HamiltonJet

MARINE PROPULSION UNITS

Installation & Service Manual

MODEL 321

Jet Unit:	HJ-321
Part Number:	89321
Revision 1	20/01/99
Amendment 5	27/01/00

NOTE:
AMENDMENT 2 OF THIS MANUAL IS ONLY APPLICABLE TO JET UNITS FROM SERIAL No #201 ONWARDS.

Due to our policy of continuous development, specifications in this manual are subject to change without notice or obligation.

AMENDMENT RECORD

Part No 89321
Jet Model HJ-321
Manual Installation & Servicing

Amdt	Incorporated By	Date
1.	[illegible]	23/4/99
2.	[illegible]	13/5/99
3.	K Brown	9-6-99
4.	K Brown	26-11-99
5.	K Brown	21-1-00
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Warranty

The Company warrants each new Hamilton product to be free from defects in materials and workmanship under normal use and service, its obligations under this Warranty being limited to make good at its factory or at the factory of any subsidiary or branch of the Company the product or any part or parts thereof which shall be returned to it with transportation charges prepaid and which its examination shall disclose to its satisfaction to have been defective provided or such part or parts thereof shall be so returned to it not later than 24 months from the date of the original purchase from the Company or its authorised distributor, or 12 months from commissioning date, whichever occurs first. No allowance shall be granted for any repairs or alterations made by the purchaser or its agent without the written consent of the Company. This Warranty is expressly in lieu of all other warranties expressed or implied and of all other obligations or liabilities on its part, including any liability under the Sale of Goods Act, 1908, and no other person or agent or dealer is authorised to give any other condition or warranty to assume for the Company any other liability in connection with the sale of its products whether new or second hand. Any obligation on the part of the Company under this Warranty does not apply to any Hamilton product which may have been repaired or altered in any way outside the factory of the Company or to damages caused in the opinion of the Company by overloading, misuse, misapplication, improper storage, abnormal wear and tear due to exposure to the elements, negligence, accident, or whilst being operated in any other way other than in accordance with the operating and maintenance instructions of the Company nor does it apply to repairs made necessary by the use of parts or accessories not recommended by the Company. There is no liability on the part of the Company with respect to any items incorporated in any Hamilton product when such items have been manufactured by others and are warranted by their respective manufacturers in favour of the purchaser or when they are supplied by the Company on special order. The Company shall not be liable for any consequential loss or damage resulting directly or indirectly from any defect in the product the subject of this agreement. No liability on the part of the Company with respect to this Warranty shall extend to second - hand and reconditioned goods and the Warranty does not cover the cost of labour involved in the replacement of defective parts. No liability on the part of the Company with respect to this Warranty shall exist if the Hamilton product is not, in the opinion of the Company, installed as per the "Installation and Service Manual", "Designer's Manual" and/or "Owners Manual" supplied with each product. Warranty will not apply unless a negative earth bonding system has been installed in the vessel and a mainshaft critical speed check carried out to the Company's satisfaction.

C.W.F. HAMILTON & Co. Ltd.

This portion must be completed in every detail and returned immediately to:
C.W.F. HAMILTON & CO LTD, PO BOX 709, CHRISTCHURCH, NEW ZEALAND.

- -

Purchaser ....

Address ....

Hamilton Jet Model .... Serial number ....

Signed .... Date ....

Dealer ....

Delivery date .... Dealer's signature ....

GENERAL SAFETY NOTICE

The specific Safety Warnings and Cautions summarised below appear in appropriate sections of this Manual. Each is referenced to the text by the Section and Page on which it appears.

WARNINGS

A WARNING: is an operation or maintenance procedure, practice condition or statement which, if not strictly observed, could result in injury or death to personnel.

This is a list of standard Warnings that will be found throughout this Manual. C.W.F. Hamilton & Co. Ltd advise that in the interests of safety, these Warnings be read and understood prior to commencement of any maintenance or overhaul activities on the Jet Units / Controls Systems described within this Manual.

WARNING:

THE JET UNIT THRUST BEARING MUST NOT BE SUBJECTED TO EXCESSIVE RADIAL LOADS CAUSED BY:

a) ADAPTORS AND BELT PULLEYS OVERHANGING THE JET UNIT COUPLING FLANGE.
b) RIGID DRIVELINES WHICH DO NOT ACCOMMODATE MISALIGNMENT CAUSED BY GEARBOX MOVEMENT.
c) DRIVESHAFT WEIGHT.

1.7.

WARNING:

SPARE "V" BELTS WILL CAUSE A POTENTIAL HAZARD TO BOTH PERSONNEL AND MACHINERY IF NOT PROPERLY SECURED.

ENSURE THAT THE SPARE "V" BELTS ARE FASTENED SECURELY TO THE JET UNIT AND DO NOT COME LOOSE AND FOUL OTHER EQUIPMENT DURING VESSEL OPERATION.

2.12.

WARNING:

ENSURE THAT THE VESSEL IS SECURELY MOORED DURING COMMISSIONING. AS THE JET UNITS MAY PRODUCE LARGE THRUST FORCES.
DO NOT PROCEED IF ANY CONTROL SYSTEM FAULT ALARMS ARE STILL ACTIVATED.

3.1.

WARNING:

SELECTING 'ASTERN' (CRASH STOP) WHILE THE VESSEL MOVING AHEAD AT HIGH SPEED CAN PRODUCE A VERY RAPID DECELERATION.

NEW OPERATORS SHOULD USE THE "CRASH STOP" FEATURE VERY CAREFULLY.

DO NOT USE FULL HELM CONTROL UNTIL THE VESSEL HAS SLOWED.

SELECT ZERO SPEED AND REDUCE THROTTLE AS SOON AS THE VESSEL HAS SLOWED.

4.6.

WARNING:

EXTREME CARE IS REQUIRED WHENEVER THE INSPECTION COVER IS REMOVED AS WATER MAY ENTER THE VESSEL THROUGH THIS OPENING. NEVER LEAVE THE INSPECTION COVER REMOVED WITHOUT CONSTANT MONITORING OF THE WATER LEVEL.

4.9, 4.10, 6.4.

WARNING:

EXERCISE EXTREME CARE IF THE BEARING HOUSING IS OVERHAULED WITH THE VESSEL AFLOAT, AS WATER MAY ENTER THE VESSEL THROUGH THE OPENING IN THE JET INTAKE.

8.12.

WARNING:

EXERCISE EXTREME CARE IF WATER SEAL REPLACEMENT IS TO BE CARRIED OUT IN THE VESSEL AS WATER MAY ENTER THE VESSEL THROUGH THE INTAKE OPENING. NEVER LEAVE THE INSPECTION COVER REMOVED.

8.14, 8.16.

CAUTIONS

A CAUTION: is an operation or maintenance procedure, practice condition or statement which, if not strictly observed, could result in damage to, or destruction of, equipment or loss of mission effectiveness.

This is a list of standard Cautions that will be found throughout this Manual. C.W.F. Hamilton & Co Ltd advise that these Cautions should be read and understood prior to commencement of any maintenance on the Jet Units / Controls Systems described within this Manual.

SECTION 1.

CAUTION:

Not all Hull shapes are suitable for propulsion by water jets. Some advice on suitable Hull shapes, estimating performance and engine matching is given in the Designers Manual.

1.4.

CAUTION

If a gearbox or clutch is fitted to the engine, a conventional hull water pick-up and engine raw water pump must be used.

1.8, 1.14.

CAUTION:

Ensure that any through hull water pick up is not directly ahead of the Jet Unit intake, but well to the side to avoid turbulent water flow into the *Jet Unit*.

1.14.

SECTION 2.

CAUTION

Prevention of Corrosion

The Jet Unit has been designed to withstand the corrosive affects of operation in salt water through the use of materials that are resistant to salt water corrosion and by the placement of sacrificial zinc anodes in suitable locations. However, the Jet Unit is still vulnerable to the actions of the person who fits the Waterjet System into the hull and to the actions of the electrician.

One of the major causes of corrosion of metal parts in salt water, are stray currents coming from the vessel's electrical system. These currents can be very small, often defying detection, but acting over a long period can cause significant corrosion.

Vessels using Hamilton Jet Units at sea , must be bonded and wired as described in Section 7 *Precautions against Corrosion.*

2.1.

CAUTION:

In Multi Jet Unit installations, each Jet Unit is specifically assembled for Port, Starboard or Centre mounting and are matched to their individual Intake Blocks. Care should be taken to ensure that each Jet is fitted onto the correct Intake Block.

2.2.

CAUTION:

Switch off the Reverse Control System during steering adjustment so the Reverse Duct is not accidentally lowered onto a clamp.

2.10.

CAUTION

If a gearbox or clutch is fitted to the engine, a conventional hull water pick-up and engine raw water pump must be used.

2.13..

SECTION 3.

CAUTION:

Ensure that all Bearing Housings are filled with the correct amount and grade of oil. If this is not done, then damage will occur to the Jet Units.

3.1.

CAUTION:

If a problem is detected, then return to mooring immediately at reduced power. Do not operate the Jet Unit until the fault has been repaired. Refer to Section 5 Faultfinding.

3.2.

SECTION 4.

CAUTION:

Never stop the Engine(s), or disengage the drive to the Jet Unit, when approaching a mooring or at any time when control of the vessel may be required.

4.1.

CAUTION:

Running at speed with a partially blocked Inlet Grill or debris on the Impeller will result in cavitation damage to the Jet Unit.

4 6, 4.8.

CAUTION:

If in lightweight planing craft, which is moving forward at speed, the "Astern" or "Zero Speed" positions are selected with the throttle left open, the resultant "Braking Effect" is very severe - even more so than full braking with a motor car.

4.6.

CAUTION:

Do not run the Jet if the vessel has run aground. Damage may occur to Impellers.

4.7.

CAUTION:

Ensure the water level is below the Inspection Cover level before removing the Inspection Cover.

4.8.

CAUTION:

Before removing the Inspection Cover:

a) Stop all engines.
b) Check that the static water level will be below the Intake Inspection Cover lip.
c) If the static water level is too high, ballast should be placed on the bow to raise the stern high enough to allow the Intake Inspection Cover to be removed.
d) Alternatively, an optional extra Overflow Preventer can be fitted to the inspection point to allow inspection of the Intake Housing at higher water levels.

4.10.

SECTION 5.

NIL.

SECTION 6.

CAUTION:

Do not run the Jet Unit out of the water, unless fitted with a Dry Run Kit.

6.2.

CAUTION:

Before moving any Controls, ensure that any marine growth is removed from the Steering and Reverse Linkage Rods. This will prevent damage to the seals that these Controls Rods pass through.

6.2.

CAUTION:

ANTI FOULING PAINTS

Do not use copper oxide based anti-fouling paints. Tin base anti-fouling paints are suitable or anti-fouling paint suitable for an aluminium hull as recommended by the paint manufacturer. Leave all stainless steel parts polished and unpainted. Do not paint over the anodes.

ANTI-SEIZE COMPOUNDS:

Do not use anti-seize compounds which are based on graphite, nickel or copper flakes- these will cause corrosion. Anti-seize compounds, usually containing zinc flakes, are available for aluminium.

6.6, 6.8.

CAUTION:

Tightening Torque's: Ensure all fasteners as tightened to the correct torque's as described in Drawing 85113 or relevant assembly drawings.

6.7.

CAUTION:

It is common to use a copper based antifouling paint on steel hulls. Copper based antifouling paint cannot be used near or on the Aluminium Jet as it will cause the Jet Unit to corrode.

6.8.

SECTION 7.

CAUTION:

Prevention of Corrosion

The Jet Unit has been designed to withstand the corrosive affects of operation in salt water through the use of materials that are resistant to salt water corrosion and by the placement of sacrificial anodes in suitable locations.

Vessels using Hamilton Jet Units, must be bonded and wired as described in this Section to prevent corrosion occurring due to the presence of stray currents or due to galvanic interactions along the shore power grounding conductor.

7.1.

CAUTION:

An isolation transformer or a galvanic isolator must be correctly fitted to the vessel electrical system if the vessel is to be connected to an external AC shore supply.

7.2.

CAUTION:

ANTI FOULING PAINTS

Do not use copper oxide based anti-fouling paints. Tin base anti-fouling paints are suitable or anti-fouling paint suitable for an aluminium hull as recommended by the paint manufacturer. Leave all stainless steel parts polished and unpainted. Do not paint over the anodes.

ANTI-SEIZE COMPOUNDS:

Do not use anti-seize compounds which are based on graphite, nickel or copper flakes- these will cause corrosion. Anti-seize compounds, usually containing zinc flakes, are available for aluminium.

7.5.

CAUTION:

For steel and carbon fibre reinforced GRP hulls, the Jet Unit must be electrically insulated from the Hull.

7.6.

CAUTION:

For Steel Hulls, the Jet Unit must be totally electrically insulated from the Hull.
For Steel Hulls, insulating hardware is supplied with the Jet Unit. The insulation should be checked before finally bolting the Jet Unit and Transom Seal assembly in place and again on completion of the assembly of the Jet Unit and Transom Seal assembly.

7.9.

SECTION 8.

CAUTION:

ANTI FOULING PAINTS

Do not use copper oxide based anti-fouling paints. Tin base anti-fouling paints are suitable or anti-fouling paint suitable for an aluminium hull as recommended by the paint manufacturer. Leave all stainless steel parts polished and unpainted. Do not paint over the anodes.

ANTI-SEIZE COMPOUNDS:

Do not use anti-seize compounds which are based on graphite, nickel or copper flakes- these will cause corrosion. Anti-seize compounds, usually containing zinc flakes, are available for aluminium.

8.2.

CAUTION:

The Water Seal face must remain clean and free of dirt, oil and grease.

8.16.

CAUTION:

Avoid using excessive heat during welding.

8.25.

CAUTION:

If the Bearing is excessively tight to remove, place an insert aft of the Bearing to press the Fairing out rearwards. Turn the Tailpipe over and support it at the Bearing Hub, pressing the Marine Bearing forward, to avoid damaging and distorting the Stator Blades.

8.26.

CONTENTS LIST

8. OVERHAUL

HJ 321 Jet (#89321) Drawings Package

Drawings contained within this Drawings Package

Drawing Number		Amdt Status	Up-Issued
HJ 321 30 001		C	02/12/98
HJ 321 01 001	2 Shts	H	07/12/99
HJ 321 01 004	2 Shts	D	07/12/99
HJ 321 02 001		F	04/07/98
HJ 321 02 006		B	05/05/97
HJ 321 03 001		D	04/12/97
HJ 321 06 004		B	05/05/97
HJ 321 06 005	2 Shts	D	13/01/00
HJ 321 07 001	2 Shts	J	30/04/99
HJ 321 07 002		B	05/05/97
HJ 321 08 001	2 Shts	E	25/08/98
HJ 321 08 002	2 Shts	E	22/12/98
HJ 321 08 003	2 Shts	D	18/01/99
HJ 321 11 001		D	15/10/98
HJ 321 09 001		B	05/05/97
HJ 321 09 002		C	05/05/97
HJ 321 10 001		C	05/05/97
63974		O	28/08/95
85018	2 Shts	F	22/02/99
85080		B	24/09/96
85113		O	18/08/99
85114		B	23/11/99

Position of Marker Tabs

Jet Drawings

Basic Jet

Couplings

Impellers & Inserts

Steering

Reverse

Installation

Tools

Other

1. Design Basics

1.1. INTRODUCTION AND PRODUCT DESCRIPTION

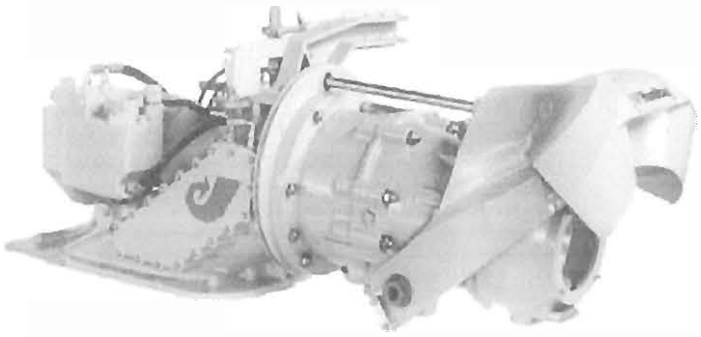
THE HAMILTON WATER JET SYSTEM

Introduction:

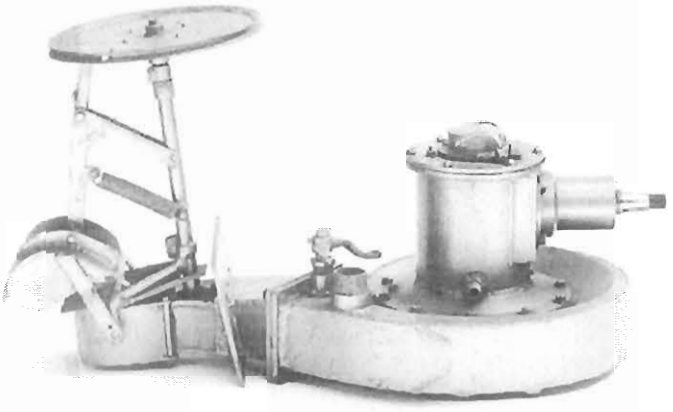
In the modern world, waterjets have rapidly gained acceptance as the leading means of propulsion for all types of high speed marine craft including ferries, work boats, patrol craft and pleasure boats. Recent advances in waterjet technology have put them ahead of conventional propeller systems in both high speed performance and also reliability. Modern waterjet powered vessels offer many advantages, such as high efficiency, rapid acceleration, shallow draft, unrivalled manoeuvrability and smooth, quiet operation. Whilst conventional propeller powered craft have several shortcomings, such as vibration, higher engine loading and susceptibility to damage from water borne debris, waterjets generally offer lower maintenance, longer engine life and simplified installation.

Hamilton Jet pioneered the commercial development of the modern waterjet system in the early 1950's and today have over 25,000 units installed world-wide. With a complete range of models suitable for power inputs of up to 3000 kW per unit, Hamilton waterjets are ideally suited to the efficient propulsion of a wide variety of high speed vessels, in either single or multiple configuration, typically from 5 to 50 meters in length.

Hamilton Jet is dedicated to the production of the highest quality waterjets and controls systems designed and manufactured to meet the requirements of the worlds leading certifying authorities. Full logistic support for projects is provided by the global Hamilton Jet organisation through factory support staff, regional offices and an extensive network of factory trained distributors in over 50 locations world-wide.



Modern Hamilton HJ-321 Jet Unit - Circa 1995.



Hamilton "Quinnat" Jet - Circa 1953.

Equipment Description:

The Hamilton HJ Series is a range of highly efficient single stage waterjets suitable for propelling craft typically up to 20 meters in length and 30 tonnes displacement, at speeds up to 50 knots. HJ Series waterjets are generally directly driven by high speed diesel engines. The HM Series are larger single stage waterjets suitable for vessels typically up to 50m in length and are generally driven by high speed diesel engines via a reduction gearbox.

Mounted partly inboard at the stern of the vessel, the Hamilton waterjet consists of a totally integrated package with steering and reverse mechanisms and jet mounted control system hydraulic equipment. Water is drawn into the waterjet through an intake screen at the base of the intake, which is mounted flush with the hull bottom. The pumping unit (impeller + stator) increases the pressure or "head" of the flow, which is then discharged at high velocity at the nozzle. The reaction to this high velocity jet stream provides the net thrust force, which is fully transmitted through the intake to the hull bottom.

A single piece balanced steering nozzle precisely directs the jet stream as commanded by the helm, providing high turning forces to either port or starboard. An independent split-duct type Reverse Deflector, usually hydraulically actuated, directs the jet stream back underneath the hull to provide powerful astern thrust. The reverse deflector may be set to a "Zero Speed" position (where the ahead and astern thrusts are balanced) at which point full steering is still available. Infinitely variable forward and reverse thrust may be selected by varying the position of the Reverse Duct and combined with the highly efficient steering, results in unparalleled vessel control and manoeuvrability.

A vessel fitted with a Hamilton waterjet has the minimum possible draft, with no protruding underwater appendages. This allows operation in shallow waters and in water with floating debris that may foul or damage a typical propeller driven vessel and also means increased safety for personnel working in the water near the vessel. The waterjet unit is an ideal form of propulsion for vessels working in a marine mammal environment.

Main Components:

INTAKE AND INTAKE BLOCK

The Intake represents the main structural body of the Jet Unit and is an integral part of the Hamilton Jet design. The Intake is cast from high silicon aluminium alloy and is capable of transmitting the full net thrust force of the Jet Unit to the hull bottom, and not to the transom or to the engine via the drive shaft. The Intake casting has a lower flange which mounts to an Intake Block, which is welded or bolted into the vessel hull. All Hamilton waterjets include an Intake Screen that is carefully engineered into the waterjet design so that operational parameters such as cavitation resistance are unaffected by its presence.

OIL COOLER

The Intake has an integrated Oil Cooler for the hydraulic control system. This is connected to a Jet mounted Hydraulic Power Unit (JHPU) via hoses.

THRUST BEARING AND WATERSEAL

The thrust force generated by the pressure differential across the waterjet Impeller is reacted by a Thrust Bearing inside a Bearing Housing attached to front of the Intake. No additional external thrust bearing is required. Aft of the Thrust Bearing on the waterjet Mainshaft is a mechanical face type Water Seal which prevents water from entering the vessel and Bearing Housing.

COUPLING

A Coupling is mounted on the Mainshaft forward of the Bearing Housing. A variety of Couplings are available to suit the type of driveshaft flange used. The driveshaft to the waterjet must have axial and radial flexibility.

IMPELLER

The Impeller design employed in all Hamilton waterjets is a highly refined mixed flow type capable of pumping large volumes of water at relatively low pressures, permitting high propulsive coefficients to be achieved at fast vessel speeds with outstanding resistance to cavitation. All Impellers have been designed using sophisticated flow analysis software. The cast stainless steel Impeller runs within a replaceable stainless steel Wear Ring located in the rear section of the Intake or within an Impeller Housing attached to the rear face of the Intake (on larger HM Series Jet Units).

TAILPIPE

Aft of the Impeller is the Tailpipe section containing a water lubricated marine bearing to support the rear of the Mainshaft. The Tailpipe contains a stator section that has vanes to remove the rotational component of the flow so that a uniform axial flow is presented to the Nozzle.

NOZZLE

After the water flow passes the pump (Impeller + Stator), it is at a higher pressure and relatively low velocity. At the Nozzle outlet, the pressure is at atmospheric. This difference in flow *pressure* is converted to flow *velocity* in the Nozzle. The correct Nozzle sizing is critical to the correct operation of the pump in a given application.

STEERING DEFLECTOR

The Steering Deflector is attached by vertical pivot pins to the rear of the Nozzle. It is rotated to port and starboard by linkages attached to either the inboard Steering Cylinder or to a Cable Steering System.

REVERSE DUCT

The Reverse Duct is attached by horizontal pivot pins to the Tailpipe and can be positioned up or down by the inboard Reverse Cylinders. The ahead / astern function of the Reverse Duct is an integral part of the Hamilton Jet package. The split deflector type Reverse Duct is designed to provide maximum astern thrust under all conditions of vessel speed, water depth and throttle setting. A splitter is incorporated to divide the flow and angle the astern jet stream downwards and to the side, to clear the vessel Transom and Intake opening. This prevents recycling of flow through the Jet Unit (which may be aerated or contain sediment) and also excessive disturbance of the bottom of the waterway. The result is very high reverse efficiency that contributes to the excellent manoeuvrability afforded by a Hamilton waterjet.

TRANSOM SEAL

The Transom Seal serves to seal the hole in the vessel Transom through which the waterjet passes. It is bolted to the vessel Transom and incorporates a flexible element which contacts and seals around the Intake.

SCREEN RAKE

The Jet Unit may be fitted with a Screen Rake as an accessory item. The Screen Rake is a foot operated rake mounted in the lower half of the Intake, designed to clear any debris that may be caught by the Intake Screen. The spring return foot pedal for operating the Screen Rake is mounted on the port side of the Intake casing.

OVERFLOW PREVENTER OR HATCH EXTENSION (OPTIONAL EXTRA)

Hamilton Jet Units are not fitted with Overflow Preventers as standard - this is an optional extra.

The Overflow Preventer / Hatch Extension is used where the static water-line (vessel fully laden) is above the level of the Inspection Cover. It is attached to the top of the Intake outside the Inspection Hatch.

DRY RUN KIT (OPTIONAL EXTRA)

The Dry Run System is a simple solution to the problem of starting a boat engine before putting the vessel in the water. It is particularly useful for Man-Overboard boats and Lifeboats where it is important to ensure that the engine will start before the vessel is in the water.

The Dry Run Kit consists of a specially formulated plastic Marine Bearing which can be run dry for short periods and run for long periods with water lubrication. The Bearing runs on a specially hardened Mainshaft. A special seal replaces the standard bronze or stainless steel Water Seal. **The standard rubber Marine Bearings are designed to run in a water immersed environment where the water acts as a coolant and lubricant for the Bearing and Waterseal. These type of Marine Bearing cannot be run out of water.**

1.2. PROPULSION SYSTEM DESIGN

JET UNIT SELECTION

Jet Unit selection is a complex task requiring analysis of the interaction between the Jet Unit and the vessel. It is handled by consultants between C.W.F. Hamilton & Co Ltd. and the customer.

1.3. HULL DESIGN

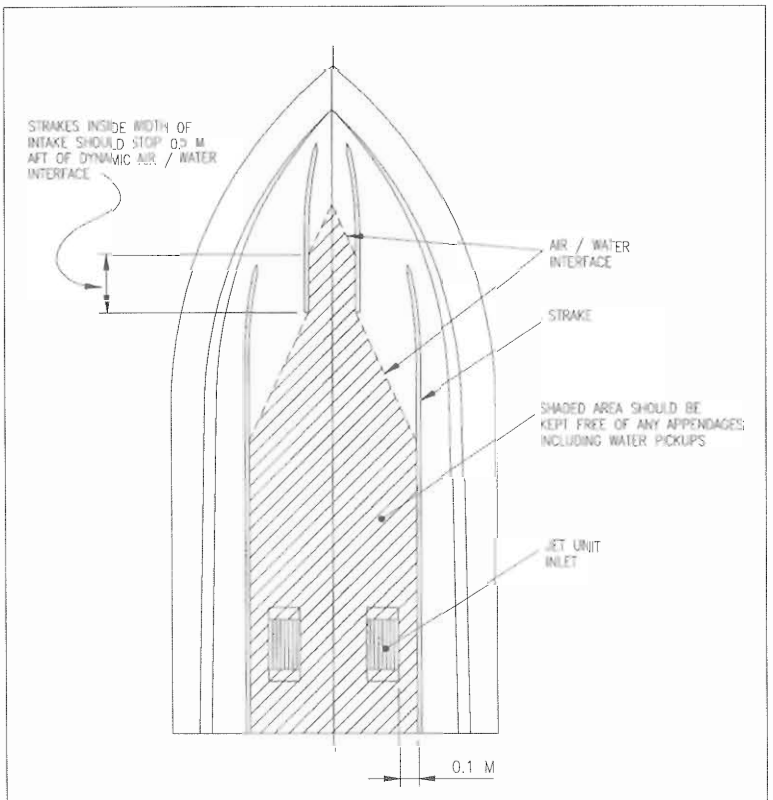
CAUTION:

Not all Hull shapes are suitable for propulsion by water jets. Some advice on suitable Hull shapes, estimating performance and engine matching is given in the Designers Manual.

1.3.1.Mono Hulled Vessel

1. Aerated water generated by the craft's bow wave must not pass directly aft to the jet intake(s).

   a) A vee'd bow stem in conjunction with 10º minimum deadrise angle is recommended.
   b) Mount multiple Jet Units as close to the keel line as possible. ("Staggered" engines are recommended).
   c) Planing strakes, keelsons, "plank keels" etc must be removed from in front of and closer to the keel than the Jet Unit intakes. Recommended strakes are as in the following diagram.

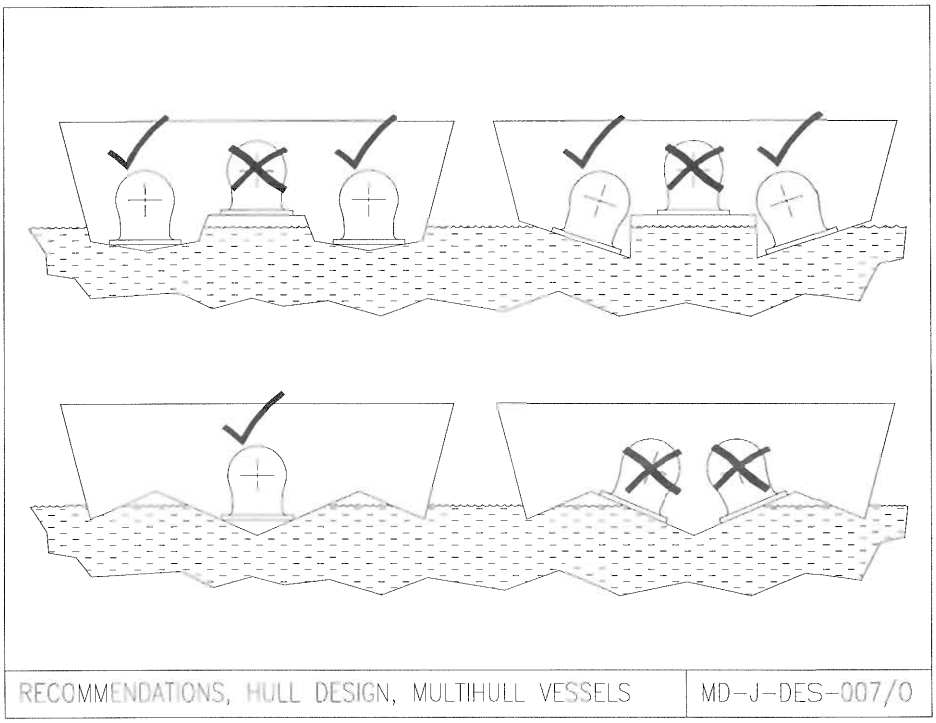


1. For speeds over 30 knots, monohedron (constant deadrise) hulls are recommended for directional stability without appendages.
2. Displacement speed and warped plane (reducing deadrise going aft) hulls may need additional directional stability. Twin small bilge keels are normally sufficient. These do not increase draft or interfere with waterflow into the jet intake.
3. Immersion. The jet must be immersed with the water line at least up to the underside of the mainshaft (at the impeller) in order to prime (pump water) when the engine is started.
4. Minimum distances between Jets for multiple installations. ***Refer to drawings HJ-321 08 001 / 002 and 003 for further information.***

1.3.2. Multi Hulled Vessel

Jet Units can be fitted in catamaran and some trimaran hulls. Air entrainment between the hulls occurs with these craft. Care must be taken to ensure that this entrained air does not enter the jet intakes(s). This is alleviated if the hulls are deep in relation to the air tunnels so that the jet(s) when mounted in the hull(s) sit well down in the water, as indicated on the following diagram. The reverse duct of the Jet Unit, when in the "up" (ahead) position must not project beyond the sidewalls of a catamaran or trimaran hull. Otherwise, substantial drag may be caused.

Consult with **C.W.F. Hamilton & Co. Ltd.** in all cases if Jet Units are proposed in these type of hull.



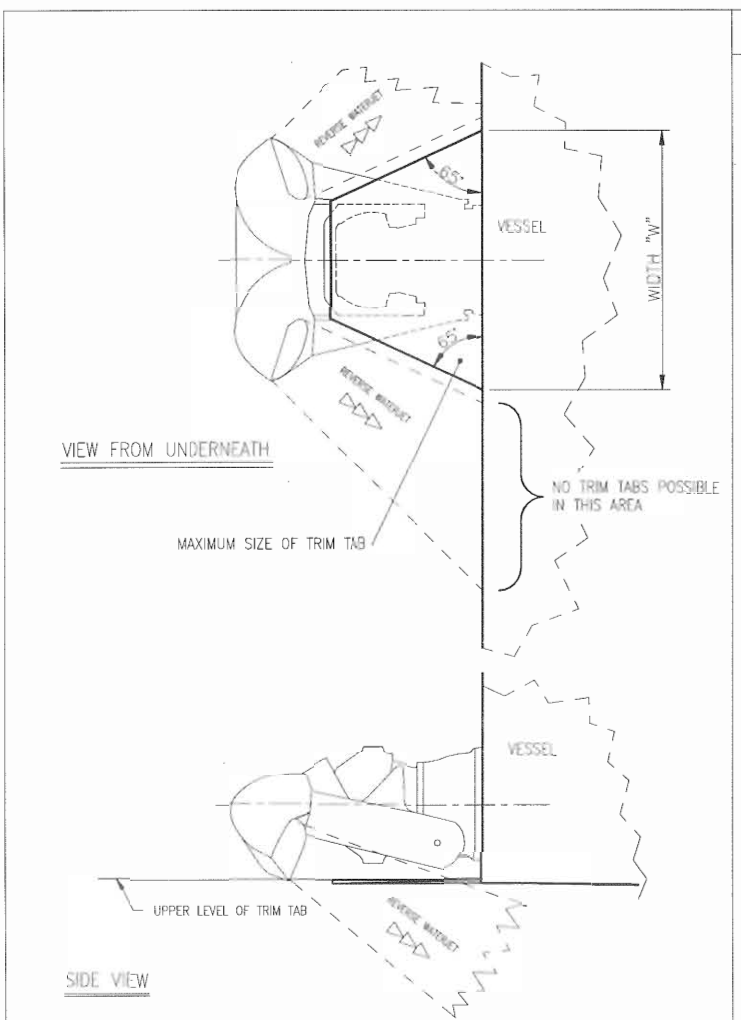
RECOMMENDATIONS, HULL DESIGN, MULTIHULL VESSELS	MD-J-DES-007/0

1.3.3. Trim Tabs

Trim Tabs cannot be mounted directly alongside the Jet Unit. As when moving astern, the reverse waterjet will hit the Trim Tabs and reduce reverse thrust.

It is possible to mount trim tabs under the Jet Unit with control equipment on either side of the Jet Unit. The adjacent diagram serves as a guide to the maximum size of trim tab that may be located under the Jet Unit. Contact C.W.F. Hamilton & Co Ltd, if further details are required.

The diagram shows the area within which the Trim Tab must lie. From the maximum width "W" at the Transom, the area tapers inwards at 25º per side until it reaches the same width as the Reverse Duct bottom corners.



JET	WIDTH "W"	LENGTH "L"
HM--811	2400	1500
HM-721	2130	1330
HM-651	1900	1180
HM-571	1880	1360
HM-521	1730	1250
HM-461	1540	1110
HM-422	1250	800
HJ-391	1250	800
HS-363	1270	950
HJ-362	930	580
HJ-321	1030	740
HJ-291	800	500
HJ-274	950	640
HJ-273	890	570
HS-272	1020	710
HJ-241	850	650
HJ-213	850	550
HJ-212	850	550

TRIM TABS, ALLOWABLE LOCATIONS — MD--J--DES--008/B

1.3.4. Engine Exhausts

Engine exhausts should not be located below the waterline near the Jet Units as water containing exhaust gases can be ingested by the Jet Unit when moving astern. This can cause loss of thrust and control of the Jet Unit.

1.4. DRIVELINES

WARNING:

THE JET UNIT THRUST BEARING MUST NOT BE SUBJECTED TO EXCESSIVE RADIAL LOADS CAUSED BY:

1. **ADAPTORS AND BELT PULLEYS OVERHANGING THE JET COUPLING FLANGE.**
2. **BY RIGID DRIVELINES WHICH DO NOT ACCOMMODATE MISALIGNMENT CAUSED BY GEARBOX OR ENGINE MOVEMENT.**
3. **DRIVESHAFT WEIGHT.**

1.4.1.Requirements of Drivelines

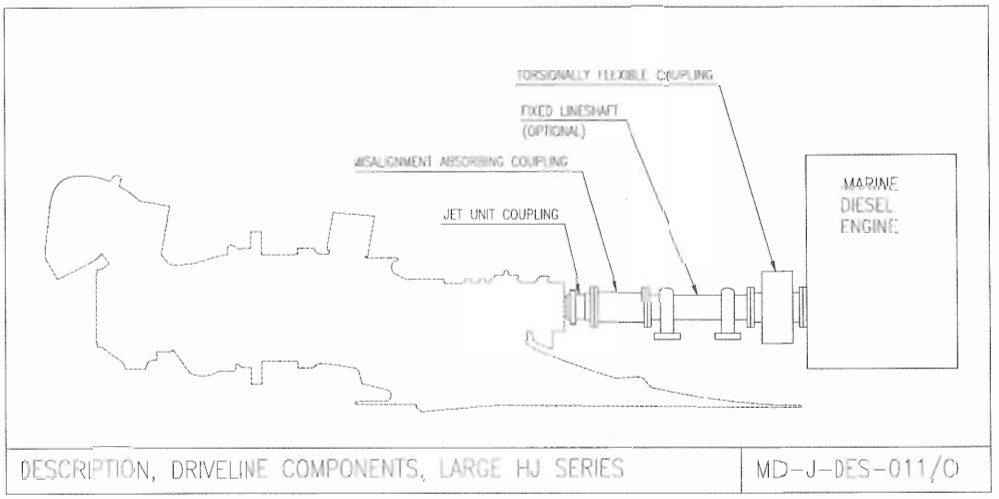
1. The Driveline must accommodate parallel and angular misalignment plus allow axial movement.
2. The Driveline must transmit the torque input to the Jet Unit with an acceptable life expectancy. It does not have to transmit thrust loads as these are absorbed by the Jet Unit.
3. Torsional flexibility may be required in the Driveline. A torsional vibration analysis must always be carried out. The resultant torque on the Jet Unit must always be in the same direction. This should be carefully checked at engine idle speed.

1.4.2.Engineering Checks

All driveline component suppliers (including engine and jet suppliers) must be consulted with full driveline details to ensure suitability and compatibility of components.

Check must include:

1. **Critical speed check for whirling of the Mainshaft:** consult C.W.F. Hamilton & Co. Ltd.*
2. **Critical speed check for whirling of the Driveshaft:** consult driveline supplier.
3. **Engine to Jet alignment:** consult C.W.F. Hamilton & Co. Ltd.
4. **Torsional Vibration Analysis:** consult engine or torsionally flexible coupling supplier.



NOTE:

Critical speed checks should allow safe operation up to the engine's "no load" governor setting (or high idle).

1.4.3.Driveshaft Options

CAUTION

If a gearbox or clutch is fitted to the engine, a conventional hull water pick-up and engine raw water pump must be used.

The diagrams shows the main types of Driveline components and the different ways they can be used. These diagrams are a guide only. Always contact **C.W.F. Hamilton & Co. Ltd** before designing the Driveline.

MISALIGNMENT ABSORBING COUPLING (MAC)

The following types of Misalignment Absorbing Couplings may be used:

A: GEAR COUPLINGS

This Coupling is steel double-jointed copling which is both flexible to allow for angular offset and also rigid to absorb torsional twisting.

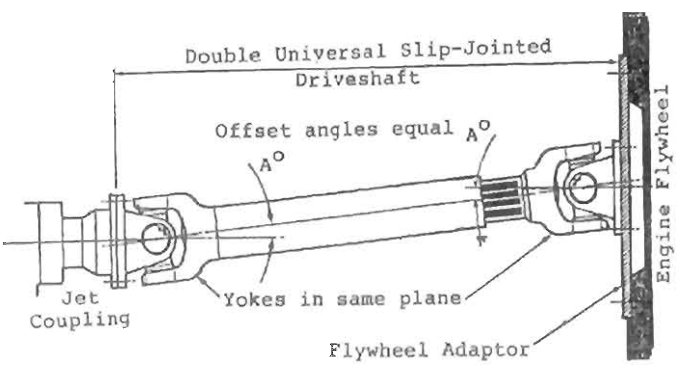
The Coupling is formed by two hubs which engage into a flanged sleeve with internal straight parallel teeth. Due to the design of the of the teeth curvature, if shaft misalignment occurs, the hub can oscillate in the flanged sleeve. The curved face teeth couplings are flexible enough to compensate for misalignments and axial movements of coupled shafts. The same type of coupling also allows for greater shaft offset.

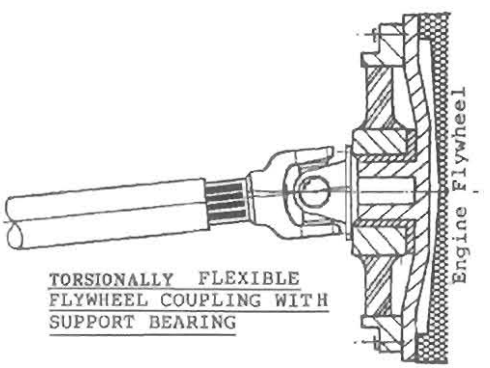
Manufacturers recommendations regarding installation and alignment should be followed. **Note that a double jointed coupling is required.**

B. UNIVERSAL DRIVESHAFTS

This is the usual type of driveshaft used. It bolts directly to the Jet Unit Coupling. An adaptor plate or alternatively a suitable Torsionally Flexible Flywheel Coupling (TFFC) can be used between the universal driveshaft and the engine flywheel. The TFFC must be of the type with a support bearing to support the universal driveshaft. "Vulcan", "Centa" and "Kusel" have suitable couplings for use with universal driveshafts. Use of a TFFC is more appropriate for diesel engines and may be stipulated by some manufacturers.

Length limitations are from approximately 650 mm upwards but limited by the weight which can be allowed at the coupling. **(Refer to Section 1.4.6. "Critical Speed Of Mainshaft" and Section 1.4.2. "Engineering Checks").**



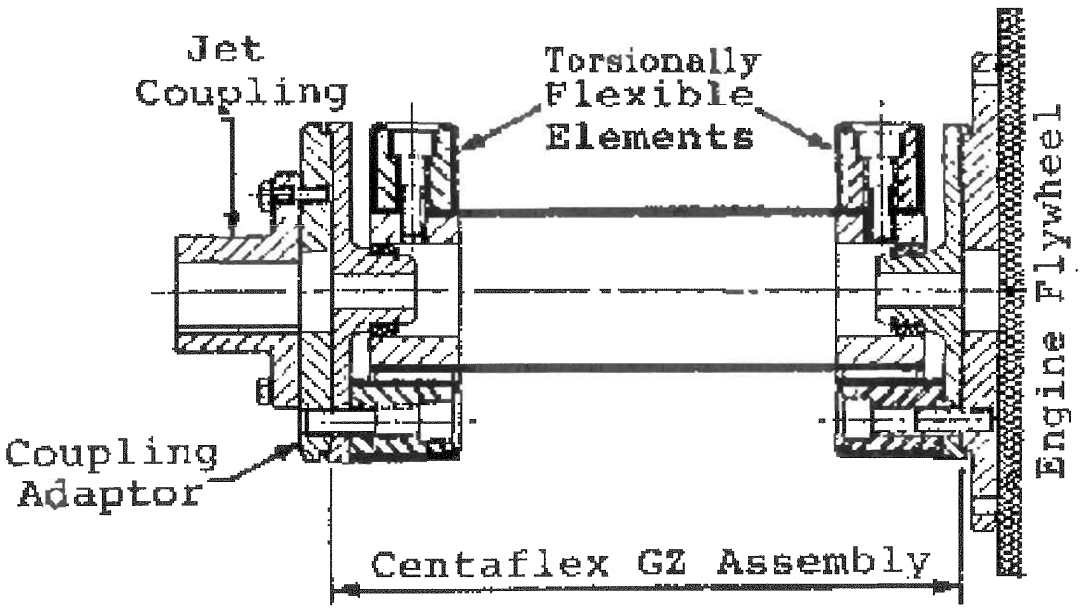


C. DOUBLE ELEMENT TORSIONALLY FLEXIBLE COUPLINGS

Examples of such couplings are "Centaflex" and "Megaflex".

Use a double element torsionally flexible driveshaft with support bearings such as the "Centaflex GX" type illustrated. The engine is located in-line with the Jet Unit and can be flexibly mounted with this type of coupling.

Length - From approximately 300mm upward, but limited by the weight which can be allowed at the Jet Unit coupling **(Refer to Section 1.4.6. "Critical Speed Of Mainshaft").**



DOUBLE ELEMENT NON TORSIONALLY FLEXIBLE COUPLINGS

An example of such a Coupling is "Centalink".

TORSIONALLY FLEXIBLE COUPLING (TFC)

The torsional vibration analysis will determine how many TFCs are required and where they should be located. At least one TFC should be fitted either:

- Between the engine and the gearbox.
- Immediately between the gearbox and any shafting leading to the Jet Unit.

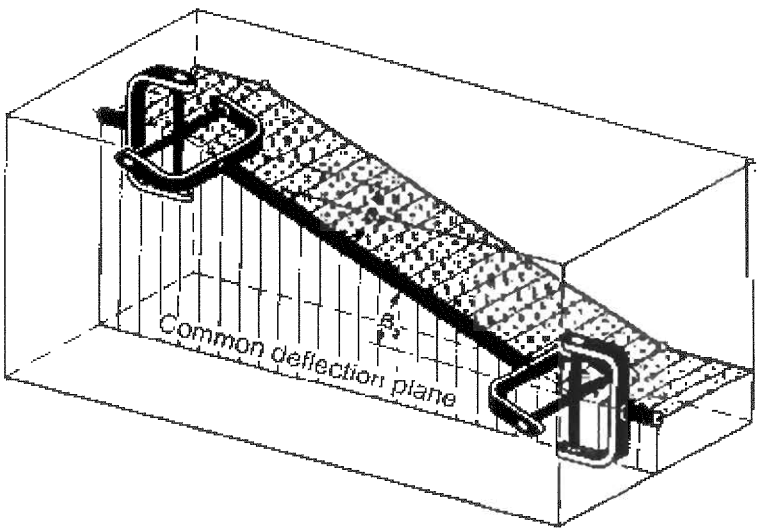
NOTE

1. **There are only two allowable configurations for location of centerlines for the Jet Unit and Gearbox. These are the "Z" and "W" configurations shown. If these requirements are not met, then cavitation of the Jet Unit and machinery damage can result because the drive speed to the Jet Unit is not constant.**

2. **The universal Driveshafts must be assembled with the yokes (forks) in the same plane.**

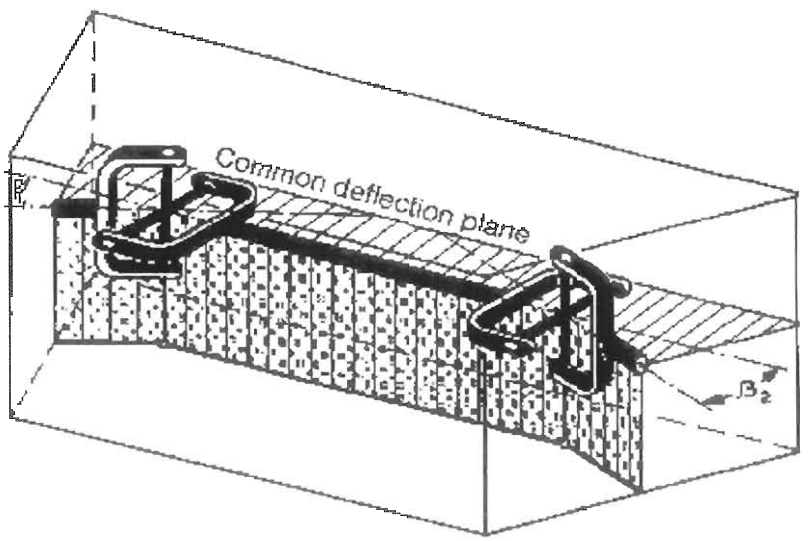
3. **Correct running length of the shaft is with the shaft extended to half the total spline extension length.**

4. **The splined end of the driveshaft is heavier and should be installed at the gearbox end of the Driveline.**



"Z" CONFIGURATION COUPLING (For Constant Velocity $B_1 = B_2$.)

Input and Output Shaft are parallel to each other in one plane. $B_1 = B_2$



"W" CONFIGURATION COUPLING (For Constant Velocity $B_1 = B_2$)

Input and Output Shaft intersect in one plane. Requirement $B_1 = B_2$

NOTE

1. **When the TFC couples directly to a universal driveshaft, the TFC must provide a bearing to support the universal driveshaft.**

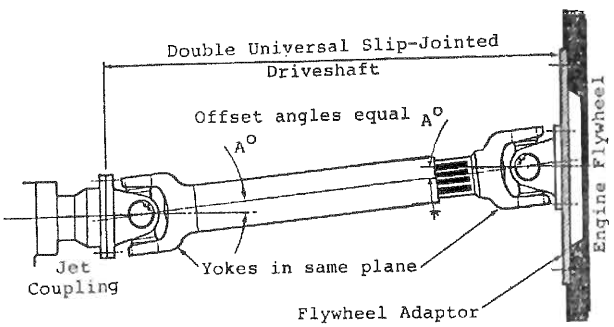
2. **When the TFC couples directly to a Lineshaft supported on bearings, a support bearing is not required.**

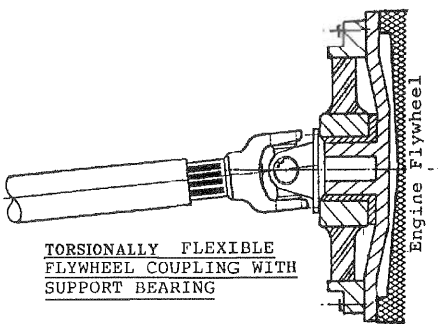
LONG DRIVESHAFTS

Where the distance between the gearbox flange and the Coupling flange exceeds that possible with a MAC, then a fixed Lineshaft supported on pedestal bearings should be used in conjunction with either universal driveshafts or torsionally flexible couplings.

NOTE

If the TFC is not required between the gearbox and the Lineshaft, then the Lineshaft can be directly attached to the gearbox flange using normal propeller shafting criteria. The gearbox should be mounted rigidly to avoid misalignment.





1.4.4. Jet Coupling Flange Details

Please refer to **Drawing HJ-321-02-001 Couplings and V Belts HJ-321,** for all relevant Coupling details.

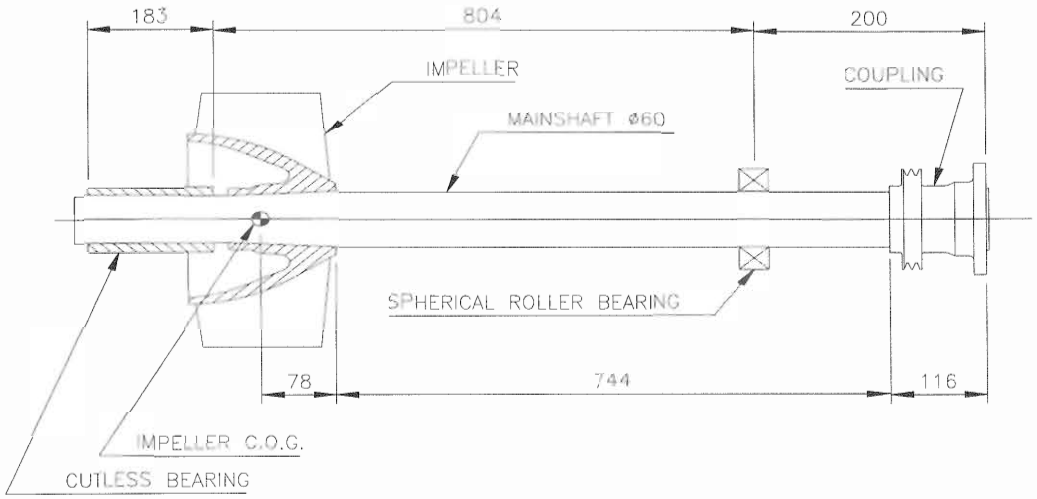
1.4.5. Moments Of Inertia

It is advisable to have a torsional vibration analysis carried undertaken for the complete engine, driveshaft and Jet Unit assembly, especially where a universal driveshaft is used without a torsionally resilient member or gearbox in the driveline. The engine is the most complex and therefore the analysis is normally done by the engine supplier.

It is most important that the resultant torque at any operating RPM is always in the same direction.

The following diagram gives data required for these calculations.

1.4.6.Critical Speed Of Mainshaft

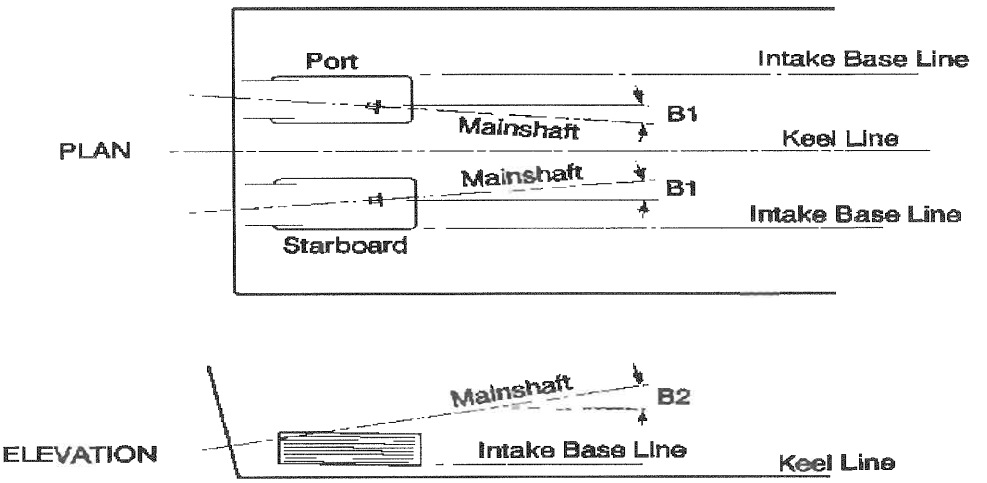


ITEM	TYPE	MASS (kg)	I_P (kg.m^2)
MAINSHAFT	-	24	0.0108
COUPLING	180 MM	4.25	0.009
IMPELLER	15 TO 19	16.53	0.145
	20 TO 25	16.80	0.149
	26 TO 32	16.97	0.154

DATA, DRIVELINE INERTIA, HJ321 | MD-DES-002/O

1.5. JET MAINSHAFT ALIGNMENT

The Jet Unit Mainshaft is inclined at an angle of 5º to the Intake base. When port and starboard are mounted at the hull deadrise angle, the jet mainshafts are no longer parallel to the keel line in plan. The following diagram and table describe the angle deviation of the Jet Unit mainshaft when the Jet base is mounted parallel to the keel line



ANGLES (relative to keel in degrees)		
Hull Deadrise in degrees	B1	B2
0	0.0	5.0
5	0.4	5.0
10	0.9	4.9
15	1.3	4.8
20	1.7	4.7
25	2.1	4.3

NOTE:

1. Intake base parallel to keel line:
2. B1 = shaft angle in plan view
3. B2 = shaft angle in elevation

1.6. COOLING WATER OFF TAKE

CAUTION:

If the Gearbox or Clutch are fitted to the engine, a conventional hull water pick-up and engine raw water pump must be used.

The Jet Unit has a single Water Offtake point **(Drawing HJ-321-01-004 (item 64))** which provides water at approximately 7kN per sq/m (1psi) at 600 rpm and 550 kN per sq/m (80 psi_ at 4000 rpm. The water may be fed directly to the engine without the need for a raw water pump, provided the following criteria is satisfied:

a) The pressure from the Water Offtake at idle is sufficient to cool the engine.
b) The engine can withstand the full pressure from the Jet Offtake.

To ensure correct flow for engine cooling, a conventional water pickup and the engine raw water pump should be used. The Jet Water Offtake can be used for a deck cleaning hose but the pressure is not high enough for use as a fire hose.

CAUTION:

Ensure that any through hull water pick-up is not directly ahead of the Jet Intake, but well to the side to avoid turbulent water flow into the Jet Unit.

NOTE

1. **Pressure increases with vessel speed. Pressures in excess of 30psi are likely at vessel speeds over 30 knots.**

1.7. DRY RUN SYSTEM (OPTIONAL)

Drawing HJ-321-01-004 refers.

NOTE:

Hamilton Jet Units are not fitted with the Dry Run Kit as a standard fit. The Dry Run Kit is an optional extra which can be fitted to the Jet Unit at the customers request. Should the customer require a Dry Run System, it can be purchased at additional cost and should be requested when the Initial Jet Order is placed.

This Dry Run System is used where it is an advantage to start the vessel engine before putting the vessel in the water. It is particularly useful for Man-Overboard boats and Lifeboats where it is important to ensure that the engine will start before the vessel is in the water.

The Dry Run Kit consists of a specially formulated plastic Marine Bearing which can be run dry for short periods and run for long periods with water lubrication. The Bearing runs on a specially hardened Mainshaft. A special seal replaces the standard bronze or stainless steel Water Seal. The standard rubber Marine Bearings are designed to run in a water immersed environment where the water acts as a coolant and lubricant for the Bearing and Waterseal. These cannot be run out of water.

1.7.1.Installation

The Dry Run Bearing components are a direct replacement for the standard Marine Bearing components, therefore there is no requirement for a special installation procedure for converting a Jet Unit to the Dry Run System. The Dry Run Bearing components can be fitted as shown for the normal Marine Bearing replacement in the Jet Unit Manual.

1.7.2. Corrosion

All the components of the Dry Run Kit are made of high quality corrosion resistant materials. The plastic Bearing will turn slightly blue / green after being immersed in sea water,. This is only a surface discolouration and is not detrimental to the performance of the Dry Run Kit System.

1.7.3. Scope of Use

Because there is no cooling for the Dry Run System Waterseal and Marine Bearing, if a Jet Unit is run without the vessel being immersed in water, the Waterseal and the Marine Bearing will heat up rapidly in the absence of water to act as a coolant.

THE FOLLOWING LIMITS MUST BE ADHERED TO, to ensure good component life.

Maximum Dry Run Time: 3 minutes.
Maximum Dry Run Engine Speed: 1000 RPM.
Minimum Time Between Dry Runs: 1 hour.

The plastic Dry Run Kit Bearing is a compromise for use in both dry and wet running conditions. The best wet running design solution is the rubber Marine Bearing which cannot be run dry. The plastic Dry Run Kit Bearing will wear out far quicker than a standard rubber Marine Bearing if the dry run system is used constantly in a dirty water environment. When used in silty water, life of the bearing and sleeve will be reduced, depending on the volume of grit in the water. **THIS SYSTEM SHOULD ONLY BE USED IN A CLEAN WATER ENVIRONMENT.**
If extended use in a dirty water environment is expected, then regular monitoring of Marine Bearing wear is required.

