



RETURN BIDS TO:

RETOURNER LES SOUMISSIONS À:

Bid Receiving - PWGSC / Réception des soumissions
- TPSGC

Place Bonaventure, portail Sud-Est
Place Bonaventure, Portail South-Eas
800, rue de La Gauchetière Ouest
800 de La Gauchetière Street West
Bureau 7300 / Suite 7300
Montréal
Québec
H5A 1L6

SOLICITATION AMENDMENT MODIFICATION DE L'INVITATION

The referenced document is hereby revised; unless otherwise indicated, all other terms and conditions of the Solicitation remain the same.

Ce document est par la présente révisé; sauf indication contraire, les modalités de l'invitation demeurent les mêmes.

Comments - Commentaires

Vendor/Firm Name and Address
Raison sociale et adresse du
fournisseur/de l'entrepreneur

Issuing Office - Bureau de distribution
TPSGC/PWGSC
Place Bonaventure, portail Sud-Est
Place Bonaventure, Portail S. E.
800, rue de La Gauchetière Ouest
800 de La Gauchetière Street West
Bureau 7300/Suite 7300
Montréal
Québec
H5A 1L6

| | |
|---|---|
| Title - Sujet Steering Gear Repl. project for GCC | |
| Solicitation No. - N° de l'invitation F7049-150372/A | Amendment No. - N° modif. 004 |
| Client Reference No. - N° de référence du client F7049-15-0372 | Date 2016-06-08 |
| GETS Reference No. - N° de référence de SEAG PW-\$MTE-150-13861 | |
| File No. - N° de dossier MTE-5-38380 (150) | CCC No./N° CCC - FMS No./N° VME |
| Solicitation Closes - L'invitation prend fin at - à 02:00 PM on - le 2016-07-15 | Time Zone Fuseau horaire Eastern Daylight Saving Time EDT |
| F.O.B. - F.A.B. Plant-Usine: <input type="checkbox"/> Destination: <input checked="" type="checkbox"/> Other-Autre: <input type="checkbox"/> | |
| Address Enquiries to: - Adresser toutes questions à: Giguère, Réjean | Buyer Id - Id de l'acheteur mte150 |
| Telephone No. - N° de téléphone (514) 496-3346 () | FAX No. - N° de FAX (418) 496-3822 |
| Destination - of Goods, Services, and Construction: Destination - des biens, services et construction: | |

Instructions: See Herein

Instructions: Voir aux présentes

| | |
|---|--|
| Delivery Required - Livraison exigée | Delivery Offered - Livraison proposée |
| Vendor/Firm Name and Address Raison sociale et adresse du fournisseur/de l'entrepreneur | |
| Telephone No. - N° de téléphone Facsimile No. - N° de télécopieur | |
| Name and title of person authorized to sign on behalf of Vendor/Firm (type or print) Nom et titre de la personne autorisée à signer au nom du fournisseur/de l'entrepreneur (taper ou écrire en caractères d'imprimerie) | |
| Signature | Date |

Steering Gear System for the Pierre Radisson vessel (F7049-150372/A)

Amendment # 4 is raised to provide additional information, change the following Terms and Conditions and to provide answers to the questions received to date.

Questions 9 to 10

| | | |
|----------|------------|--|
| 9 | Question : | Is it possible to have the plans and drawings for the existing steering gear system? |
| | Answer : | Yes, please refer to the attached PDF documents. |

| | | |
|-----------|-----------|---|
| 10 | Question: | Is it possible to visit the other two icebreaker vessels? |
| | Answer : | No, it will not be possible to visit the vessels due to operational reasons. The vessels are no longer in Quebec city at this time. |

La version française des textes précédents est disponible à la page suivante

Système de Direction pour le navire Pierre Radisson (F7049-150372/A)

L'amendement # 4 est publié afin de fournir des informations, changer les Clauses et Conditions suivantes ainsi que de répondre aux questions reçues à ce jour.

Questions 9 à 10

| | | |
|----------|------------|---|
| 9 | Question : | Est-il possible d'obtenir les plans et devis du système de direction existant? |
| | Réponse : | Oui, svp vous référer aux documents PDF ci-joints. Ces documents ne sont pas disponibles en Français. |

| | | |
|-----------|------------|--|
| 10 | Question : | Est-il possible de visiter les deux autres navires brise-glace? |
| | Réponse : | Non, il ne sera pas possible de visiter les autres navires pour des raisons opérationnelles. Les navires ne sont plus à Québec présentement. |

OPERATING and SERVICE MANUAL

C.C.G.S. PIERRE RADISSON

German & Milne Design 1180/1
Burrard Dry Dock Hull 221

Model L2 100-52-37 EB2**

CANADIAN AGENTS - SALES and SERVICE

Ampower Canada Ltd.
145 Montee de Liesse
St. Laurent, Quebec
(514) 341-3575
Tlx: 05-825666

Steel & Engine Products Ltd.
Liverpool, Nova Scotia
(902) 354-3483
Tlx: 019-21651

 **WAGNER ENGINEERING LTD.**
Manufacturers of MARINE HYDRAULIC STEERING GEARS and AUTOMATIC PILOTS

1742 WEST 2nd AVENUE
VANCOUVER, B.C.
CANADA V6J 4P6

TELEPHONE: (604) 736-0451
TELEX: 04-508833
CABLE "WAGENG"

TABLE OF CONTENTS

| | <u>PAGE</u> |
|------------------------------|-------------|
| STEERING SYSTEM PARTICULARS | ii |
| OPERATING PRINCIPLE | 1 |
| The Power System | 1 |
| The Control System | 1 |
| The Control Valve Assembly | 1 |
| SYSTEM COMPONENTS | 3 |
| The Power System | 3 |
| The Control System | 5 |
| The Control Valve Assembly | 7 |
| The Steering Gear Assembly | 10 |
| The Carrier Bearing | 11 |
| The Locking Pin | 11 |
| SYSTEM COMPONENT DRAWINGS | 13 |
| INSTALLING THE STEERING GEAR | 14 |
| PIPING THE SYSTEM | 16 |
| RECOMMENDED OIL | 17 |
| FILLING THE SYSTEM | 18 |
| TESTING THE INSTALLATION | 20 |
| GENERAL MAINTENANCE | 24 |
| LIST OF SPARE PARTS | 25 |

STEERING SYSTEM PARTICULARS

Ref: WQN 0824

| | |
|---------------------------------------|---------------------------------------|
| Steering Gear Model | - L2 100-52-37EB2** |
| Steering Angle | - 2 x 37° |
| Hardover Rudder Speed | - 10 sec. w/both pumpsets |
| No. of Wheel Turns (Power) | - 3 |
| No. of Wheel Turns (Emergency Manual) | - approx. 500 |
| Max. Power System Pressure | - 1100 psi (77kg/cm ²) |
| Max. Control System Pressure | - 1100 psi (77kg/cm ²) |
| Max. Lockpin System Pressure | - 1100 psi (77kg/cm ²) |
| Relief Valve Settings | - 1300 psi (91kg/cm ²) |
| Power System Motors | 2 - Lincoln 75HP, 1800 RPM (440/3/60) |
| Control System Motors | 2 - Lincoln 1HP, 1800 RPM (440/3/60) |
| Lockpin System Motor | 1 - Lincoln 5HP, 1800 RPM (440/3/60) |
| Power System Pumps | 2 - Vickers 50V-72 |
| Control System Pumps | 2 - Vickers V110-1.5 |
| Lockpin System Pump | 1 - Vickers V110-3.5 |
| Control System Solenoid Valves | 2 - Vickers DG4S4 018C 50 (24VDC) |
| Lockpin System Solenoid Valve | 1 - Vickers DG4S4 012A 50 (110VAC) |
| Cylinder Bypass Solenoid Valve | 1 - Vickers DG4S4 018C 50 (110VAC) |
| Steering Cylinders | 2 - Model L 100-52 |
| Bridge Helm Pumps | 3 - Model D |
| Steering Compartment Helm Pumps | 2 - Model D |
| Helm Pump Lockvalves | 5 - 3/4" Wagner |
| Telemotor Cylinder | 1 - 3" w/5 7/8" stroke |
| Pressure Line Filters | 2 - 2" Wagner |
| 4-Way Flow Control Valve | 1 - 2 1/2" Wagner |
| Power System Lockvalve | 1 - 2" Wagner |
| Cylinder Relief Valves | 2 - Vickers CF-16-C-10 |
| Lockpin System Relief Valve | 1 - Gresen J-50 |

Note: The position of all components in the system can be determined by referring to Piping Diagram C-1-934-02.

All drawings referred to in the following text are arranged in order of first mention.

OPERATING PRINCIPLE

Refer to Piping Diagram C-1-934-02 to review the hydraulic steering system component relationships. Two separate systems - POWER and CONTROL - are interconnected through mechanical linkage. This linkage is also attached to the rudder stock to provide rudder position feedback to the control valve assembly.

THE POWER SYSTEM

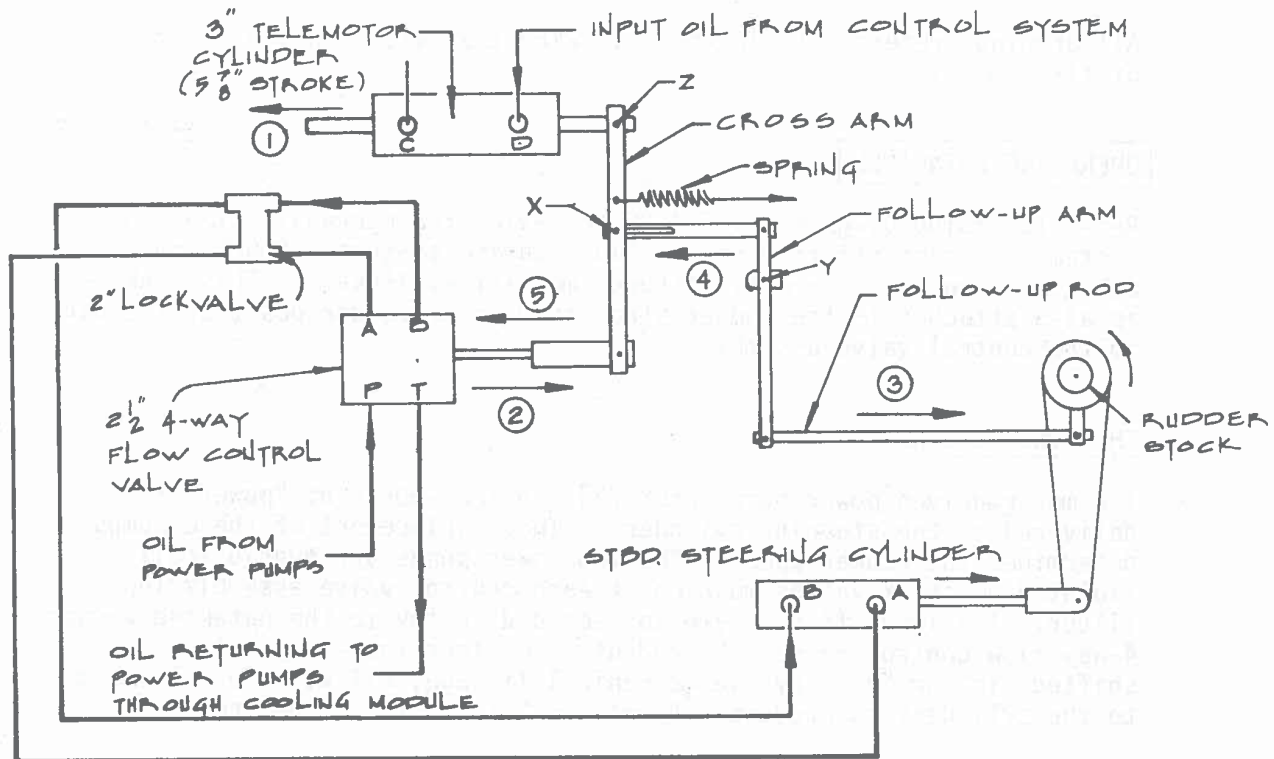
The motor driven power pumps [50V-72] are the source of "power oil" delivered to the steering cylinders. The displacement of these pumps determines the rudder speed. The two power pumps are hydraulically isolated by check valves mounted at each control valve assembly input filter. The input filters are connected directly to the patented Wagner 4-way flow control valve. Dependent on whether the 4-way valve is shifted "in" or "out" by the mechanical linkage, oil will be delivered to the cylinders to produce a "port" or "starboard" manoeuvre.

THE CONTROL SYSTEM

The telemotor cylinder is the input from the CONTROL system to the control valve assembly through the mechanical linkage. The three helm pumps located in the bridge consoles or the indicated helm pump in the steering compartment are the source of oil delivered to the telemotor cylinder when a change of rudder position is called up by turning the steering wheel on any one helm pump. The motor driven control pumps [V110-1.5] (also known as After Power Units) are the source of oil delivered to the telemotor cylinder when a change of rudder position is called up through the electric steering or gyropilot. The movement of the telemotor cylinder is directly proportional to the rudder angle and for any telemotor position there is a corresponding rudder position.

THE CONTROL VALVE ASSEMBLY

The control valve assembly features positional accuracy of better than ± 0.25 degrees at maximum hardover rudder speeds up to three seconds and provides motion storage with automatic slack compensation and silent, shockless positioning.



Consider a call for STARBOARD RUDDER.

Input oil from either control system source (helm pump or motor driven pump) flows to port D of the telemotor cylinder causing the cylinder rod to stroke in the direction of Arrow (1). The cross arm, being attached to the cylinder rod, is caused to pivot about Point X and pulls the 4-way flow control valve spindle in the direction of Arrow (2). Oil from the power pump(s) is now directed out of Port B through the lockvalve and into Port B of the steering cylinder. This causes counter-clockwise rotation of the rudder stock or STARBOARD RUDDER.

The rotation of the rudder stock causes the follow-up rod to move in the direction of Arrow (3). The follow-up arm, being pinned to the follow-up rod, is caused to pivot about Point Y and moves the slotted bar in the direction of Arrow (4). The slotted bar picks up the cross arm, which is loaded by the spring, and pivots about Point Z. The 4-way flow control valve spindle is pushed in the direction of Arrow (5) back to a neutral position.

With the 4-way flow control valve in neutral position, oil from the power pump(s) is circulated to the inlet of the pumpset.

A call for PORT RUDDER produces reverse telemotor cylinder, linkage and 4-way valve motion.

SYSTEM COMPONENTS

THE POWER SYSTEM

Ref: C-1-934-02

Power System Pumpsets

Ref: C-2165-02

These pumpsets consist of 2 - 75HP 440/3/60 electric motors mounted on a common frame, each driving a Vickers 50V-72 vane type pump. Each runs at a constant speed of 1800 RPM and provides a rudder speed of 20 seconds hardover independently or 10 seconds hardover together. The pumps are C-flange mounted to the motors and driven through a flexible coupling. Shutoff valves (3") at the pump inlets allow each pump to be isolated for independent maintenance. The pressure lines to the control valve assembly on the steering gear are hydraulically isolated by Vickers C2-835 check valves which are mounted directly onto the pressure line filters.

Power System Header Tank

Ref: C-3114-02

This tank has a volumetric capacity of approximately 250 U.S. gallons. It should be mounted as high as possible above the steering gear in order to flood and provide a positive pressure at the power pump inlets. The tank outlet should be no less than 5 feet above the pump inlet ports.

The tank is provided with a 12 in. dia. access hole in the top to facilitate removal of the suction strainer and access to the sight gauge fittings. The access cover includes a filler/breather/strainer mounted at its centre. A separate vent pipe is also provided at the top of the tank opposite the access cover. A 3/4" NPT tank drain plug is located at the lower right corner on the front of the tank.

The strainer is located directly inside of the tank outlet. The threaded element should be removed and cleaned after the first 10 hours of operation and after each system overhaul. Varsol or a similar agent should be used for cleaning. The element should be checked regularly at 3 to 6 month intervals. It may be removed without draining the oil from the tank.

The sight gauge is a 15" heavy duty type with self-closing push button operation. Breakage of the gauge thermal glass will result in only the loss of the oil in the glass. This is a closed circuit gauge and the push button at the lower tank boss MUST be depressed in order to read the gauge. The tank should not be filled more than 3/4 of the sight glass reading at any time.

A low level sensor (GEM LS-1800 (01801) is also installed in the tank and located on the left side when facing the front of the tank. A low level will be indicated by the sensor if the tank oil level drops below a depth of 10 inches. This will provide a safety depth of 3 - 4 inches of oil above the top of the suction strainer. Should the alarm system triggered by this sensor be activated, the power pumpset should be shut off immediately and the reason for the low oil condition determined.

The sensor assembly may be withdrawn from the tank by removing the 4 screws securing its mounting plate to the side of the tank. Care must be taken to avoid damaging the sensor.

A shutoff valve (2") is to be mounted at the tank outlet. This valve is normally open. Although the system could appear to operate satisfactorily with the valve closed and completely filled with oil, it is not advisable to do so. The system is self-venting by design and "breathes" through the tank. Entrapped air must be allowed to escape or component damage and/or system noise may result.

Cooling Module

Ref: A-2157

The cooling module is free standing and should be oriented approximately parallel with the ships' centre line. Clearance must be provided on all sides of the unit to allow free air circulation. The return line oil from the control valve assembly enters at one end housing and is dispersed through the finned cooling tubes.

Care should be taken when securing the unit to the compartment floor as the mounting holes in one foot are slotted to allow expansion and contraction. The mounting bolts in these slotted holes must be snug but not tight and held in position with liquid thread locking compound. The unit is reversible being identical at both ends with 3" NPT and 1/2" NPT female connections and a 1" NPT drain.

A return line temperature sensor (Barksdale MLIH-H354) is connected to the 1/2" NPT fitting on the pumpset side of the unit. On initial start-up of the system, both of these 1/2" NPT fittings should be "cracked" to purge any air collected at the top of each end housing.

THE CONTROL SYSTEM

Ref: C-1-934-02

Control System Pumpsets

Ref: B-2166-01

These pumpsets consist of 2 - 1HP 440/3/60 double ended electric motors mounted on a common frame, each driving a Vickers V110-1.5 vane type pump at one end. Each runs at a constant speed of 1800 RPM and operate singly or together in combination with the power pumps. The pumps are C-flange mounted to the motors and driven through a flexible coupling. Each motor is monitored by a centrifugal switch (Allen-Bradley 808) directly driven and mounted on the motor opposite the pump.

Two DG4S4 manifold solenoid valve assemblies (Ref: D-3080-01) are mounted on the pumpsets and are the electric-hydraulic interface for the electric steering controls and automatic pilot. The output from these manifolds runs to the telemotor cylinder ports. Each manifold includes a 3/4" pressure line filter, a 3/8" flow control valve, a solenoid operated 4-way valve (Vickers DG4S4 018C (24VDC), and a 3/8" lockvalve. Each of these components will be considered individually.

3/4" Pressure Line Filter

[Wagner Part No. 3082-0000]

The filter cleans the oil entering the manifold block from the pump. The reusable element MUST be cleaned after the first 10 hours of operation and after each system overhaul. The element is removed from the filter body by removing the four bolts on the body end. The element should be cleaned in Varsol or a similar agent. The element should be checked regularly at 3 - 6 month intervals.

3/8" Flow Control Valve

[Wagner Part No. 424-0000]

The valve regulates the stroking speed of the telemotor cylinder. The flow adjustment is initially set to correspond with the speed of the steering gear and should not require further adjustment.

The valve contains an integral pilot-operated relief valve to prevent pump overload. This relief valve is pre-set and should not require further adjustment. Oil through the relief valve is returned directly to the pump inlet port. If the flow control valve is disassembled for servicing, care must be taken to ensure all original settings are maintained.

Solenoid 4-Way Valve

Ref: DG4S4 0180C (24VDC) brochure

This valve directs control oil to the telemotor cylinder to command either a port or starboard steering manoeuvre. The valve is controlled by electrical signal to either solenoid as directed by the electric steering controls or automatic pilot.

Manual operation of the valve, as may be required during servicing, is performed by forcing a slender rod in the centre of the end of the solenoid coil.

3/8" Lockvalve

[Wagner Part No. 411-9100]

The lockvalve isolates the manifold valve assembly from the other control system components as well as hydraulically locking the telemotor cylinder in position. The design of this valve is more basic than the 2" lockvalve described in "THE POWER SYSTEM" but its operation is similar.

Two 1/4" shutoff valves are connected directly to the lockvalve outlet ports for use if the lockvalve should bypass oil. These valves are normally open. If these valves must be closed, since the valve stem is gland packed, the gland nut should be backed off, the valve closed and then the nut retightened. This will ensure long seal and valve service life.

Control System Header Tank

Ref: A-3112

This tank has a volumetric capacity of approximately 9 U.S. gallons. It should be mounted above the helm pumps on the bridge in order to ensure that all helm pump reservoirs are completely full of oil.

The tank includes a filler/breather/strainer mounted on top. A dipstick is also provided and is located adjacent to the filler cap. This is provided in the event of installation where viewing of the 5" sight gauge mounted on the tank front might be difficult. The tank should not be filled more than 3/4 capacity at any time.

Helm Pumps

Ref: C-337

[Wagner Part No. 342-0000]

Five Wagner Model D helm pumps, each with a 3/4" lockvalve, are included in the control system. Three pumps are located on the bridge and two are in the steering compartment. Four of these pumps (3 on bridge and one in steering compartment) are connected to the telemotor cylinder. The fifth pump is connected directly to the steering cylinders for emergency use upon complete power failure.

The helm pumps are positive displacement axial piston type. Oil flows from the outlet ports relative to the direction of shaft rotation. Turning to the right (clockwise) pumps oil from the right-hand port when viewing from the front.

Periodically, in a new installation, a helm pump will develop a small leak at the shaft seal. This is usually caused by air-borne contamination working in between the shaft and the seal, although it could possibly be mechanical damage caused during installation. The seal must be removed and either cleaned or replaced. If the pump is full of oil when this is attempted, it is advisable to wrap rags around the shaft or drain the pump.

The pump contains two suction balls, one for each outlet port. Periodically, contamination will hold one of these balls open and oil will circulate back to the pump reservoir when turning in one direction. If the pump operates only when turning to the left, the suction valve connected to the right hand outlet port is contaminated. Often this contaminate can be flushed out and into the piping by spinning the wheel rapidly.

The 3/4" lockvalve (Ref: D-429-01) [Wagner Part No. 409-0000] supplied with each helm pump isolate the pumps from each other and the other control system components as well as hydraulically locking the telemotor cylinder (or the steering cylinders as with the pump in the steering compartment connected directly to the cylinders). All pumps are operative at all times without the need to transfer control. These lockvalves are of the balanced spool design.

The operation of this valve is identical to that of the 2" lockvalve previously described in "THE POWER SYSTEM" excepting the use of ball checks rather than poppet type valves.

Both 3/4" lockvalves at the two helm pumps located in the steering compartment have 3/4" shutoff valves plumbed to their outlet ports to isolate these pumps from normal use. These valves are normally closed.

THE CONTROL VALVE ASSEMBLY

Ref: D-3115-01

2" Pressure Line Filter [Wagner Part No. 3021-0000]

Ref: D-3081

Two pressure line filters clean and combine the oil from both pumpsets at the inlet of the 4-way flow control valve. These filters have reusable elements which MUST be cleaned after the first 10 hours of operation and after each system overhaul.

The element is removed from the filter body by removing the four bolts on the body end. The element should be cleaned in Varsoil or a similar agent. The element should be checked regularly at 3 - 6 month intervals.

A low pressure sensor (Barksdale PIH-B30) is connected to the element end of the filter. The sensor unit is mounted on the control valve assembly plate.

2 1/2" 4-Way Flow Control Valve
[Wagner Part No. 462-0000]

Ref: C-469

Normally, the rudder torque (load) and the steering system pressure increase as the rudder angle increases at a given hull speed. With an ordinary 4-way valve, the position of the valve spindle must be changed for each change in the operated load (or system pressure) to maintain a constant flow of oil to the load. With the patented Wagner 4-way flow control valve (Pat. No. 1328789) (at any set position of the valve spindle) the oil flow is constant regardless of the load.

The oil delivered is proportional to the position of the valve spindle which is shifted open and then closed by the mechanical linkage in response to a telemotor cylinder command.

A very small movement of the valve spindle from the neutral position will deliver oil to the load. This small deadband makes the valve extremely sensitive and provides a fast system response to telemotor command. With the valve in neutral position, oil from the power pump(s) is returned to the inlet of the pump(s) through the integral flow control valve.

A built-in pilot relief valve limits the system operating pressure, in this case to 1100 psi. The entire output of the pump(s) will be returned to the pumpset inlet upon activation of this valve.

2" Lockvalve Ref: D-439
[Wagner Port No. 460-0000]

This lockvalve is manifolded directly to the output side of the 4-way flow control valve and its outlet ports are connected to the steering cylinders. The valve holds the steering cylinders (and the rudder) in fixed position when the 4-way flow control valve is in neutral. This allows power oil to be circulated at low pressure.

This valve is essentially a double pilot-operated check valve. Power oil directed from the 4-way flow control valve (upon steering command) flows into the lockvalve and through the poppet valve corresponding to the 4-way valve outlet port. The lockvalve spool is simultaneously shifted by the flow of oil, compressing the spring at the opposite end of the spool. Power oil flows by the open poppet valve to the cylinders causing them to stroke and displace oil on the other side of the piston.

This displaced oil flows back into the other side of the lockvalve around the opposite poppet valve which is closed and is ported by the shifted lockvalve spool into the return side of the 4-way flow control valve.

When the new rudder position is reached, the 4-way flow control valve is shifted to neutral. This stops the oil flow into the lockvalve, the poppet valve closes and the lockvalve spool shifts back to its centre position. The rudder cannot runaway at this point because the lockvalve has a "balanced" spool design and will shut off - again locking the rudder.

Telemotor Cylinder Ref: C-3083
[Wagner Part No. 3008-0000]

The telemotor cylinder is the input to the control valve assembly from all control modes of the steering gear under power operation. Reference to the piping diagram (C-1-934-02) shows that the control units are all T'd into the 2 telemotor lines. This cylinder has 1/2" NPT ports and a 5 7/8" stroke. Its' rod is attached to the mechanical linkage which strokes the 4-way flow control valve. The rod seals at both ends are the gland packed type and must be inspected and adjusted if required during the routine maintenance schedule. If these packings are too tight, excessive effort will be required at the helm pumps or a higher than normal control system pump pressure will be indicated. The term normal should be judged relative to original operating condition if possible.

Relief Valves Ref: CF-16/24 Series brochure

Two Vickers CF-16-C-10 relief valves are mounted on the control valve assembly plate. These valves are of the balanced piston design and protect the steering system components and rudder stock from excessive loading. They are set at 1300 psi or 200 psi above the maximum operating pressure of the steering system. They do not operate under normal conditions.

Shutoff valves (2") are plumbed into the unloading line which is connected to the pumpset return line and are normally open. If either relief valve becomes contaminated, (indicated by a loss of steering to one side, allowing power oil to return directly back to the pumpset) its shutoff valve must be closed until the valve can be repaired. Ensure that the original settings are maintained if the valve is disassembled for cleaning. Both of these valves have a pressure gauge with a needle shutoff valve mounted on them to indicate operating pressures during port or starboard manoeuvre. These needle shutoff valves are normally closed.

Cylinder Bypass Valve

This valve (2") is located between the 2" lockvalve outlet ports and is used to "short-circuit" the steering system if the rudder stock must be turned manually. This valve is normally closed. If this valve is open the steering gear will not operate.

Cylinder Bypass Solenoid Valve

Ref: DG4S4 018C (110VAC) brochure

This solenoid operated valve (110VAC) is mounted on the control valve assembly plate and is connected between the 2" lockvalve outlet ports. It is used to "short-circuit" the steering cylinders at the same time as the lockpin is activated. This allows the pin to pull the steering gear tiller into position as the locking pin enters the tiller pin socket.

