HamiltonJet

MARINE PROPULSION UNITS

Installation & Service Manual

MODEL 291

Jet Unit:	HJ-291
Part Number:	89291
Revision 1	25/09/98
Amendment 8	30/09/99

NOTE:

AMENDMENT 1 / 2 OF THIS MANUAL IS ONLY APPLICABLE TO JET UNITS FROM SERIAL No #2963 ONWARDS.

AMENDMENT RECORD

Part No: 89291
Jet Model: HJ-291
Manual: Installation & Servicing

Amdt	Incorporated By	Date
1.	CWF Hamilton & Co Ltd	26/11/98
2.	CWF Hamilton & Co Ltd	01/12/98
3.	Dave Bull	23/4/99
4.	K Brown	11/5/99
5.	K Brown	24/5/99
6.	K Brown	23/8/99
7.	K Brown	14.9.99
8.	DBull	27/9/99
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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:

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.

4.7.

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.

4.10, 4.11, 6.4, 8.33 and 8.34.

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.

8.15.

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.

8.18.

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.

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:

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

2.8.

CAUTION:

Ensure that the 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.

2.8.

CAUTION:

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

2.12.

SECTION 3.

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. & 4.9.

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.

4.7.

CAUTION:

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

4.8.

CAUTION:

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

4.9.

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.

4.11.

SECTION 5.

NIL.

SECTION 6.

CAUTION:

The Jet Unit cannot be run out of 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- based anti-fouling paints. Tin base anti-fouling paints are suitable or any paint suitable for an aluminium hull. Leave all stainless steel parts polished and unpainted. Do not paint over anodes.

ANTI-SEIZE COMPOUNDS:

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

6.6.

CAUTION:

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

6.9.

CAUTION:

Anti-Seize Compounds:

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

6.10.

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.

SECTION 8.

CAUTION:

DO NOT use copper based antifouling paints. Tin or non metallic base antifouling paints are suitable.

8.2.

CAUTION:

The Steering Assembly can be reassembled in several ways. It is important to follow the relevant drawings contained in this Manual, to prevent damage to the Steering Assembly. Also refer to Section 2.5.7 "Assembling the Jet Steering Tillers" in this Manual, for details.

8.13.

CAUTION:

The Water Seal should not be removed if it is not being replaced. The Water Seal will not perform correctly if it is removed and then reinstalled.

The Water Seal need only be replaced if it is leaking or it is suspected of leaking, or there is insufficient material left to last to the next inspection. Refer to Section 6. Maintenance - General, for details of the maintenance required.

8.17.

CAUTION:

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

8.18.

CAUTION:

Avoid using excessive heat during welding.

8.24. & 8.26.

CAUTION:

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

8.26.

CONTENTS LIST

HJ-291 #89291 Drawings Package

Drawings contained within this Drawings Package

Drawing Number	Amdt Status	Up-Issued	Position of Marker Tabs
			Jet Drawings
HJ 291 30 001	B	22/03/99	
			Basic Jet
HJ 291 01 001 2 Shts	D	27/04/99	
HJ 291 01 004 2 Shts	D	27/04/99	
			Couplings
HJ 291 02 001	A	03/03/99	
			Impeller & Inserts
HJ 291 03 001	O	27/7/98	
			Steering
HJ 291 06 001	B	01/02/99	
			Reverse
HJ 291 07 001 2 Shts	B	21/07/99	
			Installation
HJ 291 08 001 2 Shts	A	03/12/98	
HJ 291 08 002 2 Shts	A	03/12/98	
HJ 291 08 003 2 Shts	A	03/12/98	
			Tools
HJ 291 11 000	A	27/04/99	
			Other
HJ 291 09 001	O	27/7/98	
HJ 291 09 002	O	27/7/98	
HJ 291 10 001	O	27/7/98	
HJ 291 13 002	O	29/4/99	
61502	A	27/7/98	
63974	O	28/8/98	
85018	G	18/08/99	
85080	B	24/9/96	
85113	O	18/08/99	
85114	A	16/09/99	

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, unrivaled 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 worldwide. 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 worldwide.

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 Waterseal 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 (JT TYPE STEERING NOZZLE)

The Steering assembly is attached to the rear of the Tailpipe. It consists of a Steering Housing, Nozzle Insert and Steering Nozzle (which incorporates the Nozzle described above). The Steering Nozzle is mounted inside the Steering Housing on vertical pivot pins and is rotated to port or starboard by linkages attached to an inboard Steering Cylinder. The Insert inside the Steering Housing ensures that the flow exiting the Stator section reaches the final Steering Nozzle outlet without being disturbed by the steering mechanism, thus maximising steering efficiency.

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 HJ-291 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 waterline (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)

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. Refer to Section 1.6. "Description of the Dry Run System (Optional)". 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.

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 sleeve. 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 consultations between **C.W.F. Hamilton** and the customer.

1.3. HULL DESIGN

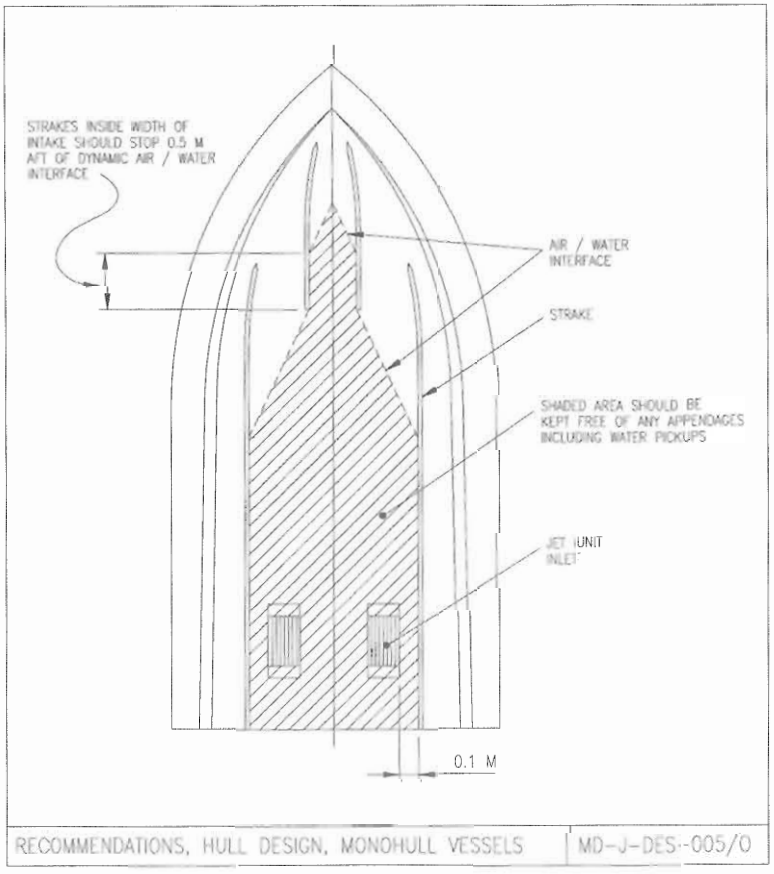
CAUTION:

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.

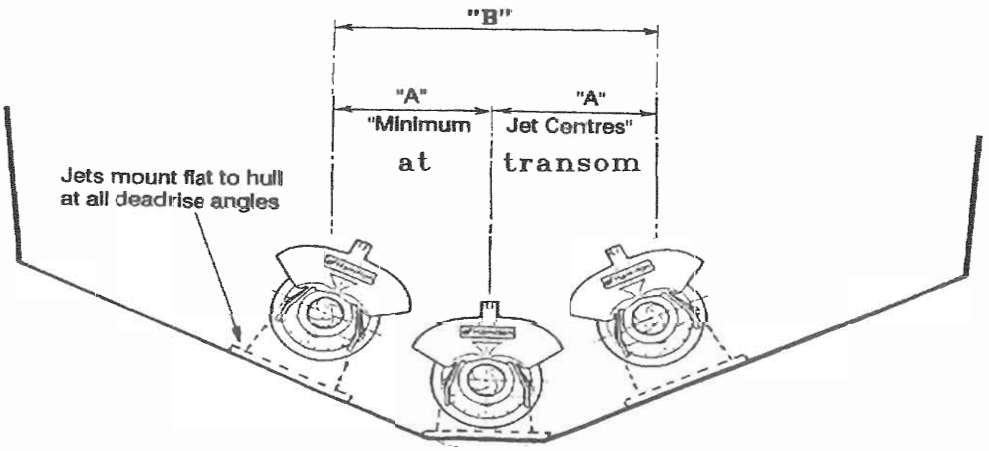
1.3.1.Mono Hulled Vessel

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 10° minimum deadrise angle is recommended.
   b) Mount multiple Jet Units close to the keel line as possible ("staggered" engines recommended). refer to "Minimum Jet Centers" below.
   c) Planing strakes, keelsons, "plank keels" and any other appendage causing turbulent flow into the Jet Unit Intake(s), must be removed in front of and closer to keel than the Jet Intake(s). Recommended strakes are as in the following diagram.



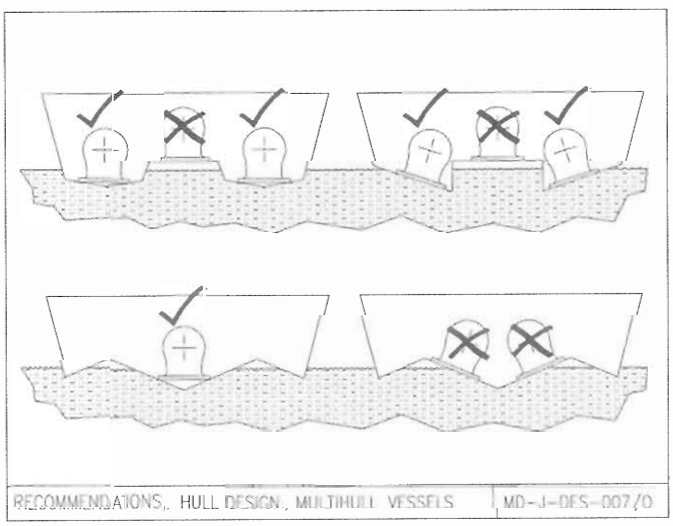
2. For speeds over 30 knots, monohedron (constant deadrise) hulls are recommended for directional stability without appendages.
3. Displacement speed and warped plane (reducing deadrise going aft) hulls may need additional directional stability. Twin small bilge keels aft are normally sufficient (these do not increase draft or interfere with water flow into the Jet).
4. 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.
5. Minimum distances between Jets for multiple installations.
   a) For twin Jets;
      Dimension "B" =800 for 0-25° deadrise angles.
   b) For triple Jets;
      Dimension "A" = 700 for 0 - 25° deadrise angles.
   c) For more than three Jets, consult **C.W.F. Hamiltion & Co Ltd** for distances between Jets.



1.3.2. Multi Hulled Vessel

Jet Units can be fitted in catamaran or trimaran hulls. Air entrainment between the hulls occurs with these craft. Care must be taken that this entrained air does not enter the Jet Unit Intake(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. The Reverse Duct of the Jet Unit, when in the "Up" (ahead) position must not project beyond the side walls of a catamaran or trimaran hull otherwise substantial drag may be caused.

Refer full details to **C.W.F. Hamilton & Co.** in all cases if Jet Units are proposed in these types of hulls.

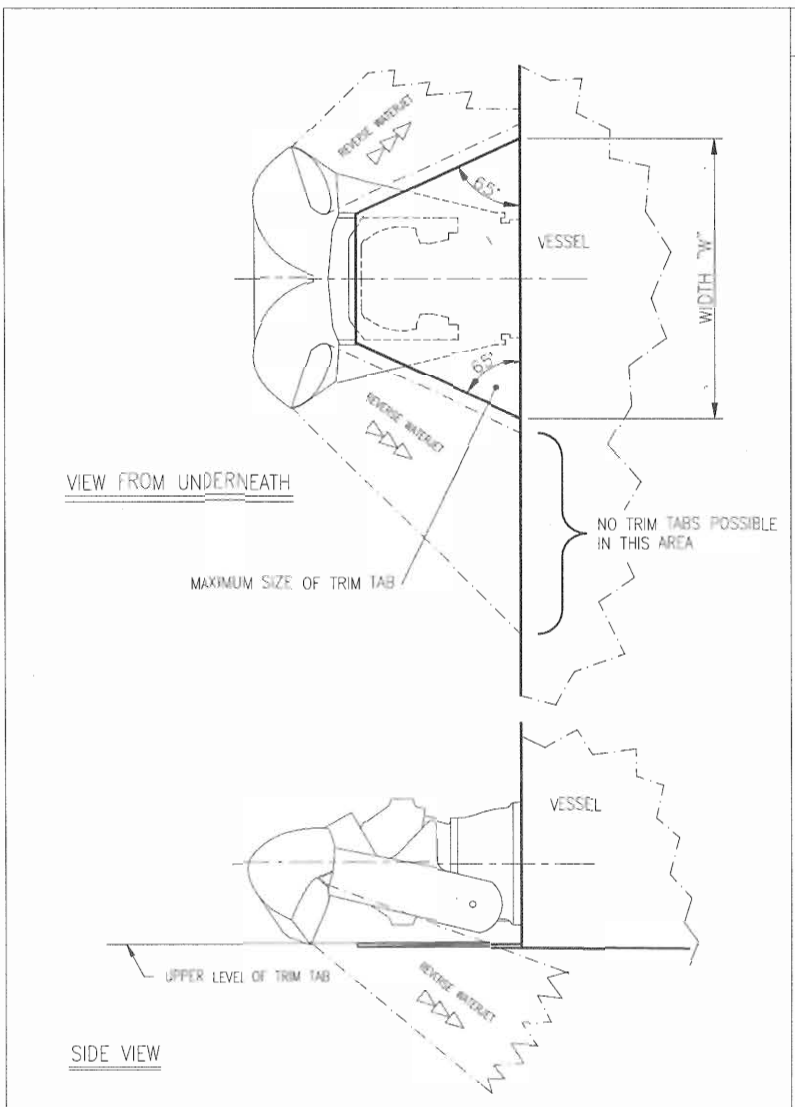


1.3.3. Trim Tabs

Trim tabs cannot be mounted directly alongside the Jet Unit. This is because when moving astern, the reverse waterjet will hit them 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 25° 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.

If engine exhausts are located below the waterline near the Jet Units, 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:

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.

1.4.1. Requirements Of Drivelines

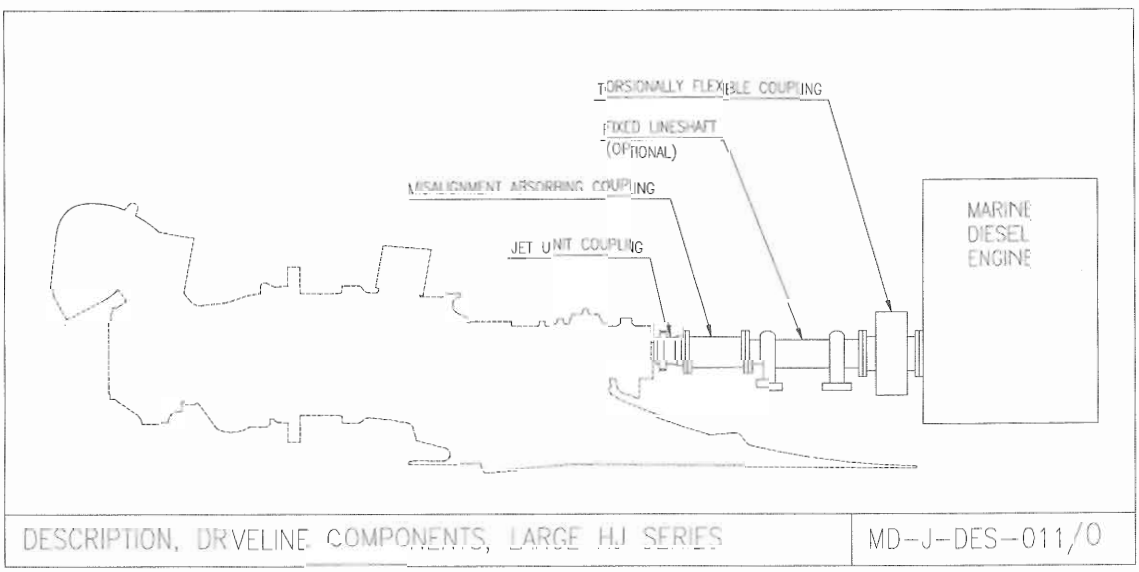
1. The Driveline must accommodate parallel and angular misalignment plus allow axial movement.
2. The Driveline must transmit the torque input to the Jet Unit with an acceptable life expectancy. It does not have to transmit thrust loads as these are absorbed by the Jet Unit.
3. Torsional flexibility will 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 Jet 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. **(Details of the Jet for this analysis are given in Section 1.3.5. Moments of Inertia.**



NOTE:

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

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 following show 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 coupling which is both flexible to allow for angular offset and also rigid to absorb torsional twisting.

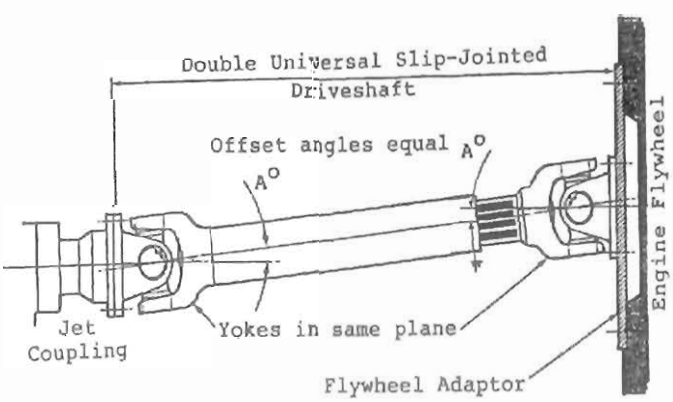
The Coupling is formed by two hubs which engage into a flanged sleeve with internal straight parallel teeth. Due to the design of the of the teeth curvature, if shaft misalignment occurs, the hub can oscillate in the flanged sleeve.
The curved face teeth couplings are flexible enough to compensate for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

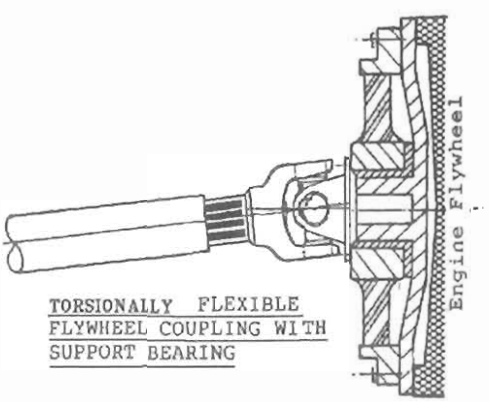
Manufacturers recommendations regarding installation and alignment should be followed. **Note that a double jointed coupling is required.**

B. UNIVERSAL DRIVESHAFTS

These are double universal slip-jointed Driveshafts, also called Cardan shafts. They bolt directly to the Jet Unit Coupling.

Lengths range from approximately 900 mm to 3,000 mm. Lengths are limited by the weight which can be allowed at the Jet Unit Coupling. **(Refer to Section 1.3.6 Critical Speed of Mainshaft** and **Section 1.3.2 Engineering Checks)**.



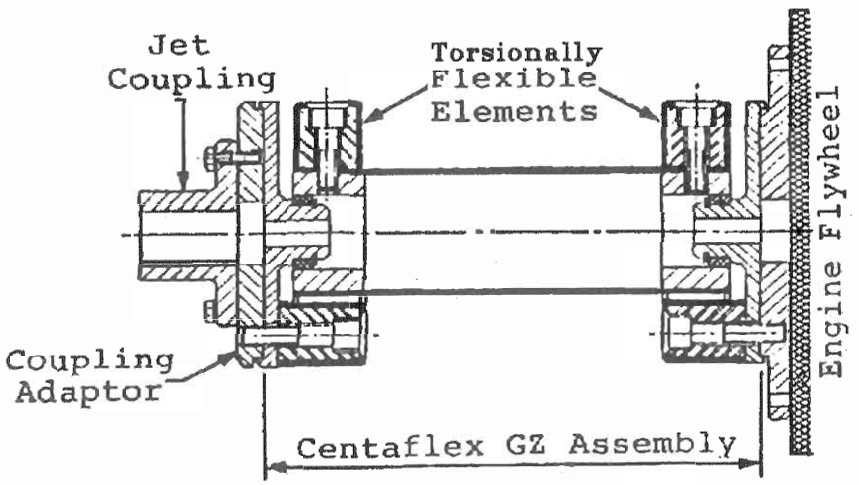


C. DOUBLE ELEMENT TORSIONALLY FLEXIBLE COUPLINGS

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

Use a double element torsionally flexible driveshaft with support bearings such as the "Centaflex GZ" 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 200 mm (8") upwards, but limited by the weight which can be allowed at the Jet Unit coupling (Refer to Critical Speed Check).



DOUBLE ELEMENT NON TORSIONALLY FLEXIBLE COUPLINGS

An example of such a Coupling is "Centalink".

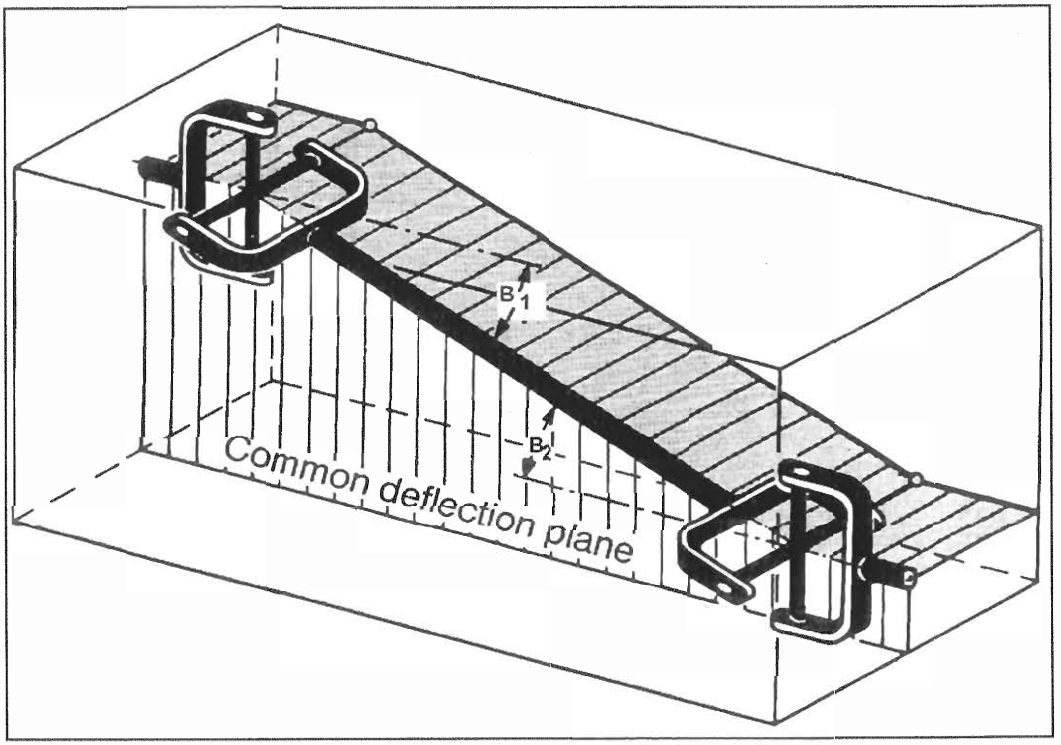
TORSIONALLY FLEXIBLE COUPLING (TFC)

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.

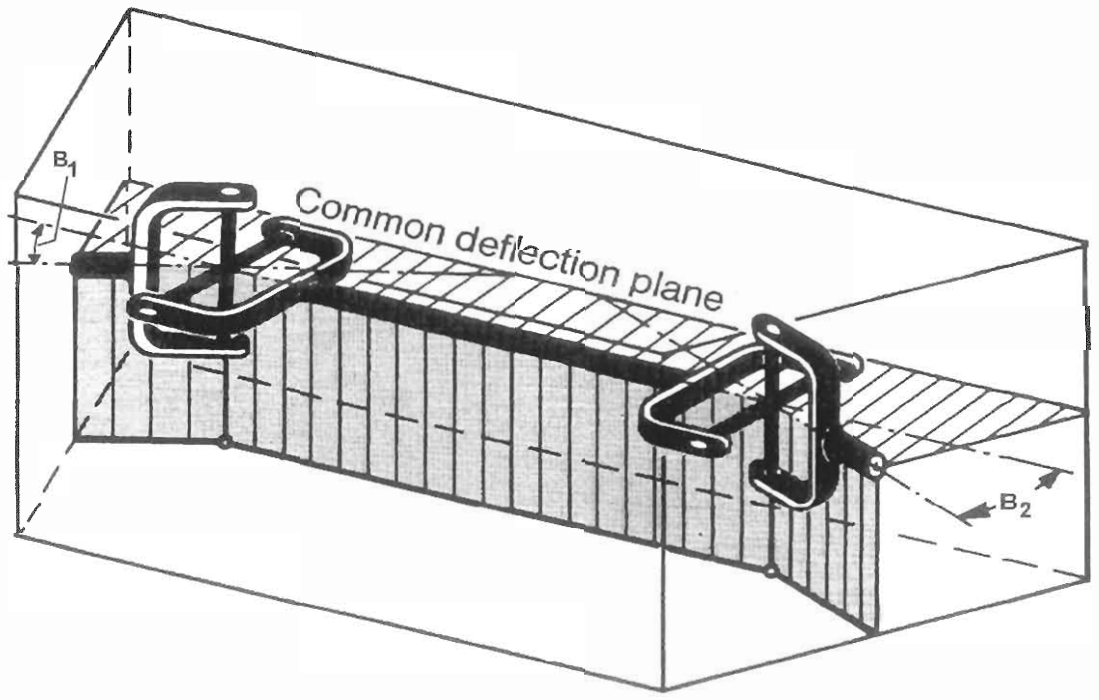
NOTE:

1. **If a gearbox is used, a torsionally flexible coupling should already be fitted between the engine and gearbox. If so then the universal driveshaft can be bolted directly between the Jet and the gearbox flange (an adapter will normally be required at the gearbox flange).**
2. **The engine should be positioned so that the universal joints of the driveshaft each have equal offset angles of between 1.5 and 5 degrees - this is most important.**
3. **Detail of the driveshaft make, model and length should be supplied to C.W.F. Hamilton & Co Ltd for a critical speed check.**
4. **Correct running length of shaft is with the shaft extended to half the total spline extension.**
5. **The splined end of the driveshaft is the heavier end and should be installed at the engine and not the Jet.**
6. **The universal driveshaft must be assembled with yokes (forks) in the same plane and the engine should be positioned so that the universal joints of the driveshaft each have offset angles at each end. (See diagrams "Z" and "W" Configurations on following page) If not, cavitation of the Jet and machinery damage can result because the drive motion to the Jet is not a constant velocity.**



"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.**

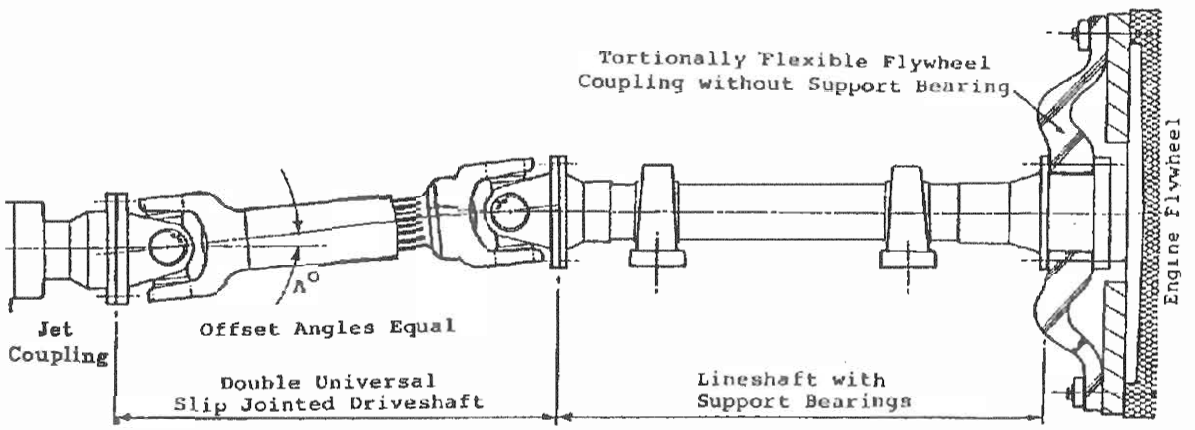
2. **When the TFC couples directly to a Lineshaft supported on bearings, a support bearing is not required.**

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 a 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

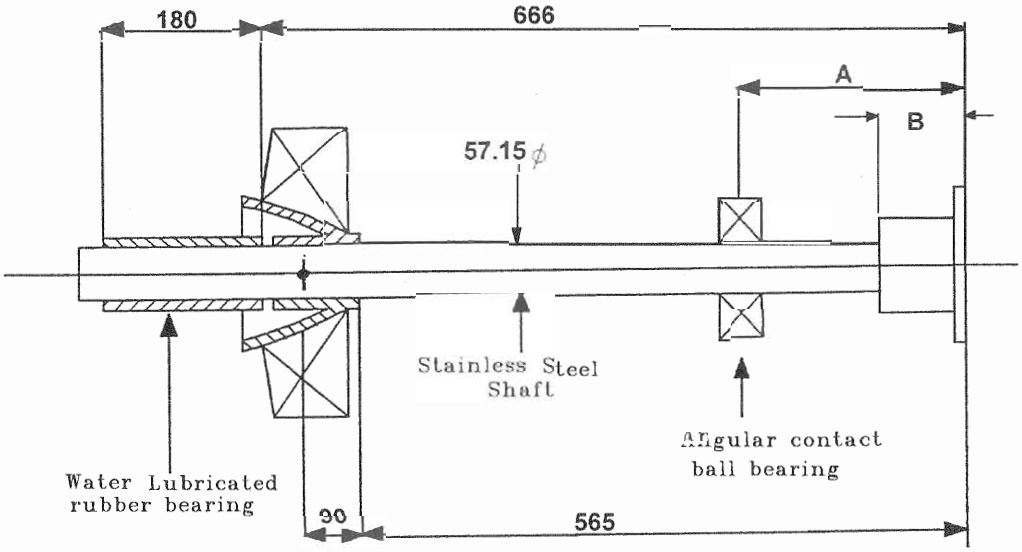
Please refer to **Drawing HJ-291-02-001 Couplings for HJ-291 Jet,** for all relevant Coupling details.

1.4.5. Moments Of Inertia

A Torsional Vibration Analysis must be carried out for the complete drive-train including Engine Flexible Coupling, Gearbox, Driveshaft and Jet rotational assembly, especially where a universal driveshaft is used without a torsionally resilient member or gearbox in the driveline. It is the responsibility of the vessel builder to see that this is carried out by either the engine manufacturer or the flexible coupling manufacturer.

The Moment of Inertia Data for the Jet Unit is provided below, to enable a Torsional Vibration Analysis to be carried out.

HJ-291 JET MAINSHAFT DIMENSIONS



Dimensions A 172mm except Aquadrive CVA Coupling A = 195mm.
Dimensions B 117mm except Aquadrive CVA Coupling B = 140mm.

Item	Description	Mass (kg)	Polar MoI (kgm)$^{2)}$
Mainshaft	dia 57.15	9.003	0.002
Impellers	Type 10 to 12.5	9.18	0.067
-//-	Type 13 to 15.5	10.07	0.078
-//-	Type 16 to 20	12.3	0.1
Couplings	150 mm	4.743	0.0079
-//-	1610	4.75	0.0124
-//-	1440 / 1446	7.53	0.033

1.4.6. Critical Speed Of Mainshaft

NOTE:

1. **In all cases, for the calculation of the "Critical Speed of the Jet Mainshaft" consult C.W.F. Hamilton & Co Ltd.**

2. **The heavier splined end of the Universal Driveshaft should be located towards the engine.**

If a heavy Driveline is used then a transverse vibration analysis of the Jet Mainshaft should be carried out.

1.5. JET MAINSHAFT ALIGNMENT

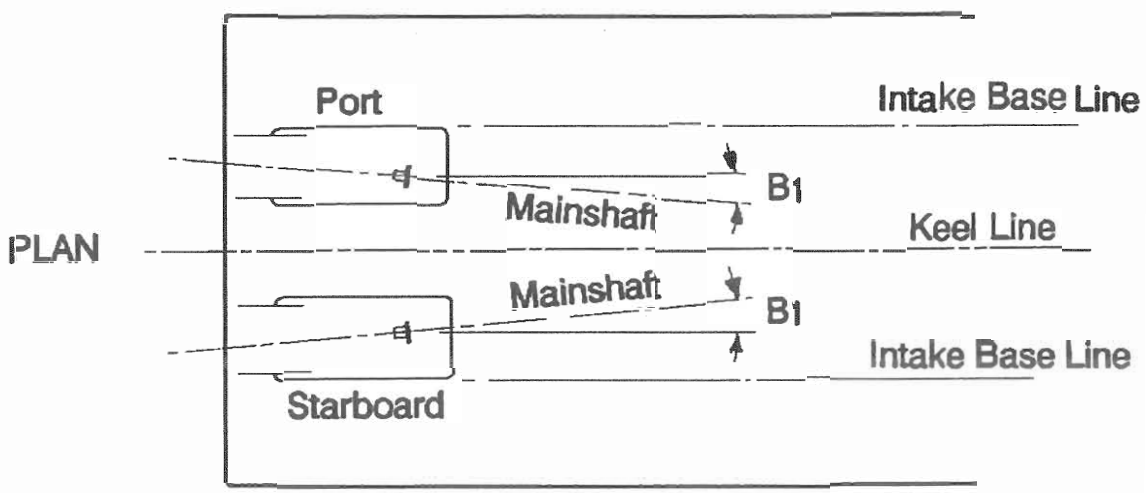
(Port and Starboard Jets Only)

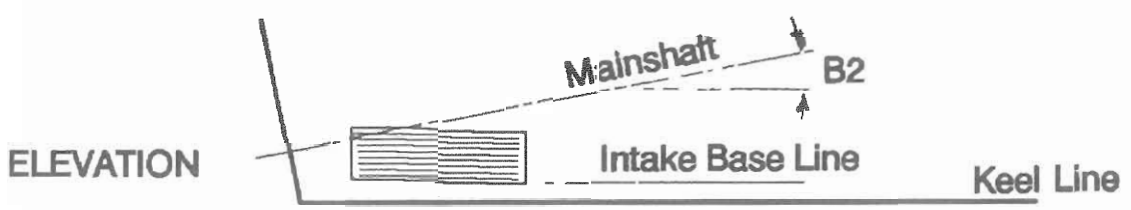
The HJ-291 Waterjet Mainshaft is inclined at an angle of 5° to the intake base. When port and starboard Jets are mounted at the hull deadrise angle, the Jet Mainshafts are no longer parallel to the keel line in plan. The following table lists the angle deviation of the Jet Mainshaft when the Jet base is mounted parallel to the keel line.

FOR INTAKE BASE PARALLEL TO KEEL LINE:

B1 = Shaft angle in Plan view.
B2 = Shaft slope in Elevation.

ANGLES (relative to Keel in degrees) :		
Hull deadrise	**B1**	**B2**
0	0	5.0
5	0.4	5.0
10	0.9	4.9
154	1.3	4.8
20	1.7	4.7
25	2.1	4.5
30	2.5	4.3

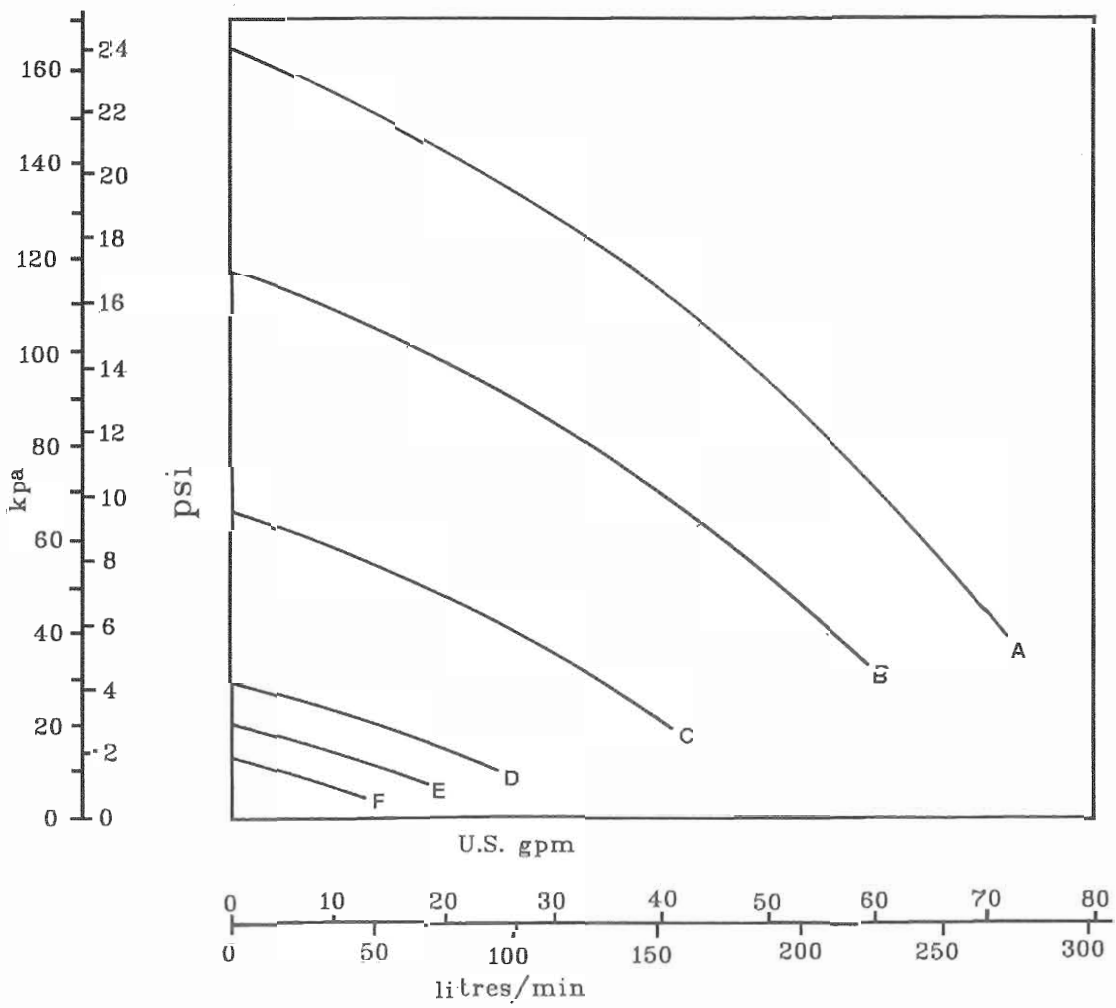




1.6. COOLING WATER OFF-TAKE

The cooling water off-take can supply water for engine cooling or deck washing. The following graph of flow rates is for the jet at zero speed. To determine rpm refer to hp-rpm curves in Designers Manual or to calculate RPM from horse power use the following formula:

$$RPM = 1000 \times \left[\frac{(\text{horsepower} \times 746)}{\text{Impeller Type No}}\right]^{1/3}$$



NOTE:

Pressure increases with vessel speed. Pressures in excess of 205kPa (30psi) are likely at vessel speeds over 30 knots and in excess of 275kPa (40psi) at vessel speeds over 40 knots.

1.7. DESCRIPTION OF THE DRY RUN SYSTEM (OPTIONAL EXTRA)

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 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 sleeve. 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:	**1000RPM**
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.

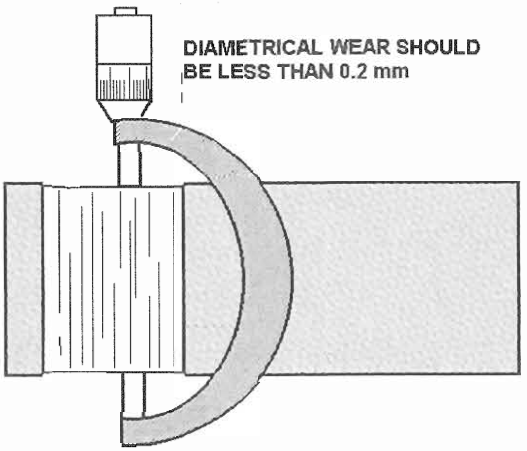
1.7.4. Fault Finding

Fault	Cause	Remedy
Bearing Jams up when dry running	Excessive heat buildup 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.