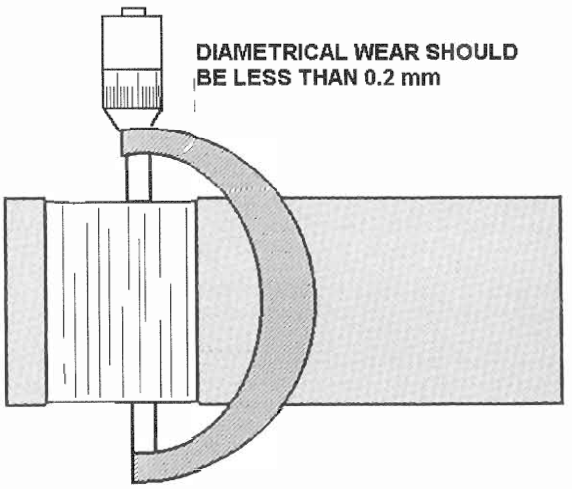
1.7.4. Fault Finding

Fault	Cause	Remedy
Bearing Jams up when dry running	Excessive heat build-up May have grit in bearing	Run in water to cool Leave overnight to cool Flush out with clean water
Clanging sound from the Jet	Impeller hitting the Wear Ring due to worn Bearing	Replace worn Bearing and / or Sleeve. Check the Wear Ring and replace if damaged
Excessive scouring of Shaft Sleeve	Running in dirty water and sucking sand or silt into Jet	Be careful not to suck sand or silt into Jet, do not use high RPM in water when starting off

1.7.5.Maintenance

Inspection

Inspect every 100 hours, 50 dry starts, or yearly, whichever is the soonest.
Remove the Tailpipe and inspect.
If the wear on the Sleeve is greater than 0.2mm, replace the Sleeve. Replace the plastic Bearing when replacing the Sleeve.



Assembly Notes

1. When changing The 'Dry Run Bearing Assembly', dismantle and reassemble the whole assembly (plastic and metal shell) to the Tailpipe in the same manner as removing / replacing a standard rubber Water Bearing. The plastic part of the Bearing should be fitted so it sits closest to the Impeller. The shell should sit flush with the Tailpipe as shown on the diagram below.

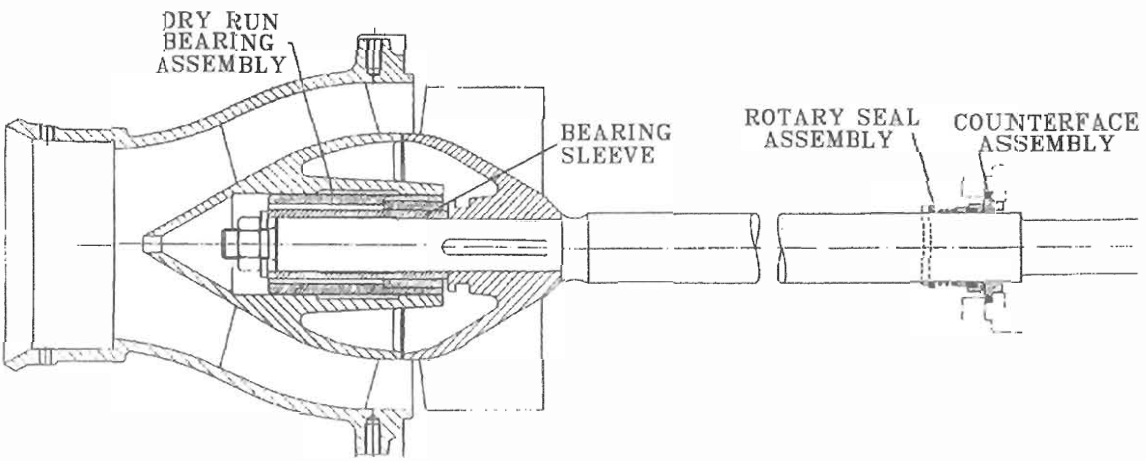
2. The Bearing Sleeve is fitted to the Mainshaft in the same manner as the Bearing Sleeve for the rubber Marine Bearing (Refer to the Overhaul Section of the Jet Manual).

NOTE:

The Bearing Sleeve is hardened at one end only. Assemble with the larger diameter *end* (*hardened* end) nearest to the Impeller.

1.7.6.Parts List

Drawing HJ-321-01-004 refers.



2. Installation

CAUTION:

Prevention of Corrosion

The Jet Unit has been designed to withstand the corrosive affects of operation in salt water through the use of materials that are resistant to salt water corrosion and by the placement of sacrificial anodes in suitable locations.

Vessels using Hamilton Jet Units, must be bonded and wired as described in this Section to prevent corrosion occurring due to the presence of stray currents or due to galvanic interactions along the shore power grounding conductor.

2.1. BASIC INSTALLATION METHOD AND DRAWING REFERENCES

1. **GRP OR WOODEN HULLS:**
   Refer to Installation Drawings: HJ321 08 001.

   An aluminium "Intake Block" (Part No. 107255) is supplied with the Intake Block Installation Kit (Part No 107212) for GRP or Wooden Hulls, for fibre glassing into fibre glass and wooden Hulls. The Intake Block is best fitted into the Hull prior to moulding. After moulding into the Hull the Intake Block is also bolted to the Hull. For fibre glass Hulls, refer to the following Installation Drawings in the Drawings Package at the rear of the Manual.

2. **ALUMINIUM HULLS:**
   Refer to Installation Drawing HJ 321-08-002.

   An aluminium "Intake Block" (Part No. 107255) is supplied ready to weld into a prepared opening in the Hull bottom, with the Intake Block Installation Kit (Part No 107213) for Aluminium Hulls.

   It is assumed that the aluminium plating of the Hull is one of the following types 5083, 5086, 6061, 6063, 6101, 6202, 6151, or 6951. If not consult **C.W.F Hamilton & Co Ltd.** The intake block is Lm6 grade aluminium. Weld the Intake Block into the Hull using the weld procedure shown on Drawing 85080. Ensure the contours between the Hull and the Intake Block at front and rear are smooth to within 1mm.

   The aluminium Intake Block is supplied ready to weld into a prepared opening in the hull bottom. For further details contact **C.W.F Hamilton & Co. Ltd**

3. **STEEL HULLS:**
   Refer to Installation Drawings: HJ-321-08-003

   Special installation is required to ensure that the Jet Unit is totally insulated from the Hull.

   An aluminium "Intake Block" (Part No. 107255) is supplied with the Intake Block Kit (Steel Hull) (Part No 109805) to weld into a prepared opening in the Hull bottom. An insulation kit is supplied to totally insulate the Jet Unit from the Hull.

2.2. HULL PREPARATION

CAUTION:

In Multi Jet Unit installations, each Jet Unit is specifically assembled for Port, Starboard or Center mounting and are matched to their individual Intake Blocks. Care should be taken to ensure that each Jet is fitted onto the correct Intake Block.

2.2.1.Fixing the Intake Block To the Hull

G.R.P. HULLS OR WOODEN HULLS:

If possible tape the Intake Block into the hull mould prior to moulding the hull. For center-mounted jets an additional smooth surface will have to be taped to the mould in front of the Intake Block to mould over and form a fairing between the vee hull form and flat of Intake Block. For a Wooden hull, or an existing GRP hull, cut a hole in the hull larger than the Intake Block base flange to allow a scarfed joint in GRP between the Intake Block and the hull.

After moulding, drill 36 x 11mm diameter holes from underneath the hull up through the Intake Block Flange and hull. Use the cast in dimples to locate the drill. Countersink these holes to suit the countersunk Screws [16]. Fit the countersunk Screws [16], Flat Washer [18] and Spring Washer [19] using RTV Silicon Sealant [10] provided and tighten to recommended torque.

Ensure that the contours between hull and Intake Block, at front and rear, are smooth to within 1 mm.

ALUMINIUM HULLS:

It is assumed that the aluminium plating of the hull is of one of the following types: 5083, 5086, 6061, 6063, 6101, 6202, 6151 or 6951. If not consult **C.W.F. Hamilton & Co Ltd.**

The Intake Block is LM6 grade aluminium. Weld the intake block into the hull using the Weld procedure shown on drawing 85080. Ensure that the contours between hull and Intake Block, at front and rear, are smooth to within 1 mm.

STEEL HULLS:

Electrical Isolation

The Intake Block, Jet Unit and Transom Plate must be completely electrically isolated from the rest of the Hull. This is achieved by the use of gaskets, bushes and studs, as shown on the Hull Preparation Drawings.

Installing the Intake Block

A steel recess must be built into the Hull to accept the Intake Block, as shown on the drawing. Note that the prepared opening has sloping faces fore and aft to match the Intake Block. Use the following procedure to mount the Intake Block.

1. Once the prepared recess in the Hull is completed, trial fit the Intake Block in place using 3mm spacers instead of the Neoprene Gasket [18].
2. With the Intake Block in place, drill through from below, the 36 countersunk points on the Intake Block with an 11mm dia Drill. After piercing the Intake Block make a small marking cut in the steel hull with the drill.
3. Remove the Intake Block and clean off all burrs.
4. Drill out the marked positions in the steel edges of the prepared opening to 16mm to accept the Nylon Insulating Bushes [19]. Remove all burrs.

5. Liberally smear both sides of the Intake Block Gasket [18] with RTV Sealant [13] and fit the Intake Block Gasket onto the Intake Block. **Note that the Gasket is designed to fold down around the edges of the Intake Block.**
6. Smear RTV Sealant [13] on top of the Gasket [18] and run a bead of RTV Sealant around the internal corner of the prepared recess.
7. Ensure that all the Screws [20] are liberally smeared with RTV Sealant prior to fitting.
8. Install the Intake Block and secure in 3 positions with Screws [20], Nylon Insulating Bushes [19], Flat Washers [22], Spring Washers [23] and Nuts [21]. Hand tighten.
9. Check for electrical isolation between the Intake Block and the vessel hull before fitting the remaining screws.
10. Fit the remaining Screws [20], Nylon Insulating Bushes [19], Flat Washers [22], Spring Washers [23] and Nuts [21].
11. Torque load to the recommended torque.
12. Once the Intake Block is installed, check again for electrical isolation and then fill any gap at the edges and corners with RTV Sealant. Clean off any excess Sealant and trim off any protruding part of the Intake Block Gasket.

2.2.2. Transom Preparation

An area at 95° to the Jet Intake base has to be prepared as shown on the drawing. Ideally this area is flush with the Transom. If not a box may have to be made.

FOR GRP AND WOODEN HULLS:

If the Transom is not close to 95° already an insert can be taped into the hull mould so the required area at 95° can be moulded with the hull. Alternatively, the are to be at 95° can be cut from the Transom and re fibre glassed back at the correct angle. One method to locate the cut-out Transom at the correct angle is to install the Jet Unit, bolt the Transom Plate assembly and Transom cut-out into position on the Jet and then to fibreglass the cut-out back into the Transom.

FOR METAL HULLS:

If the Transom is not close to 95° already, cut out the required area, reposition at 95° and re-weld back to the Transom with any necessary inserts at the sides and top.

2.3. EQUIPMENT PREPARATION

Do not unpack equipment until it is required for installation. This prevents mechanical damage and entry of foreign matter. Unpack carefully to prevent damage and loss of small items.

2.3.1. Steering Components

Drawing HJ-321-06-005 refers.

The Jet Unit is shipped complete with the steering components attached. It should not be necessary to remove any steering components prior to installation.

The Steering Cylinder is shipped separately and will be fitted by the Boat Builder on completion of the Jet installation.

However, if problems with installation occur, *refer to Section.8.4.* "Steering Assembly Removal and Overhaul" for removal and refitting instructions.

2.3.2. Reverse Components

Drawing HJ-321-07-001 refers.

The Jet Unit is shipped complete with the Reverse Cylinder and Reverse Duct attached. If, during installation, the Reverse Duct needs to be removed, *refer to Section. 8.2.1.* "Reverse Duct Removal", in this Manual for the removal and refitting procedure.

2.3.3. Remove Other Parts

The Jet Unit is shipped with the Controls System fitted. Should it be necessary to remove the Controls System, refer to the Controls Manual supplied, for details on the fitting and removal procedures.

2.4. MOUNTING THE JET UNIT

Refer to following Installation Drawings in the Jet Unit Drawings Package.

HJ-321 08 001 GRP Hulls.
HJ-321 08 002 Aluminium Hulls.
HJ-321 08 003 Steel Hulls.

After mounting the Intake Block and making the transom hole in the hull, carry out the following actions:-

1. Remove the Reverse Duct from the Jet Unit to accommodate the installation of the Jet Unit from inside the Hull. Removal of the Reverse Duct is described in ***Section. 8.2.1. "Reverse Duct Removal".***
2. Remove the Transom Plate and O-Ring Seal from the Jet Unit. **(Items [48] and [47] of Drawing HJ-321-01-001).**
3. Temporarily install the Jet Unit into the vessel to ensure that the hull preparation is correct. This also serves to check for clearances with any other parts of the hull.
4. To carry out this operation, using approved lifting equipment, lift the Jet Unit (complete with the Intake Screen attached) into the hull and position the Jet Unit so that the Tailpipe passes out through the Transom opening and the Intake Screen fits centrally in the Intake block hole.
5. Check that the Jet Unit is correctly located in relation to the Transom hole, and that the Intake Block mates neatly with the Intake casting. Correct the hull preparation as necessary.
6. Check that the contours between the hull and the Jet Unit Intake, at the front and rear are smooth to within 1mm ($^1/_{32}$"). There should be no steps.

If satisfactory, proceed as follows:-

2.4.1.GRP and Aluminium Hulls

1. Lift the Jet Unit off the Intake Block and move it away from the Intake Block.
2. Apply Loctite 262 [14] or equivalent to the threaded end of the Studs [6] and fit into the tapped holes in the Intake Block [15]. A convenient method of fitting Studs is to tighten two nuts together on the top of the Stud so that a spanner can be engaged on the nuts to tighten the studs into the base.
3. Liberally apply neutral cure R.T.V. Silicone Sealant [10] (supplied) to the top of the Intake Block, underside of the Jet Unit Flange and to the bolt heads.
4. Carefully position the Jet Unit centrally over the Intake Block hole and lower onto Studs [6] on the Intake Block.
5. Fit Flat Washers [9], Spring Washers [8] and Nuts [7] as shown in **Installation Drawings. HJ-321-08-001 / 002. GRP Hulls / Aluminium Hulls.**
6. Mount the Screen Rake Spring Anchor Bracket **(Item [12] on drawing HJ 321 09 002) if fitted.** This is attached to the 3rd Stud back from the front of the Intake Block on the Starboard side of the Jet.
7. Torque the 26 M12 Nuts to the torque indicated in Drawing **85113**.
8. Remove any excess sealant from inside and outside the Jet Unit.

2.4.2.Steel Hulls

1. Lift the Jet Unit off the Intake Block and move it away from the Intake Block.
2. Apply Loctite 262 [16] or equivalent to the threaded end of the Studs [9] and fit into the tapped holes in the Intake Block [17]. A convenient method of fitting Studs is to tighten two nuts together on the top of the Stud so that a spanner can be engaged on the nuts to tighten the studs into the base.
3. Liberally apply neutral cure R.T.V. Silicone Sealant [13] (supplied) to the top of the Intake Block, underside of the Jet Unit Flange and to the bolt heads.
4. Carefully position the Jet Unit centrally over the Intake Block hole and lower onto Studs [9] on the Intake Block.
5. Fit Flat Washers [12], Spring Washers [11] and Nuts [10] as shown in **Installation Drawings. HJ-321-08-003. Steel Hulls.**
6. Mount the Screen Rake Spring Anchor Bracket **(Item [12] on drawing HJ 321 09 002) if fitted.** This is attached to the 3rd Stud back from the front of the Intake Block on the Starboard side of the Jet.
7. Torque the 26 M12 Nuts to the torque indicated in Drawing 85113.
8. Remove any excess sealant from inside and outside the Jet Unit.

2.5. ATTACHMENT OF THE TRANSOM PLATE TO THE TRANSOM

1. Place the Transom Plate [1] in over the Jet Unit Tailpipe and against the Transom.
2. Centralize the Transom Plate in relation to the Intake and rotate to position the Transom Plate's vertical centerline square with the Jet Unit Intake base. Ensure that the Transom Plate Anode is located at the bottom of the Transom Plate.

2.5.1. G.R.P and Aluminium Hulls

1. Using an 8.5 mm diameter drill bit, drill through the 24 holes in the Transom Plate to just dimple the Transom for correct hole location.
2. Slide the Transom Plate back off the Tailpipe.
3. Lubricate the Transom Seal O-Ring [11] with vegetable oil. Fit in place in the seal groove on the Jet Unit Intake. **Take care not to get any oil on the Transom where sealant will be applied.**
4. Liberally apply neutral cure RTV Silicone Sealant [10] to the Transom Plate contact area on the hull, also the joint face of the Transom Plate and bolt heads.
5. Slide the Transom Plate [1] over the O-Ring [11] and line up the Transom Plate with the holes in the Transom.
6. Fit bolts [12], washers [13] [5] and nuts [4] to secure the transom plate as per the appropriate installation drawing. Install with bolt heads to the outside of the boat.
7. Tighten the bolts [12] and nuts [4] to the recommended torque. Remove excess sealant.

2.5.2. Steel Hulls

1. Using an 8.5 mm diameter drill bit and an Insulating Bush [3] to centrally locate the drill bit, drill through the 24 holes in the Transom Plate to just dimple the Transom for correct hole location.
2. Slide the Transom Plate back off the Tailpipe.
3. Lubricate the Transom Seal O-Ring [11] with vegetable oil. Fit in place in the seal groove on the Jet Unit Intake. **Take care not to get any oil on the Transom where sealant will be applied.**
4. Liberally apply neutral cure RTV Silicone Sealant [13] to the Transom Plate contact area on the hull, also the joint face of the Transom Plate.
5. Slide the Transom Plate [1] over the O-Ring [11] and line up the Transom Plate with the holes in the Transom.
6. Smear the Insulating Bushes [3] with RTV Sealant [13] and fit to the 24 holes in the Transom Plate [1].
7. Smear the Screws [14] with RTV Sealant [13] and fit to the Transom Plate [1] with Flat Washers [15], Spring Washer [8] and Nut [7] to secure the Transom Plate.

NOTE:

Ensure that the screw heads are fitted to the outside of the Transom as shown on Installation Drawing HJ-321-08-003.

8. Tighten the Screws [14] and Nuts [7] to the recommended torque. Wipe off any excess sealant.

2.6. REFITTING THE REVERSE COMPONENTS

Drawing HJ-321 07 001 refers.

1. The Reverse Duct will have been removed for installation of the Jet Unit through the Transom opening. **To refit the Reverse Duct, refer to Section 8.3.2. "Refitting the Reverse Duct to the Jet Unit".**
2. The Reverse Cylinder will have been removed for installation of the Jet Unit. **To refit the Reverse Cylinder, refer to Section 8.3.1. "Refitting the Reverse Cylinder to the Jet Unit".**
3. Replace any position sensors and linkages that were removed from the inboard end of the Reverse Cylinder. Take care to correctly reconnect electrical connections. **Refer to the Overhaul Section of the Controls Manual for further information.**

2.7. REFITTING THE STEERING COMPONENTS

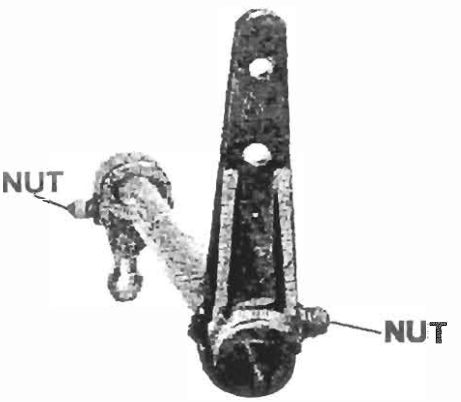
1. Steering Cylinder. **Refer to *Section 8.5.1.* "Steering Cylinder Refit to Jet Unit." for refitting details.**
2. Refit any Sensors attached to the Tiller. **Refer to the Overhaul Section of the Controls Manual for details.**

2.7.1. Assembling the Jet Steering Tillers

Drawing HJ-321-06-005 refers.

SINGLE JET INSTALLATIONS

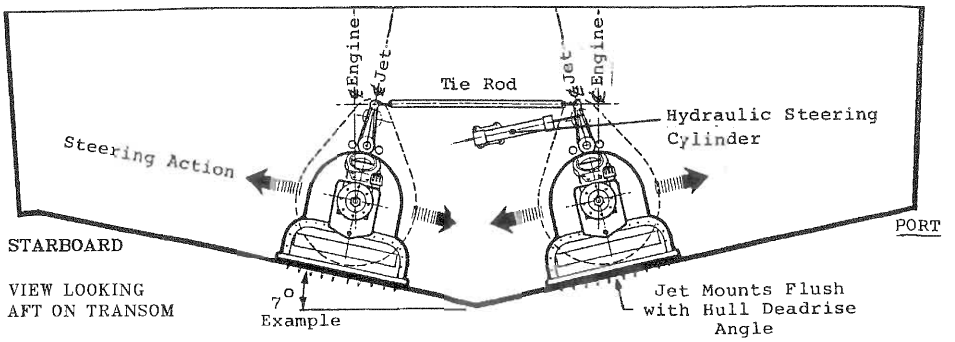
Cotter (taper) Pin in the Steering Tiller assembles from the opposite direction to the one in the Steering Crank.



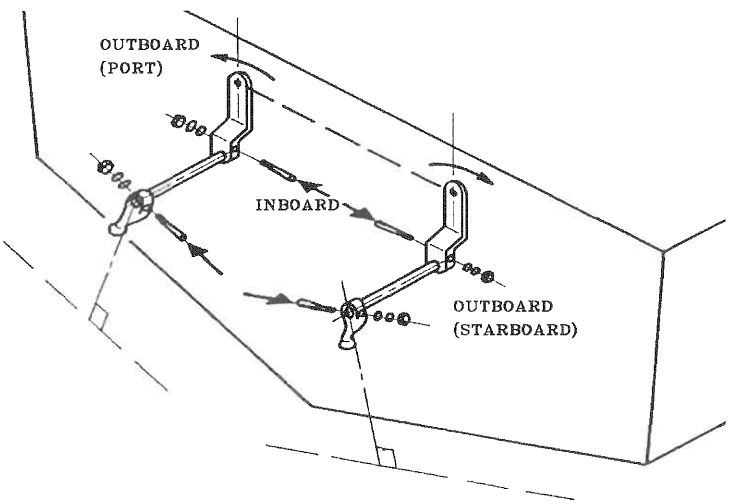
TWIN JET INSTALLATIONS

Ganged control of steering in multiple Jet installations is achieved by swivel ended Tie Rod(s) interconnecting the Jet Tillers. An adjustable length Tie Rod is supplied to facilitate accurate centreing of the Jets.

a) For Deadrise angles up to 8°:
For each Jet, fit the Cotter (taper) Pins for the Tiller and Crank from opposite directions (this places the Tiller and Crank "In-Line"). Refer to the illustration above, for "Single Jet Installations".



b) For deadrise angles at 8° or more:
For both Jets - fit the Cotter (taper) Pins for the Tiller and Crank both from inboard to outboard (with Nuts fitted outboard).

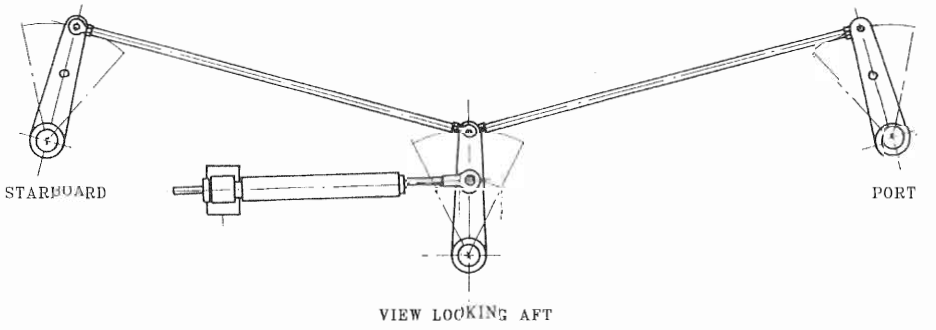


TRIPLE JETS:

- One Steering Cylinder only is required which should mount on the Center Jet.
- Two swivel ended Tie Rods are used to interconnect the Jet Tillers, from starboard to center Jet and from center to port Jet. Bolt one Tie Rod aft and one ahead of the center Jet Tiller.

a) For Deadrise Angles up to 8°:
For all three Jets, Cotter (taper) Pins in the Steering Tiller. Assemble from opposite directions to those in the Steering Crank. Refer to the illustration above, for "Single Jet Installations".

b) For Deadrise Angles of 8° or More:
For the center Jet only, Cotter (taper) Pin in Tiller assembles from opposite direction to the one in the Steering Crank. Refer to the illustration above, for "Single Jet Installations".
For the port and starboard Jets, fit the Cotter (taper) Pins for Tiller and Crank from inboard to outboard (nuts outboard). Refer to the illustration above, for "Twin Jet Installations". "For Deadrise Angles of 8° or More".



TIGHTENING COTTER (TAPER) PIN NUTS:-

Ensure all the Cotter (taper) Pins are fitted the correct way as shown for Single, Twin or Triple jets above. Then fit thick washers first, followed by the spring washers and then the nuts. Torque all nuts (2 per Jet) as for M10 Nut. Refer to Drawing 85113.

2.7.2. Centering the Jet(s) Steering

Before mounting the Cylinder or fitting the Steering Tie Rod(s) (for multiple Jet applications), ensure that all Nozzles are set to the "dead ahead" position and temporarily clamp the Nozzles so that the Tillers will not move from the dead ahead position.

CAUTION:

Switch off the Reverse Control System during steering adjustment so the Reverse Duct is not accidentally lowered onto a clamp.

2.8. DRIVELINE AND ENGINE INSTALLATION

GENERAL

The engine(s) should be located in a position that will give the craft the most suitable fore and aft trim for the proposed boat speed. For semi-planing and moderate planing speed craft it is likely that the engine should be positioned well forward towards amidships for best trim and thus speed. For very high speed craft it is likely the engine should be positioned aft, close to the jet unit, to obtain best trim and speed. Follow the recommendations of the boat designer in this regard or consult C.W.F Hamilton & Co Ltd.

2.8.1. Mounting the Engine

Mount the engine via mounting feet fixed to the engine bearers. The feet and bearers do not have to withstand the propulsion thrust load which is transmitted from the jet directly to the hull. Flexible engine mounts will reduce vibration and noise but these must be used in conjunction with a driveshaft system which does not cause a radial or side load at the jet coupling as the engine moves. Refer to JET MAINSHAFT ALIGNMENT and DRIVELINES sections of DESIGN BASICS for recommended driveshaft and engine installation angles.

2.8.2. Engine Cooling

1. The engine may be cooled conventionally or by making use of the 1 1/4" BSP outboard water offtake from the Jet. To ensure correct flow for engine cooling, a conventional water pick up and the engine raw water pump should be used.

CAUTION:

If a gearbox or clutch are fitted to the engine a conventional hull water pick-up and engine raw water pump must be used.

2. Ensure that the water pick up is not directly ahead of the jet intake, but well to the side to avoid turbulent water flow into the jet.
3. The jet water offtake can be used for a deck cleaning hose but the pressure is not high enough for a fire hose. The jet is supplied with the water offtake plugged. An 1 1/4 BSP to 1 1/4" (32 mm) hosetail, supplied loose, can be fitted in place of the plug.
4. If the jet water offtake is to be used the water may be fed directly to the engine without the need for a raw water pump provided that:
   a) The flow from the water offtake at idle is sufficient to cool the engine.
   b) The engine can withstand the maximum expected pressure from the water offtake.

2.8.3. Governor Settings

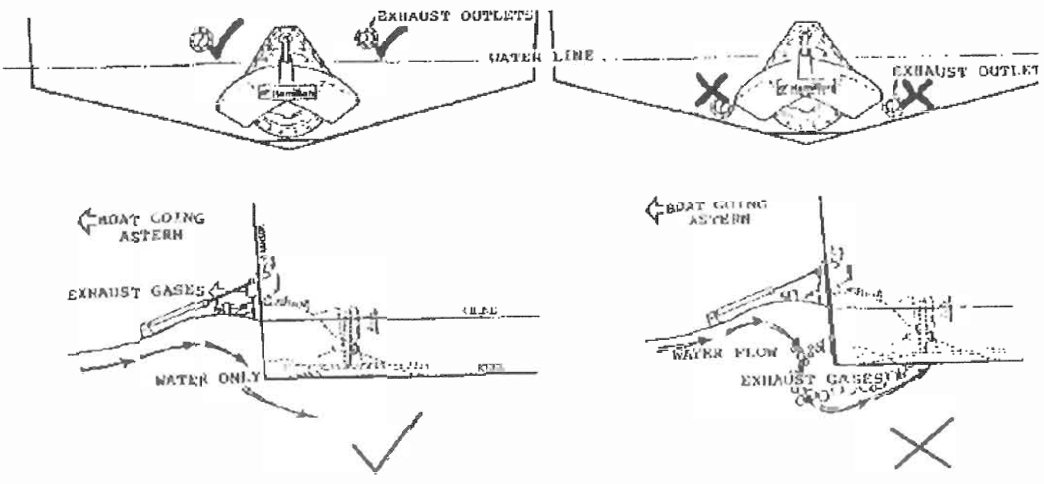
The "No Load" governor setting (or "high idle") on diesel engines should be set well clear of the full throttle R.P.M. achieved when driving the Jet Unit so that there is no chance of the governor reducing power (and performance) at full throttle. To check, select neutral if clutch or gearbox fitted but without these unbolt the driveline at the engine flywheel and open the throttle fully. To accurately measure RPM, use a hand calibrated tachometer.

Example:
If the maximum RPM for driving the Jet Unit is 2300 RPM,then the governor should not begin to act until at least 2350 RPM. On most diesel engines this means the "No Load Governor Setting" (or high idle) should be at least 2550 RPM (ie. 250 RPM higher than the loaded maximum RPM).

Ensure that the low RPM is set high enough to avoid any vibration in the driveline. Extensive idling with the driveline vibrating may damage the Jet.

2.8.4. Exhaust Systems.

The exhaust system can be any conventional system approved by the engine manufacturer, except that for the efficient operation of the Jet Unit in reverse, exhaust outlets are best sited above the waterline, as indicated by the following diagram.



2.8.5. Spare "V" Belts

WARNING:

SPARE "V" BELTS WILL CAUSE A POTENTIAL HAZARD TO BOTH PERSONNEL AND MACHINERY IF NOT PROPERLY SECURED.

ENSURE THAT THE SPARE "V" BELTS ARE FASTENED SECURELY TO THE JET UNIT AND DO NOT COME LOOSE AND FOUL OTHER EQUIPMENT DURING VESSEL OPERATION.

The Coupling will have a set of spare "V" Belts attached to it, with a Note explaining what to do with the spare belts.

Ensure that the Mainshaft passes through the "V" Belts. This allows the spare "V" Belts to be used without disconnecting the Driveshaft from the Coupling.

3. Commissioning

WARNING:

ENSURE THAT THE VESSEL IS SECURELY MOORED DURING COMMISSIONING. AS THE JET UNITS MAY PRODUCE LARGE THRUST FORCES.
DO NOT PROCEED IF ANY CONTROL SYSTEM FAULT ALARMS ARE STILL ACTIVATED.

3.1. PRE-LAUNCH CHECKS

3.1.1. Hull / Installation

Drawings HJ-321-08-001 / 002 / 003 refer.

1. The Intake Block is smoothly faired to the hull fore and aft.
2. The hull is smooth and clear aft of the Intake.
3. There are no flow obstructions forward of the Intake.
4. Intake and Transom sealing joints are firmly bolted.
5. There are no flaps or obstructions to interfere with reverse flow.

3.1.2. Jet Unit

Drawing HJ 321 01 001 refers.

1. The correct Impeller and Nozzle are fitted.
2. All external Anodes are fitted, clean and not painted.
3. The Steering Shaft is not painted.
4. The Inspection Cover is secure.
5. Thrust Bearing is correctly lubricated.
6. The Impeller rotates freely with the engine **(Note: Do not run the Jet Unit out of the water unless it is fitted with a Dry Run Kit).**
7. The Transom Plate O-Ring Seal is in place.

3.1.3. Steering Assembly

Drawing HJ-321 06 005 refers.

1. Steering Nozzle Pivot Bolts are tightened to the specified torque.
2. Cotter Pin is correctly installed and tightened on the Steering Crank.
3. The Steering Arm is free to move full stroke.
4. The Steering Wheel moves freely, giving full steering lock to lock.

3.1.4. Drive Shaft and Couplings

Drawing HJ 321 02 006 refers.

Drive line details are approved by **C.W.F. Hamilton & Co. Ltd.** If there is any doubt, check the following:

Universal Driveshafts have:

1. Yoke disposition correct.
2. Spline engagement correct.
3. Joint angles correct as shown in **Section 1.3. "*DRIVELINES*"** of this Manual.
4. Are square at flywheel.
5. Have all bolts correctly tightened.
6. Have flywheel bolting tightened to the correct torque as specified by the Driveshaft or Engine manufacturers.

3.2. POST LAUNCH CHECKS

Carry out the following checks after launching the vessel.

PRIOR TO ENGINE STARTUP:-

Check for water leaks:-

1. At the Transom Seal.
2. At the Intake Base.
3. From under the Bearing Housing (Water Seal leaking).
4. From the Inspection Cover.
5. Check that the waterline is up to at least the Jet Unit Mainshaft centreline so the Jet Unit will prime (pump water properly) when the engine is started.

AFTER ENGINE START-UP:-

Check for water leaks around the Jet Unit while the engine is running, particularly under the Bearing Housing (Water Seal leaking).

3.3. SPEED AND HANDLING TRIALS

NOTE:

It is preferable for a C.W.F. Hamilton & Co. Ltd, distributor to be present to observe, record and verify results.

3.3.1. Before Leaving the Mooring

1. Engine Systems should be adjusted and ready for trials.
2. Ensure that Jet Unit Intake Screens and waterways are clear of any debris which could have been disturbed during trial running alongside the mooring.

3.3.2. During Trials

ADJUST ZERO SPEED POSITION:

1. Run the engine at approximately 1500 RPM and experiment to find the Reverse Control Lever position at which boat does not move ahead or astern. Ensure that steering is dead-ahead.
2. Check that the Reverse Detent indicates the "Zero Speed Position". Adjust as required.

3.3.3. Propulsion System Check

CAUTION:

If a problem is detected, then return to mooring immediately at reduced power. Do not operate the Jet Unit until the fault has been repaired. Refer to Section 5 *Faultfinding*.

1. Check the surface temperature of the Bearing Housing periodically during the trials, with the palm of your hand. Due to the friction caused by the seals, the Bearing Housing is likely to be hot.
2. The temperature is satisfactory when a hand can be held on the surface for about 2 seconds. A faulty Bearing will be heard and felt as a vibration through the Bearing Housing.
3. A faulty Bearing is likely to cause significant heat generation which will be quite noticeable and could even discolour the paint on the Bearing Housing.

4. When proceeding away to open water for trials check for the following:
   - Check that the steering is working correctly when going forward, at zero speed and going astern.
   - Observe the Waterjet emerging from the Steering Deflectors when boat is going dead ahead at speed. The Waterjet should be a relatively clean and even shape.
   - If water is splashing back from the deflector then realignment of the Steering Deflectors may be required.

5. Record accurate maximum speed and engine revolutions timed over a measured course.

NOTE:

Record the actual readings given on vessel's instrumentation for future calibration of figures. At maximum speed, Jet Unit rotational speed should be verified using a hand held tachometer at the Jet Unit Coupling.

6. Record vessel speed at varying engine revolutions if possible.
7. Make and record observations on such things as vessel trim and loading.

3.4. POST TRIALS INSPECTION

AFTER INITIAL TRIALS

1. Check for water leaks around the Jet Unit especially at the Transom Seal and under the Bearing Housing (Water Seal leaks).
2. Apply Loctite thread locking fluid (or equivalent) to all thread nuts that have been adjusted during trials.
3. Re-tighten the 3 Bearing Housing Retaining Nuts to the torque specified in **Drawing 85113.**
4. **Steel Hulls Only:** Check that the insulation between the Jet Unit and the Hull of the vessel measures approximately 80 to 100 Ohms. **Refer to Section 7.3.2. "Checking the Insulation" for further details.**

4. Operation

4.1. STARTING UP

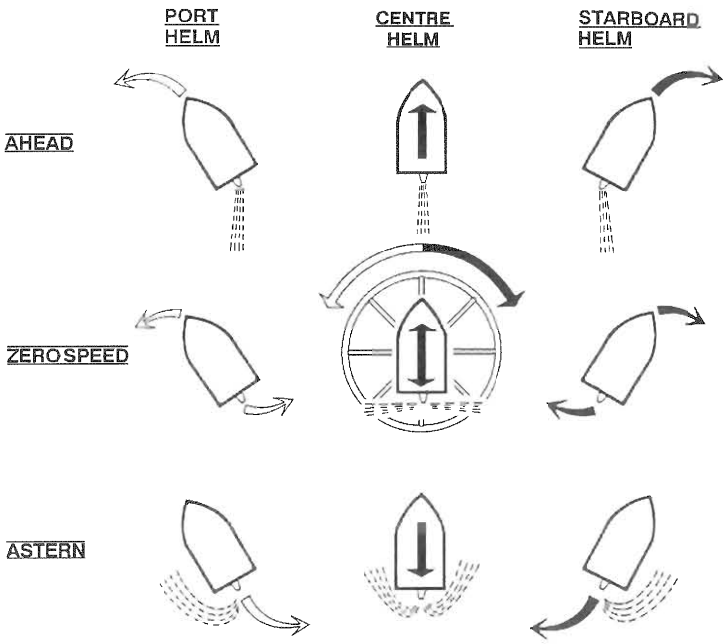
CAUTION:

Never stop the Engine(s), or disengage the drive to the Jet Unit, when approaching a mooring or at any time when control of the vessel may be required.

1. Before starting the engines, the following checks should be carried out:
   a) The vessel is securely tied up or well clear of other objects or vessels.
   b) The Helm is centred and the Reverse Control Lever is in the Zero Speed position.

2. After starting the engine move the helm and reverse levers to control vessel movement.

4.2. STEERING



The Steering Deflector deflects a jet of water to port or starboard causing the vessel to steer to port or starboard respectively.

The following points should be remembered when operating a waterjet steered vessel:

1. If the engine is stopped there is no jet of water to deflect and so the vessel cannot be steered or stopped. **Never stop the engine or disengage the drive to the Jet when approaching a mooring or at any time when steering will be required.**
2. The wider the throttle is opened the greater the steering effect. i.e. the sharper the turn.
3. Steering is available at "Zero Speed" as well as all ahead and astern speeds. This is a feature which gives the Hamilton Jet unrivalled maneuverability.
4. When moving ahead, at "Zero Speed", or going astern, **the bow of the vessel will always turn the way the steering wheel is turned. i.e.** Turn the Helm Wheel to port and the bow of the vessel will move to port and vice versa.

4.2.1. Total Hydraulic Failure

EMERGENCY STEERING

In the case of a failure of the Helm Wheel or the cable parts of the Steering System, the Jet may be steered by manually moving the Jet Tiller:
Disconnect the cable from the Steering Arm **(Drawing HJ-321 06 001 refers).**
Move the Steering Arm by hand as required to move the Steering Deflector.
Steering may only be possible at low RPM, unless an emergency Steering Arm Extension (Not included in CWF Hamilton standard supply) is used.

EMERGENCY MANUAL REVERSE DUCT CONTROL

The Reverse Duct can be raised manually and is only necessary if the hydraulic Pump has failed.

To raise the Reverse Duct:

1. Attach a rope to the Reverse Duct.
2. Take the weight of the Reverse Duct.
3. Lift the Reverse Duct and tie off the rope so that the Reverse Duct is in the raised position and out of the jet stream.

This will enable the vessel to proceed at speed and return to base to have the fault checked and rectified.

EMERGENCY MANOEUVERING AND DOCKING

1. **With a Single Jet Unit.** The vessel can be partially manoeuvred by raising the Reverse Duct using a rope and lowering the Reverse Duct under its own weight. The engine must be kept at idle.

2. **With Multiple Jet Units.** Shut down the engine driving the Jet that is driving the Jet with the faulty Reverse System and manoeuvre using the other Jet(s).

4.3. MANOEUVERING AND DOCKING

4.3.1. Low Speed Manoeuvering and Docking

The vessel is best manoeuvred as follows:-

a) Move the Reverse Control Lever to the "Zero Speed" position.
b) Set the throttle to 1/3 open - approximately 1,200 R.P.M. (In strong tide or wind conditions, increase the throttle opening to obtain greater response as required to suit the conditions).
c) A slight movement either way from the "Zero Speed" position will be sufficient to move the vessel ahead or astern until the manoeuvre is complete.
d) Steering will be very responsive at this throttle opening. Full steering control is available at all ahead/astern control lever positions and there is no change of steering "sense" at any time.

Manoeuvre at a fixed throttle opening, working the steering with one hand and the Ahead/Astern Control Lever with the other hand.

NOTE:

1. **DO NOT WORK THE THROTTLES - Leave as set. With TWIN JETS maneuvering is best carried out using the Helm with one hand and both Reverse Levers with the other hand. ONE AHEAD and ONE ASTERN is NOT AS EFFECTIVE.**

2. **USE ONLY LOW ENGINE RPM - high RPM will give faster response but makes control more difficult.**

3. **If the bow is rotating to starboard, port lock must be used to stop the rotation (or vice versa) then the Helm centred to hold the heading.**

4. **If the vessel is moving ahead then the Reverse Lever(s) must be moved astern to bring the vessel to rest (or vice versa) and then Zero Speed selected to hold position.**

4.3.2. Moving Sideways

WITH TWIN JETS:

Use the following procedure to move the vessel sideways away from the jetty. Initially both controls are at "ZERO SPEED" and the vessel is stationary.

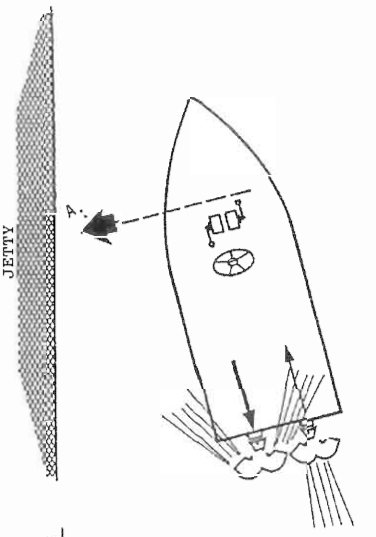
MOVING TO PORT

A

1. Set both engine RPM's to just above idle with slightly higher RPM on the port side.
2. Set steering to ahead.
3. Move the port reverse lever to full astern and the starboard lever to full ahead.

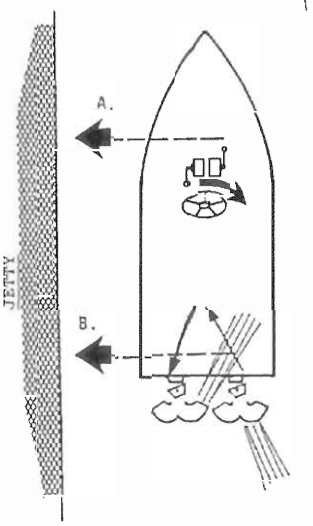
B

4. As the bow begins to swing to Port, turn the helm to starboard to keep the vessel parallel to the jetty.
5. The vessel will now move sideways to Port.
6. Adjust the port engine rpm to prevent fore and aft movement. (Higher RPM moves vessel aft). This may also be done by bringing the starboard reverse control back towards the Zero Speed position.



MOVING TO STARBOARD

7. Instructions 1 to 4 are the same but for Port read Starboard and vice versa.
8. When the Vessel is safely clear move both controls back to zero speed and centre the helm. Then move off in the required direction.



DOCKING.

9. Use the above procedure when approaching or moving away from a jetty or another vessel.

NOTE:

If the vessel is moving sideways too fast the controls should be set back to zero speed and the Helm returned to centre. Alternatively set the controls for sideways movement in the opposite direction until the vessel stops moving sideways. The required control setting will vary according to wind and tide conditions.

WITH TRIPLE JETS:

Using all three Jets to move sideways will give the best results.

1. Set Steering to dead ahead, all three Reverse Ducts to the "Zero Speed" position and RPM on all Engines to the same value. (The RPM required for maneuvering will depend on the prevailing sea conditions, higher RPM will improve response).
2. For sideways motion to port, set the port Jet full astern and the starboard Jet full ahead (this is reversed for sideways motion to starboard).
3. Use the centre Jet Reverse Duct to control fore and aft movement (Duct approximately 80% reversed).
4. Use the Helm to control turning (rotation) moments, i.e. for sideways motion to port turn the Helm to starboard to balance the turning moment of the port and starboard Jets.

This method of sideways maneuvering should result in 33% more side thrust than if only two Jets were used. Once set up, only the centre Jet Reverse Control and the Helm need to be used for controlling the sideways movement.

MOVING TO STARBOARD

Follow instructions 1 to 4 above, but for "Port" read "Starboard" and vice versa.

TO STOP SIDEWAYS MOVEMENT

Set the Helm to dead ahead, Throttle RPM to idle and Reverse to Zero Speed before the vessel reaches the required position. Alternatively set Controls to start sideways movement in the opposite direction until vessel stops sideways movement then set the Controls to :- dead ahead Steering; - ;idle Throttle and ;- zero speed Reverse.

4.4. CRUISING

CAUTION:

Running at speed with a partially blocked Inlet Grille or debris on the Impeller will result in cavitation damage to the Jet Unit.

Care must be taken to prevent cavitation damage to the Jet Units, as described below:

1. Running at speed with a partially blocked Inlet Grill or debris on the Impeller will result in cavitation damage to the Jet Unit. Before accelerating to full speed, all Jet Units should be cleared of debris. **Refer to Section 4.9. "Blockages (Debris In The Jet Unit)".**
2. Acceleration should be carried out gradually. Full power cannot be used at low vessel speeds such as when operating on one engine only.
3. If there is any blockage of the Jet Unit, the engine will run at higher than normal RPM and the vessel will accelerate slowly, and best speed will be reduced. If such symptoms are noticed, immediately slow the vessel and clear the blockage. **Section 4.9. "Blockages (Debris In The Jet Unit)" refers.**
4. In conditions of severe weather or overload, the engine speed should be reduced accordingly.

4.5. "AHEAD" / "ZERO SPEED" / "ASTERN" CONTROLS

WARNING:

SELECTING 'ASTERN' (CRASH STOP) WHILE THE VESSEL MOVING AHEAD AT HIGH SPEED CAN PRODUCE A VERY RAPID DECELERATION.

NEW OPERATORS SHOULD USE THE "CRASH STOP" FEATURE VERY CAREFULLY.

DO NOT USE FULL HELM CONTROL UNTIL THE VESSEL HAS SLOWED.

SELECT ZERO SPEED AND REDUCE THROTTLE AS SOON AS THE VESSEL HAS SLOWED.

"Astern" and "Zero Speed" are achieved by redirecting the jetstream. If the Reverse Duct is lowered fully, all of the jetstream is redirected back under the vessel giving "Full Astern Thrust". If the Reverse Duct is lowered partially the jetstream is split giving some ahead and some astern thrust. At a certain Reverse Duct position the ahead and astern thrusts will be equal so the vessel will not move ahead or astern regardless of the throttle opening. This position is given the technical term "Zero Speed". (This term should not be confused with the neutral position of a gearbox when the driveline stops rotating).

When operating the Hamilton Reverse Control, the Jet Unit is always rotating regardless of the position of the Reverse Duct. Any intermediate position between ahead and astern can be selected to give infinitely variable speeds when manoeuvering.

"CRASH" OR "EMERGENCY STOP"

This Procedure Should Only Be Used In An Emergency.

CAUTION:

If in lightweight planing craft, which is moving forward at speed, the "Astern" or "Zero Speed" positions are selected with the throttle left open, the resultant "Braking Effect" is very severe - even more so than full braking with a motor car.

For normal operation to "Brake" the vessel's forward motion :-

a) Close the throttle.
b) Select "Zero Speed" or "Astern".
c) Open the throttle, gently at first to bring the vessel to a standstill.

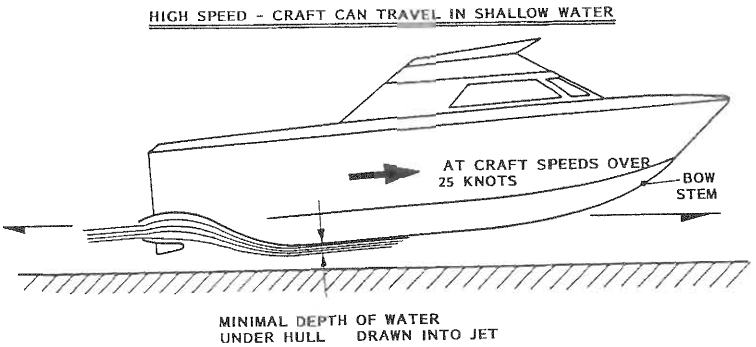
4.6. SHALLOW WATER OPERATION

CAUTION:

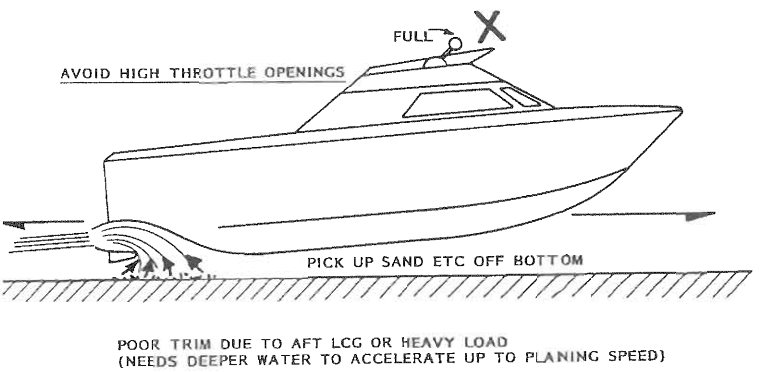
Do not run the Jet if the vessel has run aground. Damage may occur to Impellers.

It is important to avoid pumping stones, sand etc. through the Jet Unit as this will blunt and wear the impeller. The following diagrams illustrate good and bad practice:

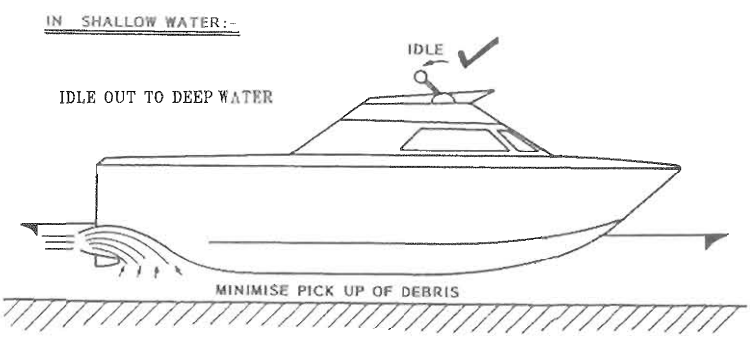
a) At high planing speeds shallow water operation is not a problem until the boat is nearly grounded.



b) At slow displacement speed avoid using high RPM in shallow water.



c) If it is not possible to pick a deep water area to start off and stop in then "idle" over the shallow area into deep water before accelerating up to planing speed. If any debris has been picked up in the intake screen, momentarily stopping the engine should allow the debris to drop away from screen.



4.7. ACCELERATION TO HIGH SPEED

If leaving an area of shallows, or with debris in the water, ensure Jets are clear of debris before accelerating to high speed. **Refer to Section 4.9.3. "Clearing Blockages".**

If there is any debris in the Jet the engine will run at higher than normal RPM and the vessel accelerate only slowly, perhaps not reaching full (planing) speed. **Refer to Section 4.9.2. "Detecting Blockages".**

Daily, prior to commencing operations, the Inspection Cover should be removed and any debris removed from around the Impeller or Intake Screen. **Refer to Section 6.3.1. "Daily "Pre Use" Servicing Checks" and Section 6.4. "Jet Unit Servicing Details, Item 1.**

CAUTION:

Ensure the water level is below the Inspection Cover level before removing the Inspection Cover.

CAUTION:

Running at speed with a partially blocked Inlet Grill or debris on the Impeller will result in cavitation damage to the Jet Unit.

4.8. AERATED WATER

It is possible that some Hulls may, under certain conditions, feed aerated water into the intake of the Jet Units.

When operating in areas where the water may be excessively aerated. (e.g. fast flowing rapids or surf) the following points should be noted:

1. There may be a loss in thrust due to the Unit pumping a significant amount of air instead of water.
2. The Impeller may unload suddenly causing the engine RPM to fluctuate wildly.

When these symptoms occur, reduce engine RPM until the Jet Unit maintains a steady RPM and thrust. The operator must be prepared to lose control temporarily in these conditions and should allow margins of safety.

4.9. BLOCKAGES (DEBRIS IN THE JET UNIT)

4.9.1. Avoiding Blockages

Pieces of debris, water weed or sticks, etc. will not normally block or harm the unit. However, it is good practice to steer around such debris where possible as any debris caught in the intake screen, impeller or tailpipe stator vanes can affect the Jet Unit's performance.

4.9.2. Detecting Blockages

In debris laden waters it may be necessary to clear the intake screens and impellers before each run. In many cases the debris is picked up while the jet is moored so it is best to clear the screen in open or clear waters.

Blockages of the Jet Unit are usually noticed by the following symptoms:

a) The engine unloading (RPM increases).
b) Lack of jet thrust (vessel speed drops).
c) Excessive noise and vibration from the Jet Unit.

4.9.3. Clearing Blockages

WARNING:

EXTREME CARE IS REQUIRED WHENEVER THE INSPECTION COVER IS REMOVED AS WATER MAY ENTER THE VESSEL THROUGH THIS OPENING. NEVER LEAVE THE INSPECTION COVER REMOVED WITHOUT CONSTANT MONITORING OF THE WATER LEVEL.

The following methods can be used.
a) Slow or stop the engine driving the blocked Jet Unit. The blockage will often clear itself. This operation works best if the vessel is moving forwards.
b) Remove the Inspection Cover on the Intake Housing and manually clear the obstruction. **Refer to Section 4.10. "Using The Inspection cover".**
c) Send a diver overboard to clear the Intake Screen.

NOTE:

1. **Check that the static water level will be safely below the Intake Inspection Cover lip.**

2. **If the static water level is too high, Ballast should be placed on the bow to raise the stern high enough to allow the Intake Inspection Cover to be removed.**

3. **Alternatively, an optional extra Hatch Extension can be fitted to the inspection point to allow inspection of the Intake Housing at higher water levels. (Drawing HJ-321-10-001 refers).**

4.10.USING THE INSPECTION COVER

WARNING:

EXTREME CARE IS REQUIRED WHENEVER THE INSPECTION COVER IS REMOVED, AS WATER MAY ENTER THE VESSEL THROUGH THE OPENING. NEVER LEAVE THE INSPECTION COVER REMOVED WITHOUT CONSTANT SUPERVISION.

CAUTION:

Before removing the Inspection Cover:-

a) Stop all engines.
b) Check that the static water level will be below the Intake Inspection Cover lip.
c) If the static water level is too high, ballast should be placed on the bow to raise the stern high enough to allow the Intake Inspection Cover to be removed.
d) Alternatively, an optional extra Overflow Preventer can be fitted to the inspection point to allow inspection of the Intake Housing at higher water levels.

The Inspection Cover can be used to gain access to the inside of the Jet Unit from inside the Hull. This is required sometimes to clear debris and blockages from inside the Jet Unit. To use the Inspection Cover:

1. Stop the engine.
2. Ensure that the static water level is below the level of the Inspection Hatch or top of the Hatch Extension. If the static water level is too high, weight can be placed in the bow of the vessel to raise the stern of the vessel.
3. Remove the Inspection Cover on the Intake Housing and clear the obstruction.
4. Replace the Inspection Cover, ensuring that the O-Ring Seal is correctly seated and the Inspection Cover Nuts are correctly tightened.

4.11.OVERFLOW PREVENTER

Drawing HJ-321-10-001 refers.

The Overflow Preventer is an optional extra for use with Jet Units where the water level is above the normal level of the Inspection Cover.

a) It is attached to the top of the Intake Casing around the Inspection Cover.
b) It provides an increase of approximately 150 mm in allowable water level height.

4.12.OPERATING WITH AN ENGINE & JET UNIT OUT OF SERVICE

If the vessel is operated with an engine and Jet Unit out of service, it is possible for the Jet Unit Mainshaft to rotate due to water flowing through the Jet Unit. This is undesirable as it can lead to damage of the gearbox.

USE OF SHAFT BRAKE (IF FITTED) TO STOP MAINSHAFT ROTATION

The Shaft Brake should be fitted to the output shaft of the Gearbox. Apply the Shaft Brake to stop the Jet Unit Mainshaft rotation in Jet Units not in service.

USE OF ENGINE TO STOP MAINSHAFT ROTATION

If a Shaft Brake is not fitted, the Jet Unit Mainshaft can be prevented from rotating by engaging the Gearbox of the Engine which is out of service.

NOTE:

When using this method, it is possible for the Jet Unit to rotate the Engine. If this occurs, disengage the Gearbox and let the Jet Unit Mainshaft rotate.

5. Fault Finding

How to use this Faultfinding Table:

1. Determine what the fault is by looking for a similar symptom.
2. Note that some symptoms have more than one possible cause (fault).
3. Try each solution listed until the fault is found and rectified.
4. The listed solutions range from easiest to most difficult, so try the easiest solution first.
5. Use the "refer to" column for more information on each solution.