This valve is normally closed. The steering gear will not operate if this valve is in the open position.

THE STEERING GEAR ASSEMBLY

Ref: D-686-01

The steering gear assembly mounts on the rudder stock as a single unit. The total weight of the assembly is approximately 27,000 lbs.

The central steel frame structure incorporates a cylinder support table and provides a mounting surface to pre-align the control valve assembly at the factory. The frame also includes split upper and lower bushings to ease installation on the stock. A grease nipple is provided in the outer half of these hubs to lubricate their bearings. A brass rudder angle indicator is mounted to the upper bushing. The rear end of the frame is supported and restrained by a torque reaction support stool. The weight of the frame and control valve assembly only is approximately 8000 lb.

The split tiller is clamped to the stock and located by 2 keys. The tiller hub is used as the support collar to carry the rudder. Mechanical stopping faces and a mid-position socket for accepting a locking pin are incorporated in the tiller. The weight of the tiller assembly is approximately 13,500 lbs.

Two Model L 100-52 double-acting steering cylinders (Ref: D-661) [Wagner Part No. 637-6000] are mounted on either side of the central frame. The cylinders are pin connected at both ends. Grease nipples for pin lubrication are located on the top of each pin. The piston rod seal is the gland packed type. Periodic inspection and routine maintenance should include checking pin lubrication and rod gland seals. The gland bolts are secured by wire and if adjustment is made to the gland, this wire must be re-installed. The weight of each cylinder is approximately 2000 lb.

THE CARRIER BEARING

Ref: D-2149-01

The split cast steel carrier/radial bearing and packing gland sits directly under the lower frame hub. The packing gland is below the radial portion of the bearing to allow repacking without disassembly of the entire unit. The gland ring is also split. Four 1" square packings are required.

A grease nipple on the side of the carrier housing is provided for lubricating the radial bearing. The grease nipple at the lower frame hub bearing not only provides lubrication at the bearing but also at the carrier bearing thrust face. A grease nipple located near the base of the carrier housing on one of the split support flanges provides lubrication to the lantern ring.

THE LOCKING PIN

Ref: D-686-01

Lock Pin Pumpset

Ref: A-3113

This pumpset consists of 1 - 5HP 440/3/60 electric motor driving a Vickers V110-3.5 vane type pump at a constant speed of 1800 RPM. The pump is C-flange mounted to the motor and driven through a flexible coupling.

A 3/4" filter (Ref: D-3081) is connected directly to the pump inlet. A shutoff valve (3/4") is connected directly to the filter inlet to isolate the pumpset from the power system header tank. This valve is normally open.

A relief valve (Gresen J-50) is T'd to the pump outlet to prevent pump overload. This relief valve outlet connects to the 1/2" NPT fitting on the inlet side of the cooling module. If this valve is disassembled for servicing ensure that the original setting is maintained when reassembling.

Stop/Lock Pin Actuator

Ref: D-694

This unit is mounted on the centre line of the steering gear assembly. The pin is engaged and retracted by the cylinder incorporated at the rear of the housing. A micro switch mounted on top of the pin housing (Ref: A-1-129) indicates when the rudder is in mid-operation.

Pin lubrication is through a grease nipple located on the top of the pin housing. Inspection of the pin should be part of the routine maintenance schedule. The stop pin inserted through the top of the pin housing and running in the grease along the top side of the lock pin must be removed if the unit is to be disassembled for servicing.

The pin housing is also designed as a mechanical rudder stop. Care must be taken when installing this housing to ensure that equal rudder travel is allowed on both sides of mid-ships.

SYSTEM COMPONENT DRAWINGS

THE POWER SYSTEM

| | |
|--------------------------------|--------------------------|
| C-1-934-02 | Piping Diagram |
| C-2165-02 | Power System Pumpsets |
| Vickers 50V Series Brochure | Power Pumps |
| Vickers C2-800 Series Brochure | 2" Check Valves |
| C-3114-02 | Power System Header Tank |
| A-2170-01 | Push Button Sight Gauge |
| A-2157 | Oil Cooling Module |

THE CONTROL SYSTEM

| | |
|------------------------------|----------------------------|
| B-2166-01 | Control System Pumpsets |
| Vickers V100 Series Brochure | Control Pumps |
| D-3080-01 | DG4S4 Manifold Assemblies |
| Vickers DG4S4 (DC) Brochure | Solenoid 4-Way Valve |
| A-3112 | Control System Header Tank |
| C-337 | Model D Helm Pump |
| D-429-01 | 3/4" Lockvalve |

THE CONTROL VALVE ASSEMBLY

| | |
|----------------------------------|---------------------------------|
| D-3115-01 | 2 1/2" Control Valve Assembly |
| D-3081 | 2" Filter |
| C-469 | 2 1/2" 4-Way Flow Control Valve |
| D-439 | 2" Lockvalve |
| C-3083 | 3" Telemotor Cylinder |
| Vickers CF-16/24 Series Brochure | 2" Relief Valve |
| Vickers DG4S4 (AC) Brochure | Solenoid 4-Way Valve |

THE STEERING GEAR ASSEMBLY

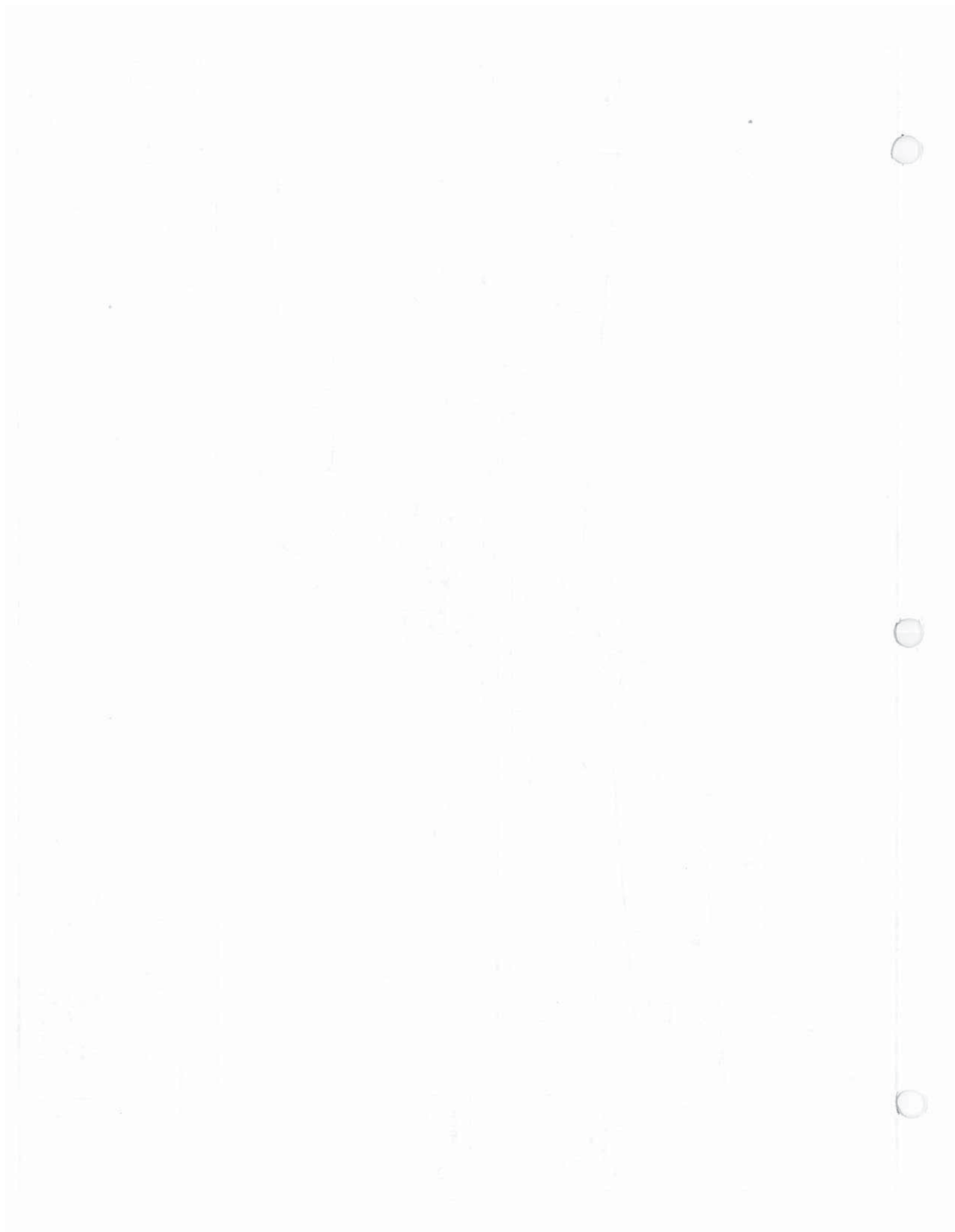
| | |
|----------|----------------------------------|
| D-686-01 | O.A. Dimensions of Steering Gear |
| D-661 | L100-52 Cylinder |

THE CARRIER BEARING

| | |
|-----------|------------------------|
| D-2149-01 | Carrier/Radial Bearing |
|-----------|------------------------|

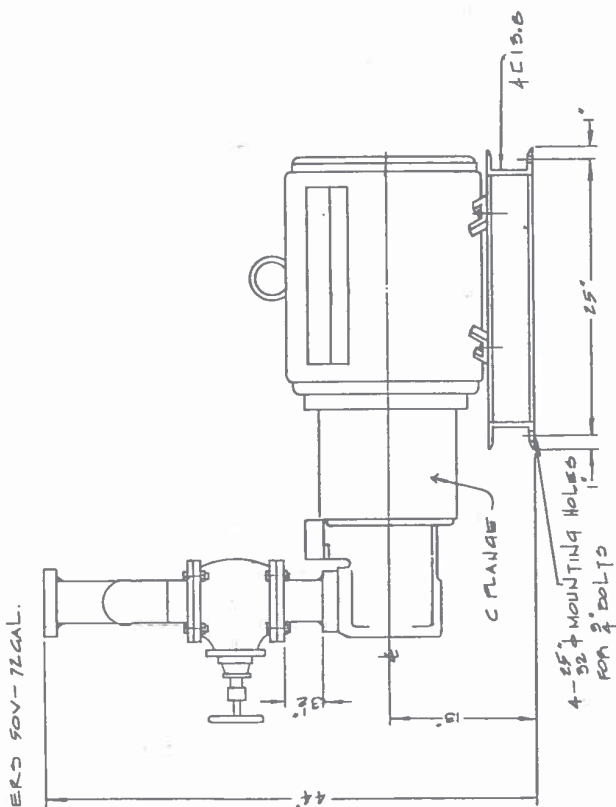
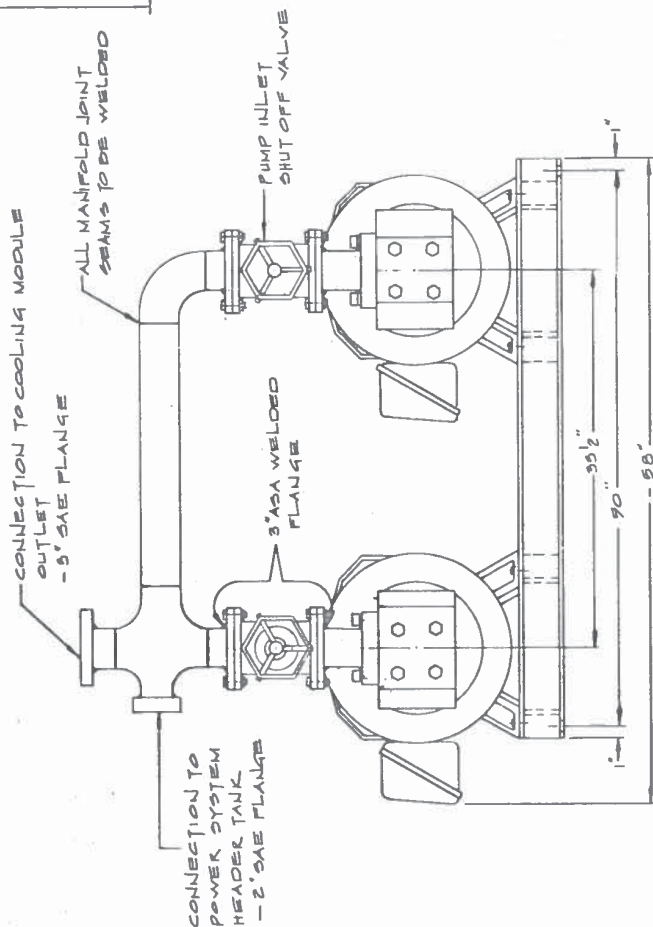
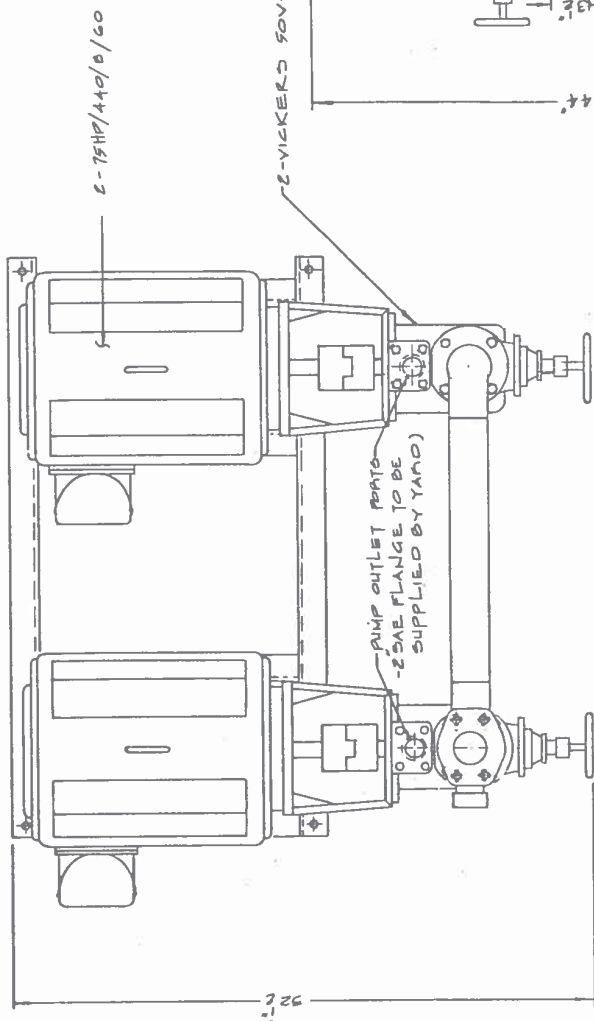
THE LOCKING PIN

| | |
|---------|--------------------------------------|
| A-3113 | Lock Pin Pumpset |
| D-694 | Stop/Lock Pin Actuator |
| A-1-129 | Tiller Centre Indicating Arrangement |



NOTE

- MAKE CONNECTIONS WITH REFERENCE TO PIPING DIAGRAM DWG. C-1-934-02
- ALL SAE CONNECTION FLANGES TO BE WELDED TYPE
- MATING SAE FLANGES FOR CONNECTION OF SHIPYARD PIPING SUPPLIED BY WAQUER

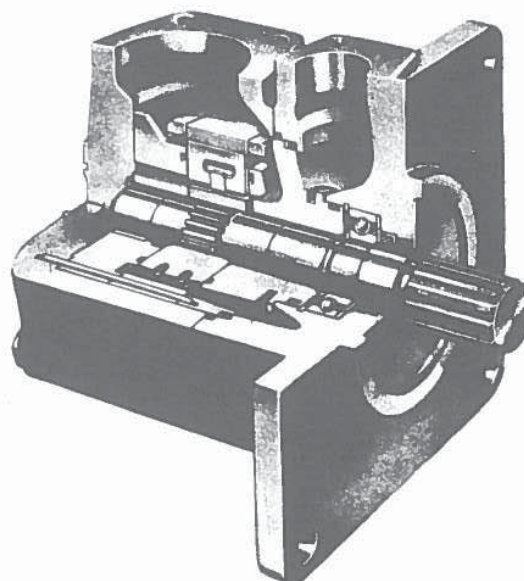


REFERENCES

GERMAN & MILNE D 1108/1
 DDD HILL NO. 221 & 222
 BDD O/NB 221-155-41
 222-155-41

| DETAIL | QUANTITY | DESCRIPTION | MATERIAL |
|--|-----------|--------------|---------------------|
| WAGNER ENGINEERING LTD. 1142 WEST 2ND AVENUE, VANCOUVER, B.C., CANADA MANUFACTURERS OF MARINE HYDRAULIC STEERING GEARS AND AUTOMATIC PILOTS | | | |
| TITLE 2X75HP MOTOR PUMPOUT OVERALL DIMENSIONS | | | |
| DESIGN | DATE | SCALE | QUOTE NO 0824 |
| P.C. | AUG 27/70 | 1/2" = 1'-0" | DRAWING NO REV. |
| REVISION NOTES | | | 01-CONNECTION NOTED |
| 02-FLANGES | | | C-2165 02 |

VICKERS
MOBILE HYDRAULICS DIVISION
**SERVICE
PARTS
CATALOG**



**50V AND 55V SERIES
-11 DESIGN
SINGLE PUMPS**

VICKERS DIVISION
TROY, MICHIGAN 48064

SPARE PARTS STOCK RECOMMENDATIONS (FOR EACH 100 UNITS IN OPERATION)

| PART NUMBER | NAME | 50, 55 | V | * | * — * | * | 11 | L — *** | SPECIAL FEATURES | QUANTITY PER UNIT | QUANTITY RECOMMENDED FOR STOCK |
|----------------|------------------|-----------------------|-----------|-------------------|---------------------|------------|--------------------|---------|-----------------------|----------------------|--------------------------------------|
| | | SERIES DESIGNATION | VANE PUMP | CAPACITY (GPM) | PORT CONNECTIONS | SHAFT TYPE | OUTLET POSITION | DESIGN | LEFT HAND ROTATION | | |
| 278739 | SCREW | 50 | | | | | | | | 4 | 10 |
| 237122 | SCREW | 55 | | | | | | | | 4 | 10 |
| 278740 | COVER | 50 | | | | | | | | 1 | 2 |
| 257241 | COVER | 55 | | | | | | | | 1 | 2 |
| SEE PAGE 1 | SCREW | | | | | | | | | • 2 | 5 |
| SEE PAGE 1 | PIN | | | | | | | | | • 2 | 5 |
| SEE PAGE 1 | BUSHING | | | | | | | | | • 1 | 15 |
| SEE PAGE 1 | WEAR PLATE S. A. | | | | | | | | | • 1 | 15 |
| SEE PAGE 1 | RING | | | | | | | | | • 1 | 15 |
| SEE PAGE 1 | ROTOR | | | | | | | | | • 1 | 15 |
| SEE PAGE 1 | VANE KIT | | | | | | | | | • 1 | 15 |
| SEE PAGE 1 | PRESSURE PLATE | | | | | | | | | • 1 | 15 |
| 923017 | CARTRIDGE KIT | | | 72 | | | | | | 1 | 15 |
| 923018 | CARTRIDGE KIT | | | 85 | | | | | | 1 | 15 |
| 923019 | CARTRIDGE KIT | | | 100 | | | | | | 1 | 15 |
| 923020 | CARTRIDGE KIT | | | 109 | | | | | | 1 | 15 |
| 923066 | CARTRIDGE KIT | | | 119 | | | | | | 1 | 15 |
| 923067 | CARTRIDGE KIT | | | 142 | | | | | | 1 | 15 |
| 209890 | LOCK RING | 50 | | | | | | | | 1 | 10 |
| 148530 | LOCK RING | 55 | | | | | | | | 1 | 10 |
| 117507 | SNAP RING | 50 | | | | | | | | 1 | 10 |
| 102835 | SNAP RING | 55 | | | | | | | | 1 | 10 |
| 1738 | BEARING | 50 | | | | | | | | 1 | 7 |
| 1739 | BEARING | 55 | | | | | | | | 1 | 7 |
| 219939 | KEY | | | | | 1 | | | | 1 | 7 |
| SEE PAGE 2 | SHAFT | | | | | 1, 4, 11 | | | | 1 | 7 |
| 197740 | WASHER | 50 | | | | | | | | 1 | 5 |
| 187550 | WASHER | 55 | | | | | | | | 1 | 5 |
| 197749 | BODY | 50 | | | | | | | | 1 | 2 |
| 308505 | BODY | 55 | | | | | | | | 1 | 2 |
| 214793 | SCREW | 50 | | | | | | | | 002 | 4 |
| 279625 | BRACKET | 50 | | | | | | | | 002 | 1 |
| 922853 | SEAL KIT | 50 | | | | | | | | 1 | 25 |
| 922854 | SEAL KIT | 55 | | | | | | | | 1 | 25 |

• MAY BE PURCHASED IN CARTRIDGE KIT



WHEN ORDERING SPARE CARTRIDGE PARTS, IT IS RECOMMENDED THEY BE OBTAINED IN CARTRIDGE KITS. KITS ARE ASSEMBLED AND TESTED BY VICKERS FOR EITHER RIGHT OR LEFT HAND ROTATION. IF LEFT HAND ROTATION IS REQUIRED IT SHOULD BE SPECIFIED ON PARTS ORDER BY ADDING SUFFIX "L" TO CARTRIDGE KIT NUMBER: FOR EXAMPLE, 923017-L.

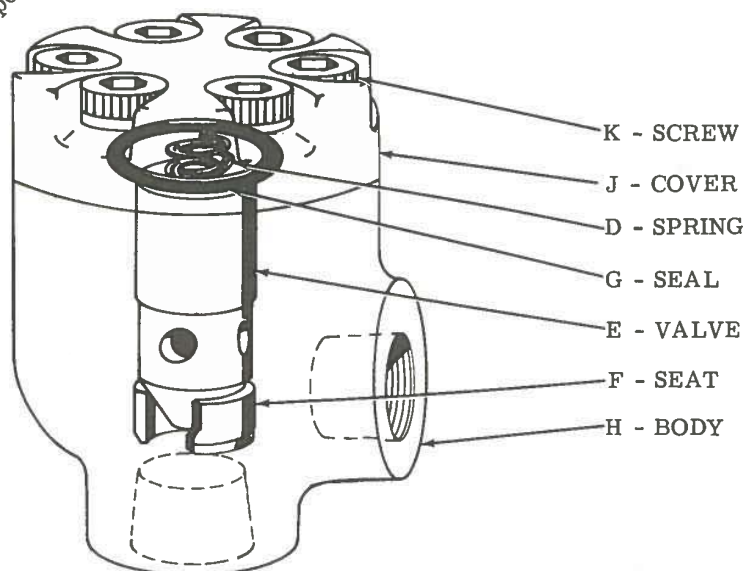
To insure sustained efficiency and maximum trouble-free life of this precision equipment, initial and continuous filtration of the fluid medium to 25 microns or less is essential. For information pertaining to Vickers economical 10 micron filters, see installation drawing M 229847.

Service Parts Information

RIGHT ANGLE CHECK VALVES C2-800 SERIES

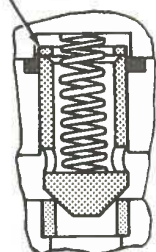
NOTICE
As this complete unit can be replaced at a nominal cost, factory repair is not practical. Parts are available from our Branch Warehouse system to support customer repair of this unit.

Nominal Pipe Size
1/4 inch to 2 inches

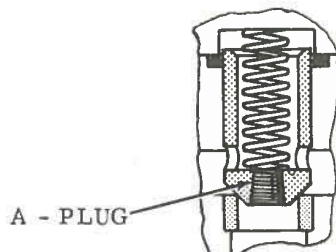


| SPACER | MODEL USED ON |
|--------|--------------------------|
| 64329 | C2-800-S17 C2-805-S17 |
| 109738 | C2-820-S17 |

SEE TABULATION ON REVERSE SIDE.