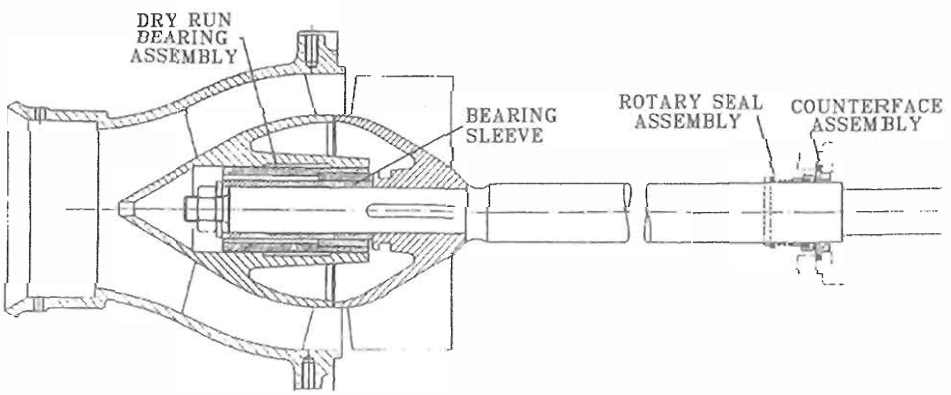
ASSEMBLY NOTES

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 Marine 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 in **Section 1.6.6. "Parts List",** of this Manual.
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



JET	DRY RUN KIT	BEARING	SLEEVE	COUNTERFACE and ROTARY SEAL
291	110731	106627	106604	61428

2. Installation

2.1. BASIC INSTALLATION METHOD AND DRAWING REFERENCES

FOR G.R.P. OR WOODEN HULLS:
Refer to Installation Drawings: HJ-291-08-001

An aluminium "Intake Block" (Part No. 106239) is supplied with the Intake Block Installation Kit (Part No 110695) 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.

FOR ALUMINIUM HULLS:
Refer to Installation Drawings: HJ-291-08-002

An aluminium "Intake Block" (Part No. 106239) is supplied ready to weld into a prepared opening in the Hull bottom.

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 & rear are smooth to within 1mm.

FOR STEEL HULLS:
Refer to Installation Drawings: HJ-291-08-003

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

An aluminium "Intake Block" (Part No. 106239) is supplied with the **Intake Block Installation Kit - Steel Hull (Part No 110697),** 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 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.

Refer to the appropriate Hull Installation Drawings in the Jet Unit Drawings Package.

HJ-291-08-001	**GRP & Wooden Hulls.**
HJ-291-08-002	**Aluminium Hulls.**
HJ-291-08-003	**Steel Hulls.**

2.2.1. Fixing the Intake Block to the Hull

GRP OR WOODEN HULLS:

Drawing HJ-291-08-001 refers.

If possible tape the Intake Block into the hull mould prior to moulding the hull. For Jets mounted on the hull centerline 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. - **See NOTE on Drawing HJ-291-08-001.**

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 30 x 9mm dia. holes at the countersunk centers from underneath the Hull up through the Intake Block flange and Hull. Fit items (8),(7),(3) & (4) using RTV silicon sealant provided & torque for M8 nut refer to Drawing 85018.

STEEL HULLS:

Drawing HJ-291-08-003 refers.

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 [7].
2. With the Intake Block in place, from below, drill through the 30 countersunk points on the Intake Block with a 9 mm 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 12mm diameter to accept the Nylon Insulating Bushes [8]. Remove all burrs.
5. Liberally smear both sides of the Intake Block Gasket [7] with RTV Sealant [24] 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 [24] on top of the Gasket [7] and run a bead of RTV Sealant around the internal corner of the prepared recess.
7. Ensure that all the Bolts [13] are liberally smeared with RTV Sealant prior to fitting.
8. Install the Intake Block and secure in 3 positions with Bolts [13, Nylon Insulating Bushes [8], Flat Washers [18], Spring Washers [21] and Nuts [15]. Hand tighten.
9. Check for electrical isolation between the Intake Block and the vessel hull before fitting the remaining screws.
10. Fit the remaining Bolts [13], Nylon Insulating Bushes [8], Flat Washers [18], Spring Washers [21] and Nuts [15].
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.

FOR ALUMINIUM HULLS:

Drawing HJ-291-08-002 refers.

It is assumed that the aluminium plating of the Hull is one of the following types 5083, 5086, 6061, 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 on Drawing 85080. Ensure the contours between the hull and the intake block at front & rear, are smooth to within 1mm. Grind flat where necessary, especially in front of the Intake.

2.2.2. Transom Preparation

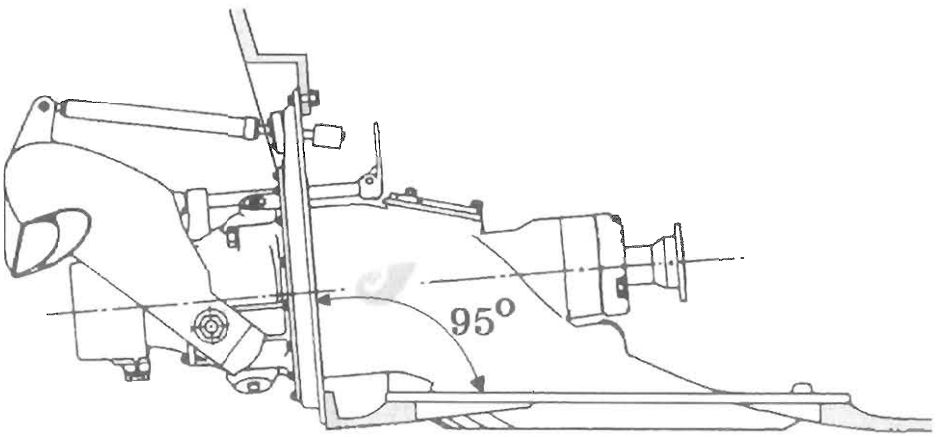
An area at 95° to the Jet Unit Intake base has to be prepared as shown on the Hull Preparation Drawing.

FOR GRP AND WOODEN HULLS:

An insert can be taped into the hull mould so the required area at 95° can be moulded with the hull. Alternatively the area to be at 95° can be cut from the Transom and re-fibre glassed back at the correct angle. One method to located the transom area at the correct angle is to install the Jet Unit, bolt the Jet Unit Transom Plate Assembly and Transom cutout into position then fibreglass the cutout back into the Transom.

FOR METAL HULLS:

Cut out the required area reposition at 95° and re-weld, with required inserts at sides and top, back to the Transom.



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-291-06-001 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 Overhaul"* for removal and refitting instructions

2.3.2. Reverse Components

Drawing HJ-291-07-001 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. "REVERSE ASSEMBLY - OVERHAUL*, in this Manual for the removal and refitting procedure.

2.3.3. Remove Other Parts

The Jet Unit is shipped with the CT3 / HSRC Controls System fitted. Should it be necessary to remove the HSRC Controls System, refer to the CT3 / HSRC Controls Manual for details.

2.4. MOUNTING

Refer to the appropriate Hull Installation Drawings in the Jet Unit Drawings Package.

HJ-291-08-001 GRP & Wooden Hulls.
HJ-291-08-002 Aluminium Hulls.
HJ-291-08-003 Steel Hulls.

2.4.1. Mounting the Jet Unit

After mounting the Intake Mounting Block and making the Transom Hole in the Hull; carry out the following:-

1. Remove the Reverse Duct and Transom Seal Plate (with Reverse Cylinder) from the Jet Unit.
2. Lift the Jet Unit (complete with the Intake Screen) 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 rectangular Intake Block hole.
3. Check that the Jet Unit is correctly located in relation to the Transom Hole.
4. Check that the contours between the Hull and Jet Unit Intake, at the front and rear, are smooth within 1mm(1/32") There should be no steps.

If satisfactory proceed as follows:

FIBREGLASS, WOODEN AND ALUMINIUM HULLS-

5. Lift the Jet Unit off the Intake Block and move it away from the Intake Block.
6. Screw in and tighten the 25mm threaded end of the Studs provided, into the tapped holes in the Intake Block. 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. Use of thread locking fluid is recommended. Loctite 262 or equivalent should be used.
7. Liberally apply neutral cure R.T.V. silicone sealant (supplied) to the top of the Intake Block, underside of the Jet Unit Flange and to the bolt heads.
8. Carefully position the Jet Unit centrally in the Intake Block hole and fit Flat Washers, Spring Washers and Nuts as shown in Installation Drawing. **HJ-291-08-001. GRP & Wooden Hulls.**
9. Torque the 30 x M10 Nuts to the torque indicated in Drawing 85113.
10. Remove excess sealant from inside and outside the Jet Unit.

STEEL HULLS

11. Lift the Jet Unit off the Intake Block and move it away from the Intake Block.
12. Screw in and tighten the studs provided into the tapped holes in the Intake Block (Refer to Stud fitting method shown at Step 6, {for "Fibreglass, Wooden and Aluminium Hulls"} above).
13. Ensure the 30 holes in the Jet Intake Base flange have been drilled out to 16.0 dia to accept the Insulating Bushes.
14. Liberally apply neutral cure R.T.V. silicone sealant (supplied) to the top of the Intake Block, underside of the Jet Unit flange and to the Stud heads.
15. Place gasket over Studs onto the Intake Base.
16. Install the Jet Unit centrally in the Intake Block hole and fit the Insulating Bushes, Flat Washers, Spring Washers and Nuts - as shown on appropriate Installation Drawing.
17. Torque the 30 x M10 Nuts as indicated in recommended torque's. **Drawing 85113 refers.**
18. Remove excess sealant from inside and outside the Jet Unit.
19. Ensure that the Jet Unit is electrically insulated from the steel Hull. If not find the cause and rectify.

2.4.2. Transom Seal Assembly

1. Place the Transom Seal Assembly over the Tailpipe and against the Transom. Centralise them in relation to the Intake and rotate to position the vertical centerline square to Jet Intake Base.
2. Using a 8.5mm dia. drill bit, drill through the 22 holes to just dimple the Transom for correct hole location.
3. Slide the Transom Seal Assembly back off the Tailpipe and proceed as follows :

FIBREGLASS, WOODEN AND ALUMINIUM HULLS

1. Refer to the appropriate installation drawing.
2. Drill 9mm dia. and 17mm dia. holes as indicated through the Transom at the dimpled holes and locations as shown on the drawing.
3. Liberally apply neutral cure R.T.V. silicone sealant (supplied) to the Transom Plate contact area on the Hull, plus the joint face of the Transom Plate and the bolt heads.
4. Fit the Transom Seal assembly into place against the Transom.
5. Fit Bolts, Washers and Nuts etc. to secure the Transom Plate to the Transom as shown on the appropriate Installation Drawing. With through bolt systems, install the Transom Plate with the bolt heads to the outside of the boat.
6. Torque the Transom Seal securing bolts and Nuts to Special Studs as shown on Drawing 85113. Remove excess sealant.
7. Tighten the Transom Seal by working round the 16 M8 Nuts - torque to the correct torque as shown on Drawing 85113.

STEEL HULLS

1. Drill 19 holes 9mm dia, as indicated through the Transom at the dimpled holes and locations as shown on the drawing.
2. Drill 3 holes 17mm dia, as indicated through the Transom at the dimpled holes and locations as shown on the drawing.
3. The Transom Seal Plate must be totally insulated from the Hull by a Gasket and flanged Insulating Bushes fitted to the mounting Studs.
4. Drill out the 22 Transom Seal Plate holes to 12mm dia. to accept the Insulating Bushes.
5. Liberally apply neutral cure R.T.V. silicone sealant (supplied) to the Transom Plate contact area on the Hull, the joint face of the Transom Plate and to the flanged Insulating Bushes.
6. Fit the Transom Seal Assembly into place against the Transom. Ensure that the Insulating Gasket is placed next to Transom.
7. Fit the flanged Insulating Bushes, Flat Washers, Spring Washers and Nuts to secure the Transom Plate including the 3 Special Studs (4), as per the appropriate Installation Drawing.
8. Torque the 22 Transom Seal securing Nuts to the recommended torque as shown in Drawing 85113. Remove any excess sealant.
9. Tighten the Seal by working round the 16 M8 Nuts. Torque to the recommended torque load as per Drawing 85113.
10. Ensure that the Jet Unit and Transom Plate are electrically insulated from the Hull. If not find the cause and rectify.

2.4.3. Final Assembly

Drawing HJ-291-07-001 refers.

The parts previously removed at *Sections 2.3.1."Steering Components" to Section 2.3.3. "Remove Other Parts"*, may now be refitted.

REVERSE DUCT FITTING

Drawing HJ-291-07-001 refers

The Reverse Duct may have been removed prior to the installation of the Jet Unit through the Transom hole.

The Reverse Duct may now be refitted to the Jet Unit in accordance with instructions at ***Section 8.3.2. Refitting the Reverse Duct***, in this Manual.

REVERSE CYLINDER FITTING

Drawing HJ-291-07-001 refers

NOTE:

The Reverse Cylinder should not be refitted until the Intake and Transom Plate are securely fastened in place.

If the Reverse Cylinder has been removed for installation of the Jet Unit, the Reverse Cylinder can now be refitted to the Jet Unit in accordance with instructions. ***Refer to the Overhaul Section 8.3.1 Refitting the Reverse Cylinder Assembly.***

Refer to the CT3 / HSRC Manual for installation and adjustment of the hydraulic system.

2.5. DRIVELINE AND ENGINE INSTALLATION

2.5.1. General

The engine(s) should be located in a position that will give the vessel 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**.

2.5.2. Mounting 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 *Section 1.4. "Jet mainshaft alignment"* and also *Section 1.3.3"Driveshaft Options"* for recommended driveshaft and engine installation angles.**

2.5.3. Engine Cooling

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.

CAUTION:

Ensure that the 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.

There is a 1 1/4" BSP outboard water offtake which provides water at approximately 10 kPa (1 1/2 psi) at 600 RPM and up to 31kPa (45 psi) at - 260 Kw (350 hp) - **refer to *Section 1.5. cooling water off-take.*** The water may be fed directly to the engine without the need for a raw water pump, provided that:

(a) The pressure from the water offtake at idle is sufficient to cool the engine.
(b) That the engine can withstand the full pressure from the water offtake.

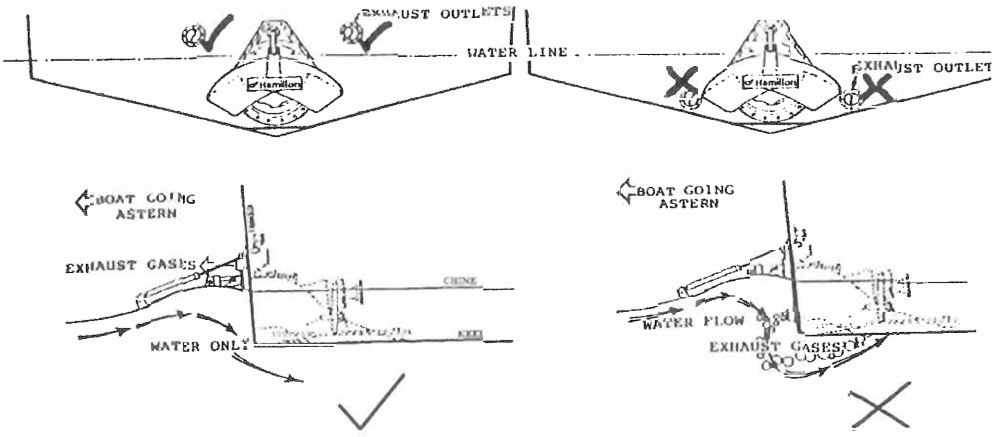
- **To be sure of correct flow for engine cooling, a conventional water pick up and the engine raw water pump should be used.**

- **The Jet Unit 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 1¼ BSP to 1¼ " (32mm) Hosetail, supplied loose, can be fitted in place of the plug.**

2.5.4. Engine Systems

Engine wiring, instrumentation and throttle systems are all conventional - follow the manufacturers recommendations.
With the standard HSRC Reverse System, two lever (separate) throttle and reverse controls MUST be used.

2.5.5. 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.

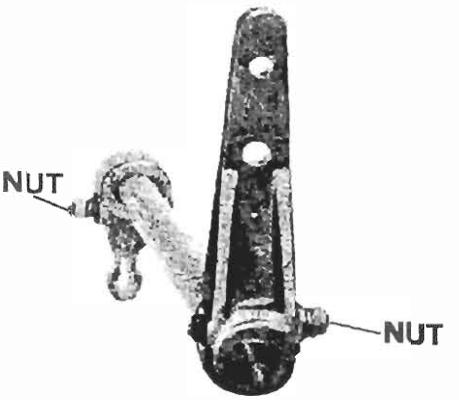
2.5.6. Governor Settings

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 calibrated hand tachometer.
Example: - If the maximum RPM for driving the Jet Unit is 2800 RPM, then the governor should not begin to operate until at least 2850 RPM. On most diesel engines this means the "No Load Governor Setting" (or "High Idle") should be at least 3050 RPM.(i.e. 250 RPM higher than the loaded maximum RPM).
Ensure that the low idle RPM is set high enough to avoid any vibration in the driveline. Extensive idling with the driveline vibrating may damage the Jet Unit. - refer to *Section 1.3. DRIVELINES*.

2.5.7.Assembling the Jet Steering Tillers

SINGLE JET INSTALLATIONS

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

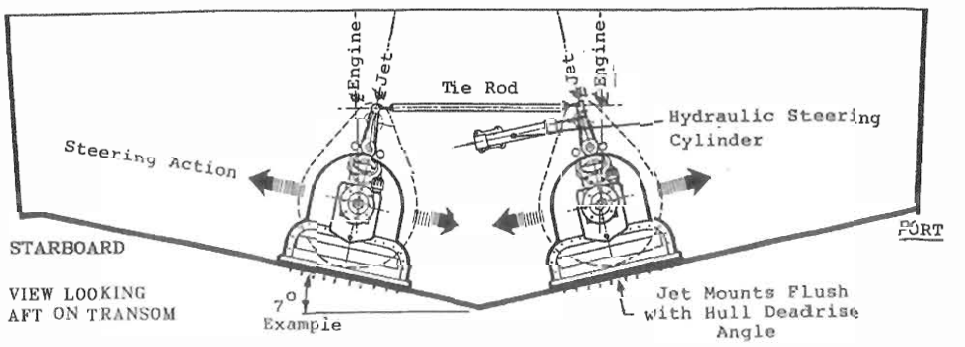


TWIN JET INSTALLATIONS

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.

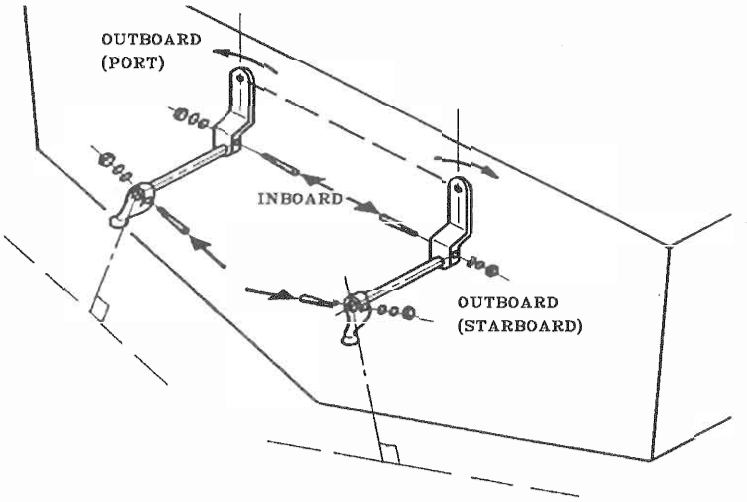
a) For Deadrise angles up to 15°:

- 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 15° 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:

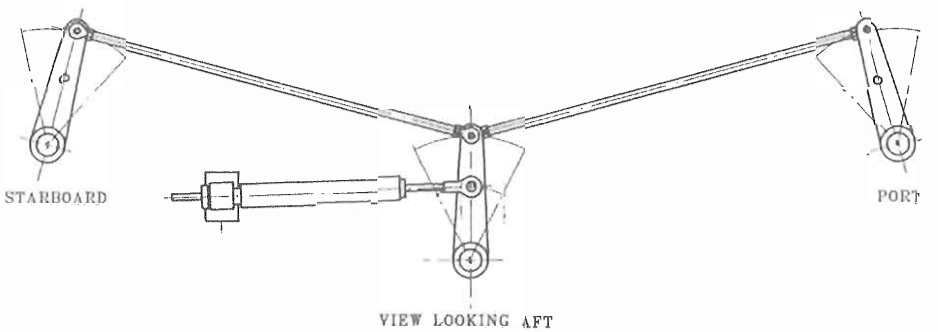
- One Steering Cylinder only is required which should mount on the Center Jet.
- Two swivel ended Tie Rods are used to interconnect the Jet Tillers, from starboard to center Jet and from center to port Jet. Bolt one Tie Rod aft and one ahead of the center Jet Tiller.

a) For Deadrise Angles up to 15°:

- 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 15° 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 15° 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.

2.5.8. 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.

3. Commissioning

WARNING:

ENSURE THAT THE VESSEL IS SECURELY MOORED AS DURING COMMISSIONING. THE JET UNITS MAY PRODUCE LARGE THRUST FORCES.

DO NOT PROCEED IF ANY OF THE CONTROL SYSTEM FAULT ALARMS ARE STILL ACTIVATED.

3.1. PRE-LAUNCH CHECKS

1. Check that all Inspection Covers on all Jet Units are securely attached.
2. Add the correct grade of oil to the Bearing Housing, using the Dipstick to determine the correct level of oil. **Refer to *Section 6.7. "Recommended Lubricants"* and Drawing 85113 for details.**
3. **STEEL HULLS ONLY:**
   Check that the insulation between the Jet Unit and the Hull of the vessel measures NOT LESS THAN 1000 Ohms. Refer to *Section 7.3. "Steel Hulls"* for further details.

3.2. POST LAUNCH CHECKS

Perform the following procedures before the engines are started.

1. Check that there are no water leaks:
   a) At the Transom Seal.
   b) At the Intake Base.
   c) From under the Bearing Housing (Water Seal leak).

2. Check that the waterline is up to at least the Mainshaft centreline so the Jet Unit will prime (pump water properly) when the engine is started.
3. Ensure that the vessel is securely moored fore and aft and located in deep clean water.

3.3. SPEED AND HANDLING TRIALS

NOTE:

It is preferable for a Hamilton 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 trial.
2. Ensure that Jet Unit Intake Screens and insides are clear of any debris which could have been disturbed during trial running alongside the mooring.

3.3.2. Propulsion System Check

CAUTION:

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

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

1. Refer to ***Section 6.3. "Servicing Intervals"*** for any after trials maintenance that may be required.

2. Ensure that all important information recorded during trials is stored for later reference.

3. Check for water leaks around the Jet Unit especially at the Transom Seal and under the Bearing Housing (Water Seal leaks).

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. "Steel Hulls"* for further details.

4. Operation

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. STARTING UP

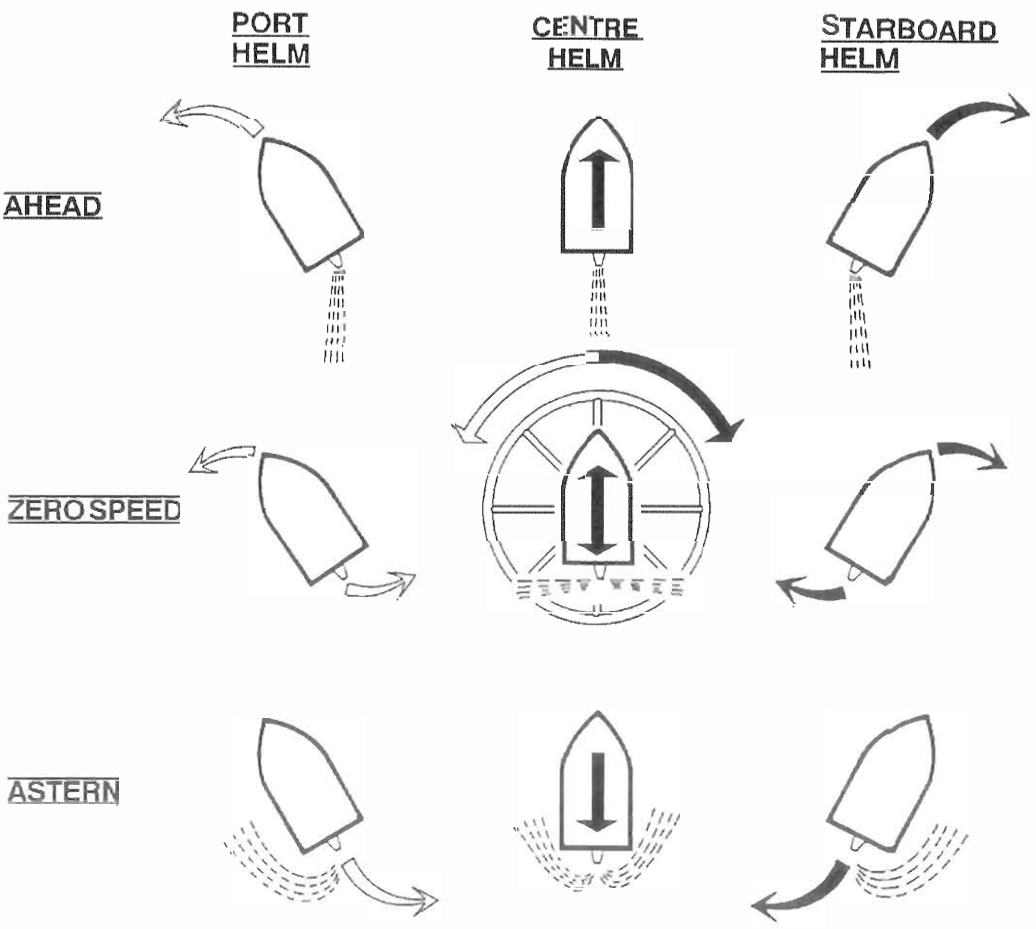
NOTE:

With the HSRC System the Control Lever cannot be moved until the engine, and Hydraulic Pump (HPU) are running.

1. Before starting the engine(s) check the following:
   - The vessel is securely tied up or well clear of other objects.
   - The Helm is centred and the Reverse Controls are at Zero Speed.
   - Clutches or gearboxes, if fitted, are in the neutral position.

2. After starting the engines:
   - Move the Helm and Reverse Levers, if necessary, to stop vessel movement.

4.2. STEERING



The Steering Deflector deflects the Jet of water to port or starboard respectively.

The following points should be remembered when operating a Jet craft:-

a) If the engine is stopped there is no jet or water to deflect and so the vessel cannot be steered or stopped. Never stop the engine or disengage the drive to the Jet Unit when approaching a mooring or at any time when steering will be required.
b) The wider the throttle is opened the greater the steering effect i.e. the sharper the turn
c) Steering is available at "Zero Speed" as well as all ahead and astern speeds - a feature which gives the Hamilton Jet unrivaled manoeuvrability.

Remember when moving ahead at "Zero Speed", or astern, the bow of the vessel will always turn the way the steering wheel is turned, i.e. move the steering to port, the bow of the vessel will move to port and vice versa. This means that going astern the vessel has the opposite steering to a motor car, a feature which can be used to advantage when manoeuvring.

EMERGENCY STEERING

In the case of a complete hydraulic failure the Jets may be steered by manually moving the Jet Tiller(s). Open the By-Pass Valve (or disconnect the hydraulic hoses at the Cylinders if there is no valve). The Steering Deflector position is indicated by the gauge at the Helm. Steering may only be possible at low RPM unless an Emergency Tiller Extension (not included in Hamilton's standard supply) is used.

4.2.1. Total Hydraulic Failure

EMERGENCY STEERING CONTROL:

In the case of a complete hydraulic failure the Jet(s) may be steered by manually moving the Jet Tiller(s). Open the By-Pass Valve (or disconnect the hydraulic hoses at the cylinders if there is no valve). The Nozzle position is indicated by the gauge at the Helm. Steering may only be possible at low RPM unless an Emergency Tiller Extension is used (not included in C.W.F Hamilton & Co Ltd standard supply).

EMERGENCY MANUAL REVERSE DUCT CONTROL

This is the manual raising of the Reverse Duct and is only necessary if the following have failed:

I. The Hydraulic Pump.
II. The Main and any Emergency Control Systems.

To Raise the Reverse Duct:

a) Attach a rope to the Reverse Duct.
b) Take the weight of the Reverse Duct.
c) Lift the Reverse Duct and tie off the rope so that the Duct is raised out of the jetstream.

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

4.3. MANOEUVERING AND DOCKING

TO MANOEUVER:

a) **With Multiple Jets.** Shut down the engine driving the Jet without reverse and manoeuvre using the other Jet(s).
b) **With a Single Jet.** The vessel can be partially manoeuvred by raising the Reverse Duct with a rope and lowering it under its own weight. The engine must be kept at idle RPM.

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.
e) 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 manoeuvring 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.**

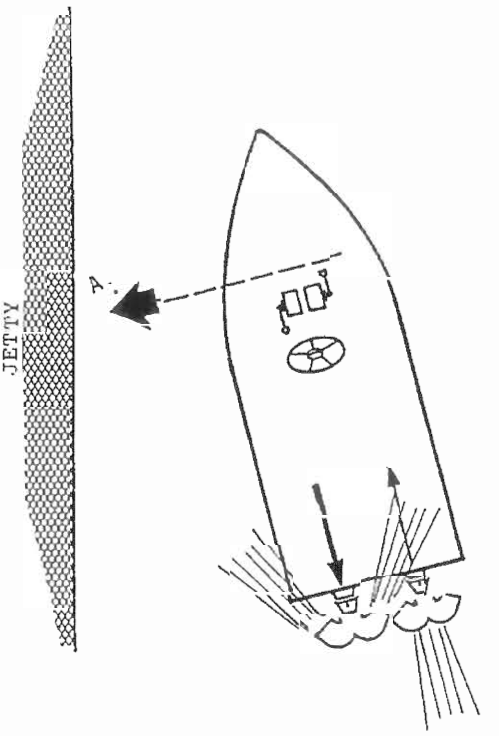
3. **If the bow is rotating to starboard, port lock must be used to stop the rotation (or vice versa) then the Helm centred to hold the heading.**

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 RPMs to just above idle with slightly higher RPM on the port side.

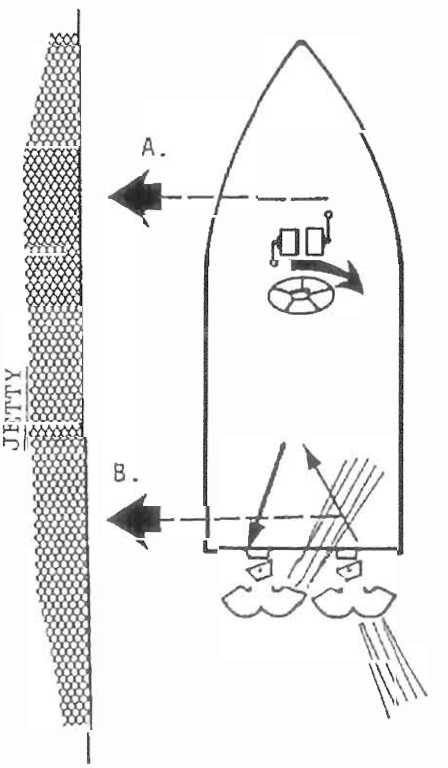
2. Set steering to ahead.

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.
The vessel will now move sideways to Port.

5. 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

Instructions 1 to 4 are the same but for Port read Starboard and vice versa. 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.

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

NOTE:

1. **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.**

2. **The required control setting will vary according to wind and tide conditions.**

WITH TRIPLE JETS:

Using all three Jets to move sideways gives 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 manoeuvring 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 manoeuvring 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. Therefore, before accelerating to full speed, all Jet Units should be cleared by BACKFLUSHING. **Refer to Section 4.9. Blockages**. This should be done on every trip as soon as clear water is reached.

2. Acceleration should be carried out gradually. Full power cannot be used at low vessel speeds such as when operating on one engine only. If there is any blockage of the Jet Unit, the engine will run at a 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 refers.**

3. 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 manoeuvring.

"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 until the desired braking is achieved.
d) Close the throttle as soon as the vessel has slowed to a standstill.
e) Do not use full steering until the vessel has slowed.

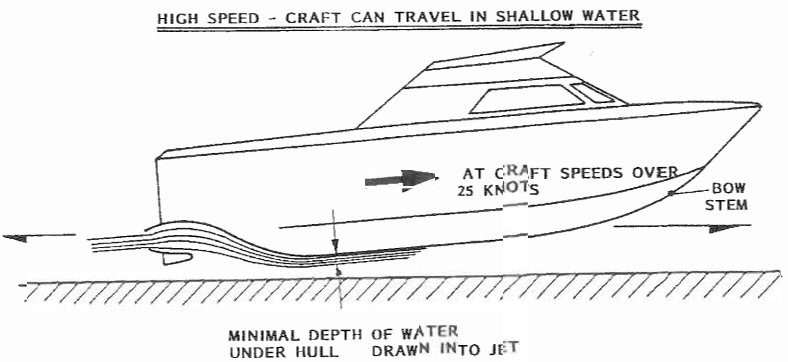
4.6. SHALLOW WATER OPERATION

CAUTION:

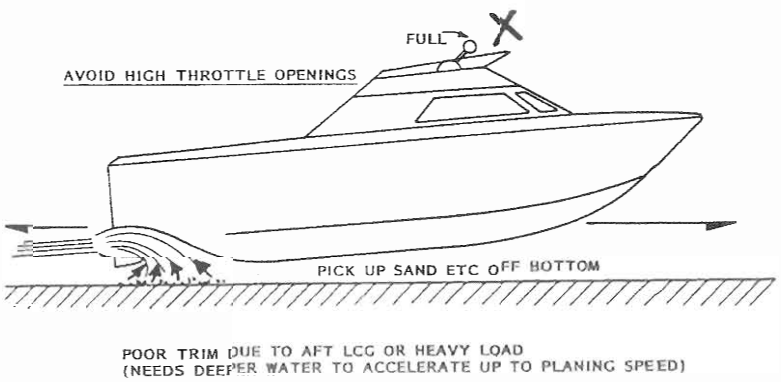
Do not run the Jet if the vessel has run aground. Damage may occur to Impellers.

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:

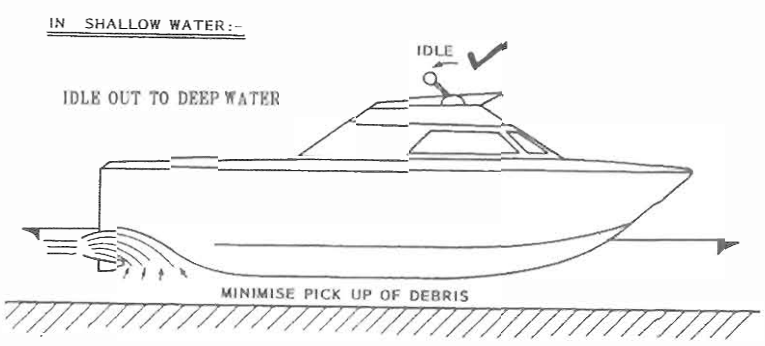
a) At high planing speeds shallow water operation is not a problem until the vessel is nearly grounded.



b) At slow displacement speeds 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 the screen.



4.7. ACCELERATION TO HIGH SPEED.

CAUTION:

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

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.**

CAUTION:

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

Every day, prior to commencing operations, the Inspection Cover should be removed and any debris removed from around the Impeller or Intake Screen.
Refer to Section 6.4. Item 1.

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. (eg. 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.

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 Jet 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 Unit is moored, so it is advisable to clear the Intake Screen in open or clear waters.

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

a) Engine unloading (RPM increases).
b) Lack of Jet thrust (vessel speed drops).
c) Abnormal 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 THE OPENING. NEVER LEAVE THE INSPECTION COVER REMOVED WITHOUT CONSTANT MONITORING OF THE WATER LEVEL.

The following methods can be used to clear a blocked Jet Unit:

a) Slow or stop the engine driving the blocked Jet Unit. The blockage will often clear itself. This operation works best when the Vessel is still moving forward at speed.
b) BACKFLUSH the blocked Jet Unit (only possible if a reversible gearbox is used) as below:
   I. Stop or slow the Vessel to displacement speed.
   II. Move the Reverse Duct to the ZERO SPEED position.
   III. Reverse the rotation direction of the blocked Jet Unit by engaging reverse gear and opening the throttle slightly. This should clear the blockage. If this fails to work, repeat several times.
c) Remove the Inspection Cover on the Intake and manually clear the obstruction. **Refer to Section 4.9.4 Using the Inspection Cover.**

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 Overflow Preventer can be fitted to the inspection point to allow inspection of the Intake Housing at higher water levels.**

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 MONITORING OF THE WATER LEVEL.

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 Hatch Extension 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 Overflow Preventer. 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 (OPTIONAL EXTRA)

Drawing HJ-291-10-001 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 140 mm in allowable water level height.

4.12. OPERATING WITH AN ENGINE AND 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:

a) Look for a symptom similar to what you have noticed.
b) Try each solution until the fault is found and rectified.
c) Use the "REFER" column for more information on each solution.
d) Try the easiest (first) solution first.

No.	SYMPTOM		
	POSSIBLE CAUSE	*SOLUTION*	*REFER:*
1	**Engine RPM increases suddenly**		
	There is some blockage of the Jet Unit	Remove the blockage	*4.9*
	Faulty engine tachometer	Repair tachometer	-
2	**Engine RPM increases suddenly, noise from Jet Unit and aerated Waterjet**		
	Intake Screen blocked	Remove the blockage	*4.9.3*
	rope jammed on Intake Screen and wrapped around Mainshaft	Remove the blockage	*4.9.3*
	object jammed on Stators and / or Impeller	Remove the blockage	*4.9.3*
3	**Engine RPM increases gradually**		
	worn or blunt Impellers	Inspect and repair Impeller	*6.4.10 b*
	excessive Impeller tip clearance	Inspect and repair Impeller	*8.8.4.*
4	**Engine RPM decreases**		
	There is some problem with the engine	Investigate engine operation	-
5	**Thrust reduces (vessel speed drops)**		
	There is some blockage of the Jet Unit	Remove the blockage	*4.9*
6	**Poor Reverse Thrust**		
	Reverse Duct not travelling fully down so that all of jetstream enters Reverse Duct.	Could be caused by the cable ball not positioned properly on the tube grooves or the Detent Plate not properly adjusted.	Refer to Controls Manual
	Reverse jetstream hitting Hull or Hull Extension such as Trim Plate	Adjust Reverse Duct and / or Trim Plate.	1.3.3
	Boat has insufficient immersion at transom and air being sucked from rear into Jet Intake	Boat should be ballasted to ensure correct immersion at Transom.	1.3. / 2.5.
	Effect of engine exhaust on Jet Reverse	Re-position Engine Exhausts.	1.3.4.
7	**Vibration suddenly increases from Jet Unit**		
	debris stuck on Impeller	Remove the blockage	*4.9*
8	**Vibration gradually increases from Jet Unit**		
	worn Driveshaft joints	Inspect and repair the driveshaft as per manufacturer's recommendations	-
	worn Marine Water Bearing	Inspect and repair the Marine Water Bearing	*6.4./3.* *8.8.*
9	**Loud high pitched rattling whine comes from Jet Unit**		
	Faulty Thrust Bearing	Inspect and repair Thrust Bearing	*8.6.*
10	**Bad vibrations, gradually increasing**		
	Worn Marine Water Bearing or Bearing water drain hole blocked.	Inspect and repair the Marine Water Bearing. Unblock drain hole.	*6.4./3.* *8.8.*
	Worn driveshaft universal joints.	Inspect and repair the driveshaft as per manufacturer's recommendations	-
11	**Water leaks from under Bearing Housing**		
	Faulty Water Seal	Inspect and repair Water Seal	*6.4/4* *8.6.4.*

6. Maintenance General

MAINTENANCE ACTIVITIES

This Section is a general section covering aspects of maintenance that apply to the Jet Unit and associated equipment.
This Section and Section 8 Overhaul cover maintenance work in more detail, as described below:

SERVICING

- Use this Section to organise all your routine preventative maintenance.
- This Section tells you what to do when servicing and when to carry it out.
- It also describes how and when to carry out inspections that can be used to indicate when overhaul is required.

OVERHAUL

- This Section will describe how to carry out the overhaul of certain parts of the Jet Unit.
- Only overhaul parts of the Jet Unit when inspections, performed as part of regular servicing, indicate the need for overhaul.

HYDRAULIC EQUIPMENT

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

1. Minimise 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 being serviced, immediately plug the connection to prevent loss of oil and entry of foreign particles.

6.1. PRESERVATION (PRE- INSTALLATION)

The following storage requirements must be provided to ensure no damage or deterioration of the Jet Unit occurs before installation:

1. Storage temperature must be between 10° and 40° and above the "dew point" (i.e. no condensation is allowed to form).

2. It is desirable to keep the Bearing Housing components coated with oil. To carry out this operation, rotate the Mainshaft 180° once every month.

3. All exposed steel (except for stainless steel) parts should be protected from corrosion. These parts should be coated with a thin layer of rust preventative oil.

4. To protect hydraulic fittings, either:

   a) Wrap all fittings with oil impregnated corrosion protection tape.

   OR

   b) Spray with a recognised corrosion protection product.

6.2. PRESERVATION (POST INSTALLATION)

CAUTION:

The Jet Unit cannot be run out of the water, unless fitted with a dry Run Kit.

PREVENTION OF MARINE GROWTH

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

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 in deep rather than shallow water. 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.

   c) If moored for longer periods the Jet Unit can be pumped dry using compressed air. A sealing plug can be ordered from Hamilton Jet. This is fitted into the Nozzle and air is introduced to push water out of the Jet Unit.

2. Rotate the Mainshaft by 180º once per week. This can be done manually if the engine is not started.

EQUIPMENT EXERCISE

CAUTION:

Before moving any controls, any marine growth must be removed from the Steering and Reverse linkage rods. This prevents damage to the seals which these 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 Push Rod fully retracted.