5.1. JET UNIT FAULTS

SYMPTOM			
No.	***POSSIBLE CAUSE***	***SOLUTION***	***REFER :***
1	**The engine unloads (rpm increases)**		
	There is some blockage of the Jet Unit	The blockage must be removed	**4.9.**
2	**A lack of jet thrust (boat speed drops)**		
	There is some blockage of the jet	The blockage must be removed	**4.9.**
3	**Excessive noise and vibration comes from the Jet Unit**		
	There is some blockage of the jet	The blockage must be removed	**4.9.**
4	**Water leaking from under front bearing**		
	Faulty water seal.	Inspect and repair the water seal	
5	**Excessive high pitched rattling, whine.**		
	There is some blockage of the jet Faulty thrust bearing	The blockage must be removed Inspect and repair the thrust bearing	**4.9.** **8.**
6	**Bad vibrations**		
	There is some blockage of the jet Worn Marine Bearing, or Marine Bearing water drain hole in the Tailpipe Cone is blocked. Worn driveshaft universal joints.	The blockage must be removed. Inspect and repair the Marine Bearing. Inspect and repair the driveshaft as per manufacturer's recommendations	**4.9.** **N/A**
7	**Engine revolutions gradually increasing over a period of time. Take off performance poor**		
	There is some blockage of the jet Worn or blunt impellers. Excessive impeller tip clearance.	The blockage must be removed. Inspect and repair the Impeller as well as the Wear Ring. Inspect and repair the Impeller as well as the wear ring.	**4.9.**
8	**Sudden increase in engine revolutions with no noticeable decrease in thrust**		
	Faulty tachometer.	Repair tachometer	**N/A**
9	**Excessive engine revolutions, noisy Jet Unit with aerated water from Nozzle.**		
	Screen blocked with wood or debris or rope through screen and wrapped around shaft. Object jammed in stators and/or impeller.	The blockage must be removed. The object must be removed.	**4.9.** **4.9.**
10	**Low engine RPM**		
	Problem with engine Incorrect Impeller and Nozzle selection	Investigate operation of engine Contact C.W.F Hamilton for a check to be made	**N/A** **N/A**
11	**Reverse Duct creeping down from the up position**		
	Reverse Cylinder Seal failure: Suspect Seals Are: Piston Seal [14] Aft Shaft Seal 12 Cylinder Aft 0-Ring [10] Piston Internal 0-Ring [13]	Overhaul Reverse Cylinder	**8.2.4** **{HJ321 07 001}**

SYMPTOM			
No.	***POSSIBLE CAUSE***	***SOLUTION***	***REFER :***
12	**Reverse Cylinder: Oil Leaking out Shaft. From Transom**		
	Reverse Cylinder seal failure: Suspect seals are Aft Shaft Seal [12]	Overhaul Reverse Cylinder	**8.2.4** **{HJ321 07 001}**
13	**Reverse Cylinder: Oil leaking out Shaft. Inside the vessel.**		
	Reverse Cylinder seal failure Suspect seals are: Forwards Shaft Seal [12]	Overhaul Reverse Cylinder	**8.2.4** **{HJ321 07 001}**
14	**Reverse Cylinder: Oil leaking around Cylinder Shaft Backhead interface**		
	Reverse Cylinder seal failure Suspect seals are: Resilient mount [8] O-Ring [13]	Overhaul Reverse Cylinder	**8.2.4** **{HJ321-07-001}**
15	**Reverse Cylinder: Oil leaking from Nipple [15]**		
	Reverse Cylinder seal failure: Suspect Seals are: Seal Ring [16] or Nitrile Seal [34]. Hose connections to Nipple	Overhaul Reverse Cylinder	**8.2.4.** **{HJ321 07 001}**
16	**Reverse Cylinder: Water leaking in by Backhead [3]**		
	Reverse Cylinder seal failure: Suspect seals are: Resilient Mount [8] O-Ring [10]	Overhaul Reverse Cylinder	**8.2.4.** **{HJ321 07 001}**
17	**Thrust Bearing Housing excessively hot**		
	Thrust Bearing or Seal failure	Overhaul Thrust Bearing	**8.6.1**
18	**Poor Reverse Thrust.**		
	Reverse Duct not travelling fully down.	Determine reason for limited travel and correct	**Refer to Controls Manual.**
	Reverse flow hitting the Trim Tabs.	Re-position Trim Tabs below Jet centre	**Sect 1.3.3.**
	Engine exhaust is being ingested into the intake.	Re position engine exhausts to exhaust above the water-line	**Sect 1.3.4.**
19	**Poor forward thrust**		
	Reverse Duct not travelling fully up	Determine reason for limited travel and correct	**Sect 8.2.**
20	**Reverse Control Lever movement is stiff**		
	Reverse Control Lever or Cable is stiff	Disconnect the Reverse Control cable at the Lever. Check Controller movement and cable movement. Lubricate as necessary. Check for bent or loose linkages Check cable run from Control Lever to the Reverse Cylinder Lever to ensure that cable is not being accidentally bent or crushed and restricting movement. Check cable type, length and route are as specified.	**Refer to Controls Manual. Overhaul Section**
21	**Steering stiff at the Helm**		
	Grit jamming Nozzle	Work Nozzle from side to side to release grit. Flush out.	**Sect 8.4.**
	Helm Wheel stiff.	Check, rectify and lubricate as necessary	**Refer to Controls Manual.**
	Steering Tiller Shaft stiff	Check movement of Steering Shaft, and clearance on Steering Bushes. Rectify to a loose running fit.	**Sect 8.4.**
	Grit between Nozzle Bushes [8], and Nozzle.	Remove Pivot Pins [6], Bushes [8]. Check Bushes and Pivot Pins for wear. Replace with new parts as necessary.	**Sect 8.4.3.** **{HJ-321-06-005}**
	Corrosion build-up under Steering Shaft or Nozzle Bushes.	Remove Bushes, clean out bores and refit using Loctite.	**Sect 8.4.**

SYMPTOM			
No.	***POSSIBLE CAUSE***	***SOLUTION***	***REFER :***
22	**Steering jamming**		
	Grit jamming Nozzle	Work Nozzle from side to side to release grit. Flush out.	**Sect 8.4.**
	Deflector Pivot Bolts loose or bent.	Remove, check and replace Bolts to the torque specified on the drawing.	**Sect 8.4. {HJ-321-06-005}**
	Deflector deformed by impact	Remove, rebuild or replace as necessary.	**Sect 8.4.**

6. Maintenance : General

Jet Unit

The Jet Unit has been designed to require a minimum of maintenance. However, it is recommended that the Jet Unit be dismantled and inspected for wear on bearings, seals etc, and checked for corrosion annually as a minimum requirement.

Hydraulic Equipment

When servicing hydraulic equipment use the following general rules to ensure effective and trouble free servicing:

1. Minimize loss of oil to surrounding areas by liberal use of oil absorbent cloth.
2. If breaking a hydraulic connection to a part which is not going to be serviced, immediately plug the connection to prevent loss of oil and entry of foreign particles.

6.1. PRESERVATION: (Pre-Installation)

NEW JET PRESERVATION

The following storage requirements must be provided to ensure no damage or deterioration occurs:

1. Temperature must be between 10º and 40º and above the "dew point" (i.e. no condensation is allowed to form).
2. Loads on the Marine Bearing must be removed to prevent permanent distortion in one place. This is done by attaching and adjusting a ***"Mainshaft Support Tool"*** which is fitted through the Inspection Cover.
3. It is desirable to keep Bearing Housing components coated with grease; turn the Shaft 180° once every month to achieve this.
4. All exposed steel (except for stainless steel) parts should be protected from corrosion. To do this, coat these parts with a thin layer or rust preventative oil, such as Shell Ensis.
5. To protect hydraulic fittings, either:
   A) Coat with oil impregnated corrosion protection tape,
   or
   B) Spray with a recognized corrosion protection product.

PREPARATION FOR USE

To prepare the Jet Unit for use:

1. Remove the ***"Mainshaft Support Tool"*** and refit the Inspection Cover.
2. Ensure that the Bearing Housing is greased via the nipple on the top of the Bearing Housing. **Refer to Section 8.7. "Bearing Housing Re-assembly".**

6.2. PRESERVATION: (Post Installation)

CAUTION:

Do not run the Jet Unit out of the water, unless fitted with a Dry Run Kit.

When the vessel is not operational for an extended period, the following procedures must be followed to prevent marine growth and corrosion problems.

If the Jet Unit is to be laid-up, carry out the following:-

1. Clean down the whole Jet Unit and wash inside and out with fresh water.
2. Hose the inside of the Jet through the Intake Grill and the Nozzle. Allow to dry completely.
3. Spray with a suitable corrosion protection oil such as Shell Ensis.
4. Oil and lubricate all moving parts.
5. **Carry out the following on a monthly basis:-**
   a) If the engine cannot be run, turn the Mainshaft by 180º. This can be done manually.
   b) Stroke the Reverse Duct fully six times and leave in the raised position.
   c) Operate the Steering from lock to lock fully six times.

If the Jet is to remain moored, carry out the following:-

1. Actively prevent marine growth through the following procedures:
   a) Paint the inside and outside of the Jet Unit with antifouling compound
   b) Keep light away from the Jet Unit. Moor the vessel in deep water rather than shallow water.
   c) Place an opaque bag over the Steering Deflector to prevent light entering the inside of the Jet Unit. In shallow water a similar cover should be tied over the Intake Screen.
   d) If moored for longer periods the Jet Unit can be pumped dry using compressed air. A sealing plug can be ordered from C.W.F. Hamilton & Co. Ltd. This is fitted into the Nozzle and air is introduced to push water out of the Jet Unit.

CAUTION:

Before moving any Controls, ensure that any marine growth is removed from the Steering and Reverse Linkage Rods. This will prevent damage to the seals that these Control Rods pass through.

Perform the following procedures at an interval ranging from 1 week to 1 month, depending on operational conditions.

1. Run the Jet Unit for a short time.
2. Stroke the Reverse Duct and Steering Deflector fully six times. Leave the Reverse Duct in the raised position and the Steering Pushrod fully retracted.
3. If the engine is not started, turn the Mainshaft by 180º once per week. This can be done manually.

6.3. SERVICING INTERVALS

Please note the following points:

1. Vessel usage is assumed to be 2000 operational hours per year. Adjust your schedule as necessary.
2. The frequency of the following service items may be varied to suit actual operating conditions. Refer to the appropriate Section for details.
   - Jet Unit examination every 5000 hours **(refer to Section 6.4 Item 13).**

SERVICING INTERVALS (JET)

ITEM	WHAT TO DO	REFER TO	FIRST 5 HOURS	1 DAY	30 HOURS	500 HOURS	1 MONTH	3 MONTHS	1000 HOURS	FIRST 2000 HOURS	5000 HOURS
INTERNAL WATER PATH	Clear blockages	4.9		●							
THRUST BEARING	Lubricate	6.4/2			●		●				
WATER SEAL	Check for leaks	6.4/4		●							
EXTERNAL ANODES	Check condition	6.4/5						●			
REVERSE CYLINDERS AND HOSES	Check for leaks damage or corrosion	6.4/7	●				●				
STEERING CYLINDERS AND HOSES	Check for leaks damage or corrosion	6.4/8	●				●				
STEERING SHAFT & BUSHES	Check and lubricate	6.4/11					●				
STEERING SHAFT SEAL	Check	6.4/12					●				
DRIVE SHAFT UNIVERSAL JOINTS	Lubricate	6.4/13				●					
SCREEN RAKE BEARINGS	Check / Lubricate	6.4/6							●		
COMPLETE JET UNIT	Examine	6.4/14								●	●
STEEL HULL	Insulation check.	7.3.2.					●				

6.3.1. Daily "Pre Use" Servicing Checks

The following areas should be checked on a daily basis if the vessel is in regular use.

DAILY SERVICING CHECKS (JET)

AREA	OPERATION
Intake Screen **Impeller** **Stator Blades**	**Ensure that the water level is below Hatch or Overflow Preventer before opening Jet Inspection Hatches.** Check via the Intake Inspection Hatch that they are clear of debris. Check for Impeller damage.
Reverse Hydraulic Oil Lines.	Check for oil leaks, especially if oil has been added to a system.
Steering System	Check the freedom of movement of the Steering Cable. Check for security of attachment of the Cable outer mount points
Bearing Housing	Check for signs of water leaking from under the Thrust Bearing Housing. (Leaking Water Seal). If the Water Seal is leaking it should be replaced as soon as possible otherwise failure of the Thrust Bearing could occur.

6.4. JET UNIT SERVICING DETAILS

WARNING:

EXTREME CARE IS REQUIRED WHENEVER THE INSPECTION COVER IS REMOVED, AS WATER MAY ENTER THE VESSEL THROUGH THIS OPENING. NEVER LEAVE THE INSPECTION COVER REMOVED WITHOUT CONSTANT MONITORING OF THE WATER LEVEL.

Item No	Item	Operation
1.	**Intake Flow Path**	**Check for obstructions inside Intake daily.** Remove Inspection Cover and check around the Impeller and Intake Screen for obstructions and debris. **Refer to Section 4.9. "Blockages (Debris In The Jet Unit)**Blockages (Debris In The Jet Unit)**.**
2.	**Thrust Bearing.**	Grease with a good quality lithium based ball bearing grease every 30 hours running (Or monthly if not run for 30 hours) **DO NOT OVER GREASE.**
3.	**Marine Bearing**	This is a water lubricated bearing and requires no attention. **Do not run the Water Jet out of water as this will damage the Bearing and Water Seal.**
4.	**Water Seal**	**Check for water leaks daily.** Visually check for water dripping from under the Bearing Housing. If water is found, the Water Seal is defective and should be replaced.
5.	**External Anodes**	**Check the condition of the Anodes every 3 months.**
	Note:	**The rate at which anodes erode away will vary considerably depending on the nature of the water. The inspection interval for Anodes can be increased after the actual erosion rate is determined from experience.** a) Inspect all external Anodes. b) Replace any Anode which is less than half its original size. c) Ensure that mating surfaces are scraped clean for good electrical contact. d) Ensure that the Anodes are not painted over (especially when applying Antifouling paint). e) Scrub down with wire brush if coating has built up on Anode. f) Re-tighten attachment fasteners to recommended torques. g) Ensure all fasteners are correctly tightened when fitting new Anodes.
6	**Screen Rake and Bearings (If fitted).**	**Grease bearings every 1000 hours with a water repellent grease.** Check at regular intervals for free operation. Stiffness or binding may be caused by debris caught in the screen or seized bearings.
7	**Reverse Hydraulic Cylinder and Hoses**	**Check after the first 5 hours and then monthly.** Check for leaks, damage or corrosion. Methodically check the Reverse Cylinder and attached hoses for any signs of oil leaks, damage or corrosion of the fittings. Repair as necessary. Refer to the Controls Manual supplied with this Jet Unit for information on Hose replacement.

Item No	Item	Operation
8	**Steering Hydraulic Cylinder and Hoses**	**Check after the first 5 hours and then monthly.** Check for leaks, damage or corrosion. Methodically check the Steering Cylinder and attached hoses for any signs of oil leaks, damage or corrosion of the fittings. Repair as necessary. Refer to the Controls Manual supplied with this Jet Unit for information on Hose replacement.
9.	**Steering System**	**Check integrity daily where possible.** Check the whole Steering System for freedom of movement.
	NOTE:	**The HJ-321 Steerable Nozzle System has been designed with minimum clearances between the Nozzle and Nozzle Housing. This allows optimum steering thrust at any lock with the minimum of loss. It is important to keep the Pivot Pins and Bushes in good condition to maintain clearances. Heavy impacts on the Nozzle Housing may deform it and cause the steering to jam.**
10.	**Steering Crank**	**Grease every 100 hrs.** Check for security of attachment and grease with water repellent grease.
11.	**Steering Shaft and Bushes**	**Monthly - Lightly grease the Shaft and Bushes** Check the play in the Steering Shaft, it should be a running fit in the Bushes with no binding.
12.	**Steering Shaft Seal**	**Monthly -** Check the Steering Shaft Seal by looking for signs of leaking and by assessing lateral play. Replace Seal if excessive lateral play, or signs of leaking around Seal.
13	**Driveshaft**	**Lubricate every 500 hrs or to suit the manufacturers recommendations.** Follow the manufacturers recommendations for type of Driveshaft used.
14.	**Jet Unit**	**Carry out internal examination of the Jet Unit after the first 2000 hrs operation and thereafter every 5000 hrs.** This examination should be carried out with the vessel out of the water. The following checks should be carried out:-

a) Impeller Blades - Check Clearance

Remove the Main Inspection Cover. Using Feeler Gauges, check the clearance between the tips of the Impeller Blades and the Wear Ring at each side of the Impeller not top and bottom).
Maximum recommended worn clearance is 1.1 mm (0.043 ") per side.

b) Impeller .-.Check for Wear and Damage

Look for signs of corrosion and erosion damage on all surfaces of the Impeller.
Check the Impeller leading and trailing edges for damage.

c) Reverse Duct - Examine

Check that the Reverse Duct Pivot Pins are tight, and that there is no binding in the Bushes.
These items are to be removed in accordance with **Section 8.2.1. "Reverse Duct Removal"** of this Manual.

Item No	Item	Operation
14 (cont.)	Jet Unit (contd.)	d) **Tailpipe, Nozzle & Steering Deflector - Removal.** These items are to be removed in accordance with **Section 8.2. "REVERSE ASSEMBLY REMOVAL AND OVERHAUL".** e) **Marine Bearing - Inspect.** Place the Bearing Sleeve inside the Marine Bearing and use feeler gauges to measure the diametrical clearance. 0.05 mm to 0.15 mm is normal. Maximum recommended clearance is 0.5 mm. Inspect the Marine Bearing for scoring or localized wear. Replace if excessively worn. f) **Insulation Checks (Steel Hull Only).** Carry out insulation checks on the hull on a monthly basis. **Refer to *Section 7.3.2. "Checking the Insulation"*.**

CAUTION

ANTI FOULANT PAINTS

Do not use copper oxide based anti-fouling paints. Tin based anti-fouling paints are suitable, or anti-fouling paint suitable for an aluminium hull as recommended by the paint manufacturer. Leave all stainless steel parts polished and unpainted. Do not paint over the anodes.

ANTI-SEIZE COMPOUNDS:

Do not use anti seize compounds which are based on graphite, nickel or copper flakes - these will cause corrosion. Anti seize compounds, usually containing zinc flakes are available for aluminium.

g) **Jet Unit Paintwork.**
The main body of the Jet Unit is constructed from Silicon-Aluminium Alloy (LM6) which is resistant to corrosion from salt water.
The castings are finished in a polyurethane paint.
Periodic cleaning down, wire-brushing and repainting may be necessary depending on water conditions prevailing, and extent of use.
When the vessel is on the slip, preferably annually, the complete Jet Unit should be inspected internally and externally for faults, corrosion, or breakage's. Clean down and repaint the castings where necessary.

h) **Refit Components.**
Refit components in accordance with the Overhaul Section of this Manual. Follow the recommendations on **Drawing 85113 "Recommendations for Fastener Locking, Torques and Thread Lubrication"**, and **Section 6.6. "Threaded Fasteners"**, for thread tightening torque's, thread and joint locking. For Bearing Housing lubricants and hydraulic fluids refer to **Drawing 85018 "Recommendations for Lubricants and Oils".**

If excessive wear or damage has been found, then undertake appropriate overhaul as described in **Section 8. *Overhaul***. Schedule the next maintenance period to suit the conditions found during this inspection, using the following guidelines:

- Decrease the time between each maintenance interval the if amount of dirt and sand in the water increases.
- Increase the time between each maintenance interval if amount of dirt and sand in water decreases.
- Decrease interval if excessive wear was found in the Jet Unit internal inspection ***(Item 14 above).***
- Increase interval if minimal wear was found at the Jet Unit internal inspection ***(Item 14 above).***

6.5. TOOLS

6.5.1. Standard Recommended Tools

The following tools are required for normal maintenance activities:

1. Torque Wrench. ¾"sq/dr.
2. Torque Wrench. ½" sq./dr.
3. Ratchet, Torque Bar And Short Extension ½" sq./dr.
4. Sockets A/F ½" sq./dr., 13 mm, 19 mm, 24 mm.
5. Spanners A/F. 1 x 9 mm, 2 x 17 mm, 1 x 24 mm.
6. Allen Keys 1 x 6 mm and 1 x 8 mm.
7. Pliers Long Nose.
8. Screw Driver Large, Flat Blade.
9. Mallet, Rubber.

6.5.2. Special Tools

There are some special tools required for work on the Mainshaft. Several Tool Kits are available, as described in Drawing HJ-321-11-001 Toolkits HJ-321 Jet.

6.6. THREADED FASTENERS

Drawing 85113. "Recommendations for Fastener Locking, Torques and Thread Lubrication".

CAUTION:

Tightening Torque's: **Ensure that all threaded fasteners are tightened to the correct torque as described in Drawing 85113 or the relevant assembly drawings.**

TIGHTENING TORQUE'S FOR THREADED FASTENERS

a) The tightening torque's for standard fasteners are given on the drawing above.
b) The tightening torque's for special fasteners are shown on the relevant drawings, and also at paragraph 1, below.
c) Ensure that recommended tightening torque's are always used.

1. **Special Fasteners -HJ-321 Jet.**

ITEMS	Torque	
	Nm	lbs/ft
Reverse Duct Pivot Pins	675	510
Nozzle Pivot Pins	350	260
Impeller Nut	400	300
Coupling Nut	400	300
Bearing Lock Nut	270	200
Cotter Pins	40	30
Impeller Nut Set Screw	8	6
KMT Lock Nut Set Screw	12	9
All other Nuts to be torque loaded as per Drawing 85113		

THREAD LOCKING AGENTS

Most fasteners require thread locking agents to prevent loosening.
a) Most applications are described on the drawing above.
b) Special applications will be shown on the relevant Assembly Drawing.

6.7. RECOMMENDED LUBRICANTS

Recommended Oils and lubricants required are specified on Drawing 85018 contained in the Drawings package supplied with this Manual.
Do not use brake fluid or heavier viscosity oils.

ANTI-SEIZE COMPOUNDS:

Do not use graphite based anti-seize compounds - these will cause a corrosion problem.

CAUTION:

ANTI FOULING PAINTS

Do not use copper oxide based anti-fouling paints. Tin base anti-fouling paints are suitable or anti-fouling paint suitable for an aluminium hull as recommended by the paint manufacturer. Leave all stainless steel parts polished and unpainted. Do not paint over the anodes.

ANTI-SEIZE COMPOUNDS:

Do not use anti-seize compounds which are based on graphite, nickel or copper flakes- these will cause corrosion. Anti-seize compounds, usually containing zinc flakes, are available for aluminium.

CAUTION:

It is common to use a copper based antifouling paint on steel hulls. Copper based antifouling paint cannot be used near or on the Aluminium Jet as it will cause the Jet Unit to corrode.

7. Precautions Against Corrosion

7.1. GENERAL

CAUTION:

Prevention of Corrosion

The Jet Unit has been designed to withstand the corrosive affects of operation in salt water through the use of materials that are resistant to salt water corrosion and by the placement of sacrificial anodes in suitable locations.

Vessels using Hamilton Jet Units, must be bonded and wired as described in this Section to prevent corrosion occurring due to the presence of stray currents or due to galvanic interactions along the shore power grounding conductor.

7.1.1. Electrical Wiring System

The guidance of the local inspecting authority rules should be sought, but in general note the following for:

D.C. SYSTEMS

Every part of the DC system should use **TWO** insulated "normally conducting" wires, a positive and a negative. The negative must not run through the frame of any unit, through the Hull of the boat, or through the bonding system. **DO NOT USE AN EARTH RETURN SYSTEM.**

It is recommended that engine starter motors or other DC motors should be the two wire type with an insulated negative terminal rather than having the casing of the starter connected to the battery negative. This is to ensure starting currents do not pass through the earth bonding system.

In smaller vessels, it is common to use negative ground engine systems in which the starter motor, starter solenoid, and alternator are single pole devices using the engine block as the local return conductor. **IN THIS SITUATION, IT IS IMPORTANT TO CONNECT THE ENGINE BLOCK TO THE BATTERY NEGATIVE WITH A HEAVY BATTERY CABLE.**

In installations with two engines and two battery banks with cross-connect starting capability, there must be two heavy conductors between the engines. Local standards if appropriate should be complied with.

A.C. SYSTEMS

For a vessel with both AC and DC circuits it is essential for safety reasons that the AC system has a separate earth wire.

Dock potentials can be as positive as +350mV relative to a silver / silver chloride reference electrode. If a vessel with bonded aluminium Jets is connected to such a dock potential through the separate earth wire, without the protection of an **isolation transformer** or a **galvanic isolator**, the corrosion rate of the aluminium would increase to a value far greater than the normal sea water corrosion rate. This would occur regardless of whether the aluminium was protected by anodes or not.

Using an Isolation Transformer

If using AC shore supply, the recommended method of preventing potentially serious galvanic or stray current corrosion is to install an Isolation Transformer on board at the incoming line.

When an Isolating Transformer is used, there must be no connection between the shore supply earth and the vessels earth bonding system. The primary winding shield is earthed to shore while the secondary winding should be grounded on board the Vessel. Only one side of the secondary winding is grounded on the secondary side of the Transformer and the Vessel's grounding circuit is tied in at this point. There must be no DC electrical connection between the shore supply and the on board AC circuit.

Using a Galvanic Isolator

Alternatively with AC shore supply, a galvanic isolator can be installed on the AC earth wire just after the shore power inlet. This isolator isolates the vessel from low voltage D.C. galvanic currents, while allowing any short circuit to be safely conducted back to shore.

Isolators with capacitors are to be preferred over isolators with diodes only. The isolator should have sufficient fault capacity to allow circuit breakers to trip under fault conditions.

A correctly wired polarization transformer in conjunction with a galvanic isolator is acceptable for connecting to an AC shore power system.

CAUTION:

An isolation transformer or a galvanic isolator must be correctly fitted to the vessel electrical system if the vessel is to be connected to an external AC shore supply.

7.1.2. Earth Bonding System

In aluminium and most GRP hulls, the Jet Unit, Hull (if aluminium), all metal objects, electrical equipment casings and Hull anodes should be connected with a low resistance bonding system (separate from normally current conducting 2 wire electric system).

The bonding strip and connecting wires should be aluminium or **insulated** copper of at least 14.5 sq.mm. cross section area (e.g. 5mm diameter.) to give very low (e.g. 0.01ohm) electrical resistance. A copper bonding strip, if used, should not be directly connected to the Jet Unit as galvanic corrosion may occur.

The bonding wire or strip which runs fore and aft down the Hull, should be kept clear of bilge water where possible.

The main function of the bonding system is to provide a path for stray currents to battery negative.

An exception exists for Steel Hulls and GRP hulls whose reinforcement is carbon fibre; the Jet Unit must be totally insulated from the Hull and machinery thus relying totally on its own Anodes for protection.

When a bonding system is used, it is essential that cathodic protection is provided. This cathodic protection can be in the form of ***Sacrificial Anodes*** or an ***Impressed Current System***.
To minimise corrosion from stray current emanating from within the vessel, all power sources (battery and battery charger negatives, AC generator and the ship side of the shore supply earth) should be connected to the earth bonding system at

a single common earth point. This will hold these circuits at a common voltage. Any stray currents will then have a direct path back to the battery negative or the AC source.

Alternatively this connection to the battery negative can be deleted PROVIDED that the following is carried out:

1 There is a two wire normally current conducting electrical system which is isolated from the Hull, Jet Unit and Engine,
and
2 There is an effective leakage monitoring system, such as the "Test Light" system, which is used regularly and the results are recorded.

Without the bonding system to battery negative connection, stray current corrosion is possible and it is important to check for leakage:-
a) For every item of electrical equipment in operation.
b) When there is any alteration to the electrical system of the boat.
c) When any electrical connection is made to shore.

7.1.3. Corrosion Monitor

It is recommended that a corrosion monitor be fitted.

The corrosion monitor should be a high impedance device. There must be no possibility of an electrical connection between the Jet Units and the ships batteries.

If the Jet Units are isolated from the hull, corrosion monitoring of each Jet Unit external wetted surface and internal Intake Duct should be carried out.

If the Jet Units are electrically connected to the hull, corrosion monitoring of the hull only and each Jet Unit internal Intake Duct should be carried out.

7.1.4. Earth Plate Connections For Electronic Transmitting Equipment

Radios, radar's and other transmitting equipment **should NOT use the Jet Unit for an earth plate** but must have a separate earth plate.

Be guided by the installation instructions for the radio; radar, etc. equipment, but in general these systems should be electrically insulated from the Jet Unit **except that both the earth plate and the metal casings of the electrical transmitting equipment should be connected to the earth bonding system.**

1. An area of metal plate is required which is not painted and always immersed, even when at planing speeds. It is always in electrical contact with the sea water.
2. The area of metal plate is typically approximately 400 x 400 mm and should be located close to the equipment radiating electrical waves but well forward of the Jet Units.
3. For a metallic hull, the earth plate can be a thickened area of the hull, formed by welding additional plate inside the hull skin, up to 25 mm thick.
4. For a non metallic hull a separate metal earth plate must be fixed externally to the hull. It should be of material compatible with both the "bonding strip" and hull (stainless steel is likely to be the best option. It is not advisable to use copper as it can cause corrosion problems for other metals).
5. The "plate" should have a large stud welded to its centre and protruding inboard to which all the zero voltage wires from equipment can be connected.
6. The earth plate should be connected by an insulated wire to the vessels "Earth Bonding System".

7.1.5.Zinc Anodes

Anodes should not be painted over as they will not function as intended. If the anodes are being eaten away they are providing protection. They should be inspected and replaced when half consumed because the material that remains will not provide full protection. It is common for zinc anodes to be partially covered with a very loose scale. The colour of the scale depends on local water conditions but can typically be creamy white, light brown or green. This scale, providing it is loose (i.e. easily scraped off with a fingernail), is normal.

If the anodes are not being eaten away, they are not doing their job and the cause should be investigated. One reason could be the anode does not have good electrical contact between the component it is protecting and itself. The electrical resistance should be less than 0.2 ohms.

Poor quality zinc anodes may contain too much iron impurity. Such anodes tend to form a dense non-conducting oxide film (usually charcoal grey in appearance). This condition usually occurs in fresh water. To confirm this condition, test for continuity between the anode and the Jet Unit using a multimeter set to ohms. If the anode has to be scraped with a knife to get a conductive reading, the anode is oxidized and must be replaced. Sanding the anode surface provides a temporary solution, but it will form the oxide again.

JET UNIT ANODES

The anodes fitted to the Jet Unit are made from zinc alloy to US military specification MIL-A-18001K. These anodes are fitted to the Reverse Duct, Steering Deflector, Reverse Cylinder and the main body of the Jet Unit. Anodes are also fitted internally within the Tailpipe and in most Jet models, within the Intake.

HULL ANODES

Further anodes should be fitted on the Hull, sufficient for Hull protection, as determined using a portable reference electrode and digital voltmeter and / or a corrosion monitor.

The Hull anodes should remain immersed at all times. **Note that anodes fitted on the Transom of a planing speed craft will not be immersed when the craft is at speed and therefore will not be providing protection.**

7.1.6.In Service Checks

In Service, the following three items should be inspected regularly:

1. **The Bonding System:** For loose or corroded connections and test to ensure that electrical resistance is still low.
2. **All Sacrificial Anodes:** Replace when half corroded / eroded.
3. **Earth Leakage:** There should be no current leakage from any electrical item to the bonding system.

7.1.7.Anti Fouling Paint / Anti Seize Compound

CAUTION:

ANTI FOULING PAINTS

Do not use copper oxide based anti-fouling paints. Tin base anti-fouling paints are suitable or anti-fouling paint suitable for an aluminium hull as recommended by the paint manufacturer. Leave all stainless steel parts polished and unpainted. Do not paint over the anodes.

ANTI-SEIZE COMPOUNDS:

Do not use anti-seize compounds which are based on graphite, nickel or copper flakes- these will cause corrosion. Anti-seize compounds, usually containing zinc flakes, are available for aluminium.

7.1.8.Impressed Current Protection

Impressed current protection may be used if desired. Follow the suppliers instructions. Impressed current systems should have a "fail safe" feature which prevents the potential falling below -1100mV referenced to a silver / silver chloride reference electrode.

7.2. ALUMINIUM, G.R.P. AND WOOD HULLS (OTHER THAN STEEL)

7.2.1. Earth Bonding System - (Not Normally Current Conducting)

Refer to Drawing 85114 which shows the layout of the Earth Bonding System.

In the case of an aluminium Hull, an engine stringer or any other continuous longitudinal member may be used as the bonding strip. All junctions should preferably be welded, but if bolted, should be clean, have a good contact and be regularly inspected and maintained.

7.3. STEEL HULLS AND CARBON FIBRE REINFORCED GRP HULLS

CAUTION:

For steel and carbon fibre reinforced GRP hulls, the Jet Unit must be electrically insulated from the Hull.

An insulating kit is supplied with the Jet Unit.

7.3.1. Earth Bonding System (Not Normally Current Conducting)

Refer to **Drawing 85114** for details of insulating the Jet Unit from the Hull.

1. If a negative earth system is used on the vessel, it **MUST NOT** be connected to the Jet Unit.
2. Every part of the vessel electrical system should have **TWO** wires to it, a positive and a negative wire.
3. With electrical auxiliary equipment installation be guided by your electrician. Do not earth electrical equipment to the Jet Unit, but to a separate earth installed as far away from the Jet Unit as possible.

7.3.2. Checking the Insulation

1. **WITH THE VESSEL OUT OF THE WATER**

   The resistance between the Jet Unit(s) and the Hull should be 1000 ohms or greater. If the reading is below 1000 ohms, the fault should be investigated and rectified.

2. **WITH THE VESSEL IN THE WATER**

   For Steel Hulls:
   a) Place a silver / silver chloride half cell in the sea-water.
   b) With the silver / silver chloride half cell connected to the 'common' of a high impedance digital voltmeter (set to read 0 to 2000 mV).
   c) Connect the 'positive' terminal to the hull and note the reading.
   d) Repeat with the 'positive' terminal connected to the Jet Unit(s) body.
   e) Place a large zinc anode in the sea-water and electrically connect the hull to the anode.
   f) Repeat the digital voltmeter readings.
   g) If Jet Unit(s) is insulated from the hull, the mV readings for the Jet Unit(s) should not change.
   h) The mV readings for the hull should be more negative (eg: The reading could be -800mV without the large zinc anode connected and -850mV with the large zinc anode connected to the hull).
   i) This test can also be carried out with a Corrosion Monitor, if fitted.

3. **IN SERVICE** The insulation between the Jet Unit(s) and the steel hull should be checked monthly.

8. Overhaul

NOTE:

The Maintenance operations detailed in this Section should be carried out when the Vessel is on a Slip or in Dry Dock.

Overhaul of the Jet Unit should only be carried out after an examination indicates the need for an overhaul. **Refer to Section 6. Maintenance - General** for details of how to examine the Jet Unit. The Overhaul Section of the Controls manual contains additional information.

The following Overhaul procedures can be carried out on this Jet Unit:

a) Reverse Duct Overhaul.
b) Reverse Cylinder Overhaul.
c) Steering Equipment Overhaul.
d) Steering Cylinder Overhaul.
e) Tailpipe Area Overhaul.
f) Bearing Housing Area Overhaul.

PRIOR TO COMMENCEMENT OF OVERHAUL:

Disconnect and remove all control equipment attached to components being overhauled. This prevents damage to the less robust control equipment.
Take care to identify electrical or hydraulic connectors so they can be correctly replaced.
Cover all connectors to prevent entry of dirt or loss of hydraulic oil.

OVERHAUL PROCEDURE:

The following procedure describes the main activities when carrying out a complete overhaul, but can be used to plan any other type of overhaul.

1. Overhaul the Driveshaft (not described) (Refer to manufacturers manual).
2. Overhaul the Reverse Assembly.
3. Overhaul the Steering Assembly.
4. Overhaul and refit the Bearing Housing area of Jet Unit.
5. Overhaul and refit the Tailpipe area of Jet Unit.
6. Overhaul and refit the Transom Plate.
7. Refit the Steering Assembly.
8. Refit the Reverse Assembly.
9. Refit the Driveshaft (not described).

ON COMPLETION OF OVERHAUL

Perform the appropriate commissioning of the Jet Unit as described in this Jet Unit Manual **Section 3. "Commissioning".**

Commissioning the Jet Unit. It is important that a commissioning of the vessel be carried out on completion of an overhaul activity as adjustments and connections may have been altered during the overhaul operation.

Commissioning the Controls System. Perform the appropriate commissioning of the Controls System as described in the Controls Manual supplied with this Jet Unit.

TOOLS

All special tools required for the overhaul of the Jet Unit are shown on **Drawing HJ-321-11-001 Toolkits For HJ-321 Jet.**

8.1. GENERAL INFORMATION

Care of Jet Unit Paintwork
All castings on the Jet Unit are of Silicon-Aluminium Alloy (LM6) which exhibits good resistance to salt water corrosion. These castings are finished in a polyurethane paint. If the paint has deteriorated during service, it should be cleaned with a wire brush and repainted with a suitable antifouling paint.

CAUTION:

ANTI FOULING PAINTS

Do not use copper oxide based anti-fouling paints. Tin base anti-fouling paints are suitable or anti-fouling paint suitable for an aluminium hull as recommended by the paint manufacturer. Leave all stainless steel parts polished and unpainted. Do not paint over the anodes.

ANTI-SEIZE COMPOUNDS:

Do not use anti-seize compounds which are based on graphite, nickel or copper flakes- these will cause corrosion. Anti-seize compounds, usually containing zinc flakes, are available for aluminium.

Care of Stainless Steel Parts
Leave all stainless steel parts polished and unpainted.

Anodes
Leave all Anodes unpainted.

8.2. REVERSE ASSEMBLY REMOVAL AND OVERHAUL

Drawing HJ-321 07-001 refers.

For fault finding with the Reverse System, refer to the Controls Manual supplied with this Jet Unit.

For the overhaul of the Reverse Cylinders refer to Section 8.2.4. "Reverse Cylinder Overhaul", in this Manual.

8.2.1. Reverse Duct Removal

1. Disconnect any Sensors attached to the Reverse Cylinder. Refer to the ***Overhaul Section of the Controls Manual supplied with this Jet Unit.***
2. Whilst supporting the Reverse Duct with suitable approved lifting equipment and a lifting sling attached to the Reverse Duct, disconnect the Reverse Cylinder [2] from the Reverse Duct [25] by removing the Split Pin [22] and Flat Washer [23] from the Hydraulic Cylinder Connecting Pin [21].
3. Take the weight of the Reverse Duct and withdraw the Hydraulic Cylinder Connecting Pin [21].
4. Lower the Reverse Duct.
5. Take the weight of the Reverse Duct and unscrew the Reverse Duct Pivot Pins [28] and remove with Spacer Washers [29].
6. Remove the Reverse Duct, taking care not to damage the Reverse Duct Pivot Bushes [27] fitted in the Reverse Duct Arms.

8.2.2. Reverse Duct Overhaul

If the Reverse Duct Pivot Bushes [27], Special Flat Washers [29] and the Reverse Cylinder Pin Bushes [24] fitted in the Reverse Duct Arms and Cylinder attachment point are worn or damaged, these should be replaced.

Replacing the Reverse Duct Pivot Bushes [27]:

1. Prior to refitting the Reverse Duct, the Reverse Duct Pivot Pin Bushes [27] and Special Flat Washers [29] should be checked and replaced if required.
2. The Pivot Bush [27] is normally a loose fit over the Pivot Pins [28] and should be round (not oval) to within approx 0.5 mm.
3. Check that threads on Reverse Duct Pivot Pins [28] are free from burrs.
4. If replacing the Pivot Bushes [27] carry out the following actions:-
   a) The bore in the Reverse Duct Arms must be cleaned of old Loctite, paint and corrosion deposits and painted with a Zinc Chromate Etch Primer.
   b) Coat the outer surfaces of the Bushes [27] and the bore of the Reverse Duct Arms with Loctite 262.
   c) When the paint is dry, press the new Bushes into the Reverse Duct Arms and rotate twice to distribute the Loctite evenly over the surfaces. Wipe off any surplus Loctite.

Replacing the Reverse Cylinder Pin Bushes [24]:

1. Prior to refitting the Reverse Duct, the Reverse Cylinder Pin Bushes [24] should be checked and replaced if required.
2. The Bush [24] is normally a loose fit over the Connecting Pin [21] and should be round (not oval).
3. If replacing the Reverse Cylinder Pin Bushes [24] carry out the following actions:-
   a) The bore in the Reverse Duct Cylinder Attachment Point must be cleaned of old Loctite, paint and corrosion deposits.
   b) Coat the outer surfaces of the Bushes [24] with Loctite 325.
   c) Press the new Bushes into the Reverse Duct Attachment Point. Wipe off any surplus Loctite.

Replacing the Reverse Duct Anodes [30]:

Visually check the 2 Anodes [30] attached to the rear of the Reverse Duct Arms. If these Anodes are less than half of their original size, they should be replaced.

1. Remove the Nuts [33] and Spring Washers [32] from Studs [31] securing the Anodes [30] to the rear of the Reverse Duct Arms.
2. Remove the Anodes [30] from the rear of the Reverse Duct Arms.
3. The mating surfaces of the Anode / Reverse Duct Arms should be scraped clean to ensure a good electrical contact.
4. Fit a new Anodes [30] and attach to the Stud [31] with Nuts [33] and Spring Washers [32]. Torque load to the recommended torque.

8.2.3. Reverse Cylinder Removal

Drawing HJ-321-07-001 refers.

The Reverse Cylinder need only be dismantled if it is suspected of having Seal failure or at a routine servicing interval.

Typical symptoms of Seal failure are:

- **Piston Seal [13]:** Reverse Bucket not staying in up position. Note that this can also be caused by faults in the Control System.
- **Shaft Seals [12 & 14]:** Oil leaking from the Front Head / Back Head Retainers [3].

Reverse Cylinder Removal

1. Disconnect and blank off all hydraulic hoses and sender linkages attached to the Reverse Cylinder.
2. If the Reverse Cylinder has not already removed for overhaul, carry out the actions at **Section 8.2.1. "Reverse Duct Removal"**, to remove the Reverse Duct.
3. Remove the two Hydraulic Hose Nipples [15] complete with Seal Ring [16] and Nitrile Seal [34] from the Front and Back Heads [3] and fit blanking caps to the hydraulic connections to prevent the ingress of dirt and moisture.
4. From inside the vessel, remove the Reverse Cylinder from the Jet Unit Intake Flange by removing the 2 Nyloc Nuts [20], Thin Nuts [19], and Washers [18] from the mounting Studs [17] attached to the Intake Flange.
5. The Cylinder can now be withdrawn into the vessel with the Mounting Plate [7] attached and removed for further maintenance.
6. Remove the Resilient Mount [8] from the 2 Studs [17] taking care not to lose the Scraper Retainer [9] which passes through the Resilient Mount.

8.2.4. Reverse Cylinder Overhaul

Drawing HJ-321-07-001 refers.

The Reverse Cylinder need only be dismantled if it is suspected that a seal has failed and hydraulic oil is found leaking along the Piston Shaft Assembly from either end of the cylinder. This indicates that the Reverse Cylinder Seals are defective and must be replaced.

This operation should be carried out in a clean workshop environment where the cleanliness of components can be maintained.

Refer to the Overhaul Section of the Controls Manual supplied with this Jet Unit for further information on the Reverse Assembly.

DISMANTLING OF THE REVERSE CYLINDER

1. Remove the 4 Nuts [6] and Spring Washers [5] from the Studs [4] securing the Front Head / Back Head [3] to the Reverse Cylinder [2].

NOTE:

The 4 Studs [4] are loctited to the Mounting Plate [7] and should not be removed unless the Studs [4] or the Back Head [3] are damaged and require repair or replacing.

2. Withdraw the Mounting Plate [7] complete with the Studs [4] attached, from the Cylinder [2] and Shaft / Piston Assembly [1].
3. Ensure that the Scraper Retainer [9] is also removed.
4. Withdraw the Front Head [3] and Back Head from the Cylinder [2] and Shaft / Piston Assembly [1].

5. Remove the Shaft / Piston Assembly [1] and attached components from the Cylinder [2]. **Note, this assembly should not normally need to be dismantled.**
6. Remove the Scraper Retainer [9].
7. Remove O-Ring [10] from between the Mounting Plate [7] and the rearward Front / Back Head [3].
8. Remove O-Rings [11] from the Front and Back Heads [3].
9. Remove O-Seals [12] and [14] from the Front and Back Heads [3].
10. Remove O-Seal [13] from the Shaft / Piston Assembly [1].
11. Discard all old Seals and O-Rings.
12. Thoroughly clean all parts.
13. Check all running surfaces of cylinder, shaft, piston and Back Head / Front Head for wear or score marks. Replace if obviously worn or scored.

REASSEMBLY OF THE REVERSE CYLINDER

A Reverse Cylinder Seat Kit is available as specified on Drawing HJ-321-07-001.

1. Fit new O-Seal [13] to the Shaft / Piston Assembly [1].
2. Fit new Shaft Seals [12] and Wiper Seals [14] to the Front / Back Heads [3].

NOTE:

A. The rearward Front / Back Head has an extra Wiper Seal [14] fitted, this Seal is fitted when the Mounting Plate [7] is fitted. Ensure that these Wiper Seals are fitted with the lip facing outwards.

B. The Shaft / Piston Assembly is factory built and match drilled for the securing pin. This should be replaced as an assembly complete. If this item is to be field repaired, be sure to reassemble the Piston and Shaft the correct way round so the match-drilled holes line up.

3. Fit new O-Rings [11] to the Front and Back Heads [3].
4. Oil the Shaft / Piston Assembly [1] and insert into the Reverse Cylinder [2]
5. Oil the Front and Back Heads [3] and assemble on to the Piston Shaft, taking care not to damage the Seals [12], [13] and Wiper Seals [14].
6. Slide the Front and Back Heads into the Reverse Cylinder taking care not to damage O-Rings [11].
7. Assemble the Mounting Plate [7] with a new Wiper Seal [14], Scraper Retainer [9] and Studs long [4]. If the Studs [4] have to be replaced, use the recommended Loctite to secure the Studs to the Mounting Plate [7].
8. Fit a new O-Ring [10] to the Mounting Plate [7].
9. Grease the mating faces of the Mounting Plate and Back Head and carefully pass the long Studs [4] through the Back Head / Front Head, ensuring that the Mounting Plate [7] seats properly onto the Reverse Cylinder.
10. Take care to properly engage the O-Ring [10] in the inner face of the Mounting Plate.
11. Secure the Front Head / Back Head together to the Cylinder with Spring Washer [5] and Nuts [6] attached to Studs [4] and tighten to the recommended torque.
12. Remove the blanking caps and refit the Nipples [15] with Seal Rings [16] and Seal Nitrile [34] and tighten.
13. Ensure the Shaft / Piston Assembly slides freely inside the Reverse Cylinder and Back Head / Front Head.
14. Ensure that all fasteners are tightened to the recommended torques.
15. **On completion of the Reverse Cylinder re-assembly, it is recommended that the Reverse Cylinder is Pressure Tested to the recommended test pressure of 165 Bar (2400 psi), before installing the Reverse Cylinder into the vessel. (Operating Pressure - 110 bar (1600 psi)).**

8.3. REVERSE ASSEMBLY REFITTING AND ADJUSTING

(Drawing HJ-321-07-001 refers).

8.3.1. Refitting the Reverse Cylinder to the Jet Unit

1. Smear the Scraper Retainer [9] with grease and fit to the rear facing end of the Reverse Cylinder Piston Shaft [1] and slide it forwards until the Scraper Retainer is located inside the Mounting Plate [7] against the rear face of the outer Wiper Seal [14].
2. Fit the Resilient Mount [8] to the rear facing end of the Reverse Cylinder Piston Shaft [1] and slide it forwards until the Resilient Mount is located against the rear face of the Mounting Plate [7].
3. From inside the vessel, locate the Reverse Cylinder onto the 2 Studs [17] fitted to the starboard forward face of the Jet Intake Flange ensuring that the hydraulic connectors on the Reverse Cylinder face upwards.
4. Fit Washers [18] and Thin Nuts [19] to Studs [17].
5. Tighten Nuts [19] to compress the Resilient Mount [8] to provide an 8mm gap between the Mounting Plate [7] and the Jet Intake Flange.

NOTE:

Item 6 below can only be carried out once the Reverse Duct has been refitted to the Jet Unit.

6. ***Tighten one of the Thin Nuts [19] further to align the Reverse Cylinder Shaft with the Reverse Cylinder attachment point on the Reverse Duct.***
7. ***Once Item 6 above is completed, fit Nyloc Nuts [20] to Studs [17] and tighten against Thin Nuts [19]to lock in position.***
8. Reconnect the hydraulic hoses, ensuring that the hoses are fitted to the correct ports. **(Refer to the Overhaul Section of the Controls Manual supplied with this Jet Unit).**
9. Reconnect any linkages and sensors attached to the Reverse Cylinder **(Refer to the Overhaul Section of the Controls Manual supplied with this Jet Unit).**

8.3.2. Refitting the Reverse Duct to the Jet Unit

(Drawing HJ-321-07-001 refers).

1. Apply marine grease to the threaded portion and shank of the Pivot Pins [28] and to Washers [29].
2. Fit one Washer [29] to each of the Pivot Pins [28].
3. Using approved lifting equipment and a lifting sling attached securely around the Reverse Duct, lift the Reverse Duct into position and align the Pivot Bushes [27] in the Reverse Duct Arms with the Threaded Bushes [26] in the Tailpipe.
4. Insert the Pivot Pins [28] with Washer [29] fitted, and hand tighten the Pivot Pins into the Tailpipe.
5. Tighten both Pivot Pins to the recommended torque. **(675 Nm - 510 ft/lbs). Refer to Section 6.6. "Threaded Fasteners".**
6. Raise the Reverse Duct to align the Reverse Cylinder with the Reverse Duct attachment point. **(Refer to Item 6 in Section 8.3.1. "Refitting the Reverse Cylinder to the Jet Unit", above).**
7. Once the Reverse Cylinder is aligned, connect the Reverse Cylinder to the Reverse Duct with Connecting Pin [21]. Ensuring that the Connecting Pin Bushes [24] are securely fitted to the inside faces of the Reverse Duct Attachment Bracket.
8. Fit Flat Washer [23] to the end of Connecting Pin [21] and secure in position with Split Pin [22], ensuring that the legs of the Split Pin are splayed to retain the Connecting Pin in position.

8.4. STEERING ASSEMBLY REMOVAL AND OVERHAUL

Drawing HJ-321-06-005 refers

If the Jet Unit is fitted with a Seastar Steering Cylinder, refer to the Seastar Maintenance Manual for any maintenance required.

8.4.1. Steering Cylinder Removal

Drawing HJ-321-06-005 refers

The Steering Cylinder need only be dismantled if it is suspected that a seal has failed and hydraulic oil is found leaking along the Piston Rod Assembly from either end of the cylinder. This indicates that the Piston Rod Seals are defective and must be replaced. Refer to the Seastar Manual for information on Seal replacement.

This operation should be carried out in a clean workshop environment where the cleanliness of components can be maintained.

1. Disconnect any Sensors attached to the Tiller [17]. **Refer to the Overhaul Section of the Controls Manual.**
2. Disconnect the Steering Cylinder hose connections from the Seastar Steering Cylinder, ensuring that all connections are fitted with blanking plugs to prevent the ingress of moisture and dirt and the leaking of hydraulic oil.
3. Disconnect the Steering Cylinder Rod End from the Tiller [17].
4. Remove the Steering Cylinder from the Steering Bracket. **Refer to Drawing CT-SJK-02-001 in the Controls Manual Drawing Package and the Overhaul Section of the Controls Manual.**
5. Check all components for signs of corrosion, wear and damage and replace as required. **Refer to the Seastar Manual for information on Seal replacement.**

8.4.2. Steering Crank and Shaft Removal

Drawing HJ-321-06-005 refers.

Ensure that the Steering Tiller [17] has been disconnected from the Steering Cylinder as shown above.

INSPECTING THE STEERING SHAFT

While moving the Tiller full stroke, check the Steering Shaft and linkage for:

- Freedom of movement
- Excessive wear in the Steering Shaft Bush [18] and sideways movement of the Steering Shaft [16].
- Worn or damaged Scraper Ring [20] and Seal [19].
- Excessive wear in the ball end of the Steering Crank [10].

1. Replace Steering Bushes and Seals if damaged or worn.
2. Remove Nut [14], Spring Washer [11] and Thick Washer [12] securing the Steering Crank [10] to the Steering Shaft [16].
3. Remove Cotter [11] from the Steering Crank.
4. Push the Steering Shaft [16] forwards and slide the Steering Crank [10] off the end of the Steering Shaft [16].
5. Remove the Steering Crank from the Steering Crank Bush [5].
6. To remove the Steering Shaft from the Steering Shaft Bushes, remove the Tiller [17] from the inner end of the Steering Shaft by removing Nut [14] Spring Washer [13], Thick Washer [12] from the Cotter [12]. Remove the Cotter.
7. Remove the Tiller [17] from the Steering Shaft [16].
8. Withdraw the Steering Shaft rearwards from the Steering Shaft Bushes [15] and [18].

8.4.3. Nozzle / Nozzle Housing Removal

Drawing HJ-321-06-005 refers

NOTE:

The Nozzle / Nozzle Housing should be removed as a complete item to prevent damage to the Lip Seals [28].

1. Ensure that the Steering Crank [10] has been removed from the Steering Crank Bush [5] in the Steering Arm [4].
2. Check the Steering Crank Bush [5] for security and wear. Replace if loose or worn.
3. Rotate the Nozzle [1] through its full arc of travel to check for stiffness or wear in the Nozzle Bushes [8].
4. Withdraw the Steering Shaft [16] into the vessel until it clears the rearward Steering Shaft Bush [15].
5. Unscrew and remove the 8 Nuts [56] and Spring Washers [57] from the Studs [55] securing the Nozzle / Nozzle Housing to the Tailpipe. **(Drawing HJ-321-01-001 refers).**
6. Carefully remove the Nozzle complete with the Nozzle Housing [2] and the JT Steering Insert [3] from the Studs [55].
7. Remove O Ring [31] from the recess in the JT Steering Insert [3].
8. Place the Nozzle / Nozzle Housing face down on a workbench, carefully remove the JT Steering Insert [3] from the Nozzle Housing.
9. With the JT Steering Insert [3] removed from the Nozzle Housing, this allows access to the Capscrews [29] securing the Lip Seals [28] to the Nozzle.
10. To remove the Nozzle from the Nozzle Housing, firstly loosen **but do not remove** the Capscrews [29] securing the Lip Seals [28] in position and ensure that the Lip Seal is free to move.
11. Withdraw the Lip Seals inwards away from the inner walls of the Nozzle Housing.
12. Using a flat bladed screwdriver, flatten off the tab on Lock Washer [9] retaining Pivot Pin [6] at the top and bottom of Nozzle [1].
13. Whilst supporting the Nozzle, unscrew and remove the upper and lower Pivot Pins [6] and Lock Washers [9].
14. Hook out Thrust Washers [7] fitted between the Nozzle and the Nozzle Housing at the upper and lower Pivot Pin positions.
15. Firstly rotate the Nozzle either to the left or right the twist the Nozzle to align the upper and lower attachment Bushes [8] with the cut outs in the Nozzle Housing [2].
16. Push the top of the Nozzle forwards to release the lower Nozzle Bush from the Nozzle Housing.
17. Pull the Nozzle rearwards to remove the Nozzle from the Nozzle Housing.
18. Clean all parts thoroughly and examine for wear and damage and replace as necessary.

INSPECTING THE STEERING NOZZLE [1]

Examine the following components for wear or damage and repair or replace as necessary:-

a) **Nozzle Pivot Pin Bushes [8].** Replace if worn or damaged.
b) **Pivot Pins [6].** Replace if worn or damaged.
c) **Nozzle Crank Bush [5].** Check for wear or damage. Replace if worn.
d) **Steering Crank [10].** Check the condition of the Crank Ball, replace if excessively worn.
e) **Thrust Washers [7].** Check for wear or damage. Replace if worn.
f) **Lock Washers [9].** Discard and replace once removed. **Do not re-use.**
g) **Cotter [11].** Check the condition. Replace if damaged.
h) **JT Steering Lip Seals [28].** Check the condition and security of the Lip Seals. Replace if damaged or worn.
i) **Anodes [21].** Check the condition. Replace if more than $^{2}/_{3\ rds}$ corroded.

REPLACING THE NOZZLE PIVOT PIN BUSHES [8]

The Nozzle is fitted with two Pivot Pin Bushes [8] to locate the Steering Nozzle Pivot Pins [6].
Inspect the Pivot Pin Bushes [8] in the Nozzle. These should be replaced if any signs of wear or damage is found.

a) The Nozzle should be removed from the Nozzle Housing, and taken to a workshop facility.
b) Using a suitable Press, carefully press out the old Pivot Pin Bushes [8]. It may be necessary to apply light heat to the Nozzle in the area of the Bushes to break the Loctite Seal.
c) Ensure that the Pivot Pin Bush bores are cleaned of old loctite.
d) Apply a thin coat of Loctite 747 or Primer 'T' to the mating surfaces of the Bush and the bores of the Nozzle and allow to dry.
e) Coat the surfaces of the Bush and bores with Loctite 262.
f) Press the new Pivot Pin Bushes [8] fully home into the Nozzle, rotating the Bush twice to distribute the loctite.
g) Ensure that the Bushes are pressed in evenly and are fully home into the Nozzle.
h) Clean off any surplus Loctite from around the replacement Bushes.

REPLACING THE NOZZLE CRANK BUSH [5]

To replace the Nozzle Crank Bush [5], carry out the following operation:-

a) With the Nozzle removed from the Nozzle Housing and taken to a workshop facility.
b) Remove the Steering Arm [4] from the Nozzle [1] by removing the 2 x Nuts [26] and Spring Washers [27] from Studs [25].
c) Using a suitable Press, push the old Bush [5] out of the Steering Arm [4].
d) Clean out the bore of the Nozzle Boss.
e) Apply Loctite 262 to the bore of the Nozzle Boss and to the replacement Crank Bush [5].
f) Carefully press the Bush [5] into the Nozzle Boss ensuring that the Bush is pressed in evenly and does not protrude above the sides of the Nozzle Boss.
g) **Ensure that the Bush [5] does not protrude below the lower face of the Steering Arm [4].**
h) Clean off any surplus Loctite from around the replacement Bush.
i) Refit the Steering Arm [4] to the Nozzle [1] by refitting the 2 x Nuts [26] and Spring Washers [27] to Studs [25]. Tighten to the recommended torque.

REPLACING THE JT STEERING LIP SEALS [28]

NOTE:

To replace the JT Steering Lip Seals [28], the Steering Assembly must be removed from the Jet Unit and the Nozzle must be removed from the Nozzle Housing.

To replace the JT Steering Lip Seals [28], carry out the following actions:-

a) With the JT Steering Nozzle [1] removed complete from the Nozzle Housing [2] and placed face down on a work bench, unscrew and remove the 4 Cap Screws [29] and Spring Washers [30] securing the 2 JT Steering Lip Seals [28] to the rear face of the Nozzle.
b) Carefully remove the 2 JT Steering Lip Seals [28] and discard.
c) Replace with 2 new JT Steering Lip Seals, ensuring that the JT Steering Lip Seals [29] are fitted with the overhang of the Seal facing outwards when the Seal is fitted to the JT Steering Nozzle [1]. *(Will be facing towards the front of the Jet Unit when completely assembled to the Nozzle Housing [2]).*
d) Thoroughly clean the threads of the Cap Screws [29] and apply Loctite 262.
e) Refit the 2 new JT Steering Lip Seals [28] and loosely secure in position with Spring Washers [30] and Cap Screws [29].

NOTE:

There is some movement in the Lip Seals [29] when loosely secured with Cap Screws [29], this is to allow the Lip Seals to be adjusted to fit the inside of the Nozzle Housing [2].

REPLACING THE STEERING SHAFT BUSH [15] (Nozzle Casing)

Examine the Steering Shaft Bush [15] located on the Tailpipe. If the Steering Shaft Bush is found to be worn and requires replacement, carry out the following action:

a) Drift out the Bush [15] and clean out the Steering Shaft Bush bore.
b) Apply a thin coat of Loctite 747 or Primer "T" to the mating surfaces of the Bush [15] and bore and allow to dry.
c) Coat the primed surfaces of the Bush and bore with Loctite 262.
d) Fit the Bush into the bore and rotate twice to distribute the Loctite.
e) Wipe off any excess Loctite.