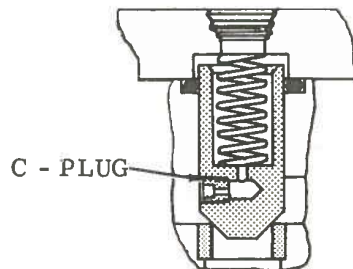


-S17 DESIGN



A - PLUG

-S12 DESIGN

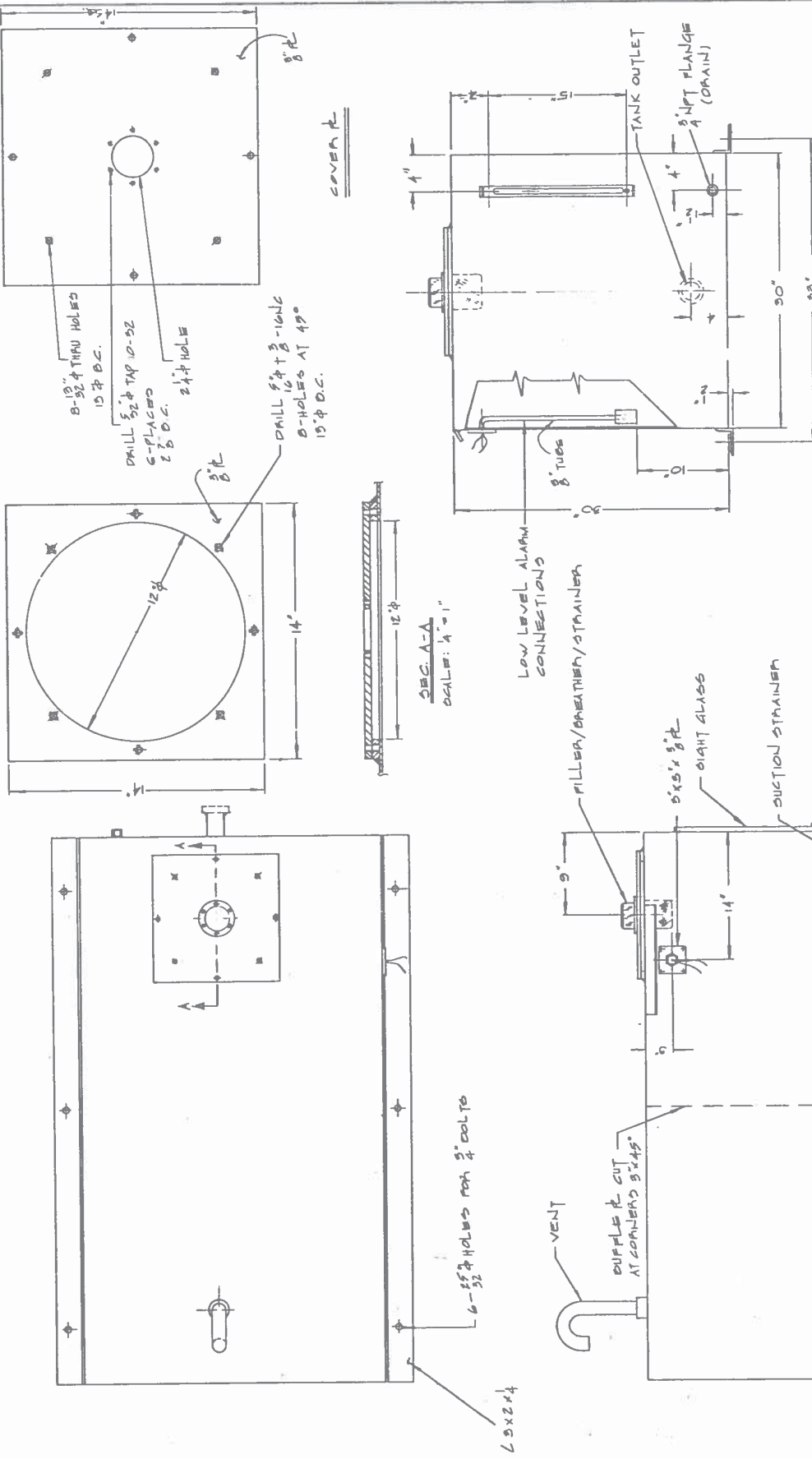


C - PLUG

-S18 DESIGN

WHEN ORDERING REPLACEMENT PARTS FURNISH COMPLETE MODEL NUMBER AND PART NUMBER. DO NOT ORDER BY INDEX REFERENCE ALONE.

| PIPE SIZE | MODEL | A PLUG | B CRACKING PRESSURE P. S. I. | C PLUG | D SPRING | E VALVE | F SEAT | G "O" RING SEAL | H BODY | J COVER | K SCREW (6 REQ'D) |
|--------------|------------|-----------|---------------------------------------|-----------|-------------|------------|-----------|-----------------------|-----------|------------|-------------------------|
| 1/4" | C2-800 | — | 5 | — | 2978 | 118-X | 913-X | 154142 | 94100 | 5657 | 1050 |
| | C2-800-S2 | — | 35 | — | 31717 | | | | | | |
| | C2-800-S3 | — | 50 | — | 35298 | | | | | | |
| | C2-800-S8 | — | 75 | — | 55233 | 54097 | | | | | |
| | C2-800-S12 | 81593 | 5 | — | 2978 | | | | | | |
| | C2-800-S17 | — | 125 | — | 112407 | | | | | | |
| | C2-800-S19 | — | 20 | — | 65915 | 118-X | | | | | |
| C2-800-S20 | — | 1 | — | 140804 | | | | | | | |
| 3/8" | C2-805 | — | 5 | — | 2978 | 118-X | 913-X | 154142 | 94005 | 5657 | 1050 |
| | C2-805-S2 | — | 35 | — | 31717 | | | | | | |
| | C2-805-S3 | — | 50 | — | 35298 | | | | | | |
| | C2-805-S8 | — | 75 | — | 55233 | 54097 | | | | | |
| | C2-805-S12 | 81593 | 5 | — | 2978 | | | | | | |
| | C2-805-S17 | — | 125 | — | 112407 | | | | | | |
| | C2-805-S19 | — | 20 | — | 65915 | 118-X | | | | | |
| C2-805-S20 | — | 1 | — | 140804 | | | | | | | |
| 1/2" | C2-810 | — | 5 | — | 2943 | 2714 | 2715 | 154020 | 94010 | 94099 | 1071 |
| | C2-810-S2 | — | 35 | — | 36316 | | | | | | |
| | C2-810-S3 | — | 50 | — | 25896 | | | | | | |
| | C2-810-S8 | — | 75 | — | 32999 | | | | | | |
| | C2-810-S12 | 81592 | 5 | — | 2943 | 48936 | | | | 2714 | |
| | C2-810-S17 | — | 125 | — | 84235 | | | | | | |
| | C2-810-S18 | — | 5 | 62014 | 49178 | 75928 | | | | | |
| | C2-810-S19 | — | 20 | — | 2287 | 2714 | | | | | |
| C2-810-S20 | — | 1 | — | 83902 | 2714 | | 94099 | | | | |
| 3/4" | C2-815 | — | 5 | — | 2943 | 2714 | 2715 | 154020 | 94015 | 94099 | 1071 |
| | C2-815-S2 | — | 35 | — | 36316 | | | | | | |
| | C2-815-S3 | — | 50 | — | 25896 | | | | | | |
| | C2-815-S8 | — | 75 | — | 32999 | | | | | | |
| | C2-815-S12 | 81592 | 5 | — | 2943 | 48936 | | | | 2714 | |
| | C2-815-S17 | — | 125 | — | 84235 | | | | | | |
| | C2-815-S18 | — | 5 | 62014 | 49178 | 75928 | | | | | |
| | C2-815-S19 | — | 20 | — | 2287 | 2714 | | | | | |
| C2-815-S20 | — | 1 | — | 83902 | 2714 | | 94099 | | | | |
| 1" | C2-820 | — | 5 | — | 2990 | 6422 | 6423 | 154026 | 94020 | 94098 | 1073 |
| | C2-820-S2 | — | 35 | — | 60290 | | | | | | |
| | C2-820-S3 | — | 50 | — | 19767 | | | | | | |
| | C2-820-S8 | — | 75 | — | 45685 | | | | | | |
| | C2-820-S12 | 81592 | 5 | — | 2990 | 58781 | | | | 6422 | |
| | C2-820-S17 | — | 125 | — | 109735 | | | | | | |
| | C2-820-S18 | — | 5 | 62014 | 99977 | 100004 | | | | | |
| | C2-820-S19 | — | 20 | — | 39067 | 6422 | | | | | |
| C2-820-S20 | — | 1 | — | 104485 | | 94098 | | | | | |
| 1-1/4" | C2-825 | — | 5 | — | 2284 | 2587 | 2937 | 154077 | 94025 | 94097 | 1073 |
| | C2-825-S2 | — | 35 | — | 2953 | | | | | | |
| | C2-825-S3 | — | 50 | — | 29059 | | | | | | |
| | C2-825-S8 | — | 75 | — | 39778 | | | | | | |
| | C2-825-S12 | 81591 | 5 | — | 2284 | 58782 | | | | 2587 | |
| | C2-825-S17 | — | 125 | — | 64062 | | | | | | |
| | C2-825-S18 | — | 5 | 62014 | 18493 | 66207 | | | | | |
| | C2-825-S19 | — | 20 | — | 106669 | 2587 | | | | | |
| C2-825-S20 | — | 1 | — | 2950 | | 94097 | | | | | |
| 1-1/2" | C2-830 | — | 5 | — | 2284 | 2587 | 2937 | 154077 | 94030 | 94097 | 1073 |
| | C2-830-S2 | — | 35 | — | 2953 | | | | | | |
| | C2-830-S3 | — | 50 | — | 29059 | | | | | | |
| | C2-830-S8 | — | 75 | — | 39778 | | | | | | |
| | C2-830-S12 | 81591 | 5 | — | 2284 | 58782 | | | | 2587 | |
| | C2-830-S17 | — | 125 | — | 64062 | | | | | | |
| | C2-830-S18 | — | 5 | 62014 | 18493 | 66207 | | | | | |
| | C2-830-S19 | — | 20 | — | 106669 | 2587 | | | | | |
| C2-830-S20 | — | 1 | — | 2950 | | 94097 | | | | | |
| 2" | C2-835 | — | 5 | — | 9803 | 10748 | 10749 | 154085 | 94035 | 10746 | 1115 |
| | C2-835-S2 | — | 35 | — | 10766 | | | | | | |
| | C2-835-S3 | — | 50 | — | 44425 | | | | | | |
| | C2-835-S8 | — | 75 | — | 105614 | | | | | | |
| | C2-835-S12 | 81590 | 5 | — | 9803 | 58783 | | | | 10748 | |
| | C2-835-S17 | — | 125 | — | 234965 | | | | | | |
| | C2-835-S18 | — | 5 | 51305 | 65939 | 65667 | | | | | |
| | C2-835-S19 | — | 20 | — | 79798 | 10748 | | | | | |
| C2-835-S20 | — | 1 | — | 114304 | | 10746 | | | | | |



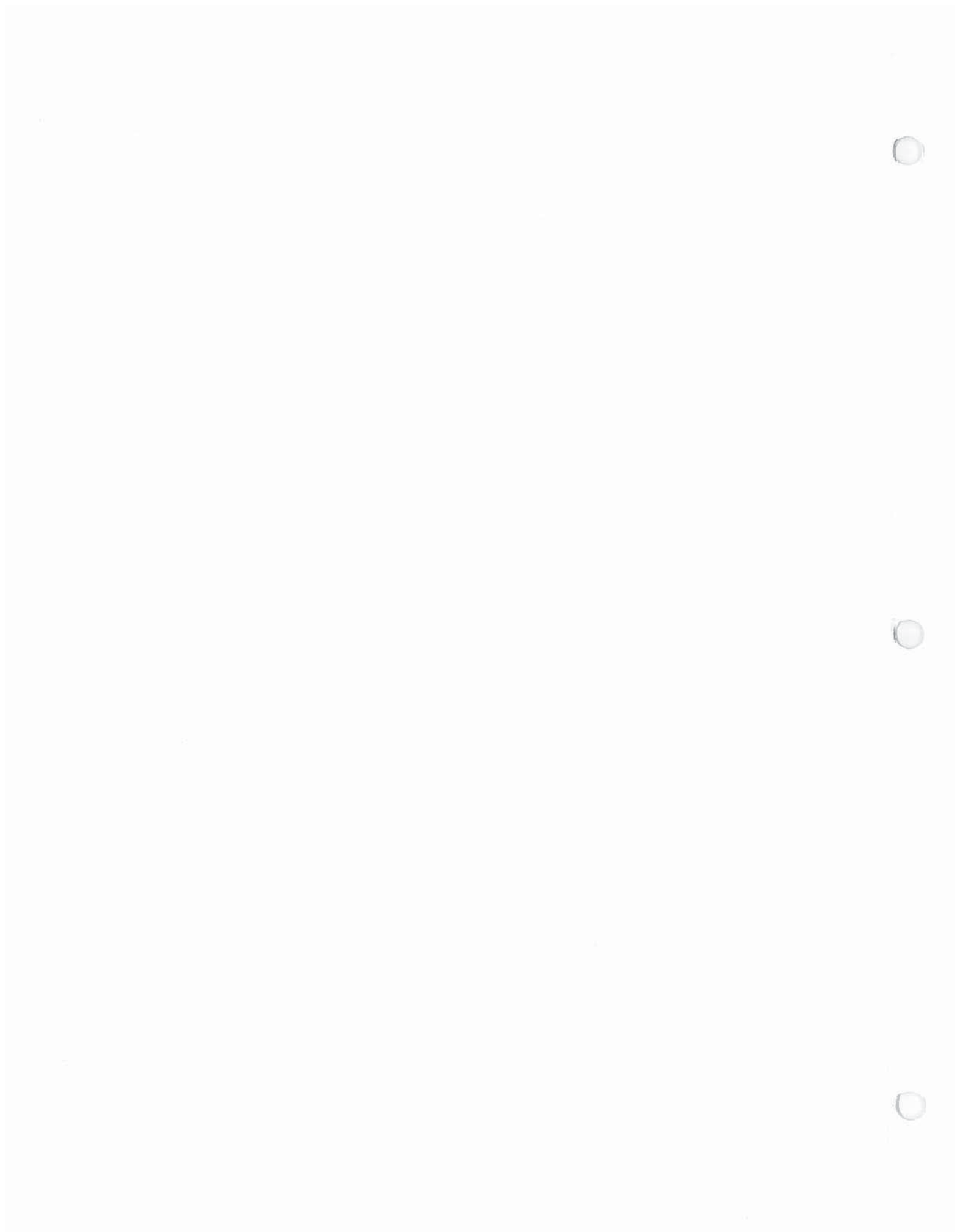
| DETAIL | QUANTITY | DESCRIPTION | MATERIAL |
|---|------------|--------------|------------|
| VAGNER ENGINEERING LTD. 1742 WEST 2ND AVENUE, VANCOUVER, B.C. CANADA MANUFACTURERS OF MARINE HYDRAULIC STEERING GEARS AND AUTOMATIC PILOTS | | | |
| TITLE POWER SYSTEM HEADER TANK CAPACITY: 250 GAL. (946L) | | | |
| DRAWN | DATE | SCALE | QUOTE NO |
| P.C. | DEPT. 1/16 | 1/2" = 1'-0" | 0824 |
| REVISION | NOTES | | REV. |
| 01- FLANGE OUTLET | | | DRAWING NO |
| 02- VENT & SIGHT GLASS | | | C-3114 |
| | | | 02 |

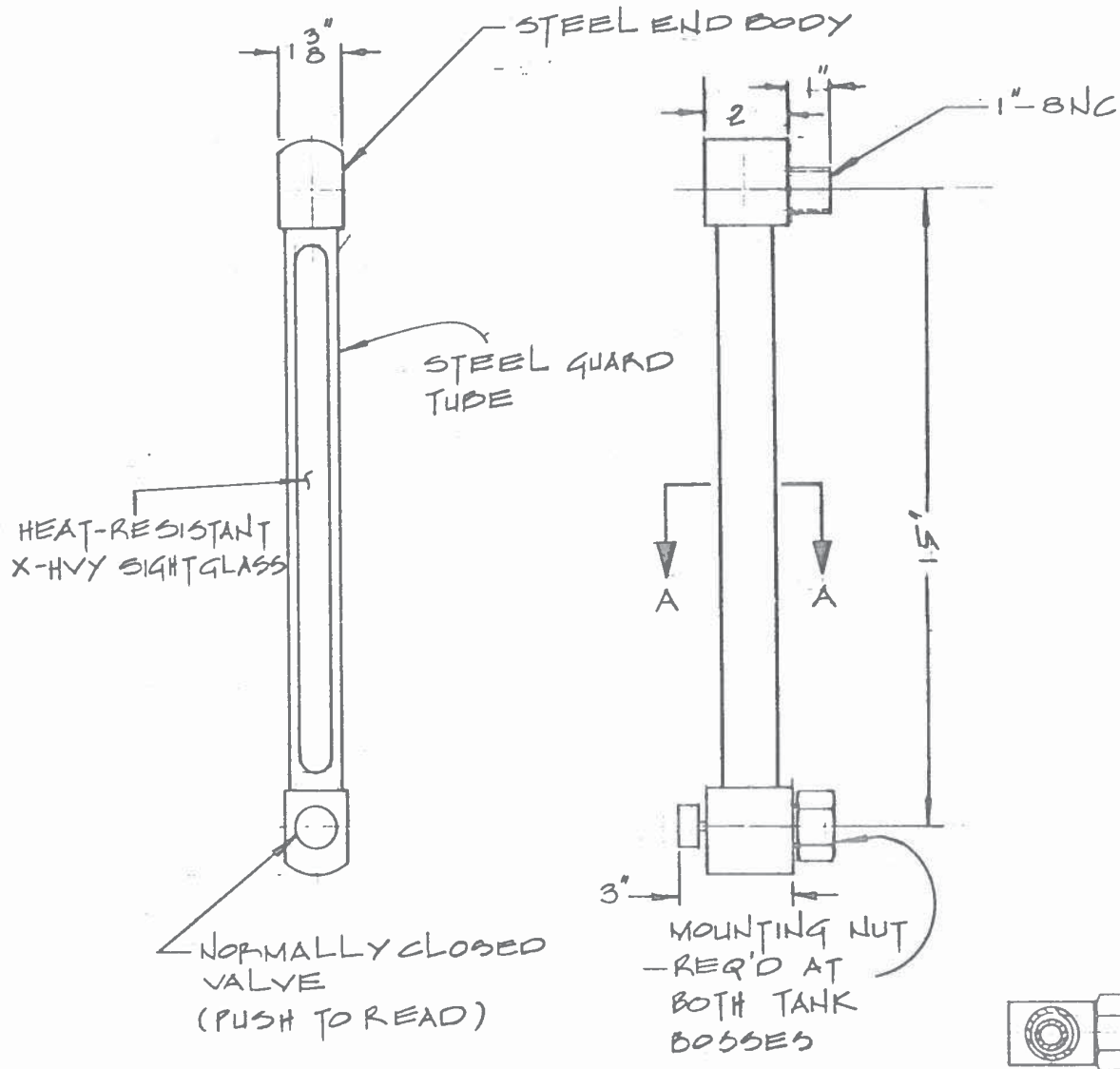
REFERENCES

GERMAN & WILLE D 1108/1
 BDD HULL NO. 221 & 222
 BDD OINS 221-135-41
 222-135-41

NOTE
 MOUNT TANK ABOVE POWER PUMPSET INLET

- ALL DIMENSIONS IN INCHES





SELF-CLOSING PUSH BUTTON SIGHT GAUGE



WAGNER ENGINEERING LTD.

1742 WEST 2nd AVENUE, VANCOUVER, B.C., CANADA

Manufacturers of MARINE HYDRAULIC STEERING GEARS and AUTOMATIC PILOTS

DATE

NOV. 12/76

DRAWN

F.C.

DWG No.

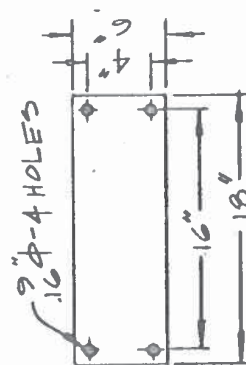
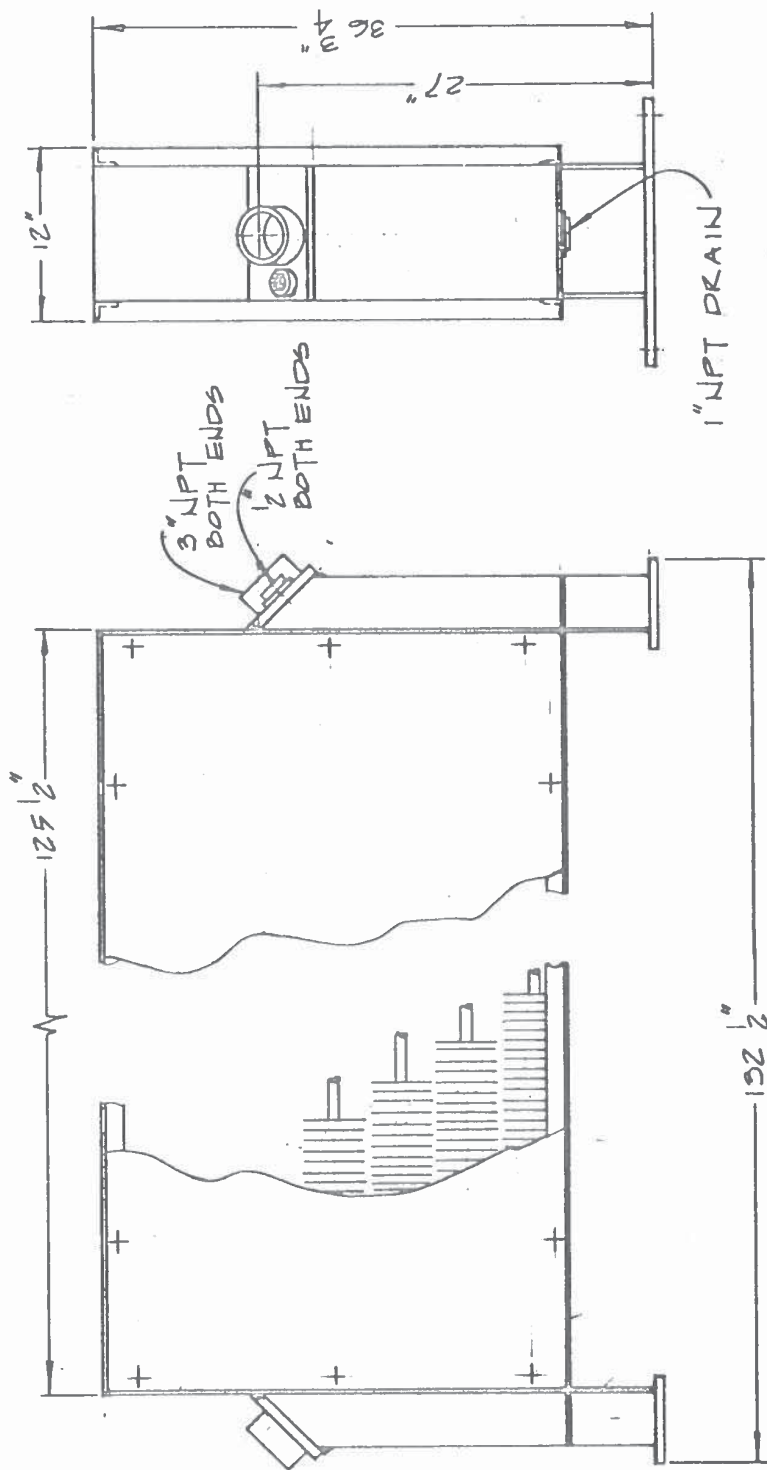
A-2170

REV.

01

SCALE: 1/4" = 1"





MOUNTING FOOT DET'LS
8-1/2" Ø BOLTS REQ'D

REFERENCE

GERMAN & MILNE D1108/1
BDD HULL Nos 221 & 222
BDD O/Ns 221-135-41
222-135-41

SCALE: 1"=1'-0"

OIL COOLING MODULE - OVERALL DIMENSIONS



WAGNER ENGINEERING LTD.

1742 WEST 2nd AVENUE, VANCOUVER, B.C., CANADA

Manufacturers of MARINE HYDRAULIC STEERING GEARS and AUTOMATIC PILOTS

| |
|-----------|
| DATE |
| MAY 28/76 |
| DRAWN |
| F.C. |

DWG No.

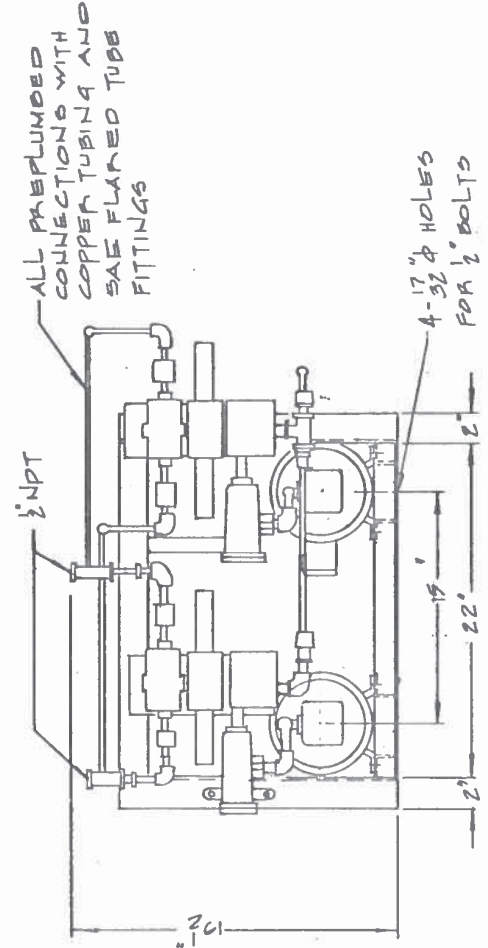
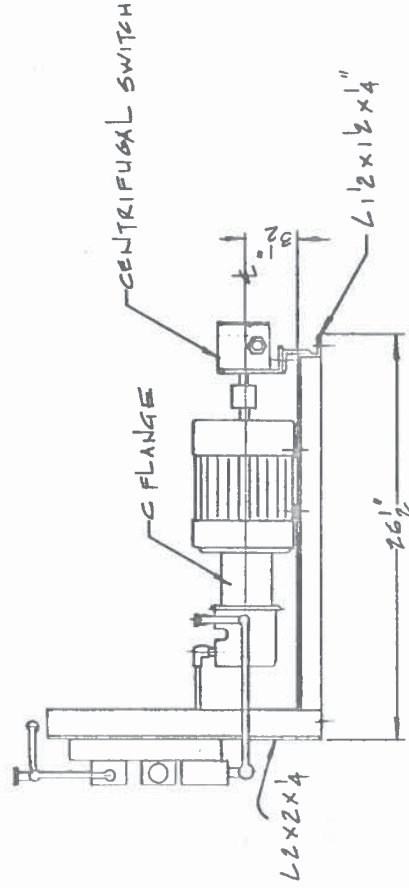
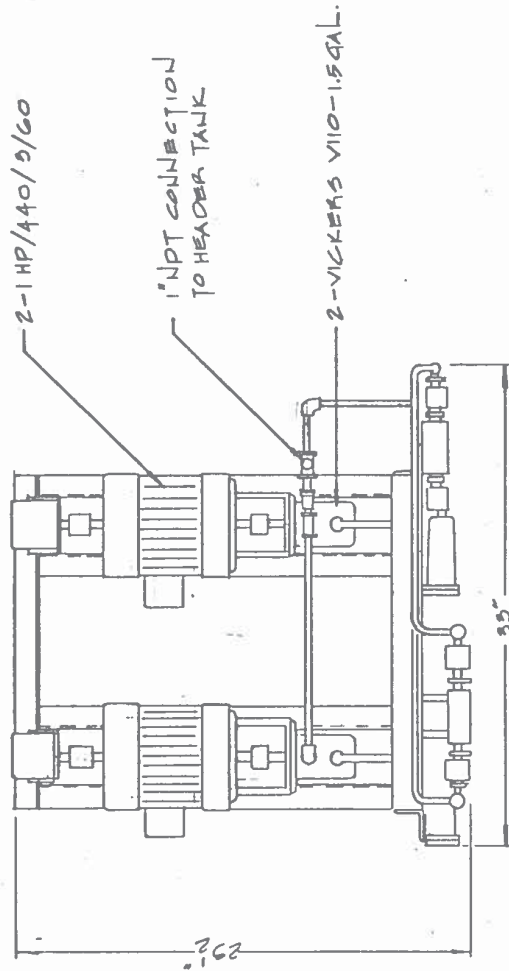
A-2157


REV.