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	100 HOURS	500 HOURS	1 MONTH	3 MONTHS	1000 HOURS	FIRST 2000 HOURS	5000 HOURS
INTERNAL WATER PATH	CLEAR BLOCKAGES	4.9		●							
WATER SEAL	CHECK FOR LEAKS	6.4/4		●		●					
THRUST BEARING	LUBRICATE	6.4/2					●				
DRIVESHAFT UNIVERSALS	LUBRICATE		**As recommended by the manufacturer**								
EXTERNAL ANODES	CHECK CONDITION	6.4/5						●			
REVERSE CYLINDERS AND HOSES	CHECK FOR LEAKS, DAMAGE OR CORROSION	6.4./6	●	●			●				
REVERSE CYLINDER SHAFT	LUBRICATE	6.4./7			●						
STEERING CYLINDERS AND HOSES	CHECK FOR LEAKS, DAMAGE OR CORROSION	6.4./8	●	●			●				
STEERING LINKAGES	CHECK INTEGRITY	6.4/9		●							
STEERING CRANK	LUBRICATE	6.4/11			●						
STEERING PUSH ROD	LUBRICATE	6.4/10			●						
COMPLETE JET UNIT	EXAMINE / REPAIR	6.4/13								●	●
(STEEL HULLS ONLY)	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 the Inspection Cover.** Check via the Inspection Hatch that they are clear of debris.
Reverse Hydraulic Cylinders and Oil Lines.	Check for oil leaks, especially if oil has been added to the system.
Position Indicator Senders (Transmitters)	Check for loose electrical connections and linkages if fitted on the System.
Thrust Bearing Housing	Check for signs of water leaking from under the Thrust Bearing Housing. (Leaking Water Seal). If Water Seal is leaking it should be replaced as soon as possible otherwise water could contaminate the Thrust Bearing causing corrosion and failure of the Thrust Bearings.

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).**
2	Thrust Bearing	Grease with a good quality lithium-based ball bearing grease every month in operation. Do not over grease. Normal operating temperature is 50-55°C (120 - 130° F) but the Bearing can operate up to 120°F satisfactorily, noting that most of the heat is generated by the Seals. A faulty Bearing will be indicated by noise and vibration rather than temperature.
3	Water Bearing	This is a water lubricated Bearing and requires no attention. **Do not run the Jet Unit out of water as this will damage the Bearing and Waterseal.**
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.** a) Inspect all external Anodes . b) Replace any Anode which is less than half its original size. c) Ensure all fasteners are correctly tightened when fitting new Anodes.
6	Reverse 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.
7	Reverse Cylinder Shaft	**Grease every 100 hrs.** Grease periodically with water repellent grease.
8	Steering Cylinder and Hoses	**Check after the first 5 hours and then monthly.** Check for leaks, damage or corrosion. Methodically check the Steering 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
9	Steering Linkages	**Check integrity daily where possible.** Check that all linkages between the Steering Crank and the Steering Deflector are secure and have a small amount of free play.
10	Steering Pushrod	**Grease every 100 hrs.** Grease periodically with water repellent grease.
11	Steering Crank	**Grease every 100 hrs.** Grease periodically with water repellent grease.
12	Driveshaft	**Lubricate every 500 hrs or to suit the manufacturers recommendations.** Follow the manufacturers recommendations for type of Driveshaft used.
13	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 1.25mm (0.049 inches) per side. Maximum New Clearance = 0.6mm 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) **Water Bearing - Inspect** Inspect the Water Bearing for scoring or localised wear. Replace if excessively worn. To check for wear, push the Mainshaft hard from side to side. Check total sideways movement at Impeller tips. **Maximum recommended worn movement is 0.6 mm (0.024. ins).** This indicates the amount of wear in the Rubber Bearing and Shaft Sleeve. These items are to be removed in accordance with **Section 8, Overhaul** of this Manual. d) **Steering Linkages - Disconnect** These items are to be removed in accordance with **Section 8. Overhaul** of the Controls Manual. e) **Tailpipe, Nozzle & Steering Deflector - Removal** These items are to be removed in accordance with **Section 8. Overhaul**. Of this Manual.

Item No	Item	Operation
13 (cont'd)	Jet Unit (cont'd)	f) **Screen Rake Bearings (Optional Equipment)** The Screen Rake should be checked at regular intervals for free operation. Stiffness or binding may be caused by debris caught in the screen or seized bearings. Grease bearings periodically with water repellent grease. **Ensure the Screen Rake is returning to the fully up position otherwise reduced Jet Unit performance may result.**

CAUTION

ANTI FOULANT PAINTS

Do not use copper- based anti-foulant paints. Tin based anti-foulant paints are suitable, or any paint suitable for an aluminium hull. Leave all stainless steel parts polished and unpainted.

ANTI-SEIZE COMPOUNDS:

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

The main body of the 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.

g) **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"**, for thread tightening torques, joint lubrication, thread and joint locking, Bearing Housing lubricants and hydraulic fluids.

h) **Insulation Checks (Steel Hull Only).**
Carry out Insulation Checks as shown on **Drawing 63974**, on a monthly basis, , also refer to ***Section 7.3. "Steel Hulls and Carbon Fibre Reinforced GRP Hulls".***

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 13 above).
- Increase interval if minimal wear was found at the Jet Unit internal inspection (Item 13 above).

6.5. TOOLS

6.5.1.Standard Recommended Tools

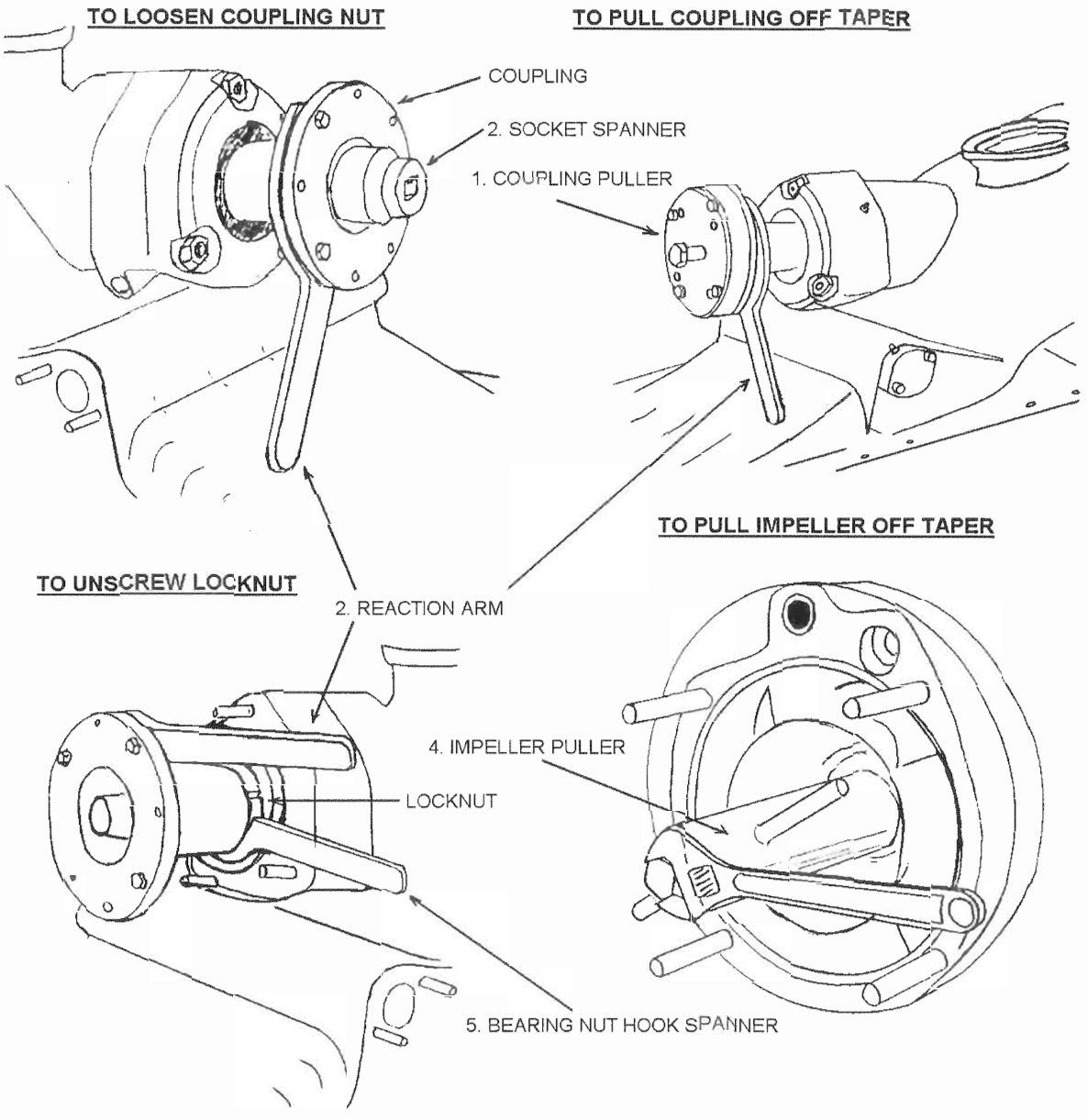
The following tools are required for normal maintenance activities:

1. Torque Wrench. ¾"sq/dr with capacity up to 400 Nm (295 lbs/ft). Impeller Nut, Coupling Nut and Reverse Duct Pivot Pins.
2. Torque Wrench. ½" sq/dr with capacity up to 200 Nm (145 lbs/ft).
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

The following Tools are included as part ot the Tool Kit (Part No 104752) for the HJ-291 Jet Unit:

ITEM	DESCRIPTION	PART NO
	Complete Kit of Special Tools	104752
	Each Kit Contains the Following:-	
1	Coupling Puller	104918
2	Reaction Arm - Coupling	104917
3	Socket (50mm AF x ¾" drive)	JMNGAAP
4	Puller - Impeller	104688SY
5	Bearing Nut "Hook Spanner"	JNODAEY
For Aquadrive Coupling Flange (106633) - Tool Kit Part No 106978 is required where items 1 & 2 of Drawing HJ-291-11-000 are replaced with Puller 106979 and Reaction Arm 106980 respectively.		


TO LOOSEN COUPLING NUT
TO PULL COUPLING OFF TAPER
COUPLING
2. SOCKET SPANNER
1. COUPLING PULLER
TO PULL IMPELLER OFF TAPER
TO UNSCREW LOCKNUT
2. REACTION ARM
4. IMPELLER PULLER
LOCKNUT
5. BEARING NUT HOOK SPANNER

6.6. THREADED FASTENERS

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

CAUTION:

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

TIGHTENING TORQUES FOR THREADED FASTENERS

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

1. Special Fasteners -HJ-291Jet.

Description (Item No)	Torque Nm	Torque lbs / ft
Impeller Nut [19]	400	300
Coupling Nut [17]	400	300
Cotter (taper) Pins	40	30
KMT10 Bearing Locknut [27]	270	200
KMT10 Bearing Locknut **M6 Set Screws**	**5**	**4**
KMT10 Bearing Locknut **M8 Set Screws**	**12**	**9**
Coupling Nut Setscrew [52]	8	6
Reverse Duct Pivot Pins	400	300
Steering Deflector Pivot Pins	200	150

THREAD LOCKING AGENTS

Most fasteners require thread locking agents to prevent loosening.
a) Most applications are described on Drawing 85113 above.
b) Special applications will be shown on the relevant Assembly Drawings.

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.

Purpose	Lubricant
Reverse System	I.S.O. viscosity grade 32 (See notes) Refer to a HSRC or HERC Manual for operating temperatures of various oils in the hydraulics
Steering System (Teleflex Seastar II)	Hydraulic oil meets MIL Spec H 5606A Approximately 1 litre (1 quart) per station required plus a bleeding (purging) allowance of an addition 1 litre (1 quart) per station. **Examples of recommended oils are:-** Teleflex, Seastar HA5430 Flexatrol, Seastar HA5430 Shell, Aero fluid 4 Univis, N 15 or J13 Texaco, HO 15 Chevron, Aviation hydraulic fluid A Mobil, Aero HFA Gulf, Harmony HV 115 (Canada only) **DO NOT USE BRAKE FLUID or a heavier viscosity oil**
Grease filled Bearing Housing	Shell Alvania R2 or equivalent
All other applications eg. Bearings Tapers, Threads, Mating Joints and Corrosion Protection	BP ENERGREASE MM - EP2 (marine multi-purpose extreme pressure grease) or equivalent

CAUTION:

Anti-Seize Compounds:

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

6.7.1. Use of Thread Locking Fluid

Drawing 85113 refers.

PURPOSE	TYPE
Fitting Studs into Housings	"Loctite" 262*.
Set Screws	"Loctite" 222*
Hydraulic Fittings and Cylinders	"Loctite" 569*
Bushes and Sleeves	"Loctite" 262*
Tailpipe Fairing	"Loctite" 680*

* Or equivalent.

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 "Earth Bonding System Recommendations and Layout" 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 seawater.
   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 seawater 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 regularly checked.

8. Overhaul

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

NOTE:

A. The Overhaul Section in the Control Manual contains additional information.

B. Overhaul of any part 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 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.
g) Transom Plate Overhaul.

BEFORE COMMENCING 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 reconnected.
- 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 HM-291-11-000, Toolkits for HJ-291 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:

DO NOT use copper based antifouling paints. Tin or non metallic base antifouling paints are suitable.

CARE OF STAINLESS STEEL PARTS

Leave all stainless steel parts polished and unpainted.

ANODES

Leave all Anodes unpainted. **Refer to *Section 8.8.5."Overhaul of the Tailpipe"*** and the various inspection and replacement information for the various Anodes which will be found in the various Overhaul Sections of the Jet Unit Manual.

8.2. REVERSE ASSEMBLY - OVERHAUL

Drawing HJ-291-07-001 refers:

For Fault Finding with the Reverse Controls System, refer to the Controls Manual supplied with this Jet Unit.

For the Overhaul of the Reverse Cylinders refer to *Section 8.2.3. "Reverse Cylinder Overhaul"*, in this Manual.

8.2.1.Reverse Duct Removal

REMOVAL

1. Disconnect any Sensors attached to the Reverse Cylinder. Refer to the ***Controls Manual Overhaul Section.***
2. Whilst supporting the Reverse Duct with suitable approved lifting equipment and a lifting sling attached to the Reverse Duct, disconnect the Reverse Cylinder [20] from the Reverse Duct [18] by removing the Split Pin [24] from the Cylinder retaining Pin [5].
3. Take the weight of the Reverse Duct and withdraw the Hydraulic Cylinder retaining Pin [12] and the 2 Special Rod End Washers [9] located on either side of the Rod End [2].
4. Lower the Reverse Duct.
5. Take the weight of the Reverse Duct and unscrew the Reverse Duct Pivot Pins [2] and remove with the Special Thrust Washers [4].
6. Remove the Reverse Duct, taking care not to damage the Reverse Duct Shouldered Bushes [3] and Special Thrust Washers [4].fitted in the Reverse Duct Arms.

OVERHAUL

If the Reverse Duct Shouldered Bushes [3] and Special Thrust Washers [4] fitted in the Reverse Duct Arms are worn or damaged, these should be replaced.

Replacing the Reverse Duct Shouldered Bushes [3]:

1. Prior to refitting the Reverse Duct, the Reverse Duct Pivot Pin Bushes [3] and Special Thrust Washers [4] should be checked and replaced if required.
2. The Bush [3] is normally a loose fit over the Pivot Pins [2] and should be round (not oval) to within approx 0.5 mm.
3. Check that threads on Reverse Duct Pivot Pins [2] are free from burrs.
4. If replacing the Pivot Bushes [3] 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 surfaces of the Bushes [3] 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.

8.2.2. Reverse Cylinder Removal

Drawing HJ-291-07-001 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 [26]: Reverse Bucket not staying in up position. Note that this can also be caused by faults in the Control System.
- Shaft Seals [21 & 27]: Oil leaking from the Front Head Retainer [15].

Reverse Cylinder Removal

1. Disconnect and blank off all hydraulic hoses and Sender linkages attached to the Reverse Cylinder.
2. If 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 [28] complete with Seal Ring [29] and Nitrile Seal [30] from the Connector [12]. Fit blanking caps to prevent the ingress of dirt and moisture.
4. From outside the vessel, unscrew the 4 mounting Nuts [34] and remove with Spring Washers [37].
5. Withdraw the Reverse Cylinder through the hole in the Transom.
6. Tape the two halves of the Hemispherical Seat [17] together around the trunnion of the Connector [12], to prevent the ingress of dirt into the trunnion.
7. The Reverse Cylinder can now be removed for overhaul.

8.2.3. Reverse Cylinder Overhaul

Drawing HJ-291-07-001 refers.

It is only necessary to overhaul the Reverse Cylinder if excessive leakage or other problems have been experienced. To remove the Reverse Cylinder carry out the following actions:-

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

1. Hold the Reverse Cylinder Shaft [11] with a spanner just forward of the Connector [12] and unscrew the Connector Block [12].

NOTE:

It may be necessary to apply heat to break the thread lock fluid used on this joint. Extend the Reverse Cylinder Shaft [11] fully and apply minimal heat at the joint only.

2. Hold the Back Head [10] with a spanner and unscrew the Front Head Retainer [15].

NOTE:

If the joint between Back Head [10] and the Cylinder [20] is undone it should be reassembled using Loctite 569 thread locking fluid.

3. Withdraw the Reverse Cylinder Shaft Assembly [11] and Front Head [19] from the Cylinder.
4. Remove End Plug [13] and O-Ring [23] from Connector [12]. Apply minimal heat if necessary to break thread lock fluid used on this joint.
5. Remove all other Seals [21, 26, 27 & 31] and thoroughly clean all parts. Ensure that all thread lock fluid residue is removed from the engaging threads between Shaft [11] and Connector [12], also from between Connector [12] and Plug [13].
6. Check the Reverse Cylinder [20] bore and Shaft [11] outside diameter. Replace if obviously worn, scored or damaged.
7. The Back Head [10] need not be removed from the Cylinder [20] unless either have been damaged or require replacement.

NOTE:

The Cylinder and Shaft must be replaced as a matched pair.

8. Check the two halves of the Hemispherical Seat [17] for wear and damage and replace as required.
9. Check that the Nylon Screw [25] is still fitted to the outboard half of the Hemispherical Seat [17]. Replace if damaged or missing.
10. Check that Seal [22] is still in position in the inboard half of the Hemispherical Seat [17] and is not perished, damaged or worn. Replace Seal [22] as required.
11. Check that the Anti Rotation Pin [16] is secure and not damaged or bent. Replace if damaged bent or missing.
12. Check the Anode [14] fitted to the outboard end of the Reverse Cylinder Shaft Assembly [20] is less than $^{2}/_{3}{}^{rds}$ its original size the Anode should be replaced.
13. To replace the Reverse Cylinder Anode [14] carry out the following actions:
    a) Unscrew the Thin Locknut [36] securing the Anode to the Back Head [10].
    b) Mark the position of the Rod End [7] in relation to the Back Head [10], this will ensure that the Reverse Duct upper and lower position is correct when the Reverse Cylinder is attached to the Reverse Duct.
    c) Whilst retaining the Back Head [10], unscrew the Rod End [7] from the Back Head [10] and remove complete with Anode [14].
    d) Ensure that the Anode to Back Head contact surface is scraped clean to give a good electrical contact for the Anode.

e) Refit a new Anode [14] onto the Back Head [10].
f) Ensure that the Thin Locknut [36] is screwed fully onto the threaded end of the Rod End [7].
g) Screw the Rod End [7] into the Back Head [10] to the position marked at 13b) above.
h) Tighten the Thin Locknut [36] to secure the Anode [14] to the Backhead [10].

14. If the Anode is still in good condition, ensure that it has not been painted over.
15. Scrub down with a wire brush if a coating has built up on the Anode.

REASSEMBLY:

1. Fit a new Wiper Seal [31] to the Front Head Retainer [15], ensuring that the Seal is fitted correctly.
2. Fit new Seals [21] & [27] to the Front Head [19].
3. Fit a new Seal [26] to the Reverse Cylinder Shaft Assembly [11].

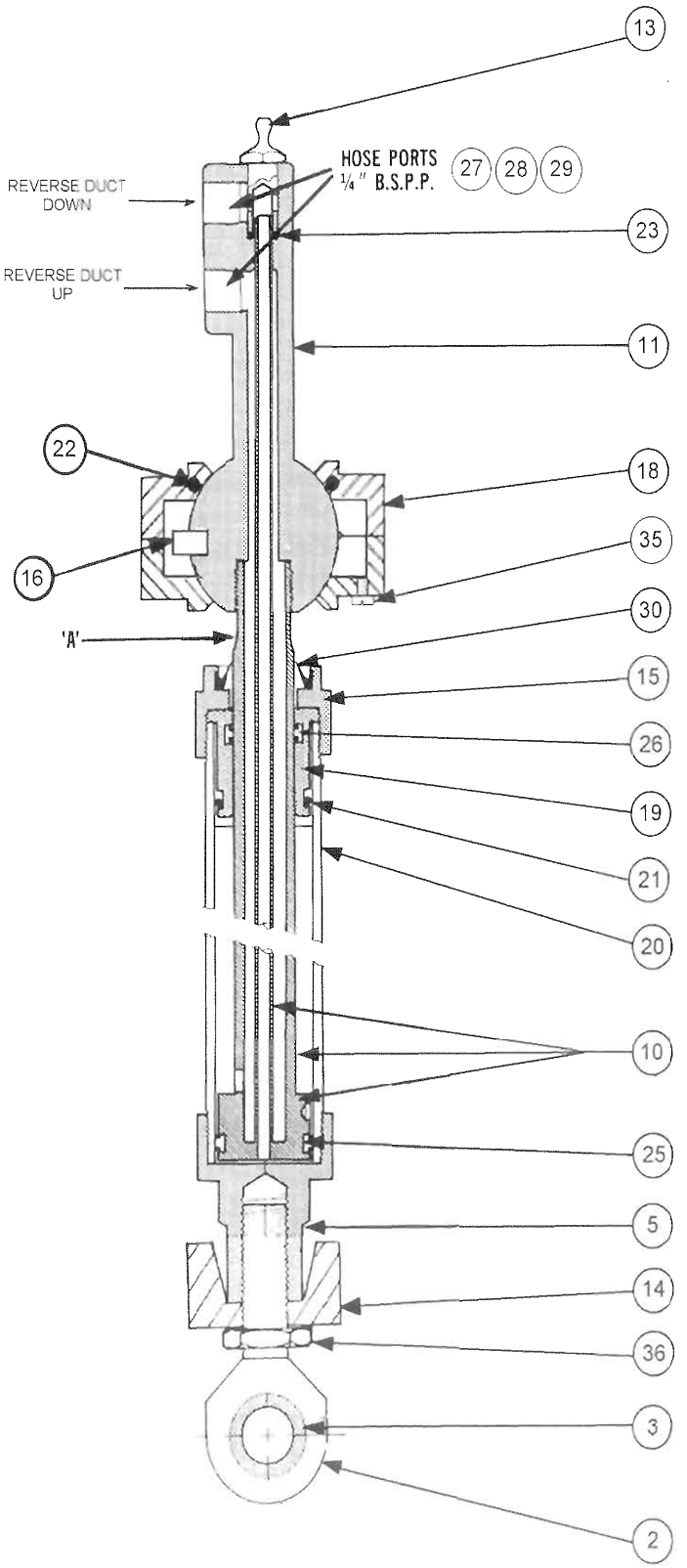
NOTE:

Cylinder Overhaul Kit part number 106243 is available. This includes all seals [21], [22], [23], [26], [27], [28], [29], [30] and [31] also a container of thread lock fluid 'Loctite 569' to be used when refitting the Reverse Cylinder Shaft Assembly [11] to the Connector [12].

4. Oil Reverse Cylinder Shaft Assembly [11] and insert into Cylinder [20].
5. Oil the inside and outside of the Front Head [19]. Fit over the Shaft [11] (taking care not to damage the Seals [27] and [31] on the threads of the Shaft [11]) and insert into Cylinder [20].
6. Grease the mating threads on Front Head Retainer [15] and Cylinder [20] and screw together. **(Do not apply thread lock fluid here).** Torque load to between 40 and 50 Nm.
7. If the Anti Rotation Pin [16] has been replaced, ensure that the pin is refitted using Loctite 680 or equivalent. **Refer to Drawing HJ-291-07-001 View "C" for the correct location of the Anti Rotation Pin in the two holes in the trunnion.**
8. Refit Seal [22] to the inboard half of the Hemispherical Seat [17] and smear the seal with grease.
9. Ensure that the Nylon Screw [25] has been fitted to the grease hole **in the inboard half** of the Hemispherical Seat [17].
10. Pack the inboard and outboard halves of the Hemispherical Seat [17] with grease and locate the two halves over the trunnion of the Connector [12] ensuring that the Anti Rotation Pin [16] is correctly located.
11. Secure the inboard and outboard halves of the Hemispherical Seat [17] temporarily with tape to prevent the ingress of dirt.
12. Ensure that the Grease Hole in the outboard half of the Hemispherical Seat aligns with the blanked off grease hole in the inner half of the Hemispherical Seat.
13. Clean the mating threads on Shaft Assembly [11] and Connector [12], apply thread lock fluid ('Loctite 569 or equivalent) to the threads and screw together. Torque load to between 40 and 50 Nm using a spanner on the flat on the Shaft Assembly [11] **just forward of the Connector [11].**
14. Fit a new O-Ring [23] into the End Plug [13] end of the Connector [12] and push fully home until seated.
15. Clean the mating threads of Plug [13] and Connector [12], apply thread lock fluid (Loctite 569 or equivalent) to threads and screw together.
16. **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)). Drawing HJ-291 07-001 refers.**

REVERSE CYLINDER FOR HJ-291 JET:

(Drawing HJ-291-07-001 refers).



8.3. REVERSE ASSEMBLY REFITTING AND ADJUSTING

(Drawing HJ-291-07-001 refers).

8.3.1. Refitting the Reverse Cylinder Assembly

NOTE:

The Reverse Cylinder should not be refitted until the Intake and Transom Seal are securely fastened in place.

1. Feed Reverse Cylinder assembly through the Transom hole. Slip the Hemispherical Seats [17] onto their Studs [32].
2. Remove the adhesive tape securing the two halves of the Hemispherical Seat together.
3. Check that the drilling for grease supply in the forward hemispherical seat lines up with drilling in Transom Plate and that the Anti Rotation Pin [16] is assembled correctly. **Refer to the Drawing HJ-291-07-001 "View C".**
4. Fit the 4 Spring Washers [37] and Nuts [34] and tighten to recommended torque.
5. Remove the blanking caps from the hydraulic connections on the Connector [12] and refit the 2 Hydraulic Nipples [28] with new Seal Ring [29] and Nitrile Seal [30] and tighten.
6. Reconnect the hydraulic hoses, ensuring that the hoses are fitted to the correct ports as shown on the diagram on the previous page.
7. 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. Apply grease to the Connector Trunnion at the Grease Nipple located on the top of the Steering Bracket. **(Refer to the Controls Manual Drawings Package. Steering Assembly Drawings).**

8.3.2. Refitting the Reverse Duct

(Drawing HJ-291-07-001 refers).

1. Apply marine grease to the threaded portion and shank of the Pivot Pins [2] and to Washers [4].
2. Fit one Washer [4] to each of the Pivot Pins [2].
3. Using approved lifting equipment and a lifting sling attached securely around the Reverse Duct, lift the Reverse Duct into position and align the Shouldered Bushes [3] in the Reverse Duct Arms with the Threaded Bushes [1] in the Tailpipe.
4. Insert the Pivot Pins [2] with Washer [4] fitted, and hand tighten into the Tailpipe.
5. Tighten both Pivot Pins to the recommended torque. (600 Nm - 450 ft/lbs). **Refer to *Section 6.6. "THREADED FASTENERS"*.**
6. Raise the Reverse Duct and connect the Reverse Cylinder to the Reverse Duct with Pin [5]. Ensure that Washers [9] are located on either side of the Rod End [7], inside the Reverse Duct attachment bracket.
7. Secure Pin [5] in position with Split Pin [24].

8.3.3. Reverse Duct Position Adjustment

(Drawing HJ-291-07-001 refers).

The Reverse Duct must be adjusted so that all the water exiting from the Steering Deflector enters the Reverse Duct when it is in the "Full Astern" position.

1. Commission the Control system so that the Reverse Duct can be properly controlled. ***Refer to the Commissioning Section in the Controls Manual supplied with this Jet Unit.***
2. Move the Reverse Duct to the fully"Down" (Astern) position.
3. Place an oar behind the Reverse Duct to detect if water is passing astern of the Reverse Duct.
4. Adjust the length of the Reverse Cylinder as described below to minimise the amount of water pass astern of the Reverse Duct.

Adjusting Length of the Reverse Cylinder

5. Whilst supporting the Reverse Duct with suitable approved lifting equipment and a lifting sling attached to the Reverse Duct, disconnect the Reverse Cylinder [20] from the Reverse Duct [18] by removing the Split Pin [24] from the Hydraulic Cylinder Retaining Pin [5].
6. Take the weight of the Reverse Duct and withdraw the Reverse Cylinder retaining Pin [5] and the 2 Washers [9] located on either side of the Rod End [7].
7. Lower the Reverse Duct.
8. Loosen Locknut [36] and then rotate Rod End [7] either in or out as required. Take care not to apply torque to the Reverse Cylinder body when rotating the Rod End (if it is tight).
9. Raise the Reverse Duct and connect the Reverse Cylinder to the Reverse Duct with Pin [5]. Ensure that Washers [9] are located on either side of the Rod End [7], inside the Reverse Duct attachment bracket.
10. Secure Pin [5] in position with Split Pin [24].
11. Operate the Reverse Duct through its full range of movement to ensure that the adjustment is correct using the oar to detect if water is passing astern of the Reverse Duct.

> **CAUTION:**
>
> **The Reverse Duct can interfere with the Steering Deflector. Thus, move the Steering Deflector full stroke to check that it is not contacting the Reverse Duct.**

12. When adjustment is correct, tighten Locknut [36] firmly and ensure that the Split Pin securing the Reverse Cylinder to the Reverse Duct has been fitted correctly.

8.4. STEERING ASSEMBLY - OVERHAUL

Drawing HJ-291-06-001 refers

The Steering Assembly may use either a Manual Cable operating System or it may use a Seastar Hydraulic Cylinder to operate the Steering Tiller.
If the Jet Unit is fitted with a Seastar Steering Cylinder, refer to the Seastar Maintenance Manual for any maintenance required.
If the Jet Unit uses a Manual Cable System, refer to the relevant Controls Manual supplied with the Jet Unit.

8.4.1. Steering Cylinder Removal

Drawing HJ-291-06-001 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 [24]. **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 [24].
4. Remove the 4 Nuts securing the Cylinder in position and remove the Steering Cylinder from the vessel.

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 Assembly Removal

Drawing HJ-291-06-001 refers.

Disconnect the Steering Tiller [19] from the Steering Control Cable OR Steering Cylinder (whichever fitted).

1. Check the Steering Shaft for:-
   a) Freedom of movement
   b) Excessive wear in Bushes [26] and [28].
   c) Worn or damaged Scraper [25] and Seal [27].
   d) Excessive wear in the ball end of the Steering Crank [20].
3. Replace Steering Bushes and Seals if damaged or worn.
4. Remove Nut [15] Spring Washer [16] and Washer [22] and remove Cotter [21] from the Steering Crank.
5. Push the Steering Shaft [23] forwards and slide the Steering Crank off the end of the Steering Shaft.

8.4.3. Nozzle / Nozzle Housing Removal

Drawing HJ-291-06-001 refers

1. Remove the Steering Crank [20] from the Steering Crank Bush [5].
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 [7].
4. Loosen the Cap Screws [30] securing the JT Steering Nozzle Lip Seals [29] to the inner face of the JT Steering Nozzle [1] and ensure that the Lip Seal is free to move.
5. Using a flat bladed screwdriver, flatten off the tab on Lock Washer [9] retaining Pivot Pin [8] at the top and bottom of Nozzle [1].
6. Whilst supporting the Nozzle, unscrew and remove the upper and lower Pivot Pins [8] and Lock Washers [9].
7. Hook out Thrust Washers [6] from upper and lower positions.
8. Rotate the Nozzle to align the upper and lower Bushes [7] with the cut outs in the Nozzle Housing [2].
9. Push the top of the Nozzle towards the Jet Unit to release the lower Nozzle Bush from the Nozzle Housing.
10. Pull the Nozzle rearwards to remove the Nozzle from the Nozzle Housing.
11. To remove the Nozzle Housing, remove the Nuts [15] and Spring Washers [16] from the Studs [14] securing the Nozzle Housing to the Tailpipe.
12. Hit the Nozzle Housing sideways with a Soft Hammer and remove the Nozzle Housing off the Studs [14].
13. 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 Bushes [7].** Replace if worn or damaged.
b) **Pivot Pins [8].** Replace if worn or damaged.
c) **Nozzle Crank Bush [5].** Check for wear or damage. Replace if worn.
d) **Steering Crank [20].** Check the condition of the Crank Ball, replace if excessively worn.
e) **Thrust Washers [6].** Check for wear or damage. Replace if worn.
f) **Lock Washers [9].** Discard and replace once removed. **Do not re-use.**
g) **Cotter [21].** Check the condition. Replace if damaged.
h) **JT Steering Lip Seal [29].** Check the condition and security of the Lip Seal. Replace if damaged or worn.
i) **Anode [10].** Check the condition. Replace if more than $^{2}/_{3\ rds}$ corroded.

REPLACING THE JT STEERING LIP SEAL [29]

The JT Steering Lip Seals can be replaced without separating the Nozzle from the Nozzle Housing. To replace the JT Steering Lip Seal [29], carry out the following actions:-

a) With the JT Steering Nozzle [1] and the Nozzle Housing [2] removed complete from the Jet Unit Tailpipe and placed face down on a work bench, unscrew and remove the 4 Cap Screws [30], Spring Washers [31] and Flat Washers [32] securing the 2 JT Steering Lip Seals [29] to the rear face of the Nozzle.
b) Carefully remove the 2 JT Steering Lip Seals [29] through the rear of the Nozzle Housing 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 [30] and apply Loctite 222.

e) Refit the 2 new JT Steering Lip Seals [29] in position and adjust the Lip Seals [29] to just contact the spherical inner surface of the Nozzle Housing [2].

NOTE:

There is some movement in the Lip Seals [29] when loosely secured with Cap Screws [30], this is to allow the Lip Seals to be adjusted to fit the inside of the Nozzle Housing [2].

f) Secure the 2 JT Steering Lip Seals [29] using Cap Screws [30], Flat Washers [32] and Spring Washers [31]. Tighten to the recommended torque.
g) Refit the JT Steering Nozzle [1] complete with the Nozzle Housing [2] to the Tailpipe as shown in **Section 8.5.2. "Nozzle / Nozzle Housing Refit".**

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 [18] and Spring Washers [17] from Studs [17].
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 [18] and Spring Washers [17] to Studs [17]. Tighten to the recommended torque.

REPLACING THE STEERING SHAFT BUSH [28]

Examine the Steering Shaft Bush [28] located on the Tailpipe. If the Steering Shaft Bush [28] is found to be worn and requires replacement, carry out the following action:

a) Drift out the Bush [28] 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 [28] 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 SCRAPER HOUSING SEALS

If the Scraper Seal [25], Seal [27] or the Scraper Housing Bush [26] are worn or damaged, new Seals and a Bush should be fitted to the Tailpipe Flange. To carry out this operation:-

a) Ensure that the Steering Shaft [23] has been withdrawn from the Scraper Housing.
b) Remove the Scraper Seal [25] and take note of the way the Seal is fitted. **(With the Scraper Seal facing aft).**
c) Remove the Seal [27] and take note of the way the Seal is fitted. **(With the Seal lip facing aft).**
d) Remove the Scraper Housing Bush [26].
e) Clean out the bore of the Scraper Housing.
f) Smear a new Seal [27] with grease ensuring that the inner face of the Seal is packed with grease.
g) Fit Seal [27] into the Scraper Housing bore ensuring that the Seal lip faces aft.
h) Fit the Scraper Housing Bush [26] and gently tap into position against the rear face of Seal [27].

i) Smear a new Scraper Seal [25] with grease and fit the Scraper Seal [25] into the Bore of the Tailpipe and pushing it firmly home against the rear face of the Bush [26], ensuring that the Scraper Seal is fitted correctly. **(With the lip facing aft).**

NOTE:

Ensure that the lips on the Seal [27] and the Scraper Seal [25] are facing aft when fitted.

REPLACING THE PIVOT PIN BUSHES [7]

The Nozzle is fitted with two Pivot Pin Bushes [7] to accommodate the Steering Nozzle Pivot Pins [8].
Inspect the Pivot Pin Bushes [7] 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 [7]. 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) Press the new Pivot Pin Bushes [7] fully home into the Nozzle, ensuring that the Bushes are pressed in evenly and are fully home in the recess in the Nozzle.
e) Clean off any surplus Loctite from around the replacement Bushes.

REPLACING THE JT STEERING NOZZLE ANODE [10]

a) Remove Nuts [12] and Spring Washers [13] from Studs [11] securing the Anode [10] to the underside of Nozzle [1].
b) Remove the Anode [10] from the underside of the Nozzle.
c) The mating surfaces of the Anode / Nozzle should be scraped clean to ensure a good electrical contact.
d) Fit a new Anode [10] and attach to the Studs [11] on the underside of the Nozzle with Nuts [12] and Spring Washers [13]. Torque load to the recommended torque.

8.5. STEERING ASSEMBLY REFITTING AND ADJUSTING

Drawing HJ-291-06-001 refers.

The Steering Assembly may use either a Manual Cable operating System or it may use a Seastar Hydraulic Cylinder to operate the Steering Tiller.

If the Jet Unit is fitted with a Seastar Steering Cylinder, refer to the Seastar Maintenance Manual when refitting the Steering Cylinder.

If the Jet Unit uses a Manual Cable System, refer to the relevant Controls Manual supplied with the Jet Unit when reassembling the system.

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

CAUTION:

The Steering Assembly can be reassembled in several ways. It is important to follow the relevant drawings contained in this Manual, to prevent damage to the Steering Assembly. Also refer to Section 2.5.7 "Assembling the Jet Steering Tillers" in this Manual, for details.

8.5.1.Steering Cylinder Refit to Jet Unit.

1. Refit the Steering Cylinder in the position prepared by the Boat Builder and secure as required.
2. Reconnect the Cylinder Rod End to the Tiller [24].
3. Reconnect the Steering Cylinder Hose Connections to the Steering Cylinder. **Refer to the Controls Manual Drawing Package for correct Hose connection layout.**
4. Re connect any Sensors that were previously attached to the Steering Tiller [24]. **Refer to the Overhaul Section of the Controls Manual.**

8.5.2.Nozzle / Nozzle Housing Refit

1. Ensuring that the Steering Crank boss is uppermost, rotate the Nozzle [1] to align with the cut outs in the Nozzle Housing.
2. With the nose of the Nozzle tilted slightly upwards, feed the upper nozzle mounting point into the Nozzle Housing.
3. Push down on the nose of the Nozzle ensuring that the lower nozzle mounting point passes into the Nozzle Housing.
4. Rotate the Nozzle to align the upper and lower Bushes [7] with the upper and lower openings in the Nozzle Housing.
5. Refit the lower curved Thrust Washer [6] and locate with the Pivot Pin [8] fitted with a new Lock Washer [9]. Screw in slightly to retain the Nozzle in position.
6. Refit the upper curved Thrust Washer [6] and locate with the Pivot Pin [8] fitted with a new Lock Washer [9].
7. Tighten both Pivot Pins [8] and torque load to 200 Nm (150 lbs/ft).
8. Bend over the locking tab on Lock Washers [9] to secure the Pivot Pins.

NOTE:

If the JT Steering Lip Seals are to be changed, they should be refitted at this point. Refer to "Replacing the JT Steering Lip Seals [24]" on the previous pages.

9. Rotate the Nozzle through its full arc of travel to ensure that there is no stiffness or binding of the Nozzle.

8.5.3.Steering Assembly Refit

Drawing HJ-291-06-001 refers

If the Steering Shaft [23] has been completely removed from the Jet Unit, refit as follows, otherwise commence from paragraph 2 and ignore paragraph 5:-

1. With the Tiller [24] removed from the Steering Shaft [23], lightly smear the Steering Shaft with grease and refit from the rear of the Jet Unit, forwards, through the Bushes [28] and [26].
2. Smear the ball of the Steering Crank [20] with grease and refit to the Steering Crank Bush [5].
3. Pull the Steering Shaft [23] rearwards and slide the Steering Crank onto the end of the Steering Shaft.
4. Refit Cotter [21] to the Steering Crank [20] using Nut [15], Spring Washer [16] and Washer [22] and torque load to the recommended torque.
5. Refit Cotter [21] to the Steering Tiller [24] using Nut [15], Spring Washer [16] and Washer [22] and torque load to the recommended torque.
6. Reconnect the Steering Tiller [24] to the Steering Control Cable.