REPLACING THE STEERING SHAFT BUSH [18], SCRAPER SEAL [20] AND OIL SEAL [19] (Intake Flange)

If the Scraper Seal [20], Oil Seal [19] or the Steering Shaft Bush [18] are worn or damaged, new Seals and Bush should be fitted to the Intake Flange. To carry out this operation:-

a) Ensure that the Steering Shaft [16] has been withdrawn from the inboard Scraper Housing.
b) Remove the Scraper Seal [20] and take note of the way the Seal is fitted. **(With the Scraper Seal facing aft).**
c) Remove the Oil Seal [19] and take note of the way the Seal is fitted. **(With the Seal lip facing aft).**
d) Remove the Steering Shaft Bush [18].
e) Clean out the bore of the Steering Shaft Housing.
f) Smear a new Oil Seal [19] with grease ensuring that the inner face of the Seal is packed with grease.
g) Fit the Oil Seal [19] into the Steering Shaft Housing bore ensuring that the Seal lip faces aft.
h) Fit the Steering Shaft Housing Bush [18] and gently tap into position against the rear face of Oil Seal [19].
i) Smear a new Scraper Seal [20] with grease and fit the Scraper Seal into the bore of the Steering Shaft Housing, pushing it firmly home against the rear face of the Steering Shaft Housing Bush [18], ensuring that the Scraper Seal is fitted correctly. **(With the lip facing aft).**

NOTE:

Ensure that the lips on the Oil Seal [20] and the Scraper Seal [19] are facing aft when fitted.

REPLACING THE NOZZLE / NOZZLE HOUSING ANODES [21]

a) Remove Nuts [23] and Spring Washers [24] from Studs [22] securing the Anodes [21] to the underside of Nozzle [1] and Nozzle Housing [2].
b) Remove the Anodes [21].
c) The mating surfaces of the Anode / Nozzle - Nozzle Housing should be scraped clean to ensure a good electrical contact.
d) Fit new Anodes [21] and attach to the Studs [22] on the underside of the Nozzle / Nozzle Housing with Nuts [23] and Spring Washers [24]. Torque load to the recommended torque.

8.5. STEERING ASSEMBLY REFITTING AND ADJUSTING

Drawing HJ-321-06-005 refers.

The Steering Assembly uses a Seastar Hydraulic Cylinder to operate the Steering Tiller. Refer to the Seastar Maintenance Manual when refitting the Steering Cylinder.

Also refer to the relevant Controls Manual supplied with the Jet Unit when reassembling the Steering System.

Any worn bushes or joints in the Steering System should be replaced before re-assembly.

8.5.1. Steering Cylinder Refit to Jet Unit.

To refit the Steering Cylinder to the Steering Bracket on the Jet Unit, refer to **Drawing CT-SJK-02-001** contained in the Controls Manual Drawing Package.

STEERING BRACKET

1. If the Steering Bracket has been removed, refit the Steering Bracket to the Jet Unit. Ensuring that the Bracket is correctly orientated for the Jet steering arrangement **(Refer to the Steering Assembly Drawings in the Controls Manual).**
2. Refit the Steering Cylinder Mounting Bracket to the Jet Unit Intake and secure with Bolt [2] and Spring Washer [3] **(CT-SJK-02-001 refers).**

STEERING CYLINDER

CT-SJK-02-001 refers.

1. Refit the Steering Cylinder to the Steering Bracket and secure to Studs [5] with Spring Washer [7] and Nuts [6].
2. Torque load to the recommended torque.
3. Reconnect the Cylinder Rod End to the Tiller [16]. **(Drawing HJ-321 06-005 refers).**
4. Reconnect the Steering Cylinder Hose Connections to the Steering Cylinder. **(Refer to Drawing CT-HSE-02-001 in the Controls Manual Drawing Package for correct Hose connection layout).**
5. Re connect any Sensors that were previously attached to the Steering Tiller [17]. Refer to the Overhaul Section of the Controls Manual.

NOTE:

No adjustment for Cylinder positioning is provided for, so there may be slightly more lock deflection on one lock than on the other. This will not cause an operational problem.

8.5.2. Steering Assembly Refitting

Drawing HJ-321-06-005 refers

NOZZLE / NOZZLE HOUSING AND INSERT REFITTING

Prior to refitting the Nozzle Assembly to the Jet Unit, the assembly must be built up and the Lip Seals [28] adjusted.

1. Refit the JT Steering Nozzle [1] to the Nozzle Housing [2], ensuring that the Lip Seal attachment Screws [29] have been slackened off.
2. With the Steering Crank boss uppermost, rotate the Nozzle [1] to align the upper and lower attachment Bushes [8] with the cut outs in the Nozzle Housing [2].
3. With the nose of the Nozzle tilted slightly upwards, feed the upper nozzle mounting point into the Nozzle Housing.
4. Push down on the nose of the Nozzle ensuring that the lower nozzle mounting point passes into the Nozzle Housing.
5. Rotate the Nozzle to align the upper and lower Bushes [8] with the upper and lower attachment spigot openings in the Nozzle Housing.
6. Refit the lower curved Thrust Washer [7] and locate with the Pivot Pin [6] fitted with a new Lock Washer [9]. Screw in the Pivot Pin slightly to retain the Nozzle in position.
7. Refit the upper curved Thrust Washer [7] and locate with the Pivot Pin [6] fitted with a new Lock Washer [9].
8. Tighten both Pivot Pins [6] and torque load to 350 Nm (260 lbs/ft).
9. Bend over the locking tab on Lock Washers [9] to secure the Pivot Pins.
10. Rotate the Nozzle through its full arc of travel to ensure that there is no stiffness or binding of the Nozzle.

NOTE:

If the JT Steering Lip Seals have been removed, they should be refitted at this point. Refer Section 8.4.3. "Replacing the JT Steering Lip Seals [28]".

11. Place the Nozzle / Nozzle Housing with the Nozzle downwards on a workbench.
12. Adjust the Lip Seals [28] outwards to just contact the spherical inner surface of the Nozzle Housing [2].
13. Secure the 2 JT Steering Lip Seals in position with Screws [29] and Spring Washers [30]. Tighten to the recommended torque.
14. Smear a new O Ring [31] with grease and fit to the recess in the rear of the Steering Insert [3].
15. Refit the Steering Insert [3] into the centre of the Nozzle Housing [2]
16. Align the Steering Assembly complete with the Steering Arm [4] uppermost and refit onto Studs [55] fittedn on the rear face of the Tailpipe.
17. Secure with Spring Washers [57] and Nuts [56]. Torque load to the recommended torque. **(Drawing HJ-321-01-001 refers).**

STEERING SHAFT REFITTING

1. Lightly grease the Steering Shaft [16] and pass the Shaft forward through the rear Steering Shaft Bush [15], pushing the Steering Shaft further forward through the forward Steering Shaft Bush [18]. **Ensure that when passing the Steering Shaft through the Forward Steering Shaft Bush [18]., the Scraper Seal [20] and Oil Seal [19] are not dislodged.**
2. Ensure that the Steering Shaft is pushed forward up to the face of the Rear Steering Shaft Bush [15] to allow the Crank to be fitted to the Steering Arm [4].
3. Smear the ball of the Steering Crank [10] with grease and refit to the Steering Nozzle Housing, ensuring that the Crank is fitted as shown in the **Drawing HJ-321-06-005 for Port / Starboard or Standard Jet setup.**
4. Slide the Steering Shaft [16] rearwards and pass the Steering Shaft through the Crank [10].

NOTE:

For the correct fit of Cotters for alternative steering configurations, refer to Drawings HJ-321-06-005, included in this Manual.

5. With the cut-away in the Steering Shaft facing downwards, fit the Cotter [11] with the flat upwards, through the Crank. **Ensure the Cotter is fitted correctly. (Refer to the Drawing HJ-321-06-005 for the different Steering Options available).**
6. Fit Thick Washer [12], Spring Washer [13] and Nut [14. Tighten to the recommended torque.
7. If the Tiller [17] has been removed from the forward end of the Steering Shaft [16], refit the Tiller [17] to the Steering Shaft and secure with Cotter [11], Thick Washer [12], Spring Washer [13] and Nut [14] and tighten to the recommended torque.
8. Ensure that the Cotter is fitted correctly. **(Refer to the Steering Assembly Drawing HJ-321-06-005).**
9. Operate the Tiller to ensure that it can move the Steering Deflector smoothly with no binding.

8.5.3. Steering Linkages Adjustment

NOTE:

A. **No adjustment for Cylinder positioning is provided for, so there may be slightly more lock deflection on one lock than on the other. This will not cause an operational problem.**

B. **Should any foul of the Steering Deflector and the Tailpipe occur, check for worn Bushes in the Steering Deflector.**

C. **FOR MULTI JET APPLICATIONS ONLY. If the Steering Tie Rods have been removed or replaced, refer to *Section 2.7.* "Refitting the Steering Components", in the Installation Section of this Manual for information on installation of the Tie Rods for Multi Jet applications.**

8.6. BEARING HOUSING AREA REMOVAL AND OVERHAUL

Drawing HJ-321-01-001 refers.

This part of the Overhaul can be carried out with the vessel afloat, provided that the water level remains below the bottom of the Bearing Housing. Ballasting of the vessel may be required to achieve this.

WARNING:

EXERCISE EXTREME CARE IF THE BEARING HOUSING IS OVERHAULED WITH THE VESSEL AFLOAT, AS WATER MAY ENTER THE VESSEL THROUGH THE OPENING IN THE JET INTAKE.

8.6.1. Dismantling the Bearing Housing

INITIAL WORK

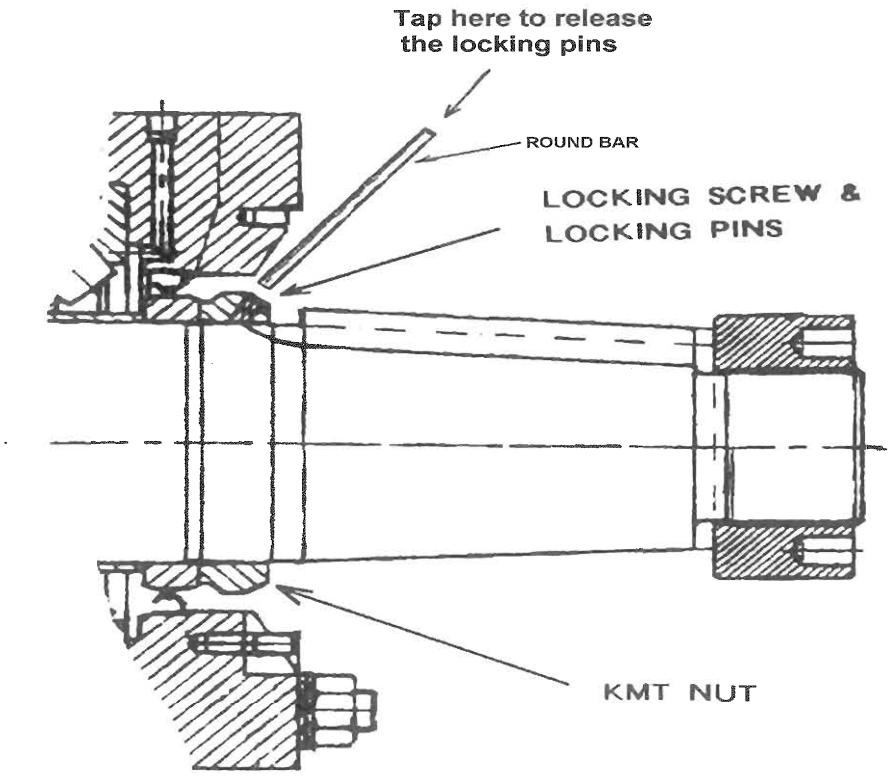
To dismantle the Bearing Housing, carry out the following operations:

1. Remove the JHPU from its mounting on the Bearing Housing. Refer to the Controls Manual supplied with this Jet Unit for information on the removal of the JHPU.
2. Disconnect the driveshaft from the Jet Unit Coupling.
3. Remove the Inspection Cover [5] and fit the Shaft Support **Tool (Item [2] on drawing HJ 321 11 001)** to the Mainshaft [9]. This is done so that the Water Seal [18] will not move against its Counterface when the Bearing [22] is removed).
4. Unscrew the Set Screw [11] from the end of the Coupling Nut [25].
5. Fit the *"Reaction Arm"* tool to the Coupling, and using the *"Coupling Nut Spanner"* tool with an extension pipe, unscrew the Coupling Nut [25] two turns only, using Special Tools M50 *"Socket Spanner"*.
6. Fit the *"Coupling Puller"* tool to the Coupling Flange and tighten the Puller bolt firmly. Strike the bolt with a heavy hammer to free the coupling off it's taper.
7. Do not remove the Coupling Puller and Reaction Arm from the Coupling, as the coupling will be temporarily refitted, then removed again.
8. Remove the Coupling Nut [25] and Coupling Flange.
9. Remove the Coupling Key [24] from the Jet Unit Mainshaft [9].
10. Unscrew the Bearing Cap Retainer Nuts (28) and Spring Washers [27] from Studs [35] and withdraw the Bearing Cap [7] with Oil Seal [19] attached.

REMOVING THE KMT BEARING RETAINING NUT [23]

1. To remove the KMT Bearing Retaining Nut, slacken the three Bearing Nut Lockscrews and tap the edges of the Nut with a soft hammer to release the locking pins.
2. Because the brass Locking Pins inside the KMT Nut are a force fit onto the Mainshaft and do not easily release from the threads of the Mainshaft, the brass Locking Pins have to be released by lightly tapping in the vicinity of the Locking Screws, with a suitable hammer.
3. In some applications, the KMT Nut is shrouded by the Bearing Housing and so access to the nut is restricted. To overcome this problem, a long bar may be used by placing the one end of the bar against the surface of the KMT Lock Nut, in the vicinity if the Locking Screw and lightly striking the opposite end of the bar with a suitable hammer until the Locking Pins are released. **(See diagram overleaf).**
4. Temporarily refit the Coupling Key [24], the Coupling [25] with the Coupling Puller and Reaction Arm attached, and the Coupling Nut, to prevent the Mainshaft from turning.
5. Unscrew the KMT Bearing Retaining Nut [23].

6. Unscrew and remove the Coupling Nut [25] and withdraw the Coupling Flange complete with the Coupling Puller and Reaction Arm attached, off the Mainshaft.
7. Remove the Coupling Key [24] from the Mainshaft [9].
8. Remove the KMT Bearing Nut [23] from the Mainshaft.
9. Withdraw the front Seal Sleeve [20], Bearing [22] and the split Bearing Carrier [21].



VIEW OF KMT NUT

NOTE:

If the Bearing [22] is difficult to remove from the Bearing Housing [6], hot water poured over the Bearing Housing will help to remove the Bearing.

10. Remove the rear Seal Sleeve [20] from the rear of the Bearing Housing.

REMOVING THE BEARING HOUSING [6]

1. Withdraw the Bearing Housing [6] complete with the rear Oil Seal [19] attached, off Studs [35], taking care not to damage the Water Seal Assembly [18].
2. Remove the Bearing Housing to Intake 'O' Ring [49] from the recess in the rear of the Bearing Housing.

NOTE:

A. The rear O Ring [49] and Oil Seal [19] will be removed with the Bearing Housing [13].

8.6.2. Checking the Bearing Housing Components for Wear

Check the following parts for wear and replace where necessary:

- **Oil Seal - Front and Aft [19].** Oil Seals should be replaced at every overhaul).
- **Oil Seal Sleeve - Front and Aft [20].** (Oil Seal Sleeves may be turned end for end instead of replacing if in reasonable condition.
- **Bearing [22].** Check that the Bearing has no signs of wear. Replace if any signs of wear are evident. The Bearing should be a sliding fit onto the Mainshaft. If the housing bore is scored or worn and the Bearing is loose, replace the Bearing Housing [6].
- **Bearing Carriers [21].** Ensure that there are no signs of wear, fretting, or relative movement. If such signs are found, then a problem exists. Contact CWF Hamilton & Co Ltd.
- **The KMT Bearing Retaining Nut.** Examine and check for damage and wear of the nut and threads, security of the locking screws and pins.
- **O-Ring. [49].** Check for cuts, deformation cracking or perishing.
- **Bearing Housing [6].** Check the bore of the Bearing Housing [6] where the Bearing Carriers [21] locate for signs of wear fretting or relative movement.

Thoroughly clean all parts prior to re-assembly.

8.6.3. Water Seal Removal

Refer to Diagram overleaf.

WARNING:

EXERCISE EXTREME CARE IF WATER SEAL REPLACEMENT IS TO BE CARRIED OUT IN THE VESSEL AS WATER MAY ENTER THE VESSEL THROUGH THE INTAKE OPENING. NEVER LEAVE THE INSPECTION COVER REMOVED.

The Water Seal Assembly should not be removed unless it is to be replaced. The Water Seal will not perform correctly if it is removed and then reinstalled. The Water Seal must be replaced if:

- **It has worn and will not reach the next overhaul without failure.**
- **There has been signs of water leaking from underneath the Bearing Housing.**

Refer to the *Servicing* Section of this Manual for details of the inspection required.

NOTE:

The stationary face of the Water Seal [18] is pressed into the aft face of the Bearing Housing. Take care during removal. Once, the Water Seal is removed, separate the component parts so that they can be inspected.

1. With the Bearing Housing removed from the Jet Unit, remove the Rotary Face Seal Ring [3] and Spring [C] complete with O Ring [P] and Washer [SR], by sliding these components forward off the Mainshaft.
2. Remove by loosening the 5 M6 Set Screws [S] securing the spring retaining Drive Collar [5] in position.
3. Release the Circlip [H] and slide the Circlip off the Mainshaft.
4. Remove the Drive Collar [5] from the Mainshaft.

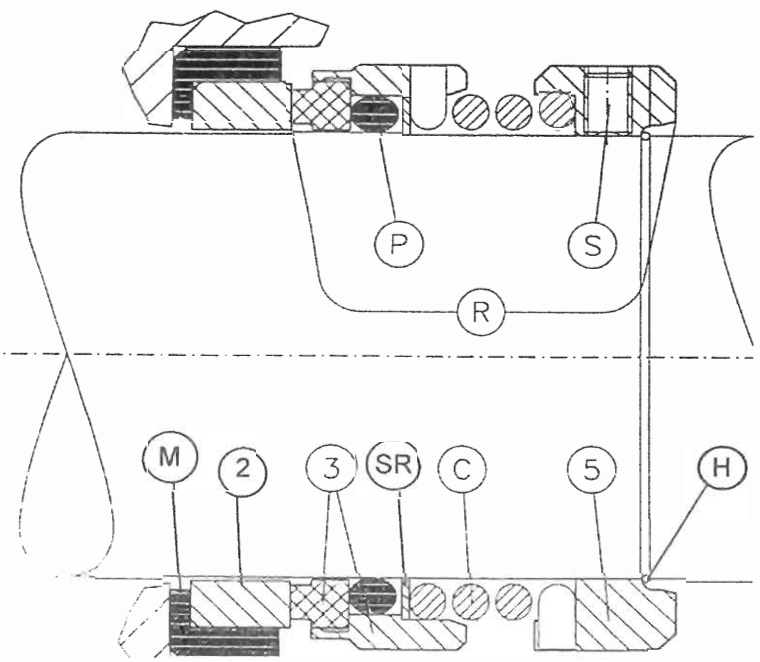
8.6.4. Checking the Water Seal Components for Wear

Refer to Diagram overleaf.

Check the following parts for wear and fit replacement parts where necessary:

- **Water Seal and Counterface Assembly [18].** Check to see if mating faces are scored or chipped. The Water Seal stationary face can be checked without removing it from the Bearing housing. Always replace both Water Seal [3] and Counterface [2] even if one or the other appears unworn.
- **O-Ring [P].** Check for cuts or deformation. Replace if any such defects are found.
- **Spring [C].** Check for broken spring or spring binding, wear of the spring coils. Replace if damaged or worn.
- **Nitrile Boot [M].** Check for cuts, wear or damage. Replace.
- **Circlip [H].** Ensure that the Circlip will still retain the Water Seal effectively and securely on the Mainshaft.
- **Set Screws [S].** Ensure that the set screws are still all present and that the threads are not damaged.

Thoroughly clean all parts.



HJ-321 WATER SEAL

HJ-321 WATER SEAL COMPONENTS		
Item	Qty	Description
H	1	Hamilton Circlip
P	1	"O"-Ring Nitrile
M	1	Boot Nitrile
S	5	Set Screw
C	1	Spring
SR	1	Washer
2	1	Insert
3	1	Seal Ring
5	1	Drive Collar

8.6.5. Re-Assembly of the Water Seal

WARNING:

EXERCISE EXTREME CARE IF WATER SEAL REPLACEMENT IS TO BE CARRIED OUT IN THE VESSEL AS WATER MAY ENTER THE VESSEL THROUGH THE INTAKE OPENING. NEVER LEAVE THE INSPECTION COVER REMOVED.

CAUTION:

The Water Seal face must remain free of dirt, oil and grease.

1. To allow the Water Seal [18] to slide on the Mainshaft, lubricate the seal area of the Mainshaft with a 20:1 water and household detergent mix.
2. Ensure that there are no sharp edges or burrs on the Mainshaft, as these could damage the Water Seal O-Ring [P] and Nitrile Boot [M].
3. Refit the Circlip [H], and the Water Seal Drive Collar [5] onto the Mainshaft.
4. Fit the Rotary Seal Fitting Sleeve (Item [12] on drawing HJ 321-11-001) onto the Mainshaft and run the sleeve up to the shoulder on the Mainshaft.
5. The Fitting Sleeve allows the Water Seal to pass over the shoulder on the Mainshaft without causing damage to the Water Seal.
6. Reassemble the Waterseal components in the correct fitting order prior to fitting them onto the Main Shaft. These are to be assembled in the following order:
   - **Spring [C].**
   - **Washer [SR].**
   - **O-Ring [P].**
   - **Seal-Ring [3] fitted with the Carbon Face attached.**
7. Carefully slide the Water Seal components onto the Mainshaft, passing over the Guide Ring, and butting up against the Drive Collar [5].
8. Wipe away all traces of the water and detergent mixture from the Mainshaft and Water Seal. This prevents corrosion of the Mainshaft if the Jet is put in storage. Do not allow grease or oil near the Water Seal face. Guide Ring
9. Tighten the 5 x M6 Set Screws [S} in the Drive Collar [5].
10. Remove the Guide Ring from the Mainshaft.

8.7. BEARING HOUSING RE-ASSEMBLY

1. If a new Water Seal [18] has been fitted to the Mainshaft, a new Insert [2] and Nitrile Boot [M] are to be pressed into the rear of the Bearing Housing [6].
2. Smear the inner Oil Seal [19] with marine grease and press into the Bearing Housing [6], ensure that the lip of the Seal faces forward towards the Coupling Flange.
3. Smear the outer Oil Seal [19] with marine grease and press into the Bearing Cap [7], ensure that the lip of the Seal faces forward towards the Coupling Flange. **Refer to Drawing HJ-321-01-001. (With the lip facing forwards).**
4. Assemble the following components into the Bearing Housing [6] prior to refitting the Bearing Housing onto the Jet Unit:
   - **Bearing [22].**
   - **Bearing Carriers [21].**
   - **Inner Seal Sleeve [20].**

5. Grease the inner Seal Sleeve [20] and push fully rearwards onto the Mainshaft until the Seal Sleeve reaches the step on the Mainshaft.
6. Pack the Bearing [22] and Bearing Carrier [21] with grease, ensuring that the correct type of grease is used. **Refer to Drawing 85018 contained in the Jet Drawings Package.**

NOTE:

It may help to warm the Bearing Housing in hot water before fitting the Bearing into the Bearing Housing.

7. Fit the Bearing [22] and Bearing Carrier [21] into the Bearing Housing, ensuring that the Bearing is pushed fully home against the shoulder in the Bearing Housing.
8. Smear a new O-Ring [49] and Intake contact faces with grease and fit O Ring to the Bearing Housing rear face.
9. Fit the Bearing Housing, complete with the Bearing and Bearing Carrier fitted, over the Mainshaft and onto the 3 Studs [35] on the forward face of the Intake.
10. If the Seal Sleeves have not been changed, ensure that the lip of Seal [19] locates on an unworn part of the Seal Sleeve [20].

NOTE:

Care must be taken to prevent the Seal Sleeve [20] from being knocked away from the Seal [19] during fitting of the Bearing Housing.

11. Grease the outer Seal Sleeve [20] and push fully rearwards on the Mainshaft until the Seal Sleeve is in contact with the forward face of the outer Bearing Carrier [21].
12. If the Seal Sleeves have not been changed, ensure that the lip of Seal [19] locates on an unworn part of the Seal Sleeve [20].
13. Prior to fitting the KMT Bearing Locknut, ensure that the Locking Screws in the Locknut are partially withdrawn and that the Locking Pins are not protruding into the thread path of the KMT Locknut.
14. Lubricate the KMT Bearing Lock Nut [23] and assemble onto the Mainshaft **hand tight only.**
15. Temporarily refit the Coupling Key [24] and the Coupling, to the Mainshaft.
16. Fit the Reaction Arm to the Coupling.
17. Lightly tighten the Coupling Nut [25] so as to snugly locate Coupling on Mainshaft taper.
18. Tighten the KMT Bearing Lock Nut [23] to the recommended torque. (Use Spanner - SKF Locknut with a tube extension to gain sufficient leverage. Item [3] on drawing HJ 321-11-001).
19. Restrain rotation of the Mainshaft by using the Reaction Arm which is attached to the Coupling.
20. Lightly tighten the 3 KMT Bearing Locknut Set Screws until the locking pins engage in the Mainshaft threads.
21. Continue tightening the Locknut Set Screws, alternating around until all 3 Locknut Set Screws are tightened to the recommended torque. **(Refer to Section 6.6. "Recommended Fasteners" or Drawing HJ-321-01-001 for the correct torque).**

22. Remove the Coupling from the Mainshaft.
23. Ensure that the outer Oil Seal [19] has been fitted to the Bearing Cap [7], ensure that the lip of the Seal faces forward towards the Coupling Flange. **Refer to Drawing HJ-321-01-001. (With the lip facing forwards).**
24. Apply grease to the contact faces between Bearing Housing [6] and Bearing Cap [7], to the Seal [19] lips, to the Studs [35] and Nuts [28].
25. Fit Bearing Cap into position on the Studs [35] on the Bearing Housing.
26. Fit Nuts [28] and Spring Washers [27] to the Studs [35] and tighten to the recommended torque.
27. Once the Bearing Housing is fitted, whilst slowly rotating the Mainshaft, lightly grease the Main Bearing via the Nipple [63] located on the top of the Bearing Housing. Do not over grease the Bearing [22] as this can cause overheating. Ensure that the correct grease is used, **refer to Drawing 85018 in the Jet Drawings Package**.
28. Turn the Mainshaft by hand, to ensure it is free to move before reattaching the Coupling.
29. Lightly grease the Coupling taper, keyway and thread on the Mainshaft [9] along with the bore of the Coupling and the thread and face of the Coupling Nut [25] with marine grease.
30. Fit the Coupling Key [24] and Coupling to the Mainshaft.
31. Fit the Coupling Nut (25) to the Mainshaft, ensuring that the Set Screw [11] has been backed off.
32. Tighten the Coupling Nut to the recommended torque.
33. Remove the Set Screw [11] from the Coupling Nut and apply Loctite 222 to the Set Screw [11]. Refit to the Coupling Nut and tighten to secure the Coupling Nut to the Mainshaft.
34. **Re-attach the driveshaft to the Jet Unit Coupling.**

8.8. OVERHAUL OF THE TAILPIPE AREA

Drawing HJ-321-01-001 refers.

NOTE:

The Maintenance operations detailed in this Section should be carried out when the Vessel is in dry dock.

If The Reverse Duct has not already been removed, it must be removed before proceeding. **Refer to *Section. 8.2.1. "Reverse Duct Removal".***

If the Steering Linkages have not already been disconnected, they must be disconnected before proceeding. **Refer to *Section. 8.5.2. "Design Basics".***

8.8.1.Impeller: Checking for Wear

The Impeller wear should have been checked prior to commencing overhaul. If an examination of the Impeller has not been carried out, carry out the checks as described in *Section. 6.4.* "Jet Unit Servicing Details". *Para 13-a) and 13-b).*

Before dismantling the Tailpipe end of the Jet Unit, remove the Inspection Cover [5] (Or the Intake Screen [8] if in dry dock) and carry out the following checks:

a) **Impeller Tip Wear Check:**
Using feeler gauges, check clearance between the tips of the Impeller Blades and Wear Ring at each side of the Jet Unit (i.e. NOT top and bottom). **Maximum recommended worn clearance is 1.6mm per side. (Maximum new clearance is 1.0mm per side).**

b) **Marine Bearing Wear Check:**
Push the Mainshaft [9] hard from side to side. Check total sideways movement at the Impeller blade tips. Maximum recommended worn total movement is 0.6mm (.024 ins). This indicates the amount of wear in the Marine Water Bearing [13] and Water Bearing Sleeve [12].

8.8.2. Tailpipe Area Dismantling

Drawings HJ-321-01-001 and HJ-321-06-005 refer.

Ensure that the Reverse Duct Assembly has been removed. If it has not already been removed. Refer to Section 8.2.1. "Reverse Duct Removal".

Ensure that the Steering Assembly has been removed. If it has not already been removed. Refer to Section 8.4. "Steering Assembly Removal and Overhaul".

The Nozzle and Tailpipe may be removed as a complete assembly, or may be removed separately as follows:-

NOZZLE REMOVAL

1. Remove the 8 Nuts [56] and Spring Washers [57] from Studs [58] securing the Nozzle to the Tailpipe [3].
2. Hit the Nozzle sideways with a rubber or wooden mallet to free the joint.
3. Withdraw the Nozzle from the Tailpipe [3].

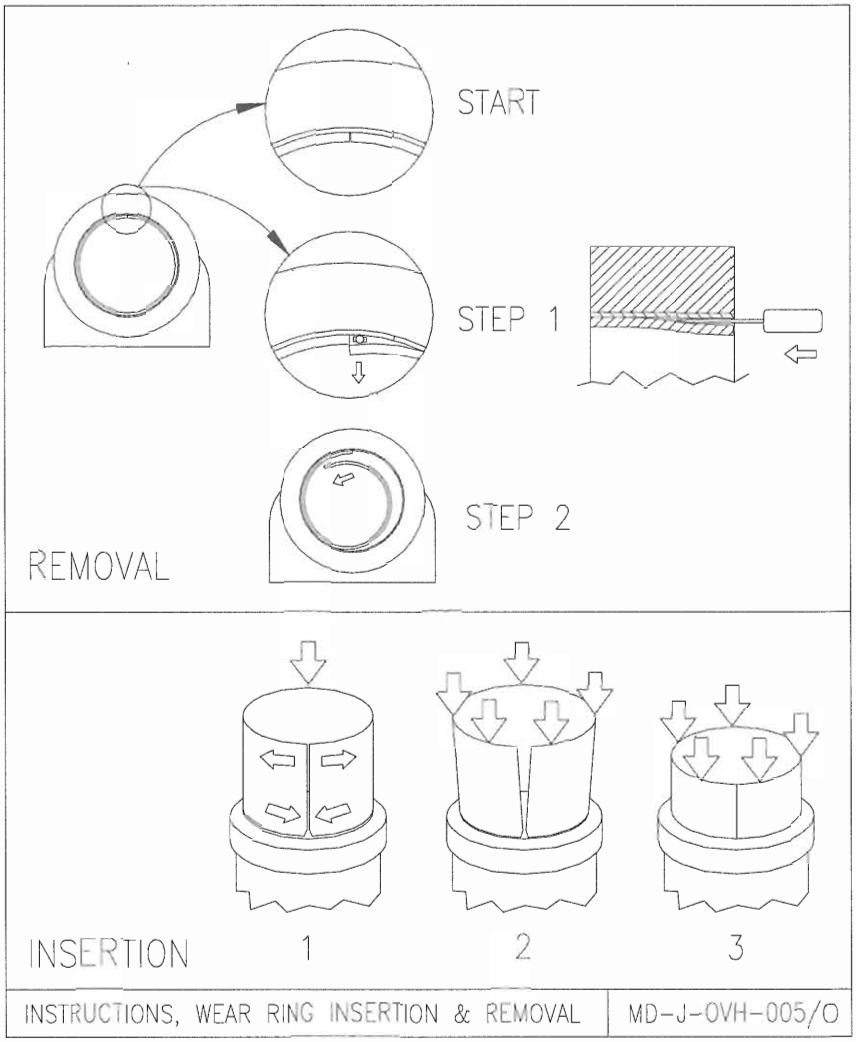
TAILPIPE REMOVAL

1. Remove the Inspection Cover [5] and fit the Shaft Support Tool to the Mainshaft so that the Water Seal [18] does not move against its Counterface when the Tailpipe assembly and Impeller are removed.
2. Remove the 8 Nuts [28] and Spring Washers [27] from Studs [29] securing the Tailpipe to the Impeller Race [2].
3. Hit the Tailpipe sideways with a rubber or wooden mallet to free the joint.
4. Withdraw the Tailpipe from the Impeller Race [2], taking care not to damage the O-Ring [37] fitted between the Tailpipe / Impeller interface.

IMPELLER REMOVAL

1. Adjust the Shaft Support Tool so that the Impeller is not resting on the Wear Ring.
2. Remove the Set Screw [11] from the Impeller Nut [10].
3. Fit the Reaction Arm Tool to the Coupling so that the Coupling cannot rotate. Unscrew the Impeller Nut [10] using a socket spanner.
4. Leave the Reaction Arm tool fitted to the Coupling, as it will be used for re-assembly of the Impeller..
5. Withdraw the Shaft Sleeve [12] off the Mainshaft.
6. Screw the Impeller Puller tool onto the Impeller Hub and tighten the Puller bolt firmly.
7. Free the Impeller from the Mainshaft by applying a sharp blow with a hammer to the Puller bolt.
8. Withdraw the Impeller and Impeller Puller off the Mainshaft.
9. Remove Impeller Key [15] ensuring that the Locating Dowel [16] remains in place in the Impeller Key [15].
10. Examine the Wear Ring [38] and the Wear Ring Insulator [39]. In the unlikely event of these being very badly scored, or swollen inwards, they should be replaced. If possible, request your local agent to carry out the replacement.

8.8.3. Wear Ring and Insulator Strip Removal and Replacement



REMOVING THE OLD WEAR RING AND INSULATOR:

Drawing HJ-321-01-001 refers.

Step 1:

1. Find the joint in the Wear Ring [38] and force a long thin screw driver between the Wear Ring [38] and the Wear Ring Insulator [39], adjacent to the Wear Ring joint, until the end of the Wear Ring is free **(See Step 1 in Diagram MD-J-OVH-005/0).**

Step 2:

2. Pull the free end of the Wear Ring inwards and remove it from the Intake **(See Step 2 in Diagram MD-J-OVH-005/0).**
3. Remove the Wear Ring Insulator [39] and thoroughly clean and degrease the Intake Bore.

FITTING A NEW INSULATOR:

1. Paint the recess in the Intake Bore with a thin layer of two pot zinc chromate etch primer and allow to dry. **(Alternatively Zinc Phosphate may be used).**
2. Apply a coat of zinc chromate primer and allow to dry.
3. Paint a second coat of zinc chromate primer.
4. While the zinc chromate primer is still wet, fit in a new Insulator [39] to the Intake, ensuring the Insulator is in contact with the primer over the whole surface.

FITTING A NEW WEAR RING:

NOTE:

Because of variations in paint and grease thickness the Wear Ring may not fit without some "dress" filing of the mating ends to reduce the circumference slightly. DO NOT REMOVE TOO MUCH METAL - the Wear Ring must be a tight fit in the Insulator to remain in the correct position.

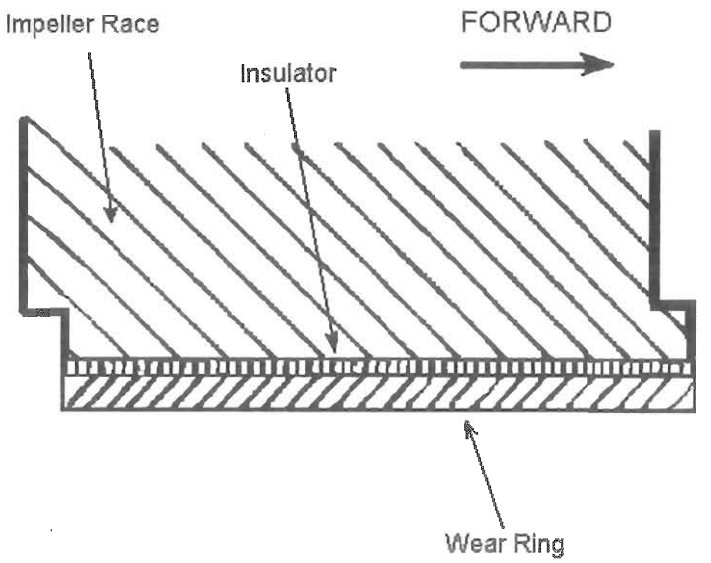
1. Smear the whole Insulator surface with a thin layer of grease or oil.

Step 1:

2. Take a new Wear Ring [38] and with the chamfer end leading, butt the strip at the chamfers by twisting slightly, (this reduces the lead in diameter) and gradually feed it inside the Insulator [39] already fitted in the Intake, until it butts fully.
3. Slide the Wear Ring in evenly as far as possible by hand.

Step 2:

4. Place a heavy steel plate against the edge of the Wear Ring (The plate is used to prevent damage to the end of the Wear Ring and should cover whole diameter of Wear Ring).
5. Drive the Wear Ring evenly into the Intake recess by hitting the plate with a large hammer.
6. Continue pushing the Wear Ring into the Intake until the Wear Ring sits flush with the end of the recess in the Intake. **(Refer to Diagram Wear Ring Position).**
7. The Wear Ring must not touch any part of the Jet Unit except the Insulator.
8. The Wear Ring is correctly fitted when it sits flush with the inner end of the Intake Flange.



HJ-321 JET - WEAR RING FITTING POSITION

NOTE:

The Wear Ring is in the correct position when it sits flush with the forward and rearward face of the Intake. This gap must be maintained to prevent electrical contact between the Wear Ring and the Tailpipe / Intake of the Jet Unit.

On completion of the fitting of the Wear Ring. Electrical insulation between the Wear Ring and the Intake Casting should be checked, using a multimeter. The resistance reading should be over 1000 ohms.

8.8.4. Impeller Overhaul

Drawing HJ-321-03-001 refers.

IMPELLER SPECIFICATIONS:

Outside Diameter (OD): 319.2 to 319.0 mm.
Balance to within 100 gm/cm (0.72 oz/ins).

WELDING

CAUTION:

Avoid using excessive heat during welding.

Impellers are stainless steel type CG8M conforming to ASTM A 743 or 316 to BS 3100. Filler metal should have chemical analysis similar to AISI 316L (Carbon content less than 3%) Post weld heat treatment is not required.

CORROSION OR EROSION DAMAGE

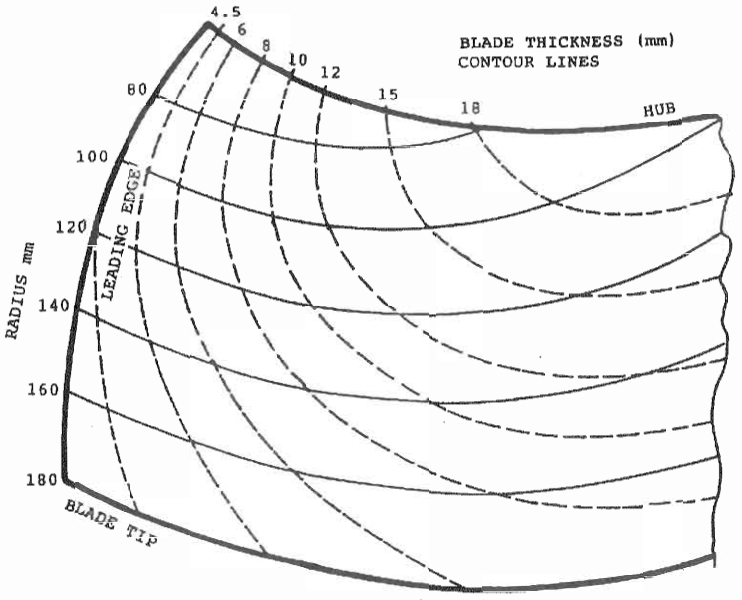
Inspect all surfaces of the Impeller for any sign of corrosion or erosion damage. Damaged areas should be weld repaired and dressed back to a smooth surface.

BENT BLADES

The outer corners of a blade may be bent if the Impeller has been dropped or mishandled. Bent or dented blades may be straightened using a large adjustable spanner or other suitable tools. Bring the blade back to it's original smooth profile checking against undamaged blades.

LEADING & TRAILING EDGE DAMAGE

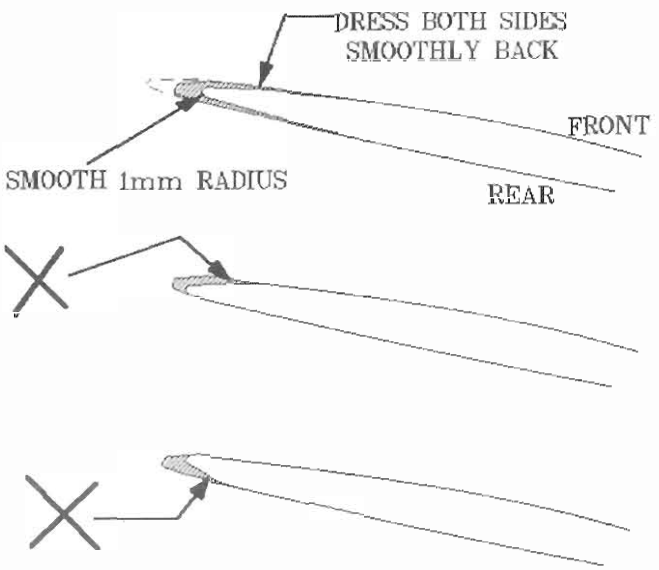
Check the Impeller leading and trailing edges for damage. Excessively worn or blunt leading edges may be built up by welding. Sharpen the edges as shown on the drawing. Blunt impellers cause loss of performance and sometimes cavitation.



BLADE SHARPENING PROCEDURE

The drawing shows the main points involved in blade sharpening. Use the following notes as well:

a) Dress the edge back to a smooth curve removing the minimum amount of metal.
b) Dress both faces of the blade taking slightly more metal off the rear side until the leading edge is 2mm thick all along.
c) Blend well back into the original blade surface.
d) Both front and rear surfaces are to be a smooth uniform curve with no sudden bumps or change in direction.
e) Grind or file a smooth 1mm radius along the leading edge.



IMPELLER OD MODIFICATIONS

1. If the Impeller OS is excessively worn it may be built up by welding. After welding turn on a mandrel to the correct OD. Use light cuts to avoid blade distortion. Dress the faces back flush with the original surfaces.
2. **Balance the Impeller:** With its key fitted, statically, on a suitable mandrel set on horizontal knife edges or bars to within 100 gm cm. Balance weights of 316 SS may be welded to the inside of the hub and grinding material off the weights is permitted as long as these weights are over 20mm inside the hub rim to miss the Anode Plate [46].
3. **Heat Treating if Welded:** Passivate the impeller in a hot 30% Nitric Acid solution for at least 2 hours.

INSPECTION

1. Inspect all surfaces of the Impeller for any sign of corrosion or erosion damage. Damaged areas should be weld repaired and dressed back to a smooth surface again. Impellers are stainless steel type CF8M conforming to ASTM A 743 or 316 C16 to BS 3100. Filler metal should have chemical analysis similar to AISI 316L [Carbon content less than 3%] Post weld heat treatment is not required.

2. Check the Impeller leading and trailing edges for damage. In particular the outer corners of a blade may be bent if the Impeller is dropped or mishandled. Bent or dented blades may be straightened using a large adjustable spanner or other suitable tool. Bring the blade back to its original smooth profile checking against other undamaged blades. Excessively worn or blunt leading edges may be built up by welding. Otherwise sharpen as instructed. Blunt Impellers cause loss of performance and sometimes cavitation.

8.8.5. Overhaul of the Tailpipe

Drawing HJ-321-01-001 refers.

TAILPIPE

1. Ensure that the Nozzle has been removed from the Tailpipe. **Refer to Section 8.8.2. "Tailpipe Area Dismantling".**
2. Check the fit of the Water Bearing Sleeve [12] in the Marine Bearing [13]. A diametrical clearance of 0.11 to 0.26 mm is normal. **The Maximum allowable worn clearance is 0.6 mm.**
3. Replace the Marine Bearing if the diametrical clearance exceeds this maximum.
4. If the Water Bearing Sleeve is badly scored or worn then it must be replaced.
5. If the Impeller has just been overhauled and the Wear Ring [38] has been replaced, both the Water Bearing Sleeve [12] and the Marine Bearing [13] must be replaced irrespective of whether they are worn.
6. To remove the Marine Bearing [13], press both the Bearing and the Tailpipe Fairing [14] aft together.

CAUTION:

If the Bearing is excessively tight to remove, place an insert aft of the Bearing to press the Tailpipe Fairing out rearwards. Then turn the Tailpipe over and support it at the Bearing Hub, pressing the Marine Bearing forward to avoid damaging or distorting the Stator Blades.

7. Clean out the bore and repaint with two part etch primer.
8. Grease the Tailpipe bore before pressing in the new Marine Water Bearing [13] ensuring that grease is kept away from the rubber bearing surfaces.
9. Place a wooden block under the nose of the Tailpipe Fairing when pressing in the new bearing, to take the load.
10. Thoroughly clean all grease from the Tailpipe bore and refit the Tailpipe Fairing [14] using Loctite 680 or equivalent.
11. **Do NOT paint the mating surfaces,** but ensure that the Loctite is spread evenly over the whole of the mating surfaces to keep water out.

INTERNAL TAILPIPE ANODES [40]

Drawing HJ-321-01-001 refers.

1. Check the condition of the 2 Internal Tailpipe Anodes [40] attached to the Anode Mounting Plate [46] which is fitted to the forward face of the Tailpipe, **(Drawing HJ-321-01-001 sheet 1 of 2 refers).**
2. If the Anodes are still in good condition, ensure that they are not painted over.
3. Scrub the Anodes with a wire brush if corrosion has built up on the Anodes.
4. Should these be less than $^{2}/_{3}$rds their original size, they should be replaced.
5. To replace the 2 Internal Tailpipe Anodes [40], carry out the following operation:-
   a) With the Tailpipe removed from the Intake, remove Nuts [42] and Spring Washers [43] from Studs [41] attaching the Anode Mounting Plate [46] to the Tailpipe.
   b) Remove the Anode Mounting Plate from the Tailpipe.
   c) Remove the 4 x Bolts [45], Nuts [42] and Spring Washers [43] attaching each Anode [40] to the Anode Mount Plate.
   d) Remove the 2 Internal Tailpipe Anodes [40].
   e) Ensure that the mating surfaces between the Anode and the Anode Mounting Plate are scraped clean for a good electrical contact.
   f) Fit new Internal Tailpipe Anodes [40] to the Anode Mounting Plate [46] and secure with Bolts [45], Spring Washer [43] and Nuts [42]. Torque load to the recommended torque.
   g) Refit the Anode Mounting Plate [46] to the Tailpipe and attach to Studs [41] with Nuts [42] and Spring Washers [43]. Torque load to the recommended torque.

EXTERNAL TAILPIPE ANODES [44]

Drawing HJ-321-01-001 refers.

1. Check the 3 external Tailpipe Anodes [44] attached to the outside of the Tailpipe, if these are less than half of their original size, they should be replaced.
2. If the Anode is still in good condition, ensure that it has not been painted over.
3. Scrub down with a wire brush if a coating of corrosion has built up on the Anode.
4. To replace the External Tailpipe Anodes fitted to the rear face and underside of the Nozzle, carry out the following operation:-
   a) Remove the Nut [42] and Spring Washer [43] from Stud [26].
   b) Remove the External Anode [44].
   c) Ensure that the mating surfaces are scraped clean for a good electrical contact.
   d) Fit a new External Anode [44].
   e) Attach with Nut [42] and Spring Washers [43]. Torque load to the recommended torque.
   f) Repeat the above actions for the other two external Anodes attached to the Tailpipe.

8.8.6. Reassembly of the Tailpipe and Nozzle

Drawing HJ-321-01-001 refers.

Ensure that all parts are cleaned thoroughly prior to re-assembly.

The following steps only apply if the Impeller Race [2] has been removed.

IMPELLER RE-ASSEMBLY

1. With the Mainshaft Support Tool supporting the Mainshaft through the Intake Inspection Cover.
2. Apply grease to the Impeller Race [2] and Intake [1] mating faces.
3. Apply grease to 'O' Ring [37] and fit onto Impeller Race spigot.
4. Slide the Impeller Race onto the Intake Studs [30].
5. Apply grease to the Studs [30] and to Nuts [28].
6. Attach the Nuts [28] and Spring Washers [27] to Studs [30] and tighten to the recommended torque.
7. Smear a light coating of grease over Mainshaft from 25 mm ahead of the Impeller taper, back to and including the Impeller Nut thread [10].
8. Insert the Impeller Key [15] and locate with the Locating Dowel [16].
9. If a new Impeller is being fitted, the Impeller taper must be lapped to the Mainshaft in accordance with British Standard MA 74.
10. Slide the Impeller fully home onto the Mainshaft, ensuring that the Impeller locates onto the Impeller Key.
11. Fit the Water Bearing Sleeve [12] onto the Mainshaft and push fully home against the Impeller.
12. Fit the Reaction Arm tool to the Coupling to prevent the Mainshaft from rotating.
13. Fit the Impeller Nut [10] to the Mainshaft and tighten to the recommended torque.
14. Fit Set Screw [11] to the Impeller Nut with Loctite 222 (or equivalent) thread locking fluid and tighten.
15. Remove the Mainshaft Support Tool from the Intake Inspection Cover.
16. Working through the Intake Inspection Cover, remove any surplus grease from in front of the Impeller.
17. Smear a new O-Ring [34] with marine grease and fit to the Main Inspection Cover [5].
18. Fit to the Main Inspection Cover [5] to the Studs [31] fitted on the top of the Intake and secure the Main Inspection Cover with Spring Washers [33] and Nuts [32].

TAILPIPE REFITTING

1. Wipe the Water Bearing Sleeve [12] clean to ensure the Marine Bearing [13] remains free of grease.
2. Dust the Marine Bearing with talcum powder or french chalk.
3. Clean and grease the mating faces of the Tailpipe and Impeller Race with marine grease.
4. Fit a new O-Ring [37] to the Tailpipe spigot.
5. Apply marine grease to Nuts [28], Spring Washers [27] and Studs [29] located on the rear face of the Impeller Race.
6. Fit the Tailpipe [3] to the Studs [29] and secure with Spring Washers [27] and Nuts [28]. Tighten to the recommended torque.
7. If the Tailpipe Fairing [14] has been removed, refit using
8. Loctite 680.
9. Turn the Mainshaft to ensure that the assembly rotates freely. This can be done by using the Reaction Arm tool, fitted to the Coupling.

NOZZLE RE-ASSEMBLY

1. Clean and grease the mating faces of the Nozzle and Tailpipe interface with marine grease.
2. Apply marine grease to Studs [55], located on the rear face of the Tailpipe.
3. Apply marine grease to Nuts [56], Spring Washers [57].
4. Refit the Nozzle Housing onto Studs [55] and secure with Spring Washers [57] and Nuts [56]. Torque load to the recommended torque.
5. Refit the Steering Equipment in accordance with **Section 8.5. "STEERING ASSEMBLY REFITTING AND ADJUSTING".**

8.9. TRANSOM SEAL ASSEMBLY OVERHAUL

Drawing HJ-321-08-001 / 002 / 003 refers.

Should it be necessary to remove the Transom Seal Assembly for repair or replacement of the following components, carry out the following operation. To replace the Transom Seal, the Reverse Duct, Reverse Cylinder and Steering Shaft must be removed to allow access.

8.9.1. Transom Plate Removal

NOTE:

The Transom Plate should not be removed unless it or the Transom Seal is suspected of leaking or unless the Transom Plate is corroded or damaged.

GRP AND ALUMINIUM HULLS: (Drawings HJ-321-08-001 / 002 refer).

To remove the Transom Plate and replace the Transom Seal, carry out the following operation:

1. Remove the Reverse Duct as shown in **Section. 8.2.1. "Reverse Duct Removal".**
2. Slacken and remove the Transom Plate attachment Nuts [4] and Spring Washers [5] from Screws [12].
3. The Transom Plate can now be removed from the Jet Unit.

NOTE:

The Transom Plate is secured to the Transom using RTV Silicone Sealant [10]. Some effort may be required to separate the Transom Plate from the Transom.

4. Clean off all the old RTV Sealant from the Transom Plate and the Transom and examine for damage and corrosion. Replace or repair as required.
5. Clean and examine the Transom Seal [11] for damage cuts or perishing. Replace as required.

STEEL HULLS: (Drawing HJ-321-08-003 refers).

To remove the Transom Plate and replace the Transom Seal, carry out the following operation:

1. Remove the Reverse Duct as shown in **Section. 8.2.1. "Reverse Duct Removal".**
2. Slacken and remove the Transom Plate attachment Nuts [7], Spring Washers [8], Flat Washers [15] from Screws [14]. Take care to remove the Flat Washer [15] fitted under the head of Screw [14].
3. Remove the 24 Nylon Flanged insulating Bushes [3] from the screw holes in the Transom Plate.
4. The Transom Plate can now be removed from the Jet Unit.

NOTE:

The Transom Plate is secured to the Transom using RTV Silicone Sealant [24]. Some effort may be required to separate the Transom Plate from the Transom.

5. Remove the Transom Plate Gasket [2] from around the circumference of the Transom Plate.
6. Clean off all the old RTV Sealant from the Transom Plate and the Transom and examine for damage and corrosion. Replace or repair as required.
7. Clean and examine the Transom Seal [4] for damage cuts or perishing. Replace as required.

8.9.2. Transom Plate Re-Fitting

GRP AND ALUMINIUM HULLS: (Drawings HJ-321-08-001 / 002 refer).

1. Liberally grease the Transom Seal [11] and the flange in the Jet Unit Intake.
2. Refit the Transom Seal [11] to the flange in the Jet Unit Intake.
3. Smear the Transom Plate interface around the Transom to Transom Plate attachment holes with RTV Silicone Sealant [10].
4. From the Tailpipe end of the Jet Unit, slide the Transom Plate up the Jet Unit to the Transom.
5. Ensure that the holes in the Transom Plate and the Transom are liberally coated with RTV Silicone Sealant [10] before fitting the attachment Screws [12].
6. Ensure that the Transom Plate is correctly located over the Intake and Transom Seal [11].
7. Align the Transom Plate with the Transom and secure with Screws [12]. **(These are to be fitted with the Screw Head outside the vessel).**
8. From inside the vessel, fit Flat Washers [13] and Spring Washers [5] to the Screws [12] and secure with Nuts [4].
9. Tighten to the recommended torque.
10. Wipe off any excess sealant.
11. Refit the Reverse Cylinder as shown in **Section 8.3.1. "Refitting the Reverse Cylinder to the Jet Unit".**
12. Refit the Reverse Duct as shown in **Section 8.3.2. "Refitting the Reverse Duct to the Jet Unit".**

STEEL HULLS: (Drawing HJ-321-08-003 refers).

1. Liberally grease the Transom Seal [4] and the flange in the Jet Unit Intake with marine grease.
2. Refit the Transom Seal [4] to the flange in the Jet Unit Intake.
3. Smear the Transom Plate interface around the Transom to Transom Plate attachment holes with RTV Silicone Sealant [13].
4. Smear the Insulating Bushes with RTV Silicone Sealant [13].
5. From outside the vessel, fit the insulating Bushes [3] to the 24 attachment holes in the Transom Plate so that the shoulder of the Insulating Bush is on the outside of the Transom Plate.
6. From the Tailpipe end of the Jet Unit, slide the Transom Plate up the Jet Unit to the Transom.
7. Ensure that the holes in the Transom Plate and the Transom are liberally coated with RTV Sealant [10] before fitting the attachment Screws [14].
8. Ensure that the Transom Plate is correctly located over the Intake and Transom Seal [11].
9. Fit Flat Washers [15] to the Screws [14] prior to fitting to the Transom Plate.
10. Align the Transom Plate with the Transom and secure with Screws [14]. **(These are to be fitted with the Screw Head outside the vessel).**
11. From inside the vessel, fit Flat Washers [15] and Spring Washers [8] to the Screws [14] and secure with Nuts [7].
12. Tighten to the recommended torque.
13. Wipe off any excess sealant.
14. Check the Insulation between the Transom Plate and the Transom. **The resistance should be 1000 ohms or greater. Refer to *Section. 7.3.2 "Checking the Insulation".***
15. Refit the Reverse Cylinder as shown in **Section 8.3.1. "Refitting the Reverse Cylinder to the Jet Unit".**
16. Refit the Reverse Duct as shown in **Section 8.3.2. "Refitting the Reverse Duct to the Jet Unit".**

CONVERSION CHART

TORQUE

1 pound foot = 1.3558 newton metres

1 newton metre = 0.7375 pounds foot.

DISTANCE

1 inch = 2.54 centimetres
1 foot = 0.3048 metre
1 mile =1.609 kilometres
1 nautical mile = 1.8532 kilometre

1 millimetre = 0.03937 inches
1 metre = 3.2808 feet

1 kilometre = 0.6214 mile
1 kilometre = 0.539 nautical mile

SURFACE or AREA

1 square inch = 6.4516 square centimetres
1 square foot = 929.03 square centimetres

1 square centimetre = 0.1550 square inch
1 square metre = 10 .76 square feet

POWER

Horsepower
1 Horsepower = 0.7457 Kilowatts
1 Horsepower (Metric) = 0.7355 Kilowatts

Kilowatts
1 Kilowatt = 1.341 Horsepower
1 Kilowatt = 1.3596 Metric Horsepower

FORCE

I kilonewton = 224.86 pounds force

1 pound force = 4.448 newtons

WEIGHT

1 ounce = 28.35 grams
1 pound = 0.4536 Kilograms

1 gram = 0.0353 ounce
1 kilogram = 2.205 pounds
1 Tonne = 2205 pounds

TEMPERATURE

Farenheit	Celsius
248 °F	120 °C
212	100
176	80
140	60
104	40
95	35
86	30
77	25
68	20
59	15
50	10
41	5
32	0

LIQUID MEASURE (IMPERIAL)

1 pint = 0.5506 litre
1 gallon = 4.546 litres
1 (UK) gallon = 1.201 (US) gallon
1 litre = 0.2199 (UK) gallons

LIQUID MEASURE (U.S.)

1 pint = 0.473 litre
1 gallon = 3.785 litres

Fahrenheit to Celsius:
Subtract 32, then multiply by $^{5}/_{9}$.

Celsius to Fahrenheit:
Multiply by $^{9}/_{5}$ then add 32

SPEED

1 mile per hour = 0.8690 knots
1 kilometre per hour = 0.621 miles per hour
1 knot = 1.8532 kilometres per hour

1 mile per hour = 1.609 kilometres per hour
1 kilometre per hour = 0.5396 knots
1 knot = 1.151 miles per hour

PRESSURE

1 pound /inch ^{2} = 0.0689 bar
1 pound / foot ^{2} = 4.8824 kilogram / metre ^{2}
1 pound /inch ^{2} = 6.895 Kilopascal
1 Newton / millimetre^2 = 145.04 pounds/square inch

1 bar = 14.5038 pound / inch ^{2}
1 kilogram / metre ^{2} = 0.2048 pound / foot^2
1 Kilopascal = 0.145 pound /inch ^{2}
1 bar = 100 Kilopascal

KMT NUT: FITTING AND REMOVAL INSTRUCTIONS

TECHNICAL DATA:

MATERIAL:	High Strength Steel.
FINISH:	Phosphated and Saturated with Oil.
LOCKING SCREWS:	P6SS ISO/DIN 913, Grade 12.9.
LOCKING PINS:	Hard Drawn Brass.
THREAD TOLERANCE:	5H, ISO 965/3.
Recommended Shaft Thread Tolerance:	6g.