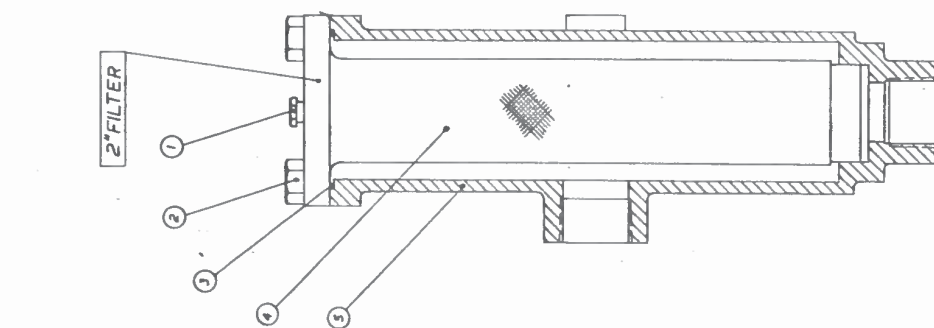
NOTE:
MAKE CONNECTIONS WITH
REFERENCE TO PIPING
DIAGRAM DWG. C-1-994-02

REFERENCES

GERMAN & MILNE D1108/1
BOD HULL Nos. 221 & 222
BOD O/Ns 221-135-41
222-135-41



| DETAIL | QUANTITY | DESCRIPTION | MATERIAL |
|--|------------------|------------------|---------------------------------|
|  WAGNER ENGINEERING LTD. 1742 WEST 2ND AVENUE, VANCOUVER, B.C., CANADA Manufacturers of MARINE HYDRAULIC STEERING GEARS and AUTOMATIC PILOTS | | | |
| TITLE 2 X 1 HP CONTROL PUMP SET OVERALL DIMENSIONS | | | |
| DRAWN F.C. | DATE SEPT 176 | SCALE 1" = 6" | QUOTE NO 0824 |
| REVISION NOTES TUBING & FITTINGS NOTE | | | REV. DRAWING NO B-2166 01 |



2" FILTER [NO. 3021-0000]

| | | | |
|---|---|------------|-----------|
| 1 | 1 | 41-02001 | PLUG |
| 2 | 4 | 51-21001 | CAPSCREW |
| 3 | 1 | 11-06249 | O RING |
| 4 | 1 | 71-3021004 | CARTRIDGE |
| 5 | 1 | 3002-0005 | HOUSING |

1" FILTER [NO. 3001-0000] RIPPED [NO. 3001-9000: MANIFOLD]

| | | | |
|----|---|------------|-----------|
| 1 | 1 | 41-02001 | PLUG |
| 2 | 4 | 51-21001 | CAPSCREW |
| 3 | 1 | 11-06232 | O RING |
| 4 | 1 | 71-3001003 | CARTRIDGE |
| 5 | 1 | 11-06227 | O RING |
| 6 | 1 | 3001-0006 | HOUSING |
| 6A | 1 | 3001-9006 | HOUSING |
| 7 | 1 | 3001-0007 | PIN |

3/4" FILTER [NO. 3082-0000]

| | | | |
|---|---|------------|-----------|
| 1 | 1 | 41-02001 | PLUG |
| 2 | 4 | 51-21001 | CAPSCREW |
| 3 | 1 | 11-06224 | O RING |
| 4 | 1 | 71-3003004 | CARTRIDGE |
| 5 | 1 | 3003-0005 | HOUSING |

*** 3/4" FILTER [NO. 3003-0000] RIPPED [NO. 3003-9000: MANIFOLD]**

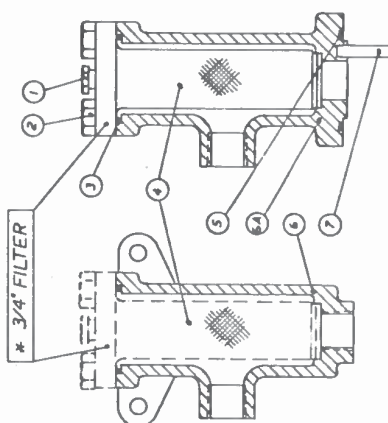
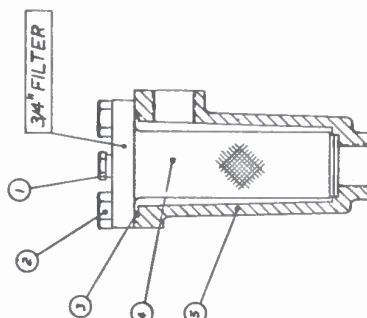
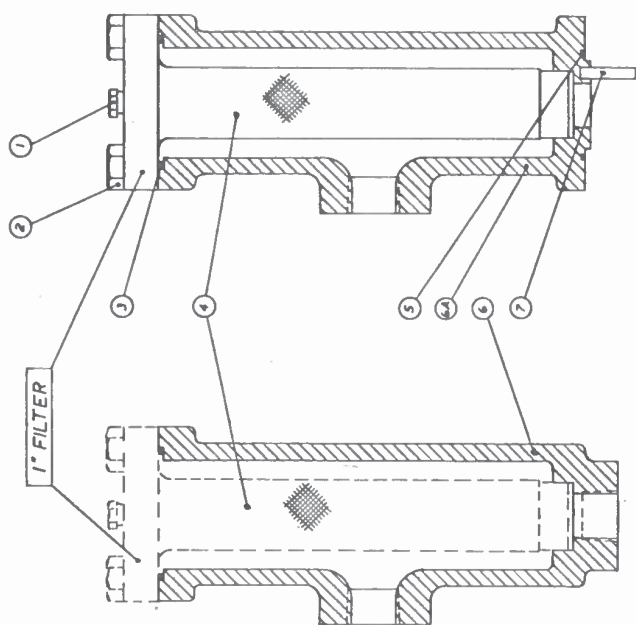
| | | | |
|----|---|------------|-----------|
| 1 | 1 | 41-02001 | PLUG |
| 2 | 4 | 51-21001 | CAPSCREW |
| 3 | 1 | 11-06224 | O RING |
| 4 | 1 | 71-3003001 | CARTRIDGE |
| 5 | 1 | 11-06225 | O RING |
| 6 | 1 | 3003-0006 | HOUSING |
| 6A | 1 | 3003-9006 | HOUSING |
| 7 | 1 | 3003-0007 | PIN |

| ITEM | QTY | PART NO. | DESCRIPTION |
|------|-----|----------|-------------|
|------|-----|----------|-------------|

MAGNER ENGINEERING LTD.
 1142 WEST 104 AVENUE, VANCOUVER, B.C. CANADA
 MANUFACTURERS OF MARINE AUTOMATIC STEERING DEVICES AND AUTOMATIC PUMPS

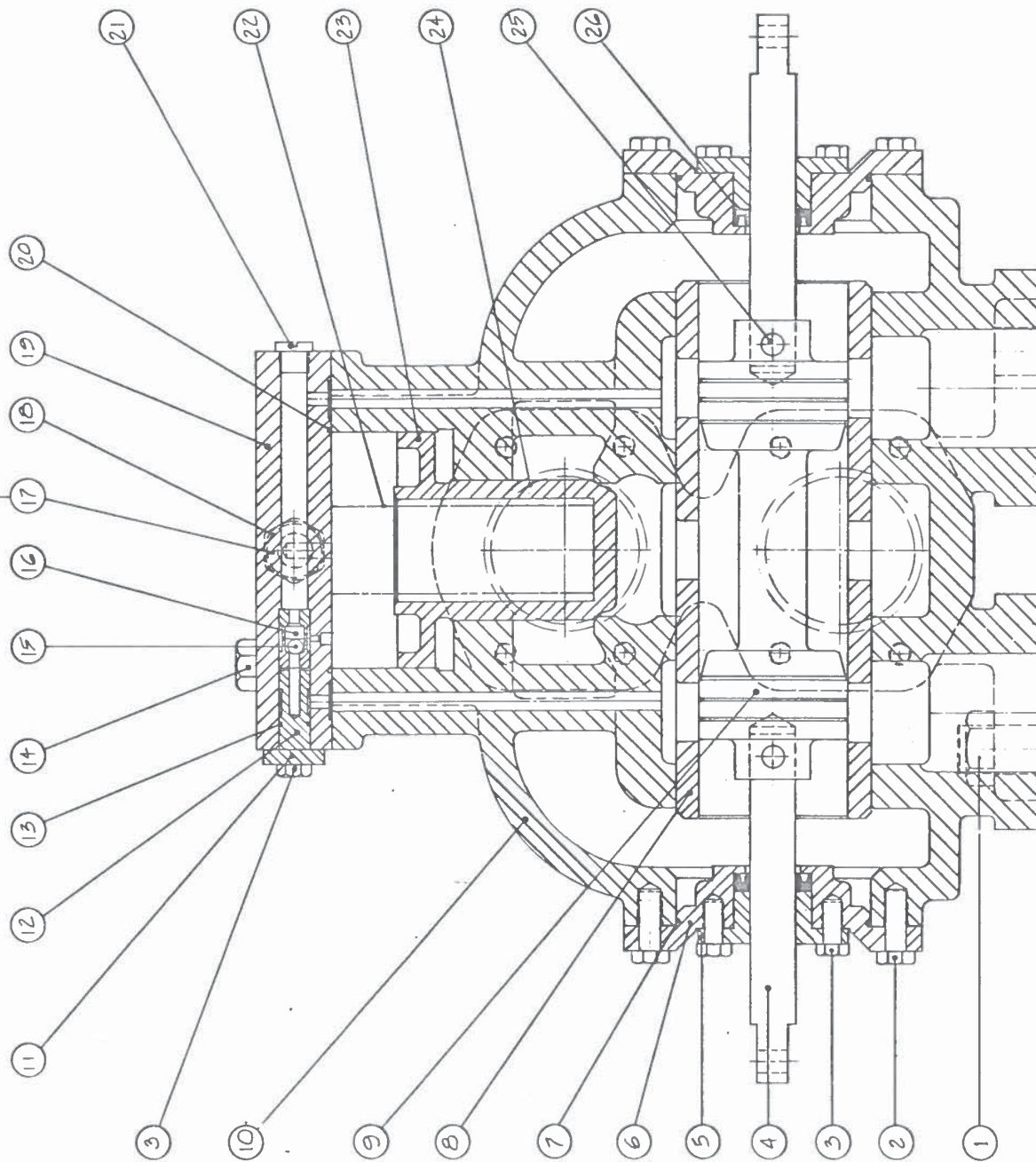
FILTERS PARTS LIST

| | | |
|------|------|-------------|
| DATE | REV | QUOTE NO. |
| 7/8 | 1 | |
| BY | CHKD | DRAWING NO. |
| | | D-3081 |





SEE DWG. B-426 FOR DETAILS

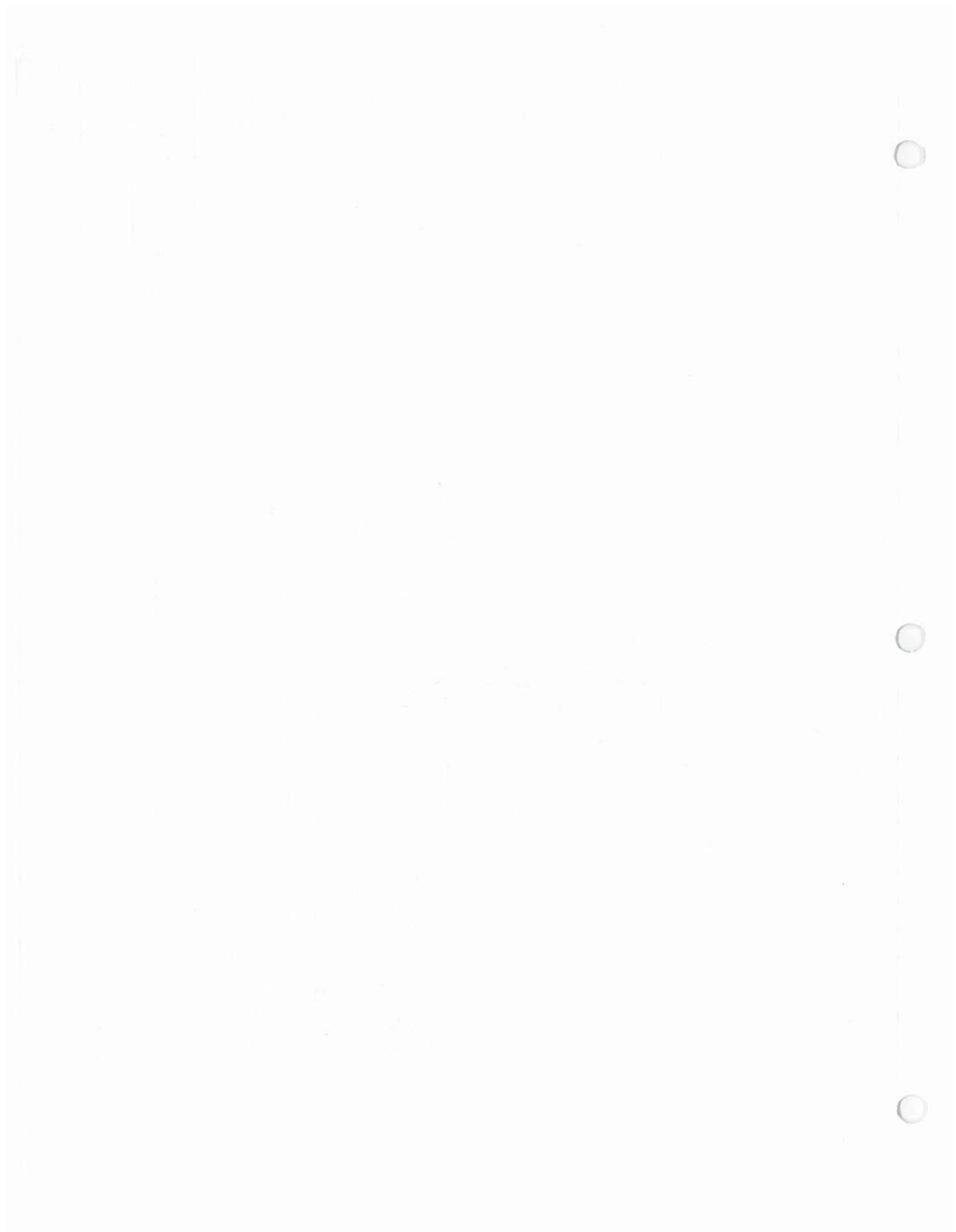


| | | | |
|----|---|-----------|------------------------|
| 1 | 4 | 51-28002 | STUD |
| 2 | 8 | 51-21001B | CAPSCREW |
| 3 | 6 | 51-21001B | CAPSCREW |
| 4 | 2 | 462-0004 | SPINDLE ROD |
| 5 | 2 | 462-0005 | GLAND |
| 6 | 2 | 462-0006 | ENDPLATE |
| 7 | 2 | 11-106234 | O-RING |
| 8 | 1 | 462-0008 | SLEEVE |
| 9 | 1 | 462-0009 | SPINDLE |
| 10 | 1 | 461-0000 | HOUSING |
| 11 | 1 | 462-0012 | SHUTTLE KEEPER R. |
| 12 | 1 | 462-0013 | SHUTTLE DISTANCE PIECE |
| 13 | 1 | 11-106012 | O-RING |
| 14 | 4 | 51-21003G | CAPSCREW'S |
| 15 | 1 | 51-300011 | BALL |
| 16 | 2 | 462-0017 | SHUTTLE BALL SEAT |
| 17 | 2 | 426-0000 | PILOT RELIEF VALVE |
| 18 | 1 | 11-106114 | O-RING |
| 19 | 1 | 462-0020 | COVER PLATE |
| 20 | 1 | 11-106242 | O-RING |
| 21 | 1 | 41-110002 | PLUG |
| 22 | 1 | 51-100027 | SPRING |
| 23 | 1 | 462-0024 | PISTON |
| 24 | 2 | 11-106232 | O-RING |
| 25 | 2 | 51-170004 | PIN |
| 26 | 2 | 11-206002 | U-CLIP |

PAT. NO. 3125789

| ITEM | QTY | PART NO. | DESCRIPTION |
|------|-----|----------|-------------|
|------|-----|----------|-------------|

| | | | |
|--|-------------------|-----------------|----------------------|
| DETAILS | QUANTITY | DESCRIPTION | MATERIAL |
| WAGNER ENGINEERING LTD. 1142 WEST 2ND AVENUE, VANCOUVER, B.C., CANADA Manufacturers of MARINE HYDRAULIC STEERING GEARS and AUTOMATIC PILOTS | | | |
| TITLE PARTS LIST FOR 2 1/2 4-WAY FLOW CONTROL VALVE [No. 462-0000] | | | |
| DRAWN FC | DATE DEC 30/79 | SCALE N.T.S. | QUOTE NO. |
| REVISION NOTES | | | DRAWING NO. C-460 |
| | | | REV. |



| 2" LOCKVALVE [NO 460-0000] | |
|----------------------------|-------------------------|
| 1 | 2 460-0001 END PLATE |
| 2 | 2 460-0002 DAMPER |
| 3 | 8 51-210015 CAPSCREW |
| 4 | 2 460-0004 POPPET VALVE |
| 5 | 8 51-210035 CAPSCREW |
| 6 | 2 41-102002 PLUG |
| 7 | 2 51-400007 WASHER |
| 8 | 1 460-0008 SLEEVE |
| 9 | 1 460-0009 SPOOL |
| 10 | 1 460-0010 INLET BODY |
| 11 | 2 460-0011 COVER PLATE |
| 12 | 2 31-100025 SPRING |
| 13 | 2 11-106141 O RING |
| 14 | 2 31-100026 SPRING |
| 15 | 2 11-106233 O RING |

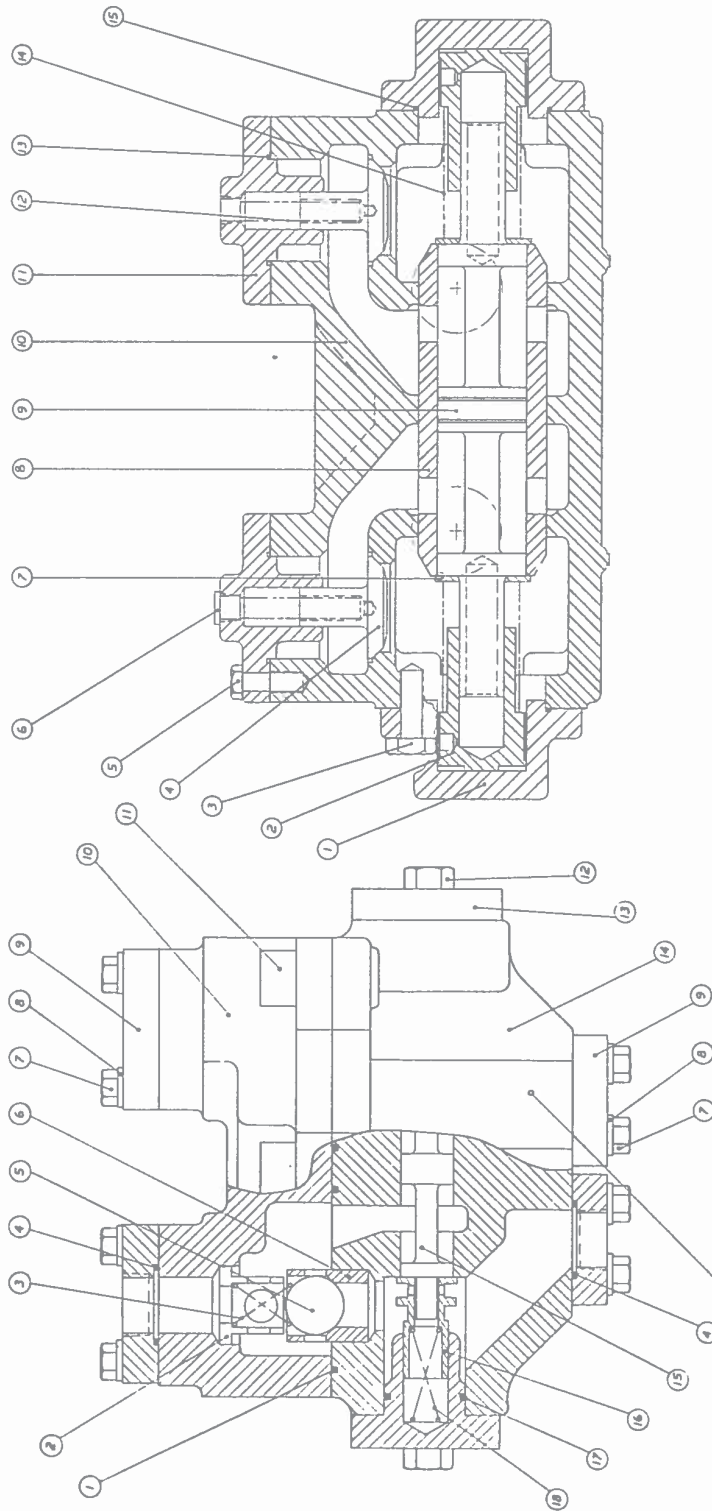
| 1 1/4" LOCKVALVE [NO 442-0000] | |
|--------------------------------|----------------------------|
| 1 | 2 11-106242 O RING |
| 2 | 2 442-0002 SPRING RETAINER |
| 3 | 2 31-100013 SPRING |
| 4 | 2 11-106218 O RING |
| 5 | 2 21-100007 BALL SEAT |
| 6 | 2 442-0006 BALL SEAT |
| 7 | 16 51-210010 CAPSCREW |
| 8 | 16 51-430003 LOCK WASHER |
| 9 | 4 41-504001 FLANGE |
| 10 | 1 442-0010 OUTLET BODY |
| 11 | 6 51-210026 CAPSCREW |
| 12 | 4 51-210027 CAPSCREW |
| 13 | 2 442-0013 END PLATE |
| 14 | 1 442-0014 INLET BODY |
| 15 | 1 442-0015 SPOOL |
| 16 | 2 442-0016 SPOOL STOP |
| 17 | 2 11-106222 O RING |
| 18 | 2 31-100014 SPRING |

| 1" LOCKVALVE [NO 441-0000] | |
|----------------------------|----------------------------|
| 1 | 2 11-106234 O RING |
| 2 | 2 441-0002 SPRING RETAINER |
| 3 | 2 31-100015 SPRING |
| 4 | 4 11-106218 O RING |
| 5 | 2 21-100008 BALL SEAT |
| 6 | 2 441-0006 BALL SEAT |
| 7 | 16 51-210007 CAPSCREW |
| 8 | 16 51-430004 LOCK WASHER |
| 9 | 4 41-504002 FLANGE |
| 10 | 1 441-0010 OUTLET BODY |
| 11 | 6 51-210026 CAPSCREW |
| 12 | 2 51-210011 CAPSCREW |
| 13 | 2 441-0013 END PLATE |
| 14 | 1 441-0014 INLET BODY |
| 15 | 1 441-0015 SPOOL |
| 16 | 2 441-0016 SPOOL STOP |
| 17 | 2 11-106216 O RING |
| 18 | 2 31-100016 SPRING |

| ITEM | QTY | PART NO | DESCRIPTION |
|------|-----|---------|-------------|
|------|-----|---------|-------------|

2" LOCKVALVE

1" AND 1 1/4" LOCKVALVE

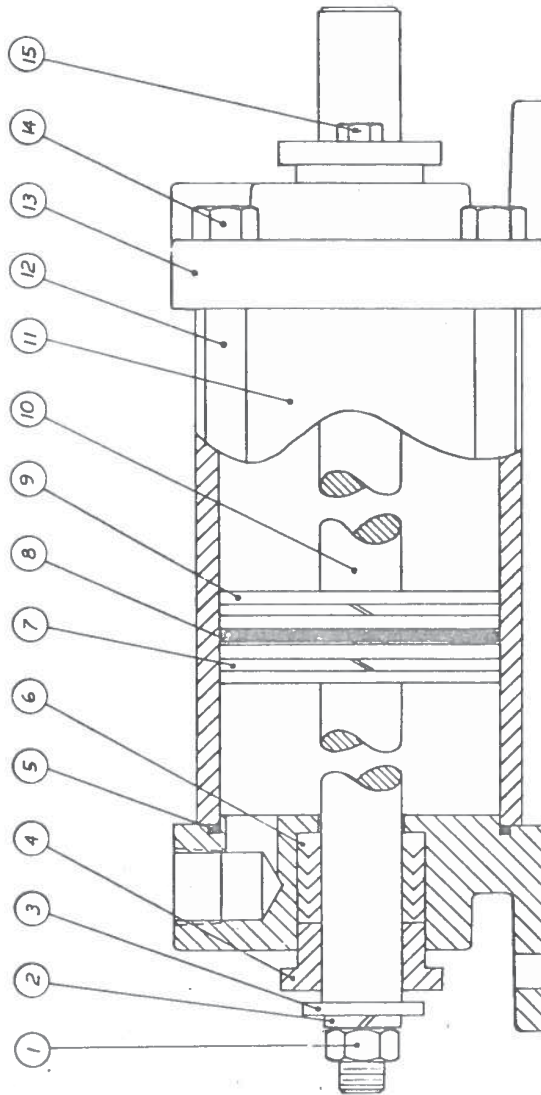


WAGNER ENGINEERING LTD.
 114 WEST 10TH AVENUE, VANCOUVER, B.C., CANADA
 MANUFACTURERS OF SAFETY VALVES, STEAM VALVES AND AUTOMATIC PIPES

TITLE: 1" - 1 1/4" 2" LOCKVALVE

PARTS LIST

DATE: FEB 27/51
 DRAWING NO: D-439
 REV: 1



3 1/2" ACCUMULATOR CYLINDER [NO. 3009-0000]

| | | | |
|----|---|------------|-------------|
| 1 | 1 | 51-500005 | NUT |
| 2 | 1 | 51-430002 | LOCKWASHER |
| 3 | 1 | 51-400002 | WASHER |
| 4 | 2 | 81-3002001 | GLAND |
| 5 | 2 | 11-106238 | O RING |
| 6 | 2 | 11-406001 | PACKING |
| 7 | 2 | 11-804003 | PISTON RING |
| 8 | 1 | 11-106236 | O RING |
| 9 | 1 | 3009-0021 | PISTON |
| 10 | 1 | 71-3009006 | PISTON ROD |
| 11 | 1 | 3009-0011 | BARREL |
| 12 | 4 | 3009-0012 | TIE ROD |
| 13 | 2 | 3009-0013 | HEAD |
| 14 | 8 | 51-500002 | NUT |
| 15 | 4 | 51-210002 | CAPSCREW |

3" ACCUMULATOR CYLINDER [NO. 3008-0000]

| | | | |
|----|---|------------|-------------|
| 1 | 1 | 51-500005 | NUT |
| 2 | 1 | 51-430002 | LOCKWASHER |
| 3 | 1 | 51-400002 | WASHER |
| 4 | 2 | 81-3002001 | GLAND |
| 5 | 2 | 11-106234 | O RING |
| 6 | 2 | 11-406001 | PACKING |
| 7 | 2 | 11-804002 | PISTON RING |
| 8 | 1 | 11-106232 | O RING |
| 9 | 1 | 3008-0021 | PISTON |
| 10 | 1 | 71-3008005 | PISTON ROD |
| 11 | 1 | 3008-0011 | BARREL |
| 12 | 4 | 3008-0012 | TIE ROD |
| 13 | 2 | 3008-0013 | HEAD |
| 14 | 8 | 51-500002 | NUT |
| 15 | 4 | 51-210002 | CAPSCREW |

| ITEM | QTY. | PART NO. | DESCRIPTION |
|------|------|----------|-------------|
|------|------|----------|-------------|



WAGNER ENGINEERING LTD.
1742 WEST 2ND AVENUE, VANCOUVER, B.C., CANADA

Manufacturers of MARINE HYDRAULIC STEERING GEARS and AUTOMATIC PILOTS

TITLE
PARTS LIST FOR 3 1/2" 3"
ACCUMULATOR CYLINDERS

| | | | |
|----------------|------------------|-------|------------|
| DRAWN D.W. | DATE FEB 3/75 | SCALE | QUOTE NO |
| REVISION NOTES | | | DRAWING NO |
| | | | REV. |
| | | | C-3083 |