STEERING BRACKET AND STEERING SHAFT REFITTING

1. If the Steering Bracket has been removed, refit the Steering Bracket to the vessel.
2. Lightly grease the Steering Shaft [23] and pass the Steering Shaft through the Scraper Housing Seals and Bush in the Tailpipe Flange and through the Steering Shaft Bush [28]. **Ensure that when passing the Steering Shaft through the Scraper Housing Seals and Bush, that the Seals are not dislodged.**
3. Ensure that the Steering Shaft is pushed far enough through the Steering Shaft Bush [28] to allow the Crank to be fitted to the Nozzle.
4. Smear the ball of the Steering Crank [20] with grease and refit to the Nozzle, ensuring that the Crank is fitted as shown in the **Drawing HJ-291-06-001.**
5. Slide the Steering Shaft (23) rearwards and pass the Shaft through the Crank (20).
6. With the cut-away in the Steering Shaft facing downwards, fit the Cotter (21) through the Crank with the flat upwards. Ensure that the Cotter is fitted correctly.
7. Fit Washer (22), Spring Washer (16) and Nut (15) and tighten to the recommended torque.
8. If the Tiller [24] has been removed from the forward end of the Steering Shaft [23], refit the Tiller to the Steering Shaft and secure with Cotter [21], Washer (22), Spring Washer (16) and Nut (15). Tighten to the recommended torque.
9. Ensure that the Cotter is fitted correctly.
10. Operate the Tiller to ensure that it can move the Steering Deflector smoothly with no binding.

8.5.4.Steering Linkages Adjustment.

Refer to *Section 2.5.8 "Centering the Jet(s) Steering"* for information on how to adjust the steering linkages.

8.6. BEARING HOUSING AREA REMOVAL AND OVERHAUL

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. Baliasting of the vessel may be necessary 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

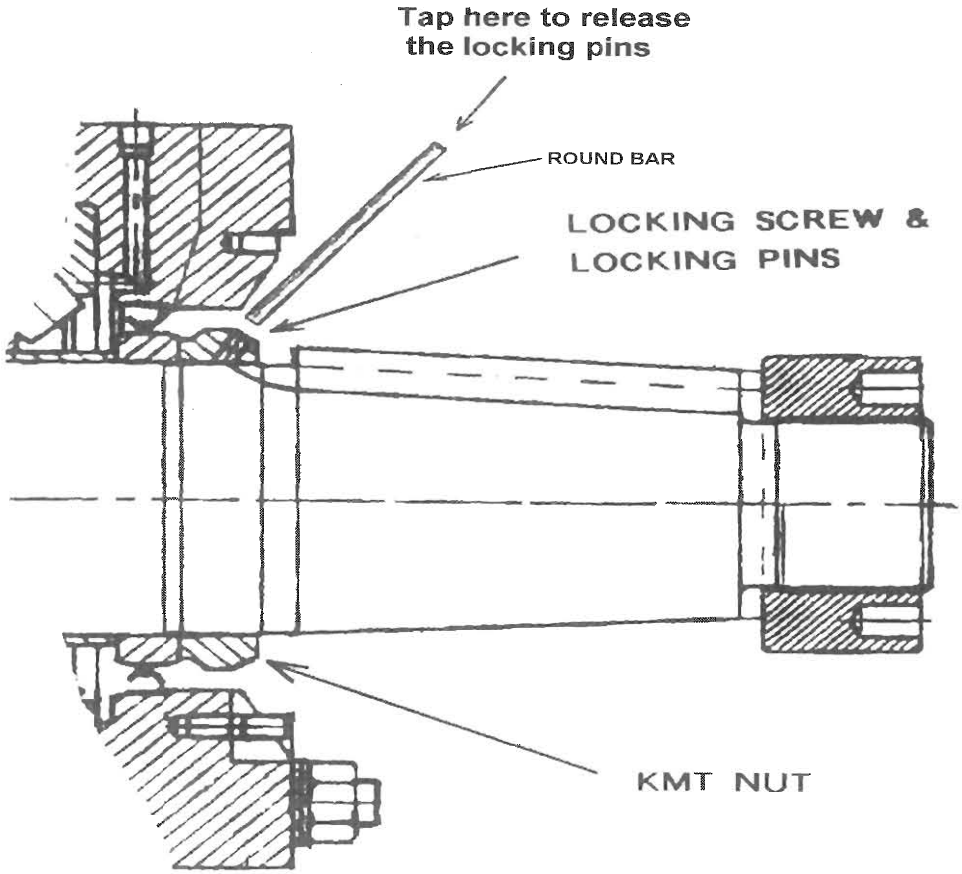
INITIAL WORK

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. Unscrew Set Screw [52] from the end of the Coupling Nut [17].
4. Fit the ***"Reaction Arm"*** tool to the Coupling, and using the ***"Coupling Nut Spanner"*** tool with an extension pipe, unscrew the Coupling Nut [17] **two turns only**, using Special Tools M50 *"Socket Spanner"*.
5. 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.
6. Remove the Reaction Arm and Puller from the Coupling.
7. Remove the Coupling Nut [17] and Coupling Flange.
8. Remove the Coupling Key [8] from the Jet Unit Mainshaft [20].
9. Unscrew the Bearing Cap Retainer Nuts (56) and Spring Washers [61] from Studs [49].and withdraw the Bearing Cap [14].

REMOVING THE KMT BEARING RETAINING NUT [27]

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 with the Coupling Key [8] and Reaction Arm, to prevent the Mainshaft from turning, and unscrew the KMT Bearing Retaining Nut.
5. Unscrew and remove the Coupling Nut and withdraw the Coupling Flange off the Mainshaft.
6. Remove the Coupling Key [8] from the Mainshaft [20].
7. Remove the KMT Bearing Nut [27] from the Mainshaft.
8. Withdraw the front Seal Sleeve [15], Bearing [36] and Bearing Carrier [18].



VIEW OF KMT NUT

NOTE:

Hot water poured over the Bearing Housing [13] will help to remove the Bearing [36].

1. Remove the rear Seal Sleeve [15] from the rear of the Bearing Housing.

REMOVING THE BEARING HOUSING [13]

1. Withdraw the Bearing Housing [13] off Studs [49], taking care not to damage the Water Seal Assembly [29].
2. Remove the Bearing Housing to Intake 'O' Ring [39] from the recess in the rear of the Bearing Housing.

NOTE:

The rear Seal Sleeve [15] and Oil Seal [37] will be removed with the Bearing Housing [13].

The Mainshaft will now rest on the fairing inside the Intake Casting.

8.6.2. Water Seal Removal

CAUTION:

The Water Seal should not be removed if it is not being replaced. The Water Seal will not perform correctly if it is removed and then reinstalled.

It is only necessary to replace the Water Seal if it is leaking, or there is insufficient material left to last to the next inspection. Refer to the *Servicing* Section of this Manual for details of the inspection required.

The Water Seal Assembly should not be removed unless it is to be replaced. 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.**

1. With the Bearing Housing removed, release the 3 Set Screws retaining the Waterseal Drive Collar in position on the Mainshaft.
2. Withdraw Water Seal Assembly [29] complete.
3. Remove the Round Circlip (Water Seal) [7] from the Mainshaft [20].

8.6.3. Checking the Bearing Housing Components for Wear

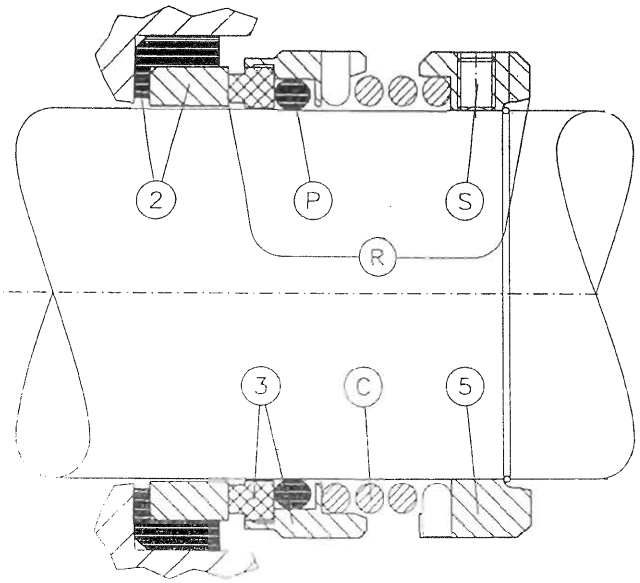
Check the following parts for wear and replace where necessary:-

a) **The two Seals [37] and Seal Sleeves [15].** If the Seal Sleeves are grooved they can be turned end for end so that the Seals run on unused portions of the Seal Sleeve.
b) **Bearing [36].** There should be no gap between the Bearing and Bearing Carrier [18] also Bearing Carrier [18] and the Mainshaft.
c) **Bearing Carrier [18].** Ensure that the mating faces are not scored or worn.
d) **Water Seal and Counterface Assembly [29].** Check and ensure that the mating faces are not scored or chipped. Always replace both Water Seal and Counterface if one or other appears worn.
e) **Bearing Housing / Intake 'O' Ring [39].** Check for cuts or deformation.
f) Thoroughly clean all parts.

8.6.4.Water Seal Replacement

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.



R	ROTARY UNIT CONSISTING OF:-
3	SEAL RING
5	DRIVE COLLAR
C	SPRING
S	SET SCREWS
2	INSERT
P	O-RING

HJ-291 WATERSEAL

1. To allow the Water Seal to slide onto the Mainshaft, lubricate the seal area of the Mainshaft with a 20:1 water and household detergent mix.
2. Carefully replace the Water Seal components in the following order :-
   a) Seal Retainer (Drive Collar [5]) with the 3 Set Screws.
   b) Spring [C].
   c) Seal Ring [3].
   d) O-Ring [P].
   e) Inserts [2].

CAUTION:

The water seal face must remain free of dirt, oil and grease.

3. Slide the Round Circlip (Waterseal) [7] through the hole in the Intake and down the Mainshaft until the Circlip engages with the groove in the Mainshaft.
4. Slide the Waterseal Assembly [29] down the Mainshaft, through the hole in the Intake until the Seal Retainer (5) (Shown in diagram above) engages over the Round Circlip [7].
5. Tighten the 3 Set Screws on the Seal Retaining Collar to secure the Collar to the Mainshaft.

8.7. BEARING HOUSING RE-ASSEMBLY

Drawing HJ-291-01-001 refers.

1. Prior to re-fitting the Bearing Housing, press the Seal Stationary Face into the Bearing Housing [13].
2. Smear the Inner Oil Seal [37] with marine grease and press the seal into the Bearing Housing ensuring that the lip on the Seal faces forwards towards the Coupling Flange **(refer to Drawing HJ-291-01-001).**
3. Smear the 'O' Ring [39] and Bearing Housing to Intake contact faces with marine grease.
4. Fit the 'O' Ring [39] to the recess in the rear of the Bearing Housing.
5. Grease the inner Seal Sleeve [15] and push fully rearwards on the Mainshaft [20] until the Seal Sleeve reaches the step in the Mainshaft.
6. Slide the Bearing Housing over the Mainshaft and push into place onto Studs [49] attached to the forward face of the Intake. **(Do not secure with Nuts [56] yet).**
7. Fit the Bearing Carrier [18] onto the Mainshaft and push up to the Seal Sleeve [15].
8. Pack the Bearing [36] with grease and fit into position on the Bearing Carrier [18].

NOTE:

It may help to warm the Bearing Housing [13] in warm water before fitting the Bearing [36] to the Bearing Housing.

9. Grease the outer Seal Sleeve [15] and push fully rearwards on the Mainshaft [20] until the Seal Sleeve is in contact with the forward face of the Bearing [36].
10. 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.
11. Lubricate the KMT Bearing Lock Nut [27] and assemble onto the Mainshaft hand tight only.
12. Temporarily refit the Coupling Key [8] and Coupling to the Mainshaft.
13. Lightly tighten the Coupling Nut to secure the Coupling in position.
14. Fit the Reaction Arm to the Coupling and torque the KMT Bearing Lock Nut [27] to the recommended torque. **(270 Nm. Refer to Drawing HJ-291-01-001).**
15. **Tighten the 3 KMT Bearing Lock Nut Set Screws to the recommended torque.** ***Refer to Section 6.6. "THREADED FASTENERS".***
16. Remove the Coupling Nut, Coupling and Coupling Key from the Mainshaft.
17. Lubricate the Seal [37] and press into the Bearing Cap [14]. **(Ensure that the Seal Spring faces outwards towards the Coupling - refer to Drawing HJ-291-01-001 as this will allow excess grease to escape from the Bearing Housing).**
18. Grease the contact faces between the Bearing Housing [13] and the Bearing Cap [14]. Lightly grease the inner face of Seal [37] and fit the Bearing Cap [14] into position onto Studs [49].
19. Fit Nuts [56] and Spring Washers [61] onto Studs [49] and tighten to the recommended torque.
20. Lightly grease the coupling taper, keyway and thread on Mainshaft along with the bore of the Coupling and the thread and face of the Coupling Nut [17].
21. Fit the Coupling Key [8] and the Coupling to the Mainshaft.
22. Fit the Coupling Nut [17], ensuring that the Set Screw [52] has been backed off, and tighten to the recommended torque. **(Drawing HJ-291-01-001 refers).**
23. Remove the Set Screw [52] and apply Loctite 222 to the Set Screw. Refit to the Coupling Nut and tighten to the recommended torque. ***Refer to Section 6.6. "THREADED FASTENERS".***
24. Whilst slowly rotating the Mainshaft, lightly grease the Bearing via the Grease Nipple [34] on the top of the Bearing Housing. **Do not over grease the Bearing.**
25. Turn the Mainshaft by hand, to ensure that it is free to rotate before re-coupling the Jet Unit to the drive shaft.

8.8. OVERHAUL OF THE TAILPIPE AREA

Drawing HJ-291-01-001 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. "REVERSE ASSEMBLY - OVERHAUL".***

If the Steering Linkages have not already been disconnected, they must be disconnected before proceeding. **Refer to *Section 8.4. "STEERING ASSEMBLY - OVERHAUL".***

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 [25] (Or Intake Screen [10] 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 unit (i.e. NOT top and bottom). Maximum recommended worn clearance is 1.25mm (.049") per side. (Maximum new clearance is 0.6mm per side).

b) **Marine Bearing Wear Check:**
Push the Mainshaft (20) 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 [24] and Water Bearing Sleeve [6].

8.8.2. Tailpipe Area Dismantling

Drawings HJ-291-01-001 and HJ-291-06-001 refer.

Ensure that the Steering Nozzle has been removed prior to commencing Tailpipe Area dismantling. Refer to *Section 8.4.3. "Nozzle Removal".*

The Nozzle and Tailpipe may be removed as a single assembly. Otherwise dismantle as follows:-

NOZZLE HOUSING REMOVAL:

Drawing HJ-291-06-001 refers:

1. Remove the 6 Nuts [15] and Spring Washers [16] from Studs [14], securing the Nozzle Housing to the Nozzle Insert and Tailpipe.
2. Remove the Nozzle Housing from the Tailpipe.

NOZZLE INSERT REMOVAL:

Drawing HJ-291-01-001 refers:

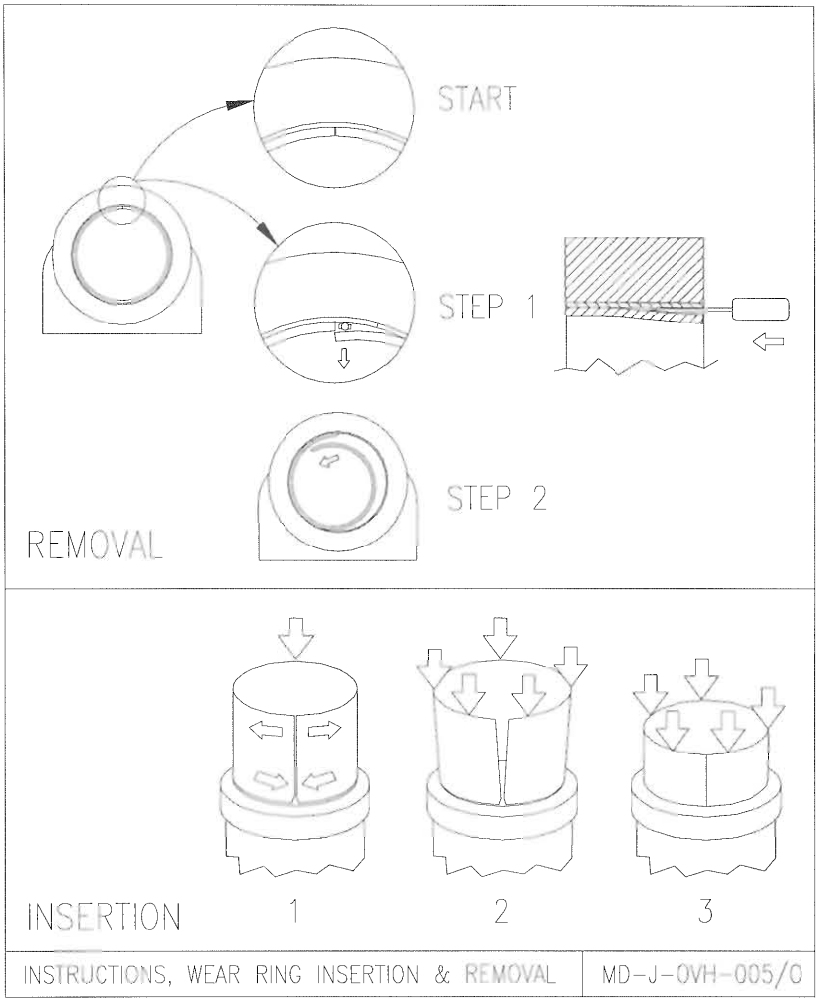
1. Remove the 8 x Nuts [54] and Spring Washers [59] from Studs [45], securing the Nozzle Insert to the Tailpipe.
2. Hit the Nozzle Insert sideways with a rubber or wooden mallet to free the joint and remove the Nozzle Insert from the Tailpipe.
3. If the Hose Tail [63] is connected up, disconnect any attached hose from the Hose Tail.
4. Remove the 4 Nuts [57] and Spring Washers [62] from Studs [50] securing the Tailpipe to the Intake.
5. Hit Tailpipe sideways with a rubber or wooden mallet to free the joint and remove from the remainder of the Jet Unit.
6. Remove O Ring [38] from the Tailpipe to Intake interface.

IMPELLER REMOVAL:

Drawing HJ-291-01-001 refers:

1. Remove the Set Screw [52] from the Impeller Nut [19].
2. Fit the Special Tool *"Reaction Arm"* to the Coupling, to prevent the Coupling from rotating.
3. Unscrew and remove the Impeller Nut [19] using Special Tool *"Shaft Nut Socket"*.
4. Withdraw the Water Bearing Sleeve [6] from between the Mainshaft and the Marine Water Bearing [24].
5. Fit the Special Tool *"Impeller Puller"* onto the Impeller Hub and tighten the Puller bolt firmly.
6. Free the Impeller from the Mainshaft by applying a sharp blow with a hammer to the Puller bolt. Withdraw the Impeller and Puller complete.
7. Remove the Impeller Key [4] ensuring that the Dowel [5] remains in place in the Key.
8. Remove the Impeller Seal [3] rearwards off the Mainshaft.
9. Examine the Wear Ring [11] and the Wear Ring Insulator [21]. 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-291-01-001 refers.

Step 1:

1. Find the joint in the Wear Ring [11] and force a long thin screw driver between the Wear Ring [11] and the Wear Ring Insulator [21], 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 [21] 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 [21] 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 [11] 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 [21] 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 approximately **0.8 mm ($^1/_{32}$")** from the end of the recess in the Intake. **(Refer to Diagram 1 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.

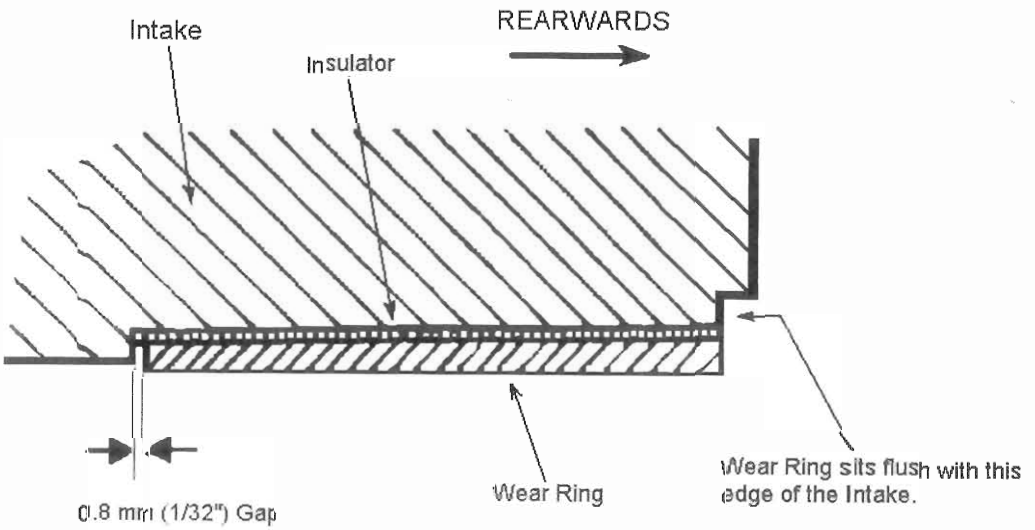


DIAGRAM 1- WEAR RING FITTING POSITION

NOTE:

The Wear Ring is in the correct position when it is located approximately 0.8 mm ($^1/_{32}$") from the end of the recess in the Intake (Diagram 1) and the Wear Ring sits flush with the 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-291-03-001 refers.

IMPELLER SPECIFICATIONS:	
Outside Diameter (OD):	288.0 to 287.8 mm. (11.34" - 11.33").
Balance to within 52 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

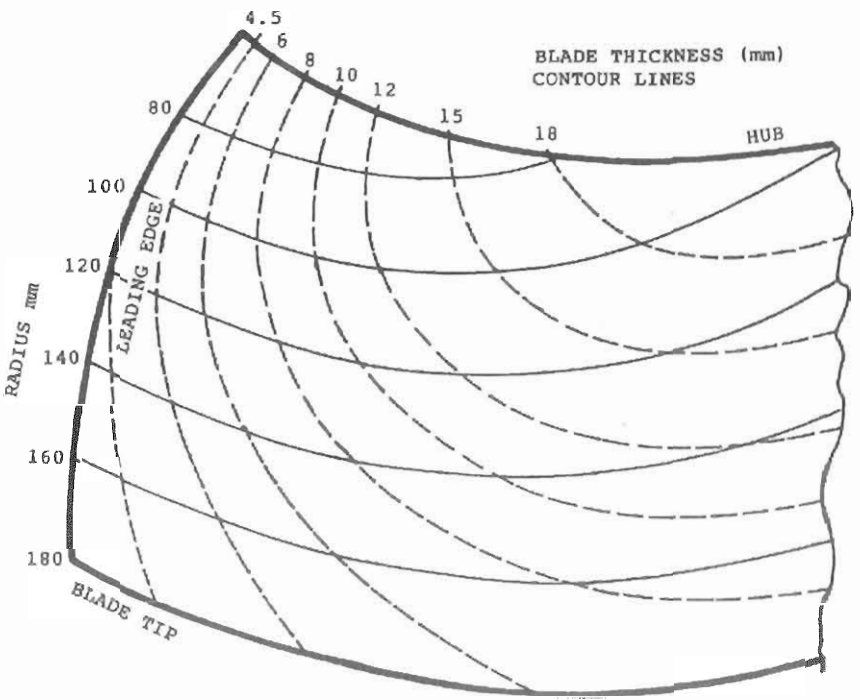
Inspect all surfaces of the Impeller for any sign of corrosion or erosion damage. Damaged areas should be weld repaired and dressed back to a smooth surface.

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

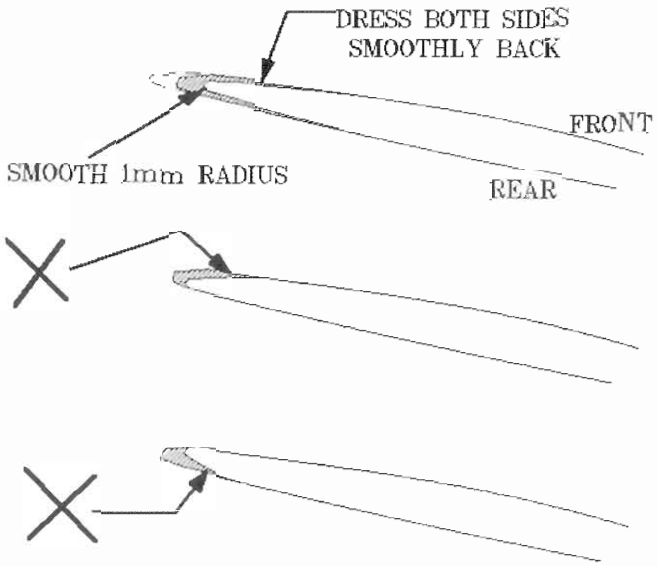
Check the Impeller leading and trailing edges for damage. Excessively worn or blunt leading edges may be built up by welding. Sharpen the edges as shown on the drawing. Blunt impellers cause loss of performance and sometimes cavitation.



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 statically on a suitable mandrel set on horizontal knife edges or bars to less than the specified value. Balance weights of 316 SS may be welded to the inside of the hub and grinding is permitted.
3. 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.

IMPELLER REPAIR

CAUTION:

Avoid using excessive heat during welding.

Worn or blunt leading edges should be repaired as shown below.

1. Dress the edge back to a smooth curve removing the minimum necessary amount of metal.
2. Then dress both faces of the blade taking slightly more metal off the rear side until the leading edge is 2mm thick all along.
3. Blend well back into the original blade surface.
4. Both front and rear surfaces are to be a smooth uniform curve with no sudden bumps or change in direction. Finally grind or file a smooth 1mm radius along the leading edge.
5. The above instructions also apply where the leading edge has to be built up by welding.
6. If the Impeller OD is excessively worn it may be built up by welding. After welding turn on a mandrel using light cuts to avoid blade distortion. Turn the OD to the diameter specified above. Dress the faces back flush with the original surfaces.
7. Balance the Impeller statically on a suitable mandrel set on horizontal knife edges or bars to within the maximum out of balance specified above. Balance weights of 316 SS may be welded to the inside of the hub and grinding is permitted.
8. Passivate the Impeller in a hot 30% Nitric Acid solution for at least 2 hours.

8.8.5. Overhaul of the Tailpipe

Drawing HJ-291-01-001 refers.

TAILPIPE

1. Check the fit of the Water Bearing Sleeve [6] in the Marine Water Bearing [24].
2. A diametrical clearance of 0.11 to 0.26 mm is normal and 0.6 mm maximum worn clearance. If the Bearing Sleeve is badly scored or worn it should be replaced.
3. Replace the Bearing Sleeve and the Marine Bearing if the Impeller has just been overhauled and the Wear Ring [20] replaced.
4. To remove the Marine Bearing [28], press both the Bearing and the Tailpipe Fairing [6] 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. Turn the Tailpipe over and support it at the Bearing Hub, pressing the Marine Bearing forward to avoid overloading the Stator Blades.

5. Clean out the bore and repaint with two part etch primer.
6. Grease the Tailpipe bore before pressing in the new Marine Water Bearing [24] ensuring that grease is kept away from the rubber bearing surfaces.
7. Place a wooden block under the nose of the Tailpipe Fairing when pressing in the new bearing, to take the load.
8. Thoroughly clean all grease from the Tailpipe bore and refit the Tailpipe Fairing [16] using Loctite 680 or equivalent.
9. **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 [2]

Drawing HJ-291-01-001 refers.

1. Check the 4 x Internal Tailpipe Anodes [2] attached to the Anode Mounting Plate [26] which is fitted to the forward face of the Tailpipe, **(Drawing HJ-291-01-001 sheet 1 of 2 refers).**
2. Should these be less than $^{2}/_{3}$rds their original size, they should be replaced.
3. To replace the 4 x Internal Tailpipe Anodes [1], carry out the following operation:-
   a) With the Tailpipe removed from the Intake [9], remove the Nuts [53] and Spring Washers [58] from the Studs [42] attaching the Anode Mounting Plate [26] to the Tailpipe.
   b) Remove the 2 x Bolts [51], Nuts [53] and Spring Washers [58] attaching each Anode to the Anode Mount Plate.
   c) Remove the 4 Internal Tailpipe Anodes [2].
   d) Ensure that the mating surfaces between the Anode and the Anode Mounting Plate are scraped clean for a good electrical contact.
   e) Fit new Internal Tailpipe Anodes [2] to the Anode Mounting Plate [26] and secure with Bolts [51], Nuts [53] and Spring Washer [58]. Torque load to the recommended torque.
   f) Refit the Anode Mounting Plate [26] to the Tailpipe and attach to Studs [42] with Nuts [53] and Spring Washers [58]. Torque load to the recommended torque.

4. If the Anodes are still in good condition, ensure that the Anodes are not painted over.
5. Scrub the Anodes with a wire brush if a coating of corrosion has built up on the Anodes.

EXTERNAL TAILPIPE ANODES [1]

Drawing HJ-291-01-001 refers.

1. Check the external Tailpipe Anodes [1] attached to the outside of the Tailpipe, if these are less than half of their original size, they should be replaced.
2. To replace the External Tailpipe Anodes fitted to the underside of the Nozzle, carry out the following operation:-
   a) Remove the Nut [53] and Spring Washer [58] from Stud [44].
   b) Remove the External Anode [1].
   c) Ensure that the mating surfaces are scraped clean for a good electrical contact.
   d) Fit a new External Anode [1].
   e) Attach with Nut [53] and Spring Washers [58]. Torque load to the recommended torque.
   f) Repeat for the second external Anode.

3. If the Anode is still in good condition, ensure that it has not been painted over.
4. Scrub down with a wire brush if a coating has built up on the Anode.

8.8.6. Re-Assembly of the Tailpipe and Nozzle

Drawing HJ-291-01-001 refers.

IMPELLER RE-ASSEMBLY

1. Ensure that all parts have been thoroughly cleaned prior to re-assembly.
2. Smear a light coating of grease over complete Mainshaft from in front of the Impeller Seal position, aft to the Impeller Nut thread.
3. Check the Impeller Seal [3] for damage, replace if seal shows signs of wear / damage.
4. Fit the Impeller Seal to the Mainshaft and push to just ahead of the Impeller taper on the Mainshaft.
5. Insert the Impeller Key [4] and locate into the Mainshaft with Dowel [4].
6. Slide the Impeller onto the Mainshaft followed by the Water Bearing Sleeve [6].

NOTE:

When fitting a new Impeller into a Jet Unit, the Impeller Taper must be lapped to the Main Shaft in accordance with British Standard MA 74.

7. Prevent the Main Shaft rotating by fitting *"Reaction Arm"* tool on to the Coupling.
8. Fit the Impeller Nut [19] and tighten to recommended torque.
9. Fit the Set Screw [52] with Loctite 222 (or equivalent) and tighten.
10. Working through the Main Inspection Cover, remove any surplus grease from the Impeller Seal recess (at the front of the Impeller).
11. Slide the Impeller Seal [3] back into the recess, while rotating the Mainshaft and Impeller by hand.
12. Refit the Main Inspection Cover [25] and O Ring [40]. Secure to Studs [47] with Spring Washers [60] and Nuts [55]. Torque load to the recommended torque.

TAILPIPE RE-ASSEMBLY

1. Wipe the Water Bearing Sleeve [6] clean to ensure that the Marine Water Bearing [24] remains free of grease.
2. Dust the rubber of the Marine Water Bearing [24] with talc or french chalk.
3. Clean and grease the Tailpipe to Intake contact faces.
4. Refit O-Ring [38] to the Tailpipe flange with grease to retain in position.
5. Refit the Tailpipe onto the Studs [50] on the Intake and secure with Spring Washers [62] and Nuts [57]. Tighten nuts to the recommended torque.
6. Using the Special Tool *"Reaction Arm"*, fitted to the Coupling, as a handle, turn the Main Shaft to ensure that the assembly rotates freely.

NOZZLE INSERT:- RE-ASSEMBLY

Drawing HJ-291-01-001 refers.

1. Offer the Nozzle Insert up to the Tailpipe and locate onto Studs [45].
2. Attach the Nozzle Insert to Studs [45] with Nuts [54] and Spring Washers [59] to secure the Nozzle to the Tailpipe. Torque load to the correct torque.
3. Reconnect any hoses that were attached to the Hose Tail [63]. If none attached, ensure that Blanking Plug [35] is fitted securely.

NOZZLE HOUSING REFITTING

Drawing HJ-291-06-001 refers.

1. Refit the Nozzle Housing [2] onto the Studs [14] around the rear face of the Nozzle Insert [3] and secure with Nut [15] and Spring Washer [16].
2. Refit the Nozzle to the Nozzle Housing in accordance with **Section 8.5.2. "Nozzle** / Nozzle Housing Refit".
3. Refit the Steering Equipment in accordance with "**Section 8.5.3. "Steering Assembly Refit".**

8.9. TRANSOM PLATE ASSEMBLY OVERHAUL

Drawings HJ-291-08-001 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 [2], the Reverse Duct and Reverse Cylinder must be removed to allow access.

8.9.1. Transom Plate Removal

NOTE:

The Transom Seal and the Header Ring should not be removed unless they are suspect of leaking or unless the Header Ring, the Transom Seal or the Transom Plate are corroded or damaged.

GRP HULLS: (Drawing HJ-291-08-001 refers).

To remove the Header Ring 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 Header Ring attachment Nuts [12] and Spring Washers [18] from Studs [7].
3. Remove the Header Ring [2] and the Transom Seal [3] and withdraw them off the rear if the Jet Unit.

Should the Transom Plate require removal for repair or replacement continue as follows:-

4. Slacken and remove 19 Screw [9], Nut [12] complete with Flat Washers [15] and Spring Washers [18] from around the circumference of the Transom Ring.
5. Slacken and remove 3 Special Studs [4] and Nyloc Nuts [14] from the top of the Transom Ring. **Note the location of the Special Studs [4] as these locate the HSRC Controls Assembly.**
6. The Transom Plate can now be removed from the Jet Unit.

NOTE:

The Transom Plate is secured to the Transom using RTV Silicone Sealant [21]. Some effort may be required to separate the Transom Plate from the Transom.

7. 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.
8. Clean and examine Header Ring [2] for damage, distortion and corrosion. Replace as required.
9. Clean and examine the Transom Seal [3] for damage cuts or perishing. Replace as required.

ALUMINIUM HULLS: (Drawing HJ-291-08-002 refers).

To remove the Header Ring 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 Header Ring attachment Nuts [11] and Spring Washers [17] from Studs [7].
3. Remove the Header Ring [2] and the Transom Seal [3] and withdraw them off the rear if the Jet Unit.

Should the Transom Plate require removal for repair or replacement continue as follows:-

4. Slacken and remove 19 Screw [9], Nut [11] complete with Flat Washers [14] and Spring Washers [17] from around the circumference of the Transom Ring.
5. Slacken and remove 3 Special Studs [4] and Nyloc Nuts [13] from the top of the Transom Ring. **Note the location of the Special Studs [4] as these locate the HSRC Controls Assembly.**
6. The Transom Plate can now be removed from the Jet Unit.

NOTE:

The Transom Plate is secured to the Transom using RTV Silicone Sealant [20]. Some effort may be required to separate the Transom Plate from the Transom.

7. 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.
8. Clean and examine Header Ring [2] for damage, distortion and corrosion. Replace as required.
9. Clean and examine the Transom Seal [3] for damage cuts or perishing. Replace as required.

STEEL HULLS: (Drawing HJ-291-08-003 refers).

To remove the Header Ring 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 Header Ring attachment Nuts [15] and Spring Washers [21] from Studs [10].
3. Remove the Header Ring [1] and the Transom Seal [2] from Stud [10] and withdraw them off the rear if the Jet Unit.

Should the Transom Plate require removal for repair or replacement continue as follows:-

4. Slacken and remove 19 Screws [12], Nuts[15] complete with the Spring Washers [21] and Flat Washers [18] fitted on either side of the Screws, from around the circumference of the Transom Ring.
5. Slacken and remove 3 Special Studs [4] and Nyloc Nuts [17] from the top of the Transom Ring. **Note the location of the Special Studs [4] as these locate the HSRC Controls Assembly.**
6. Remove the 22 Nylon Flanged insulating Bushes [8] from the screw holes in the Transom Plate.
7. 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.

8. Remove the Transom Plate Gasket [3] from around the circumference of the Transom Plate.
9. 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.
10. Clean the Header Ring [1] and examine for damage, distortion and corrosion. Repair or replace as required.
11. Clean and examine the Transom Seal [2] for damage cuts or perishing. Replace as required.

8.9.2. Transom Plate Re-Fitting

GRP HULLS: (Drawing HJ-291-08-001 refers).

1. Smear the Transom Plate interface around the Transom to Transom Plate attachment holes with RTV Sealant [20].
2. From the Tailpipe end of the Jet Unit, slide the Transom Plate up the Jet Unit and over the Reverse Cylinder.
3. Ensure that the holes in the Transom Plate and the Transom are liberally coated with RTV Sealant [20] before fitting the attachment Screws [10].
4. Ensure that the Transom Plate is correctly located over the Intake.
5. Align the Transom Plate with the Transom and secure with Screws [10]. **(These are to be fitted with the Screw Head outside the vessel).**
6. From inside the vessel, fit Flat Washers [15] and Spring Washers [18] to the Screws [10] and secure with Nuts [13].
7. Tighten to the recommended torque.
8. Liberally grease the Transom Seal [2] and refit over the Studs [8] into the channel between Transom Plate and the Jet Unit.
9. Fit the Header Ring [3] onto Studs [8] and secure to the Transom Plate using Spring Washer [17] and Nut [12]. Tighten to the recommended torque. **(Drawing 85113 refers).**
10. Liberally grease the Header Seal [4] and refit over the rear end of the Reverse Cylinder and into the recess around the Reverse Cylinder Hemi Seat.
11. Refit the Reverse Jack Header [5] onto Studs [7] and secure with Spring Washers [17] and Nuts [12]. Torque load to the recommended torque.
12. Connect the Reverse Cylinder to the Reverse Duct as shown in **Section 8.3.2. Refitting the Reverse Duct.**

ALUMINIUM HULLS: (Drawing HJ-291-08-002 refers).

1. Smear the Transom Plate interface around the Transom to Transom Plate attachment holes with RTV Sealant [19].
2. From the Tailpipe end of the Jet Unit, slide the Transom Plate up the Jet Unit and over the Reverse Cylinder.
3. Ensure that the holes in the Transom Plate and the Transom are liberally coated with RTV Sealant [19] before fitting the attachment Screws [10].
4. Ensure that the Transom Plate is correctly located over the Intake.
5. Align the Transom Plate with the Transom and secure with Screws [10]. **(These are to be fitted with the Screw Head outside the vessel).**
6. From inside the vessel, fit Flat Washers [14] and Spring Washers [17] to the Screws [10] and secure with Nuts [12].
7. Tighten to the recommended torque.
8. Liberally grease the Transom Seal [2] and refit over the Studs [8] into the channel between Transom Plate and the Jet Unit.
9. Fit the Header Ring [3] onto Studs [8] and secure to the Transom Plate using Spring Washer [16] and Nut [11]. Tighten to the recommended torque. **(Drawing 85018 refers).**
10. Liberally grease the Header Seal [4] and refit over the rear end of the Reverse Cylinder and into the recess around the Reverse Cylinder Hemi Seat.
11. Refit the Reverse Jack Header [5] onto Studs [7] and secure with Spring Washers [16] and Nuts [11]. Torque load to the recommended torque.
12. Connect the Reverse Cylinder to the Reverse Duct as shown in ***Section 8.3.2. "Refitting the Reverse Duct".***

STEEL HULLS: (Drawing HJ-291-08-003 refers).

1. Smear the Transom Plate interface around the Transom to Transom Plate attachment holes with RTV Sealant [24].
2. From the Tailpipe end of the Jet Unit, slide the Transom Plate Gasket up the Jet Unit and over the Reverse Cylinder (If fitted).
3. From the Tailpipe end of the Jet Unit, slide the Transom Plate up the Jet Unit and over the Reverse Cylinder.
4. Ensure that the holes in the Transom Plate and the Transom are liberally coated with RTV Sealant [24] before fitting the attachment Screws [12].
5. Ensure that the Transom Plate is correctly located over the Intake.
6. Align the Transom Plate with the Transom and fit the Nylon Flanged Insulating Bushes [8].
7. Fit Washers [18] to the heads of the Screws [12] and fit through the Bushes [8]. **(Ensure that these are fitted with the Screw Head [12] outside the vessel).**
8. From inside the vessel, fit Flat Washers [18] and Spring Washers [21] to the Screws [12] and secure with Nuts [15].
9. Tighten to the recommended torque.
10. Liberally grease the Transom Seal [2] and refit over the Studs [10] and into the channel between Transom Plate and the Jet Unit.
11. Fit the Header Ring [1] onto Studs [10] and secure to the Transom Plate using Spring Washer [21] and Nut [15]. Tighten to the recommended torque.
12. 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 Between the Jet(s) and the Steel Hull".***
13. Refit the Reverse Cylinder and connect to the Reverse Duct as shown in ***Section 8.3.2. "Refitting the Reverse Duct".***

8.10.OVERFLOW PREVENTER

Drawing HJ-291-10-001 refers.

C.W.F. Hamilton & Co Ltd can supply, as an optional extra, an Overflow Preventer [1]. This item enables work to be carried out on the Jet Unit where normally by removing the Inspection Cover may allow water to enter the vessel. The Overflow Preventer raises the height of the Inspection Hatch by approximately 140 mm.