GENERAL:

The KMT Nut is quite simple to fit, as each Nut is provided with 4 cut-outs and 2 Spanner Flats on its outer surface. The KMTA Nut also has a number of radial and axial holes which can be used for tightening the Nut.

A Hook or Impact Spanner is recommended for the fitting and removal of the Nut but Open Ended or Adjustable Spanners may be used.

The KMT Nut can be locked in position by means of the 3 Locking Pins which are orientated at 90º to the thread flats. These Locking Pins are located beneath each of the 3 Locking Screws adjacently placed around the circumference of the KMT Nut.

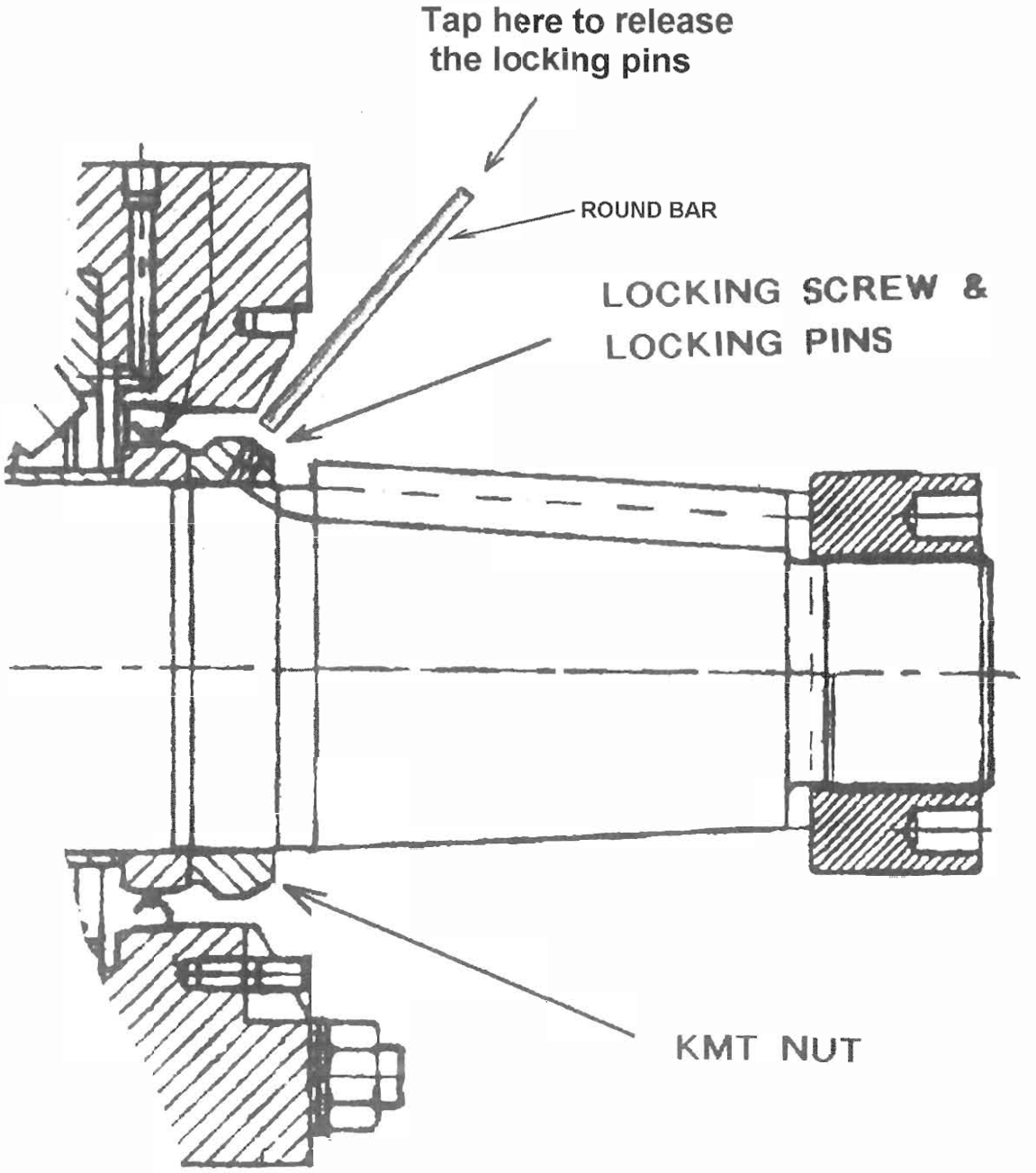
To secure the KMT Nut in position once torque loaded, the Locking Screws are tightened to the recommended torque, using a Socket / Allen Key or a Torque Wrench.

FITTING THE KMT NUT:

Prior to fitting the KMT Nut, ensure that the Locking Screws are partially withdrawn and that the Locking Pins are not protruding into the thread path of the KMT Nut.
Fit the Nut to the Shaft and torque load to the recommended torque.
Screw down the Locking Screws evenly so that the brass Locking Pins contact the screw threads of the Shaft.
Torque load the Locking Screws evenly to the recommended torque. DO NOT OVER TIGHTEN.
KMT Bearing M8 Locknut Screws - 12 Nm (9 ft/lbs).

REMOVING THE KMT NUT:

To remove the KMT Nut, partially withdraw the 3 Locking Screws located around the circumference of the Nut.
Because the brass Locking Pins are a force fit onto the Shaft and do not easily release from the threads of the Shaft, they have to be released by lightly tapping in the vicinity of the Locking Screws, with a suitable hammer.
In some applications, the KMT Nut is shrouded by the Bearing Housing and so access to the nut is restricted. To overcome this problem, a long bar may be used by placing the one end of the bar in the vicinity if the Locking Screw and lightly striking the opposite end of the bar with a suitable hammer until the Locking Pins are released. (See diagram attached). If this fails to release the pins tighten the KMT Nut slightly to remove any residual torque and tap the nut again using heavier blows. Unscrew the KMT Nut and remove from the Shaft.

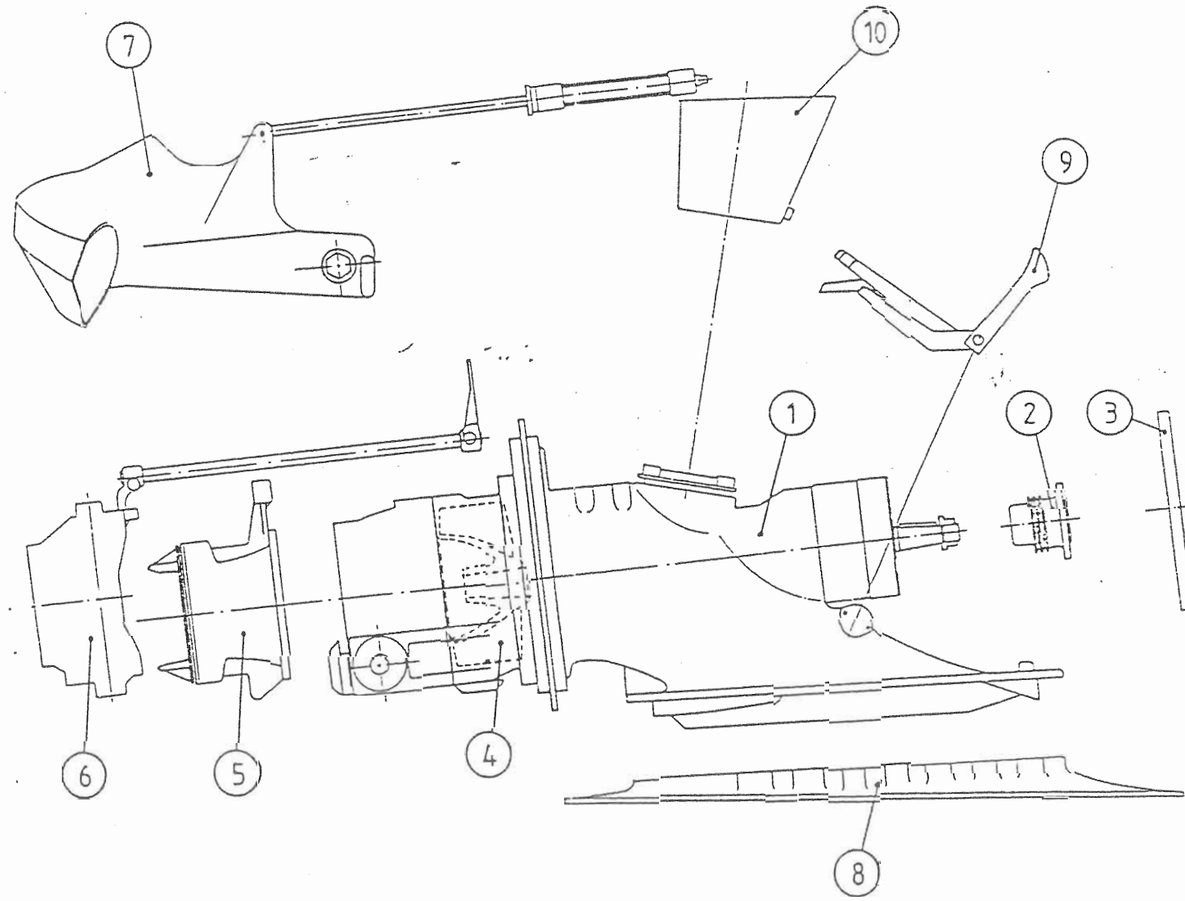


VIEW OF KMT NUT

A2 | HJ 321 QJC 000 | 0

HJ 321 QJC 000 QUAD JET CATAMARAN

OPTION	APPLICATION	ITEM	SUB-ASSEMBLY NUMBER	QTY	DESCRIPTION	DRG NO
GROUP 00						
	CERTIFICATION	0	HJ 321 00 000	4	CERTIFYING AUTHORITY	HJ 321 00 000
GROUP 01						
	STANDARD BASIC JET	1	HJ 321 01 001	4	BASIC JET ASSEMBLY	HJ 321 01 001
GROUP 02						
	DRIVE SHAFT COUPLING	2	HJ 321 02 001	4	DRIVE SHAFT COUPLINGS	HJ 321 02 001
	FLYWHEEL ADAPTOR PLATE	3	HJ 321 02 002	4	FLYWHEEL ADAPTOR PLATES	HJ 321 02 002
GROUP 03						
	IMPELLER	4	HJ 321 03 001	4	IMPELLERS	HJ 321 03 001
GROUP 04						
	NOZZLE	5	HJ 321 04 002	4	NOZZLES	HJ 321 04 002
GROUP 06						
OPTION A	STEERING FOR HULL WITH LESS THAN 8^0 DEADRISE	6	HJ 321 06 001	4	STEERING ASSEMBLY NO TILLER ROTATION	HJ 321 06 001
OPTION B	STEERING FOR HULL WITH GREATER THAN 8^0 DEADRISE	6	HJ 321 06 002	2	STEERING ASSEMBLY TILLER ROTATION PORT JET	HJ 321 06 001
		6	HJ 321 06 003	2	STEERING ASSEMBLY TILLER ROTATION STBD JET	HJ 321 06 001
OPTION C	NO STEERING	6	HJ 321 06 002	4	STEERING BLANKING PLUG	HJ 321 06 002
GROUP 7						
OPTION A	REVERSE	7	HJ 321 07 001	4	REVERSE ASSEMBLY	HJ 321 07 001
OPTION B	NO REVERSE	7	HJ 321 07 002	4	REVERSE BLANKING PLATE	HJ 321 07 002
GROUP 8						
OPTION A	G.R.P. HULL	8	HJ 321 08 001	4	INSTALLATION KIT	HJ 321 08 001
OPTION B	ALUMINIUM HULL	8	HJ 321 08 002	4	INSTALLATION KIT	HJ 321 08 002
OPTION C	STEEL HULL	8	HJ 321 08 003	4	INSTALLATION KIT	HJ 321 08 003
GROUP 9						
OPTION A	SCREEN RAKE	9	HJ 321 09 001	4	SCREEN RAKE ASSEMBLY	HJ 321 09 001
OPTION B	NO SCREEN RAKE	9	HJ 321 09 002	4	SCREEN RAKE BLANKING PLUGS	HJ 321 09 002
GROUP 10						
	WATER LEVEL ABOVE HATCH	10	HJ 321 10 001	4	OVERFLOW PREVENTER	HJ 321 10 001
GROUP 11						
	MAINTENANCE	11	HJ 321 11 001	1	TOOL KIT	HJ 321 11 001
GROUP 30						
	JET APPLICATION	12	HJ 321 30 001	1	DESIGNERS MANUAL	HJ 321 30 001
	SERVICE & INSTALLATION	12	HJ 321 30 002	1	SERVICE & INSTALLATION MANUAL	HJ 321 30 002



CL 3648	O	P.S.	8-2-94	ISSUE FOR PRODUCTION
REF	NO.	DY	DATE	AMENDMENTS

C. W. F. HAMILTON & CO. LTD. CH CH. NZ.

MATERIAL

MATL CERTS YES NO

DRAWN B DATE 10-2-94

CHECKED K.V.E 10-2-94

APPROVED [illegible] 10-2-94

$\sqrt{}$ = N9 EXCEPT AS STATED

UNLIMITED DIMENSIONS TO BE ±

NAME JET ASSEMBLY

QUAD JET CATAMARAN

HJ 321

A2 | HJ 321 QJC 000

A2 HJ 321 QJM 000 0

HJ 321 QJM 000 QUAD JET MONOHULL

OPTION	APPLICATION	ITEM	SUB-ASSEMBLY NUMBER	QTY	DESCRIPTION	DRG NO
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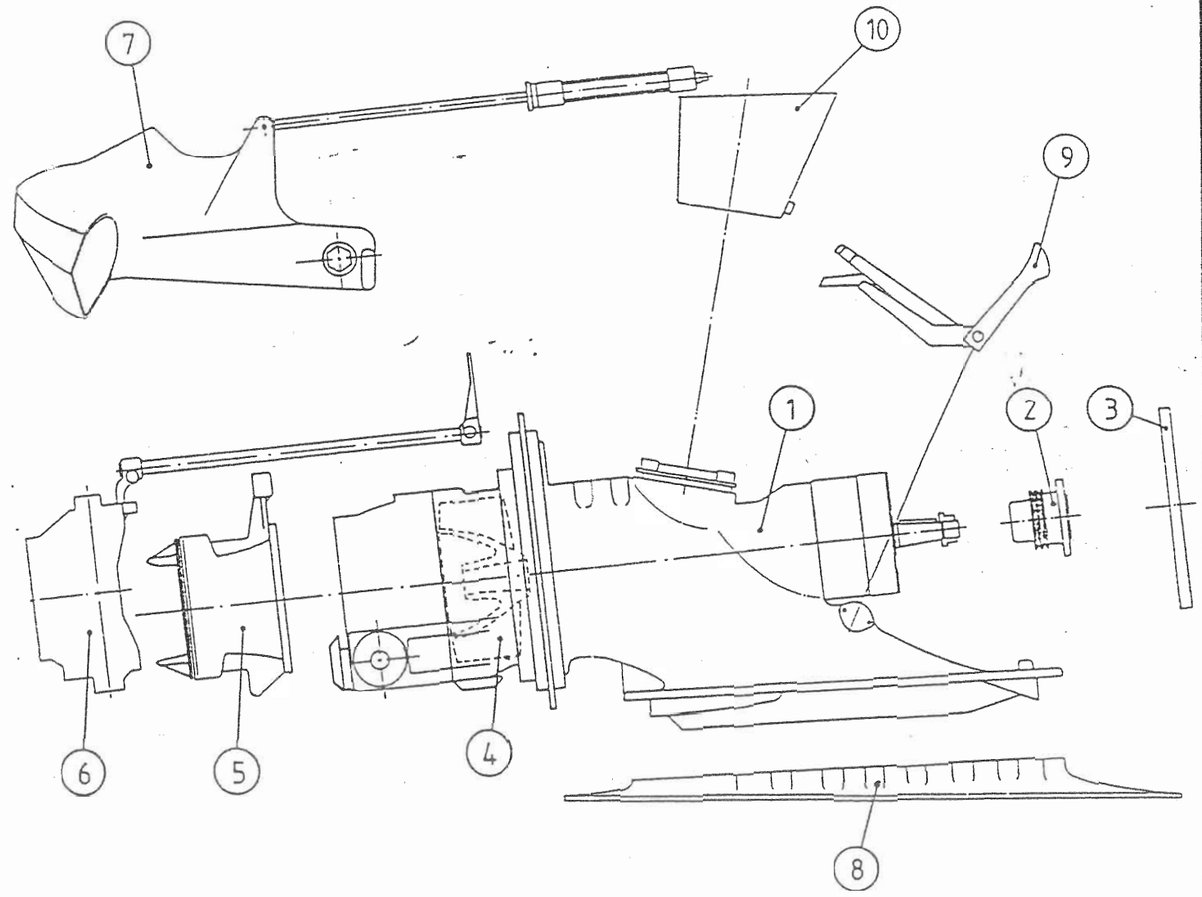
GROUP 01						
	STANDARD BASIC JET	1	HJ 321 01 001	4	BASIC JET ASSEMBLY	HJ 321 01 001
GROUP 02						
	DRIVE SHAFT COUPLING	2	HJ 321 02 001	4	DRIVE SHAFT COUPLINGS	HJ 321 02 001
	FLYWHEEL ADAPTOR PLATE	3	HJ 321 02 002	4	FLYWHEEL ADAPTOR PLATES	HJ 321 02 002
GROUP 03						
	IMPELLER	4	HJ 321 03 001	4	IMPELLERS	HJ 321 03 001
GROUP 04						
	NOZZLE	5	HJ 321 04 002	4	NOZZLES	HJ 321 04 002
GROUP 06						
OPTION A	STEERING FOR HULL WITH LESS THAN 8^0 DEADRISE	6	HJ 321 06 001	4	STEERING ASSEMBLY NO TILLER ROTATION	HJ 321 06 001
OPTION B	STEERING FOR HULL WITH GREATER THAN 8^0 DEADRISE	6	HJ 321 06 002	2	STEERING ASSEMBLY TILLER ROTATION PORT JET	HJ 321 06 001
		6	HJ 321 06 003	2	STEERING ASSEMBLY TILLER ROTATION STBD JET	HJ 321 06 001
OPTION C	NO STEERING	6	HJ 321 06 002	4	STEERING BLANKING PLUG	HJ 321 06 002
GROUP 7						
OPTION A	REVERSE	7	HJ 321 07 001	4	REVERSE ASSEMBLY	HJ 321 07 001
OPTION B	NO REVERSE	7	HJ 321 07 002	4	REVERSE BLANKING PLATE	HJ 321 07 002
GROUP 8						
OPTION A	G.R.P. HULL	8	HJ 321 08 001	4	INSTALLATION KIT	HJ 321 08 001
OPTION B	ALUMINIUM HULL	8	HJ 321 08 002	4	INSTALLATION KIT	HJ 321 08 002
OPTION C	STEEL HULL	8	HJ 321 08 003	4	INSTALLATION KIT	HJ 321 08 003
GROUP 9						
OPTION A	SCREEN RAKE	9	HJ 321 09 001	4	SCREEN RAKE ASSEMBLY	HJ 321 09 001
OPTION B	NO SCREEN RAKE	9	HJ 321 09 002	4	SCREEN RAKE BLANKING PLUGS	HJ 321 09 002
GROUP 10						
	WATER LEVEL ABOVE HATCH	10	HJ 321 10 001	4	OVERFLOW PREVENTER	HJ 321 10 001
GROUP 11						
	MAINTENANCE	11	HJ 321 11 001	1	TOOL KIT	HJ 321 11 001
GROUP 30						
	JET APPLICATION	12	HJ 321 30 001	1	DESIGNERS MANUAL	HJ 321 30 001
	SERVICE & INSTALLATION	12	HJ 321 30 002	1	SERVICE & INSTALLATION MANUAL	HJ 321 30 002



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MATERIAL

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MATL CERTS YES NO

DRAWN P.S. DATE 10-2-94

CHECKED P.S. 10-2-94

CHECKED K.U.E 10-2-94

APPROVED 10-2-94

NAME JET ASSEMBLY

QUAD JET MONOHULL

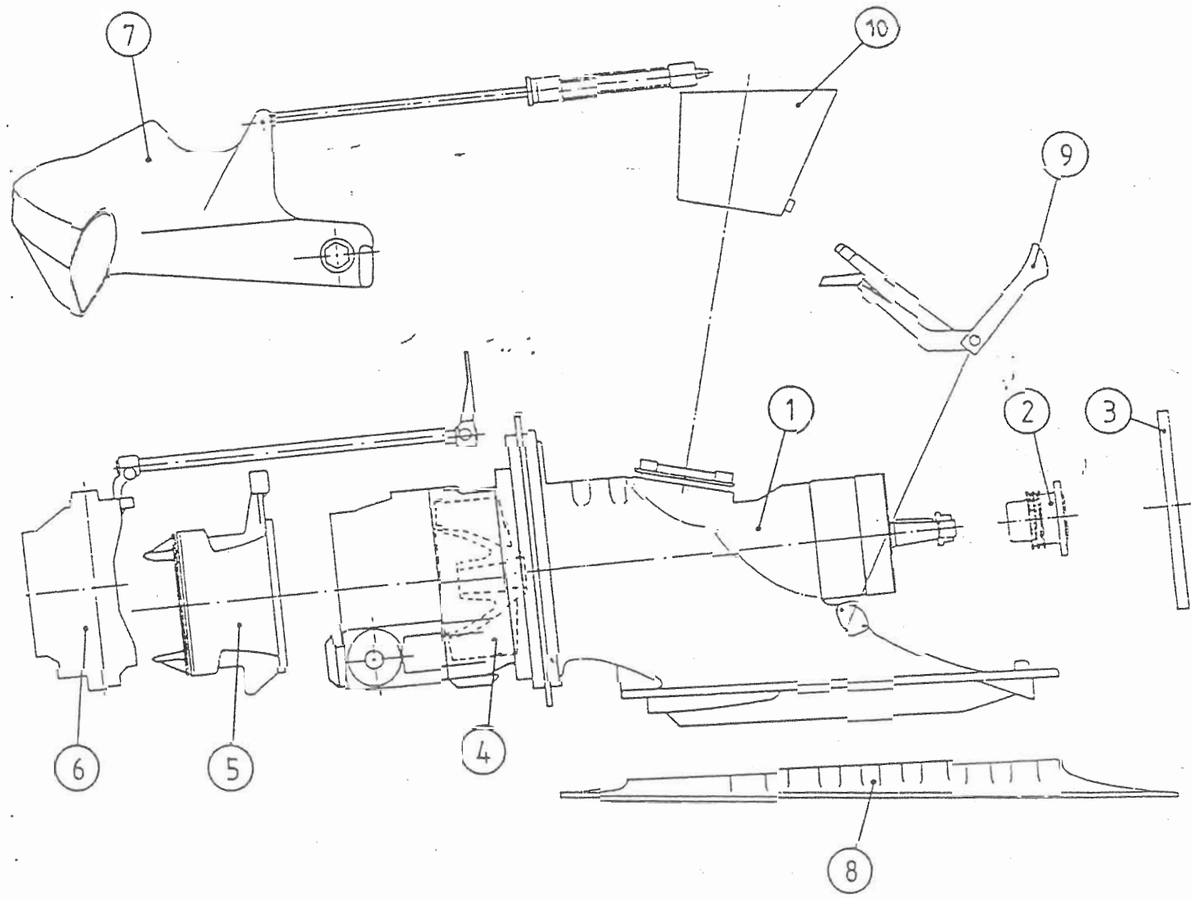
HJ 321

A2 | HJ 321 QJM 000 | 0

A2 | HJ 321 SJM 000 | 0

HJ 321 SJM 000 SINGLE JET MONOHULL

OPTION	APPLICATION	ITEM	SUB-ASSEMBLY NUMBER	QTY	DESCRIPTION	DRG NO
GROUP 00						
	CERTIFICATION	0	HJ 321 00 000	1	CERTIFYING AUTHORITY	HJ 321 00 000
GROUP 01						
	STANDARD BASIC JET	1	HJ 321 01 001	1	BASIC JET ASSEMBLY	HJ 321 01 001
GROUP 02						
	DRIVE SHAFT COUPLING	2	HJ 321 02 001	1	DRIVE SHAFT COUPLINGS	HJ 321 02 001
	FLYWHEEL ADAPTOR PLATE	3	HJ 321 02 002	1	FLYWHEEL ADAPTOR PLATES	HJ 321 02 002
GROUP 03						
	IMPELLER	4	HJ 321 03 001	1	IMPELLERS	HJ 321 03 001
GROUP 04						
	NOZZLE	5	HJ 321 04 002	1	NOZZLES	HJ 321 04 002
GROUP 06						
OPTION A	STEERING	6	HJ 321 06 001	1	STEERING ASSEMBLIES	HJ 321 06 001
OPTION B	NO STEERING	6	HJ 321 06 002	1	STEERING BLANKING PLUG	HJ 321 06 002
GROUP 07						
OPTION A	REVERSE	7	HJ 321 07 001	1	REVERSE ASSEMBLY	HJ 321 07 001
OPTION B	NO REVERSE	7	HJ 321 07 002	1	REVERSE BLANKING PLATE	HJ 321 07 002
GROUP 08						
OPTION A	G.R.P. HULL	8	HJ 321 08 001	1	INSTALLATION KIT	HJ321 08 001
OPTIONB	ALUMINIUM HULL	8	HJ 321 08 002	1	INSTALLATION KIT	HJ 321 08 002
OPTION C	STEEL HULL	8	HJ 321 08 003	1	INSTALLATION KIT	HJ 321 08 003
GROUP 09						
OPTION A	SCREEN RAKE	9	HJ 321 09 001	1	SCREEN RAKE ASSEMBLY	HJ 321 09 001
OPTION B	NO SCREEN RAKE	9	HJ 321 09 002	1	SCREEN RAKE BLANKING PLUGS.	HJ 321 09 002
GROUP 10						
	WATER LEVEL ABOVE HATCH	10	HJ 321 10 001	1	OVERFLOW PREVENTER	HJ321 10 001
GROUP 11						
	MAINTENANCE	11	HJ 321 11 001	1	TOOL KIT	HJ 321 11 001
GROUP 30						
	JET APPLICATION	12	HJ 321 30 001	1	DESIGNERS MANUAL	HJ 321 30 001
	SERVICE & INSTALLATION	12	HJ 321 30 002	1	SERVICE & INSTALLATION MANUAL	HJ 321 30 002



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C. W. F. HAMILTON & CO. LTD. CH CH. NZ.

MATERIAL

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MATL CERTS YES NO

DRAWN — DATE 10-2-94

CHECKED — 10-2-94

UNLOAD K.V.E 10-2-94

APPROVED — 10-2-94

NAME JET ASSEMBLY

SINGLE JET MONO HULL

HJ 321

A2 | HJ 321 SJM 000 | 0

A2 | HJ 321 TJC 000 | 0

HJ 321 TJC 000 TWIN JET CATAMARAN

OPTION	APPLICATION	ITEM	SUB-ASSEMBLY NUMBER	QTY	DESCRIPTION	DRG NO
GROUP 00						
	CERTIFICATION	0	HJ 321 00 000	2	CERTIFYING AUTHORITY	HJ 321 00 000
GROUP 01						
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GROUP 02						
	DRIVE SHAFT COUPLING	2	HJ 321 02 001	2	DRIVE SHAFT COUPLINGS	HJ 321 02 001
	FLYWHEEL ADAPTOR PLATE	3	HJ 321 02 002	2	FLYWHEEL ADAPTOR PLATES	HJ 321 02 002
GROUP 03						
	IMPELLER	4	HJ 321 03 001	2	IMPELLERS	HJ 321 03 001
GROUP 04						
	NOZZLE	5	HJ 321 04 002	2	NOZZLES	HJ 321 04 002
GROUP 06						
OPTION A	STEERING FOR HULL WITH LESS THAN 8^0 DEADRISE	6	HJ 321 06 001	2	STEERING ASSEMBLY NO TILLER ROTATION	HJ 321 06 001
OPTION B	STEERING FOR HULL WITH GREATER THAN 8^0 DEADRISE	6	HJ 321 06 002	1	STEERING ASSEMBLY TILLER ROTATION PORT JET	HJ 321 06 001
		6	HJ 321 06 003	1	STEERING ASSEMBLY TILLER ROTATION STBD JET	HJ 321 06 001
OPTION C	NO STEERING	6	HJ 321 06 002	2	STEERING BLANKING PLUG	HJ 321 06 002
GROUP 7						
OPTION A	REVERSE	7	HJ 321 07 001	2	REVERSE ASSEMBLY	HJ 321 07 001
OPTION B	NO REVERSE	7	HJ 321 07 002	2	REVERSE BLANKING PLATE	HJ 321 07 002
GROUP 8						
OPTION A	G.R.P. HULL	8	HJ 321 08 001	2	INSTALLATION KIT	HJ 321 08 001
OPTION B	ALUMINIUM HULL	8	HJ 321 08 002	2	INSTALLATION KIT	HJ 321 08 002
OPTION C	STEEL HULL	8	HJ 321 08 003	2	INSTALLATION KIT	HJ 321 08 003
GROUP 9						
OPTION A	SCREEN RAKE	9	HJ 321 09 001	2	SCREEN RAKE ASSEMBLY	HJ 321 09 001
OPTION B	NO SCREEN RAKE	9	HJ 321 09 002	2	SCREEN RAKE BLANKING PLUGS	HJ 321 09 002
GROUP 10						
	WATER LEVEL ABOVE HATCH	10	HJ 321 10 001	2	OVERFLOW PREVENTER	HJ 321 10 001
GROUP 11						
	MAINTENANCE	11	HJ 321 11 001	1	TOOL KIT	HJ 321 11 001
GROUP 30						
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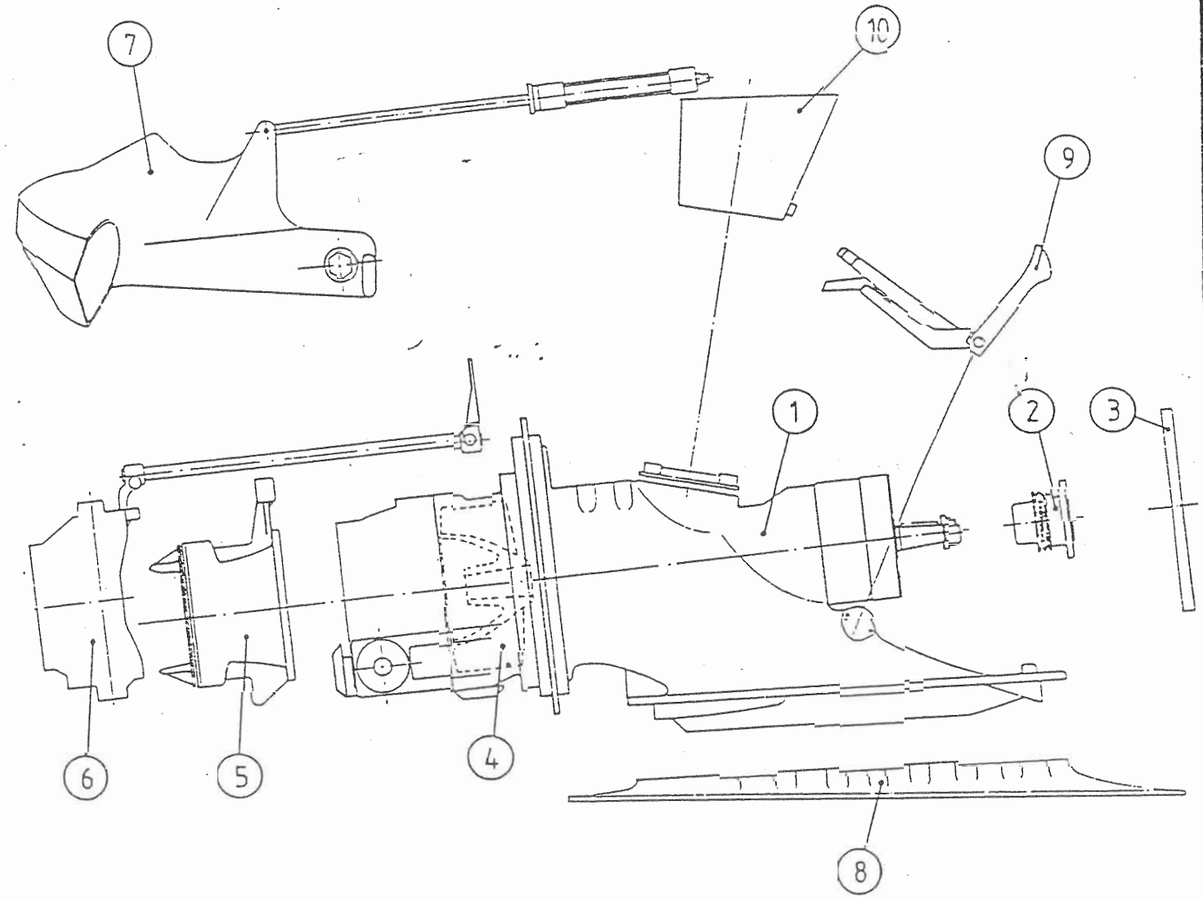

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MATERIAL

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NAME JET ASSEMBLY

TWIN JET CATAMARAN

HJ 321

	DATE
DRAWN	10-2-94
CHKD	10-2-94
DESIGN K.V.E	10-2-94
APPROVED	10-2-94

A2 | HJ 321 TJC 000 | 0

A2 | HJ 321 TJM 000 | 0

HJ 321 TJM 000 TWIN JET MONOHULL

OPTION	APPLICATION	ITEM	SUB-ASSEMBLY NUMBER	QTY	DESCRIPTION	DRG NO
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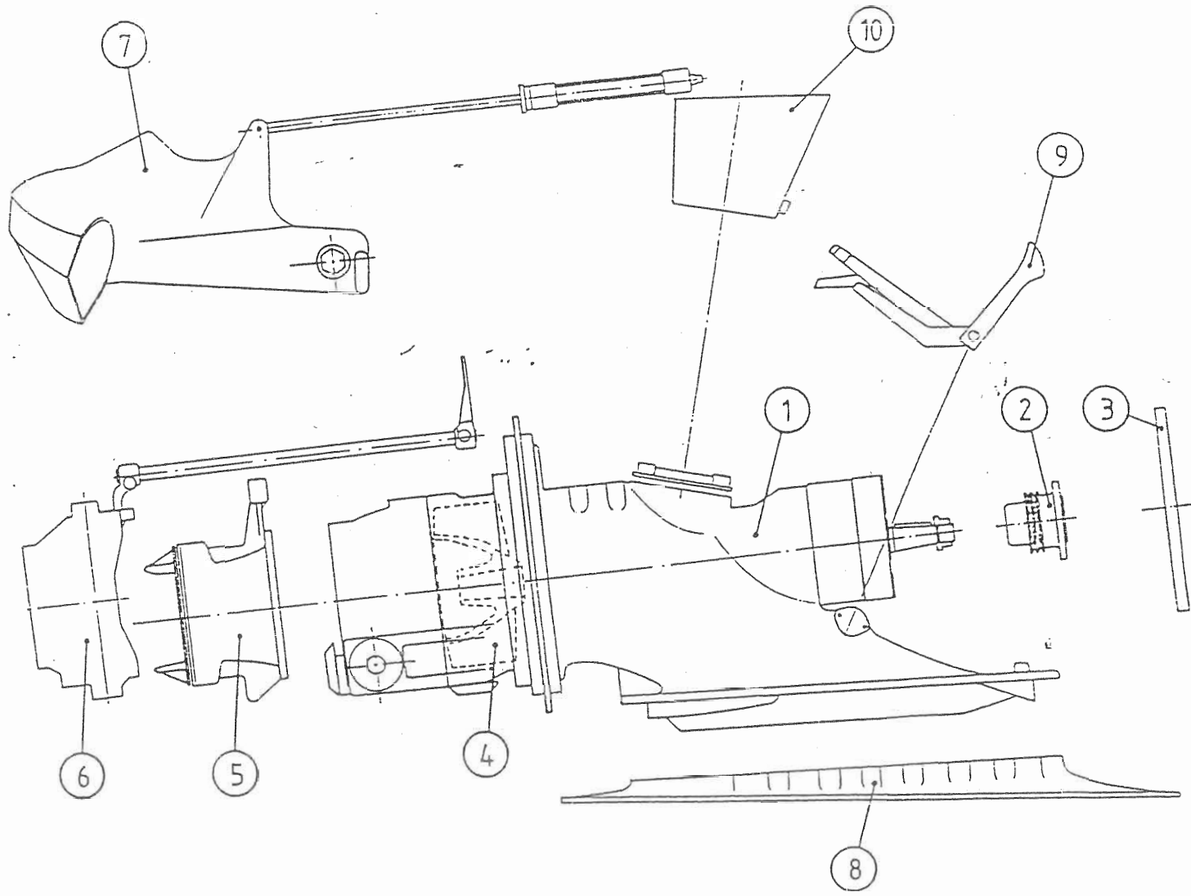
	STANDARD BASIC JET	1	HJ 321 01 001	2	BASIC JET ASSEMBLY	HJ 321 01 001
GROUP 02						
	DRIVE SHAFT COUPLING	2	HJ 321 02 001	2	DRIVE SHAFT COUPLINGS	HJ 321 02 001
	FLYWHEEL ADAPTOR PLATE	3	HJ 321 02 002	2	FLYWHEEL ADAPTOR PLATES	HJ 321 02 002
GROUP 03						
	IMPELLER	4	HJ 321 03 001	2	IMPELLERS	HJ 321 03 001
GROUP 04						
	NOZZLE	5	HJ 321 04 002	2	NOZZLES	HJ 321 04 002
GROUP 06						
OPTION A	STEERING FOR HULL WITH LESS THAN 8^0 DEADRISE	6	HJ 321 06 001	2	STEERING ASSEMBLY NO TILLER ROTATION	HJ 321 06 001
OPTION B	STEERING FOR HULL WITH GREATER THAN 8^0 DEADRISE	6	HJ 321 06 002	1	STEERING ASSEMBLY TILLER ROTATION PORT JET	HJ 321 06 001
		6	HJ 321 06 003	1	STEERING ASSEMBLY TILLER ROTATION STBD JET	HJ 321 06 001
OPTION C	NO STEERING	6	HJ 321 06 002	2	STEERING BLANKING PLUG	HJ 321 06 002
GROUP 7						
OPTION A	REVERSE	7	HJ 321 07 001	2	REVERSE ASSEMBLY	HJ 321 07 001
OPTION B	NO REVERSE	7	HJ 321 07 002	2	REVERSE BLANKING PLATE	HJ 321 07 002
GROUP 8						
OPTION A	G.R.P. HULL	8	HJ 321 08 001	2	INSTALLATION KIT	HJ 321 08 001
OPTION B	ALUMINIUM HULL	8	HJ 321 08 002	2	INSTALLATION KIT	HJ 321 08 0C2
OPTION C	STEEL HULL	8	HJ 321 08 003	2	INSTALLATION KIT	HJ 321 08 003
GROUP 9						
OPTION A	SCREEN RAKE	9	HJ 321 09 001	2	SCREEN RAKE ASSEMBLY	HJ 321 09 001
OPTION B	NO SCREEN RAKE	9	HJ 321 09 002	2	SCREEN RAKE BLANKING PLUGS	HJ 321 09 002
GROUP 10						
	WATER LEVEL ABOVE HATCH	10	HJ 321 10 001	2	OVERFLOW PREVENTER	HJ 321 10 001
GROUP 11						
	MAINTENANCE	11	HJ 321 11 001	1	TOOL KIT	HJ 321 11 001
GROUP 30						
	JET APPLICATION	12	HJ 321 30 001	1	DESIGNERS MANUAL	HJ 321 30 001
	SERVICE & INSTALLATION	12	HJ 321 30 002	1	SERVICE & INSTALLATION MANUAL	HJ 321 30 002



REF	NO.	BY	DATE	AMENDMENTS
CL 3648	0	P.S.	8-2-94	ISSUE FOR PRODUCTION

THIS PRINT IS PROVIDED ON A RESTRICTED BASIS AND IS NOT TO BE USED IN ANY WAY DETRIMENTAL TO THE INTERESTS OF C.W.F. HAMILTON AND CO LTD.

C. W. F. HAMILTON & CO. LTD. CH CH. NZ.

MATERIAL

MATL CERTS YES NO

$\sqrt{}$ = N9 EXCEPT AS STATED

UNLIMITED DIMENSIONS TO BE ±

DRAWN K.V.E DATE 10-2-94

CHECKED DATE 10-2-94

DESIGNED K.V.E 10-2-94

APPROVED DATE 10-2-94

NAME JET ASSEMBLY

TWIN JET MONOHULL

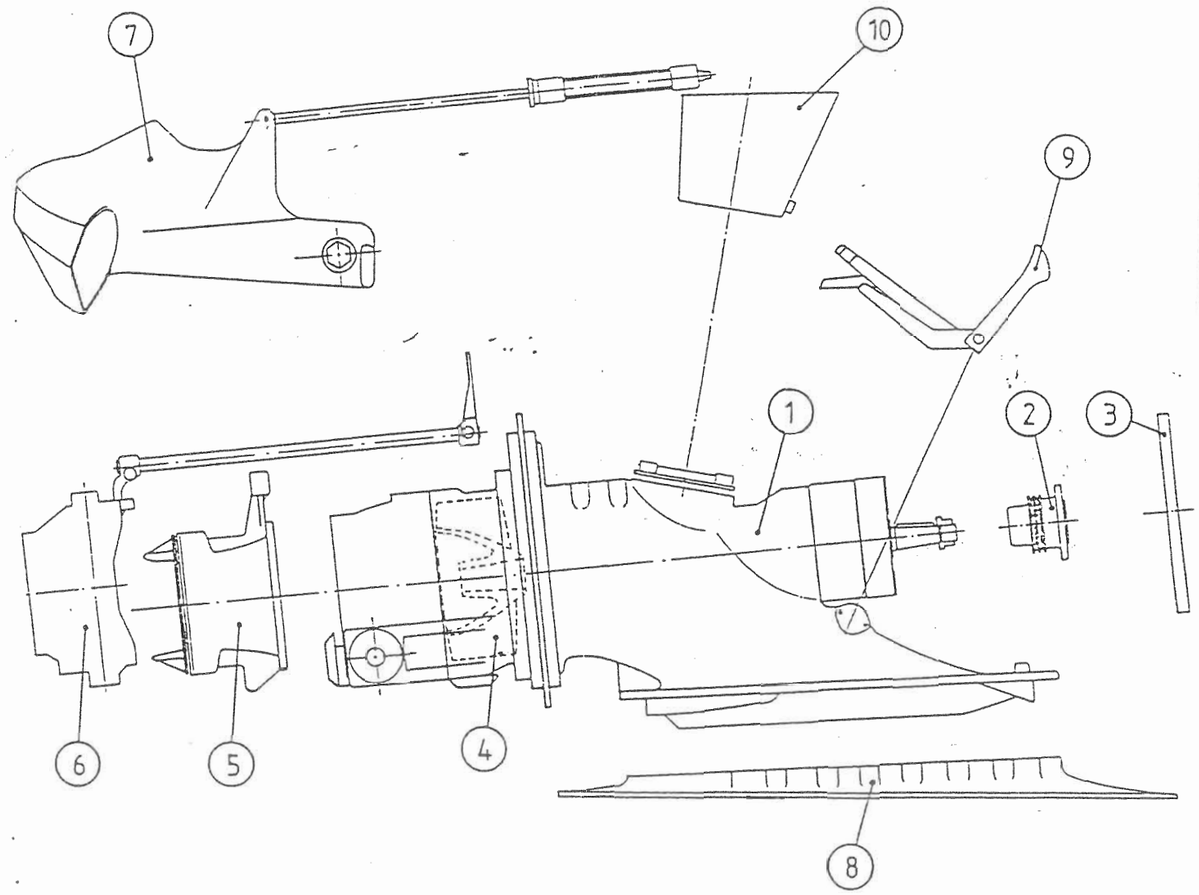
HJ 321

A2 | HJ 321 TJM 000 | 0

A2 | HJ 321 TRJ 000 | 0

HJ 321 TRJ 000 TRIPLE JET MONOHULL

OPTION	APPLICATION	ITEM	SUB-ASSEMBLY NUMBER	QTY	DESCRIPTION	DRG NO
GROUP 00						
	CERTIFICATION	0	HJ 321 00 000	3	CERTIFYING AUTHORITY	HJ 321 00 000
GROUP 01						
	STANDARD BASIC JET	1	HJ 321 01 001	3	BASIC JET ASSEMBLY	HJ 321 01 001
GROUP 02						
	DRIVE SHAFT COUPLING	2	HJ 321 02 001	3	DRIVE SHAFT COUPLINGS	HJ 321 02 001
	FLYWHEEL ADAPTOR PLATE	3	HJ 321 02 002	3	FLYWHEEL ADAPTOR PLATES	HJ 321 02 002
GROUP 03						
	IMPELLER	4	HJ 321 03 001	3	IMPELLERS	HJ 321 03 001
GROUP 04						
	NOZZLE	5	HJ 321 04 002	3	NOZZLES	HJ 321 04 002
GROUP 06						
OPTION A	STEERING FOR HULL WITH LESS THAN 8^0 DEADRISE	6	HJ 321 06 001	3	STEERING ASSEMBLY NO TILLER ROTATION	HJ 321 06 001
OPTION B	STEERING FOR HULL WITH GREATER THAN 8^0 DEADRISE	6	HJ 321 06 002	1	STEERING ASSEMBLY TILLER ROTATION PORT JET	HJ 321 06 001
		6	HJ 321 06 001	1	STEERING ASSEMBLY NO TILLER ROTATION CENTRE JET	HJ 321 06 001
		6	HJ 321 06 003	1	STEERING ASSEMBLY TILLER ROTATION STBD JET	HJ 321 06 001
OPTION C	NO STEERING	6	HJ 321 06 002	3	STEERING BLANKING PLUG	HJ 321 06 002
GROUP 7						
OPTION A	REVERSE	7	HJ 321 07 001	3	REVERSE ASSEMBLY	HJ 321 07 001
OPTION B	NO REVERSE	7	HJ 321 07 002	3	REVERSE BLANKING PLATE	HJ 321 07 002
GROUP 8						
OPTION A	G.R.P. HULL	8	HJ 321 08 001	3	INSTALLATION KIT	HJ 321 08 001
OPTION B	ALUMINIUM HULL	8	HJ 321 08 002	3	INSTALLATION KIT	HJ 321 08 002
OPTION C	STEEL HULL	8	HJ 321 08 003	3	INSTALLATION KIT	HJ 321 08 003
GROUP 9						
OPTION A	SCREEN RAKE	9	HJ 321 09 001	3	SCREEN RAKE ASSEMBLY	HJ 321 09 001
OPTION B	NO SCREEN RAKE	9	HJ 321 09 002	3	SCREEN RAKE BLANKING PLUGS	HJ 321 09 002
GROUP 10						
	WATER LEVEL ABOVE HATCH	10	HJ 321 10 001	3	OVERFLOW PREVENTER	HJ 321 10 001
GROUP 11						
	MAINTENANCE	11	HJ 321 11 001	1	TOOL KIT	HJ 321 11 001
GROUP 30						
	JET APPLICATION	12	HJ 321 30 001	1	DESIGNERS MANUAL	HJ 321 30 001
	SERVICE & INSTALLATION	12	HJ 321 30 002	1	SERVICE & INSTALLATION MANUAL	HJ 321 30 002



REF	NO.	BY	DATE	AMENDMENTS
CL 3648	0	P.S.	8-2-94	ISSUE FOR PRODUCTION

C. W. F. HAMILTON & CO. LTD. CH CH. NZ.

MATERIAL

√ = N9 EXCEPT AS STATED

UNLIMITED DIMENSIONS TO BE ±

MATL. CERTS YES NO

DRAWN — DATE 10-2-94

CHECKED — 10-2-94

CALCD K.U.E 10-2-94

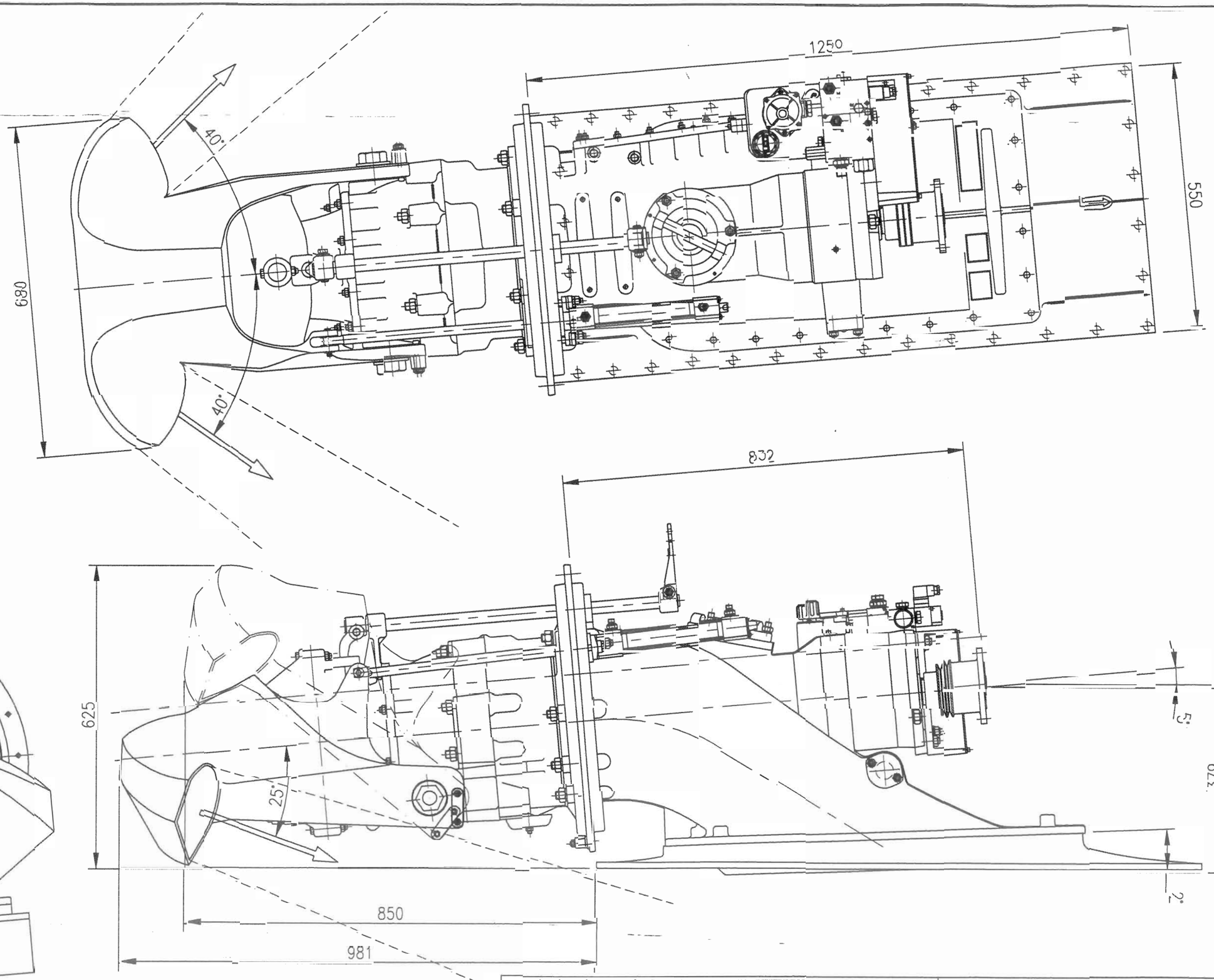
APPROVED — 10-2-94

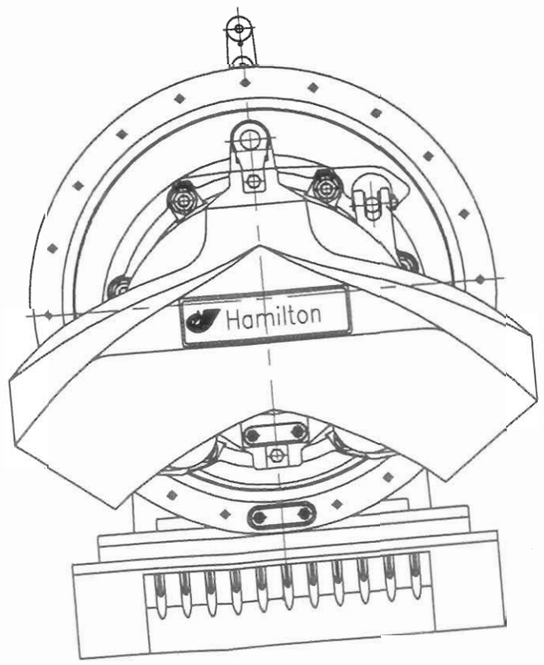
NAME JET ASSEMBLY

TRIPLE JET MONOHULL

HJ 321

A2 | HJ 321 TRJ 000 | 0





REF	NO.	BY	DATE	AMENDMENTS
CL73	C	P.S.	2 /12/97	REVERSE SHAFT COVER TUBE DELETED.
CL3808	B	P.S.	14/10/97	REV DUCT RAISED WAS 649 & 834. REV DUCT WIDTH WAS 675.
CL3786	A	P.M.W	12/6/97	REDRAWN
CL3723	0	R.J.L.	30/9/95	ISSUED FOR INFORMATION.

JET 321

C.W.F.HAMILTON & CO. LTD. CHCH. NZ.

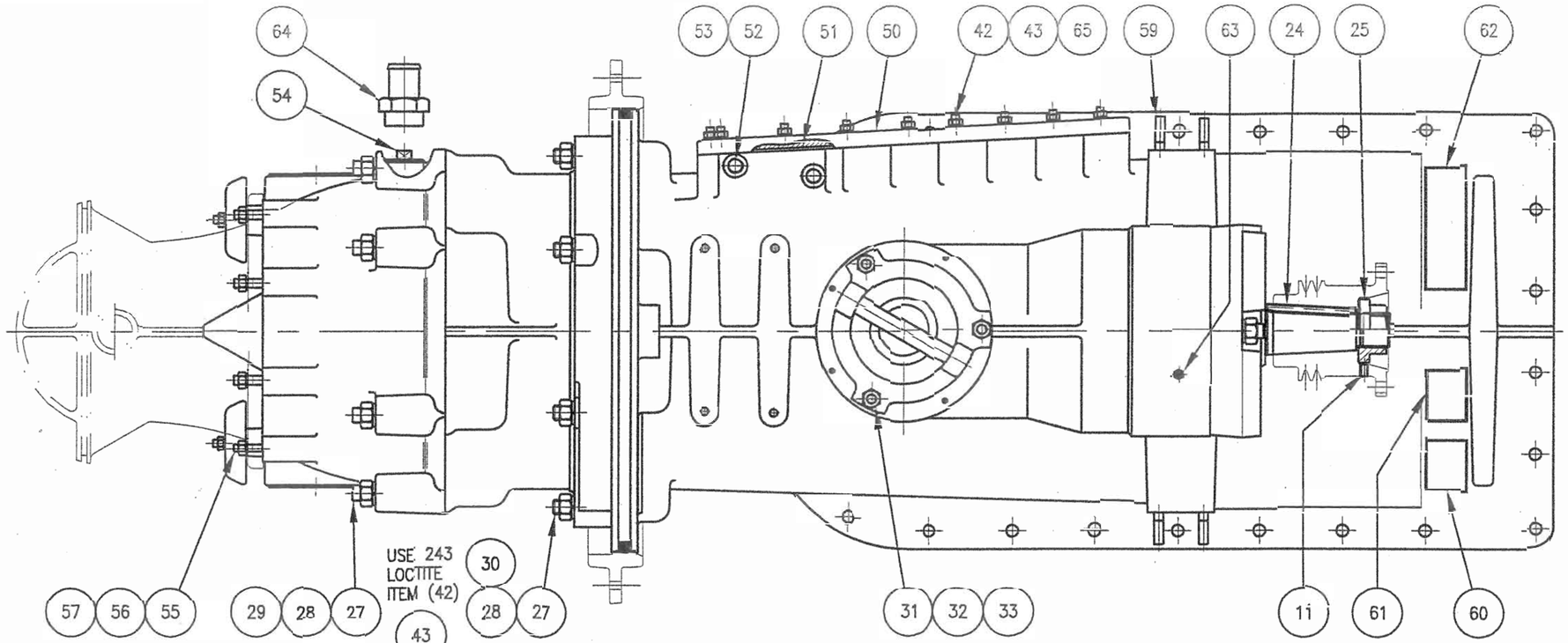
PROJECTION

NAME: GENERAL ASSEMBLY HJ321

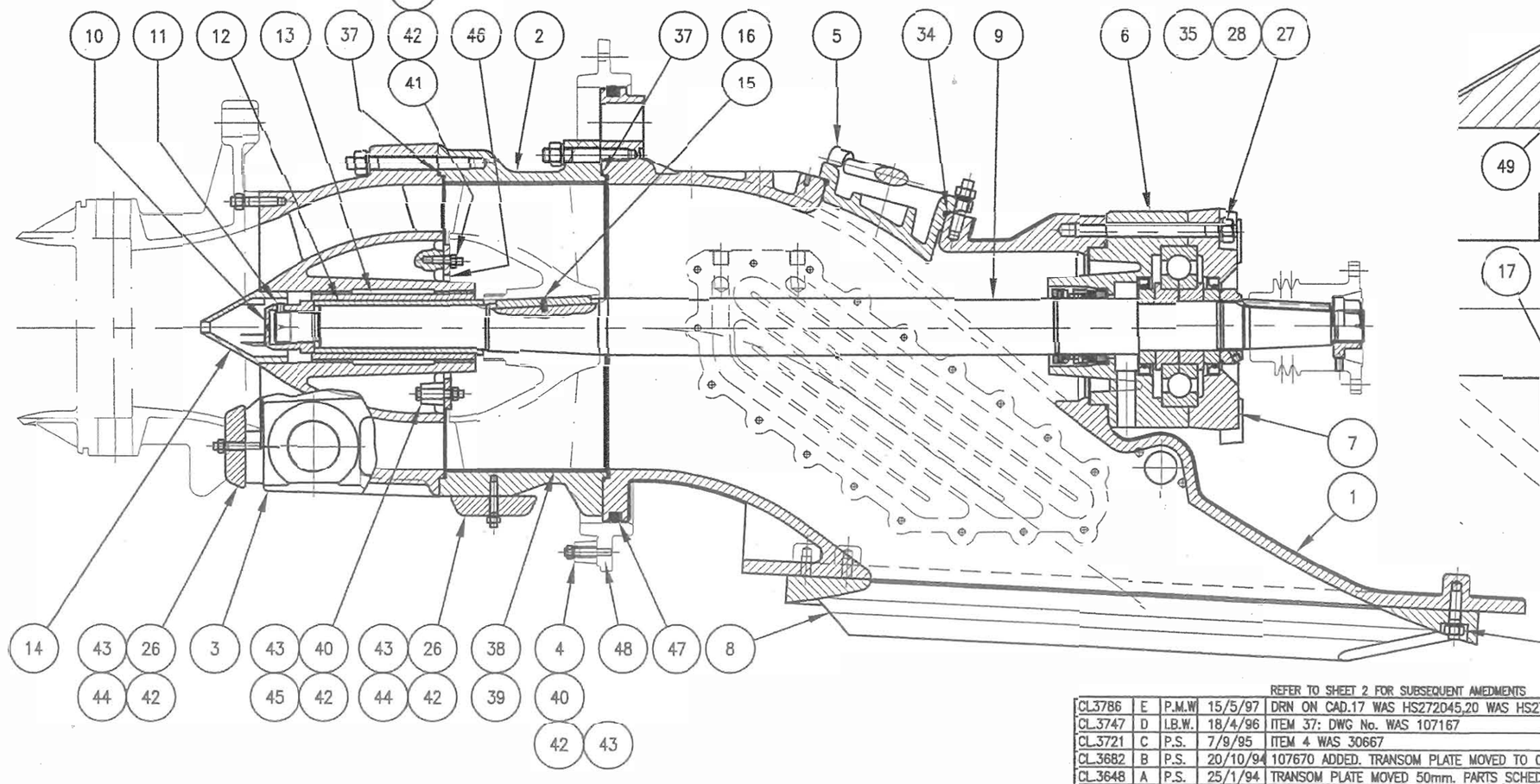
DESIGNED	DATE	
DRAWN P.M.W.	12/5/97	
CHECKED P.S.	14/10/97	
APPROVED		

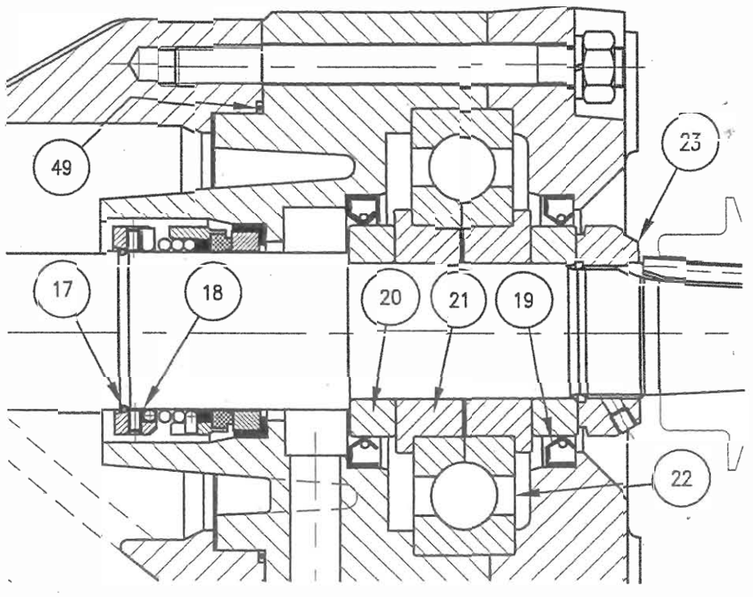
SCALE 1:8

No. ASSY-HJ321 30 001 C



TORQUE CHART	Nm	ft/lb
IMPELLER NUT (10)	400	300
COUPLING NUT (25)	400	300
BEARING LOCK NUT (23)	270	200
IMPELLER NUT SET SCREW (11)	8	6
COUPLING NUT SET SCREW (11)	8	6
BEARING LOCK NUT SET SCREW	8	6
ALL OTHER NUTS AS PER DRAWING 85018		





REFER TO SHEET 2 FOR SUBSEQUENT AMENDMENTS

REF	NO.	BY	DATE	AMENDMENTS
CL3786	E	P.M.W	15/5/97	DRN ON CAD.17 WAS HS272045,20 WAS HS272048,24 WAS HS272041
CL3747	D	I.B.W.	18/4/96	ITEM 37: DWG No. WAS 107167
CL3721	C	P.S.	7/9/95	ITEM 4 WAS 30667
CL3682	B	P.S.	20/10/94	107670 ADDED. TRANSOM PLATE MOVED TO 08 GROUP
CL3648	A	P.S.	25/1/94	TRANSOM PLATE MOVED 50mm. PARTS SCHEDULE CHANGES SEE C.L.
CL3645	0	P.S.	9/12/93	ISSUED FOR PRODUCTION
JET	321			

C.W.F.HAMILTON & CO. LTD. CHCH. NZ.