SERVICE PARTS INFORMATION

RELIEF VALVES MODELS CF-16/24 SERIES

VICKERS INCORPORATED

DIVISION OF SPERRY RAND CORPORATION

Machinery Hydraulics Division

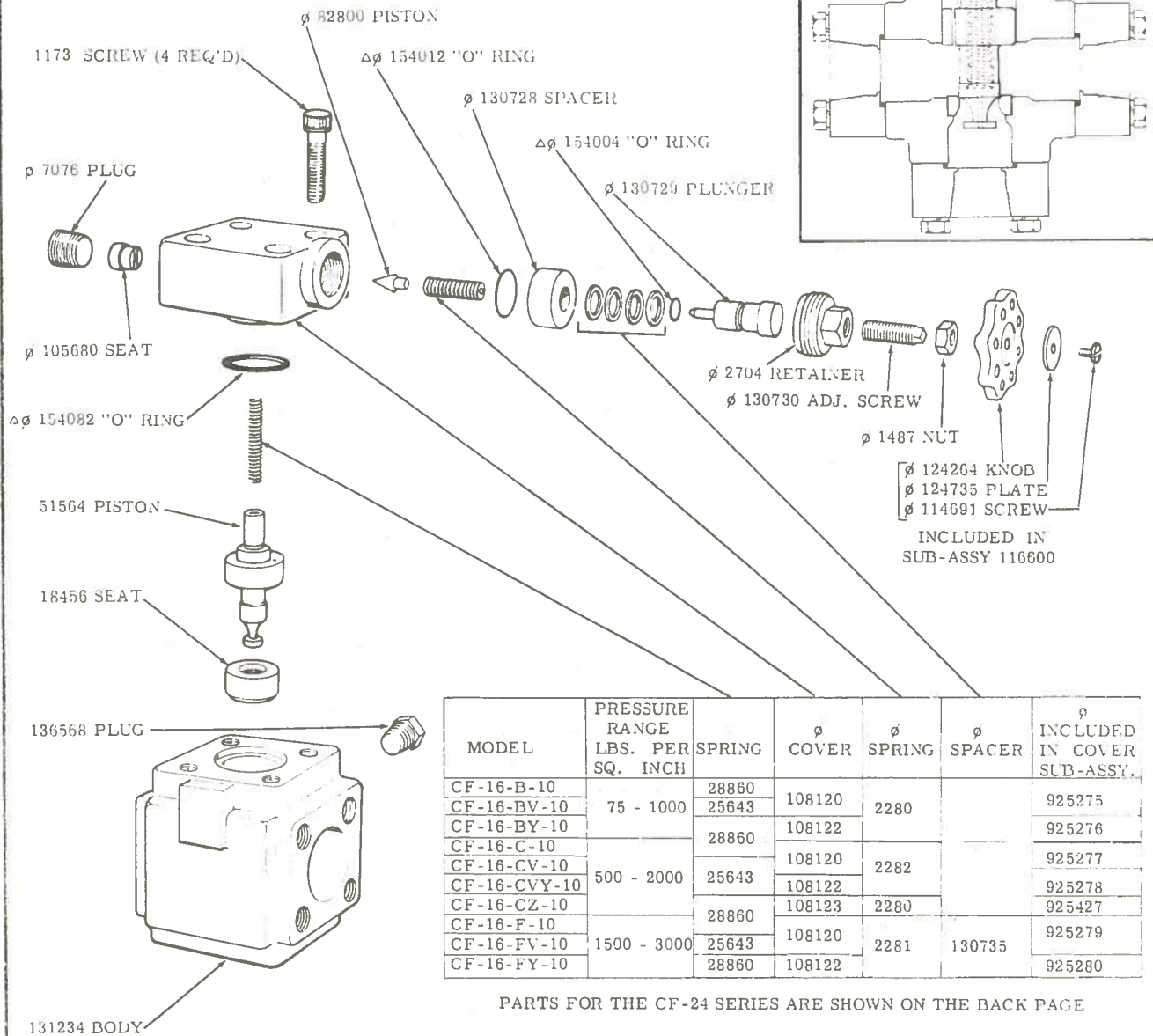
Service Department

14420 LINWOOD AVE.

DETROIT, MICH. 48238

ATLANTA • CHICAGO • DETROIT • EL SEGUNDO • HOUSTON
SEATTLE • SPRINGFIELD, N.J. • TORONTO

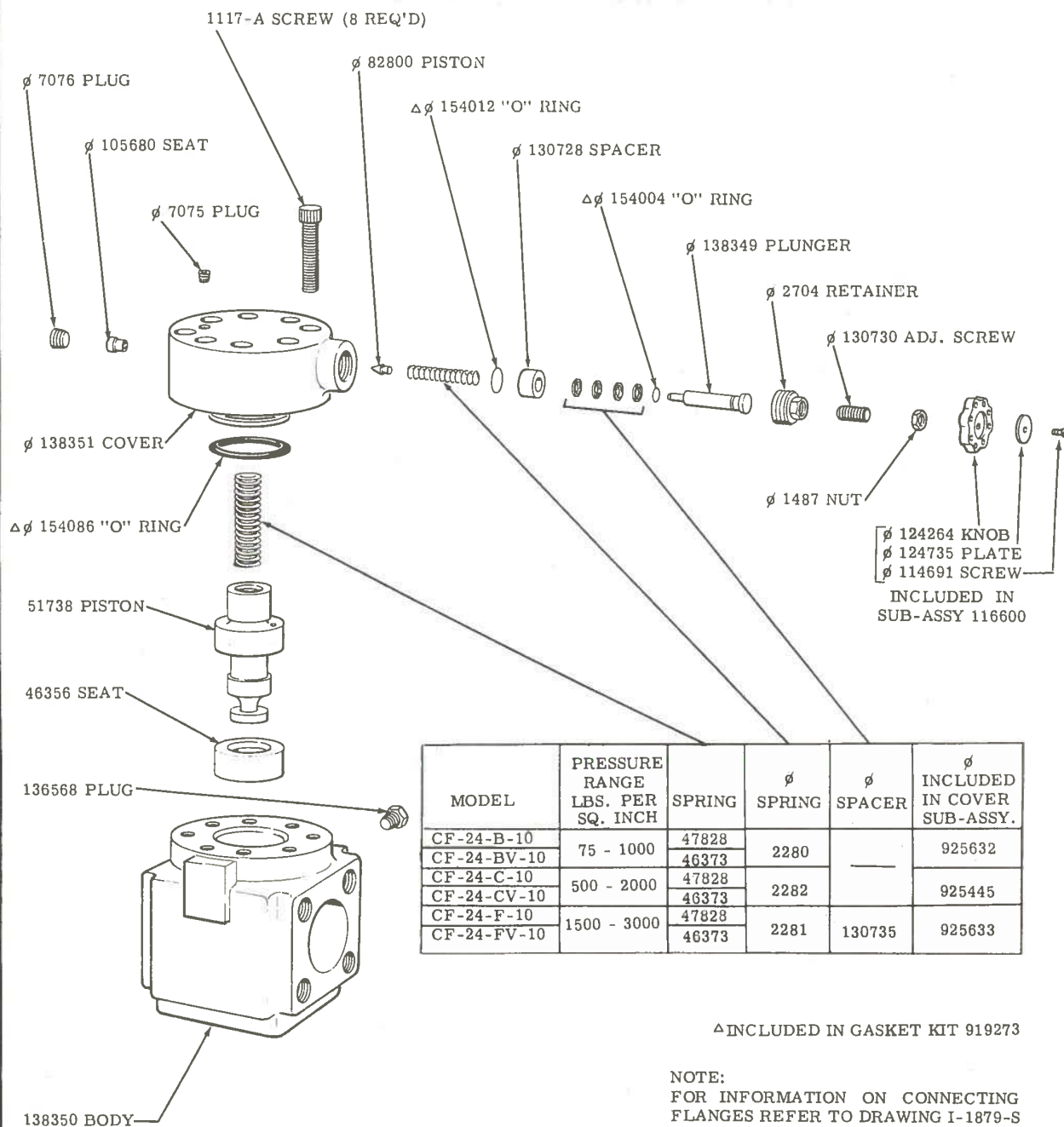
MODEL CF-16-**-10 SERIES



Δ INCLUDED IN GASKET KIT 919273

NOTE:
FOR INFORMATION ON CONNECTING
FLANGES REFER TO DRAWING I-1870-S

**MODEL
CF-24--10 SERIES**



To insure sustained efficiency and maximum trouble-free life of this precision equipment, initial and continuous filtration of the fluid medium to 25 microns or less is essential. (For information pertaining to Vickers economical 10 micron filters, see installation drawing I & M 229847.)

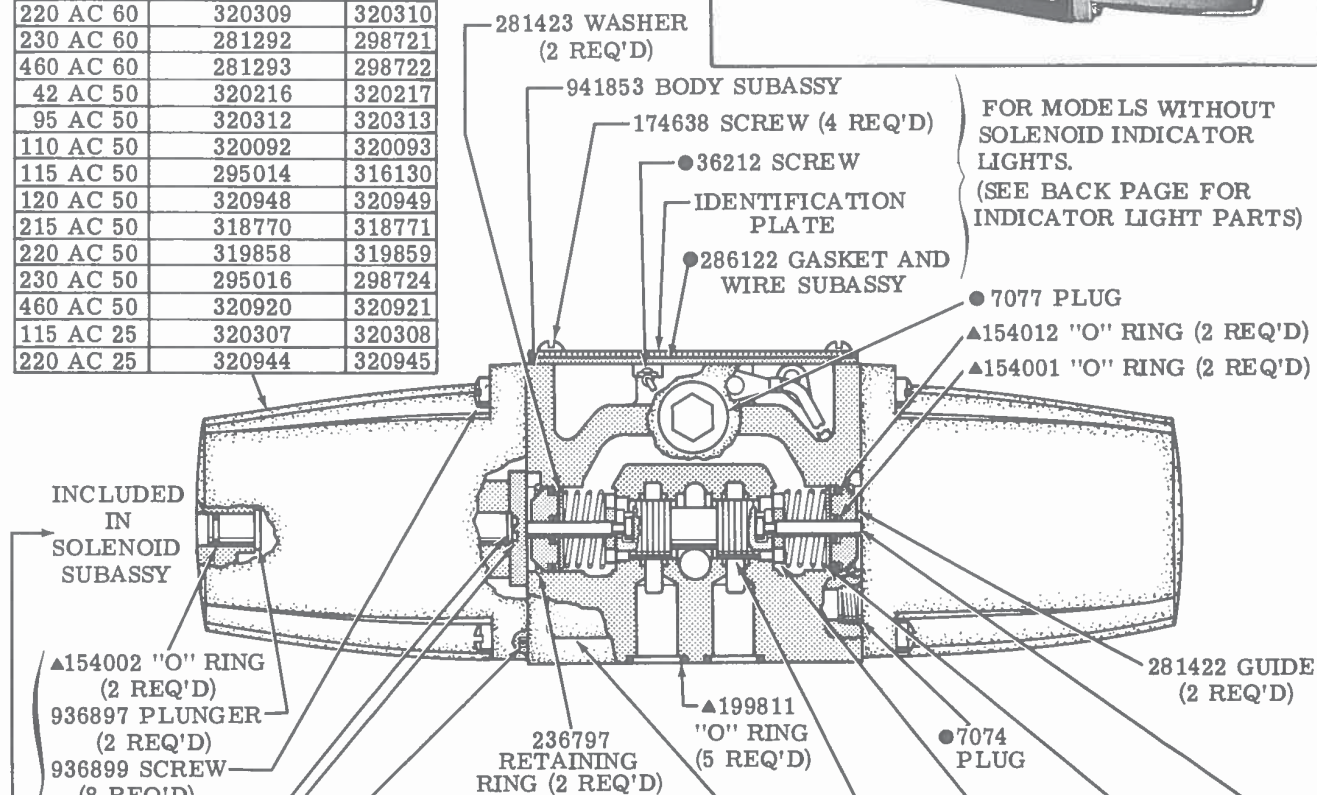
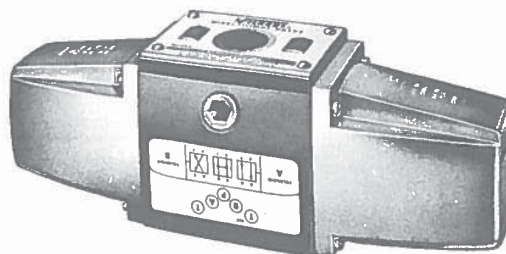
SERVICE PARTS INFORMATION

SPERRY RAND

VICKERS

DG4S4(L)-01*C-(***AC**)-50

| VOLTAGE | SOLENOID S/A (2 REQ'D) | COIL |
|-----------|---------------------------|--------|
| 24 AC 60 | 320225 | 320226 |
| 115 AC 60 | 281291 | 316011 |
| 120 AC 60 | 319123 | 319124 |
| 208 AC 60 | 320946 | 320947 |
| 220 AC 60 | 320309 | 320310 |
| 230 AC 60 | 281292 | 298721 |
| 460 AC 60 | 281293 | 298722 |
| 42 AC 50 | 320216 | 320217 |
| 95 AC 50 | 320312 | 320313 |
| 110 AC 50 | 320092 | 320093 |
| 115 AC 50 | 295014 | 316130 |
| 120 AC 50 | 320948 | 320949 |
| 215 AC 50 | 318770 | 318771 |
| 220 AC 50 | 319858 | 319859 |
| 230 AC 50 | 295016 | 298724 |
| 460 AC 50 | 320920 | 320921 |
| 115 AC 25 | 320307 | 320308 |
| 220 AC 25 | 320944 | 320945 |



INCLUDED
IN
SOLENOID
SUBASSY

▲154002 "O" RING
(2 REQ'D)
936897 PLUNGER
(2 REQ'D)
936899 SCREW
(8 REQ'D)
941840 RETAINER
(2 REQ'D)
320866 SCREW
(2 REQ'D)
936898 GASKET
(2 REQ'D)

●INCLUDED IN
941853 BODY
SUBASSY

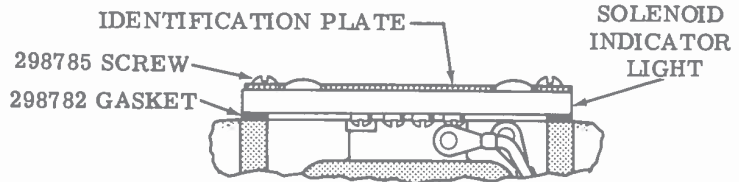
▲INCLUDED IN
919116 GASKET KIT

| MODEL | DIAGRAM PLATE | SPOOL | WASHER (2 REQ'D) | SPRING (2 REQ'D) | PUSH PIN (2 REQ'D) |
|------------------------|------------------|----------|---------------------|---------------------|-----------------------|
| DG4S4-010C-(*)-50 g/h | 290341 | 213230-7 | 211846 | 290072 | 213268 |
| DG4S4-010C-(*)-50 i/j | | 213230-9 | | | |
| DG4S4-012C-(*)-50 g/h | 290343 | 213231-7 | 211846 | 290072 | 213268 |
| DG4S4-012C-(*)-50 i/j | | 213231-9 | | | |
| DG4S4-013C-(*)-50 g/h | 290344 | 239903-7 | 211846 | 290072 | 213268 |
| DG4S4-013C-(*)-50 i/j | | 239903-9 | | | |
| DG4S4-016C-(*)-50 g/h | 290345 | 213232-7 | 211846 | 290072 | 213268 |
| DG4S4-016C-(*)-50 i/j | | 213232-9 | | | |
| DG4S4-017C-(*)-50 g/h | 290346 | 236624-7 | 211846 | 290072 | 213268 |
| DG4S4-017C-(*)-50 i/j | | 236624-9 | | | |
| DG4S4-018C-(*)-50 g/h | 290340 | 235637-7 | 283637 | 217323 | 290264 |
| DG4S4-018C-(*)-50 i/j | | 235637-9 | | | |
| DG4S4-0133C-(*)-50 g/h | 290345 | 236615-7 | 211846 | 290072 | 213268 |
| DG4S4-0133C-(*)-50 i/j | | 236615-9 | | | |

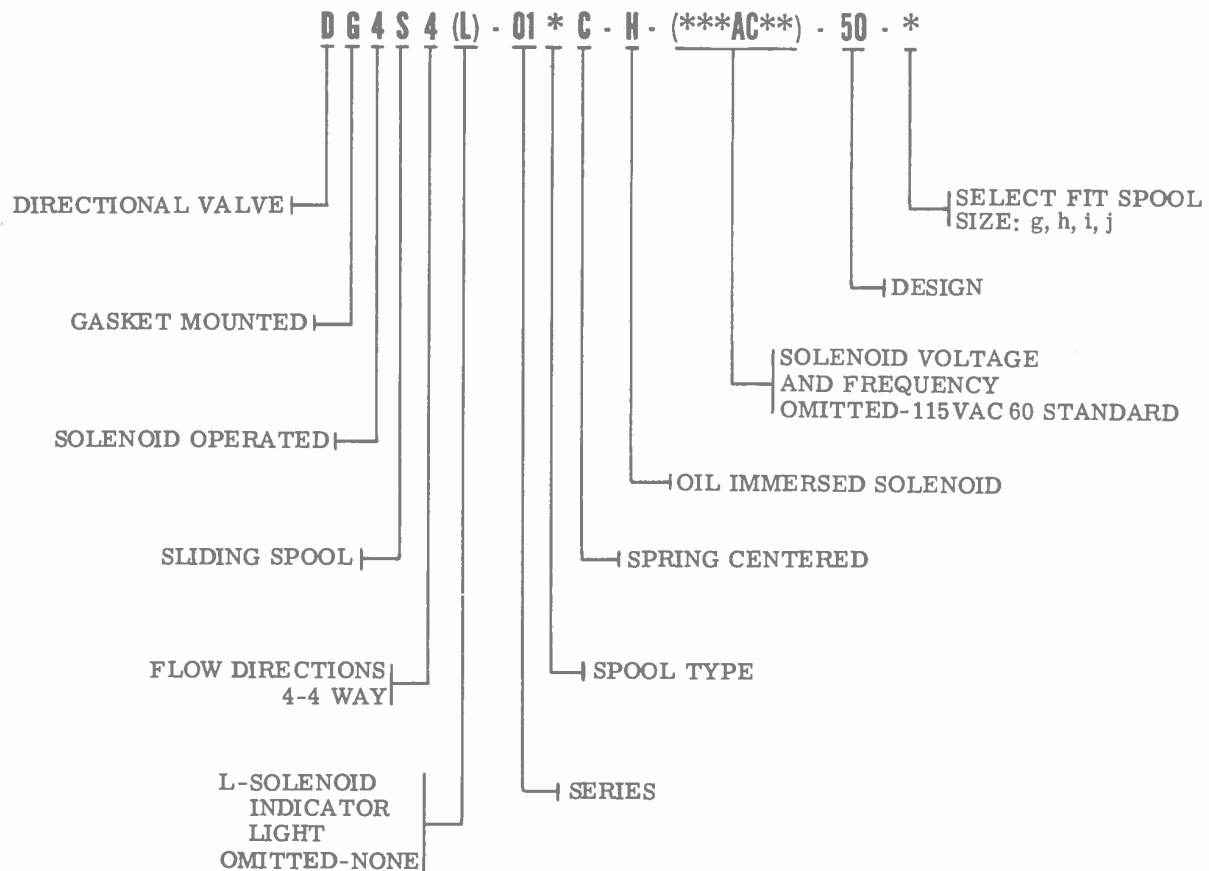
**SOLENOID INDICATOR LIGHT KIT
(INCLUDES ALL PARTS IDENTIFIED)**

| VOLTAGE RANGE | KIT |
|---------------|--------|
| 100 thru 125 | 941615 |

FOR MODELS WITH
SOLENOID INDICATOR LIGHTS

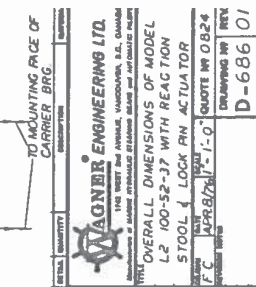


MODEL CODE BREAKDOWN



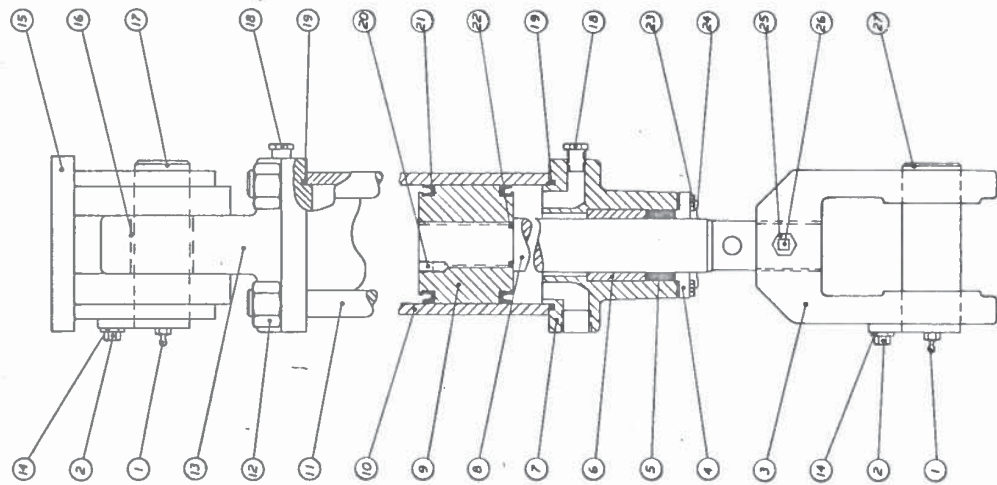
To insure sustained efficiency and maximum trouble-free life of this precision equipment, initial and continuous filtration of the fluid medium to 25 microns or less is essential. (For information pertaining to Vickers economical 10 micron filters, see installation drawing I & M 229847.)

GERMAN⁴ MILNE D108/1
BDD HULL NOS 2214-222
BDD O/NS 221-135-41
222-135-41



ALL DIMENSIONS IN INCHES

D-686 01



| CYLINDER MODEL | | 15-15 | 15-17 | 15-20 | 15-22 | 15-24 | 15-26 |
|----------------|----------------|------------|------------|------------|------------|------------|------------|
| ASSEMBLY NO. | | 15-15-0001 | 15-17-0001 | 15-20-0001 | 15-22-0001 | 15-24-0001 | 15-26-0001 |
| 1 | GREASE NIPPLE | 15-15-0001 | 15-17-0001 | 15-20-0001 | 15-22-0001 | 15-24-0001 | 15-26-0001 |
| 2 | CAPSCREW | 15-15-0001 | 15-17-0001 | 15-20-0001 | 15-22-0001 | 15-24-0001 | 15-26-0001 |
| 3 | GLAND | 15-15-0001 | 15-17-0001 | 15-20-0001 | 15-22-0001 | 15-24-0001 | 15-26-0001 |
| 4 | GLAND | 15-15-0001 | 15-17-0001 | 15-20-0001 | 15-22-0001 | 15-24-0001 | 15-26-0001 |
| 5 | PACKING | 15-15-0001 | 15-17-0001 | 15-20-0001 | 15-22-0001 | 15-24-0001 | 15-26-0001 |
| 6 | BEARING | 15-15-0001 | 15-17-0001 | 15-20-0001 | 15-22-0001 | 15-24-0001 | 15-26-0001 |
| 7 | HEAD | 15-15-0001 | 15-17-0001 | 15-20-0001 | 15-22-0001 | 15-24-0001 | 15-26-0001 |
| 8 | PISTON ROD | 15-15-0001 | 15-17-0001 | 15-20-0001 | 15-22-0001 | 15-24-0001 | 15-26-0001 |
| 9 | PISTON | 15-15-0001 | 15-17-0001 | 15-20-0001 | 15-22-0001 | 15-24-0001 | 15-26-0001 |
| 10 | BARREL | 15-15-0001 | 15-17-0001 | 15-20-0001 | 15-22-0001 | 15-24-0001 | 15-26-0001 |
| 11 | TIE ROD | 15-15-0001 | 15-17-0001 | 15-20-0001 | 15-22-0001 | 15-24-0001 | 15-26-0001 |
| 12 | NUT | 15-15-0001 | 15-17-0001 | 15-20-0001 | 15-22-0001 | 15-24-0001 | 15-26-0001 |
| 13 | WASHER | 15-15-0001 | 15-17-0001 | 15-20-0001 | 15-22-0001 | 15-24-0001 | 15-26-0001 |
| 14 | WASHER | 15-15-0001 | 15-17-0001 | 15-20-0001 | 15-22-0001 | 15-24-0001 | 15-26-0001 |
| 15 | MOUNTING PAD | 15-15-0001 | 15-17-0001 | 15-20-0001 | 15-22-0001 | 15-24-0001 | 15-26-0001 |
| 16 | BUSHING | 15-15-0001 | 15-17-0001 | 15-20-0001 | 15-22-0001 | 15-24-0001 | 15-26-0001 |
| 17 | PIN | 15-15-0001 | 15-17-0001 | 15-20-0001 | 15-22-0001 | 15-24-0001 | 15-26-0001 |
| 18 | PLUG | 15-15-0001 | 15-17-0001 | 15-20-0001 | 15-22-0001 | 15-24-0001 | 15-26-0001 |
| 19 | O RING | 15-15-0001 | 15-17-0001 | 15-20-0001 | 15-22-0001 | 15-24-0001 | 15-26-0001 |
| 20 | SETSCREW | 15-15-0001 | 15-17-0001 | 15-20-0001 | 15-22-0001 | 15-24-0001 | 15-26-0001 |
| 21 | U CUP | 15-15-0001 | 15-17-0001 | 15-20-0001 | 15-22-0001 | 15-24-0001 | 15-26-0001 |
| 22 | O RING | 15-15-0001 | 15-17-0001 | 15-20-0001 | 15-22-0001 | 15-24-0001 | 15-26-0001 |
| 23 | CAPSCREW | 15-15-0001 | 15-17-0001 | 15-20-0001 | 15-22-0001 | 15-24-0001 | 15-26-0001 |
| 24 | RETAINING WIRE | 15-15-0001 | 15-17-0001 | 15-20-0001 | 15-22-0001 | 15-24-0001 | 15-26-0001 |
| 25 | NUT | 15-15-0001 | 15-17-0001 | 15-20-0001 | 15-22-0001 | 15-24-0001 | 15-26-0001 |
| 26 | SETSCREW | 15-15-0001 | 15-17-0001 | 15-20-0001 | 15-22-0001 | 15-24-0001 | 15-26-0001 |
| 27 | PIN | 15-15-0001 | 15-17-0001 | 15-20-0001 | 15-22-0001 | 15-24-0001 | 15-26-0001 |

| CYLINDER MODEL | | 20-24 | 20-26 | 20-28 | 20-30 | 20-32 | 20-34 |
|----------------|----------------|------------|------------|------------|------------|------------|------------|
| ASSEMBLY NO. | | 20-24-0001 | 20-26-0001 | 20-28-0001 | 20-30-0001 | 20-32-0001 | 20-34-0001 |
| 1 | GREASE NIPPLE | 20-24-0001 | 20-26-0001 | 20-28-0001 | 20-30-0001 | 20-32-0001 | 20-34-0001 |
| 2 | CAPSCREW | 20-24-0001 | 20-26-0001 | 20-28-0001 | 20-30-0001 | 20-32-0001 | 20-34-0001 |
| 3 | GLAND | 20-24-0001 | 20-26-0001 | 20-28-0001 | 20-30-0001 | 20-32-0001 | 20-34-0001 |
| 4 | GLAND | 20-24-0001 | 20-26-0001 | 20-28-0001 | 20-30-0001 | 20-32-0001 | 20-34-0001 |
| 5 | PACKING | 20-24-0001 | 20-26-0001 | 20-28-0001 | 20-30-0001 | 20-32-0001 | 20-34-0001 |
| 6 | BEARING | 20-24-0001 | 20-26-0001 | 20-28-0001 | 20-30-0001 | 20-32-0001 | 20-34-0001 |
| 7 | HEAD | 20-24-0001 | 20-26-0001 | 20-28-0001 | 20-30-0001 | 20-32-0001 | 20-34-0001 |
| 8 | PISTON ROD | 20-24-0001 | 20-26-0001 | 20-28-0001 | 20-30-0001 | 20-32-0001 | 20-34-0001 |
| 9 | PISTON | 20-24-0001 | 20-26-0001 | 20-28-0001 | 20-30-0001 | 20-32-0001 | 20-34-0001 |
| 10 | BARREL | 20-24-0001 | 20-26-0001 | 20-28-0001 | 20-30-0001 | 20-32-0001 | 20-34-0001 |
| 11 | TIE ROD | 20-24-0001 | 20-26-0001 | 20-28-0001 | 20-30-0001 | 20-32-0001 | 20-34-0001 |
| 12 | NUT | 20-24-0001 | 20-26-0001 | 20-28-0001 | 20-30-0001 | 20-32-0001 | 20-34-0001 |
| 13 | WASHER | 20-24-0001 | 20-26-0001 | 20-28-0001 | 20-30-0001 | 20-32-0001 | 20-34-0001 |
| 14 | WASHER | 20-24-0001 | 20-26-0001 | 20-28-0001 | 20-30-0001 | 20-32-0001 | 20-34-0001 |
| 15 | MOUNTING PAD | 20-24-0001 | 20-26-0001 | 20-28-0001 | 20-30-0001 | 20-32-0001 | 20-34-0001 |
| 16 | BUSHING | 20-24-0001 | 20-26-0001 | 20-28-0001 | 20-30-0001 | 20-32-0001 | 20-34-0001 |
| 17 | PIN | 20-24-0001 | 20-26-0001 | 20-28-0001 | 20-30-0001 | 20-32-0001 | 20-34-0001 |
| 18 | PLUG | 20-24-0001 | 20-26-0001 | 20-28-0001 | 20-30-0001 | 20-32-0001 | 20-34-0001 |
| 19 | O RING | 20-24-0001 | 20-26-0001 | 20-28-0001 | 20-30-0001 | 20-32-0001 | 20-34-0001 |
| 20 | SETSCREW | 20-24-0001 | 20-26-0001 | 20-28-0001 | 20-30-0001 | 20-32-0001 | 20-34-0001 |
| 21 | U CUP | 20-24-0001 | 20-26-0001 | 20-28-0001 | 20-30-0001 | 20-32-0001 | 20-34-0001 |
| 22 | O RING | 20-24-0001 | 20-26-0001 | 20-28-0001 | 20-30-0001 | 20-32-0001 | 20-34-0001 |
| 23 | CAPSCREW | 20-24-0001 | 20-26-0001 | 20-28-0001 | 20-30-0001 | 20-32-0001 | 20-34-0001 |
| 24 | RETAINING WIRE | 20-24-0001 | 20-26-0001 | 20-28-0001 | 20-30-0001 | 20-32-0001 | 20-34-0001 |
| 25 | NUT | 20-24-0001 | 20-26-0001 | 20-28-0001 | 20-30-0001 | 20-32-0001 | 20-34-0001 |
| 26 | SETSCREW | 20-24-0001 | 20-26-0001 | 20-28-0001 | 20-30-0001 | 20-32-0001 | 20-34-0001 |
| 27 | PIN | 20-24-0001 | 20-26-0001 | 20-28-0001 | 20-30-0001 | 20-32-0001 | 20-34-0001 |

| ITEM | DESCRIPTION | QTY | PART NO. | QTY | PART NO. | QTY | PART NO. | QTY | PART NO. | QTY | PART NO. | QTY | PART NO. |
|------|-------------|-----|----------|-----|----------|-----|----------|-----|----------|-----|----------|-----|----------|
|------|-------------|-----|----------|-----|----------|-----|----------|-----|----------|-----|----------|-----|----------|

