USE RXMKR-1500-1AX 耐圧屋外 1/20ウォーム減速機付

日本電産シンポ株式会社 NIDEC-SHIMPO CORPORATION

図面番号 DRAWING NO. J3X04396-3

改訂 REV. MARK: 3

TITLE	Turning Gear Motor Data Sheet	DOC. No.	LGTPR-813-1116 V-9900-4-CT9901-101-0	REV. 0

CUSTOMER	LG Engineering & Construction Corp.	COMPLETE IN WITH COVER	2	SHEETS

FINAL USER	Turkish Petroleum Refineries Corp.

PROJECT	Tupras Izmir Refinery DHP Project	SERVICE	Recycle Compressor

JOB No.	7020	EBARA SER. No.	R0215708

ITEM No.	CT-9901	MODEL/ EQUIP.	25MB5/SRV-5DF	SET	1

LG E&C LG ENGINEERING & CONSTRUCTION CORP.	TÜPRAŞ TUPRAS IZMIR REFINERY DIESEL/KEROSENE HYDROPROCESSING PROJECT	JOB NO.:7020	UNIT : N/A
		REQ'N NO. : 7020-RQ-C-001	SH/OF
		CONTRACTOR SPEC NO. : V-9900-4 -CT9901- 101	1 / 2
		REV 0	

TO	SET	TO	SET
CUST-	R		
OMER	10 C	281-1	
813	1	811-1	
813E		811-2	
821-1		811-3	
821-2	1		
821-4			
819			
816-1			
816-2		4	
812-1		3	
812-2		2	
850		1	
		REV.	PAGE

☐ FOR APPROVAL

AVOID DELAY
TO MAINTAIN SHIPPING PROMISE.
ONE APPROVED PRINT MUST BE RETURNED BY:

BY: DATE:

☒ FOR RECORD

ANY REQUESTED CHANGE OF THIS EQUIPMENT WILL RESULT IN:
1.CONTRACT PRICE ADJUSTMENT
2.EXTENDED SHIPPING PROMISE AS THIS CONTRACT IS IN MANUFACTURING PROCESS.

BY: DATE: OCT-3-03

ISSUED BY

APPROVED BY	N. Sasaki	Oct. 3 '03	
CHECKED BY			
PREPARED BY	N. Sasaki	Oct. 3 '03	