8.10.1.Overflow Preventer Fitting

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.

NOTE:

The Overflow Preventer may be fitted in position before removing the Inspection Cover.

To fit the Overflow Preventer [1] carry out the following operation:-

1. Ensure that the water level is below the level of the Inspection Cover.

Drawing HJ-291-10-001 refers.

2. Smear the underside of the Overflow Preventer [1] with RTV Silicone [8].
3. Fit the Overflow Preventer over the Inspection Cover and Hatch area and secure in position with Flat Washers [6] and Screws [4] and tighten to the recommended torque.
4. Remove any excess RTV Sealant.
5. With the Overflow Preventer securely fitted in position, ensure that the Drain Bung [3] is securely closed.

Drawing HJ-291-01-001 refers.

6. Remove Nuts [55] and Spring Washers [60] from the three Studs [47] retaining the Inspection Cover [25] to the Jet Unit.

NOTE:

Water may enter the Overflow Preventer as the securing Nuts [55] are removed from the Inspection Cover [25]. Ensure that water does not overflow the Overflow Preventer.

7. Remove the Inspection Cover [25] and O Ring [40] from inside the Overflow Preventer.
8. Ensure that the Overflow Preventer is not leaking water from around the base and from the Drain Connector [2].

8.10.2.Overflow Preventer Removal

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.

To remove the Overflow Preventer from the Jet Unit Inspection Hatch, carry out the following actions:-

Drawing HJ-291-01-001 refers.

1. Ensure that the O Ring [40] fitted to the Inspection Cover [25] is not perished or damaged, replace if required.
2. Smear the O Ring [40] with grease and refit to the Inspection Cover [25].
3. Refit the Inspection Cover [25] down inside the Overflow Preventer and secure onto Studs [47] with Spring Washers [60] and Nuts [55]. Tighten to the recommended torque.

Drawing HJ-291-10-001 refers.

4. To drain any surplus water from inside the Overflow Preventer, slacken the Drain Bung [3] inside the base of the Overflow Preventer.

NOTE:

A ½" ID hose may be attached to the Drain Connector [2] to carry water to the vessel bilge.

5. Remove the attaching Screws [4] and Flat Washers [6] and remove the Overflow Preventer. Note that the Overflow Preventer has been attached using RTV Silicone Sealant and may require some effort to remove.
6. Clean off any excess Silicone Sealant from around the Inspection Hatch.
7. Visually check that the Inspection Cover is not leaking.

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.

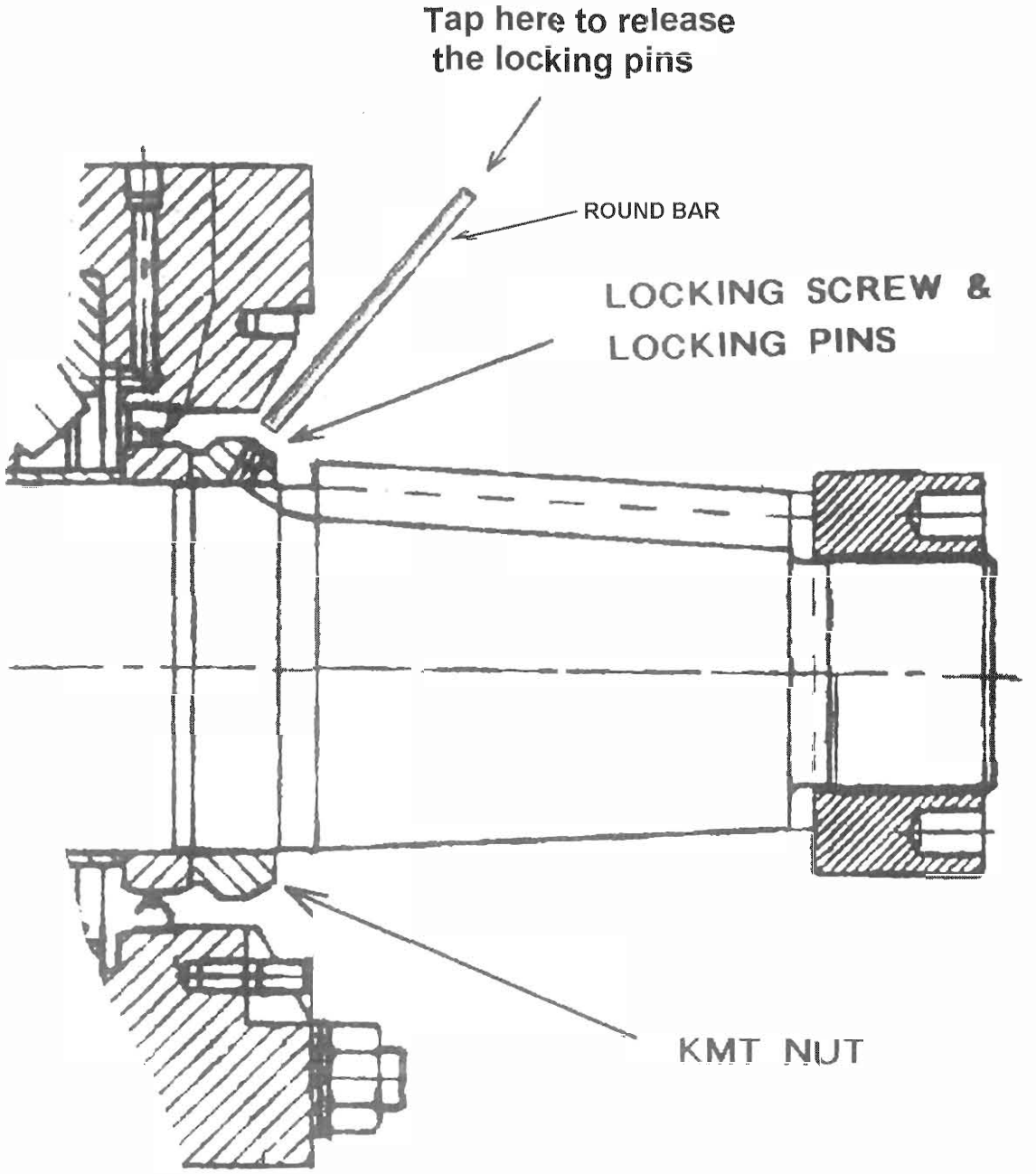
FITTING THE KMT NUT:

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.

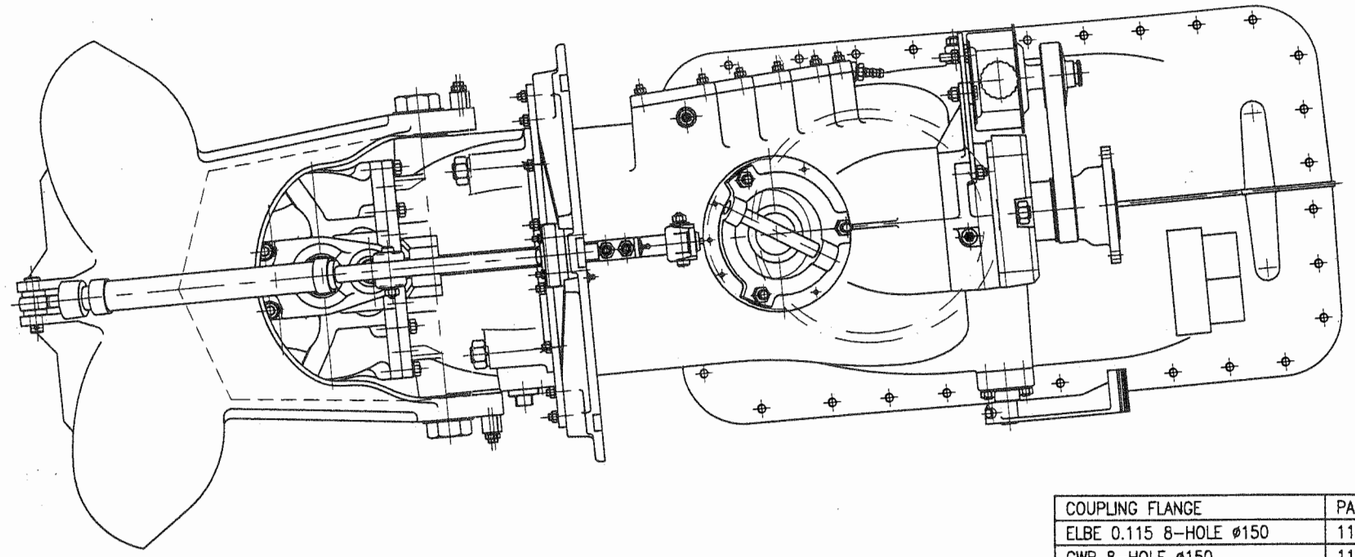
KMT Bearing M6 Locknut Screws - 5 Nm (4 ft/lbs).
KMT Bearing M8 Locknut Screws - 12 Nm (9 ft/lbs).

REMOVING THE KMT NUT:

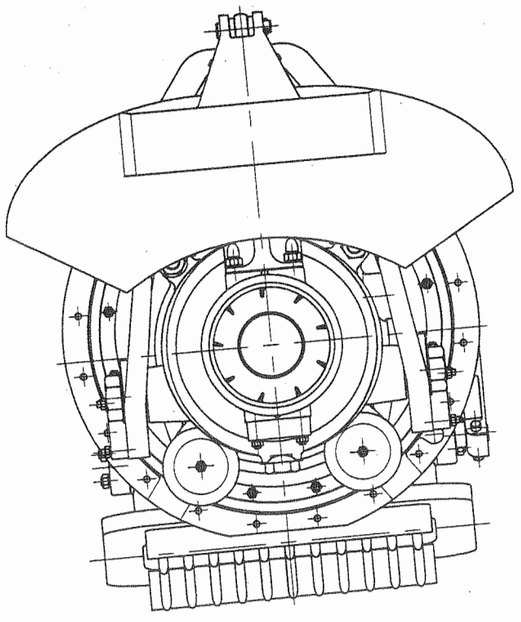
To remove the KMT Nut, partially withdraw the 3 Locking Screws located around the circumference of the Nut.
Because the brass Locking Pins are a force fit onto the Shaft and do not easily release from the threads of the Shaft, they have to be released by lightly tapping in the vicinity of the Locking 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.

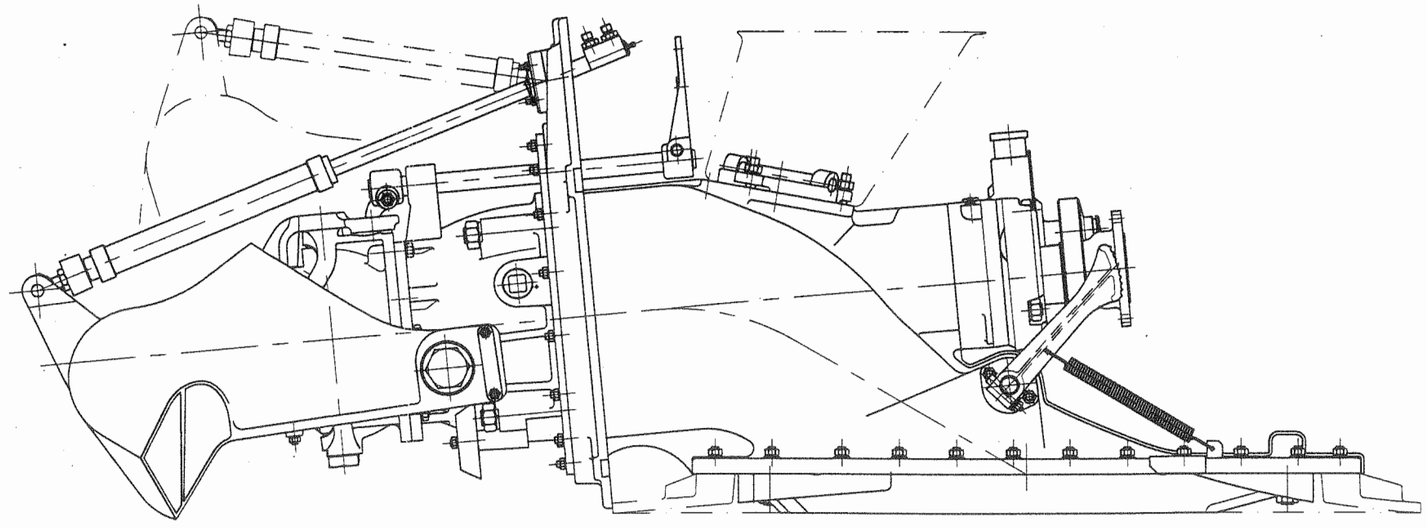


VIEW OF KMT NUT



COUPLING FLANGE	PART No	DIM'N 'A'	DIM'N 'B'
ELBE 0.115 8–HOLE ø150	110585	691.7	266.0
GWB 8–HOLE ø150	110586	691.7	266.0
H/SPICER 1600 8–HOLE ø175	110587	691.7	266.0
AQUADRIVE 8–HOLE ø200	110588	714.7	268.0





REF	NO.	BY	DATE	AMENDMENTS
CL87	B	P.S.	22/3/99	SHAFT LINE WAS HORIZONTAL.
CL60	A	PMW	27.7.98	DETAILS & DIMENSIONS UPDATED
CL3723	0	RJL	30.9.95	ISSUED FOR PRODUCTION

JET 291

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

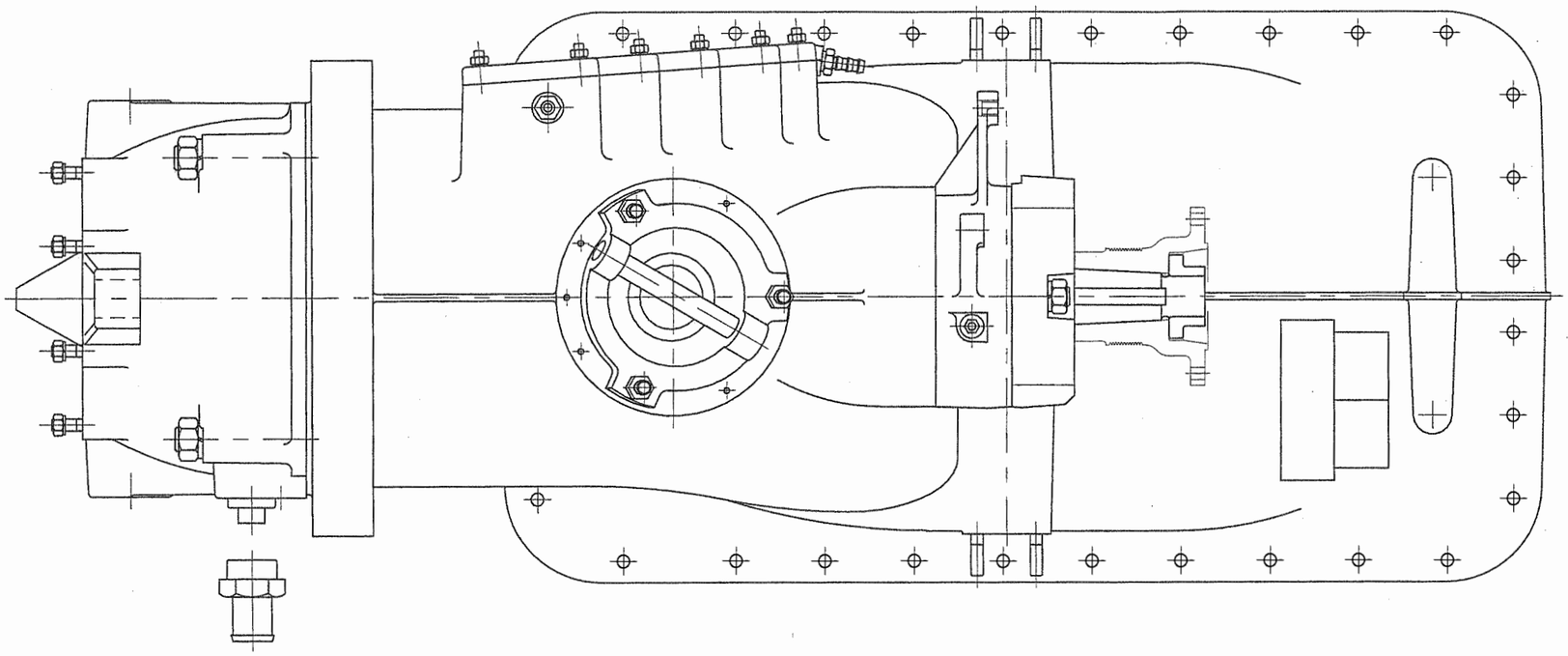
PROJECTION

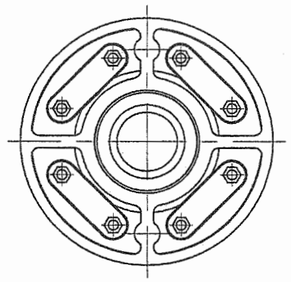
NAME: GENERAL ASSEMBLY HJ 291 JET

DESIGNED	DATE
DRAWN R.J.L.	25.9.95
CHECKED	
APPROVED K.V.E.	27.9.95

SCALE 1:8

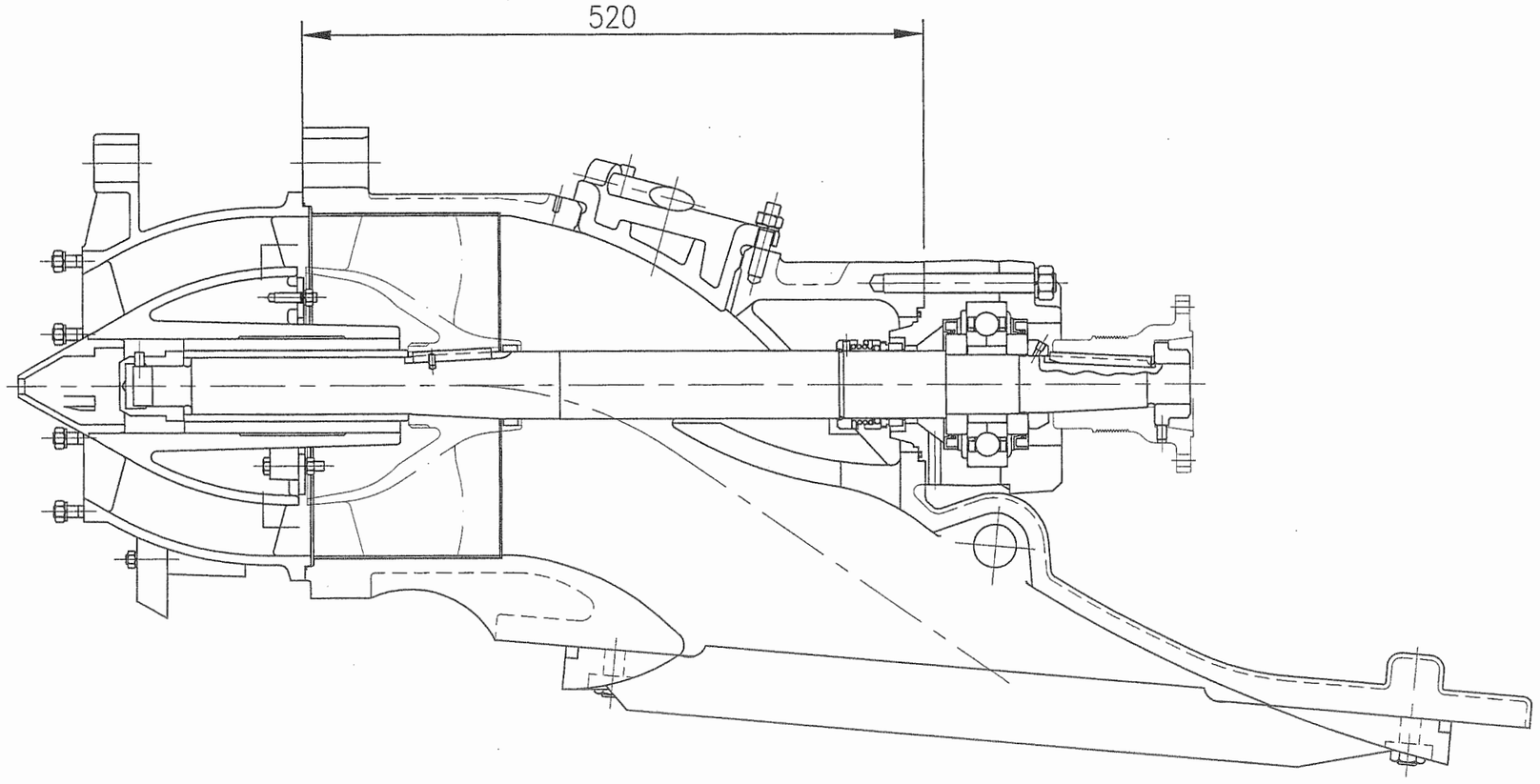
No: ASSY–HJ291 30 001 B

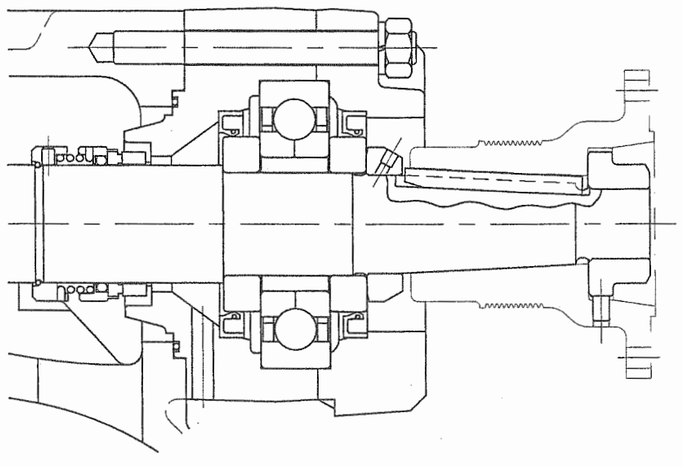




SECTION A–A SHOWING
INTERNAL ANODES

TIGHTENING TORQUES	
IMPELLER NUT	400 Nm
COUPLING NUT	400 Nm
BEARING LOCKNUT KMT10	270 Nm
STUDS: INTAKE TO TAILPIPE	120 Nm





ENLARGED DETAIL OF BEARING HOUSING
SCALE 1:3

REF	NO.	BY	DATE	AMENDMENTS
	D	P.S.	27/4/99	COOLER COVER ADDED TO INTAKE KIT.
CL76	C	P.S.	15/1/99	104755 ADDED (TAILPIPE KIT)
CL70	B	P.S.	23/10/98	ITEM 64 ADDED.
CL 64	A	PMW	25.8.98	ITEM 33 QTY WAS INCORRECT NOW 2–OFF
CL 61	0	PMW	27.7.98	ISSUED FOR PRODUCTION

JET 291

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

PROJECTION

DESIGNED | DATE

DRAWN P.M.W. | 16.6.98

CHECKED

APPROVED K.V.E.

NAME
BASIC JET ASSEMBLY
HJ 291 JET
SHEET 1 OF 2 SHEETS

SCALE 1:5 | No: ASSY–HJ291 01 001 | D

A	B	C	Item	Kit	PartNumber	Qty	ProductDescription	DrawingNbr
				A	105041		INTAKE KIT	HJ29101001
				B	105042		TAILPIPE KIT	HJ29101001
				C	110671		BEARING HOUSING KIT	HJ29101001
	B			REF	104755	1	STEERING SHAFT BUSH	104755
	B			REF	104608	2	THREADED BUSH (REV DUCT PIVOT PIN)	104608
A				REF	61353	1	(SEAL) SCRAPER RING-WYCLIP	61332
A				REF	61362	1	(OIL SEALS) 25x42x7 (GAYCO DPSM 25427) C/W SS SPRING	N/A
A				REF	108143	1	STEERING SHAFT BUSH	108143
	B		1		102185	2	ANODE	102185
	B		2		103359	4	ANODE MK3	103359
			3		104190	1	IMPELLER SEAL	104190
			4		104191	1	IMPELLER KEY	104191
			5		104192	1	(JET) DOWELS 5mm OD 316 STST	104191
			6		104193	1	WATER BEARING SLEEVE	104193
			7		104201	1	(GENERAL) CIRCLIPS CIRCLIP	104201
			8		104203	1	COUPLING KEY	104203
A			9		104205	1	INTAKE	104205
			10		104207	1	SCREEN (ALM) (std)	104207
A			11		104211	1	WEAR RING	104211
	B		12		104265	1	TAILPIPE	104265
		C	13		104613	1	BEARING HOUSING	104613
		C	14		104615	1	BEARING CAP	104615
		C	15		104617	2	SEAL SLEEVE	104617
	B		16		104618	1	TAILPIPE FAIRING	104618
			17		104619	1	COUPLING NUT	104619
		C	18		104621	1	BEARING CARRIER	104621
			19		104624	1	IMPELLER NUT	104624
			20		104625	1	MAINSHAFT	104625
A			21		104674	1	INSULATOR (WEAR RING)	104674
	B		22		105273-2	1	STONE BAR	105273
			23		105306	1	(JET) PACKAGING CASE	105306
	B		24		106265	1	MARINE WATER BEARING 80x60x180	106264
			25		106972	1	INSPECTION COVER (S/No 2506 on)	106972
	B		26		107183	1	ANODE MOUNTING PLATE	107183
		C	27		107295	1	(SKF) NUTS SPECIAL LOCKNUT KMT10 (MODIFIED)	107295
A			28		109194	1	OIL COOLER COVER PLATE	109194
			29		61502	1	(JET) ROTARY SEALS 2.25" 32HA (BM-163200)	61502
			30		63097	1	(LABELS) NAME PLATES MODEL & SERIAL No PLATE	63097
			31		63135	1	(LABELS) NAME PLATES PATENT PLATE	63135
			32		63610	1	(LABELS) NAME PLATES WARNING PLATE	63610

A	B	C	Item	Kit	PartNumber	Qty	ProductDescription	DrawingNbr
			33		68000	2	3/8 BSP PUSHLOCK FITTING MALE	N/A
		C	34		HEIDAAA	1	(GREASE) NIPPLES (H29) 1/8"BSP	N/A
	B		35		HIQUAAG	1	(PLUGS) B.S.P.P. PLUG 1-1/4" BSP SQ HD 316 S.S.	N/A
		C	36		JNODAEV	1	(SKF) BEARINGS ALL TYPES (SKF QJ313MA)	N/A
		C	37		JWKZADF	2	(OIL SEALS) Gaco DPSM8511012 C/W SS SPRING	N/A
A	B		38		104916	1	(JET) O RINGS SPECIAL 1.78mmx305mmx308.6mm	104916
			39		HMHRABV	1	(O RINGS) IMPERIAL 0.13x4.50x4.75 (246N70)	N/A
			40		HMHRADQ	1	(O RINGS) IMPERIAL 0.25x5.25x5.75 (431N70)	N/A
A			41		HMHRAEN	1	(O RINGS) IMPERIAL 0.13x9.00x9.25 (270N70)	N/A
	B		42		JCQHXAG	2	(STUDS) METRIC (316-STST) M8x35	30647
A			43		JCQHXAH	12	(STUDS) METRIC (316-STST) M8x40	30647
	B		44		30661	2	(STUDS) METRIC (316-STST) M8x51	30647
	B		45		JCQHXAN	8	(STUDS) METRIC (316-STST) M10x40	30637
A			46		JCQHXAO	4	(STUDS) METRIC (316-STST) M10x50	30637
			47		103916	3	(STUDS) METRIC (316-STST) M12x64	30639
A			48		30657	4	(STUDS) METRIC (316-STST) M16x70	30634
A			49		30644	3	(STUDS) METRIC (316-STST) M16x145	30634
A			50		30642	4	(STUDS) METRIC (316-STST) M20x138	30641
	B		51		HYQHXCB	8	(BOLTS) (METRIC) ST ST 316 M8x45	N/A
			52		JAJYXCB	2	(SCREWS) (SET SCREWS) METRIC 316 ST ST Socket M8x10	N/A
A12	B12		53		JDQHXAC	24	(NUTS) (METRIC ST ST 316) M8	N/A
	B		54		JDQHXAE	8	(NUTS) (METRIC ST ST 316) M10	N/A
			55		JDQHXAH	3	(NUTS) (METRIC ST ST 316) M12	N/A
A3			56		JDQHXAL	7	(NUTS) (METRIC ST ST 316) M16	N/A
A			57		JDQHXAP	4	(NUTS) (METRIC ST ST 316) M20	N/A
A12	B12		58		JEQKXAC	24	(WASHERS) (SPRING) METRIC ST ST 316 M8	N/A
	B		59		JEQKXAE	8	(WASHERS) (SPRING) METRIC ST ST 316 M10	N/A
			60		JEQKXAH	3	(WASHERS) (SPRING) METRIC ST ST 316 M12	N/A
A3			61		JEQKXAJ	7	(WASHERS) (SPRING) METRIC ST ST 316 M16	N/A
A			62		JEQKXAL	4	(WASHERS) (SPRING) METRIC ST ST 316 M20	N/A
A			63		JMNGAAO	1	(HOSE) TAILS CP30 BRASS 1-1/4" BSP	N/A
		C	64		110806	1	SLEEVE FOR SAGINAW PUMP MOUNT	110806

REF	NO.	BY	DATE	AMENDMENTS
				FOR AMMENDMENTS SEE SHEET 1

JET 291

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

PROJECTION

DESIGNED | DATE

DRAWN P.M.W. | 16.6.98

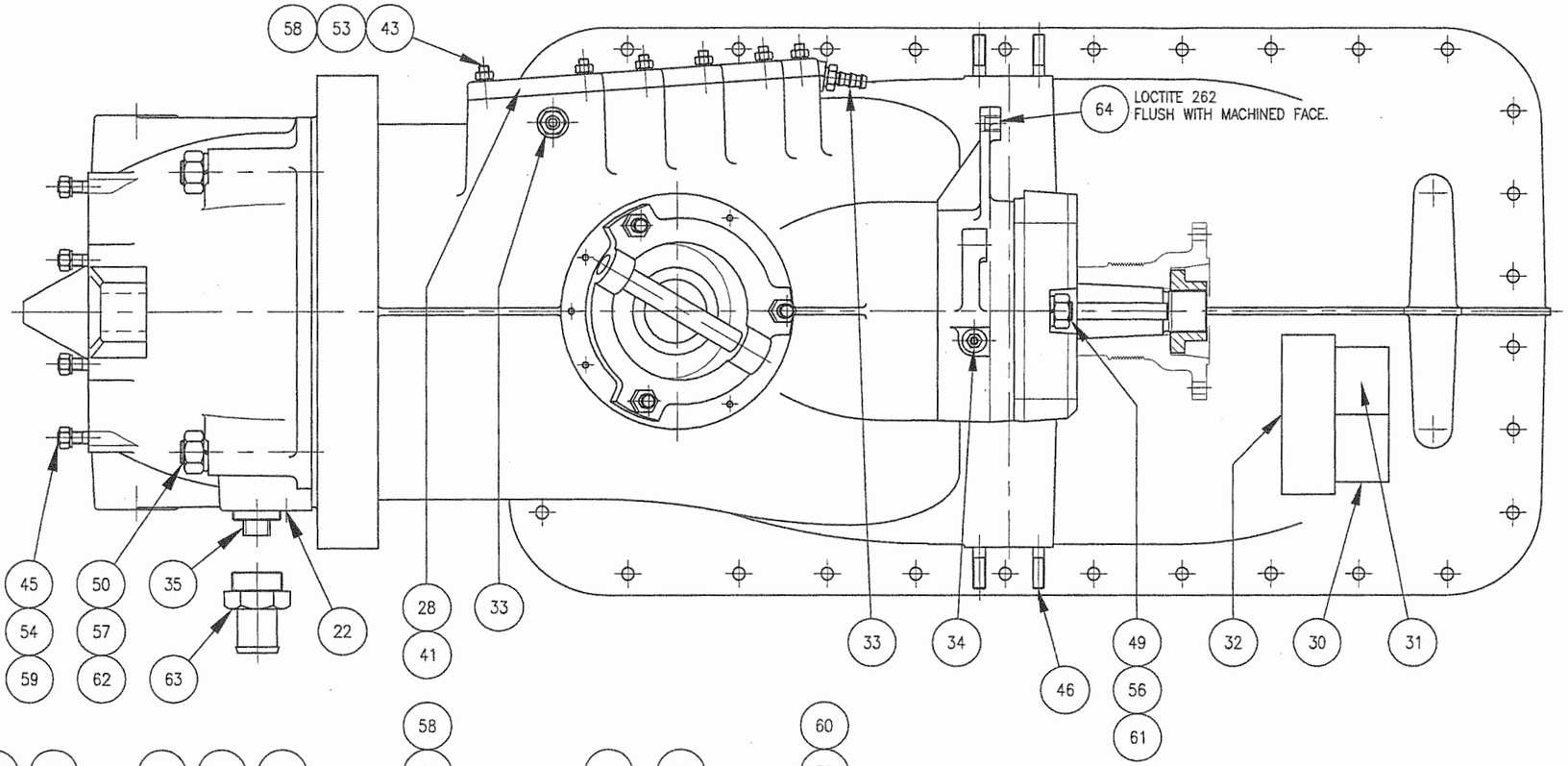
CHECKED

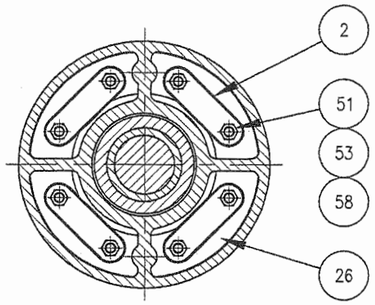
APPROVED K.V.E.

NAME
BASIC JET ASSEMBLY
HJ 291 JET
SHEET 2 OF 2 SHEETS

SCALE -

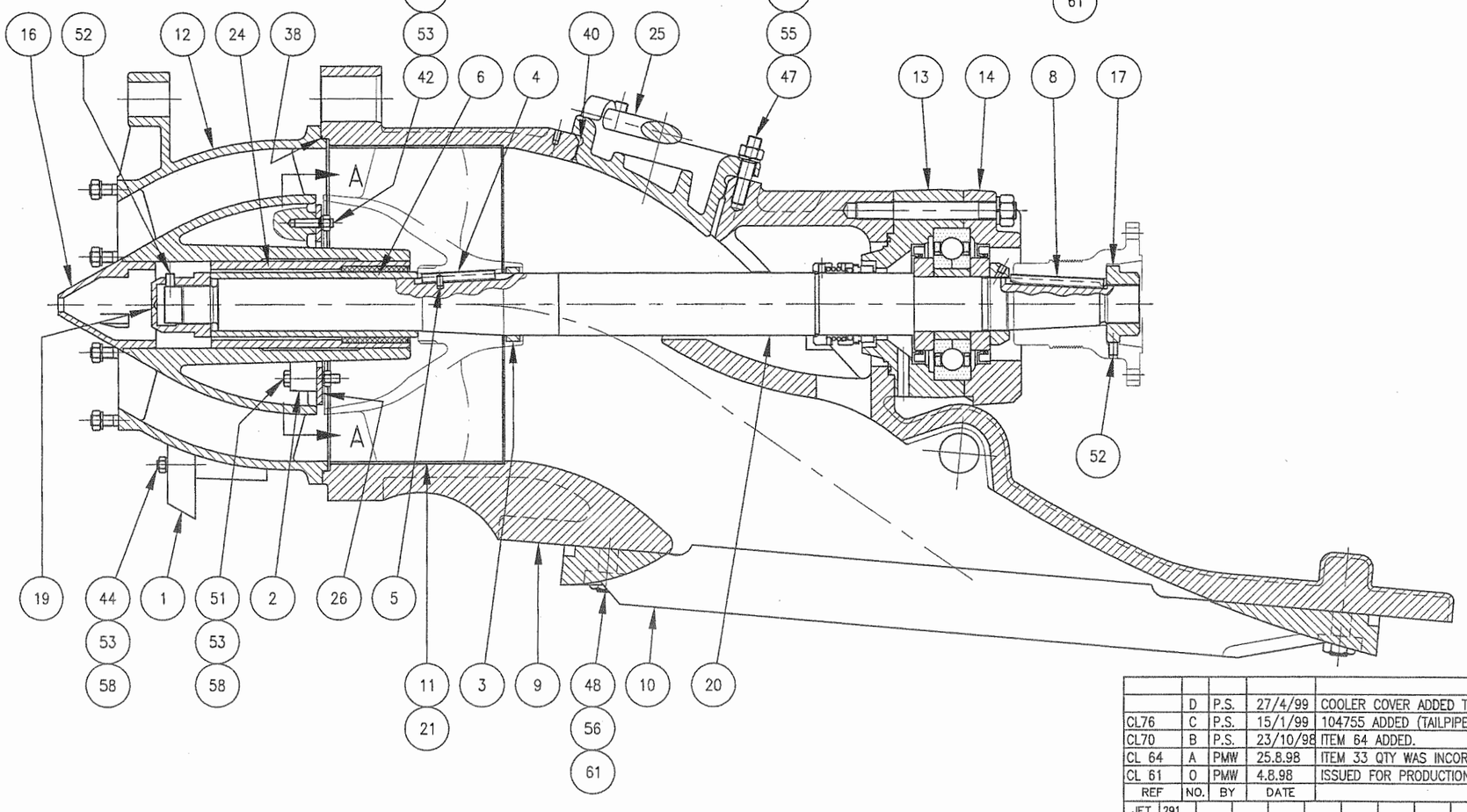
No: ASSY-HJ291 01 001 D

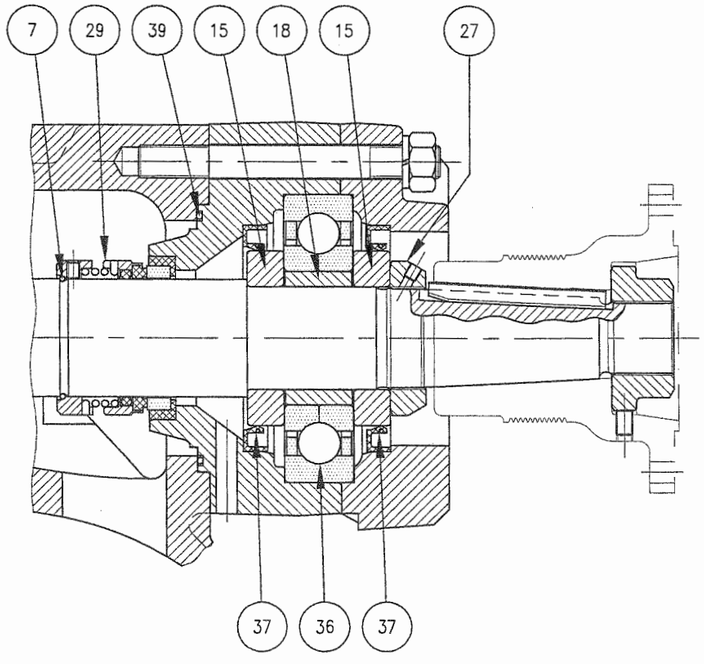




SECTION A–A SHOWING
INTERNAL ANODES

TIGHTENING TORQUES	
IMPELLER NUT	400 Nm
COUPLING NUT	400 Nm
BEARING LOCKNUT KMT10	270 Nm
STUDS: INTAKE TO TAILPIPE	120 Nm





ENLARGED DETAIL OF BEARING HOUSING
SCALE 1:3

	D	P.S.	27/4/99	COOLER COVER ADDED TO INTAKE KIT.
CL76	C	P.S.	15/1/99	104755 ADDED (TAILPIPE KIT)
CL70	B	P.S.	23/10/98	ITEM 64 ADDED.
CL 64	A	PMW	25.8.98	ITEM 33 QTY WAS INCORRECT NOW 2–OFF
CL 61	0	PMW	4.8.98	ISSUED FOR PRODUCTION
REF	NO.	BY	DATE	AMENDMENTS

JET 291

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

PROJECTION

NAME
BASIC JET
DRY RUN ASSEMBLY
HJ 291 JET
SHEET 1 OF 2 SHEETS

DESIGNED	DATE
DRAWN P.M.W.	04.8.98
CHECKED	
APPROVED K.V.E.	