NOTE:
NOT TO SCALE

WAGNER ENGINEERING LTD
1111 WEST 10TH AVENUE, SUITE 100, CALGARY, ALBERTA T2M 4K6
403-243-8888 FAX 403-243-8889
WWW.WAGNER-ENGINEERING.COM

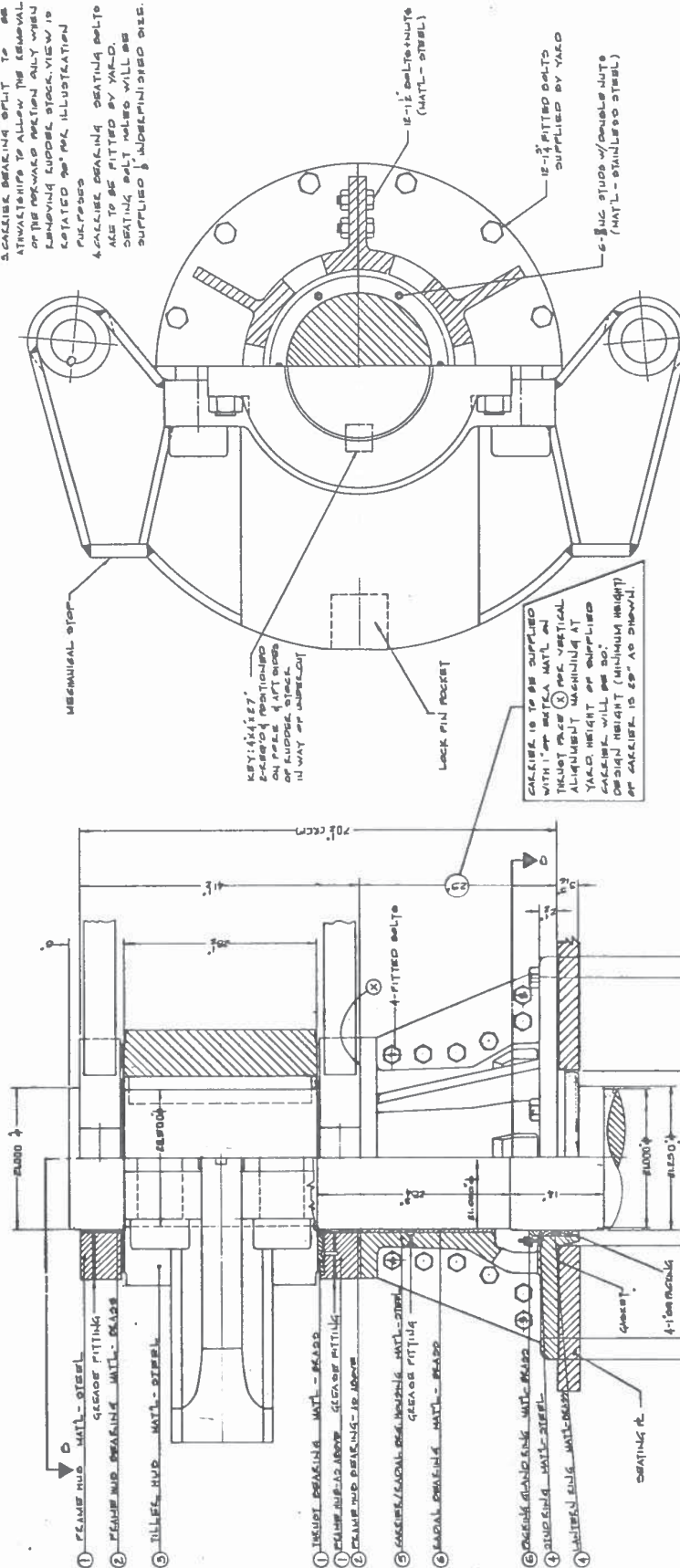
MODEL CYLINDERS

DATE: 11/11/2011
BY: JG/FEB/25
CHECKED: []
APPROVED: []

QUOTE NO. []
DRAWING NO. []
REV. []

D-661

1. BEARING IS IN WAY OF CALLER.
BEARING BEATING MUST BE
CONSIDERABLY OUTPACED.
2. BEATING MUST BE BEAT TO
PREVENT LEAKAGE OF WATER.
GASSET TO BE SUPPLIED BY SHIPYARD
CARRIES BEARING OUT TO BE
ATTEMPTING TO ALLOW THE REMOVAL
OF THE EXCESSIVE PORTION ONLY WHEN
REMOVING LUGGERS. SEE VIEW IS
RELATED TO THE ILLUSTRATION
PAGES 10
3. CALLER BEARING BEATING MUST
BE TO BE FITTED BY YARD.
BEATING OUT MUST BE
SUPPLIED BY WOODEN SHIPYARD ONE.



| LN | TITLE | DATA NAME |
|----|--------------------------------------|-----------|
| 1 | THRUOT DEG AND PLANE NUM | D-60D |
| 2 | FRAME NUM BEARING | D-60G |
| 3 | TILLER NUM | C-6100-01 |
| 4 | GLAND STUD END AND PANTHER RING | C-6100-01 |
| 5 | SWITCH CASE/LOCAL BEARING HUBBING | C-6145-02 |
| 6 | PLANT END AND TOWER BEARING | C-6144-02 |

ଉତ୍ତର-ପଶ୍ଚିମ

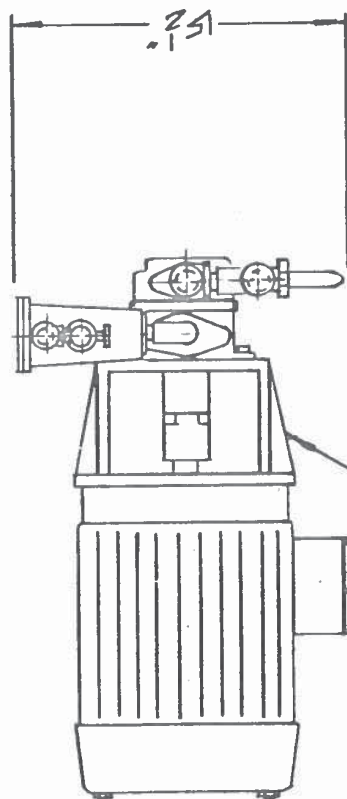
[illegible]

人民日報

GERMAN 4 MILNE D 1100/1
000 MULL 400.2214 222
000 Q/N0 221-125-41
222-195-41

REFERENCES

GERMAN & MILNE D1108/1
BDD HULL NOS. 221 & 222
BDD O/NOS. 221-135-41
222-135-41



C-FLANGE

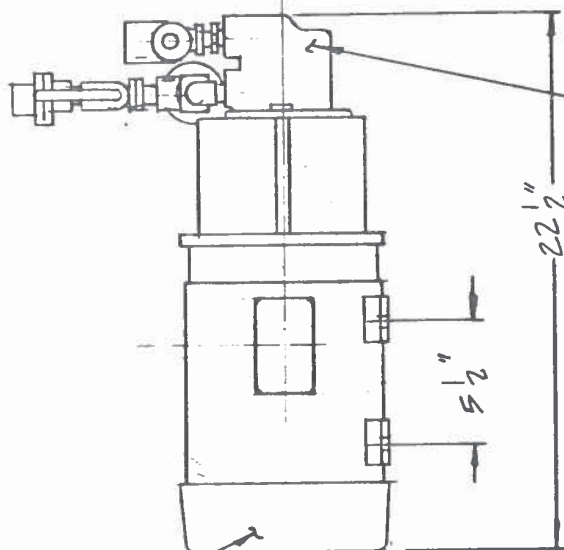
ELECTRIC MOTOR
5 HP 440/3/60

CONNECTION TO
POWER SYSTEM
HEADER TANK
3/4" NPT

CONNECTION TO
SOLENOID 4-WAY
VALVE 3/4" NPT

PUMP OUTLET CONNECTION
TO SOLENOID 4-WAY
VALVE 1/2" NPT

CONNECTION TO
COOLING MODULE
INLET 1/2" NPT



4 - 13/16" Ø HOLES
FOR 3/8" BOLTS

VICKERS V110-2.5

5 HP LOCK PIN PUMPSET OVERALL DIMENSIONS



WAGNER ENGINEERING LTD.

1742 WEST 2nd AVENUE, VANCOUVER, B.C., CANADA

Manufacturers of MARINE HYDRAULIC STEERING GEARS and AUTOMATIC PILOTS

DATE

AUG. 30/76

DRAWN

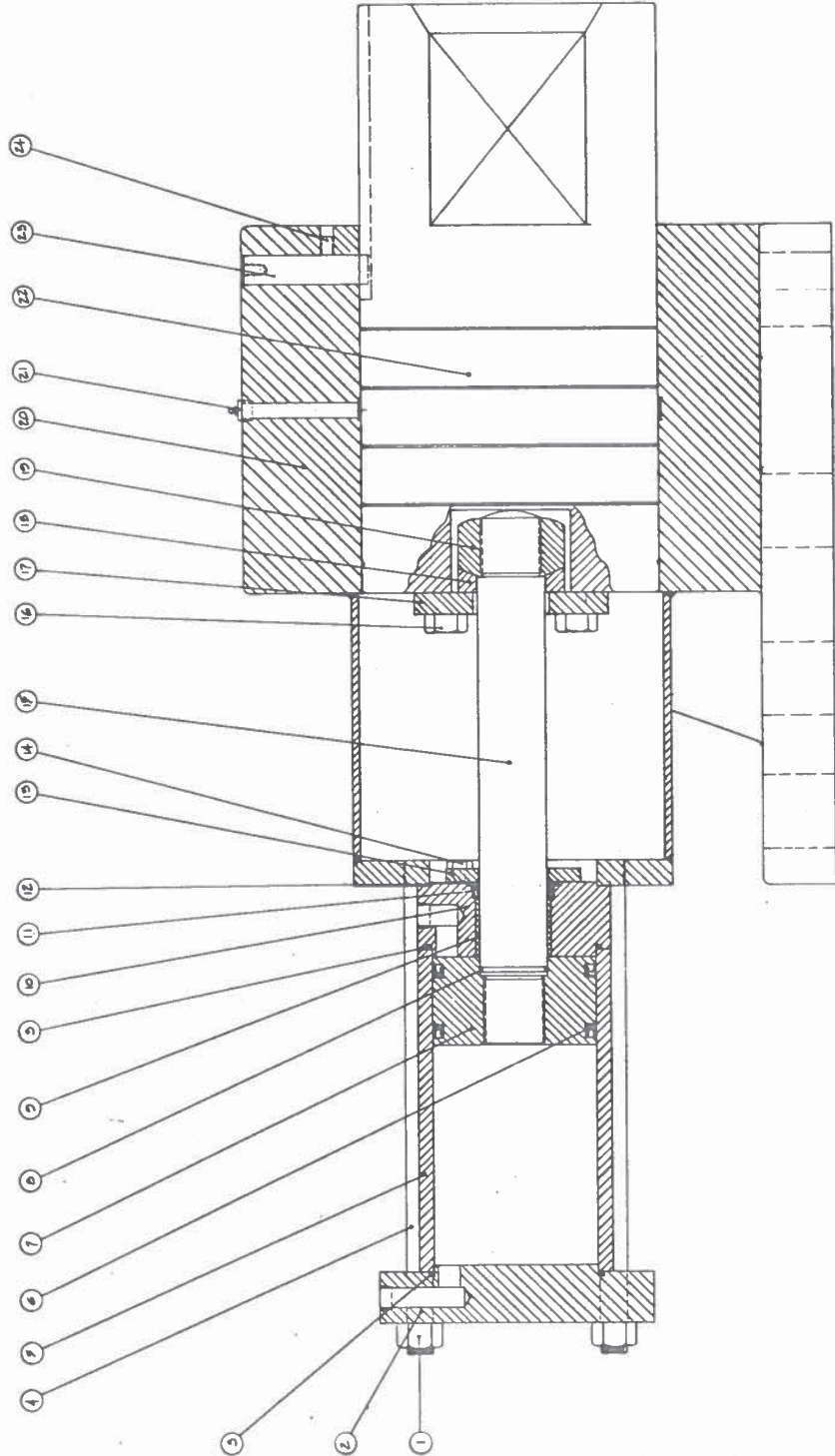
F.C.

DWG No.

A-3113

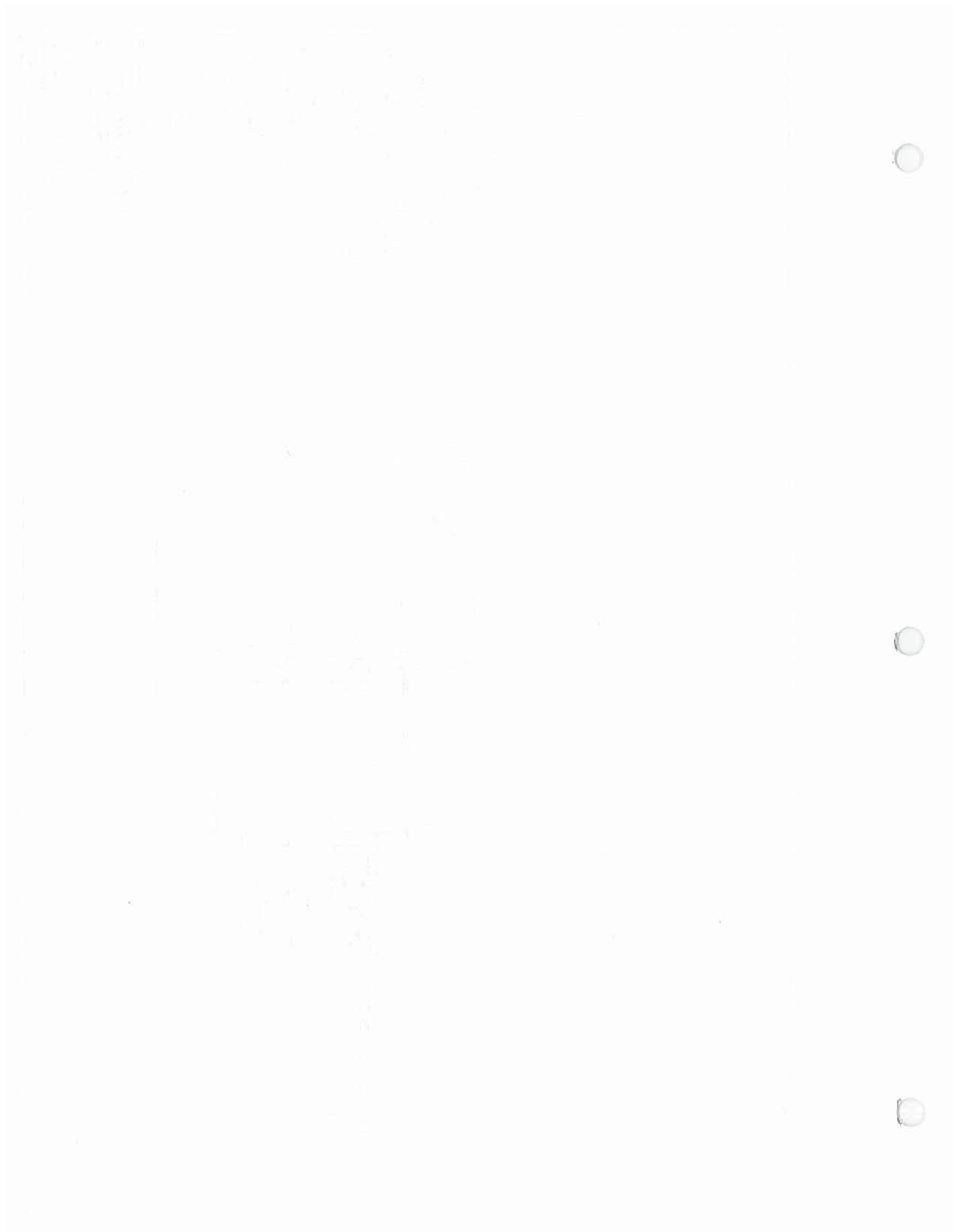
REV

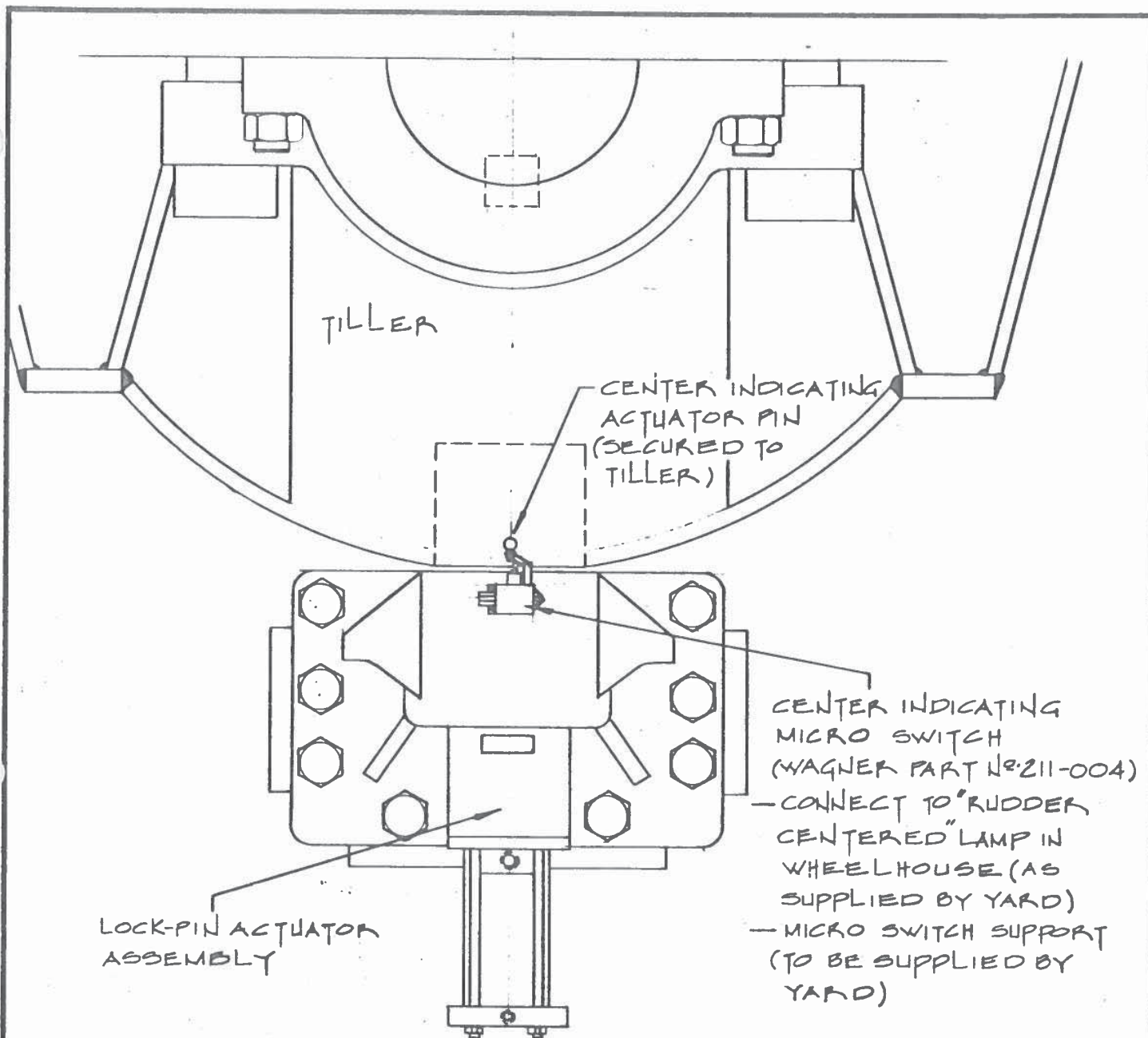
SCALE: 1 1/2" = 1'-0"



| ITEM | QTY | PART NO | DESCRIPTION | MAT |
|------|-----|-----------|-------------------|-----|
| 1 | 6 | 694-00008 | NUT 5/16" | ST |
| 2 | 1 | 694-00002 | END PLATE | ST |
| 3 | 2 | 11-100224 | O-RING 1/4" (841) | NEO |
| 4 | 6 | 694-00004 | TIE ROD | ST |
| 5 | 1 | 694-00005 | WASHER | ST |
| 6 | 2 | 11-100004 | U-CUP 1/4" | ST |
| 7 | 1 | 694-00007 | WASHER | AL |
| 8 | 1 | 11-100226 | O-RING 1/4" (841) | NEO |
| 9 | 1 | 694-00009 | WASHER | ST |
| 10 | 1 | 694-00010 | CYLINDRICAL HEAD | ST |
| 11 | 1 | 11-100010 | U-CUP 1/4" | ST |
| 12 | 1 | 694-00012 | WASHER | ST |
| 13 | 1 | 694-00013 | WASHER | ST |
| 14 | 6 | 694-00014 | WASHER 1/4" | ST |
| 15 | 6 | 694-00015 | WASHER 1/4" | ST |
| 16 | 6 | 694-00016 | WASHER 1/4" | ST |
| 17 | 1 | 694-00017 | WASHER | ST |
| 18 | 1 | 694-00018 | WASHER | ST |
| 19 | 1 | 694-00019 | WASHER 1/4" | ST |
| 20 | 1 | 694-00020 | WASHER | ST |
| 21 | 1 | 41-000002 | LOCK PIN | ST |
| 22 | 1 | 694-00022 | LOCK PIN | ST |
| 23 | 1 | 694-00023 | LOCK PIN | ST |
| 24 | 1 | 694-00024 | LOCK PIN | ST |
| 25 | 1 | 694-00025 | LOCK PIN | ST |
| 26 | 1 | 694-00026 | LOCK PIN | ST |
| 27 | 1 | 694-00027 | LOCK PIN | ST |
| 28 | 1 | 694-00028 | LOCK PIN | ST |

| | |
|--|--|
| | |
| WAGNER ENGINEERING LTD. 100 WILSON AVENUE, SUITE 100, WILSON, ONTARIO L9R 1X1 TEL: (416) 291-1111 FAX: (416) 291-1112 WWW.WAGNER-ENGINEERING.COM | |
| PART LIST FOR STOP/LOCK PIN ACTUATOR (REF DWG NO 0-0011) | |
| DATE: 1/1/11 DRAWN BY: JG CHECKED BY: JG | QUOTE NO: 0824 DRAWING NO: 0-0011 REV: D-094 |





TILLER CENTER INDICATING ARRANGEMENT



WAGNER ENGINEERING LTD.

1742 WEST 2nd AVENUE, VANCOUVER, B.C., CANADA

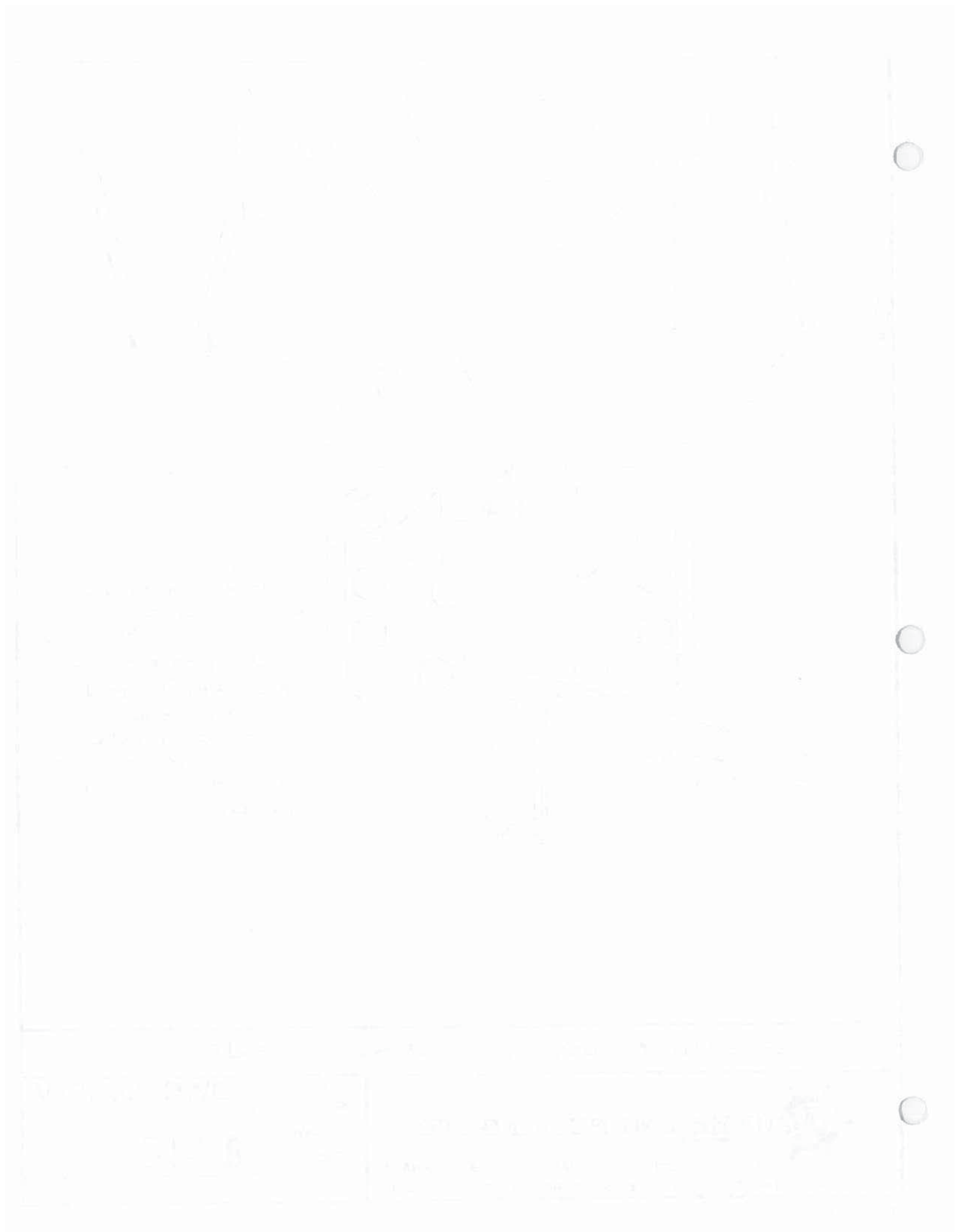
Manufacturers of MARINE HYDRAULIC STEERING GEARS and AUTOMATIC PILOTS

| |
|-----------|
| DATE |
| DEC. 3/76 |
| DRAWN |
| FW |

DWG No.

REV.