PROJECTION

NAME
BASIC JET ASSEMBLY
HJ 321 JET

SHEET 1 OF 2 SHEETS.

	DATE
DESIGNED P.S.	2-10-93
DRAWN L.C.	3-11-93
CHECKED K.V.E.	10-2-94
APPROVED K.V.A.	10-2-94

SCALE -

No: ASSY-HJ 321 01 001 H

A	B	C	D	Code	Item	Kit	Part Number	Qty	Product Description	Drawing Nbr
						A	107204		TAILPIPE KIT	HJ32101001
						B	107205		IMPELLER RACE KIT	HJ32101001
						C	107670		INTAKE KIT	HJ32101001
A2						REF	104867		THREADED BUSH	104867
		C		4	1		107253	1	INTAKE	107253
	B			4	2		107254	1	IMPELLER RACE	107254
A				3	3		107102	1	TAILPIPE	107102
				4	4		30661	REF	(STUDS) METRIC (316-STST) M8x51	30647
				4	5		106972	1	INSPECTION COVER (S/No 2506 on)	106972
				3	6		107109	1	BEARING HOUSING	107109
				3	7		107257	1	BEARING CAP	107257
				3	8		107106	1	SCREEN (ALM) (std)	107106
				3	9		107121	1	MAINSHAFT	107121
				4	10		104624	1	IMPELLER NUT	104624
				2	11		JAJYXCB	1	(SCREWS) (SET SCREWS) METRIC 316 ST ST Socket M8x10	N/A
				2	12		111202	1	WATER BEARING SLEEVE	111202
A				2	13		106265	1	MARINE WATER BEARING 80x60x100	106264
A				4	14		104618	1	TAILPIPE FAIRING	104618
				4	15		107124	1	IMPELLER KEY	107124
				4	16		104192	1	(JET) DOWELS 5mm OD 316 STST	104191
				2	17		109964	1	CIRCLIP (ROTARY SEAL RETAINER)	109964
				2	18		63880	1	(JET) ROTARY SEALS 2.5" 32HA (BM-156523)	63880
				2	19		JWKZADF	2	(OIL SEALS) Gaco DPSM8511012 C/W SS SPRING	N/A
				3	20		109965	2	SEAL SLEEVE	109965
				4	21		107122	2	BEARING CARRIER	107122
				2	22		63878	1	(SKF) BEARINGS ALL TYPES (SKF QJ317 OR QJ317NZ)	N/A
				2	23		63879	1	(SKF) NUTS SPECIAL Lock Nut KMT 11	63879
					24		109432	1	COUPLING KEY	109432
				4	25		104619	1	COUPLING NUT	104619
A2	B1			4	26		30661	3	(STUDS) METRIC (316-STST) M8x51	30647
	B8	C11		4	27		JEQKXAJ	19	(WASHERS) (SPRING) METRIC ST ST 316 M16	N/A
	B8	C11		4	28		JDQHXAL	19	(NUTS) (METRIC ST ST 316) M16	N/A
		C		4	29		107268	8	(STUDS) METRIC (SAF-2205) M16x135	30700
	B	C		4	30		107165	8	(STUDS) METRIC (SAF-2205) M16x95	30700
		C		4	31		103916	3	(STUDS) METRIC (316-STST) M12x64	30639

A	B	C	D	Code	Item	Kit	Part Number	Qty	Product Description	Drawing Nbr
		C7		4	32		JDQHXAH	11	(NUTS) (METRIC ST ST 316) M12	N/A
		C7		4	33		JEQKXAH	11	(WASHERS) (SPRING) METRIC ST ST 316 M12	N/A
				1	34		HMHRADQ	1	(O RINGS) IMPERIAL 0.25x5.25x5.75 (431N70)	N/A
		C		4	35		30723	3	(STUDS) METRIC (316-STST) M16x180	30634
		C		4	36		30658	8	(STUDS) METRIC (316-STST) M12x54	30639
A1	B			2	37		107167	2	(JET) O RINGS SPECIAL CORD DIA. 0.103x1069 LONG	108975
	B			2	38		107266	1	WEAR RING	107266
	B			2	39		107267	1	INSULATOR (WEAR RING)	107267
A2				2	40		103359	2	ANODE MK3	103359
A				4	41		JCQHXAG	4	(STUDS) METRIC (316-STST) M8x35	30647
A10	B1	C18		4	42		JDQHXAC	27	(NUTS) (METRIC ST ST 316) M8	N/A
A10	B1	C18		4	43		JEQKXAC	27	(WASHERS) (SPRING) METRIC ST ST 316 M8	N/A
A2	B1			2	44		102185	3	ANODE	102185
A				4	45		HYQHXCB	4	(BOLTS) (METRIC) ST ST 316 M8x45	N/A
A				4	46		107183	1	ANODE MOUNTING PLATE	107183
				3	47		107160	REF	(JET) O RINGS SPECIAL TRANSOM SEAL	107160
				4	48		107116	REF	TRANSOM PLATE	107116
				2	49		HMHRADK	1	(O RINGS) IMPERIAL 0.13x6.50x6.75 (260N70)	N/A
		C		4	50		107108	1	OIL COOLER COVER	107108
		C		4	51		107168	1	(JET) O RINGS SPECIAL CORD DIA. 0.13x1130	107168
				3	52		WAQUBCC	2	NIPPLE 3/8BSPP-3/8BSPP (SA 101 00 606)	N/A
				3	53		WAQUDAC	2	BONDED SEAL 3/8" BSP (400-823-4490-74)	N/A
A				4	54		HIQUAAG	1	(PLUGS) B.S.P.P. PLUG 1-1/4" BSP SQ HD 316 S.S.	N/A
A				4	55		30671	8	(STUDS) METRIC (316-STST) M10x51	30637
A				4	56		JDQHXAE	8	(NUTS) (METRIC ST ST 316) M10	N/A
A				4	57		JEQKXAE	8	(WASHERS) (SPRING) METRIC ST ST 316 M10	N/A
		C		4	59		JCQHXAO	4	(STUDS) METRIC (316-STST) M10x50	30637
				4	60		63097	1	(LABELS) (MODEL & SERIAL NO PLATE)	63097
				4	61		63135	1	(LABELS) (PATENT PLATE)	63135
				4	62		63610	1	(LABELS) (WARNING PLATE)	63610
				3	63		HEIDAAA	1	(GREASE) NIPPLES (H29) 1/8"BSP	N/A
A				4	64		JMNGAAD	1	(HOSE) TAILS CP30 BRASS 1-1/4" BSP	N/A
		C		4	65		JCQHXAH	18	(STUDS) METRIC (316-STST) M8x40	30647
					66		107285	1	(JET) PACKAGING CASE	N/A

REF	NO.	BY	DATE	AMENDMENTS
CL 119	H	R.J.L	7.12.99	43 KITS WERE 8 & QTY. WAS 25.
CL 119	H	R.J.L	7.12.99	Sht 2– ITEM 12 WAS 104193, ITEM 41 QTY. WAS 2 & ITEMS 42 &
CL0101	G	J.W.	21.7.99	ITEM 67 DELETED. ITEMS 52 & 53 SUPPLIER CODE CHANGED
CL73	F	P.S.		FOR PREVIOUS AMENDMENTS SEE SHEET 1. ITEM 58 DELETED.

JET 321

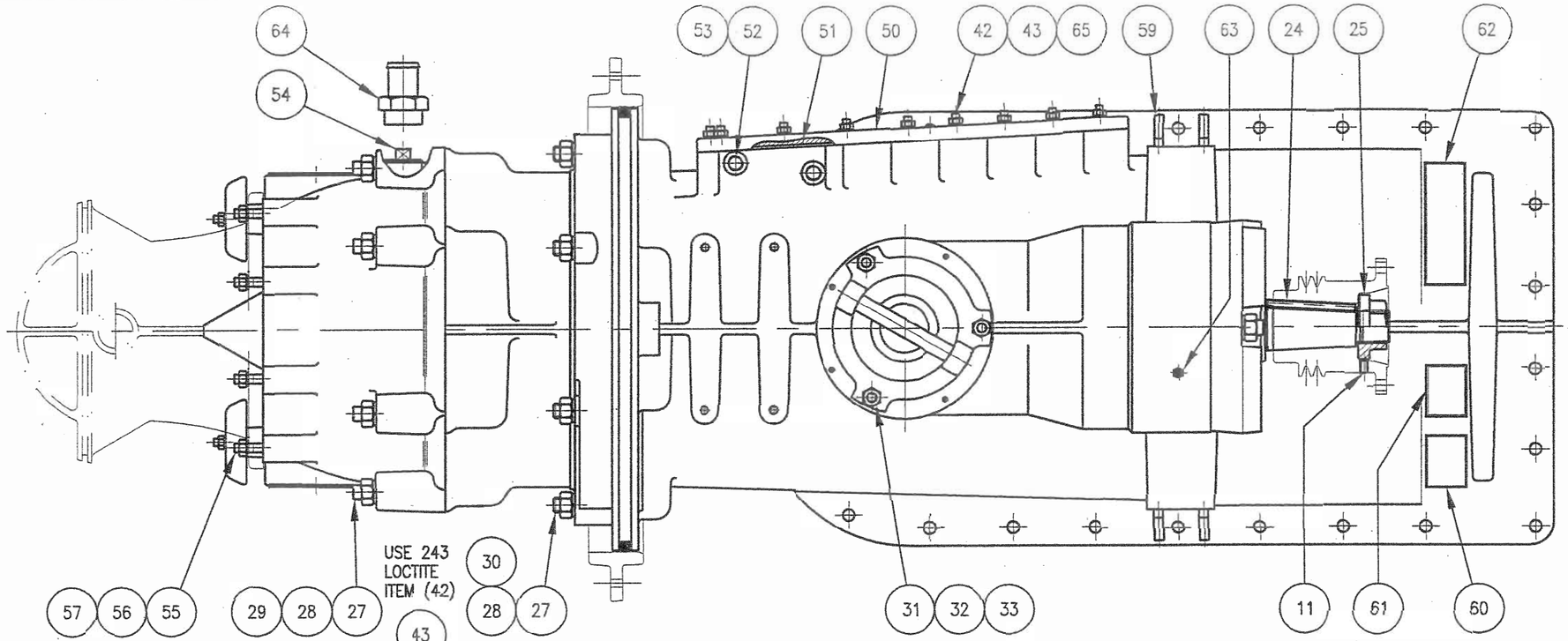
C.W.F.HAMILTON & CO. LTD. CHCH. NZ.

PROJECTION

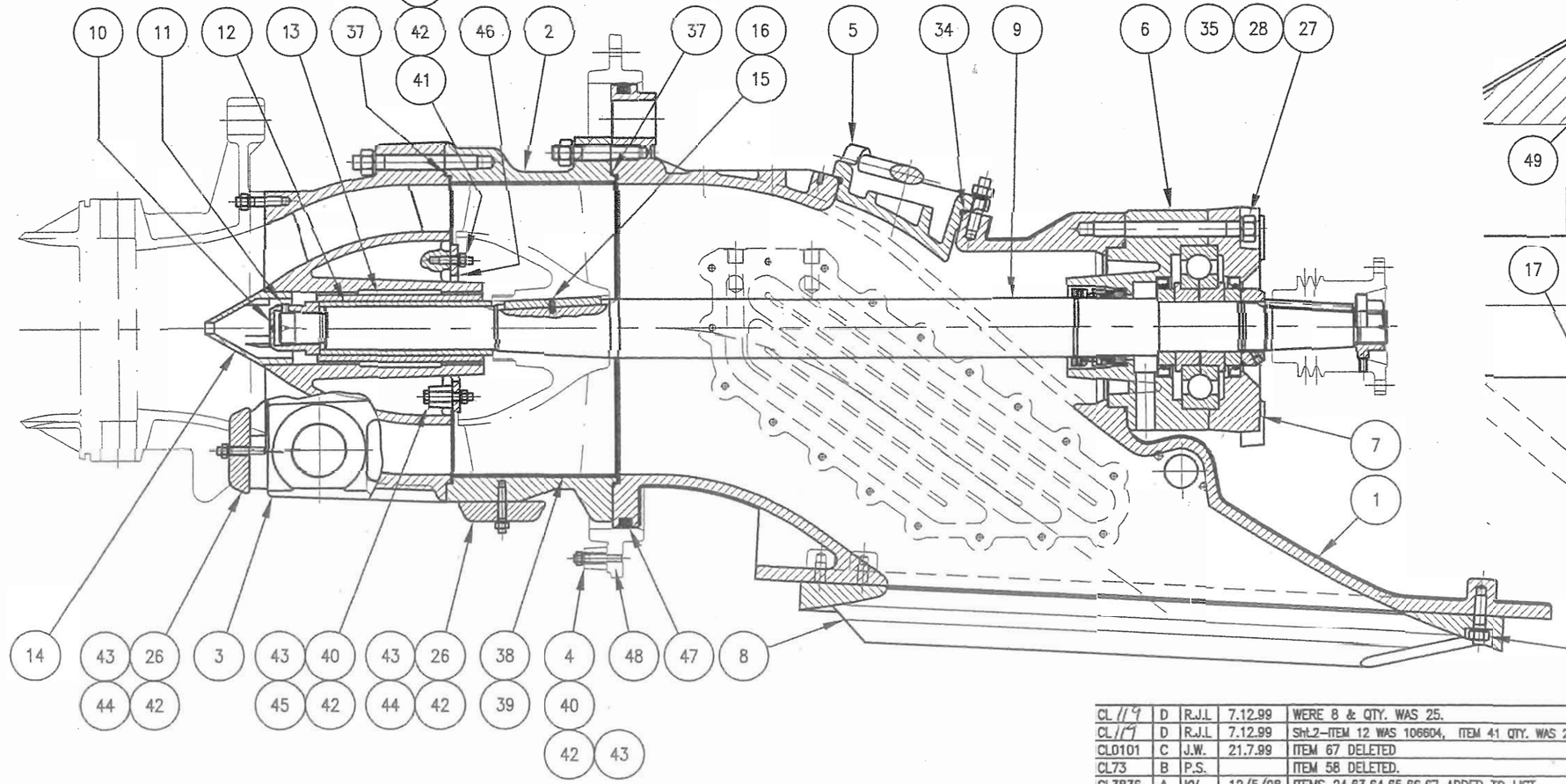
	DATE
DESIGNED K.V.A.	2/10/93
DRAWN P.A.S.	3/11/93
CHECKED K.V.A.	10/2/94
APPROVED K.V.E.	10/2/94

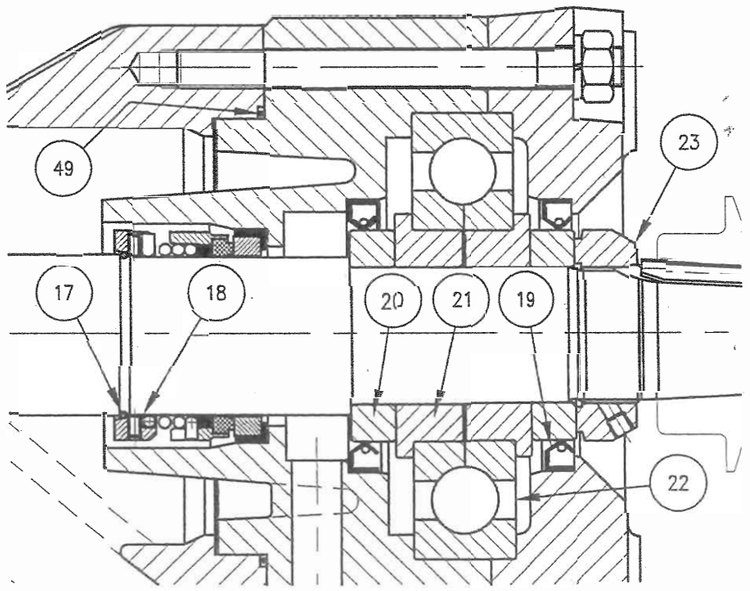
NAME
BASIC JET ASSEMBLY
HJ321 JET
SHEET 2 OF 2 SHEETS

SCALE 1.35X | No: ASSY–HJ321 01 001 | H



TORQUE CHART	Nm	ft/lb
IMPELLER NUT (10)	400	300
COUPLING NUT (25)	400	300
BEARING LOCK NUT (23)	270	200
IMPELLER NUT SET SCREW (11)	8	6
COUPLING NUT SET SCREW (11)	8	6
BEARING LOCK NUT SET SCREW	8	6
ALL OTHER NUTS AS PER DRAWING 85018		





REF	NO.	BY	DATE	AMENDMENTS
CL 119	D	R.J.L	7.12.99	WERE 8 & QTY. WAS 25.
CL 119	D	R.J.L	7.12.99	Sht 2–ITEM 12 WAS 106604, ITEM 41 QTY. WAS 2 & ITEMS 42 & 43 KITS
CL0101	C	J.W.	21.7.99	ITEM 67 DELETED
CL73	B	P.S.		ITEM 58 DELETED.
CL3836	A	KV	12/5/98	ITEMS 24,63,64,65,66,67 ADDED TO LIST
CL3836	0	P.S.	24/3/98	ISSUED FOR PRODUCTION.

JET 321

C.W.F.HAMILTON & CO. LTD. CHCH. NZ.

PROJECTION

DESIGNED	P.S.	24/3/98
DRAWN	P.A.S.	24/3/98
CHECKED		
APPROVED		

NAME
BASIC JET
DRY RUN ASSEMBLY
HJ321
SHEET 1 OF 2 SHEETS.

SCALE -

No: ASSY–HJ 321 01 004 D

A	B	C	D	Code	Item	Kit	Part Number	Qty	Product Description	Drawing Nbr
						A	110507		TAILPIPE KIT (DRY RUN)	HJ32101004
						B	107205		IMPELLER RACE KIT	HJ32101001
						C	107670		INTAKE KIT	HJ32101001
						D	110519		DRY RUN KIT HJ321	HJ32101004
A2						REF	104867		THREADED BUSH	104867
		C		4	1		107253	1	INTAKE	107253
	B			4	2		107254	1	IMPELLER RACE	107254
A				3	3		107102	1	TAILPIPE	107102
				4	4		30661	REF	(STUDS) METRIC (316-STST) M8x51	30647
				4	5		106972	1	INSPECTION COVER (S/No 2506 on)	106972
				3	6		107109	1	BEARING HOUSING	107109
				3	7		107257	1	BEARING CAP	107257
				3	8		107106	1	SCREEN (ALM) (std)	107106
				3	9		107121	1	MAINSHAFT	107121
				4	10		104624	1	IMPELLER NUT	104624
				2	11		JAJYXCB	1	(SCREWS) (SET SCREWS) METRIC 316 ST ST Socket M8x10	N/A
			D	2	12		111202	1	HARDENED SLEEVE ✓	111202
A			D	2	13		106627 ✓	1	DRY RUN BEARING (tenmat) ✓	108213 ✓
A				4	14		104618	1	TAILPIPE FAIRING	104618
				4	15		107124	1	IMPELLER KEY	107124
				4	16		104192	1	(JET) DOWELS 5mm OD 316 STST	104191
				2	17		109964	1	CIRCLIP (ROTARY SEAL RETAINER)	109964
			D	2	18		64869	1	(JET) ROTARY SEALS 2.5" 32HA (BM351764) CERAMIC FACE	64869
				2	19		JWKZADF	2	(OIL SEALS) Gaco DPSM8511012 C/W SS SPRING	N/A
				3	20		109965	2	SEAL SLEEVE	109965
				4	21		107122	2	BEARING CARRIER	107122
				2	22		63878	1	(SKF) BEARINGS ALL TYPES (SKF QJ317 OR QJ317NZ)	N/A
				2	23		63879	1	(SKF) NUTS SPECIAL Lock Nut KMT 11	63879
					24		109432	1	COUPLING KEY	109432
				4	25		104619	1	COUPLING NUT	104619
A2	B1			4	26		30661	3	(STUDS) METRIC (316-STST) M8x51	30647
	B8	C11		4	27		JEQKXAJ	19	(WASHERS) (SPRING) METRIC ST ST 316 M16	N/A
	B8	C11		4	28		JDQHXAL	19	(NUTS) (METRIC ST ST 316) M16	N/A
		C		4	29		107268	8	(STUDS) METRIC (SAF-2205) M16x135	30700
	B	C		4	30		107165	8	(STUDS) METRIC (SAF-2205) M16x95	30700

A	B	C	D	Code	Item	Kit	Part Number	Qty	Product Description	Drawing Nbr
		C		4	31		103916	3	(STUDS) METRIC (316-STST) M12x64	30639
		C7		4	32		JDQHXAH	11	(NUTS) (METRIC ST ST 316) M12	N/A
		C7		4	33		JEQKXAH	11	(WASHERS) (SPRING) METRIC ST ST 316 M12	N/A
				1	34		HMHRADQ	1	(O RINGS) IMPERIAL 0.25x5.25x5.75 (431N70)	N/A
		C		4	35		30723	3	(STUDS) METRIC (316-STST) M16x180	30634
		C		4	36		30658	8	(STUDS) METRIC (316-STST) M12x54	30639
A1	B			2	37		107167	2	(JET) O RINGS SPECIAL CORD DIA. 0.103x1069 LONG	108975
	B			2	38		107266	1	WEAR RING	107266
	B			2	39		107267	1	INSULATOR (WEAR RING)	107267
A2				2	40		103359	2	ANODE MK3	103359
A				4	41	~	JCQHXAG	4	(STUDS) METRIC (316-STST) M8x35	30647
A10	B1	C18		4	42	~	JDQHXAC	27	(NUTS) (METRIC ST ST 316) M8	N/A
A10	B1	C18		4	43	~	JEQKXAC	27	(WASHERS) (SPRING) METRIC ST ST 316 M8	N/A
A2	B1			2	44		102185	3	ANODE	102185
A				4	45		HYQHXCB	4	(BOLTS) (METRIC) ST ST 316 M8x45	N/A
A				4	46		107183	1	ANODE MOUNTING PLATE	107183
				3	47		107160	REF	(JET) O RINGS SPECIAL TRANSOM SEAL	107160
				4	48		107116	REF	TRANSOM PLATE	107116
				2	49		HMHRADK	1	(O RINGS) IMPERIAL 0.13x6.50x6.75 (260N70)	N/A
		C		4	50		107108	1	OIL COOLER COVER	107108
		C		4	51		107168	1	(JET) O RINGS SPECIAL CORD DIA. 0.13x1130	107168
				3	52		WAQUBCC	2	NIPPLE 3/8BSPP-3/8BSPP (SA 101 00 606)	N/A
				3	53		WAQUDAC	2	BONDED SEAL 3/8" BSP (400-823-4490-74)	N/A
A				4	54		HIQUAAG	1	(PLUGS) B.S.P.P. PLUG 1-1/4" BSP SQ HD 316 S.S.	N/A
A				4	55		30671	8	(STUDS) METRIC (316-STST) M10x51	30637
A				4	56		JDQHXAE	8	(NUTS) (METRIC ST ST 316) M10	N/A
A				4	57		JEQKXAE	8	(WASHERS) (SPRING) METRIC ST ST 316 M10	N/A
		C		4	59		JCQHXAO	4	(STUDS) METRIC (316-STST) M10x50	30637
				4	60		63097	1	(LABELS) (MODEL & SERIAL No PLATE)	63097
				4	61		63135	1	(LABELS) (PATENT PLATE)	63135
				4	62		63610	1	(LABELS) (WARNING PLATE)	63610
				3	63		HEIDAAA	1	(GREASE) NIPPLES (H29) 1/8"BSP	N/A
A				4	64		JMNGAAO	1	(HOSE) TAILS CP30 BRASS 1-1/4" BSP	N/A
		C		4	65		JCQHXAH	18	(STUDS) METRIC (316-STST) M8x40	30647
					66		107285	1	(JET) PACKAGING CASE	N/A

REF	NO.	BY	DATE	AMENDMENTS
				REFER TO SHEET 1 FOR AMENDMENTS.

JET 321

C.W.F.HAMILTON & CO. LTD. CHCH. NZ.

PROJECTION

DESIGNED P.S. DATE 24/3/98

DRAWN P.S. 24/3/98

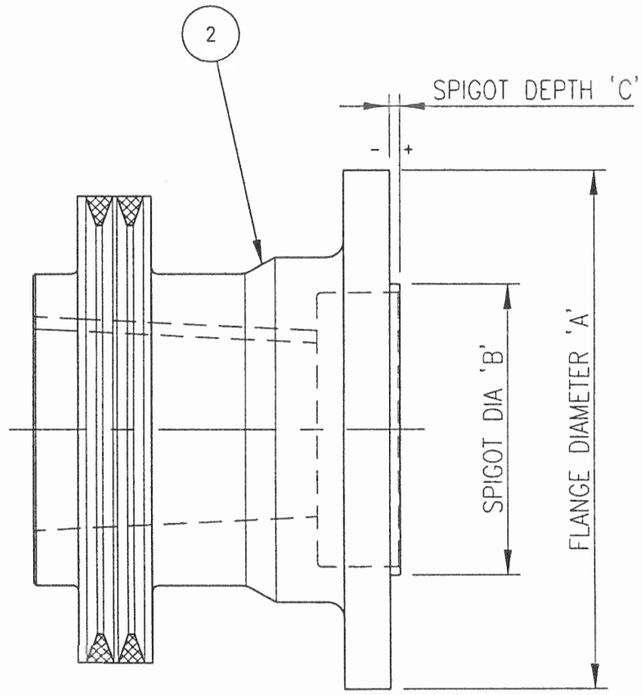
CHECKED

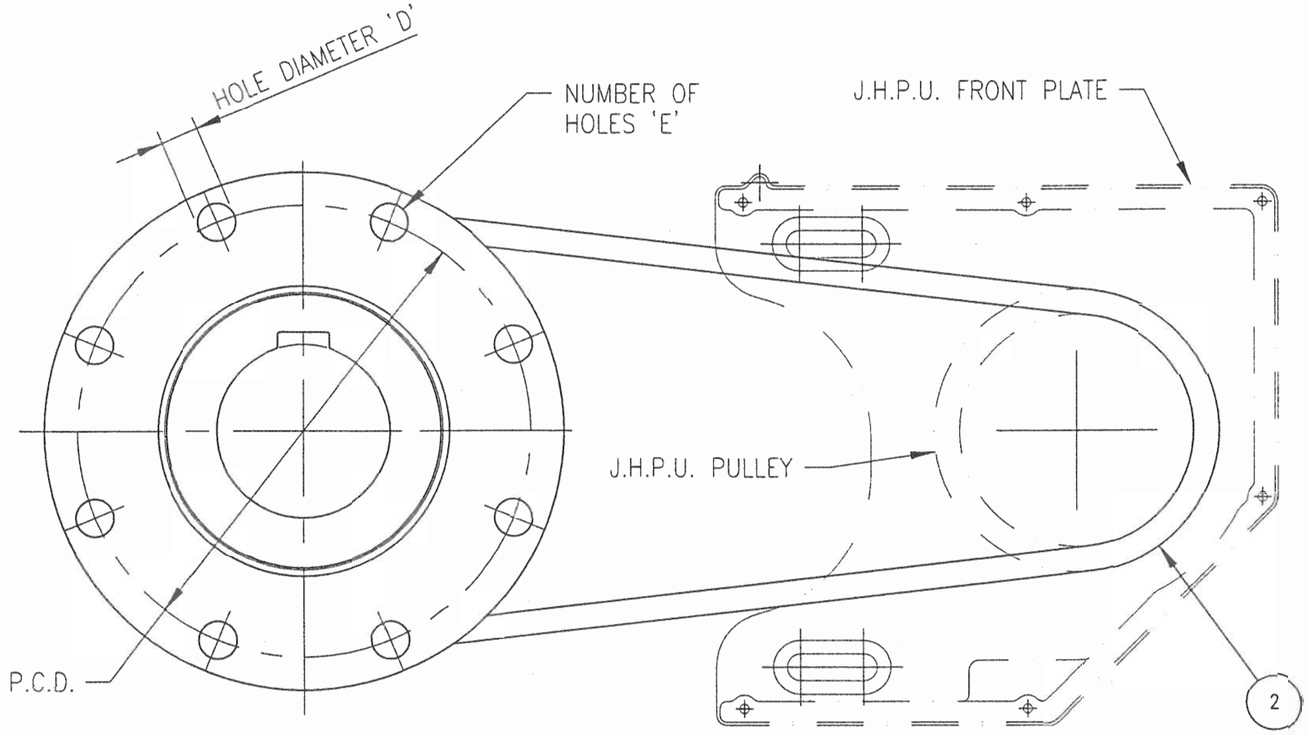
APPROVED

NAME
BASIC JET
DRY RUN ASSEMBLY
HJ321
SHEET 2 OF 2 SHEETS

SCALE -

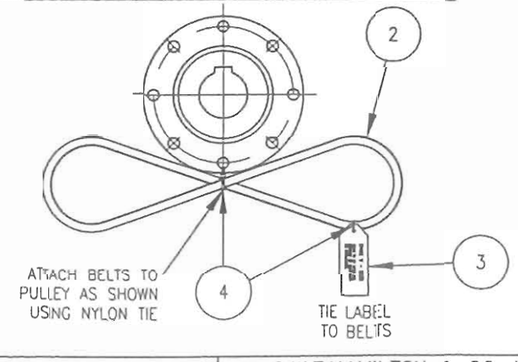
No: ASSY-HJ321 01 004 D





A	B	C	D	E	F	G	Item	Kit	PartNumber	Qty	ProductDescription	DrawingNbr
								A	108190	REF	COUPLING & V-BELT KIT (ELBE 0.115)	HJ32102001
								B	108191	REF	COUPLING & V-BELT KIT (HARDY SPICER 1650 & 1710)	HJ32102001
								C	108192	REF	COUPLING & V-BELT KIT (HARDY SPICER 1810)	HJ32102001
								D	108193	REF	COUPLING & V-BELT KIT (150 - 8 x M12) (GWB 587.30 & ELBE 0.158)	HJ32102001
								E	108194	REF	COUPLING & V-BELT KIT (180 - 10 x M16) (GWB 587.42 & ELBE 0.120)	HJ32102001
								F	109828	REF	COUPLING & V-BELT KIT (180 - 8 x M14) (GWB.587.35 & ELBE 0.119)	HJ32102001
								G	110704		COUPLING & V-BELT KIT (AQUADRIVE 20600)	HJ32102001
						G	1		110705	1	COUPLING (AQUADRIVE 20600)	110705
	B						1		107269	1	COUPLING (HARDY SPICER 1650 & 1710)	107269
A							1		107125	1	COUPLING (ELBE 0.115)	107125
					F		1		109829	1	COUPLING (180 - 8 x M14) (GWB.587.35 & ELBE 0.119)	109829
				E			1		107272	1	COUPLING (180 - 10 x M16) (GWB 587.42 & ELBE 0.120)	107272
			D				1		107271	1	COUPLING (150 - 8 x M12) (GWB 587.30 & ELBE 0.158)	107271
		C					1		107270	1	COUPLING (HARDY SPICER 1810)	107270
A	B	C	D	E	F	G	2		63763	4	(VEE BELTS) Gates XPZ710 (3Vx280)	108897
A	B	C	D	E	F	G	3		108897	1	(LABELS) (SPARE VEE BELTS)	108897
A	B	C	D	E	F	G	4		64500	2	CABLE TIE FARNELL PART # 149-327 150LG x 3.5 WIDE	N/A

DWG No	DIA `A'	DIA `B'	DEPTH `C'	DIA `D'	P.C.D.	HOLES `E'
107125	150	90	C = +2.3/2.0	10.2	130	8
107269	203	196.9 recess	C = -1.4/1.2	9.5	184.1	8
107270	203	196.9 recess	C = -1.4/1.2	11.2	184.1	12*
107271	150	90	C = +2.3/2.0	12.1	130	8
107272	180	110	C = +2.9/2.5	16.1	155.5	10
109829	180	110	C = +2.9/2.5	14.25	155.5	8
110705	200	192	C = +2.3/2.0	M16	165	8
*NOTE: NOT EQUI-SPACED SEE PART DRG						



REF	NO.	BY	DATE	AMENDMENTS
CL110		P.S.	29/9/99	ITEM 2 WAS 2 OFF. SEE THIS CL FOR PREVIOUS AMENDMENTS.
JET 321				

C.W.F.HAMILTON & CO. LTD. CHCH. NZ.

PROJECTION

NAME: COUPLINGS & BELTS
HJ 321 JET

	DATE
DESIGNED	
DRAWN C.W.R.	28.4.95
CHECKED P.A.S.	16.9.96
APPROVED K.V.E.	3.2.94

SCALE 2x

No: ASSY-HJ321 02 001 G

SPARES ASSY					ITEM	PART No	QTY	DESCRIPTION	DWG No
A				4	1	107287	1	ADAPTOR (SAE11.5) 150x8xM12	107287
B				4	1	107288	1	ADAPTOR (SAE14) 150x8xM12	107288
C				4	1	107289	1	ADAPTOR (SAE11.5) 180x10xM16	107289
D				4	1	107290	1	ADAPTOR (SAE14) 180x10xM16	107290
E				4	1	107291	1	ADAPTOR (SAE11.5) H/SPICER 1650/1710	107291
F				4	1	107292	1	ADAPTOR (SAE14) H/SPICER 1650/1710	107292
G				4	1	107293	1	ADAPTOR (SAE11.5) H/SPICER 1810	107293
H				4	1	107294	1	ADAPTOR (SAE14) H/SPICER 1810	107294
AB	CD	EF	GH	4	2	63595	1	SPARE PARTS CASE	
A	C	F		4	3	HYIUJBJ	8	3/8"UNC x1-1/2" HEX HD BOLT ZP	
A8	C8	F16	G8	4	4	JELJYAE	16	10MM SPRING WASHER ZP	
AB				4	5	HYIXXCU	8	M12x35 HEX HD GR88 BOLT ZP	
AB				4	6	HYIXXCV	8	M12x40 HEX HD GR88 BOLT ZP	
AB				4	7	JDPVYAH	8	M12 NUT ZP	
AB				4	8	JELJYAH	16	M12 SPRING WASHER ZP	
B		E	G	4	9	HYIUPCP	8	1/2" UNC x1-3/4" HEX BOLT HT ZP	
B		E	G	4	10	JELJAAG	8	1/2" SPRING WASHER ZP	
	C	E		4	11	HYIXYDP	10	M16x35 HEX HD GR88 BOLT ZP	
	C	E		4	12	JELJYAJ	20	M16 SPRING WASHER ZP	
	C	E		4	13	HYIXYDS	10	M16x45 HEX HD GR88 BOLT ZP	
	C	E		4	14	JDPVYAL	10	M16 HEX NUT	
		F	GH	4	15	HYIUABI	8	3/8"UNCx1-1/4" HEX HD BOLT HT ZP	
		F	G	4	16	HYIUABK	8	3/8"UNCx1-3/4" HEX HD BOLT HT ZP	
		F	G	4	17	JDKBPAE	8	3/8"UNC NUT ZP	
			H	4	18	HYIUABY	12	7/16"UNCx1-1/4" HEX HD BOLT HT ZP	
			H	4	19	HYIUACA	12	7/16"UNCx1-3/4" HEX HD BOLT HT ZP	
			H	4	20	JDKBAAF	12	7/16"UNC NUT ZP	
			H	4	21	JELJAAF	24	7/16" SPRING WASHER ZP	

ITEM	PART No		DESCRIPTION	DWG No
A	107273		ENGINE ADAPTOR KIT 150x8xM12	THIS
B	107274		ENGINE ADAPTOR KIT 150x8xM12	THIS
C	107275		ENGINE ADAPTOR KIT 180x10xM16	THIS
D	107276		ENGINE ADAPTOR KIT 150x8xM12	THIS
E	107277		ENGINE ADAPTOR KIT H/S 1650-1710	THIS
F	107278		ENGINE ADAPTOR KIT H/S 1650-1711	THIS
G	107279		ENGINE ADAPTOR KIT H/S 1800	THIS
H	107280		ENGINE ADAPTOR KIT H/S 1800	THIS

REF	NO.	BY	DATE	AMENDMENTS
CL3648	B	P.M.W.	5.5.97	REDRAWN ON CAD. ITEMS 2 TO 21 ADDED
CL3648	A	R.J.L.	3.2.94	UPDATED
JET 321				

C.W.F.HAMILTON & CO. LTD. CHCH. NZ.

PROJECTION

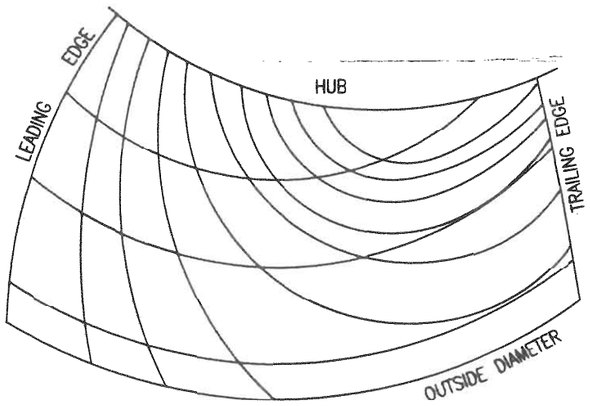
	DATE
DESIGNED	
DRAWN R.J.L.	28.1.94
CHECKED K.V.E.	10.2.94
APPROVED K.V.A.	10.2.94

NAME: ENGINE ADAPTOR PLATES HJ 321 JET

SCALE: -

No: ASSY-HJ321 02 006 B

VIEW OF BLADE FROM FRONT OF BOAT



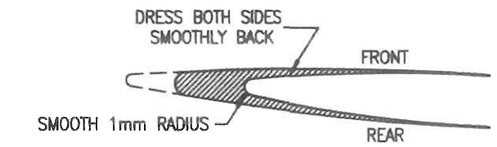
IMPELLER SHARPENING

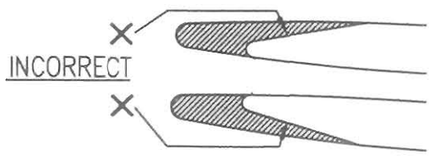
The leading edges of the impeller may tend to become "blunt" after a period of time with the action of small solid particles in the water. The performance of the impeller will drop as a result.

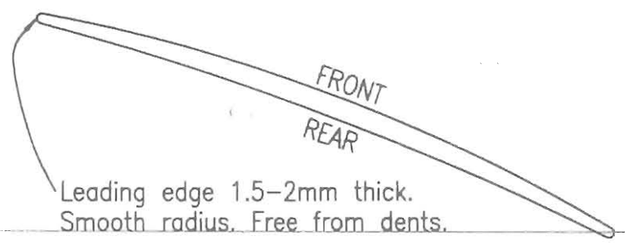
Anytime the inspection cover is removed, the leading edge of the blades should be inspected for wear. If badly worn, remove impeller (see section on dismantling unit) and sharpen as shown below.

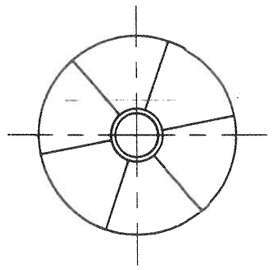
After sharpening balance within 100c.m.g.

Both front and rear surfaces to be a smooth uniform curve. Any flats will reduce efficiency and cause cavitation.



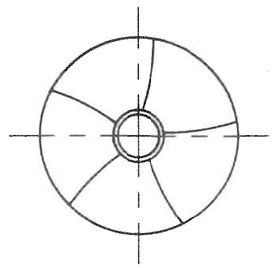






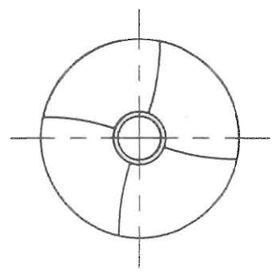
6 BLADE

SPARES ASSY				ITEM	PART NO	QTY	DESCRIPTION	DRG No
			3	1	107120	1	IMPELLER TYPE 26	107117
			3	1	107119	1	IMPELLER TYPE 28	107117
			3	1	107118	1	IMPELLER TYPE 30	107117
			3	1	107117	1	IMPELLER TYPE 32	107117
			3	1	108849	1	IMPELLER TYPE 36	107117



5 BLADE

SPARES ASSY				ITEM	PART NO	QTY	DESCRIPTION	DRG No
			3	1	107792	1	IMPELLER TYPE 20	107487
			3	1	107791	1	IMPELLER TYPE 21	107487
			3	1	107490	1	IMPELLER TYPE 22	107487
			3	1	107489	1	IMPELLER TYPE 23	107487
			3	1	107488	1	IMPELLER TYPE 24	107487
			3	1	107487	1	IMPELLER TYPE 25	107487



4 BLADE

SPARES ASSY				ITEM	PART NO	QTY	DESCRIPTION	DRG No
			3	1	107797	1	IMPELLER TYPE 15	107793
			3	1	107796	1	IMPELLER TYPE 16	107793
			3	1	107795	1	IMPELLER TYPE 17	107793
			3	1	107794	1	IMPELLER TYPE 18	107793
			3	1	107793	1	IMPELLER TYPE 19	107793

REF	NO.	BY	DATE	AMENDMENTS
CL3848	D	P.S.	4/12/97	TYPE 36 ADDED
CL3786.	C	P.M.W	27-7-96	REDRAWN ON CAD
CL3682	B	P.S.	20-10-94	4 AND 5 BLADE IMPELLERS ADDED
CL3648	A	P.S.	3-2-94	UPDATED
CL3647	0	P.S.	26-1-94	ISSUED FOR PRODUCTION

JET 321

C.W.F.HAMILTON & CO. LTD. CHCH. NZ.

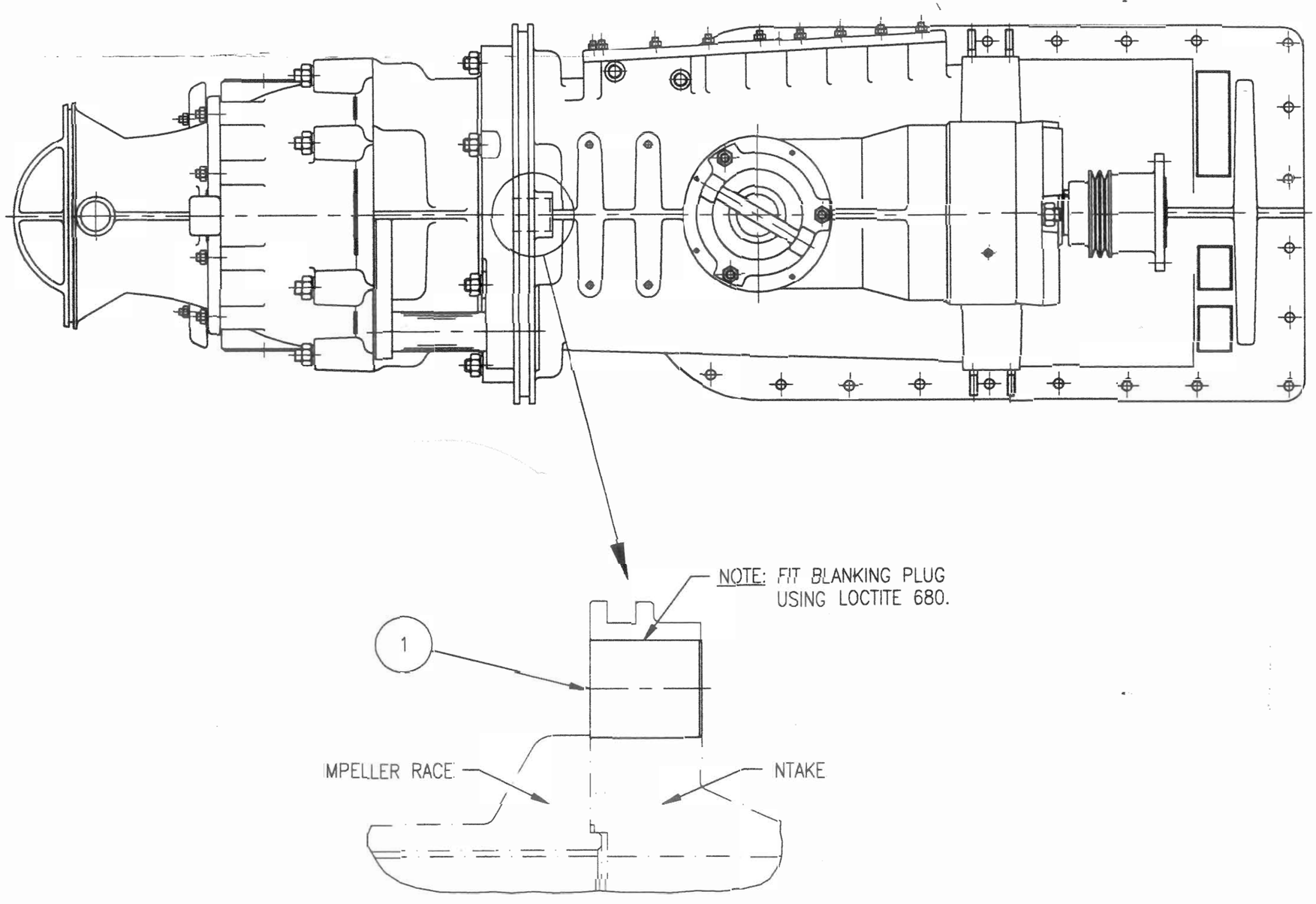
PROJECTION

	DATE
DESIGNED K.V.A	
DRAWN P.S.	26-1-94
CHECKED K.V.E.	10-2-94
APPROVED K.V.A.	10-2-94

NAME: IMPELLERS HJ 321 JET

SCALE: -

No: ASSY-HJ321 03 001 D



SPARES ASSY	ITEM	PART No	QTY	DESCRIPTION	DWG No
4	1	107218	1	BLANKING PLUG	107218

REF	NO.	BY	DATE	AMENDMENTS
C.3786	B	P.M.W	5.5.97	REDRAWN ON CAD
C.3648	A	F.L.	3.2.94	UPDATED
C.3641	0	P.S.	17.11.93	ISSUED FOR PRODUCTION

JET 321

C.W.F.HAMILTON & CO. LTD. CHCH. NZ.

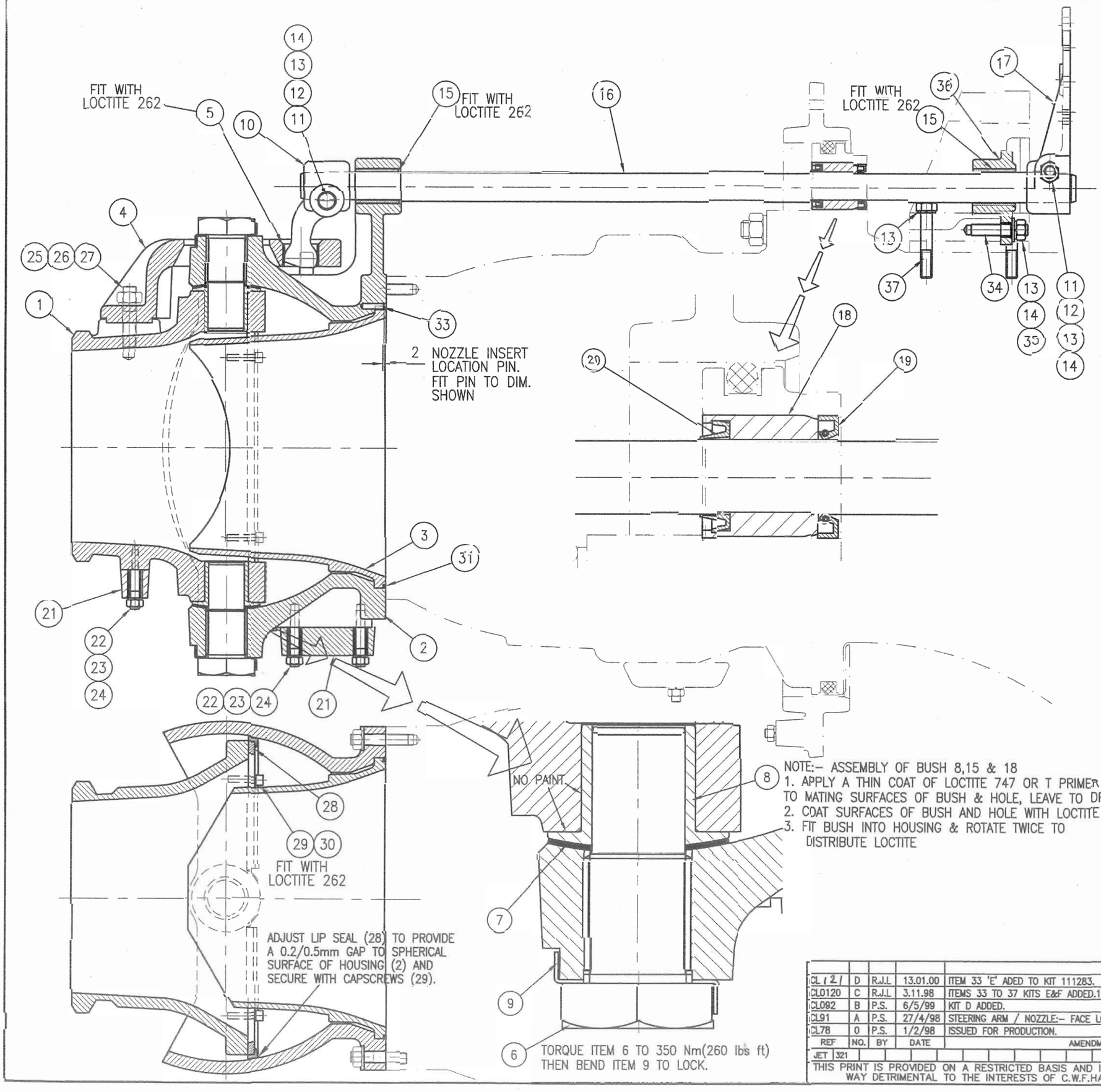
PROJECTION

	DATE
DESIGNED P.S.	15.11.93
DRAWN R.J.L.	15.11.93
CHECKED P.S.	17.11.93
APPROVED K.M.A.	10.2.94

NAME
BLANKING PLUG OPTION
STEERING
HJ 321 JET

SCALE -

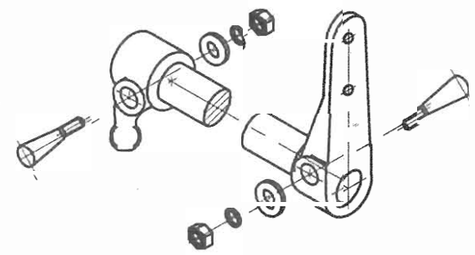
No: ASSY-HJ321 06 004 B



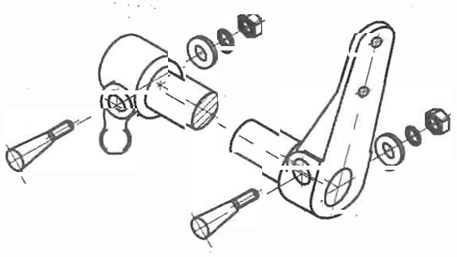
NOTE:- ASSEMBLY OF BUSH 8,15 & 18
1. APPLY A THIN COAT OF LOCTITE 747 OR T PRIMER TO MATING SURFACES OF BUSH & HOLE, LEAVE TO DRY.
2. COAT SURFACES OF BUSH AND HOLE WITH LOCTITE 262
3. FIT BUSH INTO HOUSING & ROTATE TWICE TO DISTRIBUTE LOCTITE

STEERING OPTIONS

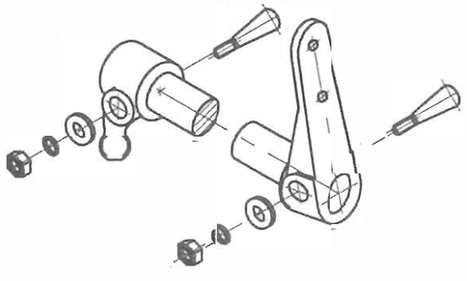
COTTER CRANK–TILLER POSITION DETAILS



STANDARD JET–part # HJ321 06 005



PORT JET–part # HJ321 06 007



STARBOARD JET–part # HJ321 06 006

CL12	D	R.J.L	13.01.00	ITEM 33 'E' ADED TO KIT 111283.
CL0120	C	R.J.L	3.11.98	ITEMS 33 TO 37 KITS E&F ADDED.13&14 WERE 2 OFF.15 WAS 1 OFF
CL092	B	P.S.	6/5/99	KIT D ADDED.
CL91	A	P.S.	27/4/98	STEERING ARM / NOZZLE:– FACE LOWERED 15mm.
CL78	0	P.S.	1/2/98	ISSUED FOR PRODUCTION.
REF	NO.	BY	DATE	AMENDMENTS

JET 321

C.W.F.HAMILTON & CO. LTD. CHCH. NZ.