SCALE 1:5

No: ASSY–HJ291 01 004 D

A	B	C	D	Item	Kit	PartNumber	Qty	ProductDescription	DrawingNbr
					A	105041		INTAKE KIT	HJ29101001
					B	110730		TAILPIPE KIT (DRY RUN ASSEMBLY)	HJ29101004
					C	110671		BEARING HOUSING KIT	HJ29101001
					D	110731		DRY RUN KIT	HJ29101004
A					REF	108143	1	STEERING SHAFT BUSH	108143
A					REF	61353	1	(SEAL) SCRAPER RING-WYCLIP	61332
	B				REF	104755	1	STEERING SHAFT BUSH	104755
	B				REF	104608	2	THREADED BUSH (REV DUCT PIVOT PIN)	104608
A					REF	61362	1	(OIL SEALS) 25x42x7 (GAYCO DPSM 25427) C/W SS SPRING	N/A
	B			1		102185	2	ANODE	102185
	B			2		103359	4	ANODE MK3	103359
				3		104190	1	IMPELLER SEAL	104190
				4		104191	1	IMPELLER KEY	104191
				5		104192	1	(JET) DOWELS 5mm OD 316 STST	104191
			D	6		106604	1	HARDENED SLEEVE	106600
				7		104201	1	(GENERAL) CIRCLIPS CIRCLIP	104201
				8		104203	1	COUPLING KEY	104203
A				9		104205	1	INTAKE	104205
				10		104207	1	SCREEN (ALM) (std)	104207
A				11		104211	1	WEAR RING	104211
	B			12		104265	1	TAILPIPE	104265
		C		13		104613	1	BEARING HOUSING	104613
		C		14		104615	1	BEARING CAP	104615
		C		15		104617	2	SEAL SLEEVE	104617
	B			16		104618	1	TAILPIPE FAIRING	104618
				17		104619	1	COUPLING NUT	104619
		C		18		104621	1	BEARING CARRIER	104621
				19		104624	1	IMPELLER NUT	104624
				20		104625	1	MAINSHAFT	104625
A				21		104674	1	INSULATOR (WEAR RING)	104674
	B			22		105273-2	1	STONE BAR	105273
				23		105306	1	(JET) PACKAGING CASE	105306
	B		D	24		106627	1	DRY RUN BEARING (BFT)	106623
				25		106972	1	INSPECTION COVER (S/No 2506 on)	106972
	B			26		107183	1	ANODE MOUNTING PLATE	107183
		C		27		107295	1	(SKF) NUTS SPECIAL LOCKNUT KMT10 (MODIFIED)	107295
A				28		109194	1	OIL COOLER COVER PLATE	109194

A	B	C	D	Item	Kit	PartNumber	Qty	ProductDescription	DrawingNbr
			D	29		61428	1	(JET) ROTARY SEALS 2.25" 32HA (BM-363357) CERAMIC FACE	61428
				30		63097	1	(LABELS) NAME PLATES MODEL & SERIAL No PLATE	63097
				31		63135	1	(LABELS) NAME PLATES PATENT PLATE	63135
				32		63610	1	(LABELS) NAME PLATES WARNING PLATE	63610
				33		68000	2	3/8 BSP PUSHLOCK FITTING MALE	N/A
		C		34		HEIDAAA	1	(GREASE) NIPPLES (H29) 1/8"BSP	N/A
	B			35		HIQUAAG	1	(PLUGS) B.S.P.P. PLUG 1-1/4" BSP SQ HD 316 S.S.	N/A
		C		36		JNODAEV	1	(SKF) BEARINGS ALL TYPES (SKF QJ313MA)	N/A
		C		37		JWKZADF	2	(OIL SEALS) Gaco DPSM8511012 C/W SS SPRING	N/A
A	B			38		104916	1	(JET) O RINGS SPECIAL 1.78mmx305mmx308.6mm	104916
				39		HMHRABV	1	(O RINGS) IMPERIAL 0.13x4.50x4.75 (246N70)	N/A
				40		HMHRADQ	1	(O RINGS) IMPERIAL 0.25x5.25x5.75 (431N70)	N/A
A				41		HMHRAEN	1	(O RINGS) IMPERIAL 0.13x9.00x9.25 (270N70)	N/A
	B			42		JCQHXAG	2	(STUDS) METRIC (316-STST) M8x35	30647
A				43		JCQHXAH	12	(STUDS) METRIC (316-STST) M8x40	30647
	B			44		30661	2	(STUDS) METRIC (316-STST) M8x51	30647
	B			45		JCQHXAN	8	(STUDS) METRIC (316-STST) M10x40	30637
A				46		JCQHXAO	4	(STUDS) METRIC (316-STST) M10x50	30637
				47		103916	3	(STUDS) METRIC (316-STST) M12x64	30639
A				48		30657	4	(STUDS) METRIC (316-STST) M16x70	30634
A				49		30644	3	(STUDS) METRIC (316-STST) M16x145	30634
A				50		30642	4	(STUDS) METRIC (316-STST) M20x138	30641
	B			51		HYQHXCB	8	(BOLTS) (METRIC) ST ST 316 M8x45	N/A
				52		JAJYXCB	2	(SCREWS) (SET SCREWS) METRIC 316 ST ST Socket M8x10	N/A
A12	B12			53		JDQHXAC	24	(NUTS) (METRIC ST ST 316) M8	N/A
	B			54		JDQHXAE	8	(NUTS) (METRIC ST ST 316) M10	N/A
				55		JDQHXAH	3	(NUTS) (METRIC ST ST 316) M12	N/A
A3				56		JDQHXAL	7	(NUTS) (METRIC ST ST 316) M16	N/A
A				57		JDQHXAP	4	(NUTS) (METRIC ST ST 316) M20	N/A
A12	B12			58		JEQKXAC	24	(WASHERS) (SPRING) METRIC ST ST 316 M8	N/A
	B			59		JEQKXAE	8	(WASHERS) (SPRING) METRIC ST ST 316 M10	N/A
				60		JEQKXAH	3	(WASHERS) (SPRING) METRIC ST ST 316 M12	N/A
A3				61		JEQKXAJ	7	(WASHERS) (SPRING) METRIC ST ST 316 M16	N/A
A				62		JEQKXAL	4	(WASHERS) (SPRING) METRIC ST ST 316 M20	N/A
	B			63		JMNGAAO	1	(HOSE) TAILS CP30 BRASS 1-1/4" BSP	N/A
		C		64		110806	1	SLEEVE FOR SAGINAW PUMP MOUNT	110806

REF	NO.	BY	DATE	AMENDMENTS
				FOR AMMENDMENTS SEE SHEET 1

JET 291

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

PROJECTION

DESIGNED

DRAWN P.M.W. 04.8.98

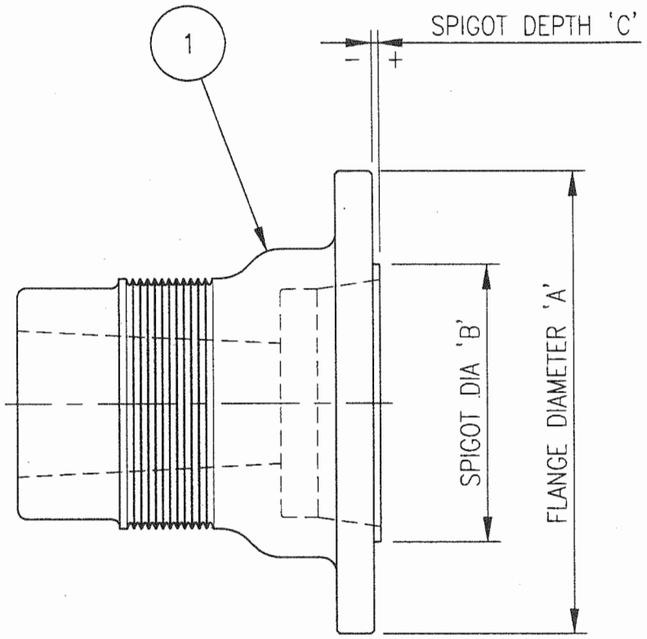
CHECKED

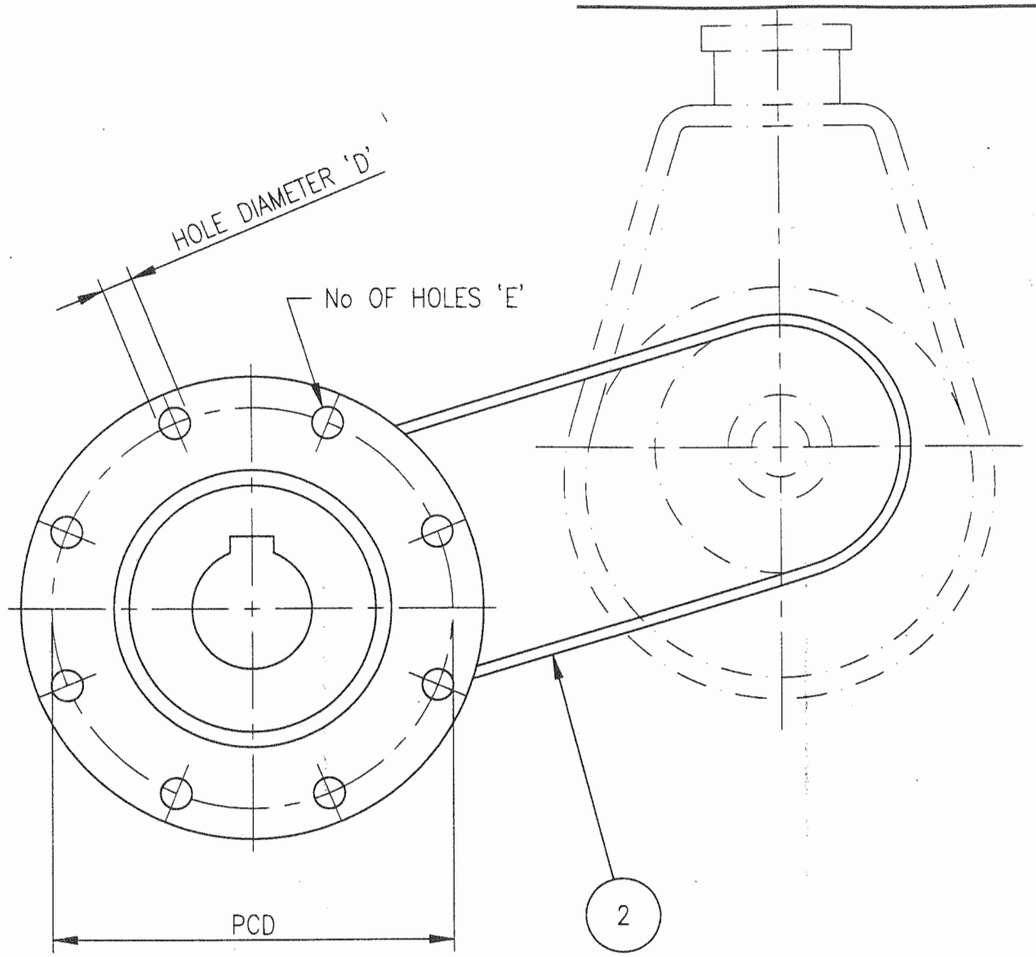
APPROVED K.V.E.

NAME
BASIC JET
DRY RUN ASSEMBLY
HJ 291 JET
SHEET 2 OF 2 SHEETS

SCALE 1.25X-

No: ASSY-HJ291 01 004 D





A	B	C	D	E	F	Item	Kit	PartNumber	Qty	ProductDescription	DrawingNbr
							A	110649		COUPLING & V-BELT KIT (ELBE 0.115)	HJ29102001
							B	110650		COUPLING & V-BELT KIT (GWB)	HJ29102001
							C	110651		COUPLING & V-BELT KIT (HARDY SPICER 1600)	HJ29102001
							D	110652		COUPLING & V-BELT KIT (AQUADRIVE 20600)	HJ29102001
							E	110928		COUPLING & V-BELT KIT (AQUADRIVE 20300)	HJ29102001
							F	110932		COUPLING & V-BELT KIT (AQUADRIVE 20400)	HJ29102001
A						1		110585	1	COUPLING WITH MICRO-V PULLEY (ELBE 0.115)	110585
	B					1		110586	1	COUPLING WITH MICRO-V PULLEY (GWB)	110585
		C				1		110587	1	COUPLING WITH MICRO-V PULLEY (HARDY SPICER 1600)	110587
			D			1		110588	1	COUPLING WITH MICRO-V PULLEY (AQUA DRIVE 20600)	110588
				E		1		110927	1	COUPLING WITH MICRO-V PULLEY (AQUADRIVE 20300)	110927
					F	1		110931	1	COUPLING WITH MICRO-V PULLEY (AQUADRIVE 20400)	110931
A	B	C	D	E	F	2		64898	1	(VEE BELTS) (PJ610 10 RIB) MICRO VEE	N/A

DIA'A'	DIA'B'	DEPTH'C'	DIA'D'	PCD	HOLES'E'
150	90	+2.3/2.0	10.2	130	8
150	90	+2.3/2.0	12.2	130	8
175	168.3	−1.4/1.2	9.5	155.6	8
200	192	−2.3/2.0	M16	165	8
130	90	−7.0	M12	108	6
148	112	−7.0	M12	128	6

REF	NO.	BY	DATE	AMENDMENTS
CL85	A	P.S.	3/3/99	KIT E & F ADDED
CL60	0	PMW	27.7.98	ISSUED FOR PRODUCTION

JET 291

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

PROJECTION

NAME: COUPLINGS HJ 291 JET

DESIGNED | DATE

DRAWN P.M.W. 8.6.98

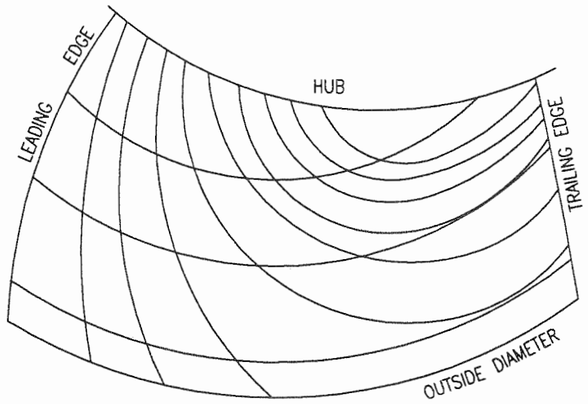
CHECKED

APPROVED K.V.E.

SCALE 1:2

No: ASSY-HJ291 02 001 A

VIEW OF BLADE FROM FRONT OF BOAT



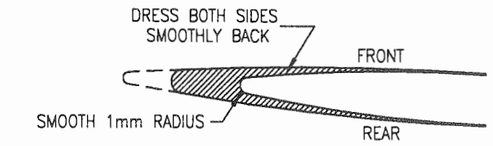
IMPELLER SHARPENING

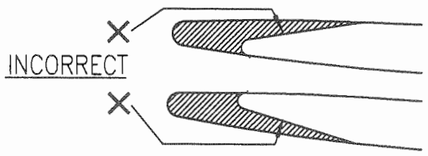
The leading edges of the impeller may tend to become "blunt" after a period of time with the action of small solid particles in the water. The performance of the impeller will drop as a result.

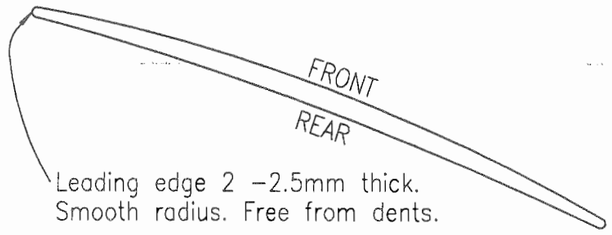
Any time the inspection cover is removed, the leading edge of the blades should be inspected for wear. If badly worn, remove impeller (see section on dismantling unit) and sharpen as shown below.

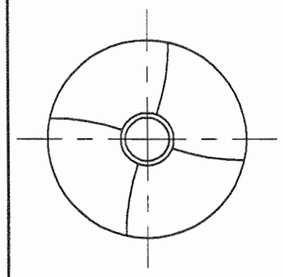
After sharpening balance within 45c.m.g.

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



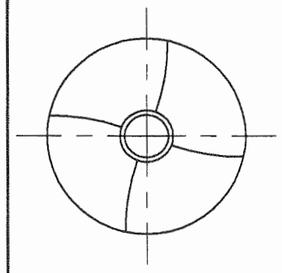






5 BLADE

A	B	C	D	Item	Part Nbr	Qty	ProductDescription	Drawing Nbr
				1	105060	1	(JET) IMPELLERS TYPE (13) - (5 BLADE)	105681
				1	104808	1	(JET) IMPELLERS TYPE (14) - (5 BLADE)	105681
				1	104764	1	(JET) IMPELLERS TYPE (15) - (5 BLADE)	105681
				1	105681	1	(JET) IMPELLERS TYPE (15.5) - (5 BLADE)	105681
				1	106341	1	(JET) IMPELLERS TYPE (16) - (5 BLADE)	105679
				1	106369	1	(JET) IMPELLERS TYPE (16.5) - (5 BLADE)	105679
				1	105680	1	(JET) IMPELLERS TYPE (17) - (5 BLADE)	105679
				1	106089	1	(JET) IMPELLERS TYPE (17.5) - (5 BLADE)	105679
				1	105679	1	(JET) IMPELLERS TYPE (18) - (5 BLADE)	105679
				1	105844	1	(JET) IMPELLERS TYPE (20) - (5 BLADE)	105679



4 BLADE

A	B	C	D	Item	Part Nbr	Qty	ProductDescription	Drawing Nbr
				1	104698	1	(JET) IMPELLERS TYPE (10) - (4 BLADE)	105138
				1	105134	1	(JET) IMPELLERS TYPE (11) - (4 BLADE)	105138
				1	104697	1	(JET) IMPELLERS TYPE (12) - (4 BLADE)	105138
				1	105138	1	(JET) IMPELLERS TYPE (12.5) - (4 BLADE)	105138

CL60	0	PMW	27.7.98	ISSUED FOR PRODUCTION	
REF	NO.	BY	DATE	AMENDMENTS	
JET 291					

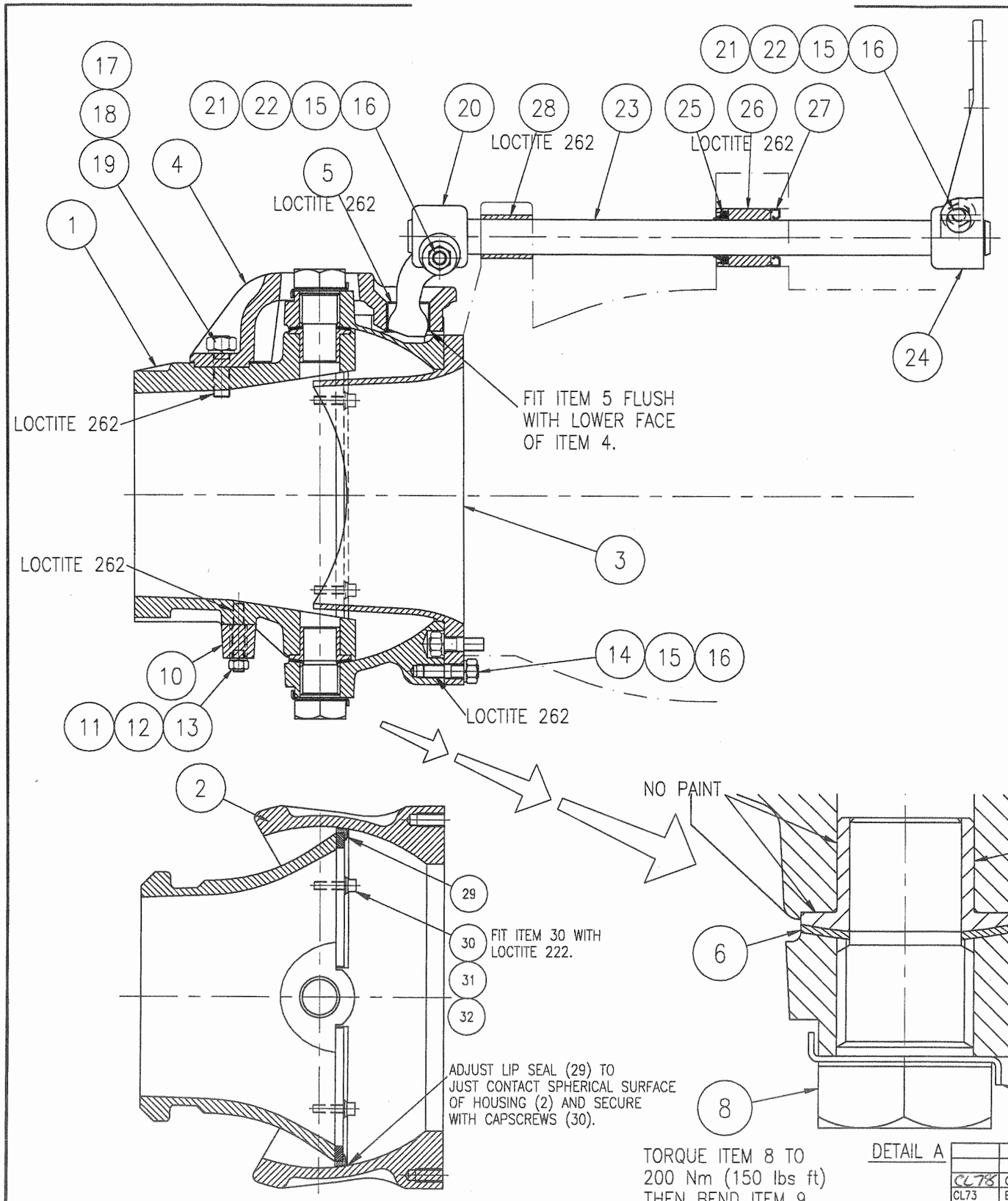
C.W.F.HAMILTON & CO. LTD. CHCH. NZ.

PROJECTION

DESIGNED P.A.S. 12.8.96
DRAWN P.A.S. 12.8.96
CHECKED
APPROVED K.V.E.

NAME
IMPELLERS
HJ 291 JET

SCALE –
No: ASSY-HJ291 03 001 0



A	B	Item	Kit	PartNumber	Qty	ProductDescription	DrawingNbr
			A	109265		STEERING NOZZLE ASSEMBLY (RETROFIT FOR T3 TYPE)	HJ29106001
			B	110896		STEERING NOZZLE ASSEMBLY	HJ29106001
A	B	1		110770	1	LIP SEAL NOZZLE JT S/NBR 2963 ON	110770
A	B	2		109238	1	NOZZLE HOUSING (JT STEERING)	109238
A	B	3		109239	1	NOZZLE INSERT	109239
A	B	4		109240	1	STEERING ARM	109240
A	B	5		109706	1	DEFLECTOR BUSH STST (JT STEERING)	102961
A	B	6		109242	2	(WASHER) SPECIAL THRUST WASHER (JT) (nyloil)	109242
A	B	7		109243	2	NOZZLE PIVOT BUSH	109243
A	B	8		104604	2	PIVOT PIN	104604
A	B	9		105139	2	(WASHER) SPECIAL 54mm OD x30.5mm ID x1.2mm thk 316 STST	105139
A	B	10		103359	1	ANODE MK3	103359
A	B	11		30661	2	(STUDS) METRIC (316-STST) M8x51	30647
A	B	12		JDQHXAC	2	(NUTS) (METRIC ST ST 316) M8	N/A
A	B	13		JEQKXAC	2	(WASHERS) (SPRING) METRIC ST ST 316 M8	N/A
A	B	14		JCQHXAN	6	(STUDS) METRIC (316-STST) M10x40	30637
A7	B6	15		JDQHXAE	8	(NUTS) (METRIC ST ST 316) M10	N/A
A7	B6	16		JEQKXAE	8	(WASHERS) (SPRING) METRIC ST ST 316 M10	N/A
A	B	17		108573	2	(STUDS) METRIC (316-STST) M12x44	30639
A	B	18		JDQHXAH	2	(NUTS) (METRIC ST ST 316) M12	N/A
A	B	19		JEQKXAH	2	(WASHERS) (SPRING) METRIC ST ST 316 M12	N/A
A		20		109241	1	STEERING CRANK	109241
A1		21		102834	2	COTTER	102834
A1		22		102993	2	(WASHER) SPECIAL 25mm ODx11mm IDx3mm thk	102993
		23		106973	1	SHAFT STEERING (S/No 2506 on)	106973
		24		106954	1	TILLER	105352
		25		61353	1	(SEAL) SCRAPER RING-WYCLIP	61332
		26		108143	1	STEERING SHAFT BUSH	108143
		27		61362	1	(OIL SEALS) 25x42x7 (GAYCO DPSM 25427) C/W SS SPRING	N/A
		28		104755	1	STEERING SHAFT BUSH	104755
A	B	29		110798	2	LIP SEAL JT STEERING	110798
A	B	30		30798	4	(SCREWS) (CAPSCREWS) METRIC ST ST 316 M6x25 (SOC HD)	N/A
A	B	31		JEQKXAA	4	(WASHERS) (SPRING) METRIC ST ST 316 M6	N/A
A	B	32		JEOZXAD	4	(WASHERS) (FLAT) METRIC ST ST 316 M6x12.5x1.0	N/A

REF	NO.	BY	DATE	AMENDMENTS
CL78	C	P.S.	1-2-99	110896 ADDED.
CL73	B	P.S.	30/10/98	ITEMS 29,30,31 & 32 ADDED. ITEM 1 WAS 109237.
CL3773	A	P.S.	4/2/97	ITEM 5 WAS 107156
CL3762	0	P.S.	24/9/96	ISSUED FOR PRODUCTION.

JET 291

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

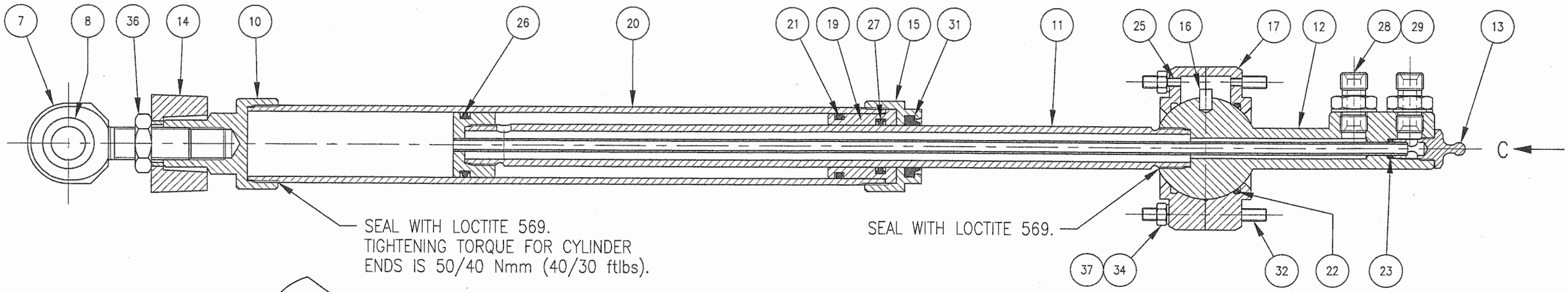
PROJECTION

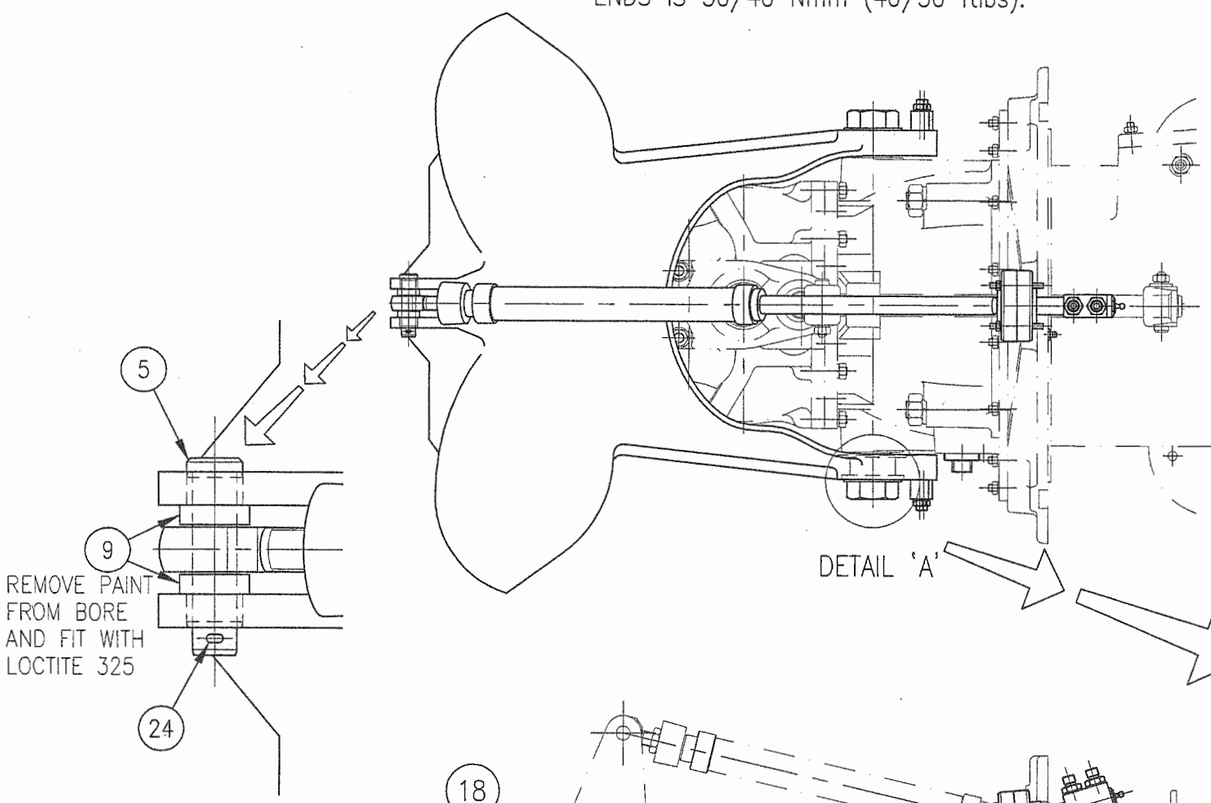
DESIGNED	P.A.S.	2/9/96
DRAWN	P.A.S.	2/9/96
CHECKED		
APPROVED	K.V.E.	6/9/96

NAME
STEERING ASSEMBLY
GENERAL ARRANGEMENT
JT TYPE STEERING
HJ291

SCALE -

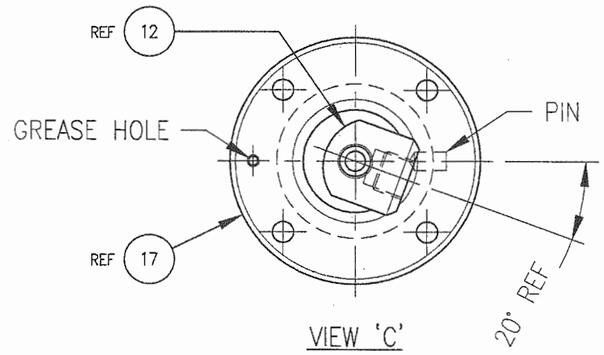
No: ASSY-HJ291 06 001 B

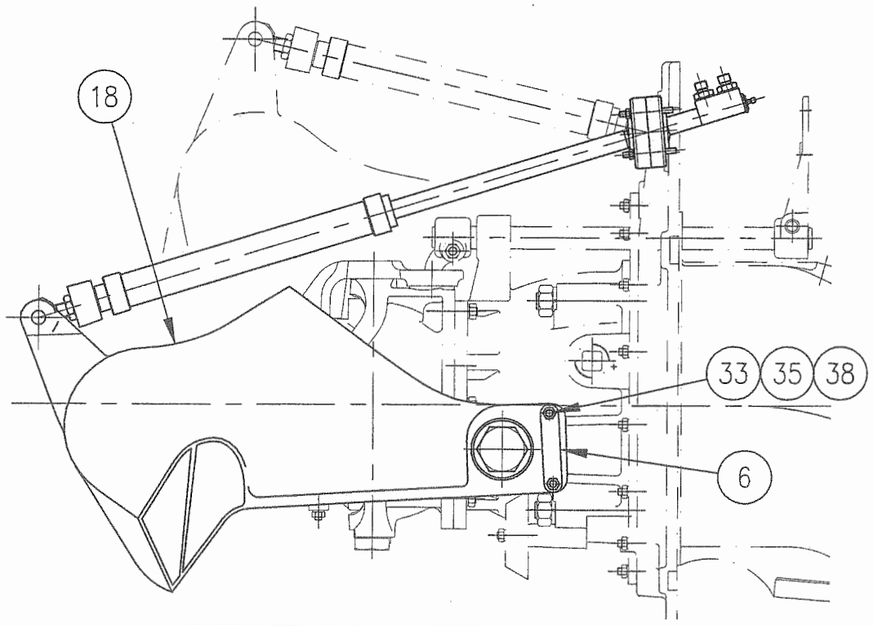


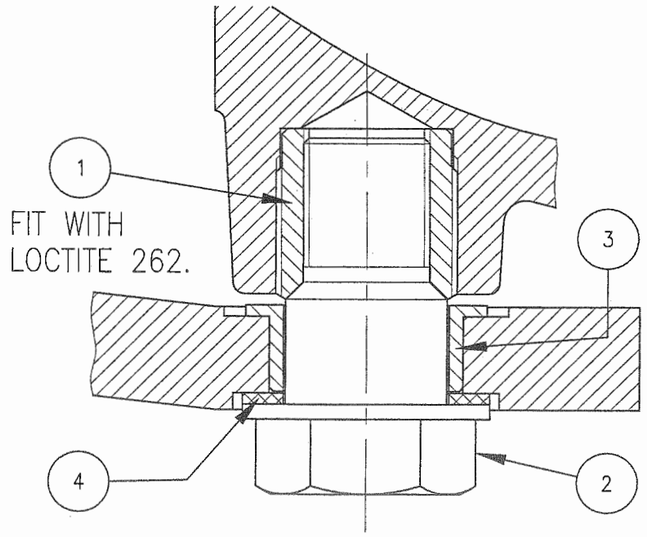


RAM SPECIFICATIONS

DOUBLE ACTING	
BORE:	31.6mm.
STROKE:	261.85mm.
CLOSED LENGTH:	452.25mm.
EXTENDED LENGTH:	714.1mm ±10mm ADJUSTMENT.
DISPLACEMENT CLOSED:	118cc.
DISPLACEMENT EXTENDED:	204cc.
OPERATING PRESSURE:	110 BAR (1600PSI).
TEST PRESSURE:	165 BAR (2400PSI).







REF	NO.	BY	DATE	AMENDMENTS
CL 101	B	J.W.	21.7.99	ITEM 30 DELETED. ITEMS 28 & 29 SUPPLIER CODE CHANGED.
CL92	A	P.S.	29/4/99	ITEM 9 WAS104655. ITEM 18 WAS 106322.
CL 60	0	PMW	27.7.98	ISSUED FOR PRODUCTION

JET 291

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

PROJECTION

NAME
REVERSE ASSEMBLY
HJ 291 JET
SHEET 1 OF 2 SHEETS

DESIGNED	DATE
DRAWN P.M.W.	24.6.98
CHECKED	
APPROVED K.V.E.	
SCALE 1:7.5	No: ASSY-HJ291 07 001 B

A	B	C	D	E	F	G	H	Code	Item	Kit	Part Number	Qty	Product Description	Drawing Nbr
										A	106255		REVERSE CYLINDER ASSEMBLY	HJ29107001
										B	106243	1	SEAL KIT (REVERSE CYLINDER)	HJ36207001
										C	106322		REVERSE DUCT KIT	106322
								4	1		104608	2	THREADED BUSH (REV DUCT PIVOT PIN)	104608
								4	2		104609	2	REVERSE DUCT PIVOT PIN	104609
								3	3		104610	2	SHOULDERED BUSH (acetal)	104610
								3	4		104611	2	(WASHER) SPECIAL THRUST WASHER	104611
								4	5		104633	1	CYLINDER PIN	104633
								2	6		104634	2	ANODE	104634
A								4	7		104653	1	ROD END	104653
A								3	8		104654	1	ROD END BUSH	104654
		C						3	9		111013	2	BUSH for REVERSE CYLINDER PIN	111013
A								4	10		104772	1	BACK HEAD	104772
A								4	11		104872	1	SHAFT ASSEMBLY	104872
A								4	12		104876	1	CONNECTOR	104876
A								4	13		105133	1	CONNECTOR END PLUG	105133
A								2	14		105447	1	ANODE	105447
A								4	15		105798	1	FRONTHEAD RETAINER (For stst shaft)	105798
A								2	16		105927	1	ANTI ROTATION PIN	105927
A								4	17		106254	2	HEMISPHERICAL SEAT	106254
		C						4	18		111019	1	REVERSE DUCT HJ291	111019
A								4	19		108987	1	FRONTHEAD	108987
A	B							4	20		108988	1	CYLINDER	108988
A	B							2	21		HMHRAAS	1	(O RINGS) IMPERIAL 0.13"x1.0"x1-1/4" (214N70)	N/A
A	B							4	22		HMHRAES	1	(O RINGS) IMPERIAL 0.10"x1.55"x1.75" (129N70)	N/A
A	B							2	23		HMHRXAS	1	(O RINGS) METRIC 2mmx6mmx10mm (6x2N70)	N/A
								4	24		HUILAAI	1	(SPLIT PINS) ST ST 316 0.13"x1.25"	N/A
A								2	25		HZMSXAH	1	CHEESE HEAD SCREW (NYLON) M4x10	N/A
A	B							2	26		JWKZADD	1	(SEAL) PISTON SEAL-GT 8065-173-HR	N/A
A	B							2	27		JWKZADE	1	(SEAL) ROD GREEN TWEED 6061-173-HR	N/A
A	B							3	28		WAQUBCB	2	NIPPLE 1/4BSPP-1/4BSPP (SA 101 00 404)	N/A
A	B							3	29		WAQUDAB	2	BONDED SEAL 1/4" BSP (400-821-4490-74)	N/A
A	B							2	31		61439	1	(SEAL) ROD WIPER (EPL D00812)	N/A
								4	32		30636	REF	(STUDS) METRIC (316-STST) M6x60	30635
								4	33		30661	4	(STUDS) METRIC (316-STST) M8x51	30647
								4	34		JDQHXAA	REF	(NUTS) (METRIC ST ST 316) M6	N/A
								4	35		JDQHXAC	4	(NUTS) (METRIC ST ST 316) M8	N/A
A								4	36		JDQKXAJ	1	(NUTS) (HALF NUTS) M16 (316 STST)	N/A
								4	37		JEQKXAA	REF	(WASHERS) (SPRING) METRIC ST ST 316 M6	N/A
								4	38		JEQKXAC	4	(WASHERS) (SPRING) METRIC ST ST 316 M8	N/A

REF	NO.	BY	DATE	AMENDMENTS
				SEE SHEET 1 FOR AMMENDMENTS

JET 291

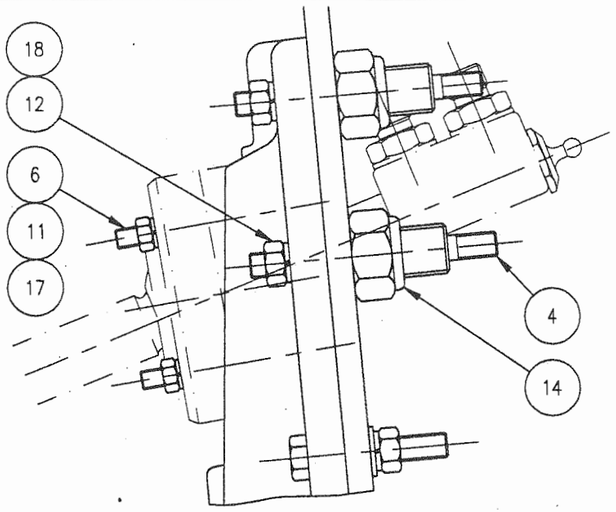
C.W.F.HAMILTON & CO. LTD. CHCH. NZ.

PROJECTION

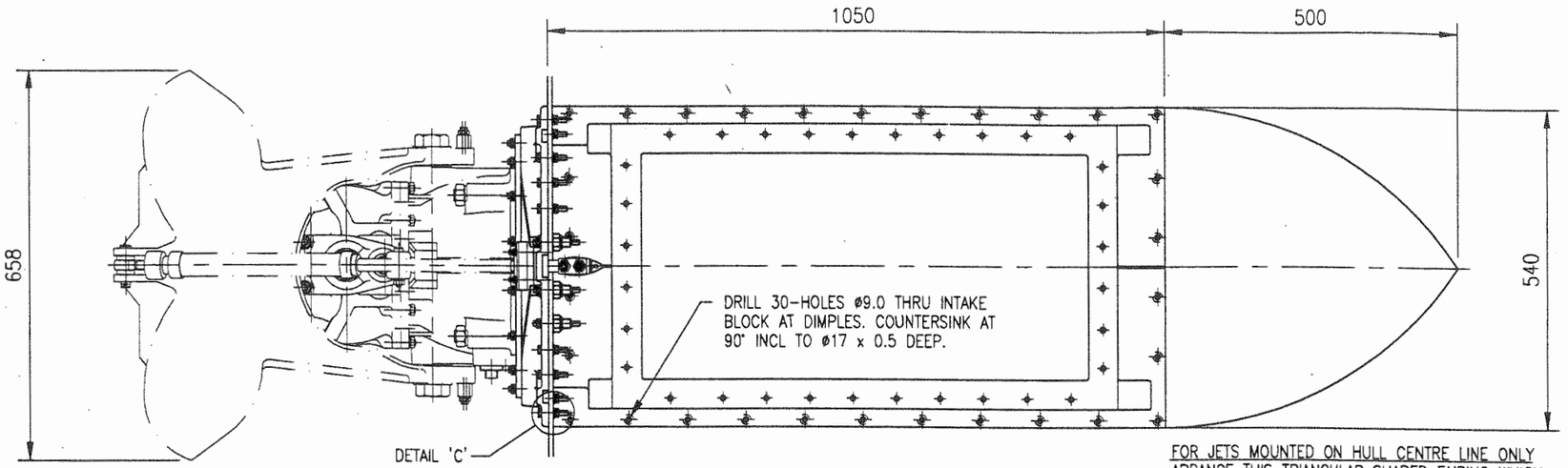
NAME
REVERSE ASSEMBLY
HJ 291 JET
SHEET 2 OF 2 SHEETS

DESIGNED | DATE
DRAWN P.M.W. | 24.6.98
CHECKED
APPROVED

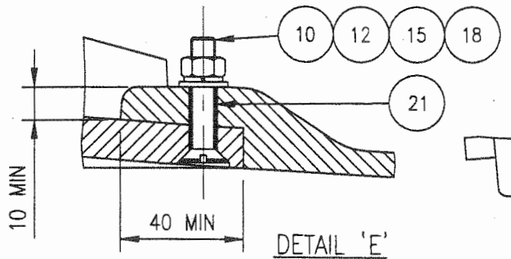
SCALE -
No: ASSY-HJ291 07 001 B



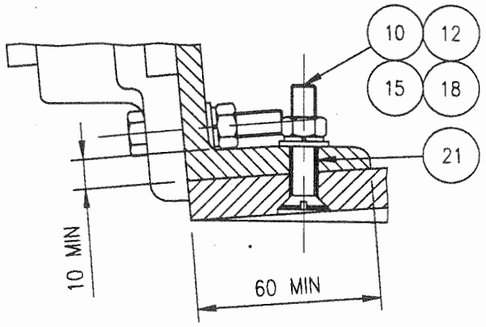
DETAIL 'B'



FOR JETS MOUNTED ON HULL CENTRE LINE ONLY
ARRANGE THIS TRIANGULAR SHAPED FAIRING WHICH BLENDS FROM VEE BOTTOM HULL TO FRONT OF JET INTAKE BLOCK IN A SMOOTHLY CURVED CONTOUR.