A-1-129



INSTALLING THE STEERING GEAR

Reference to drawing D-686-01 will determine the overall dimensions and locations of the steering gear main component parts in relation to the rudder stock. A suggested procedure for installation of these parts around the rudder stock follows.

1. The carrier bearing is installed first. The bearing is supplied with 1" of extra material at the thrust face for vertical alignment machining on the site. The overall height as supplied is 30" measured from the seating face. Note that 4 fitted bolts are used to locate the bearing halves - two at the top and two at the bottom - and that they are not interchangeable. The split lantern ring and packing gland ring should be placed in each half of the housing and secured with wire until the halves are in position. The split should be athwartships. A total of 12 - 1/2" dia. bolts are used to secure the halves.

The seating bolts are to be fitted on the site. The bolt holes are supplied 1/8" under the finished size of 1 3/4" dia. Twelve seating bolts are required and should be sealed to prevent water leakage along their threads. The spot faced seating bolt holes will provide a flat sealing surface if seal head bolts are used.

A 26" dia. spigot is incorporated at the bottom of the seating face for location and securing the assembly. The outer diameter of the sealing face flange is provided with flats for chocking the housing in place if the spigot is not used.

2. The tiller is clamped to the rudder stock. The keyways are supplied roughed-in in each half of the tiller hub and are to be finish machined on the site in relation to the rudder stock as supplied.
3. The steering gear frame is placed against the rudder stock. Table C should be constructed to establish the correct support elevation. The rudder stock should be supported by the lifting eye to provide clearance for sliding the upper and lower frame hub over the tiller hub. Once the gear is located against the stock, the outer portion of the upper and lower frame hubs may be mounted.
4. The torque reaction stool is placed in position and the elevation alignment of the steering gear is checked. The underside of the upper frame reaction pin bushing should rest on the top of the stool reaction pin bushing. The table supporting the stool must be capable of withstanding a reaction force at the pin of 23,000 lbs. An adequate safety margin must be provided when constructing this table.

The stool is secured to the table by 12 - 1" dia. bolts. Chocks are required on all sides.

5. The lock pin assembly is placed in position. The locking pin should be aligned to engage the socket centrally with clearance above and below the pin. Clearance below the pin is especially important in case the rudder stock is forced upward against the jump collar. The mechanical tiller stops are incorporated on the lock pin housing and equal tiller travel both sides of mid-ships must be provided during seating. The table supporting the lock pin housing must be capable of withstanding a force on the pin of 1,010,000 lbs. This table must be constructed with an adequate safety margin in consideration of shock loads.

The lock pin housing is secured to the table with 8 - 2 1/2" dia. bolts. Chocks are required on all sides.

6. The cylinders are positioned and pinned at the rear of the steering gear frame. They may be balanced on the cylinder support table during this operation. The clevises are placed over the tiller bushings and the pins are inserted. Care must be taken not to damage the cylinder piston rods and it is advisable to cover the rods to prevent scratching and coating with air-borne dust.
7. The follow-up rod connecting the control valve assembly linkage to the tiller pick-up point may be mounted. This rod has been pre-adjusted at the factory and should not require adjustment.

PIPING THE SYSTEM

It is important to prevent entry of any type of contaminant into the piping. The most common contaminants are: Teflon tape, pipe fittings compound, metal filings and chips, sawdust, welding splatter and parts of cleaning rags. It is of course essential that the interior of all piping is clean before beginning the installation. Copper tubing and pipe, seamless steel tubing and galvanized pipe should be blown out with air or flushed out with diesel oil, kerosene, varsol or any other solvent compatible with mineral oil. The best procedure is to flush and then blow out the piping. Black iron pipe as delivered should never be used. It is barely acceptable after pickling followed by neutralizing (pacifying). Internal sandblasting followed by flushing and blowing if properly done is better than pickling. If any welding or brazing is done after cleaning, the resulting oxidation scale must be removed by scraping and blowing out. For this reason welding should only be done at the end of pipes where any easy visual inspection can be made. Galvanized standard pipe with extra heavy fittings is quite acceptable.

To avoid contamination with pipe fitting compound such as Teflon tape or Permatex it is essential that they are applied to the male threads only. Leave the first two threads free of compound. Quite often a fitting must be removed to reposition it or to install a new one. It is important to free the female thread of all remaining compound. This is particularly important with Teflon tape as it usually shreds into small bits. If Teflon tape is used, only 1/2 the tightening effort normally applied with pipe dope should be used, otherwise the female connection is likely to distort or even crack. All open piping should be protected during installation to prevent the entry of contamination. When piping is complete, if possible, the entire system should be flushed and blown out again. To do this, a connection preferably at a high point in the system should be broken and either a wing or power pump connected to the line. This pump should be large enough to provide a fast flow of solvent through the piping to ensure a thorough cleaning. It is desirable to blow out the system after draining the solvent but a small amount of solvent remaining is harmless providing that it is oil compatible.

The size of the piping should not be smaller than recommended on the piping diagram. Hydraulic hose should only be used in short lengths at the pump or cylinder ports to facilitate movement or in consideration of vibration. Long lengths are very detrimental to performance causing stiff steering, sponginess and overheating in power systems. The system is too hot if a hand cannot be held comfortably on any line for 1/2 a minute (about 160°F - 71°C) maximum.

All piping should be done with a minimum of sharp bends and fittings. All pipes should be clamped so that vibration or pressure surges will not cause wear or noise. Clamping is essential at any pipe end which connects to a hose. "Goosenecks" in piping should be avoided. If this is not possible, provision for venting at the high points should be made. This venting provision is not important in the power system where the oil flows in one direction only at a relatively high velocity and carries trapped air along. It is important in the control system where oil flows at low speed in both directions keeping the same oil and air flowing back and forth over a short distance. This keeps air trapped at the high points. It is also extremely important that all fittings are air tight. If any connections show a trace of leaking oil, air is sure to enter the system at this point. Vent or filling lines to a header tank should be installed with a steady rise to ensure that the system will be self venting because air may occasionally enter through shaft and piston rod seals. It is extremely important to remember that trapped air can only be vented from lines where the oil velocity is low by installing the piping with a steady rise.

RECOMMENDED OIL

A good high quality all-weather oil is recommended for use in both the control and the power systems. In order to meet this requirement, a very high viscosity index (which indicates a high resistance to viscosity change when subjected to operating temperature variations) is an important property of the oil. The viscosity index should be no less than 150.

The oil should also have a low pour point. This indicates the capability of system warm up in a minimum time when the fluid temperature drops very low through an idle period.

For this purpose we recommend ESSO UNIVIS N22.

All grades of UNIVIS oils are compatible and can be mixed in any ratio. Intermediate viscosity temperature properties will result from such a blend.

A high quality multi-purpose grease is recommended for lubrication at all system wear points. A wide operating temperature range and good water tolerance are other important properties.

For this purpose we recommend: ESSO UNIREX EP1.

FILLING THE SYSTEM

The power system must be filled first through the power system header tank. The tank must be vented to atmosphere and always kept full to avoid sucking air and forcing it into the system. The power pumps should never be run until their inlets are flooded with oil. Crack the fitting at each pump inlet port to ensure ample oil has flowed from the header tank. Note that the pump inlet port is larger in diameter than the outlet or pressure port.

When oil has reached both inlet ports it is permissible to start the power pumpsets. "Pulse" start each power system pumpset for ten seconds at a time if possible to allow oil to flow from the header tank to the pump inlet to avoid "starving" and damaging the pump. The pumps could be extremely noisy at this stage because of the oil and air mixture. When the power pumps become quieter this indicates that a steady flow of oil is now being circulated. The pumpsets should now be turned off.

The control system lines from the helm pumps to the telemotor cylinder may now be filled. Start by filling the control system header tank. It must be vented to atmosphere and always kept full to avoid sucking air and forcing it into the system.

Start with the highest helm pump and work progressively down toward the lowest. The helm pump connected directly into the steering cylinders located in the steering compartment is not part of the control system and should not be included in this procedure. Begin by turning the highest wheel continually in one direction only until the system starts to become relatively solid. The helm pump should now be turned steadily in the opposite direction until solid again. Continue this same sequence with each successively lower helm pump. The lines from the helm pumps should be sufficiently full at this point to continue filling the rest of the system.

The control system pumps should not be started until their inlets are flooded with oil. Crack the fitting at each pump inlet port to ensure ample oil has flowed from the header tank. "Pulse" start each pumpset to avoid "starving" and damaging the pump. Do this until the control pumps run relatively quiet.

The manifold solenoid 4-way valves may now be electrically or manually operated to both port and starboard to fill the control pumpset to telemotor lines.

"Pulse" start the power system pumpsets again for one minute intervals and operate the highest helm pump in both directions. This will begin to fill the steering cylinders with oil from the power pumps. When the power pumps become relatively quiet again they may be left running while the highest helm pump is turned from hard over to hard over. The oil levels of both header tanks must be maintained.

To ease the continued operation of the system the manifold solenoid 4-way valves may be energized. This initial hard over to hard over cycling of the steering gear should be continued until the oil and air noise emitted by the pumpsets remains fairly constant.

It will take time for all of the air to be expelled from the system. Working the system and then allowing it to rest for a few hours is the fastest method of removing the air. The steering gear will not be smoothly responsive until most of the air is removed.

Both header tanks should be 3/4 full when all air has been vented from the system.

TESTING THE INSTALLATION

Any movement of any helm pump in the control system should cause a proportional movement in the telemotor cylinder which in turn should cause a corresponding movement in the steering gear. With all pumpsets running, the gear hardover to hardover time should be twice that with any combination of one power system pumpset and one control system pumpset running. The wheel at any helm pump in the control system may be turned as quickly as desired. The steering gear should follow that command instantaneously and steadily at a speed determined by the pumpset(s) and should stop at the position commanded through the helm.

The following test will determine the proper operation of the steering gear through a helm pump command and assist in correcting common installation faults. Reference to the descriptions of individual components under "SYSTEM COMPONENTS" will provide further information for the servicing of each component.

1. With all pumpsets running, turn any helm pump in the control system at approximately one RPM from midships to hardover starboard. Pause briefly then turn back to midships again.
 - A. THE GEAR TRAVELS FROM MIDSHIPS TO HARDOVER STARBOARD AND RETURNS TO MIDSHIPS
 - (1) The gear seems to be functioning correctly but check both hardover positions with a helm pump command. The steering gear must stop automatically in both hardover positions two degrees before reaching the mechanical stops on the lock pin housing. If the gear reaches the mechanical stops through this command, the system relief valve will open. This is not dangerous in itself but the heat produced through continual operation of this valve could cause eventual seal damage.

The follow-up linkage pick up point on the tiller must be moved outward from the rudder stock until the gear is off the stops on both sides. This adjustment regulates the total rudder angle produced by the steering gear.

Although the gear is now off the stops, the distance from the stops on each side may differ. This is corrected by lengthening or shortening the follow-up rod with the fine adjustment screw and locknut.

When the distance from the stops is equal but more than two degrees short of the stops, the sliding pick up point must be moved back toward the rudder stock to complete the adjustments.

NOTE: These adjustments have all been factory pre-set and should not be tampered with unless absolutely necessary.

B. THE STEERING GEAR OPERATES CORRECTLY BUT IS ERRATIC

- (1) Too much air is still in the system. Constant operation will remedy this as the system is self-venting.
- (2) The spring on the control valve assembly may be too slack. Increase the spring tension with the adjusting nut.

C. THE GEAR TRAVELS HARDOVER TO EITHER SIDE BEFORE ANY HELM PUMP IS TURNED AND CANNOT BE RETURNED TO MIDSHIPS.

- (1) Check the follow-up linkage and ensure that all parts are connected. If the linkage is not connected the spring will pull the 4-way flow control valve into a hardover position.
- (2) The solenoid 4-way valve on one of the control system pumpsets could be either jammed or energized in an operating condition. This is checked by closing the two shutoff valves at the manifold lockvalve outlets. This will isolate the complete manifold from the control system. These valves are normally open and must be opened after this test.

D. THE GEAR TRAVELS FROM MIDSHIPS TO HARDOVER PORT AND RETURNS TO MIDSHIPS.

- (1) Refer to the piping diagram and check for connection reversals. The lines from the helm pumps to the tele-motor cylinder must connect to the ports as shown on the drawing.

E. THE HELM PUMPS CAN BE TURNED BUT THE GEAR WILL NOT RESPOND.

- (1) Check the power system oil level and the oil supply at the power pump inlets. If the shutoff valves at the pump inlets are closed or the power system header tank shutoff valve is closed, the oil supply to the pumps is shut off. These valves are normally open.
- (2) The electric motors on the power pumpsets may not be turning in the correct direction. The pumps must turn clockwise when viewed from the shaft end.
- (3) Another helm pump in the control system may be "motored" as the operated helm pump is turned. A "motored" pump indicates that its lockvalve is contaminated and oil is flowing back into one of the "motored" pump outlet ports.
- (4) The helm pump turned may have a contaminated suction valve. This situation will cause oil to circulate within the pump when operated. If the pump does not seem to operate in either direction, both suction valves may be contaminated.

- (5) One of the lockvalves located on the control system manifold assemblies may be contaminated and allowing oil to flow into the manifold assembly. This is checked by closing the two shutoff valves at the manifold lockvalve outlets. This will isolate the complete manifold from the control system. These valves are normally open and must be opened after this test.
- (6) The flow control piston in the 4-way flow control valve may be jammed in the open position allowing power oil to be returned to the power pump inlet. The valve must be cleaned.
- (7) The pilot relief valve ball in the top cap of the 4-way flow control valve may be held open by contamination. This would allow the flow control valve piston to open and power oil would be returned to the power pump inlet. Remove the pilot relief by backing out the adjusting screw and clean all parts. Care must be taken on reassembly to ensure that the original valve setting is obtained.
- (8) One of the relief valves on the control valve assembly plate may be held open by contamination and allowing power oil to return to the pump inlet. The shutoff valve on the return line side of the valve must be closed to prevent oil return to the pump. This valve must be returned to the normally open position after this test.
- (9) The lock pin solenoid bypass valve may be jammed in the open position and be "shortcircuiting" the power system. Close its shutoff valve to test for this condition.
- (10) The system manual bypass valve may be in the open position. This valve must be normally closed.

F. A HELM PUMP WILL NOT TURN

- (1) The lockvalve plumbed to the outlet of the helm pump may be connected backwards. The letters 'P' on the lockvalve body must be connected toward the helm pump.
- (2) A shutoff valve on one of the lines connected to the helm pump may be closed.

The following test will determine the proper operation of the steering gear on a command given through the control system manifold assemblies.

Any of the previous conditions and their correction, with the exception of those directly attributable to a helm pump and its lockvalve, could apply to operation through the manifold assemblies as they perform the same function as the helm pumps - that is to reposition the telemotor cylinder.

2. With all pumpsets running, operate any electric control from midships to hardover starboard. Pause briefly and then return the rudder to midships.

G. THE STEERING GEAR TRAVELS HARDOVER ON COMMAND BUT CANNOT BE RETURNED TO MIDSHIPS.

- (1) The manifold solenoid 4-way valve may have jammed in an energized position. See condition C (2) previously described.

H. THE ELECTRIC CONTROLS AND AUTOPILOT OPERATE THE STEERING GEAR VERY SLOWLY OR NOT AT ALL.

- (1) Check the control system oil level and the oil supply at the control pump inlets. If the shutoff valve in the control system header tank line is closed, the oil supply to the pumps is restricted. This valve is to be normally open.
- (2) The electric motors on the control pumpsets may not be turning in the correct direction. The pumps must turn clockwise when viewed from the shaft end.
- (3) The piston in the manifold solenoid 4-way valve may be jammed by contamination. Manually operate the valve to check for this condition. If the piston will not shift easily, do not force it as the piston finish may be damaged. If the valve piston can be shifted easily check for a low voltage condition at the solenoid coils or a burned out solenoid coil.
- (4) The flow control piston or the relief valve in the manifold flow control valve may be stuck and permitting control pump oil to return to the pump inlet. The valve must be cleaned.
- (5) The flow adjusting knob on the manifold flow control valve may be set in the "off" or a very low position. Adjust the knob carefully. Operation through one manifold only should fully stroke the telemotor cylinder in 18-20 seconds.

GENERAL MAINTENANCE

All maintenance procedures as described under "SYSTEM COMPONENTS" should be included in the regular service schedule.

A visual inspection of the steering gear should be included as part of the maintenance routine. The various working parts of the gear must be greased regularly. It is not advisable to mix various grease types as the lubricating qualities and actual inherent properties in some types of greases may be destroyed by blending.

To ensure long service life and total reliability of all the components in the steering system, all servicing should be attended to as soon as reasonably possible. The following page details shipboard spares available for maintenance. It is suggested that this inventory be maintained and therefore parts should be reordered when used.

| | |---------------------| | LIST OF SPARE PARTS | |---------------------|

Two sets of seals for L100-52 cylinder

| | |
|-------------|-----------|
| 4 - U cups | 11-208007 |
| 4 - O rings | 11-106274 |
| 8 - V rings | 11-406007 |

Two shaft seals for non follow-up pump

| | |
|-----------------|------|
| 2 - Shaft seals | V110 |
|-----------------|------|

Two shaft seals for main power pump

| | |
|-----------------|-----|
| 2 - Shaft seals | 50V |
|-----------------|-----|

Two springs for 2 1/2" follow-up

One set of seals for 3 1/2" telemotor cylinder

| | |
|-------------|-----------|
| 8 - V rings | 11-406001 |
| 1 - O ring | 11-106232 |
| 2 - O rings | 11-106234 |

Two seals for 2" filter

| | |
|-------------|-----------|
| 2 - O rings | 11-106249 |
|-------------|-----------|

One set of seals for 2 1/2" 4-way flow control valve

| | |
|-------------|-----------|
| 2 - U cups | 11-206002 |
| 2 - O rings | 11-106151 |
| 1 - O ring | 11-106242 |
| 3 - O rings | 11-106111 |
| 2 - O rings | 11-106114 |
| 2 - O rings | 11-106012 |
| 2 - O rings | 11-106231 |
| 1 - O ring | 11-106237 |
| 1 - ball | 21-300011 |

One seal kit for 2" lockvalve

| | |
|-------------|-----------|
| 4 - O rings | 11-106228 |
| 2 - O rings | 11-106141 |
| 2 - O rings | 11-106150 |

Seals for follow-up plate flanges

| | |
|--------------|-----------|
| 16 - O rings | 11-106228 |
|--------------|-----------|

Two shaft seals for model D pump

| | |
|-----------------|-----------|
| 2 - Shaft seals | 11-806001 |
|-----------------|-----------|

Two seal kits for 3/4" lockvalve
4 - O rings 11-106121
4 - O rings 11-106134

One set of seals for non follow-up manifold

(a) 3/8" manifold flow control valve
1 - O ring 11-106012
2 - O rings 11-106013
3 - O rings 11-106016
1 - O ring 11-106019

(b) Vickers DG4S4 solenoid 4-way valve
2 - O rings 11-106007
2 - O rings 11-106115
5 - O rings 11-106014

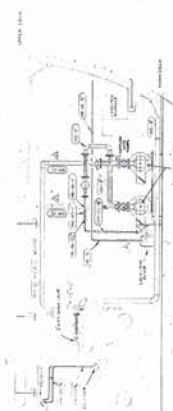
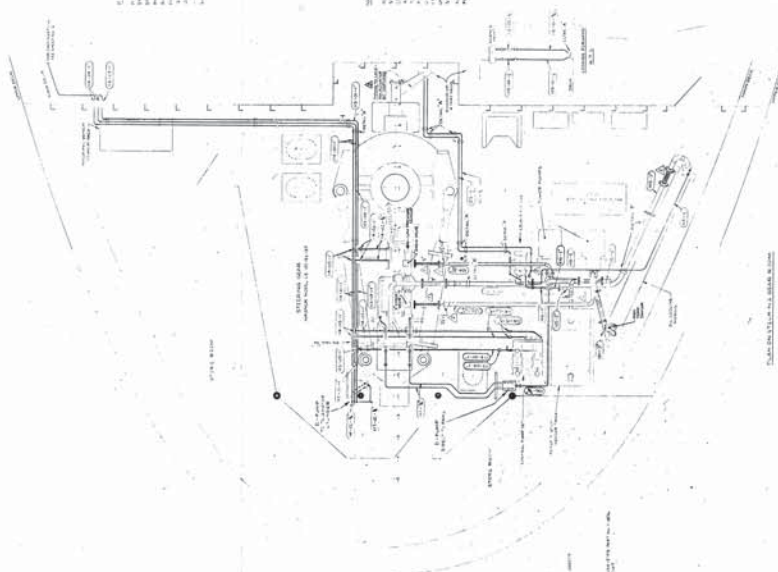
(c) 3/8" std. manifold lockvalve
2 - O rings 11-106024
2 - O rings 11-106015

(d) 3/4" filter
1 - O ring 11-106224
1 - O ring 11-106227

One spare 75HP electric motor

One spare 5HP electric motor

One spare 1HP electric motor

[illegible]

P-103-7 2c#12 → MSV-1PH-6
PROP. ANTI-
(SEE SMT.)

TO CUMPLICITY
(SEE DWG. # 901-7)

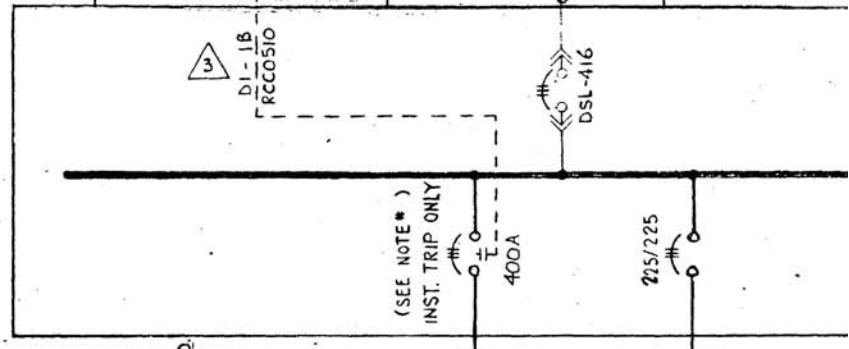
TO CUMPLICITY → DI-15E
P-0401-CVU. 12c#14 (4c#5P)

P-0401 5x3c#400MCM 115.9A
FL-1177 75% VLD: 1471A
L=150' VD=0.5%

P-0401-GOV. 3c#14

FROM H.C. #6 (SEE SMT 10) → P-415-13-

FROM S.S. DIESEL ALARM
DISTN. PANEL (SEE SMT 36) → P-112-16-



FROM EMERGENCY SWBD.
(SEE SHEET NO. 4)

EP-402

EP-402-1 (95A)
3c#1/0 (147A)

L=15'
VD=0.1%

EP-402-1-MT
75 HP
3c#1/0 (147A)

PCC-33 8c#14
PCC-10 4c#14

T.P. IN STEERING
GEAR COMPT

P-403 3c#250MCM (238A)
(200% FLC=190A)
L=160' VD=0.6%

P-403-1 (95A)
3c#1/0 (147A)

L=15'
VD=0.1%

P-403-1-MT
75 HP
3c#1/0 (147A)

PCC-34 8c#14
PCC-10 4c#14

P-404 3c#250MCM (238A)
(FLC=175A)
L=240' VD=1.0%

P-404-1-MT
150 HP
3c#250MCM (238A)

PCC-34 8c#14
PCC-10 4c#14

HS-13 16c#14

CONTROL

TO W/H CENTRAL CONTROL CONSOLE.
(SEE DRG # 221-910-2 SMT 19)

STEERING GEAR MOTOR, INBOARD (#1)
IN STEERING GEAR COMPT.

TO PROP. CONTROL CONSOLE (SEE DRG # 221-901-1 # 3)

TO W/H CENTRAL CONTROL CONSOLE
(SEE DRG # 221-910-2 SMT 19)

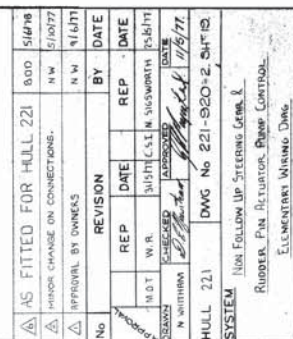
STEERING GEAR MOTOR, OUTBOARD (#2)
IN STEERING GEAR COMPT.

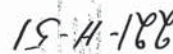
TO PROP. CONTROL CONSOLE (SEE DRG # 221-901-1 # 3)

HEELING PUMP
FITTED IN HEELING PUMP COMPT.