PROJECTION

DESIGNED P.A.S.	DATE 1/10/97
DRAWN P.A.S.	1/10/97
CHECKED	
APPROVED K.V.E	1/02/98

NAME
STEERING ASSEMBLY
JT STEERING SYSTEM
HJ321
sheet 1 of 2 sheets

SCALE –
No: ASSY–HJ321 06 005
D

A	B	C	D	E	F	G	Code	Item	Kit	PartNumber	Qty	ProductDescription	DrawingNbr
									A	108145		STEERING SHAFT BUSH KIT	HJ32106001
									B	110793		NOZZLE ASSEMBLY JT STEERING	HJ32106005
									C	110794		NOZZLE HOUSING ASSEMBLY JT STEERING	HJ32106005
									D	111027		"JT" RETROFIT KIT C/W STG CYLINDER BRACKET	HJ32106005
									E	111283		"JT"RETROFIT KIT WITHOUT STG CYLINDER BRACKET	HJ32106005
									F	111282		OUTRIGGER BEARING KIT	HJ32106005
				E					REF	111275	1	OUTRIGGER BEARING SUPPORT BRACKET	107137
			D						REF	107476	1	STEERING CYLINDER BRACKET KIT 321	CTSJK02001
	B		D	E			4	**1**		110762	1	NOZZLE JT STEERING	110762
		C	D	E			4	**2**		110763	1	NOZZLE HOUSING JT STEERING	110763
			D	E			4	**3**		110764	1	INSERT JT STEERING	110764
			D	E			4	**4**		110765	1	STEERING ARM JT STEERING	110765
			D	E			4	**5**		107156	1	DEFLECTOR CRANK BUSH	102961
			D	E			3	**6**		110788	2	PIVOT PIN JT STEERING HJ321	110788
		C	D	E			3	**7**		110767	2	THRUST WASHER JT STEERING	110767
			D	E			3	**8**		110769	2	BUSH JT STEERING	110769
	B		D	E			4	**9**		110789	2	WASHER 70mm O.D. X 36.5mm I.D. X 1.2mmTHICK 316S.S.	110789
			D	E			3	**10**		109241	1	STEERING CRANK	109241
			D1	E1			2	**11**		102834	2	COTTER	102834
			D1	E1			2	**12**		102993	2	(WASHER) SPECIAL 25mm ODx11mm IDx3mm thk	102993
			D4	E8	F3		2	**13**		JEQKXAE	9	(WASHERS) (SPRING) METRIC ST ST 316 M10	N/A
			D4	E4	F3		2	**14**		JDQHXAE	5	(NUTS) (METRIC ST ST 316) M10	N/A
A		C1	D	E	F1		2	**15**		104755	2	STEERING SHAFT BUSH	104755
			D	E			4	**16**		110791	1	STEERING SHAFT JT STEERING	106973
							4	**17**		106954	1	TILLER	105352
A							2	**18**		108143	1	STEERING SHAFT BUSH	108143
A							2	**19**		61362	1	(OIL SEALS) 25x42x7 (GACO DPSM 25427) C/W SS SPRING	N/A
A							2	**20**		61353	1	(SEAL) SCRAPER RING-WYCLIP	61332
	B1	C1	D	E			2	**21**		103359	2	ANODE MK3	103359
	B2	C2	D	E			4	**22**		30661	4	(STUDS) METRIC (316-STST) M8x51	30647
	B2	C2	D	E			2	**23**		JDQHXAE	4	(NUTS) (METRIC ST ST 316) M10	N/A
	B2	C2	D	E			2	**24**		JEQKXAC	4	(WASHERS) (SPRING) METRIC ST ST 316 M8	N/A
	B		D	E			4	**25**		30658	2	(STUDS) METRIC (316-STST) M12x54	30639
			D	E			2	**26**		JDQHXAH	2	(NUTS) (METRIC ST ST 316) M12	N/A
			D	E			2	**27**		JEQKXAH	2	(WASHERS) (SPRING) METRIC ST ST 316 M12	N/A
	B		D	E			2	**28**		110792	2	LIP SEAL JT STEERING	110792
	B		D	E			2	**29**		30798	4	(SCREWS) (CAPSCREWS) METRIC ST ST 316 M6x25 (SOC HD)	N/A
	B		D	E			2	**30**		JEQKXAA	4	(WASHERS) (SPRING) METRIC ST ST 316 M6	N/A
			D	E			2	**31**		64931	1	(O RINGS) IMPERIAL 0.1" X 9.5" X 9.7" (177N70)	N/A
A							4	**32**		MRINAAI	1	LOCTITE 262 10ML BOTTLE	N/A
		C	D	E			4	**33**		109594	1	INDEX PIN	109594
			D	E	F			**34**		JCQHXAO	3	(STUDS) METRIC (316-STST) M10x50	30637
			D	E	F			**35**		JEOZXAY	3	(WASHERS) (FLAT) METRIC ST ST 316 M10	N/A
			D	E	F			**36**		111276	1	OUTRIGGER BEARING (STEERING SHAFT HJ321)	111276
				E				**37**		HYQHXEA	4	(BOLTS) (METRIC) ST ST 316 M10x60	N/A

REF	NO.	BY	DATE	AMENDMENTS
JET 321				SEE SHEET 1 FOR AMENDMENTS.

C.W.F.HAMILTON & CO. LTD. CHCH. NZ.

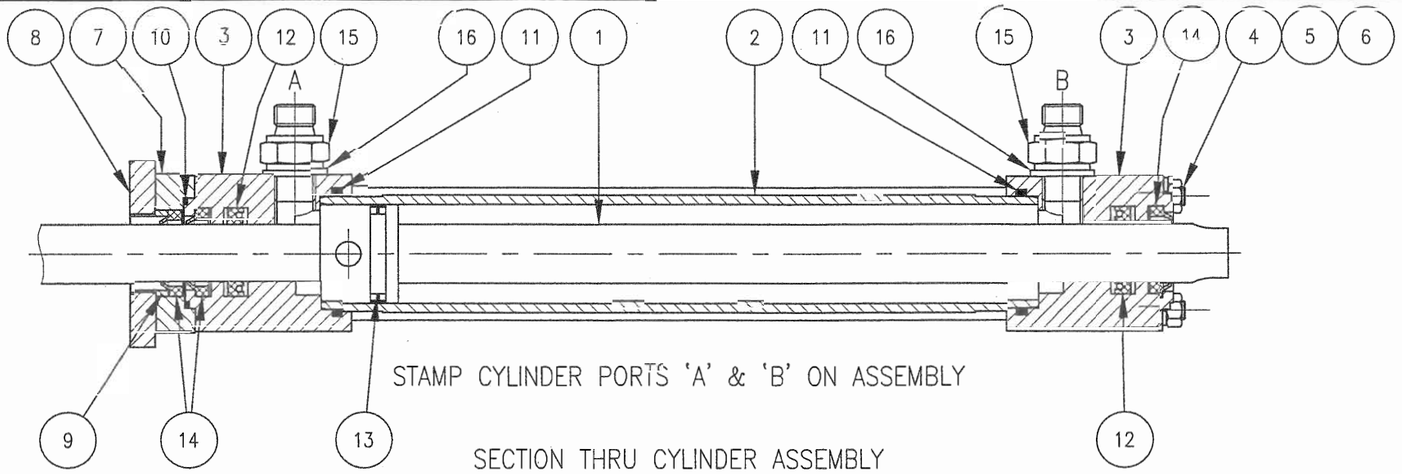
PROJECTION

NAME: STEERING ASSEMBLY JT STEERING SYSTEM HJ321 sheet 2 of 2 sheets

DESIGNED P.A.S.	DATE 1/10/97	
DRAWN P.A.S.	1/10/97	
CHECKED		
APPROVED K.V.E	1-02-98	

SCALE -

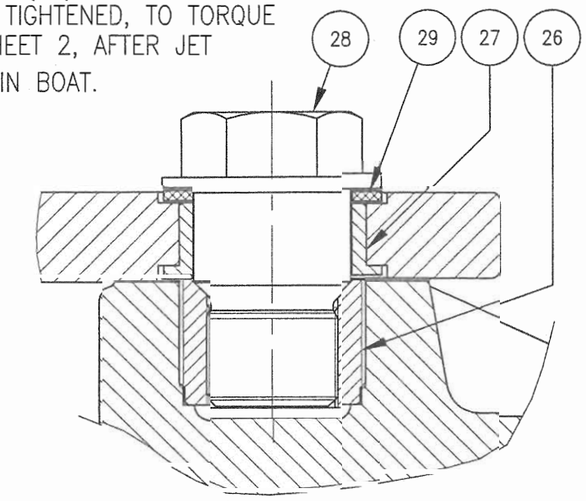
No: ASSY-HJ321 06 005 D



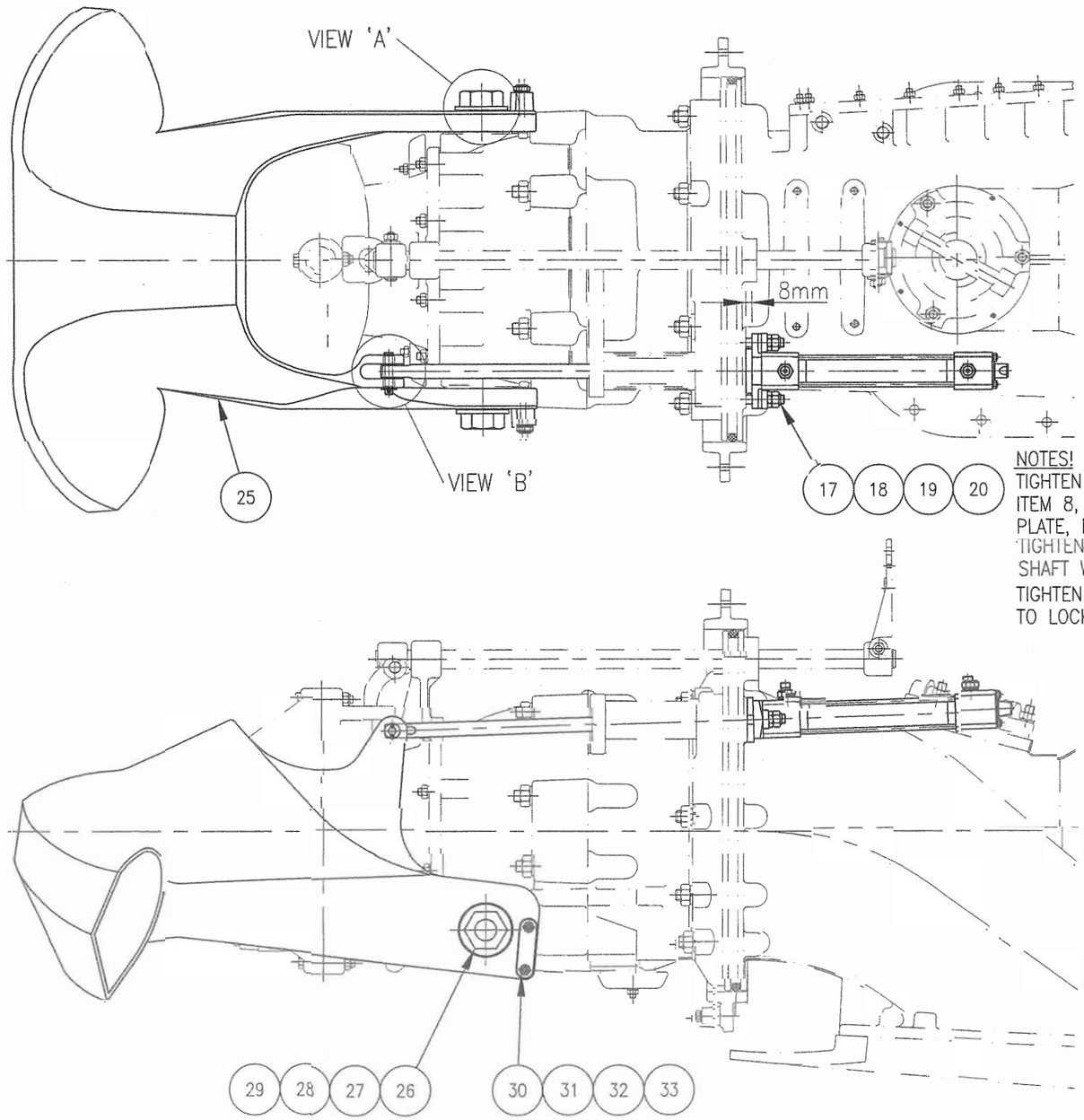
STAMP CYLINDER PORTS 'A' & 'B' ON ASSEMBLY

SECTION THRU CYLINDER ASSEMBLY

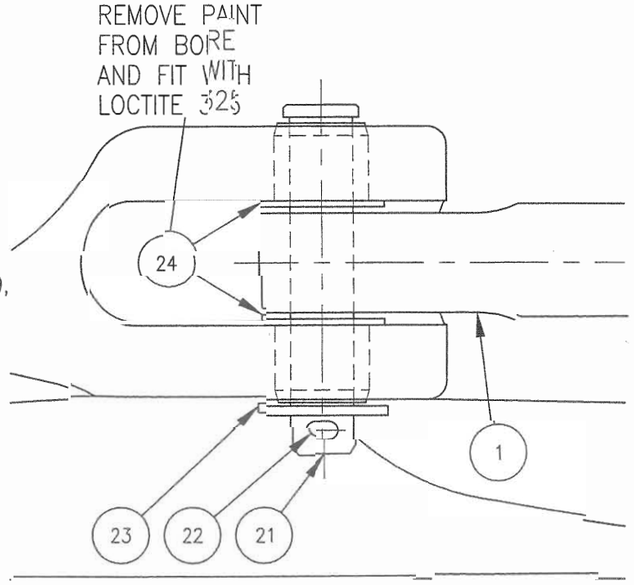
NOTE:–
JET IS TO BE SHIPPED
WITH PIVOT PIN (28) NOT TIGHTENED.
PIN IS TO BE TIGHTENED, TO TORQUE
SHOWN ON SHEET 2, AFTER JET
IS INSTALLED IN BOAT.



VIEW 'A'



NOTES!
TIGHTEN NUTS, ITEM 19, COMPRESSING RESILIENT MOUNT. ITEM 8, TO PROVIDE AN 8mm GAP BETWEEN MOUNTING PLATE, ITEM 7. AND INTAKE FLANGE.
TIGHTEN ONE OF THESE NUTS FURTHER TO ALIGN CYLINDER SHAFT WITH REVERSE DUCT ATTACHMENT POINT.
TIGHTEN NYLOC NUTS, ITEM 20, AGAINST THIN NUTS, ITEM 19, TO LOCK IN POSITION.



VIEW 'B'

REF	NO.	BY	DATE	AMENDMENTS
CL/01	K	J.W.	21.7.99	ITEM 34 DELETED. 3814, 3826, 77, 87, 92
JET 321				

C.W.F.HAMILTON & CO. LTD. CHCH. NZ.

PROJECTION

NAME: REVERSE ASSEMBLY HSRC HJ 321 JET

SHEET 1 OF 2 SHEETS

		DATE
DESIGNED		
DRAWN	P.S.	8.11.93
CHECKED	K.V.E.	10.2.94
APPROVED	K.V.A.	10.2.94

SCALE: –

No: ASSY–HJ321 07 001 K

A	B	C	D	E	F	G	H	Code	Item	Kit	Part Number	Qty	Product Description	Drawing Nbr
										A	107264	REF	REVERSE CYLINDER HSRC	HJ32107001
										B	107460	REF	REVERSE CYLINDER SEAL KIT	HJ32107001
										C	107105		REVERSE DUCT KIT	107105
A								4	1		107259	1	SHAFT/PISTON ASSEMBLY	107259
A								4	2		106555	1	CYLINDER	106555
A								4	3		107416	2	FRONT/BACK HEAD	107416
A								4	4		107133	4	(STUDS) METRIC (316-STST) M6x332	30635
A								4	5		JEQKXAA	4	(WASHERS) (SPRING) METRIC ST ST 316 M6	N/A
A								4	6		JDQHXAA	4	(NUTS) (METRIC ST ST 316) M6	N/A
A								4	7		107458	1	MOUNTING PLATE	107458
A	B							3	8		107135	1	RESILIENT MOUNT	107135
A								4	9		107459	1	SCRAPER RETAINER	107459
A	B							2	10		HMHRAEL	1	(O RINGS) IMPERIAL 0.07x1.25x1.38 (026N70)	N/A
A	B							2	11		HMHRAEW	1	(O RINGS) IMPERIAL 0.10x1.44x1.63 (127N70)	N/A
A	B							2	12		63953	2	(SEAL) SHAFT SEAL HALLITE 601#4102901	N/A
A	B							2	13		JWKZADD	1	(SEAL) PISTON SEAL-GT 8065-173-HR	N/A
A	B							2	14		63954	3	(SEAL) WIPER HALLITE 420 # 8880400	N/A
A	B							2	15		WAQUBCB	2	NIPPLE 1/4BSPP-1/4BSPP (SA 101 00 404)	N/A
A	B							2	16		WAQUDAB	2	BONDED SEAL 1/4" BSP (400-821-4490-74)	N/A
								4	17		30715	2	(STUDS) METRIC (316-STST) M12x75	30639
A								4	18		107261	2	(WASHER) SPECIAL REV JACK MOUNT	107261
A								4	19		JDQKXAH	2	(NUTS) (HALF NUTS) M12 (316 STST)	N/A
A	B							3	20		JDQSXAH	2	(NUTS) (METRIC NYLOC ST ST 316) M12	N/A
A								4	21		106503	1	CONNECTING PIN	106503
A	B							2	22		HUILAAA	1	(SPLIT PINS) ST ST 316 3/32"x3/4"	N/A
A								4	23		JEQZXA	1	(WASHERS) (FLAT) METRIC ST ST 316 M10x21x1.2	N/A
		C						4	24		111014	2	BUSH for REVERSE CYLINDER PIN	111014
		C						4	25		111020	1	REVERSE DUCT HJ321	111020
								4	26		104867	2	THREADED BUSH	104867
								4	27		104869	2	REVERSE DUCT PIVOT BUSH (orkot)	104869
								4	28		104868	2	REVERSE DUCT PIVOT PIN	104868
								4	29		104870	2	(WASHER) SPECIAL REVERSE DUCT SPACER	104870
								4	30		103359	2	ANODE MK3	103359
								4	31		30661	4	(STUDS) METRIC (316-STST) M8x51	30647
								4	32		JEQKXAC	4	(WASHERS) (SPRING) METRIC ST ST 316 M8	N/A
								4	33		JDQHXAC	4	(NUTS) (METRIC ST ST 316) M8	N/A

TORQUE CHART	Nm	ft/lb
PIVOT PIN (28)	675	510
ALL OTHER NUTS AS PER DWG 85018		

REF	NO.	BY	DATE	AMENDMENTS
JET 321				FOR AMENDMENTS SEE SHEET 1

C.W.F.HAMILTON & CO. LTD. CHCH. NZ.

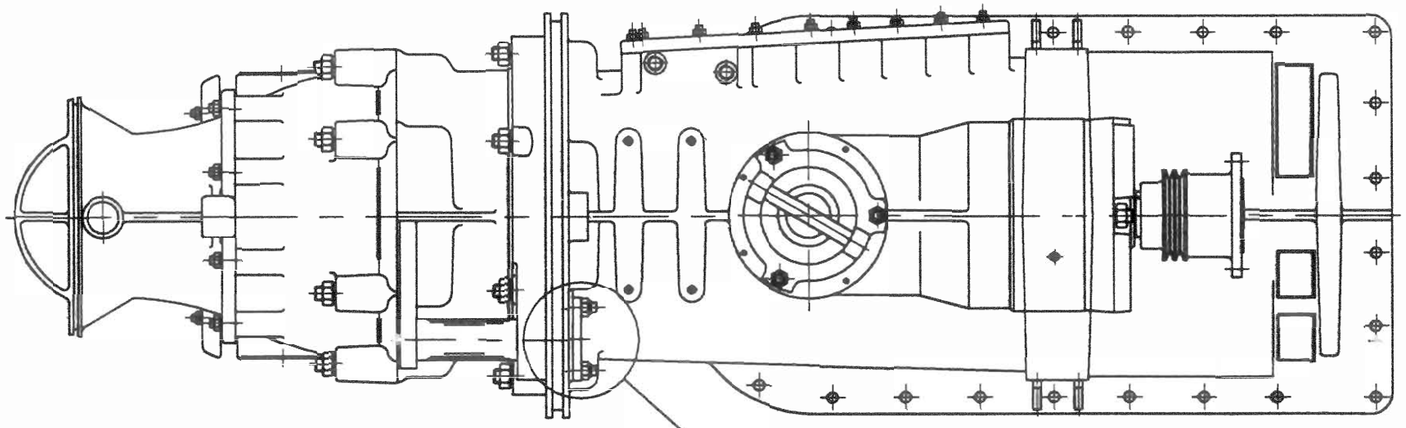
PROJECTION

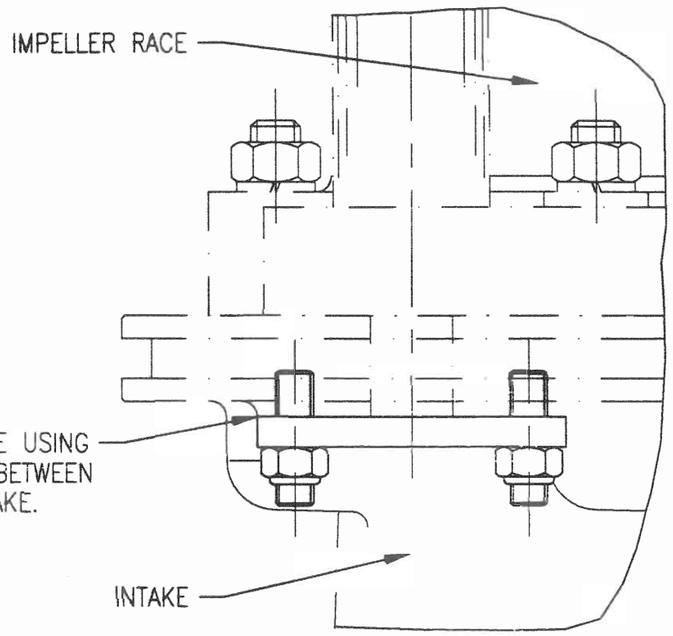
DESIGNED KVA	DATE 08/1/93
DRAWN P.A.S	09/12/93
CHECKED KVA	10/02/94
APPROVED KVE	10/02/94

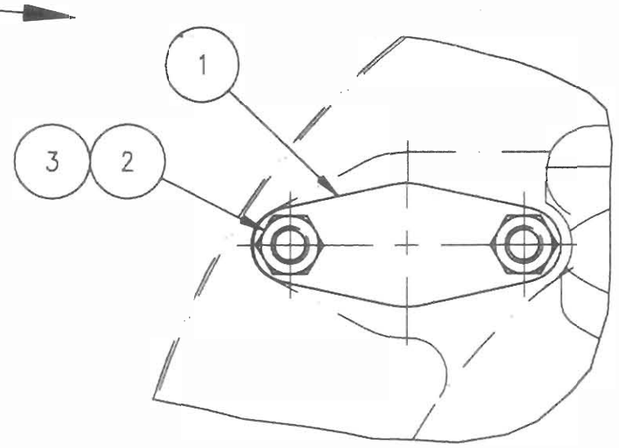
NAME
REVERSE ASSEMBLY HSRC
HJ 321 JET
SHEET 2 OF 2

SCALE -

No: ASSY-HJ321 07 001 K







SPARES ASSY	ITEM	PART No	QTY	DESCRIPTION	DWG No
4	1	107220	1	BLANKING PLATE	107220
4	2	108573	2	M12 x 44 STUD 316 S.S.	30639
4	3	JDQSXAH	2	M12 NYLOC NUT 316 S.S.	

REF	NO.	BY	DATE	AMENDMENTS
C3718	B	P.M.W	5.5.97	REDRAWN ON CAD. STUD WAS #JCQHXAN, NUT WAS #JDQSXAE
CL.3648	A	R.L.	3.2.94	UPDATED
CL.3543	0	P.S.	29.11.93	ISSUED FOR PRODUCTION

JET 321

C.W.F.HAMILTON & CO. LTD. CHCH. NZ.

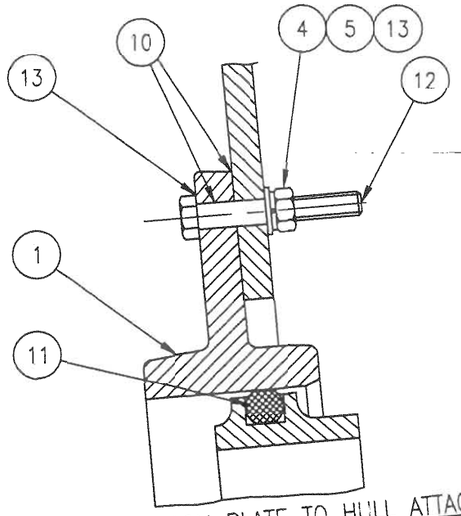
PROJECTION

	DATE
DRAWN R.J.L.	19.11.93
CHECKED P.S.	26.11.93
APPROVED K.V.A.	1.12.93

NAME: BLANKING PLATE OPTION REVERSE
HJ 321 JET

SCALE: -

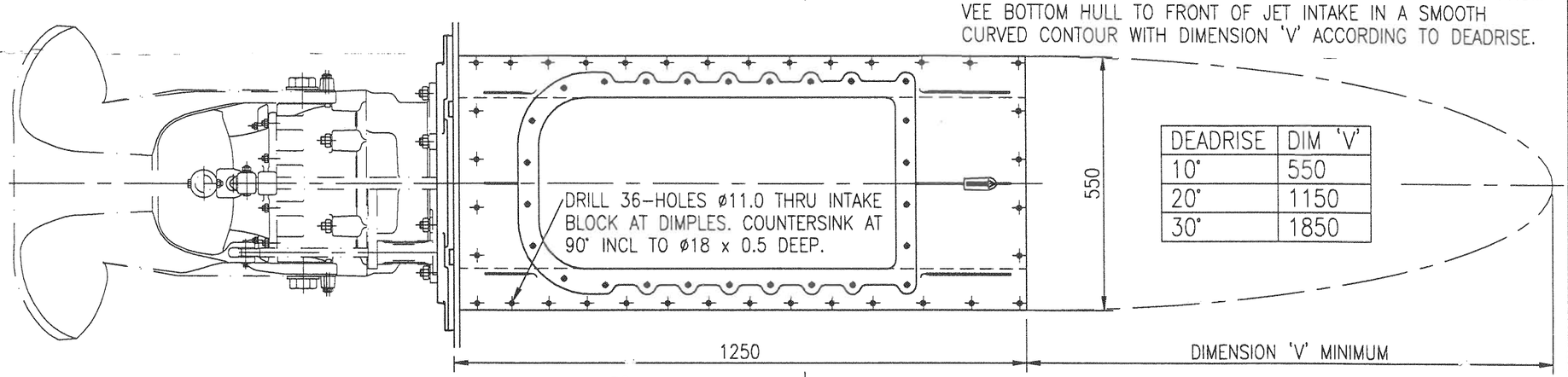
No: ASSY-HJ321 07 002 B



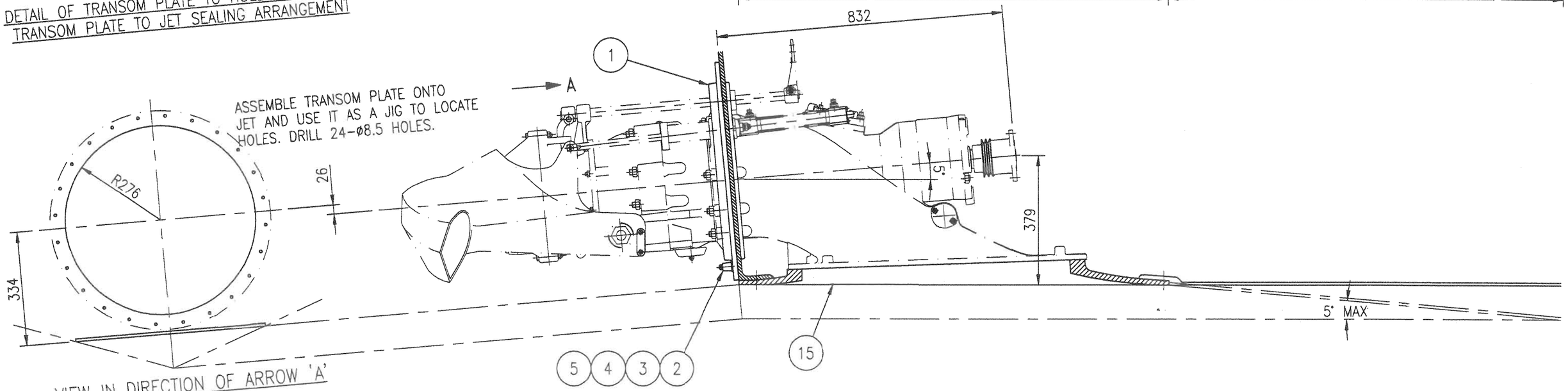
DETAIL OF TRANSOM PLATE TO HULL ATTACHMENT
TRANSOM PLATE TO JET SEALING ARRANGEMENT

FOR JETS MOUNTED ON
HULL CENTRE LINE ONLY

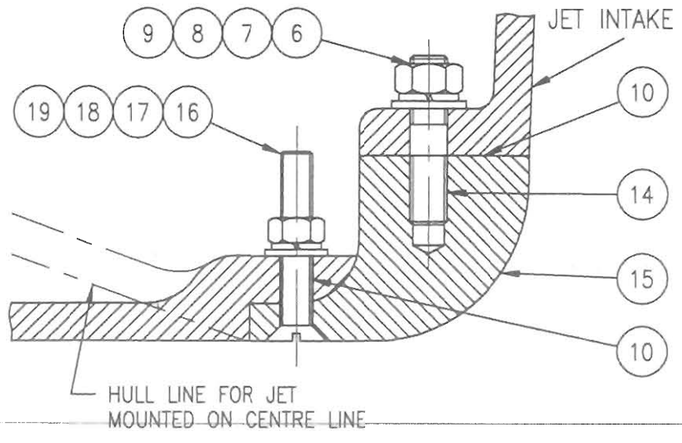
ARRANGE THIS TRIANGULAR SHAPED FAIRING WHICH BLENDS FROM VEE BOTTOM HULL TO FRONT OF JET INTAKE IN A SMOOTH CURVED CONTOUR WITH DIMENSION 'V' ACCORDING TO DEADRISE.



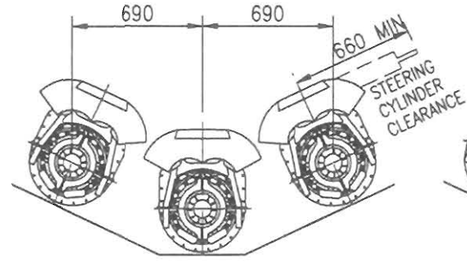
DEADRISE	DIM 'V'
10°	550
20°	1150
30°	1850



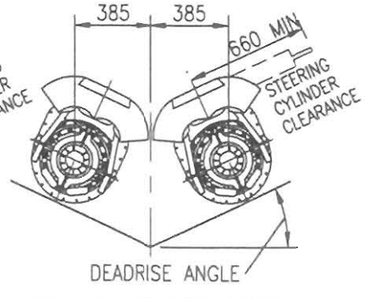
VIEW IN DIRECTION OF ARROW 'A'



SECTION THRU JOINT BETWEEN HULL, INTAKE BLOCK & JET



TRIPLE JET INSTALLATION



TWIN JET INSTALLATION

REF	NO.	BY	DATE	AMENDMENTS
CL3837	D	P.S.	3/6/98	ITEM1 WAS 107116.4&5 WAS 23 OFF.12 WAS 21 OFF.13 WAS 42 OFF
CL3786	C	P.M.W	30.4.97	REDRAWN ON CAD
CL3683	B	P.S.	3.11.94	STEERING CYL CLEARANCE NOW SHOWN ON DEADRISE
CL3648	A	P.S.	16.2.94	UPDATED
CL3645	0	P.S.	16.12.93	ISSUED FOR PRODUCTION
CL65	E	PMW	25.8.98	NOTE RE DRILLING 36–HOLES THRU DIMPLES ADDED

JET 321

C.W.F.HAMILTON & CO. LTD. CHCH. NZ.

PROJECTION

NAME: INSTALLATION DETAILS G.R.P. HULL HJ 321 JET

	DESIGNED	DATE
DRAWN	P.S.	8.9.93
CHECKED	K.V.E.	10.2.94
APPROVED	K.V.A.	10.2.94

SCALE: –

No: ASSY–HJ321 08 001 E

A	B	C	Item	Kit	PartNumber	Qty	ProductDescription	DrawingNbr
				A	107212		INTAKE BLOCK KIT (GRP HULL)	HJ32108001
				B	107213		INSTALLATION HARDWARE KIT	HJ32108001
				C	107407		TRANSOM PLATE KIT (ALUM & GRP HULL)	HJ32108001
		C	1		110506	1	TRANSOM PLATE	110506
		C	2		103359	1	ANODE MK3	103359
		C	3		30667	2	(STUDS) METRIC (316-STST) M8x46	30647
		C	4		JDQHXAC	26	(NUTS) (METRIC ST ST 316) M8	N/A
		C	5		JEQKXAC	26	(WASHERS) (SPRING) METRIC ST ST 316 M8	N/A
	B		6		30658	26	(STUDS) METRIC (316-STST) M12x54	30639
	B		7		JDQHXAH	26	(NUTS) (METRIC ST ST 316) M12	N/A
	B		8		JEQKXAH	26	(WASHERS) (SPRING) METRIC ST ST 316 M12	N/A
	B		9		JEOZXAK	26	(WASHERS) (FLAT) METRIC ST ST 316 M12x24x1.6	N/A
	B		10		JMNGAAR	1	NEUT-CURE RTV SILICONE 310G	N/A
		C	11		107160	1	(JET) O RINGS SPECIAL TRANSOM SEAL	107160
		C	12		HZQHXBK	24	(SCREWS) (M/C SCREWS) METRIC ST ST 316 HEX HD M8x70	N/A
		C	13		JEOZXAF	45	(WASHERS) (FLAT) METRIC ST ST 316 M8x16x1.2	N/A
	B		14		MRINAAI	1	LOCTITE 262 10ML BOTTLE	N/A
A			15		107255	1	INTAKE BLOCK	107255
A			16		HZPPXEE	36	(BOLTS) (M/C SCREWS) METRIC ST ST 316 M10x60 (CSK HD)	N/A
A			17		JDQHXAE	36	(NUTS) (METRIC ST ST 316) M10	N/A
A			18		JEOZXAY	36	(WASHERS) (FLAT) METRIC ST ST 316 M10	N/A
A			19		JEQKXAE	36	(WASHERS) (SPRING) METRIC ST ST 316 M10	N/A
A1	B1	C1	20		63595	1	(JET) PACKAGING BOLT BOX	N/A

REFER TO SHEET 1 FOR AMENDMENTS

REF	NO.	BY	DATE	AMENDMENTS
JET 321				

C.W.F.HAMILTON & CO. LTD. CHCH. NZ.

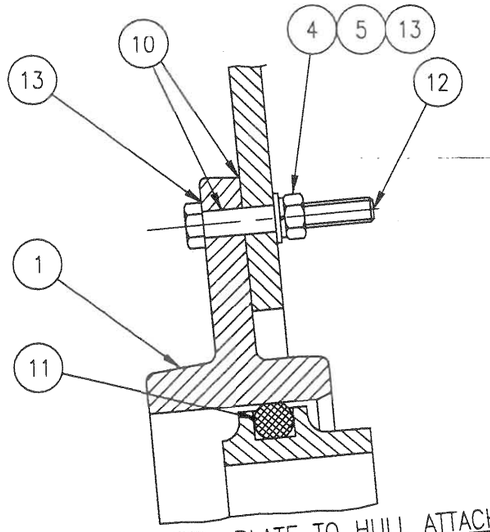
PROJECTION

DESIGNED	DATE
DRAWN P.S.	8.9.93
CHECKED K.V.E.	10.2.94
APPROVED K.V.A.	10.2.94

NAME
INSTALLATION DETAILS
G.R.P. HULL
HJ 321 JET
SHT 2 OF 2

SCALE -

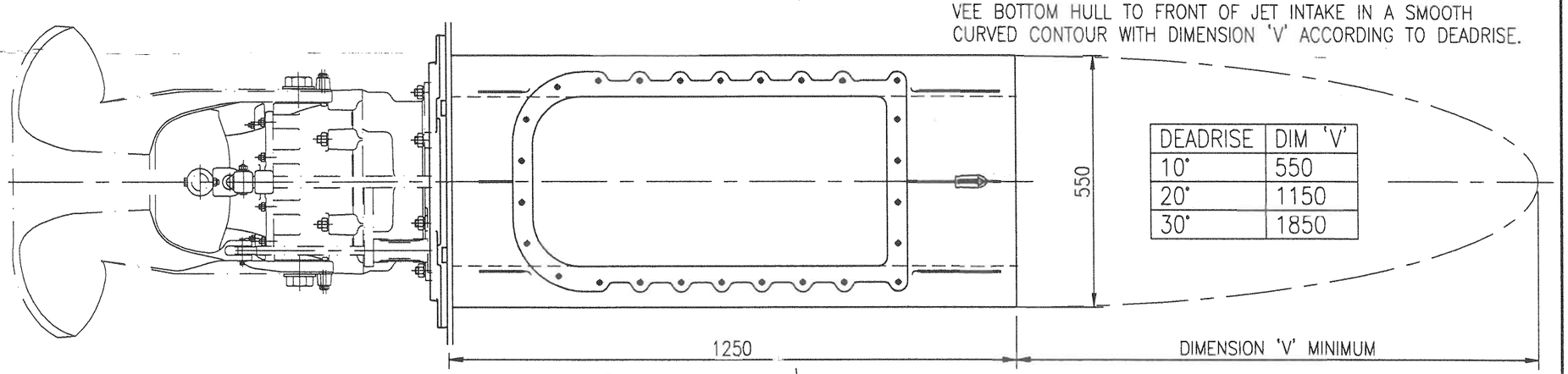
No: ASSY-HJ321 08 001 E



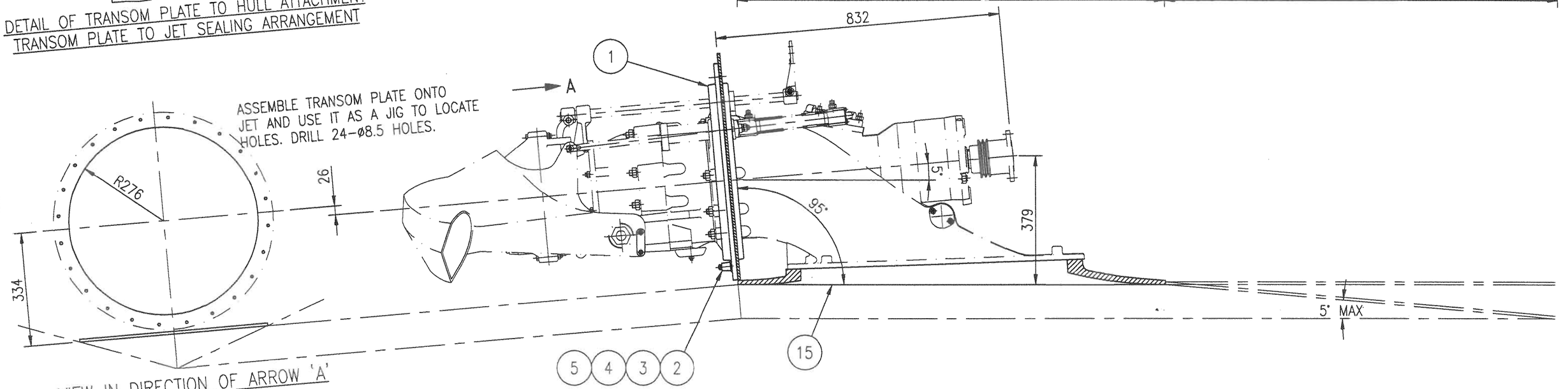
DETAIL OF TRANSOM PLATE TO HULL ATTACHMENT
TRANSOM PLATE TO JET SEALING ARRANGEMENT

FOR JETS MOUNTED ON
HULL CENTRE LINE ONLY

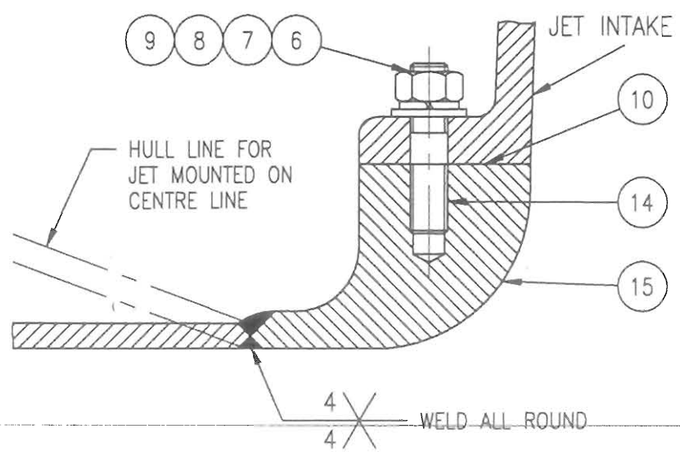
ARRANGE THIS TRIANGULARSHAPED FAIRING WHICH BLENDS FROM VEE BOTTOM HULL TO FRONT OF JET INTAKE IN A SMOOTH CURVED CONTOUR WITH DIMENSION 'V' ACCORDING TO DEADRISE.



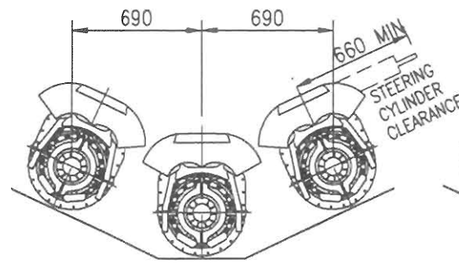
DEADRISE	DIM 'V'
10°	550
20°	1150
30°	1850



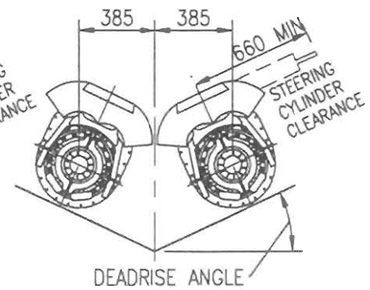
VIEW IN DIRECTION OF ARROW 'A'



SECTION THRU JOINT BETWEEN HULL, INTAKE BLOCK & JET



TRIPLE JET INSTALLATION



TWIN JET INSTALLATION

REF	NO.	BY	DATE	AMENDMENTS
CL75	E	P.S.		ITEM15 WAS 107256
CL3837	D	P.S.	3/6/98	ITEM1 WAS 107116.4&5 WAS 23 OFF.12 WAS 21 OFF.13 WAS 42 OFF
CL3786	C	P.M.W	5.5.97	REDRAWN ON CAD
CL3683	B	P.S.	3.11.94	STEERING CYL CLEARANCE NOW SHOWN ON DEADRISE
CL3648	A	P.S.	16.2.94	UPDATED
CL3645	0	P.S.	16.12.93	ISSUED FOR PRODUCTION
JET 321				

C.W.F.HAMILTON & CO. LTD. CHCH. NZ.

PROJECTION

DESIGNED	DATE	
DRAWN P.S.	8.9.93	
CHECKED K.V.E.	10.2.94	
APPROVED K.V.A.	10.2.94	

NAME
INSTALLATION DETAILS
ALUMINIUM HULL
HJ 321 JET

SCALE –
No: ASSY-HJ321 08 002
E

A	B	C	Item	Kit	PartNumber	Qty	ProductDescription	DrawingNbr
				A	107255		INTAKE BLOCK	107255
				B	107213		INSTALLATION HARDWARE KIT	HJ32108001
				C	107407		TRANSOM PLATE KIT (ALUM & GRP HULL)	HJ32108001
		C	1		110506	1	TRANSOM PLATE	110506
		C	2		103359	1	ANODE MK3	103359
		C	3		30667	2	(STUDS) METRIC (316-STST) M8x46	30647
		C	4		JDQHXAC	26	(NUTS) (METRIC ST ST 316) M8	N/A
		C	5		JEQKXAC	26	(WASHERS) (SPRING) METRIC ST ST 316 M8	N/A
	B		6		30658	26	(STUDS) METRIC (316-STST) M12x54	30639
	B		7		JDQHXAH	26	(NUTS) (METRIC ST ST 316) M12	N/A
	B		8		JEQKXAH	26	(WASHERS) (SPRING) METRIC ST ST 316 M12	N/A
	B		9		JEOZXAK	26	(WASHERS) (FLAT) METRIC ST ST 316 M12x24x1.6	N/A
	B		10		JMNGAAR	1	NEUT-CURE RTV SILICONE 310G	N/A
		C	11		107160	1	(JET) O RINGS SPECIAL TRANSOM SEAL	107160
		C	12		HZQHXBK	24	(SCREWS) (M/C SCREWS) METRIC ST ST 316 HEX HD M8x70	N/A
		C	13		JEOZXAF	45	(WASHERS) (FLAT) METRIC ST ST 316 M8x16x1.2	N/A
	B		14		MRINAAI	1	LOCTITE 262 10ML BOTTLE	N/A
A			15		107255	1	INTAKE BLOCK	107255
	B1	C1	16		63595	1	(JET) PACKAGING BOLT BOX	N/A

REF	NO.	BY	DATE	AMENDMENTS
JET 321				SEE SHEET 1 FOR AMENDMENTS

C.W.F.HAMILTON & CO. LTD. CHCH. NZ.

PROJECTION

DESIGNED DATE

DRAWN P.A.S. 18/12/98

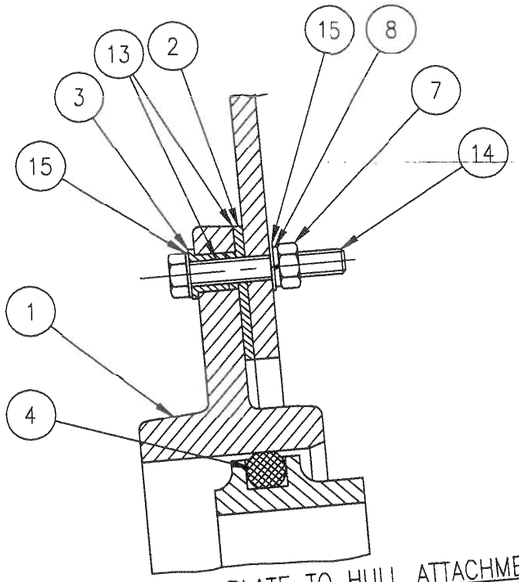
CHECKED

APPROVED

NAME
INSTALLATION DETAILS
ALUMINIUM HULL
HJ321
SHEET 2 OF 2 SHEETS

SCALE -

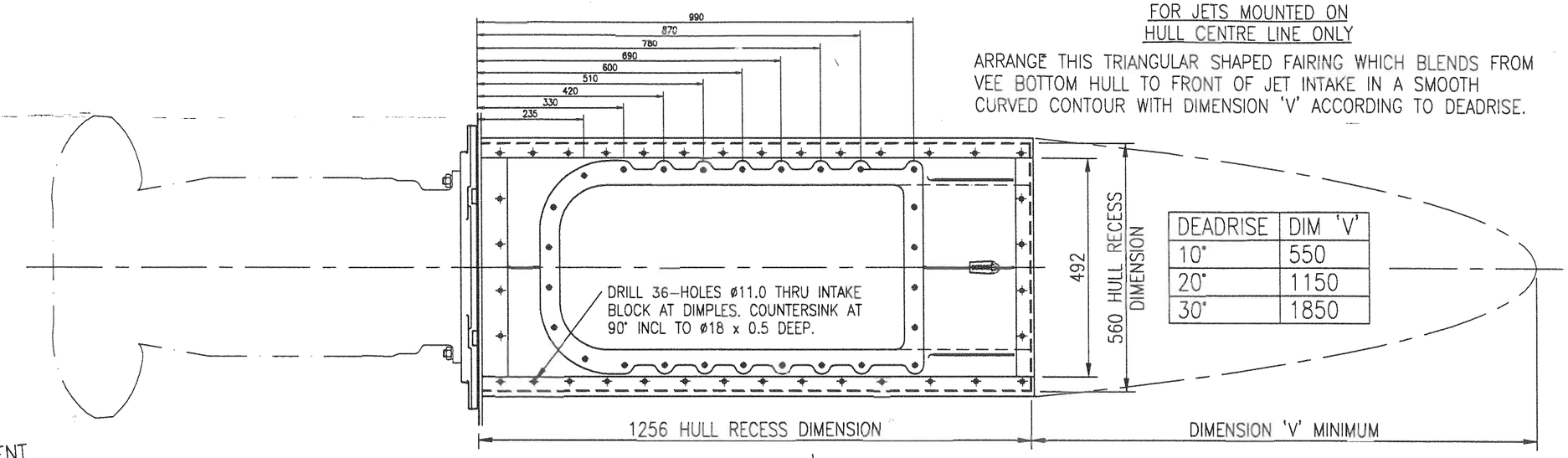
No: ASSY-HJ321 08 002 E



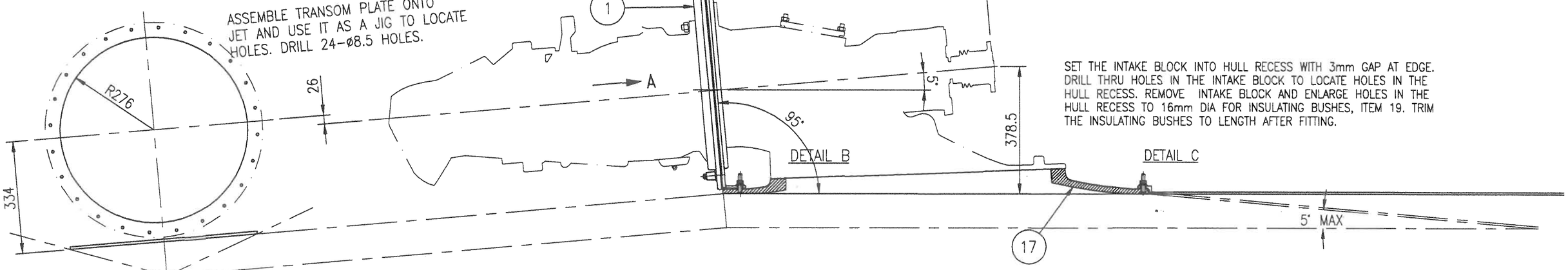
DETAIL OF TRANSOM PLATE TO HULL ATTACHMENT
TRANSOM PLATE TO JET SEALING ARRANGEMENT

FOR JETS MOUNTED ON
HULL CENTRE LINE ONLY

ARRANGE THIS TRIANGULAR SHAPED FAIRING WHICH BLENDS FROM VEE BOTTOM HULL TO FRONT OF JET INTAKE IN A SMOOTH CURVED CONTOUR WITH DIMENSION 'V' ACCORDING TO DEADRISE.



DEADRISE	DIM 'V'
10°	550
20°	1150
30°	1850

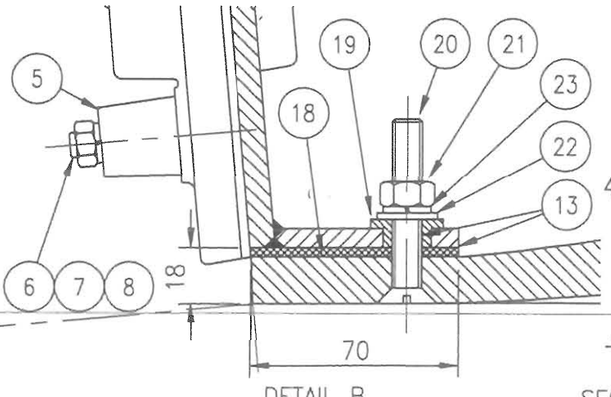


VIEW IN DIRECTION OF ARROW 'A'

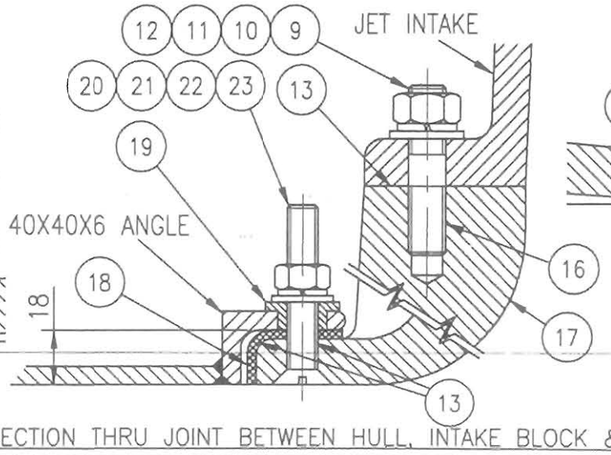
SET THE INTAKE BLOCK INTO HULL RECESS WITH 3mm GAP AT EDGE. DRILL THRU HOLES IN THE INTAKE BLOCK TO LOCATE HOLES IN THE HULL RECESS. REMOVE INTAKE BLOCK AND ENLARGE HOLES IN THE HULL RECESS TO 16mm DIA FOR INSULATING BUSHES, ITEM 19. TRIM THE INSULATING BUSHES TO LENGTH AFTER FITTING.

DETAIL B

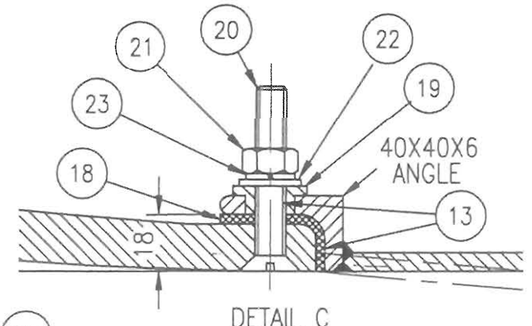
DETAIL C



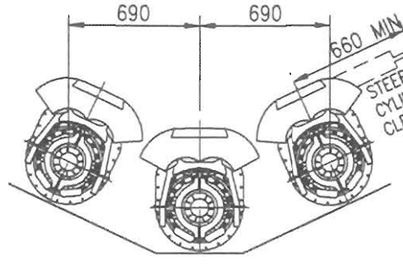
DETAIL B



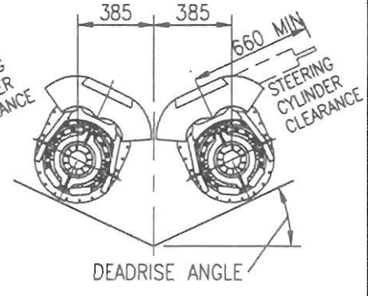
SECTION THRU JOINT BETWEEN HULL, INTAKE BLOCK & JET



DETAIL C



TRIPLE JET INSTALLATION



TWIN JET INSTALLATION

	D	P.S.	18/1/99	ITEM 4 WAS ITEM 11.
CL65	C	PMW	1.9.98	NOTE RE DRILLING 36 ø11 HOLES ADDED
CL3837	B	P.S.	3/6/98	ITEM 14 WAS 21 OFF. ITEM 15 WAS 42 OFF.
CL3837	B	P.S.	3/6/98	ITEM 1 WAS 109807. 2 WAS 109808. 7 WAS 23 OFF. 8 WAS 23 OFF.
CL3794	A	P.S.	3/7/97	INTAKE BLOCK REVISED TO SIMPLIFY INSTALLATION IN STEEL HULL
CL3779	0	P.S.	10/3/97	ISSUED FOR PRODUCTION
REF	NO.	BY	DATE	AMENDMENTS

JET 321

C.W.F.HAMILTON & CO. LTD. CHCH. NZ.

PROJECTION

NAME
INSTALLATION DETAILS
STEEL HULL
HJ 321 JET
Sht 1 of 2

DESIGNED	P.A.S.	DATE 7/3/97
DRAWN	P.W.	10/3/97
CHECKED		
APPROVED		

SCALE -

No: ASSY–HJ321 08 003 D

A	B	C	Item	Kit	PartNumber	Qty	ProductDescription	DrawingNbr
				A	109805		INTAKE BLOCK KIT (STEEL HULL)	HJ32108003
				B	107213		INSTALLATION HARDWARE KIT	HJ32108001
				C	109806		TRANSOM KIT (STEEL HULL)	HJ32108003
		C	1		110635	1	TRANSOM PLATE (steel hull)	110506
		C	2		110636	1	TRANSOM PLATE GASKET (STEEL HULL)	110636
		C	3		KHACXAF	24	(BUSHES) NYLON FLANGED GS NYLATRON S48M	N/A
		C	4		107160	1	(JET) O RINGS SPECIAL TRANSOM SEAL	107160
		C	5		103359	1	ANODE MK3	103359
		C	6		30661	2	(STUDS) METRIC (316-STST) M8x51	30647
		C	7		JDQHXAC	26	(NUTS) (METRIC ST ST 316) M8	N/A
		C	8		JEQKXAC	26	(WASHERS) (SPRING) METRIC ST ST 316 M8	N/A
	B		9		30658	26	(STUDS) METRIC (316-STST) M12x54	30639
	B		10		JDQHXAH	26	(NUTS) (METRIC ST ST 316) M12	N/A
	B		11		JEQKXAH	26	(WASHERS) (SPRING) METRIC ST ST 316 M12	N/A
	B		12		JEOZXAK	26	(WASHERS) (FLAT) METRIC ST ST 316 M12x24x1.6	N/A
	B		13		JMNGAAR	1	NEUT-CURE RTV SILICONE 310G	N/A
		C	14		HZQHXBK	24	(SCREWS) (M/C SCREWS) METRIC ST ST 316 HEX HD M8x70	N/A
		C	15		JEOZXAF	45	(WASHERS) (FLAT) METRIC ST ST 316 M8x16x1.2	N/A
	B		16		MRINAAI	1	LOCTITE 262 10ML BOTTLE	N/A
A			17		107255	1	INTAKE BLOCK	107255
A			18		109809	1	INTAKE BLOCK GASKET (STEEL HULL)	109809
A			19		64319	36	(BUSHES) NYLON INSULATING S260M	N/A
A			20		HZPPXEE	36	(BOLTS) (M/C SCREWS) METRIC STST 316 M10x60 (CSK HD)	N/A
A			21		JDQHXAE	36	(NUTS) (METRIC ST ST 316) M10	N/A
A			22		63368	36	(WASHERS) (FLAT) METRIC ST ST 316 M10	N/A
A			23		JEQKXAE	36	(WASHERS) (SPRING) METRIC ST ST 316 M10	N/A
A1	B1	C1	24		63595	3	(JET) PACKAGING BOLT BOX	N/A

REFER TO SHEET 1 FOR AMENDMENTS

REF	NO.	BY	DATE	AMENDMENTS
JET 321				

C.W.F.HAMILTON & CO. LTD. CHCH. NZ.