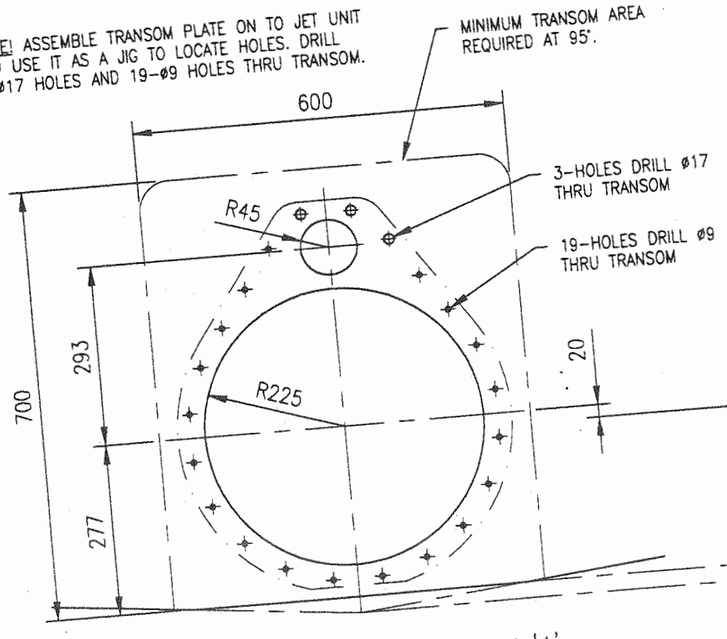


DETAIL 'E'

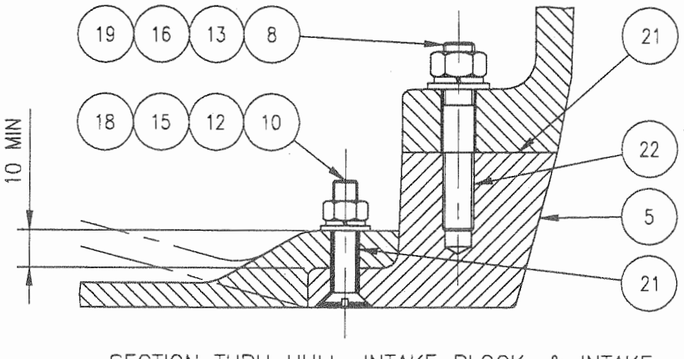


DETAIL 'D'

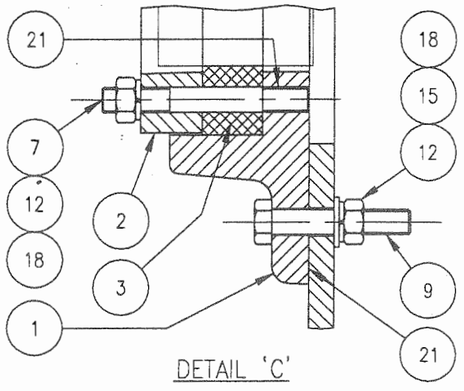
NOTE! ASSEMBLE TRANSOM PLATE ON TO JET UNIT AND USE IT AS A JIG TO LOCATE HOLES. DRILL 3–ø17 HOLES AND 19–ø9 HOLES THRU TRANSOM.



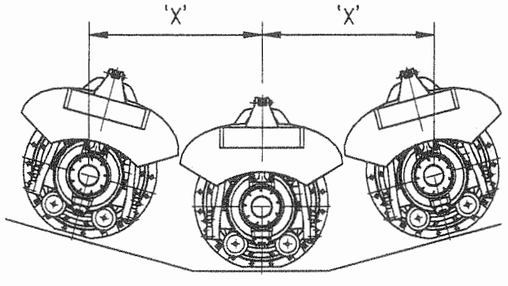
VIEW IN DIRECTION OF ARROW 'A'



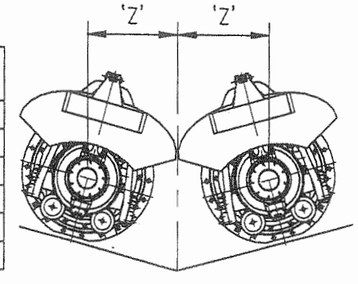
SECTION THRU HULL, INTAKE BLOCK, & INTAKE



DETAIL 'C'



TRIPLE JETS DIM'N 'X'	DEADRISE ANGLE	TWIN JETS DIM'N 'Z'
670	0°	335
680	5°	345
690	10°	355
700	15°	370
700	20°	375
690	25°	380



REF	NO.	BY	DATE	AMENDMENTS
CL73	A	P.S.	3.12.98	ITEM 14 WAS IN KIT D.
CL63	0	PMW	27.7.98	ISSUED FOR PRODUCTION

JET 291

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

PROJECTION

DESIGNED | DATE

DRAWN P.M.W. | 2.7.98

CHECKED

APPROVED K.V.E.

NAME
INSTALLATION DETAILS
G.R.P. HULL
HJ 291 JET
SHEET 1 OF 2 SHEETS

SCALE 1:10

No: ASSY–HJ291 08 001 | A

A	B	C	D	E	F	G	H	Code	Item	Kit	PartNumber	Qty	ProductDescription	DrawingNbr
										A	110695	1	INTAKE BLOCK KIT (GRP HULL)	HJ29108001
										B	110692	1	BOLT KIT (JET UNIT TO INTAKE BLOCK) (ALM, GRP & STEEL HULLS)	HJ29108001
										C	110693	1	TRANSOM PLATE KIT (ALUM & GRP HULL)	HJ29108001
										D	110694	1	TRANSOM BOLT KIT (ALUM & GRP HULL)	HJ29108001
		C						4	1		104262	1	TRANSOM PLATE (ALUM & GRP HULLS)	104262
		C						4	2		104263	1	HEADER RING	104263
		C						4	3		104264	1	TRANSOM SEAL	104264
		C						4	4		104668	3	(STUDS) METRIC (316-STST) SPECIAL	104668
A								4	5		106239	1	INTAKE BLOCK - ALM / GRP / STEEL	106239
		C						4	6		30636	4	(STUDS) METRIC (316-STST) M6x60	30635
		C						4	7		30633	16	(STUDS) METRIC (316-STST) M8x67	30647
	B							4	8		30697	32	(STUDS) METRIC (316-STST) M10x60	30637
			D					4	9		HZQHXBD	19	(SCREWS) (M/C SCREWS) METRIC ST ST 316 HEX HD M8x45	N/A
A								4	10		HZPPXDR	30	(BOLTS) (M/C SCREWS) METRIC STST 316 M8x40 (CSK HD)	N/A
		C						4	11		JDQHXAA	4	(NUTS) (METRIC ST ST 316) M6	N/A
A30		C19	D19					4	12		JDQHXAC	68	(NUTS) (METRIC ST ST 316) M8	N/A
	B							4	13		JDQHXAE	32	(NUTS) (METRIC ST ST 316) M10	N/A
		C						4	14		JDQSXAL	3	(NUTS) (METRIC NYLOC ST ST 316) M16	N/A
A30			D19					4	15		JEOZXAF	49	(WASHERS) (FLAT) METRIC ST ST 316 M8x16x1.2	N/A
	B							4	16		JEOZXAI	32	(WASHERS) (FLAT) METRIC ST ST 316 M10x21x1.2	N/A
		C						4	17		JEQKXAA	4	(WASHERS) (SPRING) METRIC ST ST 316 M6	N/A
A30		C19	D19					4	18		JEQKXAC	68	(WASHERS) (SPRING) METRIC ST ST 316 M8	N/A
	B							4	19		JEQKXAE	32	(WASHERS) (SPRING) METRIC ST ST 316 M10	N/A
		C						4	20		HEIDAAC	1	(GREASE) NIPPLES (HA34) 1/8"BSP 35 DEG	N/A
	B1		D1					4	21		JMNGAAR	2	NEUT-CURE RTV SILICONE 310G	N/A
	B							4	22		MRINAAI	1	LOCTITE 262 10ML BOTTLE	N/A
A1	B1		D1					4	23		63595	3	(JET) PACKAGING BOLT BOX	N/A

REF	NO.	BY	DATE	AMENDMENTS
				SHEET 1 FOR AMMENDMENTS

JET 291

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

PROJECTION

DESIGNED | DATE

DRAWN P.M.W. | 1.7.98

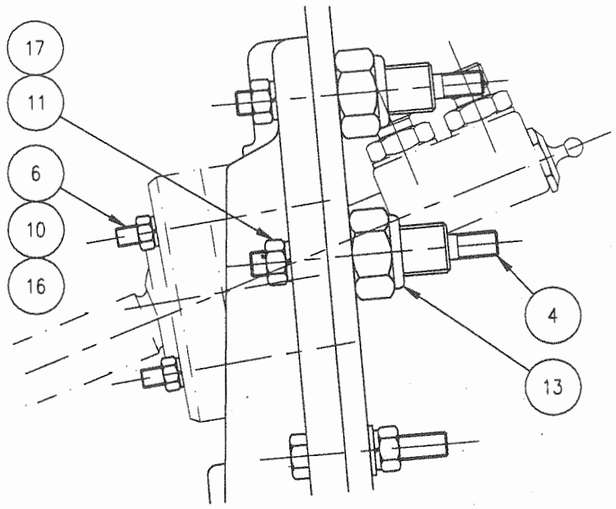
CHECKED

APPROVED K.V.E.

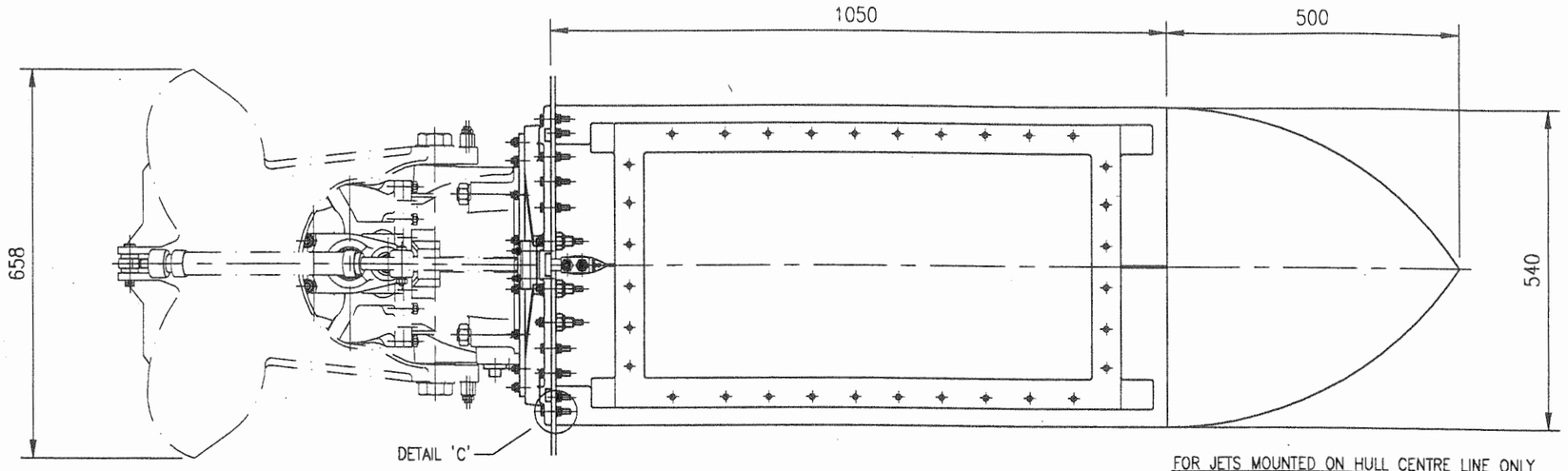
NAME
INSTALLATION DETAILS
G.R.P. HULL
HJ 291 JET
SHEET 2 OF 2 SHEETS

SCALE -

No: ASSY-HJ291 08 001 A

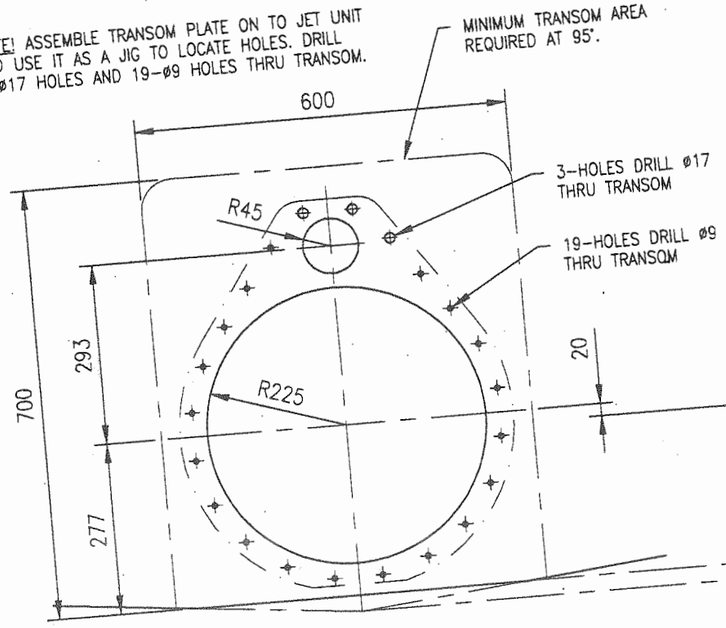


DETAIL 'B'

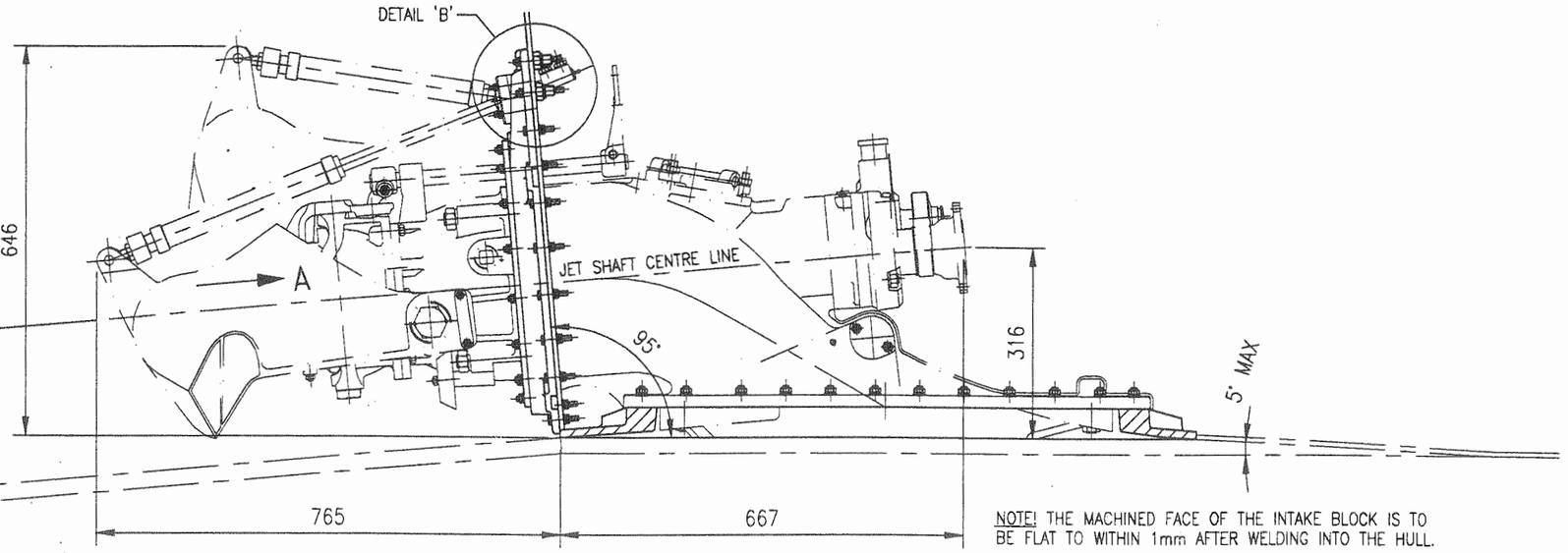


FOR JETS MOUNTED ON HULL CENTRE LINE ONLY
ARRANGE THIS TRIANGULAR SHAPED FAIRING WHICH BLENDS FROM VEE BOTTOM HULL TO FRONT OF JET INTAKE BLOCK IN A SMOOTHLY CURVED CONTOUR.

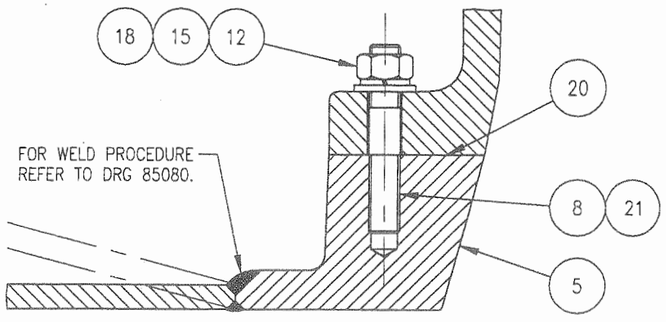
NOTE! ASSEMBLE TRANSOM PLATE ON TO JET UNIT AND USE IT AS A JIG TO LOCATE HOLES. DRILL 3-ø17 HOLES AND 19-ø9 HOLES THRU TRANSOM.



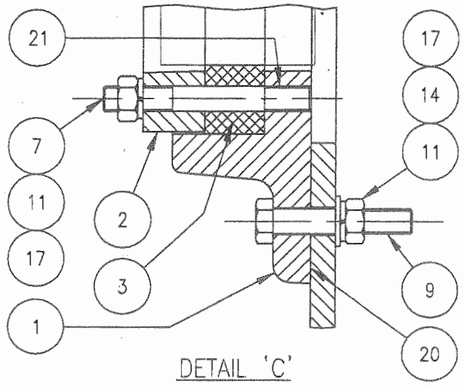
VIEW IN DIRECTION OF ARROW 'A'



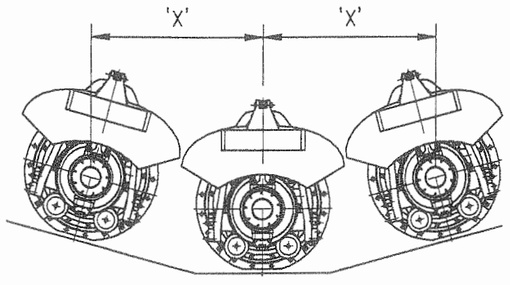
NOTE! THE MACHINED FACE OF THE INTAKE BLOCK IS TO BE FLAT TO WITHIN 1mm AFTER WELDING INTO THE HULL.



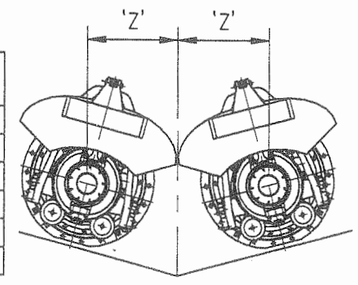
SECTION THRU HULL, INTAKE BLOCK, & INTAKE



DETAIL 'C'



TRIPLE JETS DIM'N 'X'	DEADRISE ANGLE	TWIN JETS DIM'N 'Z'
670	0°	335
680	5°	345
690	10°	355
700	15°	370
700	20°	375
690	25°	380



CL73	A	P.S.	3.12.98	ITEM 14 WAS IN KIT D.
CL63	0	PMW	27.7.98	ISSUED FOR PRODUCTION
REF	NO.	BY	DATE	AMENDMENTS

JET 291

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

PROJECTION

DESIGNED | DATE

DRAWN P.N.W. | 29.6.98

CHECKED

APPROVED K.V.E.

NAME
INSTALLATION DETAILS
ALUMINIUM HULL
HJ 291 JET
SHEET 1 OF 2 SHEETS

SCALE 1:10

No: ASSY-HJ291 08 002 | A

A	B	C	D	Code	Item	Kit	PartNumber	Qty	ProductDescription	DrawingNbr
						A	106239		INTAKE BLOCK - ALM / GRP / STEEL	106239
						B	110692		BOLT KIT (JET UNIT TO INTAKE BLOCK) (ALM, GRP & STEEL HULLS)	HJ29108001
						C	110693		TRANSOM PLATE KIT (ALUM & GRP HULL)	HJ29108001
						D	110694		TRANSOM BOLT KIT (ALUM & GRP HULL)	HJ29108001
		C		4	1		104262	1	TRANSOM PLATE (ALUM & GRP HULLS)	104262
		C		4	2		104263	1	HEADER RING	104263
		C		4	3		104264	1	TRANSOM SEAL	104264
		C		4	4		104668	3	(STUDS) METRIC (316-STST) SPECIAL	104668
A				4	5		106239	1	INTAKE BLOCK - ALM / GRP / STEEL	106239
		C		4	6		30636	4	(STUDS) METRIC (316-STST) M6x60	30635
		C		4	7		30633	16	(STUDS) METRIC (316-STST) M8x67	30647
	B			4	8		30697	32	(STUDS) METRIC (316-STST) M10x60	30637
			D	4	9		HZQHXBD	19	(SCREWS) (M/C SCREWS) METRIC ST ST 316 HEX HD M8x45	N/A
		C		4	10		JDQHXAA	4	(NUTS) (METRIC ST ST 316) M6	N/A
		C19	D19	4	11		JDQHXAC	38	(NUTS) (METRIC ST ST 316) M8	N/A
	B			4	12		JDQHXAE	32	(NUTS) (METRIC ST ST 316) M10	N/A
			D	4	13		JDQSXAL	3	(NUTS) (METRIC NYLOC ST ST 316) M16	N/A
		C		4	14		JEOZXAF	19	(WASHERS) (FLAT) METRIC ST ST 316 M8x16x1.2	N/A
	B			4	15		JEOZXAI	32	(WASHERS) (FLAT) METRIC ST ST 316 M10x21x1.2	N/A
		C		4	16		JEQKXAA	4	(WASHERS) (SPRING) METRIC ST ST 316 M6	N/A
		C19	D19	4	17		JEQKXAC	38	(WASHERS) (SPRING) METRIC ST ST 316 M8	N/A
	B			4	18		JEQKXAE	32	(WASHERS) (SPRING) METRIC ST ST 316 M10	N/A
		C		4	19		HEIDAAC	1	(GREASE) NIPPLES (HA34) 1/8"BSP 35 DEG	N/A
	B1		D1	4	20		JMNGAAR	2	NEUT-CURE RTV SILICONE 310G	N/A
	B			4	21		MRINAAI	1	LOCTITE 262 10ML BOTTLE	N/A
	B1		D1	4	22		63595	2	(JET) PACKAGING BOLT BOX	N/A

SEE SHEET 1 FOR AMMENDMENTS

REF	NO.	BY	DATE	AMENDMENTS
JET 291				

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

PROJECTION

DESIGNED | DATE

DRAWN P.M.W. | 01.7.98

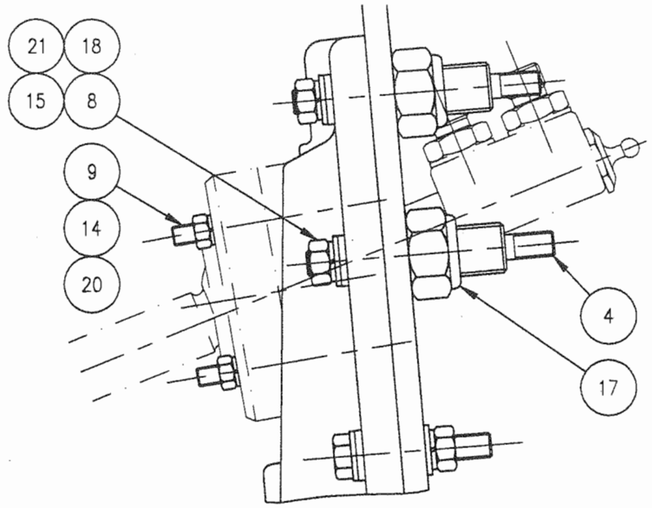
CHECKED

APPROVED K.V.E.

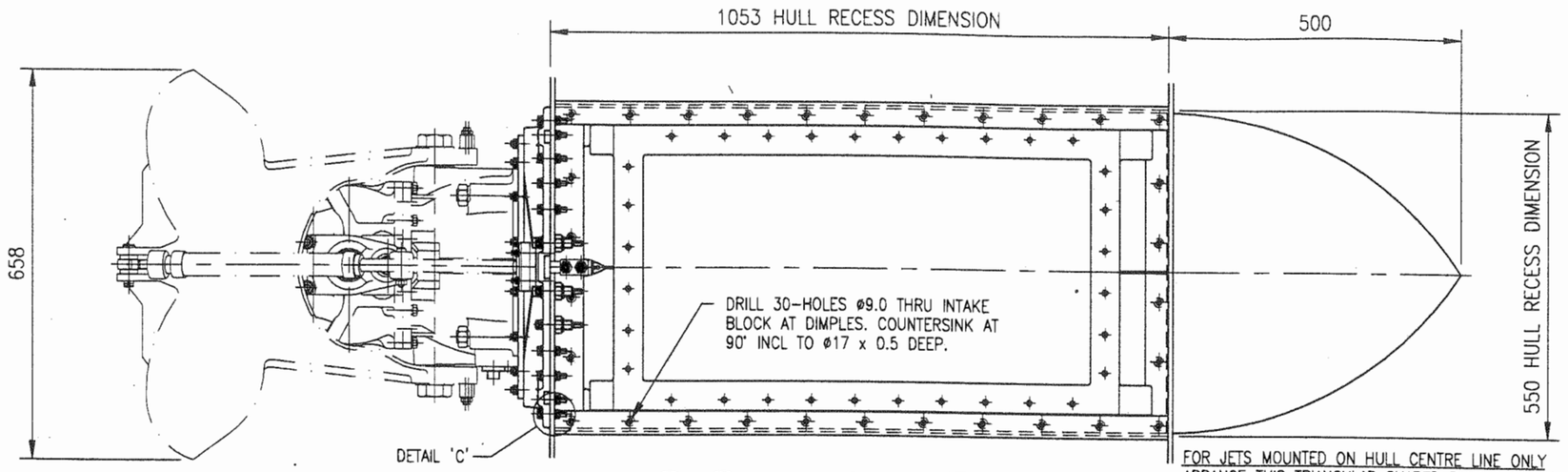
NAME
INSTALLATION DETAILS
ALUMINIUM HULL
HJ 291 JET
SHEET 2 OF 2 SHEETS

SCALE -

No: ASSY-HJ291 08 002 | A

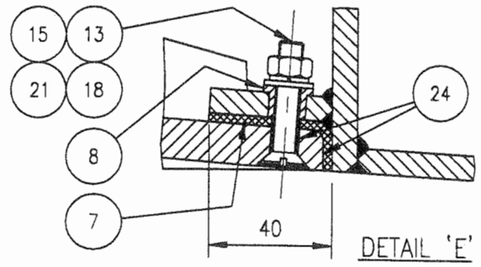


DETAIL 'B'

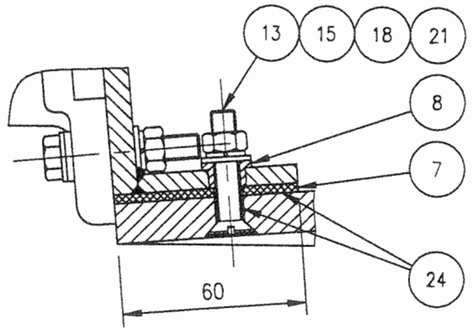


FOR JETS MOUNTED ON HULL CENTRE LINE ONLY
ARRANGE THIS TRIANGULAR SHAPED FAIRING WHICH BLENDS FROM VEE BOTTOM HULL TO FRONT OF JET INTAKE BLOCK IN A SMOOTHLY CURVED CONTOUR.

SET THE INTAKE BLOCK INTO THE HULL RECESS WITH 3mm MIMIMUM GAP AT EDGES. DRILL THRU 'DIMPLES' IN THE INTAKE BLOCK TO LOCATE THE HOLES IN THE HULL RECESS. REMOVE THE INTAKE BLOCK AND ENLARGE THE HOLES IN THE HULL RECESS TO 12mm DIA TO SUIT THE INSULATING BUSHES ITEM 8. TRIM THE INSULATING BUSHES TO LENGTH AFTER FITTING THEM TO THE HULL RECESS.

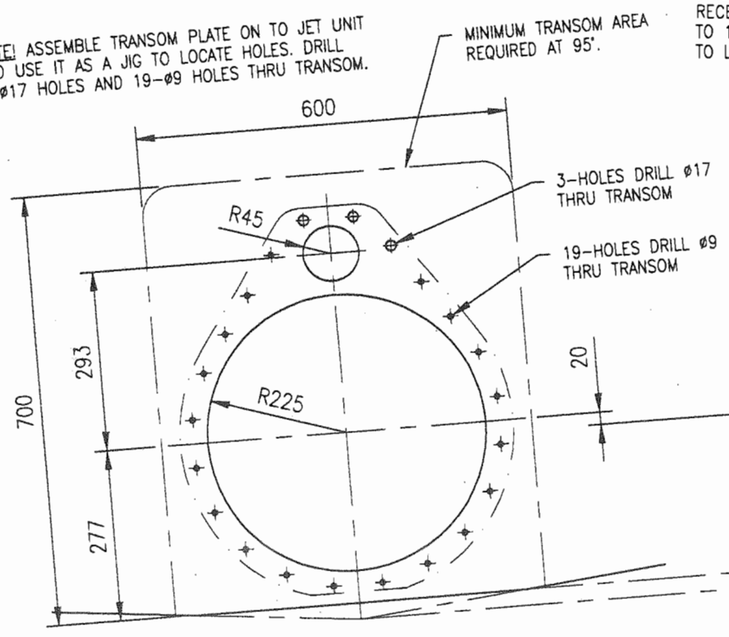


DETAIL 'E'



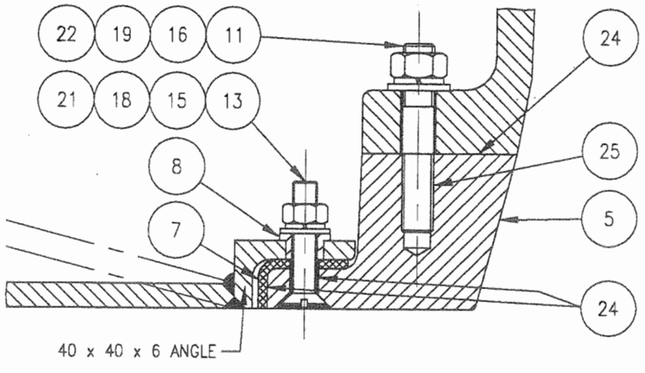
DETAIL 'D'

NOTE: ASSEMBLE TRANSOM PLATE ON TO JET UNIT AND USE IT AS A JIG TO LOCATE HOLES. DRILL 3-ø17 HOLES AND 19-ø9 HOLES THRU TRANSOM.

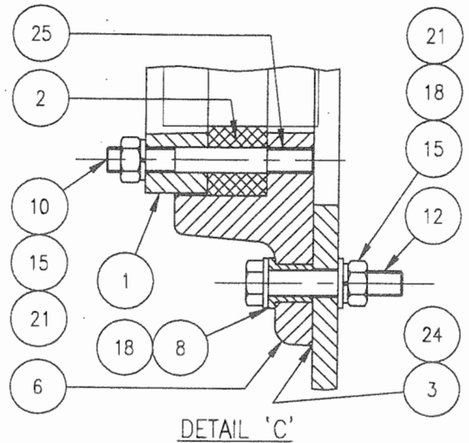


VIEW IN DIRECTION OF ARROW 'A'

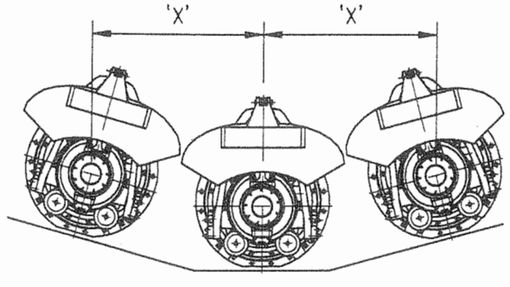
NOTE: THE FIXING OF THE INTAKE BLOCK AND THE CROSSMEMBER TO THE HULL, AND THE STRENGTH OF THE TRANSOM, MUST BE SUFFICIENT TO CARRY THE LOADS IMPOSED BY THE JET UNIT ON THE HULL. REFER TO THE MANUAL FOR JET LOADS.



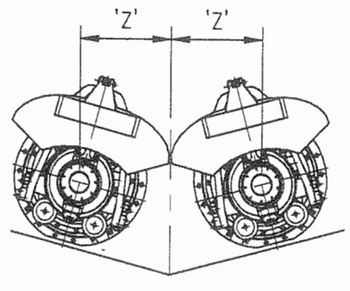
SECTION THRU HULL, INTAKE BLOCK, & INTAKE



DETAIL 'C'



TRIPLE JETS DIM'N 'X'	DEADRISE ANGLE	TWIN JETS DIM'N 'Z'
670	0°	335
680	5°	345
690	10°	355
700	15°	370
700	20°	375
690	25°	380



REF	NO.	BY	DATE	AMENDMENTS
CL73	A	P.S.	[illegible]	ITEM 17 WAS IN KIT D.
CL63	0	PMW	27.7.98	ISSUED FOR PRODUCTION

JET 291

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

PROJECTION

NAME
INSTALLATION DETAILS
STEEL HULL
HJ 291 JET
SHEET 1 OF 2 SHEETS

DESIGNED | DATE
DRAWN P.M.W. | 2.7.98
CHECKED
APPROVED K.V.E.

SCALE 1:10 | No: ASSY-HJ291 08 003 | A

A	B	C	D	Code	Item	Kit	PartNumber	Qty	ProductDescription	DrawingNbr
						A	110697		INTAKE BLOCK KIT (STEEL HULL)	HJ29108003
						B	110692		BOLT KIT (JET UNIT TO INTAKE BLOCK) (ALM, GRP & STEEL HULLS)	HJ29108001
						C	110698		TRANSOM PLATE KIT (STEEL HULL)	HJ29108003
						D	110699		TRANSOM BOLT KIT (STEEL HULL)	HJ29108003
		C		4	1		104263	1	HEADER RING	104263
		C		4	2		104264	1	TRANSOM SEAL	104264
			D	4	3		104598	1	TRANSOM PLATE GASKET (STEEL HULL)	104598
		C		4	4		104668	3	(STUDS) METRIC (316-STST) SPECIAL	104668
A				4	5		106239	1	INTAKE BLOCK - ALM / GRP / STEEL	106239
		C		4	6		110696	1	TRANSOM PLATE (steel hull)	104262
A				4	7		110700	1	INTAKE BLOCK GASKET (STEEL HULL)	110700
A30		C22		4	8		KHACXAF	52	(BUSHES) NYLON FLANGED GS NYLATRON S48M	N/A
		C		4	9		30636	4	(STUDS) METRIC (316-STST) M6x60	30635
		C		4	10		30633	16	(STUDS) METRIC (316-STST) M8x67	30647
	B			4	11		30697	32	(STUDS) METRIC (316-STST) M10x60	30637
			D	4	12		HZQHXBD	19	(SCREWS) (M/C SCREWS) METRIC ST ST 316 HEX HD M8x45	N/A
A				4	13		HZPPXDR	30	(BOLTS) (M/C SCREWS) METRIC STST 316 M8x40 (CSK HD)	N/A
		C		4	14		JDQHXAA	4	(NUTS) (METRIC ST ST 316) M6	N/A
A30		C19	D19	4	15		JDQHXAC	68	(NUTS) (METRIC ST ST 316) M8	N/A
	B			4	16		JDQHXAE	32	(NUTS) (METRIC ST ST 316) M10	N/A
		C		4	17		JDQSXAL	3	(NUTS) (METRIC NYLOC ST ST 316) M16	N/A
A30			D41	4	18		JEOZXAF	71	(WASHERS) (FLAT) METRIC ST ST 316 M8x16x1.2	N/A
	B			4	19		JEOZXAI	32	(WASHERS) (FLAT) METRIC ST ST 316 M10x21x1.2	N/A
		C		4	20		JEQKXAA	4	(WASHERS) (SPRING) METRIC ST ST 316 M6	N/A
A30		C19	D19	4	21		JEQKXAC	68	(WASHERS) (SPRING) METRIC ST ST 316 M8	N/A
	B			4	22		JEQKXAE	32	(WASHERS) (SPRING) METRIC ST ST 316 M10	N/A
		C		4	23		HEIDAAC	1	(GREASE) NIPPLES (HA34) 1/8"BSP 35 DEG	N/A
	B1		D1	4	24		JMNGAAR	2	NEUT-CURE RTV SILICONE 310G	N/A
	B			4	25		MRINAAI	1	LOCTITE 262 10ML BOTTLE	N/A
A1	B1		D1	4	26		63595	3	(JET) PACKAGING BOLT BOX	N/A

SHEET 1 FOR AMMENDMENTS

REF	NO.	BY	DATE	AMENDMENTS
JET	291			

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

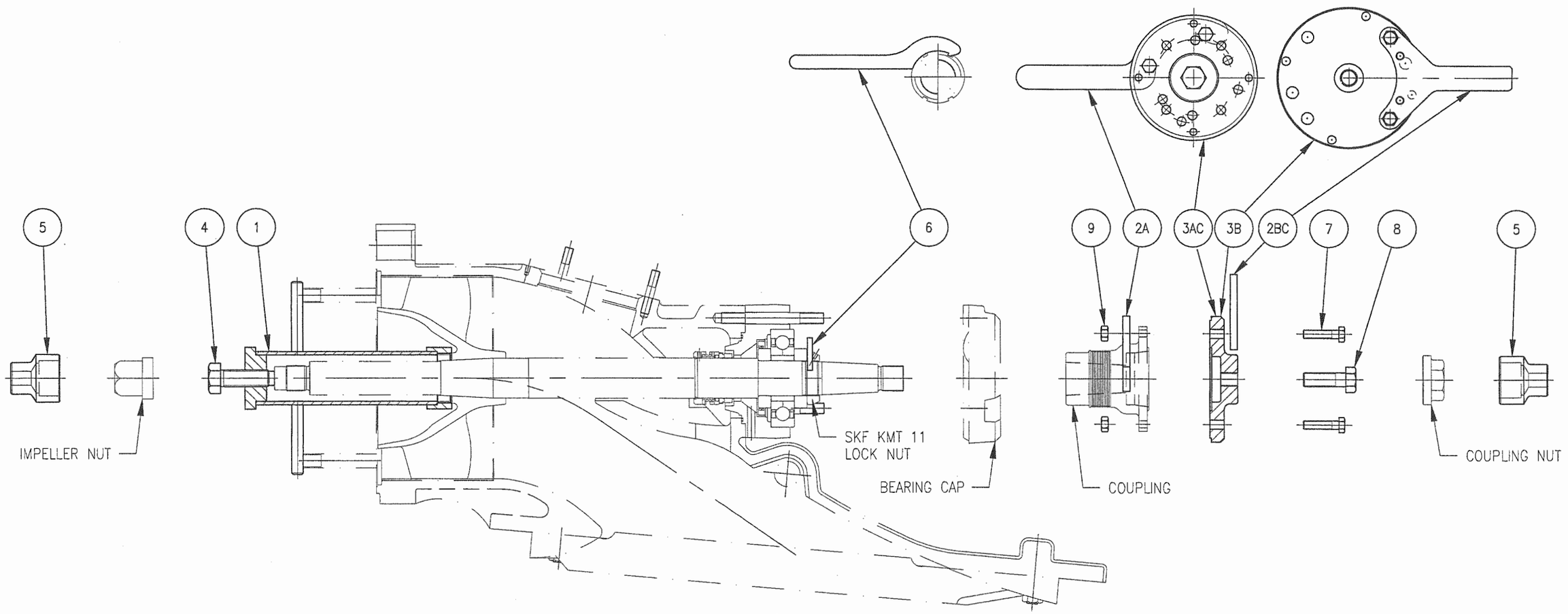
PROJECTION

NAME
INSTALLATION DETAILS
STEEL HULL
HJ 291 JET
SHEET 2 OF 2 SHEETS

DESIGNED	DATE
DRAWN P.M.W.	2.7.98
CHECKED	
APPROVED K.V.E.	