HEELING PUMP CENTRAL UNIT (SEE SMT 37)

POWER PACK HYDRAULIC

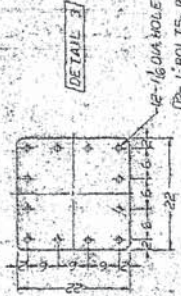
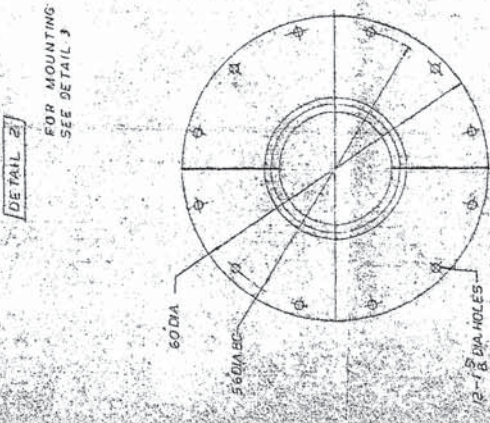
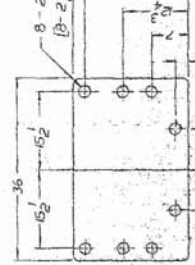
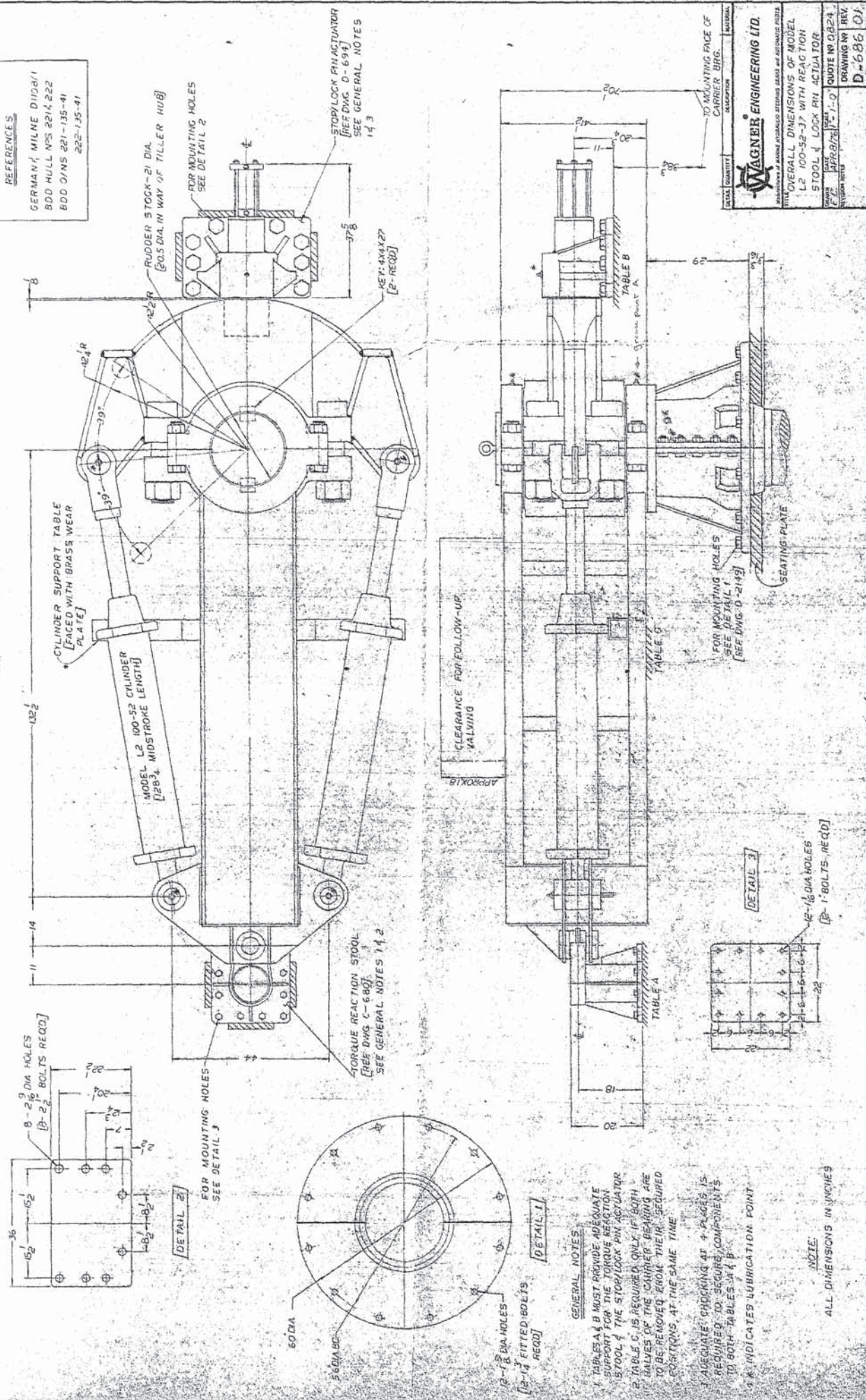




| | | | |
|----|-----------|----------|-------|
| 5 | AS BILLED | REAR 2nd | BOOKS |
| 6 | 1000 | 1000 | 1000 |
| 7 | 1000 | 1000 | 1000 |
| 8 | 1000 | 1000 | 1000 |
| 9 | 1000 | 1000 | 1000 |
| 10 | 1000 | 1000 | 1000 |
| 11 | 1000 | 1000 | 1000 |
| 12 | 1000 | 1000 | 1000 |
| 13 | 1000 | 1000 | 1000 |
| 14 | 1000 | 1000 | 1000 |
| 15 | 1000 | 1000 | 1000 |
| 16 | 1000 | 1000 | 1000 |
| 17 | 1000 | 1000 | 1000 |
| 18 | 1000 | 1000 | 1000 |
| 19 | 1000 | 1000 | 1000 |
| 20 | 1000 | 1000 | 1000 |
| 21 | 1000 | 1000 | 1000 |
| 22 | 1000 | 1000 | 1000 |
| 23 | 1000 | 1000 | 1000 |
| 24 | 1000 | 1000 | 1000 |
| 25 | 1000 | 1000 | 1000 |
| 26 | 1000 | 1000 | 1000 |
| 27 | 1000 | 1000 | 1000 |
| 28 | 1000 | 1000 | 1000 |
| 29 | 1000 | 1000 | 1000 |
| 30 | 1000 | 1000 | 1000 |
| 31 | 1000 | 1000 | 1000 |
| 32 | 1000 | 1000 | 1000 |
| 33 | 1000 | 1000 | 1000 |
| 34 | 1000 | 1000 | 1000 |
| 35 | 1000 | 1000 | 1000 |
| 36 | 1000 | 1000 | 1000 |
| 37 | 1000 | 1000 | 1000 |
| 38 | 1000 | 1000 | 1000 |
| 39 | 1000 | 1000 | 1000 |
| 40 | 1000 | 1000 | 1000 |
| 41 | 1000 | 1000 | 1000 |
| 42 | 1000 | 1000 | 1000 |
| 43 | 1000 | 1000 | 1000 |
| 44 | 1000 | 1000 | 1000 |
| 45 | 1000 | 1000 | 1000 |
| 46 | 1000 | 1000 | 1000 |
| 47 | 1000 | 1000 | 1000 |
| 48 | 1000 | 1000 | 1000 |
| 49 | 1000 | 1000 | 1000 |
| 50 | 1000 | 1000 | 1000 |
| 51 | 1000 | 1000 | 1000 |
| 52 | 1000 | 1000 | 1000 |
| 53 | 1000 | 1000 | 1000 |
| 54 | 1000 | 1000 | 1000 |
| 55 | 1000 | 1000 | 1000 |
| 56 | 1000 | 1000 | 1000 |
| 57 | 1000 | 1000 | 1000 |
| 58 | 1000 | 1000 | 1000 |
| 59 | 1000 | 1000 | 1000 |
| 60 | 1000 | 1000 | 1000 |
| 61 | 1000 | 1000 | 1000 |
| 62 | 1000 | 1000 | 1000 |
| 63 | 1000 | 1000 | 1000 |
| 64 | 1000 | 1000 | 1000 |
| 65 | 1000 | 1000 | 1000 |
| 66 | 1000 | 1000 | 1000 |
| 67 | 1000 | 1000 | 1000 |
| 68 | 1000 | 1000 | 1000 |
| 69 | 1000 | 1000 | 1000 |
| 70 | 1000 | 1000 | 1000 |
| 71 | 1000 | 1000 | 1000 |
| 72 | 1000 | 1000 | 1000 |
| 73 | 1000 | 1000 | 1000 |
| 74 | 1000 | 1000 | 1000 |
| 75 | 1000 | 1000 | 1000 |
| 76 | 1000 | 1000 | 1000 |
| 77 | 1000 | 1000 | 1000 |
| 78 | 1000 | 1000 | 1000 |
| 79 | 1000 | 1000 | 1000 |
| 80 | 1000 | 1000 | 1000 |
| 81 | 1000 | 1000 | 1000 |
| 82 | 1000 | 1000 | 1000 |
| 83 | 1000 | 1000 | 1000 |
| 84 | 1000 | 1000 | 1000 |
| 85 | 1000 | 1000 | 1000 |
| 86 | 1000 | 1000 | 1000 |
| 87 | 1000 | 1000 | 1000 |
| 88 | 1000 | 1000 | 1000 |
| 89 | 1000 | 1000 | 1000 |
| 90 | 1000 | 1000 | 1000 |
| 91 | 1000 | 1000 | 1000 |
| 92 | 1000 | 1000 | 1000 |
| 93 | 1000 | 1000 | 1000 |
| 94 | 1000 | 1000 | 1000 |
| 95 | 1000 | 1000 | 1000 |
| | | | |

REFERENCES

GERMAN MILNE DUDMAN
 800 HULL NPS 2214-222
 800 OINS 221-135-41
 222-135-41



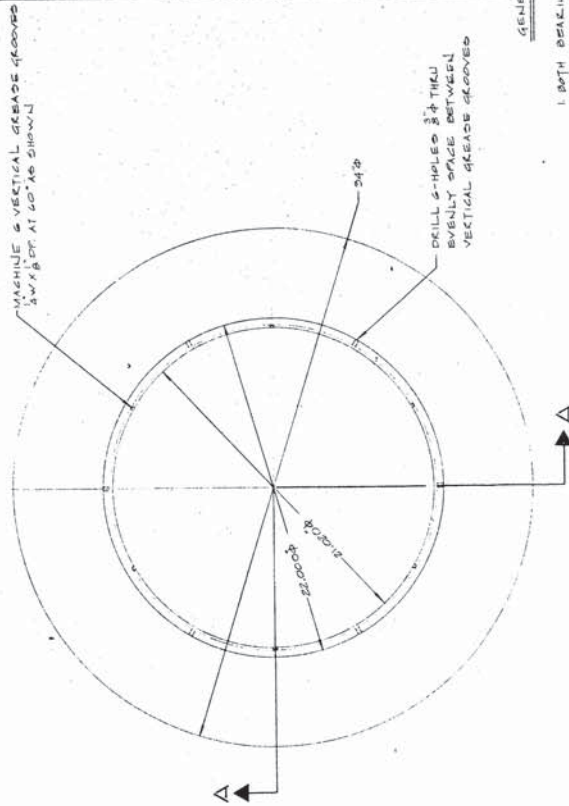
GENERAL NOTES

1. TABLES A & B MUST PROVIDE ADEQUATE SUPPORT FOR THE TORQUE REACTION STOOL & THE STOP LOCK PIN ACTUATOR.
2. TABLE C IS REQUIRED ONLY IF BOTH HALVES OF THE CARRIER BEARING ARE TO BE REMOVED FROM THEIR SECURED POSITIONS AT THE SAME TIME.
3. ADEQUATE CHECKING AT 4-PLACES IS REQUIRED TO SECURE COMPONENTS TO BOTH TABLES A & B.
4. * INDICATES LUBRICATION POINT.

NOTE:
 ALL DIMENSIONS IN INCHES

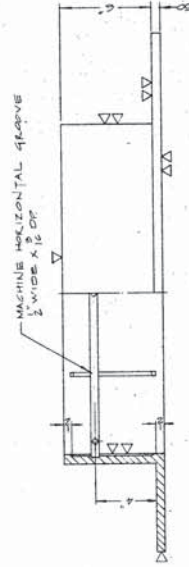
REFERENCE DWG.

| NO. | TITLE | DWG. NO. |
|-----|----------------------|-----------|
| 1 | ENGINEERING MATERIAL | D-2142-01 |
| 2 | REPAIRING AND QA | |



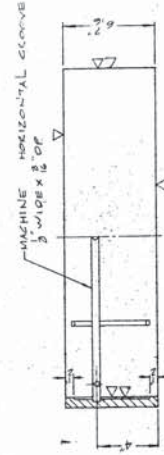
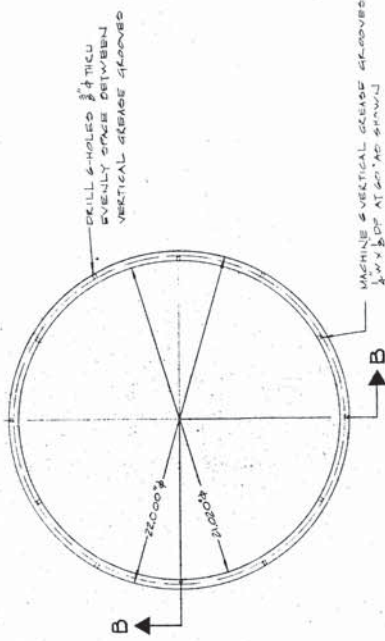
GENERAL NOTES

1. BOTH BEARINGS TO BE SPLIT IN HALF AND EACH HALF TO BE FINISHED BY SINGLE 3/4" COWEL IN HORIZONTAL PLANE TO FRAME HUB HALVES.
2. HALL TO BE CAST ALUMINUM.
3. FINISH OF BEARING SURFACES VV TO BE 60 μIN. RMS.



SECTION A-A

UPPER FRAME HUB BEARING



SECTION B-B

LOWER FRAME HUB BEARING

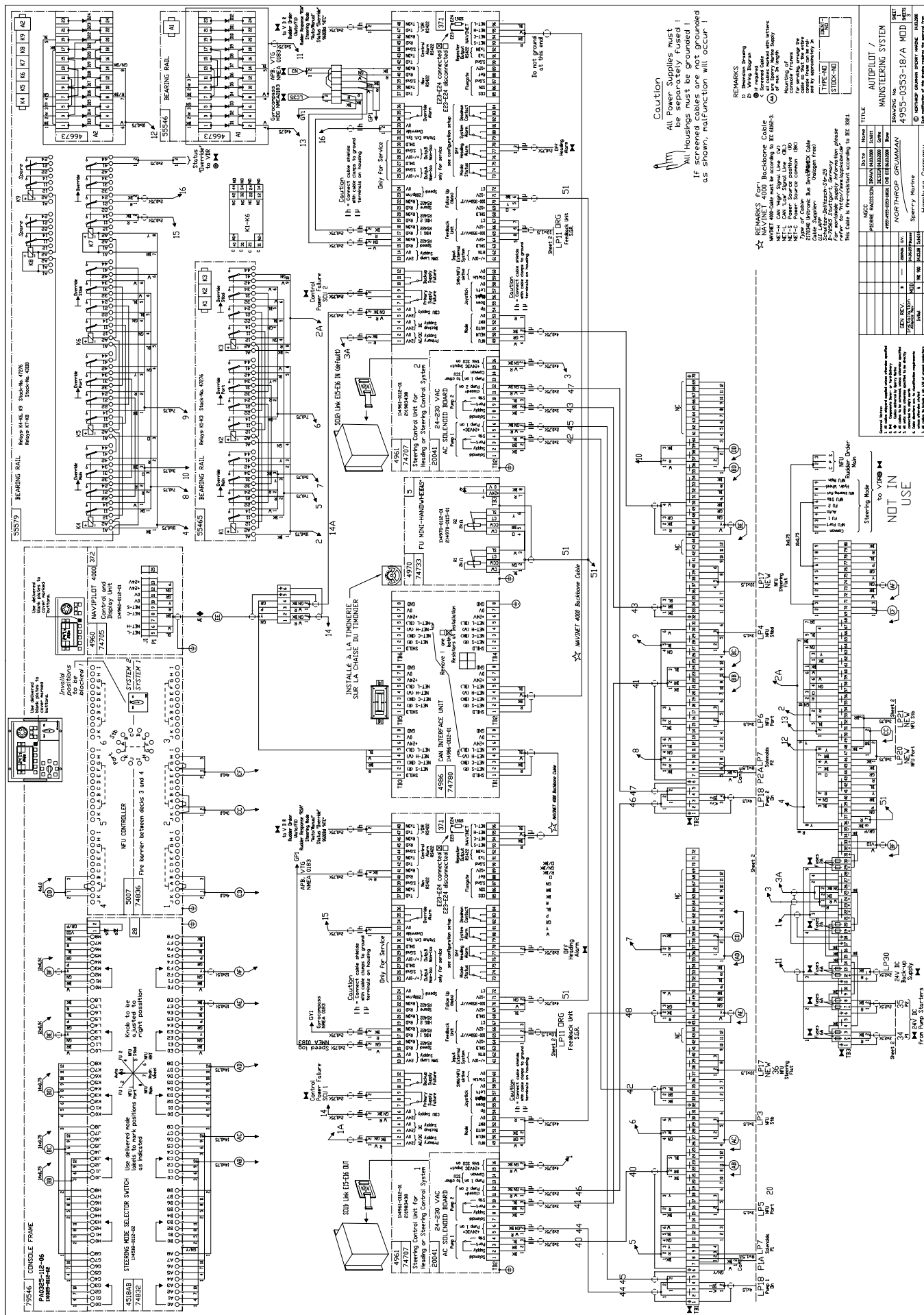
NOTE
▽ TO BE MACHINED

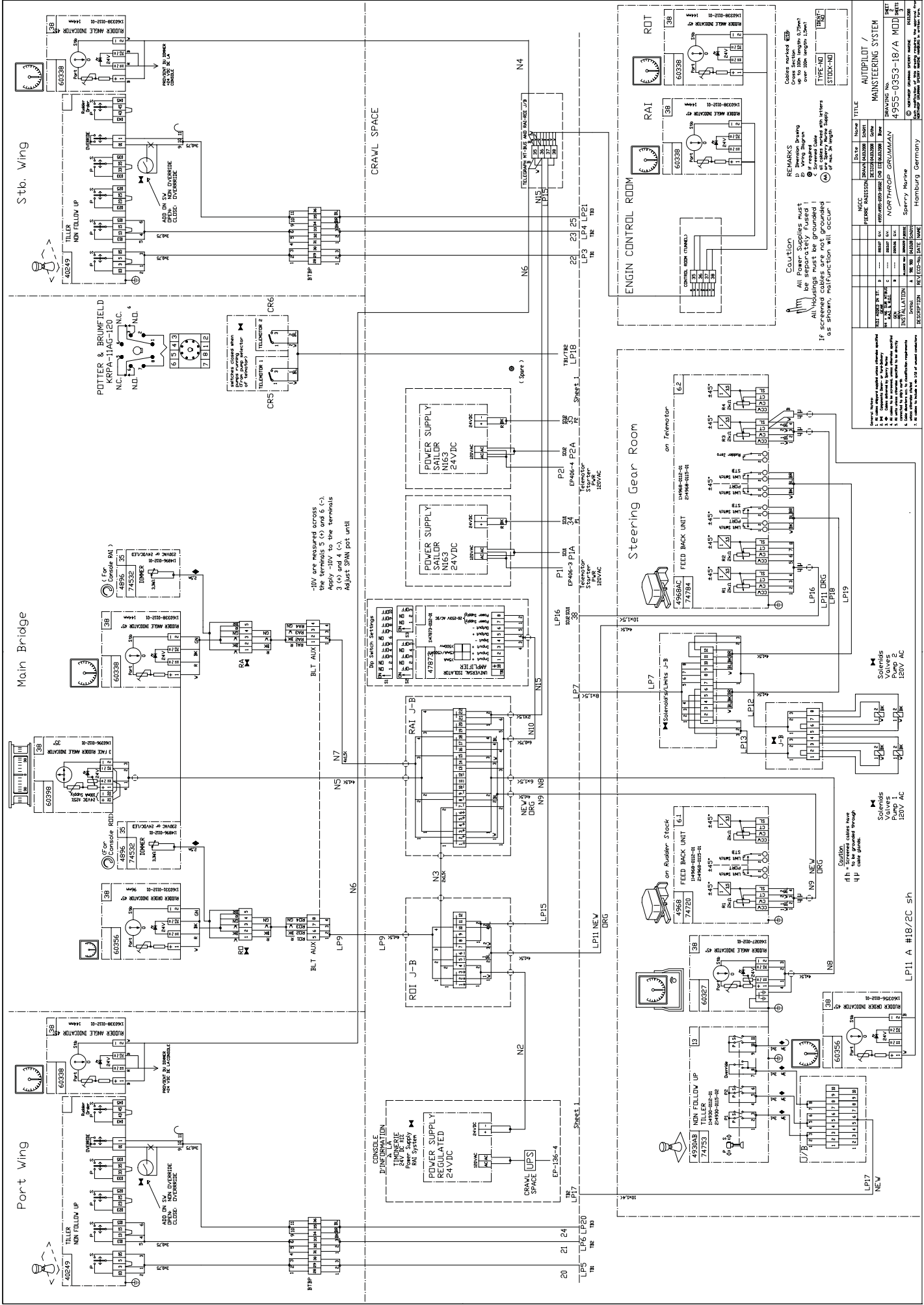
| TOLERANCES | UNLESS OTHERWISE SPECIFIED |
|--------------|----------------------------|
| XX ± .01 | |
| XX ± .001 | |
| ANGULAR ± 1° | |

FRACTIONAL ± 1/32

| DETAIL | QUANTITY | DESCRIPTION | MATERIAL |
|--|----------|-------------|----------|
| WAGNER ENGINEERING LTD. THE WESTERN ENGINEERING CO. LTD. MANUFACTURERS OF STEERING BEARS AND AUTOMATIC PILOTS | | | |
| TITLE: FRAME HUB BEARINGS FOR 'K' CLASS ICEBREAKER | | | |
| DATE | REV. | QUOTE NO. | REV. |
| 10/11/78 | 1 | 0004 | 1 |
| ISSUED BY | | D-689 | |
| ISSUED BY | | 17/78 | |

THIS DRAWING REMAINS THE PROPERTY OF WAGNER ENGINEERING LTD. IT IS TO BE USED FOR THE PURPOSES SPECIFIED ONLY AND IS NOT TO BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, WITHOUT PERMISSION IN WRITING.





Port Wing

Main Bridge

Stb Wing

Steering Gear Room

ENGINE CONTROL ROOM

| REVISIONS | | REVISIONS | |
|-----------|------------------------|-----------|---------------------------|
| NO. | DESCRIPTION | NO. | DESCRIPTION |
| 1 | Issue for construction | 2 | Issue for testing |
| 3 | Issue for operation | 4 | Issue for maintenance |
| 5 | Issue for repair | 6 | Issue for replacement |
| 7 | Issue for upgrade | 8 | Issue for overhaul |
| 9 | Issue for modification | 10 | Issue for decommissioning |

| REVISIONS | | REVISIONS | |
|-----------|------------------------|-----------|---------------------------|
| NO. | DESCRIPTION | NO. | DESCRIPTION |
| 1 | Issue for construction | 2 | Issue for testing |
| 3 | Issue for operation | 4 | Issue for maintenance |
| 5 | Issue for repair | 6 | Issue for replacement |
| 7 | Issue for upgrade | 8 | Issue for overhaul |
| 9 | Issue for modification | 10 | Issue for decommissioning |

| REVISIONS | | REVISIONS | |
|-----------|------------------------|-----------|---------------------------|
| NO. | DESCRIPTION | NO. | DESCRIPTION |
| 1 | Issue for construction | 2 | Issue for testing |
| 3 | Issue for operation | 4 | Issue for maintenance |
| 5 | Issue for repair | 6 | Issue for replacement |
| 7 | Issue for upgrade | 8 | Issue for overhaul |
| 9 | Issue for modification | 10 | Issue for decommissioning |

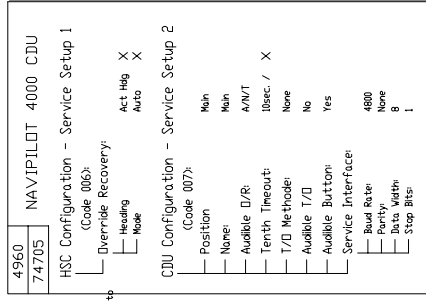
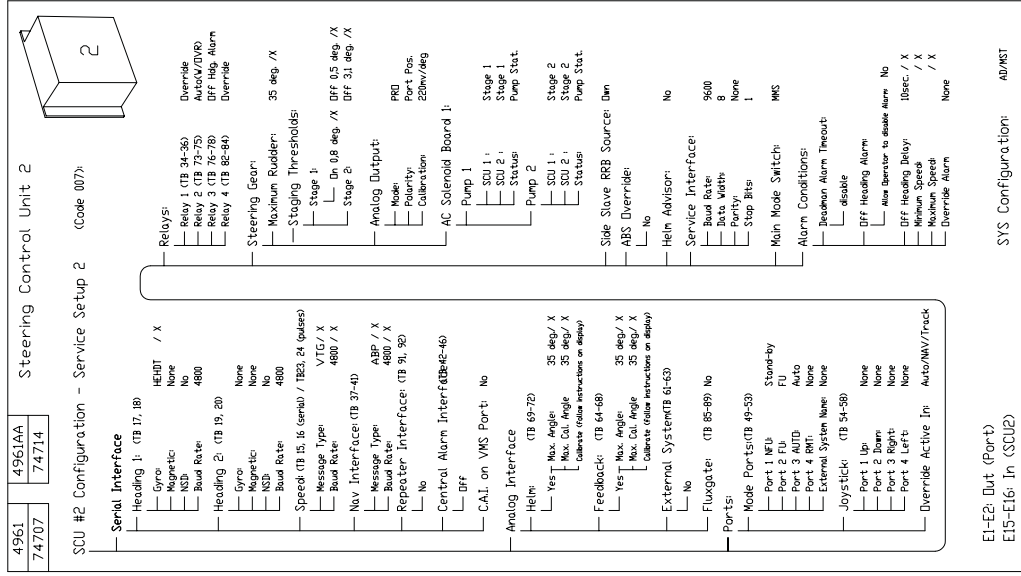
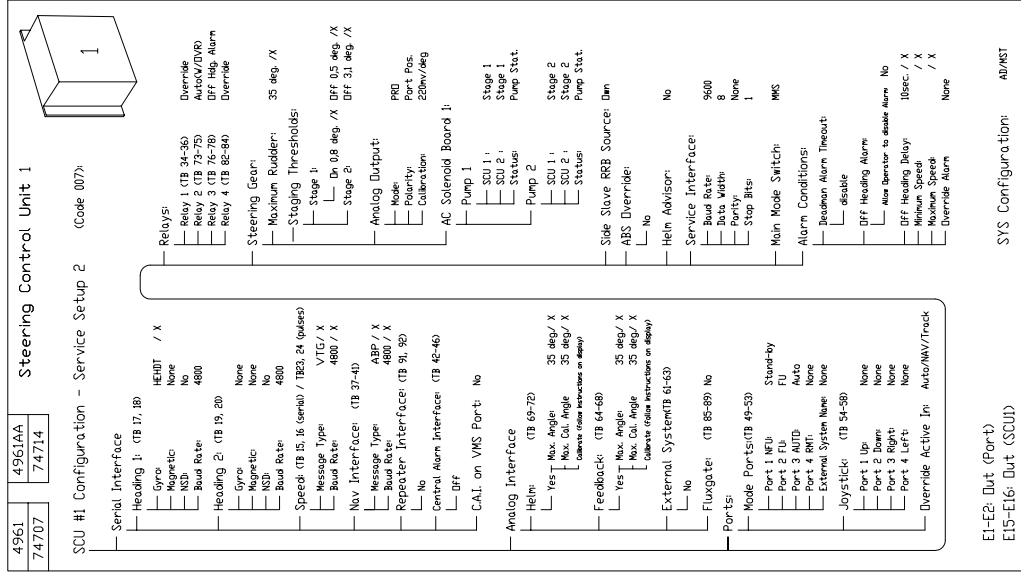
| REVISIONS | | REVISIONS | |
|-----------|------------------------|-----------|---------------------------|
| NO. | DESCRIPTION | NO. | DESCRIPTION |
| 1 | Issue for construction | 2 | Issue for testing |
| 3 | Issue for operation | 4 | Issue for maintenance |
| 5 | Issue for repair | 6 | Issue for replacement |
| 7 | Issue for upgrade | 8 | Issue for overhaul |
| 9 | Issue for modification | 10 | Issue for decommissioning |

| REVISIONS | | REVISIONS | |
|-----------|------------------------|-----------|---------------------------|
| NO. | DESCRIPTION | NO. | DESCRIPTION |
| 1 | Issue for construction | 2 | Issue for testing |
| 3 | Issue for operation | 4 | Issue for maintenance |
| 5 | Issue for repair | 6 | Issue for replacement |
| 7 | Issue for upgrade | 8 | Issue for overhaul |
| 9 | Issue for modification | 10 | Issue for decommissioning |

| REVISIONS | | REVISIONS | |
|-----------|------------------------|-----------|---------------------------|
| NO. | DESCRIPTION | NO. | DESCRIPTION |
| 1 | Issue for construction | 2 | Issue for testing |
| 3 | Issue for operation | 4 | Issue for maintenance |
| 5 | Issue for repair | 6 | Issue for replacement |
| 7 | Issue for upgrade | 8 | Issue for overhaul |
| 9 | Issue for modification | 10 | Issue for decommissioning |

| REVISIONS | | REVISIONS | |
|-----------|------------------------|-----------|---------------------------|
| NO. | DESCRIPTION | NO. | DESCRIPTION |
| 1 | Issue for construction | 2 | Issue for testing |
| 3 | Issue for operation | 4 | Issue for maintenance |
| 5 | Issue for repair | 6 | Issue for replacement |
| 7 | Issue for upgrade | 8 | Issue for overhaul |
| 9 | Issue for modification | 10 | Issue for decommissioning |

| REVISIONS | | REVISIONS | |
|-----------|------------------------|-----------|---------------------------|
| NO. | DESCRIPTION | NO. | DESCRIPTION |
| 1 | Issue for construction | 2 | Issue for testing |
| 3 | Issue for operation | 4 | Issue for maintenance |
| 5 | Issue for repair | 6 | Issue for replacement |
| 7 | Issue for upgrade | 8 | Issue for overhaul |
| 9 | Issue for modification | 10 | Issue for decommissioning |



X = to be adjusted at commissioning according to ship's configuration

X = to be adjusted at commissioning according to ship's configuration

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|----|
| General Notes: 1. All cables shipyard supplied unless otherwise specified 2. ✕ Components laser- or turn-delivery 3. Components must be checked for safety before use 4. All cables to be screened unless otherwise specified 5. All units unless otherwise specified to be directly connected to ship's earth 6. Cable diameters acc. to classification requirements unless otherwise stated 7. All cables to include a min 1/10 of unused conductors | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | </ |
|---|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|----|