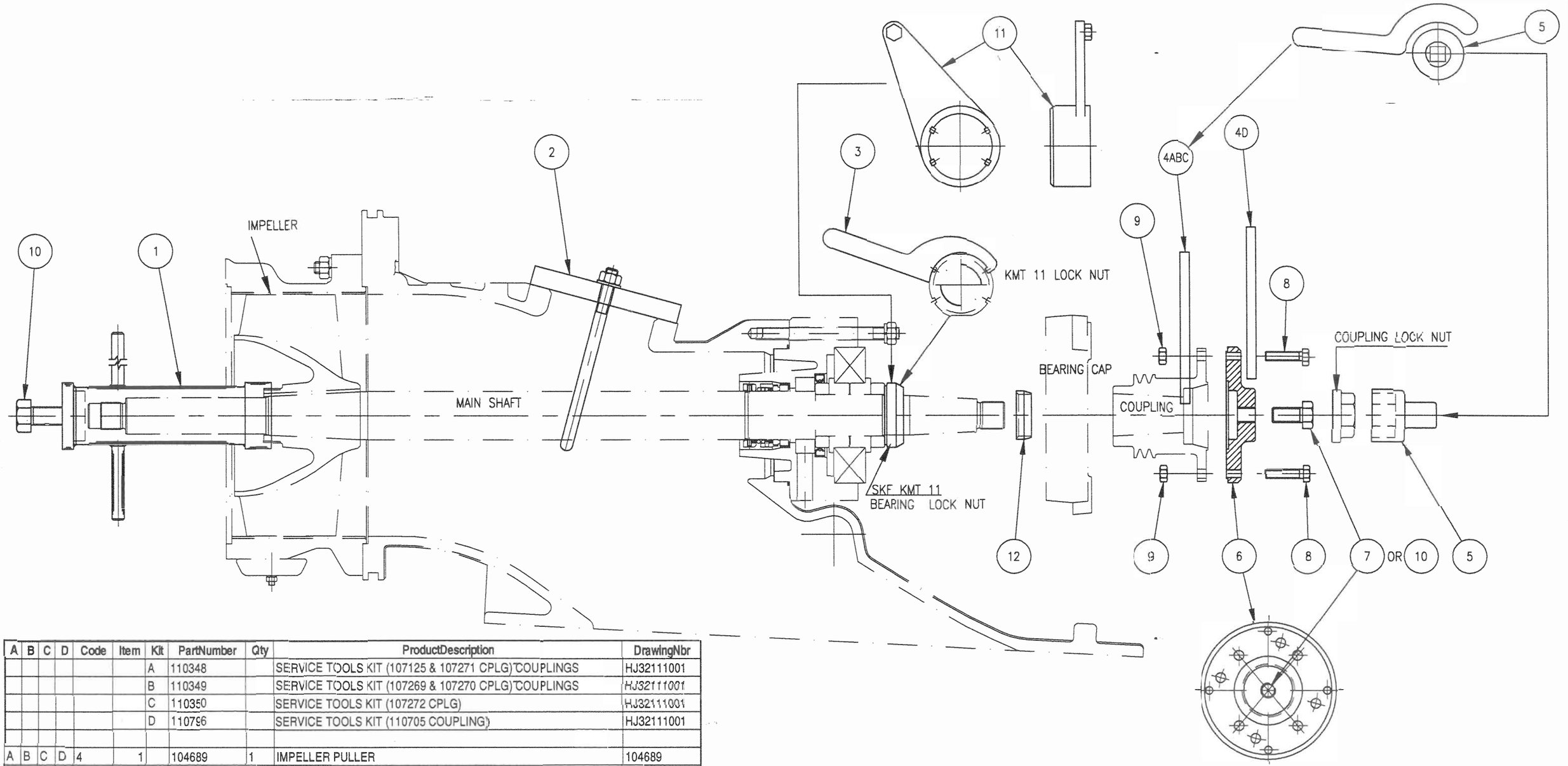
PROJECTION

DESIGNED P.A.S.	DATE 7/3/97
DRAWN P.W.	10/3/97
CHECKED	
APPROVED	

NAME
INSTALLATION DETAILS
STEEL HULL
HJ 321 JET
Sht 2 of 2

SCALE -

No: ASSY-HJ321 08 003 D



A	B	C	D	Code	Item	Kit	PartNumber	Qty	ProductDescription	DrawingNbr
						A	110348		SERVICE TOOLS KIT (107125 & 107271 CPLG) COUPLINGS	HJ32111001
						B	110349		SERVICE TOOLS KIT (107269 & 107270 CPLG) COUPLINGS	HJ32111001
						C	110350		SERVICE TOOLS KIT (107272 CPLG)	HJ32111001
						D	110796		SERVICE TOOLS KIT (110705 COUPLING)	HJ32111001
A	B	C	D	4	1		104689	1	IMPELLER PULLER	104689
A	B	C	D	4	2		109966	1	MAINSHAFT SUPPORT TOOL	109966
A	B	C	D	4	3		JNODAFC	1	(SKF) SPANNERS HN12	N/A
A				4	4		104917	1	TORQUE ARM	104917
		C		4	4		106080	1	TORQUE ARM (HARDY SPICER 1800 COUPLING)	106080
	B			4	4		104938	1	TORQUE ARM (ELBE 0.119 & GWB 587.42 COUPLINGS)	104938
			D	4	4		110795	1	TORQUE ARM (AQUADRIVE 20600)	110795
A	B	C	D	4	5		JMNGAAP	1	(SOCKETS) TOOLS A/F 50mm 3/4" SQ. DRIVE (SOCKET)	N/A
	B			4	6		104936	1	COUPLING PULLER (ELBE 0.119 & GWB 587.42)	104936
		C	D	4	6		106079	1	COUPLING PULLER (HARDY SPICER 1800 & AQUADRIVE 20600)	106079
A				4	6		104918	1	COUPLING PULLER	104918
A				4	7		HYIXYFD	1	(BOLTS) (METRIC) MILD STEEL H/TENSILE GR88 (ZP) M20x60	N/A
A		C		4	8		HYIXYCX	4	(BOLTS) (METRIC) MILD STEEL H/TENSILE GR88 (ZP) M12x50	N/A
			D	4	8		HYQHXIO	4	(BOLTS) (METRIC) ST ST 316 M16x60	N/A
A	B			4	8		HYIUPBL	4	(BOLTS) (IMPERIAL) MILD STEEL 3/8"UNCx2.0" HT (ZP)	N/A
A	B			4	9		JDKBPAE	4	(NUTS) (IMPERIAL MILD STEEL) (ZP) 3/8"UNC	N/A
A		C		4	9		JDPVYAH	4	(NUTS) (METRIC MILD STEEL) M12 (GR88) (ZP)	N/A
A	B	C	D	4	10		104937	1	FORCING SCREW M24	104937
A	B	C	D	4	11		107190	1	BEARING NUT REMOVAL TOOL - (OPTIONAL EXTRA)	107190
A	B	C	D	4	12		107191	1	ROTARY SEAL FITTING SLEEVE (nylon)	107191

REF	NO.	BY	DATE	AMENDMENTS
CL69	D	P.S.		ITEM D (KIT FOR AQUADRIVE) ADDED.
CL3814	C	P.S.	21/11/97	PART No 110348, 110349 & 110350 ADDED.
CL3786.	B	P.M.W	5.5.97	REDRAWN ON CAD. ITEM 1 UPDATED. ITEM 2 WAS PART No HS272078
CL.3648	A	R.L.	3.2.94	UPDATED
CL.3643	0	P.S.	29.11.93	ISSUED FOR PRODUCTION

JET 321

C.W.F.HAMILTON & CO. LTD. CHCH. NZ.

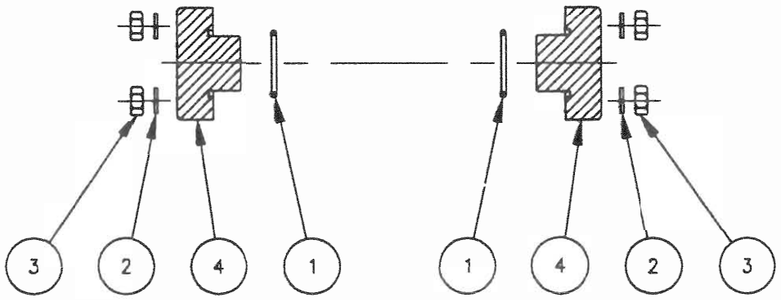
PROJECTION

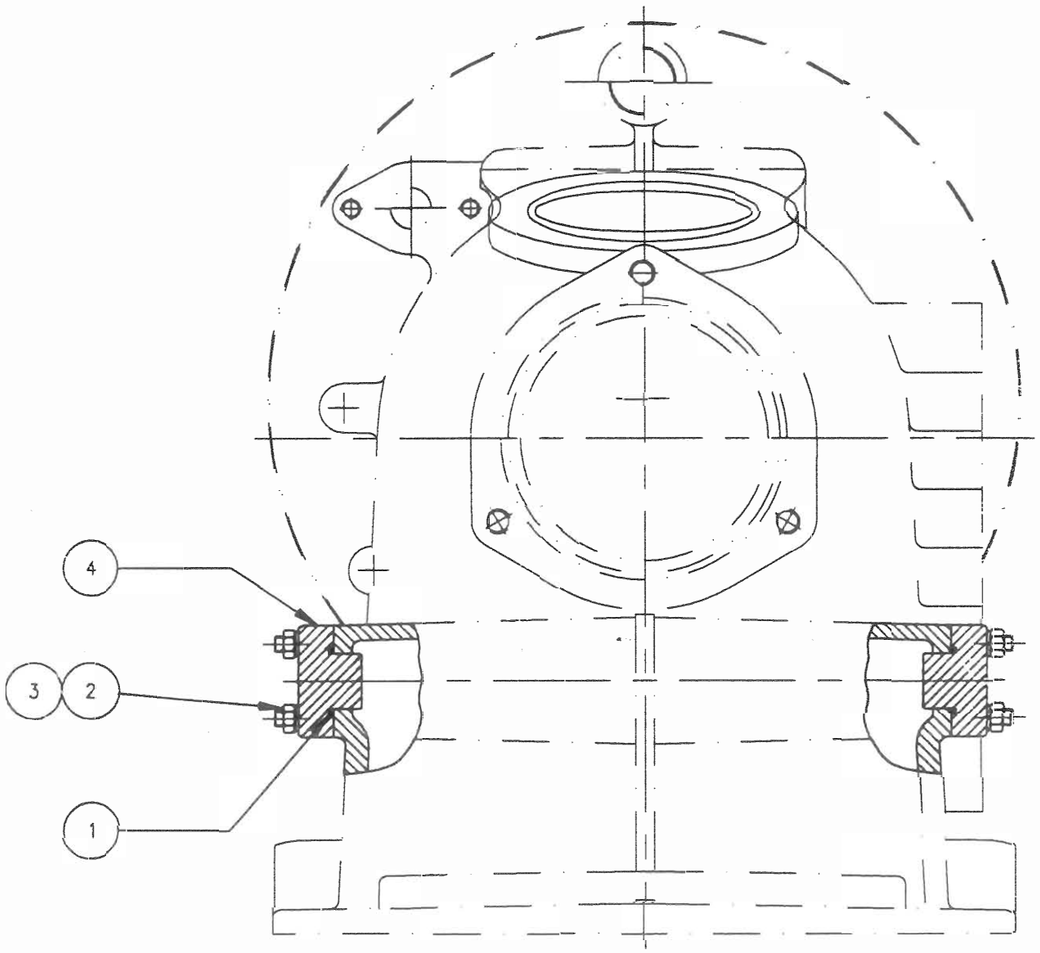
	DESIGNED	DATE
DRAWN	C.H.	15.10.93
CHECKED	P.S.	1.12.93
APPROVED	K.V.A.	1.12.93

NAME
TOOL KIT
COMPONENT SCHEDULE
HJ 321 JET

SCALE -

No: ASSY-HJ321 11 001 D





SPARES ASSY	ITEM	PART No	QTY	DESCRIPTION	DWG No
4	1	HMHRAAW	2	'O' RING: 0.13" x 1.44" x 1.69" AS 221 N70	107218
4	2	JEQKXAE	4	M10 SPRING WASHER 316 S.S.	
4	3	JDQHXAE	4	M10 HEX NUT 316 S.S.	
4	4	105921	2	BLANKING PLUG	105921

REF	NO.	BY	DATE	AMENDMENTS
CL 3718	B	P.M.W	5.5.97	REDRAWN ON CAD
CL 3648	A	R.L.	3.2.94	UPDATED

JET 321

C.W.F.HAMILTON & CO. LTD. CHCH. NZ.

PROJECTION

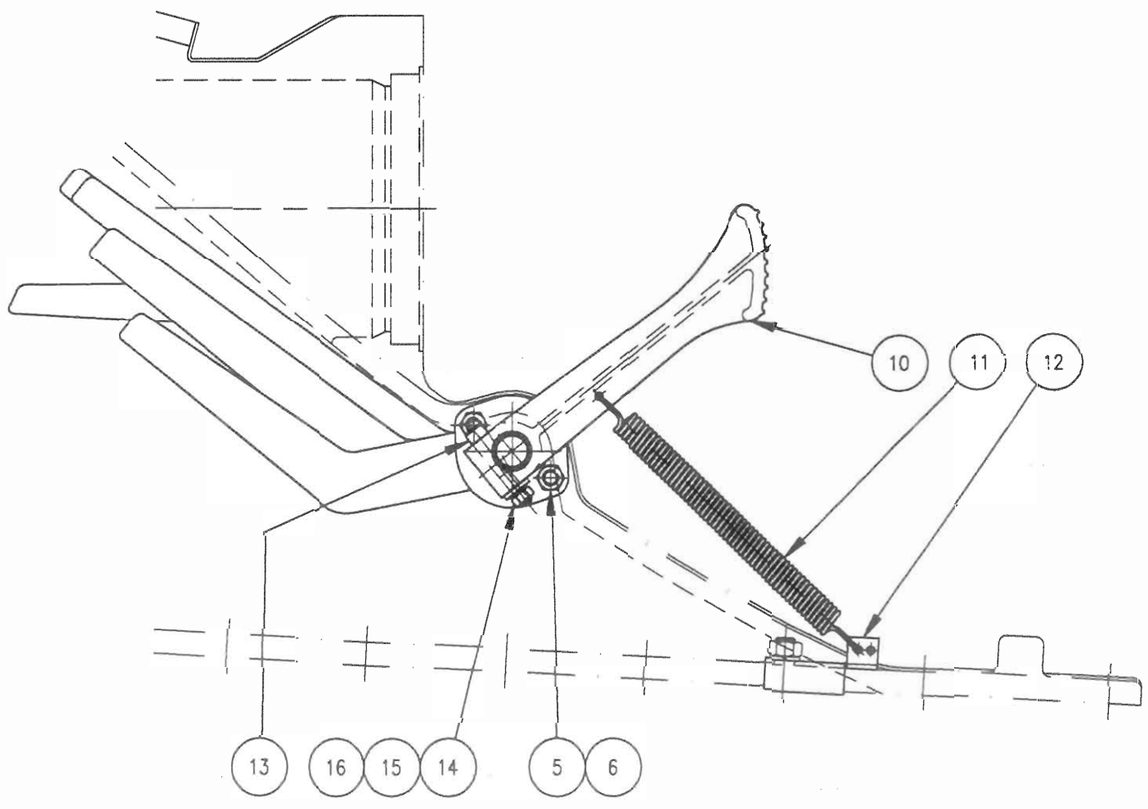
	DATE
DESIGNED	
DRAWN C.J.	6.10.93
CHECKED P.S.	10.12.93
APPROVED K.V.A.	10.2.94

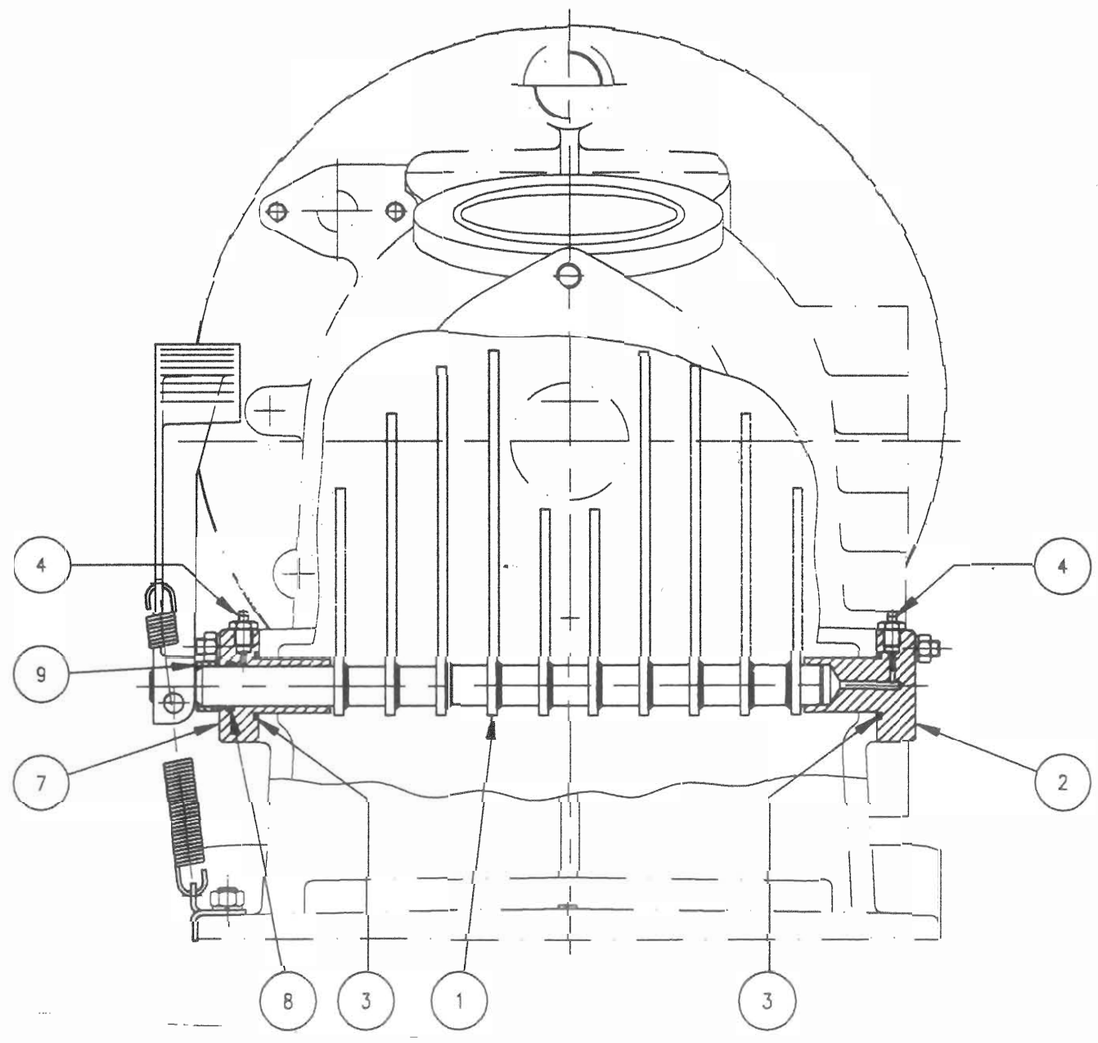
NAME
SCREEN RAKE
BLANKING PLUGS
HJ 321 JET

SCALE -

No: ASSY-HJ321 09 001 B

SPARES ASSY				ITEM	PART No	QTY	DESCRIPTION	DWG No
			4	1	107136	1	SCEEN RAKE ASSY.	107136
			4	2	105130	1	BEARING-STARBOARD	105130
			2	3	HMHRAAW	2	O RING AS 221 N70	
			4	4	HEIDAAD	2	GREASE NIPPLE 1/8 BSP x 67DEG.	
			4	5	JEQKXAE	4	10mm SPRING WASHER 316 STST	
			4	6	JDQHXAE	4	M10 NUT 316 STST	
			4	7	105131	1	BEARING-PORT	105131
			4	8	HMHRAAS	1	O RING AS 214 N70	
			4	9	104647	1	SPACER	104647
			4	10	106274	1	RAKE ACTUATING ARM	106274
			1	11	102364	1	SPRING	102364
			4	12	105165	1	SPRING ANCHOR BRACKET	105165
			4	13	105931	1	COTTER PIN	105931
			4	14	103637	1	8mm FLAT WASHER 316 STST	103637
			4	15	JEQKXAC	1	8mm SPRING WASHER 316 STST	
			4	16	JDQHXAC	1	M8 NUT 316 STST	





REF	NO.	BY	DATE	AMENDMENTS
CL3713	C	P.M.W	5.5.97	REDRAWN ON CAD
CL3712	B	P.S.	11.7.95	ITEM 2 WAS 105131. ITEM WAS 105130. ITEM 4 WAS HEIDAAA
CL3648	R.J.	P.S.	11.7.95	UPDATED
JET 321				

C.W.F.HAMILTON & CO. LTD. CHCH. NZ.

PROJECTION

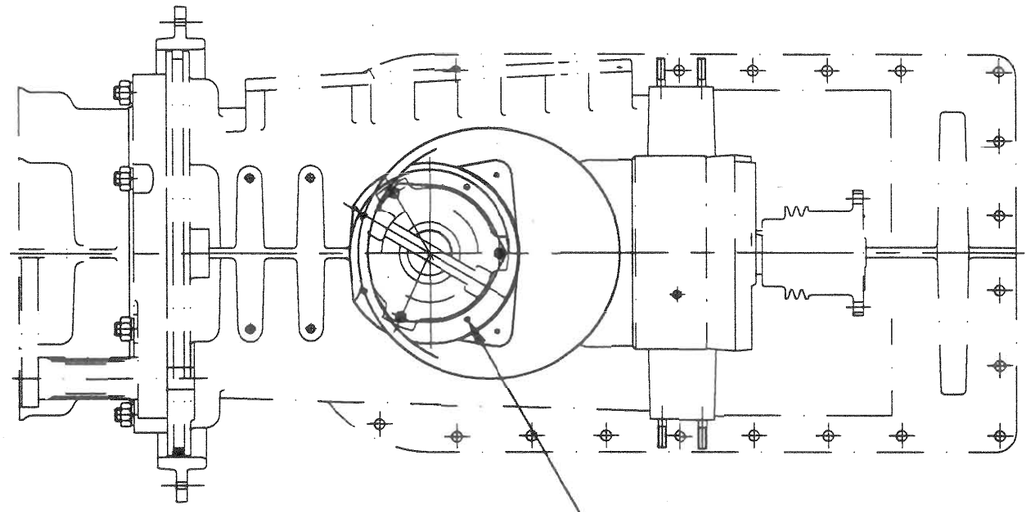
NAME: SCREEN RAKE ASSEMBLY HJ 321 JET

	DATE
DESIGNED	
DRAWN C.J.	8.10.93
CHECKED P.S.	10.12.93
APPROVED R.V.A.	10.2.94

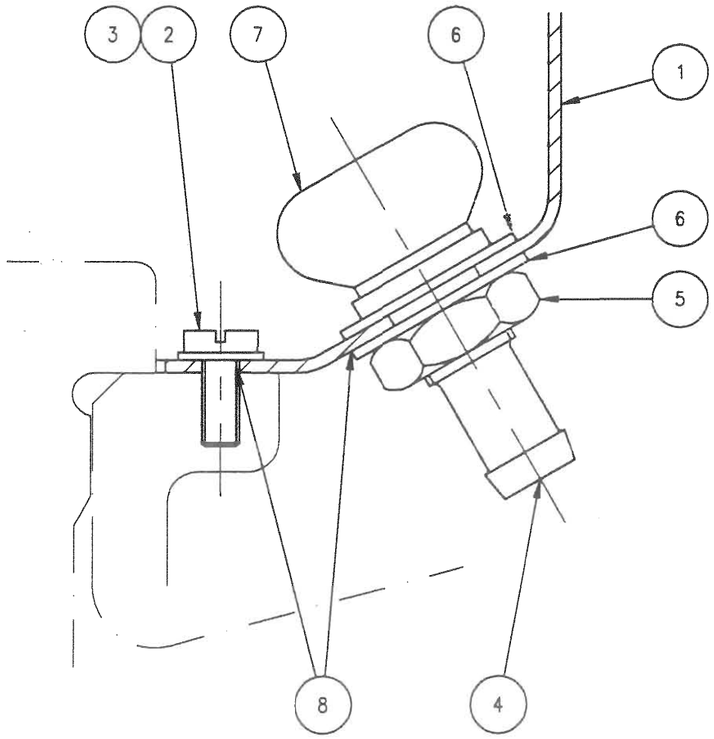
SCALE -

No: ASSY-HJ321 09 002 C

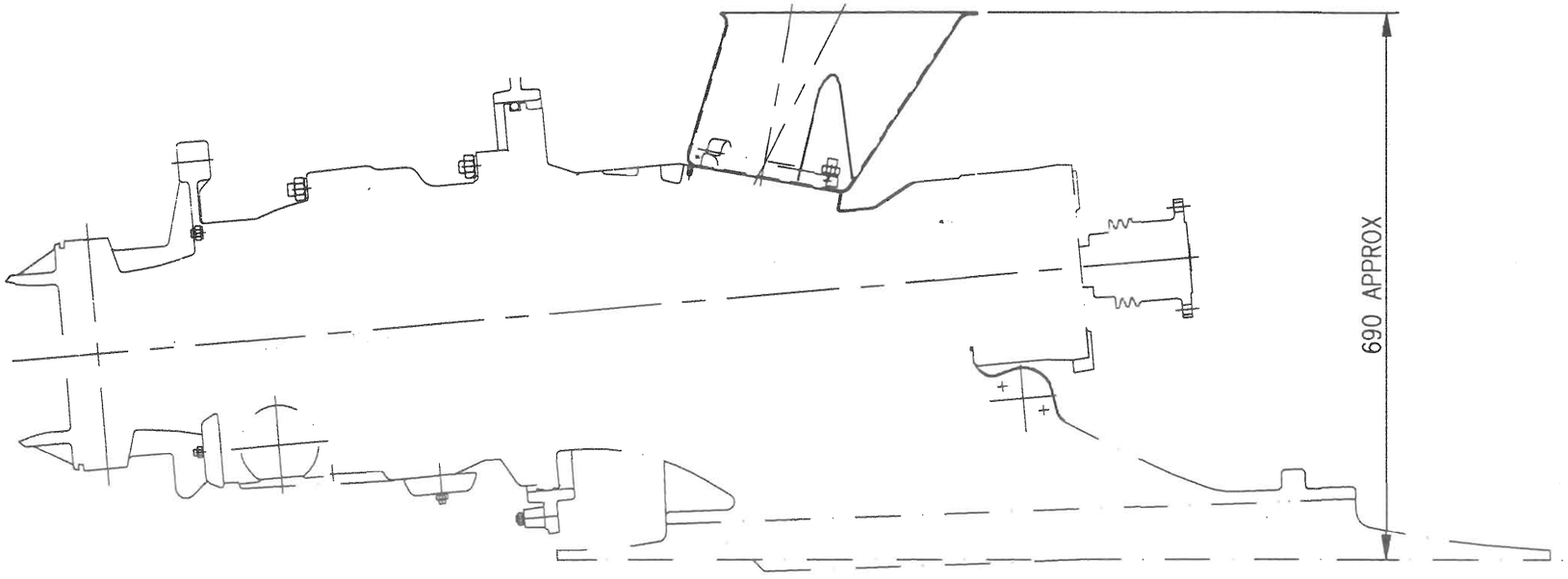
SPARES ASSY			ITEM	PART No	QTY	DESCRIPTION	DWG No
		3	1	107221	1	OVERFLOW PREVENTER	107221
		3	2	30728	4	M6 x 12 PAN HEAD M/C SCREW (316 S.S.)	
		3	3	JEOZXAD	4	M6 WASHER (316 S.S.)	
		3	4	107298	1	DRAIN CONNECTION	107298
		3	5	JDQKXAJ	1	M16 THIN NUT (316 S.S.)	
		3	6	JEOZXAM	2	M16 WASHER (316 S.S.)	
		2	7	63825	1	DRAIN BUNG-NATRA	
		2	8	JMNGAAS	1	RTV SILICONE SEALANT (NEUTRAL CURE)	



DRILL ø16.5 HOLE IN OVERFLOW PREVENTER, ON ONE SIDE ONLY POSITION MARKED BY DIMPLE. FOR PORT MOUNTED JET DRILL HOL STARBOARD SIDE. FOR STARBOARD MOUNTED JET DRILL HOLE IN F SIDE. FOR CENTRE MOUNTED JET DRILL PORT OR STARBOARD, TO SUIT INSTALLATION. A HOSE (1/2" I.D.) CAN BE ATTACHED TO CAR WATER TO BILGE.



DETAIL OF DRAIN CONNECTOR



REF	NO.	BY	DATE	AMENDMENTS
CL3796	C	P.M.W	5.5.97	REDRAWN ON CAD. SPARES RATINGS ADDED
CL3648	B	P.S.	7-3-94	GRP OVERFLOW INTRODUCED
CL3645	0	P.S.	10-12-93	ISSUED FOR PRODUCTION
JET 321				

C.W.F.HAMILTON & CO. LTD. CHCH. NZ.

PROJECTION

NAME: OVERFLOW PREVENTER OPTION HJ 321 JET

DESIGNED	DATE
DRAWN R.J.L.	24-11-93
CHECKED P.S.	10-12-93
APPROVED K.V.A.	10-2-94

SCALE: -

No: ASSY-HJ321 10 001 C

63974 | 0

PROJECTION

CORROSION METER INSTALLATION INSTRUCTIONS

Install the sensor through-hull in a convenient location where it will not be subject to physical damage. Run wire (16 gauge or larger) from the sensor to the SENSOR TERMINAL on the monitor. Protect bolt with heat shrink tubing, seal the connection at the sensor terminal with a waterproof sealer DO NOT allow the connection to rest in bilge water unprotected. ISOLATE BOLT AND NUT FROM METAL HULLS with heat shrink tubing and #10 plastic washers.

The wire from the bonding system or metal hull attaches to the D.C. GROUND terminal. These wires should be #16 AWG (1.3 metric) gauge or larger.

To use the meter, hold the "TEST" button down for 5 to 6 seconds, then release and read the meter after the needle has stabilized (usually 1 to 2 seconds). The meter will de-activate shartly.

A loop wire to the rudder shaft and a shaft brush to the shafts make a well bonded system. Read our Corrosion Workbook for more information.

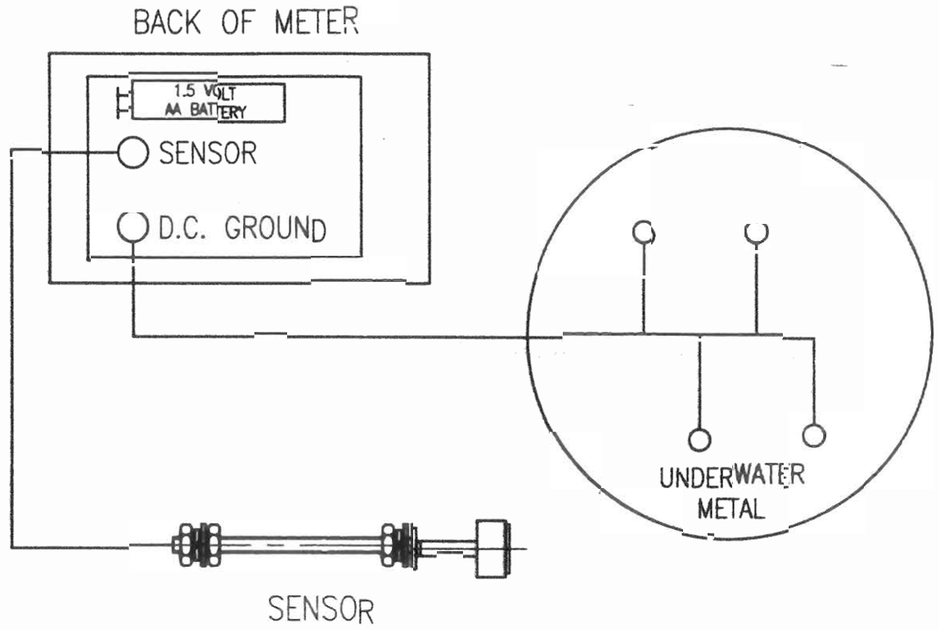
Rember
All bonding connections should be visually inspected and sealed, and checked at least twice a year with a portable corrosion test meter to assure continous protection.

Battery size is AA. Change battery annually. Drop in normal voltage indicated while pressing "TEST" button indicates weak battery.

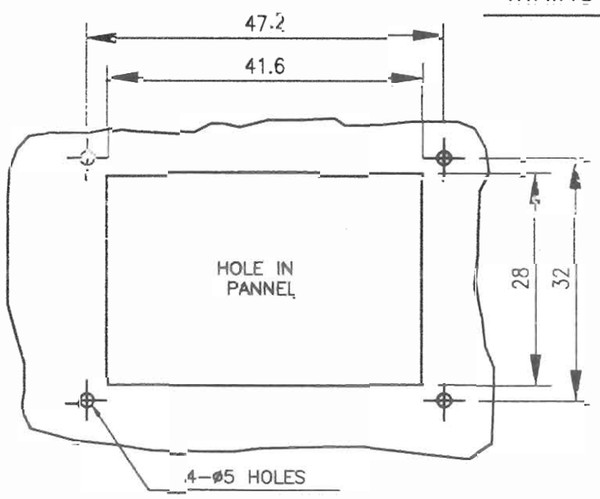
DO NOT paint sensor.

Protect meter from severe vibration. Vibration and shock can damage meter movement.

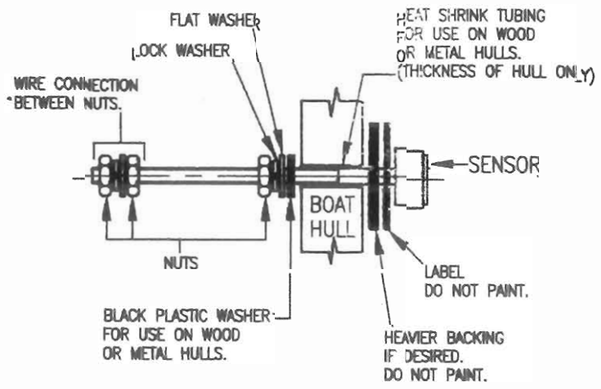
Underwater growth can affect meter readings. Clean underwater surface of sensor at least 4 times a year. Rapid de-activation of meter indicates a fouled sensor.



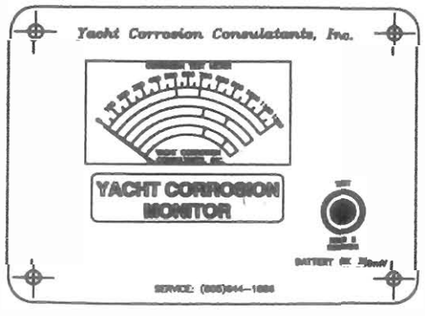
WIRING DIAGRAM



METER MOUNTING



SENSOR MOUNTING



METER

SENSOR

INSTALLATION DETAILS.

CL3718	0	R.J.L.	28.08.95	ISSUED FOR PRODUCTION	
REF	NO.	BY	DATE	AMENDMENTS	

JET ALL

THIS PRINT IS PROVIDED ON A RESTRICTED BASIS AND IS NOT TO BE USED IN ANY WAY DETRIMENTAL TO THE INTERESTS OF C.W.F.HAMILTON AND CO LTD.

C.W.F.HAMILTON & CO. LTD. CHCH. NZ.

MATERIAL

√ = N9 EXCEPT AS STATED

UNLIMITED DIMENSIONS TO BE ±

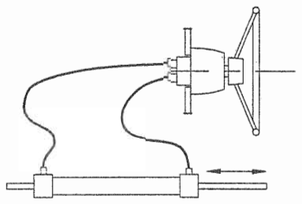
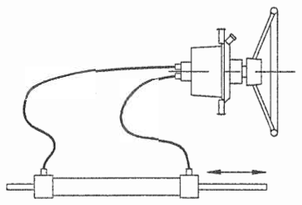
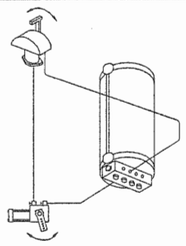
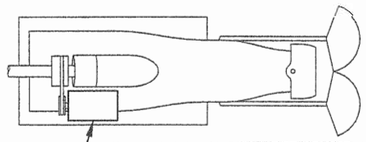
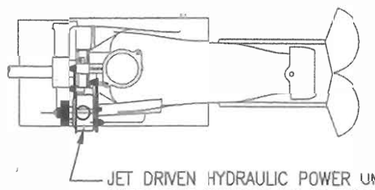
MAT'L CERT		
DESIGNED	DATE	
DRAWN R.J.L.	02/01/94	
CHECKED M.M.	04/10/94	
APPROVED K.V.E	21/8/95	

NAME
ANODE CONDITION MONITOR INSTALLATION INSTRUCTIONS

SCALE NONE | No: A2- 63974 | 0

PROJECTION

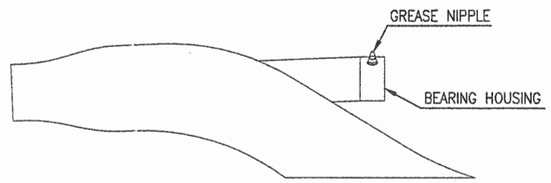
HYDRAULIC FLUIDS

		TOTAL OIL VOLUME in Litres	USED ON JET MODEL
SEASTAR MANUAL HYDRAULIC STEERING			
	FLUID: HYDRAULIC OIL TO MIL STD. H-5606C DO NOT USE: BRAKE FLUID HEAVIER VISCOSITY FLUIDS	N/A	HJ241 HJ273 HJ291 HJ321
	EXAMPLES: SEASTAR: HA5430 SHELL: AERO SHELL FLUID #4 ESSO: UNIVIS N15 OR J13 TEXACO: HO15		
WAGNER MANUAL HYDRAULIC STEERING			
	FLUID: HYDRAULIC OIL OF VISCOSITY: I.S.O. GRADE 32 DO NOT USE: BRAKE FLUID HEAVIER VISCOSITY FLUIDS	N/A	HJ362 HS363 HJ391 HM422 HM461 HM521 HM571
	EXAMPLES: SHELL: TELLUS 32 ESSO: NUTO H32 TEXACO: RANDO HD32 or RANDO HD AZ		
HYNAUTIC REMOTE CONTROL SYSTEMS			
	FLUID: 50/50 VOLUMETRIC MIXTURE OF: ETHYLENE-GLYCOL / DISTILLED WATER DO NOT USE: BRAKE FLUID or HYDRAULIC OILS.	N/A	HJ362 HS363 HJ391 HM422 HM461 HM521 HM571
	EXAMPLES: HYNAUTIC: MCO-03		
HYDRAULIC SYSTEMS with JHPU			
 JET DRIVEN HYDRAULIC POWER UNIT NOTE; UNIT SHIPPED WITH NO OIL IN HYDRAULIC POWER UNIT, BUT OIL IN COOLER & CONTROL SYSTEM. H.P.U OIL VOLUME = 4 ltrs.	FLUID: HYDRAULIC OIL OF I.S.O. 3448 VISCOSITY GRADE. VISCOSITY:- 60cSt @ 40°C 10cSt @ 100°C DO NOT USE: BRAKE FLUID HEAVIER VISCOSITY FLUIDS	5.25	HJ321
		5.25	HJ362
		?	HS363
		7.5	HJ391
		7.5	HM422
	EXAMPLES: SHELL: TELLUS 46 CASTROL: HYSPIN AWS 32/68	7.5	HM461
		7.5	HM521
		7.5	HM571
		21	HM651
		21	HM721
		21	HM811
HYDRAULIC SYSTEMS with SAGINAW HPU			
 JET DRIVEN HYDRAULIC POWER UNIT NOTE: UNIT SHIPPED FILLED WITH OIL.	FLUID: MINERAL BASED HYDRAULIC OIL. VISCOSITY:- 50cSt max. @ +40°C 7cSt min. @ +100°C DO NOT USE: BRAKE FLUID HEAVIER VISCOSITY FLUIDS	1	HJ213 HJ241
		1.2	HJ273
		1.2	HJ291
	EXAMPLES: SHELL: DONAX TM Auto Transmission Oil. DEXRON 111 Auto Transmission Oil. MOBIL: ATF Auto Transmission Oil. CASTROL: TQ DEXRON 111 Auto Transmission Oil. ESSO: PSF #91423 Power Steering Fluid TEXACO: TL-11872 Power Steering Fluid TL-15216 Power Steering Fluid		

BEARING HOUSING LUBRICANT

JET UNIT	VOLUME (litres)	
HJ211	0.3	
HJ212	0.3	
HJ241	0.3	
HJ273	0.5	
HJ291	0.5	
HJ321	0.5	
JET UNIT	VOLUME (litres)	
HJ362	0.7	
HS363	1.4	
HJ391	1.4	
HJ402	1.4	
HM422	1.4	
HM461	1.4	
HM521	2	
HM571	3.5	
HM651	5	*5
HM721	7	*5
HM811	10	*5

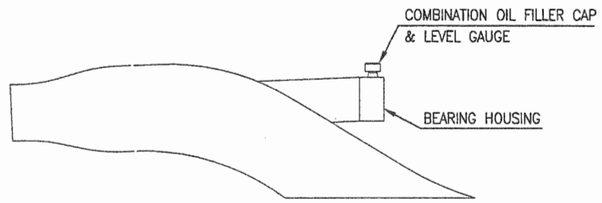
GREASE LUBRICATED



GREASE TYPE: Marine Extreme Pressure Grease

EXAMPLE: SHELL: Alvania R2

OIL LUBRICATED



OIL TYPE: I.S.O. Type HM (Enhanced Anti-Wear Type)
Multigrade Oil to I.S.O. viscosity grade 32/68
OR
Oil to I.S.O. viscosity grade 46

EXAMPLE: SHELL: Tellus 46
CASTROL: HYSPIN AWS 32/68

NOTE: JET UNIT OIL VOLUMES SHOWN ON THE RIGHT THUS *5, ARE FITTED WITH BEARING HOUSING COOLER SYSTEM & VOLUMES SHOWN ARE THE COOLER VOLUME.

NOTE: JET UNIT OIL LEVELS WILL VAIRY DEPENDING ON DEADRISE OF HULL. OIL VOLUMES SHOWN ARE FOR CENTRALLY MOUNTED UNITS NO DEADRISE. OIL LEVELS MUST BE WITHIN MARKS SHOWN ON DIPSTICK.

REF	NO.	BY	DATE	AMENDMENTS
CL104	G	J.W.	18.8.99	HSRX FLUID DETAILS ALTERED. HM651-721-811 VOLUMES AMENDED.
CL104	G	R.J.L	18.08.99	Sht.1 REMOVED FROM DRG.No, Sht.2 NOW OBSOLETE ON NEW DRG.85113
CL084	F	R.J.L	25.02.99	HJ321 & 291 JETS ADDED TO SHEET 1.
CL066	E	R.J.L	9.09.98	OIL VOLUMES UP-DATED & NOTES ADDED.
CL3831	D	R.J.L	20.04.98	Sht.2 & HSRX ADDED & FASRENERS & LOCTITE MOVED TO SHEET 2
CL3740	C	G.R.	15.2.96	REDRAWN ON CAD AND REFORMATTED
CL3646	B	R.L.	21.12.93	REDRAWN ONTO A3 WAS A4 AND LUBRICANTS ADDED

JET

C.W.F.HAMILTON & CO. LTD. CHCH. NZ.

MATERIAL: N/A

√ = N9 EXCEPT AS STATED

UNLIMITED DIMENSIONS TO BE ± N/A

MAT'L CERT: N/A

DESIGNED: DATE:

DRAWN: R.J.L 21-12-93

CHECKED:

APPROVED:

NAME: RECOMMENDATIONS, for LUBRICANTS & OILS

SCALE: N/A

No: A3-85018 G

G

85018

Weld Procedure For Welding Cast Intake Blocks Into Aluminium Hulls

1. Welds: – To be full penetration and conform to ABS rules for Aluminium vessels section 30 (Welding in Hull construction).

2. Welder Qualification: – Properly qualified welder to ABS Welder qualification (Q1) or equivalent, in downhand or overhead.

3. Inspection: –Inspection to be done by a qualified welding inspector.

4. Site: –The site must be
(a) dry and free from steel dust or any other contaminates that could effect the finished weld condition.
(b) sheltered from draughts to prevent disturbance to shielding gas.

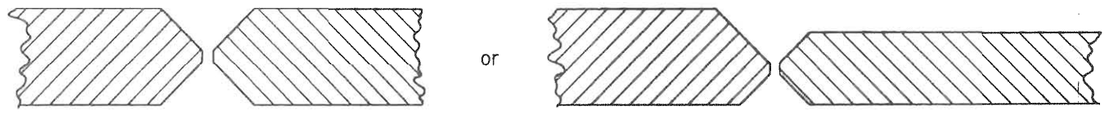
5. Welding Process: – M.I.G.

6. Welding Wire: – Casting to Plate – use 4043 Filler Wire
(LM6M) (5086 or 5083)

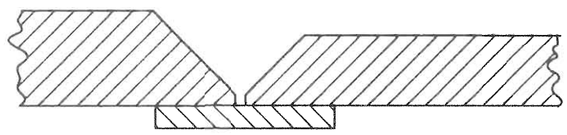
7. Shield Gas: – Argon or helium..

8 Weld position: – Flat downhand. Turn hull over to do the other side flat downhand.
– If hull cannot be turned to provide a downhand position for both inboard and outboard welds then a backing strip will be necessary. Weld downhand from one side only, then grind off backing strip.
– or use certified overhead welder.

9. Weld prep: – If Hull can be turned over use double vee butt weld prep.



– If hull cannot be turned over use a single vee butt weld prep with backing strip.



10. Cleanliness: – Dress all surfaces to be welded just prior to welding to remove surface oxides.

11 Preheat: – Remove chill 50° – 60° C (120° – 140° F)

12. Support – A rigid strong back should be clamped to the block during welding to prevent any distortion of the block

13. Weld runs
– Multipass runs may be necessary depending on plate and casting thickness.
– Stitch 75mm with 75mm gaps for first 2 runs to help eliminate distortion of block.
– Grind stop starts before filling in
– Subsequent runs may be full length runs

14. Back gouging: –Chipping, Routing, Milling, Grinding or other suitable methods are to be employed at the root or underside of the weld to obtain sound metal before applying susequent beads. Grind stop/start craters.

15. Visual Inspection of Welds
Acceptance Level:
– No cracks, Porosity, Lack of fusion, cold laps or undercut.Use dye penetrant to check outer surface of welds and intermediate weld passes, such as root passes, and also to check back–chipped ,ground or gouged joinnts prior to depositing subsequent passes, Any die penetrant used is to be thoroughly removed from area before rewelding.
– Dye penetrant is not to be used where complete removal of the dye penetrant material cannot be assured.

REF	NO.	BY	DATE	AMENDMENTS
JET 211 212 213 241 273 272 281 321 363 381	B	P.S.	24/9/96	REDRAWN ON CAD,OVERHEAD OPTION ADDED.
CL3607	A	P.S.	6/6/95	ISSUED FOR PRODUCTION
	0			

C.W.F.HAMILTON & CO. LTD. CHCH. NZ.

MATERIAL | MAT'L CERT | DRAWN P.S. 6/6/95 | DESIGNED | DATE | CHECKED | APPROVED Jane 30-10-96

√ = N9 EXCEPT AS STATED
UNLIMITED DIMENSIONS TO BE ±

NAME

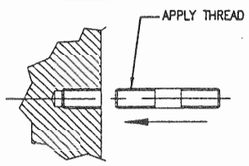
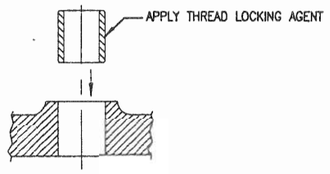
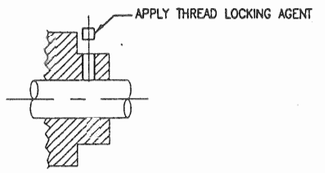
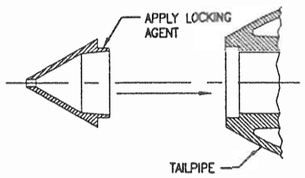
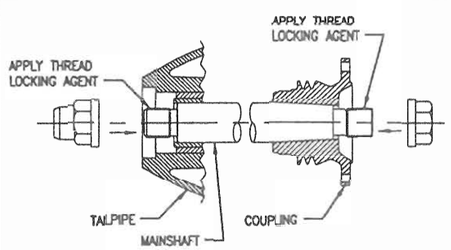
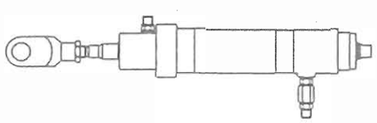
WELD PROCEDURE for WELDING CAST INTAKEBLOCKS into ALUMINIUM HULLS

SCALE | No. A3–85080 | B

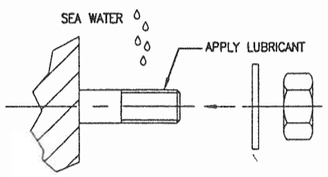
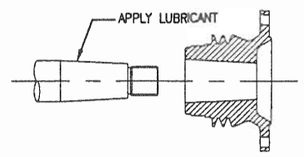
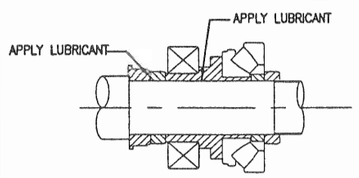
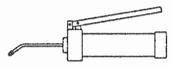
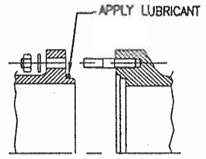
PROJECTION

PROJECTION

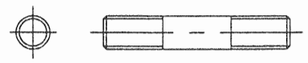
THREAD & JOINT LOCKING

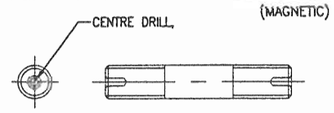
STUDS AND THREADED BUSHES	LOCKING AGENT
	
BUSHES & SLEEVES	
	
SET SCREWS & GRUB SCREWS	**LOCKING AGENT**
	
TAILPIPE FAIRING *(WITHOUT LOCKING DEVICE)*	**LOCKING AGENT**
	
MAINSHAFT NUTS *(WITHOUT LOCKING DEVICE)*	**LOCKING AGENT**
	
HYDRAULIC FITTINGS & CYLINDERS	**LOCKING AGENT**
	

JOINT LUBRICATION

NUTS ON STUDS & BOLTS (IN WATER)	LUBRICANT
	 ANTI SEIZE LUBRICANT (NOT COPPER OR GRAPHITE BASED) OR: MARINE GREASE
TAPERS	**LUBRICANT**
	
STEEL TO STEEL	
	 GREASE: MARINE MULTI PURPOSE EXTREME PRESSURE TYPE
O-RINGS	
	

THREAD TIGHTENING TORQUES

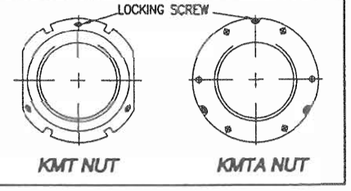
SIZE	N.m	lbs.ft	GRADE 316 STAINLESS STEEL STUDS
M6	5	4	(NON MAGNETIC)
M8	12	9	
M10	24	18	
M12	40	30	
M16	60	45	
M20	120	90	

SIZE	N.m	lbs.ft	SAF 2205 STAINLESS STEEL STUDS
M12	54	40	(MAGNETIC)
M16	130	95	
M20	260	190	
M24	450	330	

NOTE:

1. ENSURE ALL THREADS ARE CLEAN & DRY OR LIGHTLY LUBRICATED AS STAINLESS STEEL THREADS HAVE A TENDENCY TO "PICK UP"
2. RECOMMENDED LUBRICANT IS A MARINE GRADE MULTIPURPOSE EXTREME PRESSURE GREASE. EXAMPLE: BP ENERGREASE MM-EP2

TIGHTENING TORQUES

SCREW SIZE	N.m	lbs.ft	SKF KMT/KMTA NUT LOCKING SCREWS
M6	5	4	
M8	12	9	
M10	20	15	

REF	NO.	BY	DATE	AMENDMENTS
CL/04	0	R.J.L	18.08.99	ISSUED FOR PRODUCTION.
JET				

C.W.F.HAMILTON & CO. LTD. CHCH. NZ.

MATERIAL	N/A
MATL CERT	N/A
DESIGNED	DATE
DRAWN	R.J.L. 18-08-99
CHECKED	
APPROVED	

√ = N9 EXCEPT AS STATED

UNLIMITED DIMENSIONS TO BE ± N/A

NAME: RECOMMENDATIONS for FASTENER LOCKING, TORQUES & THREAD LUBRICATION.

SCALE N/A | No: A3-85113 | 0

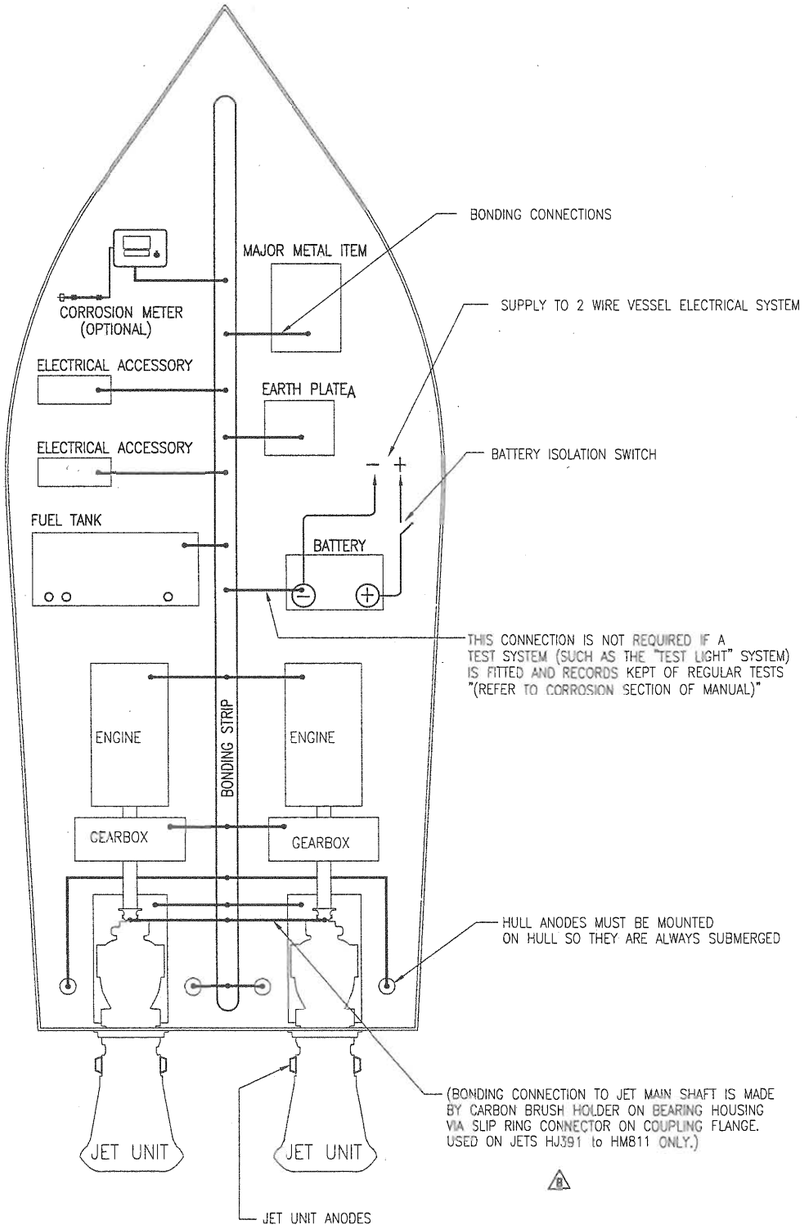
0

85113

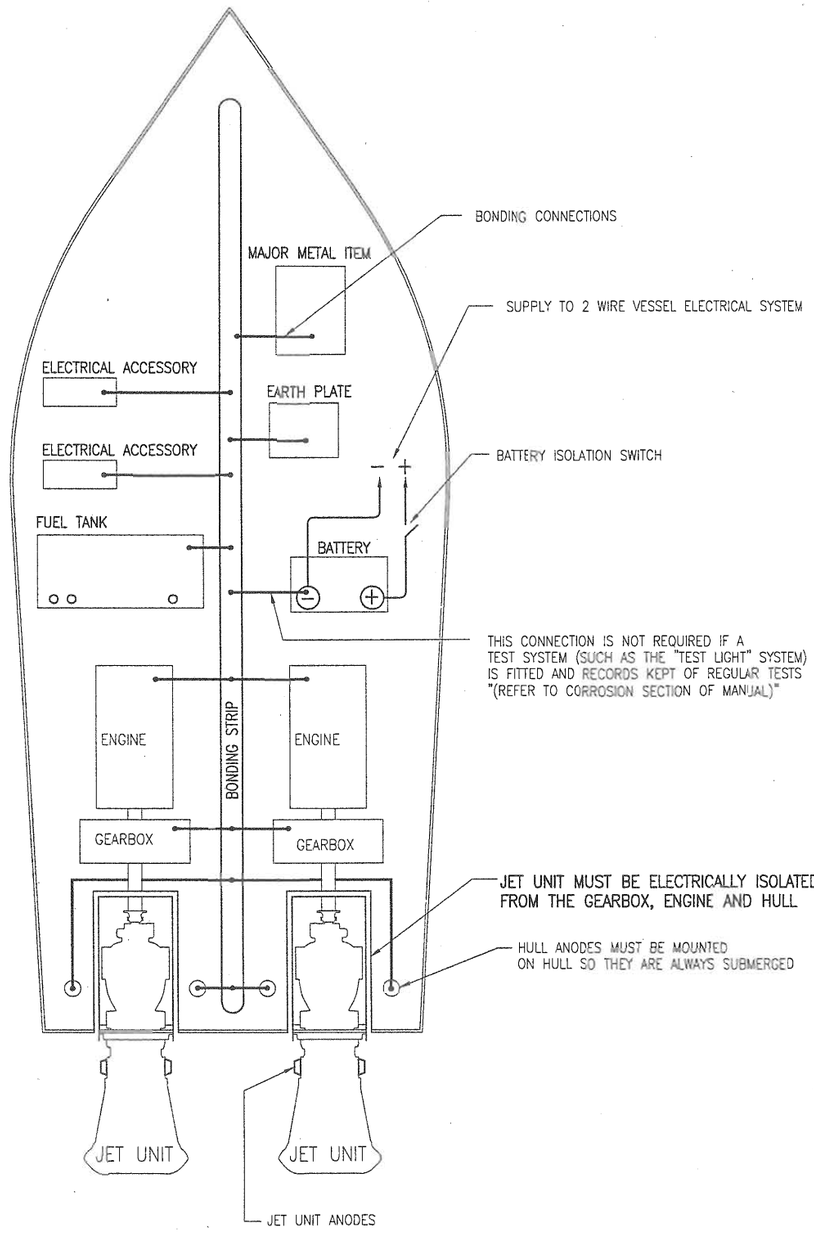
DO NOT SCALE THIS DRAWING.

PROJECTION

ALL DIMENSIONS IN mm. UNLESS OTHERWISE SHOWN.



EARTH BONDING SYSTEM FOR ALUMINIUM, G.R.P. AND WOODEN HULLS



EARTH BONDING SYSTEM FOR STEEL HULLS

NOTE: APPLYING TO BOTH DIAGRAMS ABOVE

ANODES PLACED ON THE CRAFT TRANSOM WILL BE "DRY" AND THUS NOT ACTIVE WHEN THE CRAFT IS AT PLANING SPEEDS THEREFORE ANODES SHOULD BE PLACED UNDER THE HULL WHERE THEY WILL BE "WET" AT ALL TIMES.
THESE ANODES SHOULD BE UNIFORMLY SPACED OVER THE WETTED HULL LINES. THEY SHOULD BE RECESSED INTO THE HULL OR STREAMLINED IN SHAPE TO MINIMISE RESISTANCE.
THEY SHOULD NOT BE LOCATED DIRECTLY AHEAD OF THE JET UNIT INTAKE AS THEY MAY DISTURB THE INLET FLOW.

REF	NO.	BY	DATE	AMENDMENTS
CL	B	R.J.L	23.11.99	SHAFT BONDING NOTE CLARIFIED.
CL0108	A	R.J.L	16.09.99	SPELLING CORRECTED.
CL0104	0	R.J.L	18.08.99	ISSUED FOR PRODUCTION.

JET ALL

C.W.F.HAMILTON & CO. LTD. CHCH. NZ.

MATERIAL N/A

√ = N9 EXCEPT AS STATED

UNLIMITED DIMENSIONS TO BE ±

		DATE
MAT'L CERT		
DESIGNED		
DRAWN	R.J.L	18-08-99
CHECKED	L.E.A	18-08-99
APPROVED	K.V.E	

NAME: EARTH BONDING SYSTEM RECOMMENDATIONS AND LAYOUT

SCALE -

No: A2-85114

B