SCALE -

No: ASSY-HJ291 08 003 A



A	B	C	Item	Kit	PartNumber	Qty	ProductDescription	DrawingNbr
				A	104752		TOOL KIT (H.S.1600,ELBE115,G.W.B.,AQUADRIVE 20300)	HJ29111000
				B	111007		TOOL KIT (AQUADRIVE 20600)	HJ29111000
				C	111028		TOOL KIT (AQUADRIVE 20400)	HJ29111000
A	B	C	1		104689	1	IMPELLER PULLER	104689
	B	C	2		110795	1	TORQUE ARM (AQUADRIVE 20600 & 20400))	110795
A			2		104917	1	TORQUE ARM (H.S.1600,ELBE115,G.W.B.,AQUADRIVE 20300)	104917
	B		3		106079	1	COUPLING PULLER (HARDY SPICER 1800 & AQUADRIVE 20600)	106079
A		C	3		104918	1	COUPLING PULLER (H.S.1600,ELBE115,G.W.B.,AQUADRIVE 20400 & 20300)	104918
A	B	C	4		104937	1	FORCING SCREW M24	104937
A	B	C	5		JMNGAAP	1	(SOCKETS) TOOLS A/F 50mm 3/4" SQ. DRIVE (SOCKET)	N/A
A	B	C	6		JNODAEY	1	(SKF) SPANNERS HN10	N/A
A			7		HYIUPBL	4	(BOLTS) (IMPERIAL) MILD STEEL 3/8"UNCx2.0" HT (ZP)	N/A
A			7		JDKBPAE	4	(NUTS) (IMPERIAL MILD STEEL) (ZP) 3/8"UNC	N/A
	B		7		HYQHXIO	4	(BOLTS) (METRIC) ST ST 316 M16x60	N/A
A		C	7		HYIXYCX	4	(BOLTS) (METRIC) MILD STEEL H/TENSILE GR88 (ZP) M12x50	N/A
A	B	C	8		HYIXYFD	1	(BOLTS) (METRIC) MILD STEEL H/TENSILE GR88 (ZP) M20x60	N/A
A			9		JDPVYAH	4	(NUTS) (METRIC MILD STEEL) M12 (GR88) (ZP)	N/A
A	B	C	10		63594	1	(JET) PACKAGING CARTON	N/A

	A	P.S.	27/4/99	111028 & 111007 ADDED.
CL60	0	PMW	27.7.98	ISSUED FOR PRODUCTION
REF	NO.	BY	DATE	AMENDMENTS

JET 291

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

PROJECTION

NAME: TOOLKITS HJ 291 JET

DESIGNED | DATE

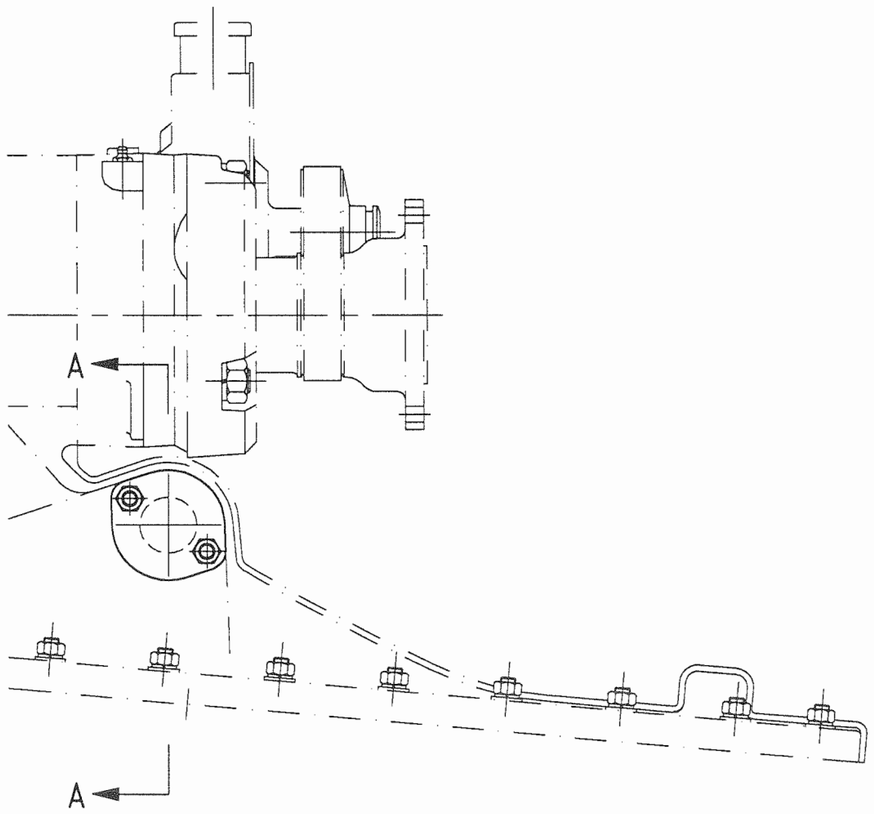
DRAWN P.M.W. | 8.7.98

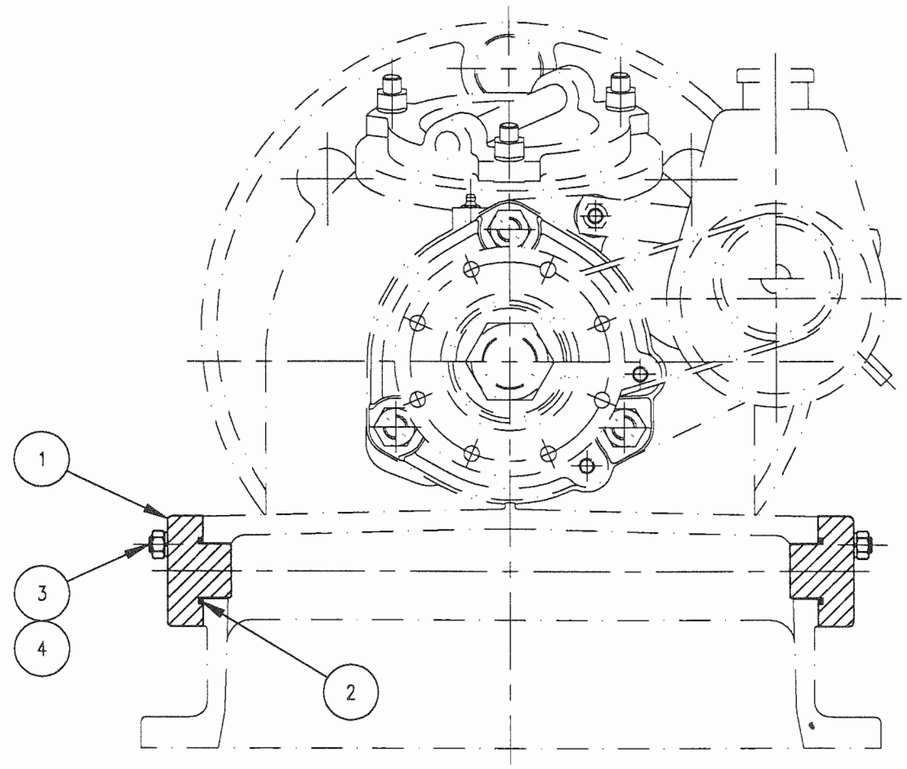
CHECKED

APPROVED K.V.E.

SCALE 1:6

No: ASSY-HJ291 11 000 A





SECTION A–A

A	B	C	D	Code	Item	Part Nbr	Qty	ProductDescription	Drawing Nbr
				4	1	105921	2	BLANKING PLUG	105921
				4	2	HMHRAAW	2	(O RINGS) IMPERIAL 0.13x1.44x1.69 (221N70)	N/A
				4	3	JDQHXAE	4	(NUTS) (METRIC ST ST 316) M10	N/A
				4	4	JEQKXAE	4	(WASHERS) (SPRING) METRIC ST ST 316 M10	N/A

REF	NO.	BY	DATE	AMENDMENTS
CL60	0	PMW	27.7.98	UPDATED
JET 291				

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

PROJECTION

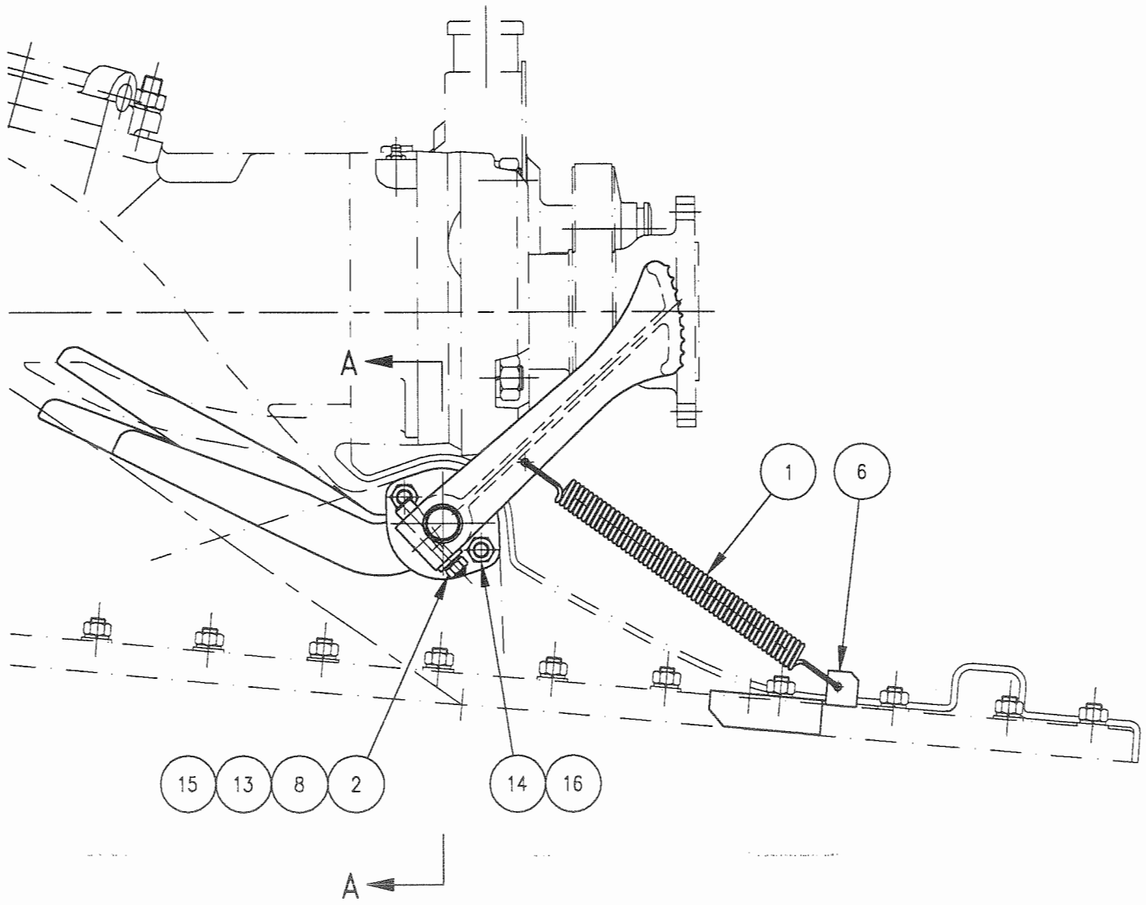
NAME
SCREEN RAKE
BLANKING PLUGS
HJ 291 JET

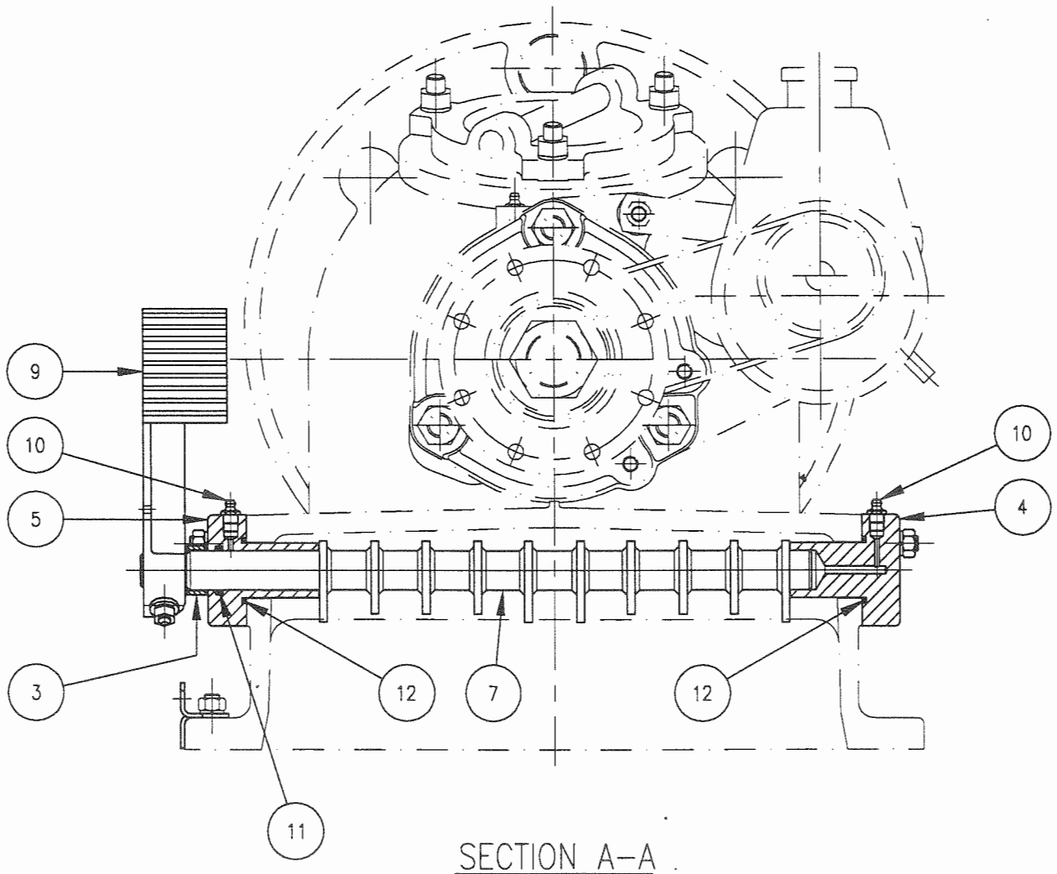
DESIGNED
DRAWN P.M.W. 26.6.98
CHECKED
APPROVED K.V.E.
DATE

SCALE 1:4

No: ASSY-HJ291 09 001 0

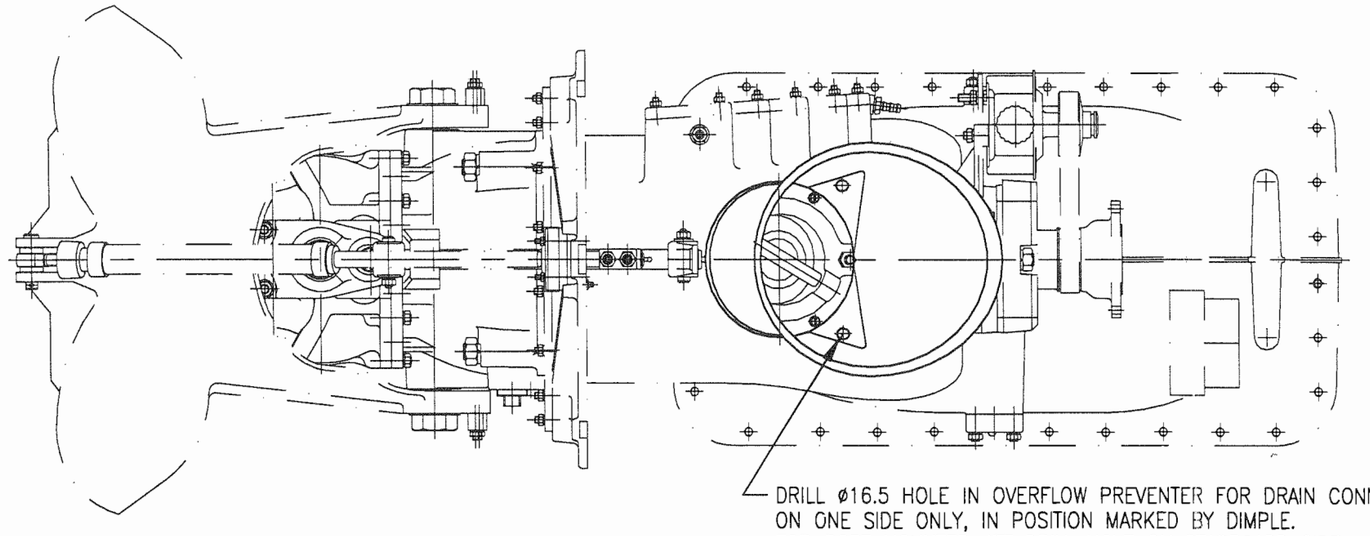
A	B	C	D	Code	Item	Part Nbr	Qty	ProductDescription	Drawing Nbr
				1	1	102364	1	TENSION SPRING 316 STST	102364
				4	2	103637	1	(JET) WASHERS SPECIAL 8mm (AB2)	103637
				4	3	104647	1	SPACER	104647
				4	4	105130	1	BEARING PORT	105130
				4	5	105131	1	BEARING STBD	105131
				4	6	105359	1	SPRING ANCHOR BRACKET	105359
				4	7	105372	1	SCREEN RAKE ASSEMBLY	105372
				4	8	105931	1	COTTER PIN	105931
				4	9	106274	1	RAKE ACTUATOR	106274
				4	10	HEIDAAA	1	(GREASE) NIPPLES (H29) 1/8"BSP	N/A
				4	11	HMHRAAS	1	(O RINGS) IMPERIAL 0.13"x1.0"x1-1/4" (214N70)	N/A
				2	12	HMHRAAW	2	(O RINGS) IMPERIAL 0.13x1.44x1.69 (221N70)	N/A
				4	13	JDQHXAC	1	(NUTS) (METRIC ST ST 316) M8	N/A
				4	14	JDQHXAE	4	(NUTS) (METRIC ST ST 316) M10	N/A
				4	15	JEQKXAC	1	(WASHERS) (SPRING) METRIC ST ST 316 M8	N/A
				4	16	JEQKXAE	4	(WASHERS) (SPRING) METRIC ST ST 316 M10	N/A



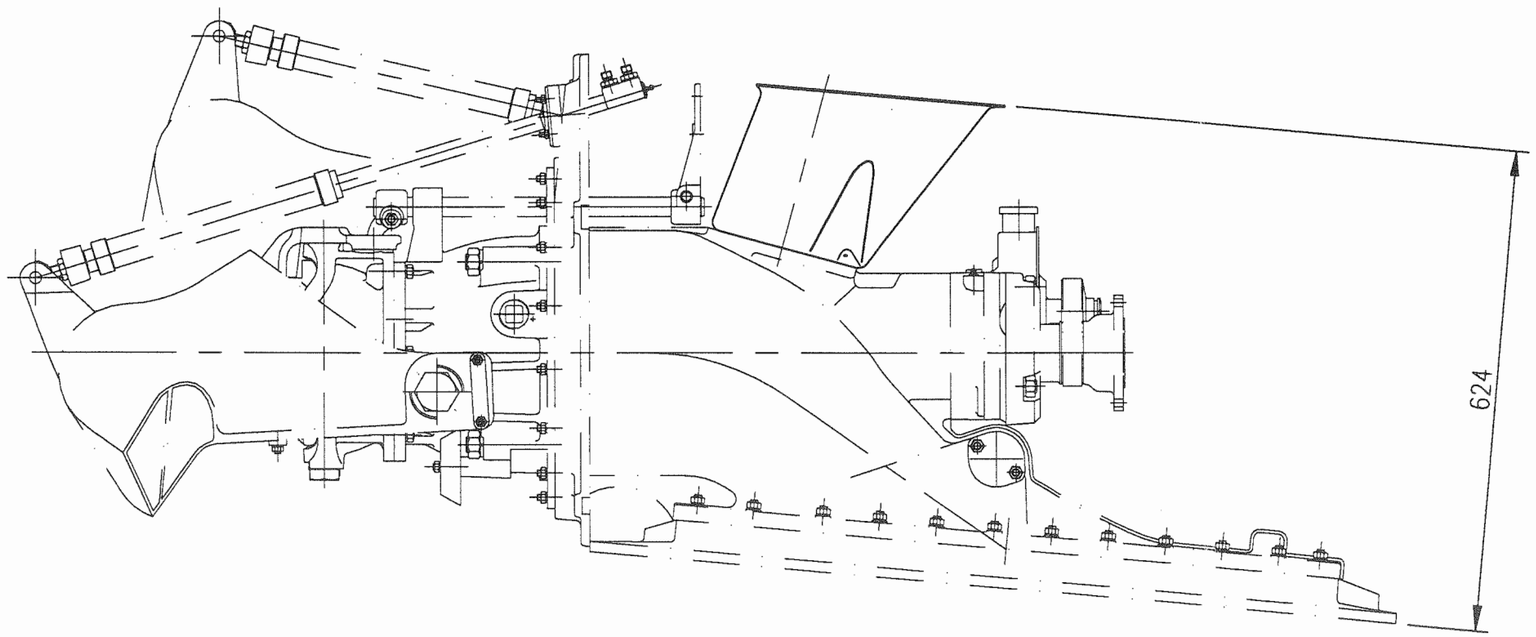


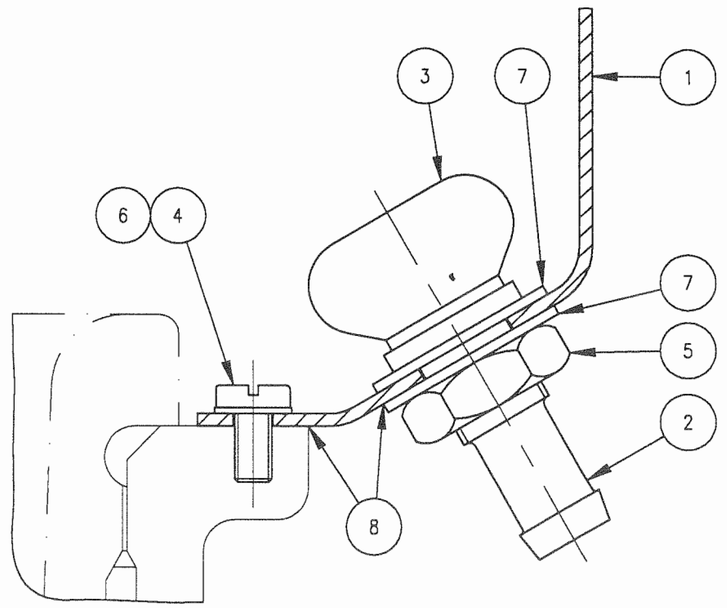
SECTION A–A

					C.W.F.HAMILTON & CO. LTD. CHCH. NZ.		
					PROJECTION	NAME	SCREEN RAKE ASSEMBLY HJ 291 JET
					DESIGNED	DATE	
CL60	0	PMW	27.7.98	ISSUED FOR PRODUCTION	DRAWN P.M.W.	29.6.98	
REF	NO.	BY	DATE	AMENDMENTS	CHECKED		
JET 291					APPROVED K.V.E.	SCALE 1:4	No: ASSY-HJ291 09 002 0



DRILL ø16.5 HOLE IN OVERFLOW PREVENTER FOR DRAIN CONNECTION,
ON ONE SIDE ONLY, IN POSITION MARKED BY DIMPLE.
FOR PORT MOUNTED JET DRILL HOLE ON STARBOARD SIDE.
FOR STARBOARD MOUNTED JET DRILL HOLE ON PORT SIDE.
FOR CENTRE MOUNTED JET DRILL HOLE ON PORT OR STARBOARD SIDE TO SUIT
INSTALLATION. A 1/2" I.D. HOSE MAY BE ATTACHED TO CARRY WATER TO BILGE.





DETAIL OF DRAIN CONNECTION

A	B	C	D	Code	Item	Part Nbr	Qty	ProductDescription	Drawing Nbr
				3	1	107221	1	OVERFLOW PREVENTER	107221
				3	2	107298	1	DRAIN CONNECTOR	107298
				2	3	63825	1	DRAIN BUNG-NATRA	N/A
				3	4	30728	4	(BOLTS) (M/C SCREWS) METRIC STST 316 M6x12 (PAN HD)	N/A
				3	5	JDQKXAJ	1	(NUTS) (HALF NUTS) M16 (316 STST)	N/A
				3	6	JEOZXAD	4	(WASHERS) (FLAT) METRIC ST ST 316 M6x12.5x1.0	N/A
				3	7	JEOZXAM	2	(WASHERS) (FLAT) METRIC ST ST 316 M16	N/A
				2	8	JMNGAAS	1	NEUT-CURE RTV SILICONE 75G	N/A

REF	NO.	BY	DATE	AMENDMENTS
CL60	0	PMW	27.7.98	ISSUED FOR PRODUCTION

JET 291

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

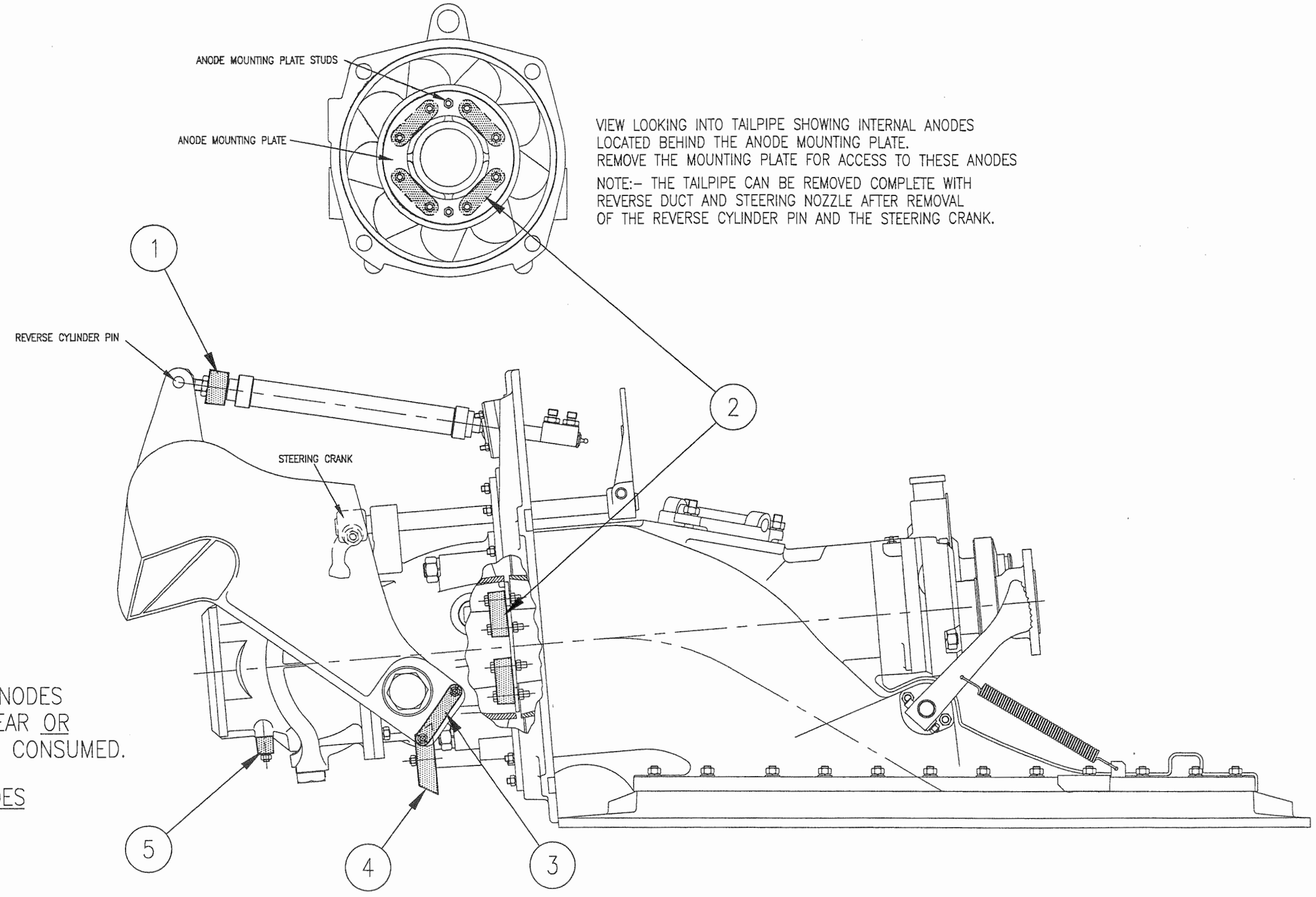
PROJECTION

NAME
OVERFLOW PREVENTER
HJ 291 JET
GRP TYPE

DESIGNED	DATE
DRAWN P.M.W.	7.7.98
CHECKED	
APPROVED	

SCALE 1:8

No: ASSY-HJ291 10 001 0



VIEW LOOKING INTO TAILPIPE SHOWING INTERNAL ANODES
LOCATED BEHIND THE ANODE MOUNTING PLATE.
REMOVE THE MOUNTING PLATE FOR ACCESS TO THESE ANODES

NOTE:– THE TAILPIPE CAN BE REMOVED COMPLETE WITH
REVERSE DUCT AND STEERING NOZZLE AFTER REMOVAL
OF THE REVERSE CYLINDER PIN AND THE STEERING CRANK.

EXTERNAL ANODES
MONITOR CONDITION OF ANODES
AND REPLACE AFTER 1 YEAR OR
WHEN THE ANODE IS 1/2 CONSUMED.

INTERNAL (TAILPIPE) ANODES
REPLACE AFTER 1 YEAR.

ITEM	PART NO	QTY	DESCRIPTION	DRG NO CWF H USE ONLY
1	105447	1	ANODE:– REVERSE CYLINDER.	105447
2	103359	4	ANODE:– TAILPIPE (INTERNAL)	103359
3	104634	2	ANODE:– REVERSE DUCT	104634
4	102185	2	ANODE:– TAILPIPE (EXTERNAL)	102185
5	103359	1	ANODE:– NOZZLE	103359

REF	NO.	BY	DATE	AMENDMENTS
	0	P.S.	29/4/99	

JET 291

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

PROJECTION

NAME
ANODE LOCATION
HJ291

		DATE
DESIGNED	P.A.S.	29/4/99
DRAWN	P.A.S.	29/4/99
CHECKED		
APPROVED		

SCALE –

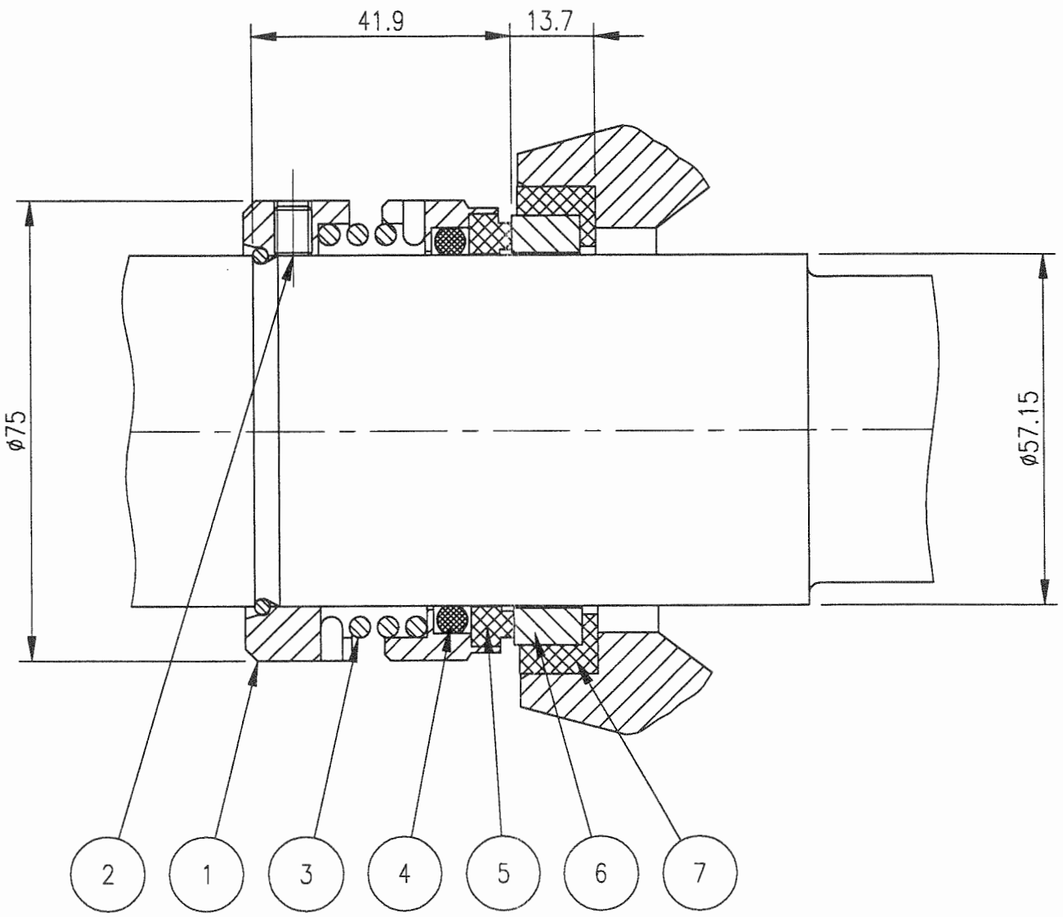
No: ASSY–HJ291 13 002 0

DO NOT SCALE THIS DRAWING

REMOVE ALL SHARP CORNERS

ALL DIMENSIONS IN mm. UNLESS OTHERWISE SHOWN

PROJECTION



ITEM	DESCRIPTION
1	DRIVE COLLAR
2	M6 x 8 SET SCREW
3	SPRING
4	'O' RING
5	SEAL RING
6	INSERT
7	INSERT BOOT

DURAMETALLIC B/M No: 163200.

REF	NO.	BY	DATE	AMENDMENTS
CL60	A	PMW	27.7.98	REDRAWN ON CAD
CL3761	A	PS	16.9.96	ISSUED FOR PRODUCTION.

JET 291

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

MATERIAL: SEE ABOVE

√ = N9 EXCEPT AS STATED

UNLIMITED DIMENSIONS TO BE ± 0.5

MAT'L CERT

DESIGNED: DURAMETALLIC DATE: 3.9.91

DRAWN: P.A.S. 3.9.91

CHECKED

APPROVED: K.V.E.

NAME: ROTARY SEAL 2.25" DIAMETER SHAFT HJ 291 JET

SCALE: 1:1

No: A3-61502 A

61502 A

63974 | 0

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.

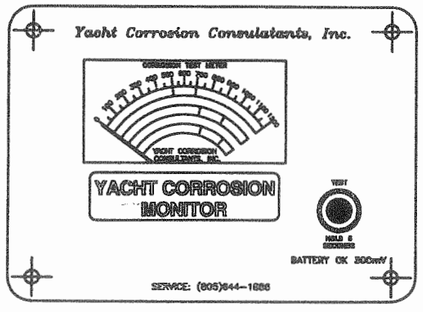
Rember
All bonding connections should be visually inspected and sealed, and checked at least twice a year with a portable corrosion test meter to assure continous protection.

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.

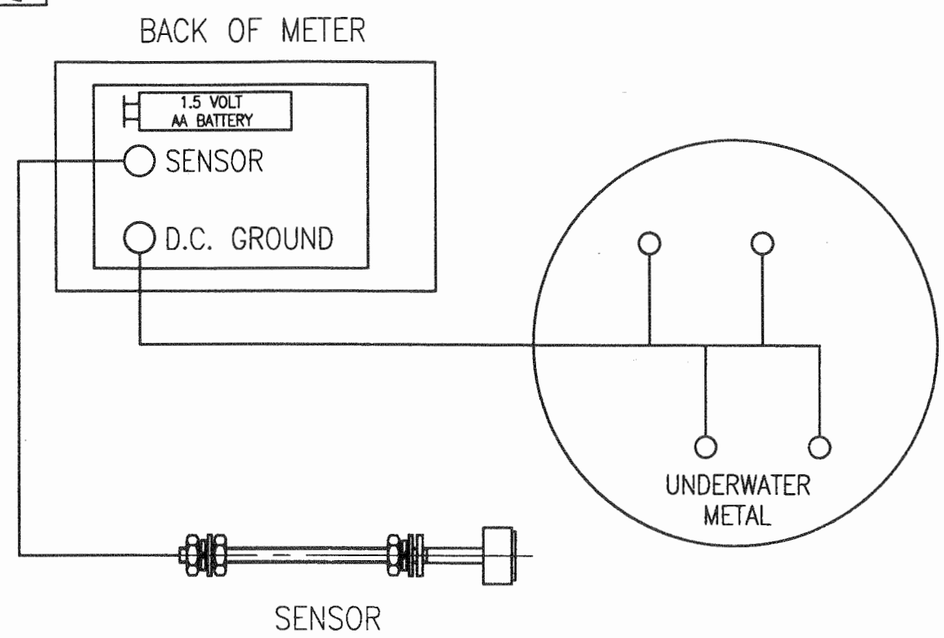
Underwater growth can affect meter readings. Clean underwater surface of sensor at least 4 times a year. Rapid de–activation of meter indicates a fouled sensor.



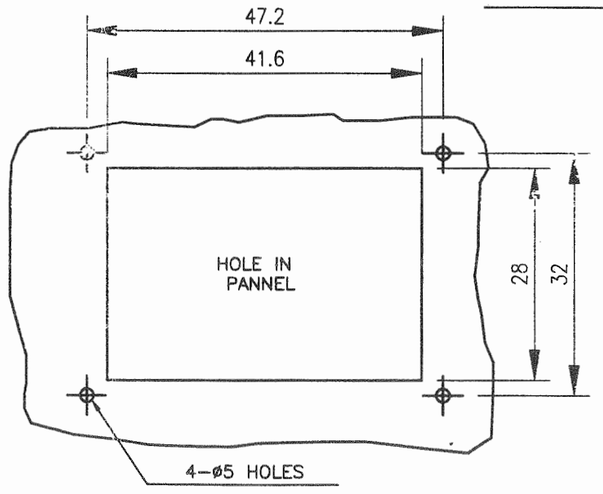
METER

SENSOR

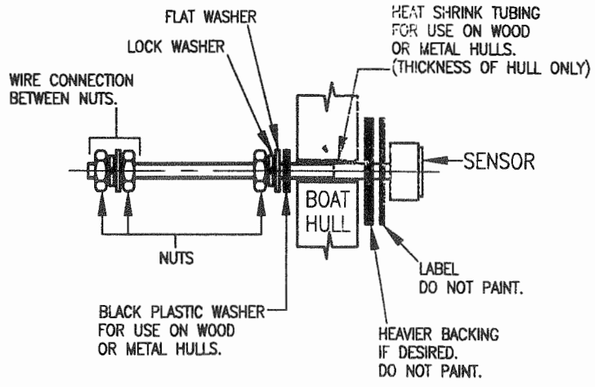
PROJECTION



WIRING DIAGRAM



METER MOUNTING



SENSOR MOUNTING

INSTALLATION DETAILS.

REF	NO.	BY	DATE	AMENDMENTS
CL3718	0	R.J.L	28.06.95	ISSUED FOR PRODUCTION

JET ALL

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

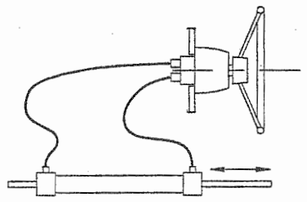
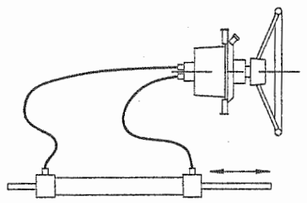
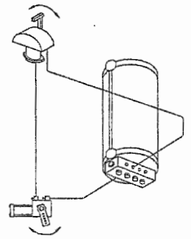
APPROVED K.V.E 21/8/95

NAME
ANODE CONDITION MONITOR INSTALLATION INSTRUCTIONS

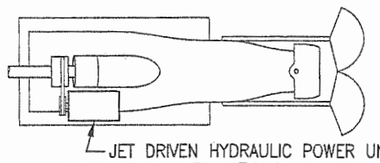
SCALE NONE | No: A2– 63974 | 0

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.

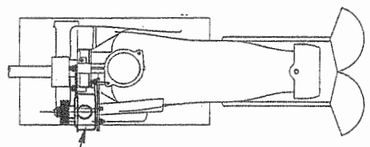
H.P.U OIL VOLUME = 4 ltrs.

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

EXAMPLES:
SHELL: TELLUS 46
CASTROL: HYSPIN AWS 32/68

TOTAL OIL VOLUME in Litres	USED ON JET MODEL
5.25	HJ321
5.25	HJ362
?	HS363
7.5	HJ391
7.5	HM422
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

EXAMPLES:

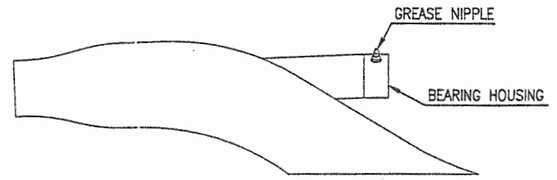
SHELL:	DONAX TM	Auto Transmission Oil.
	DEXRON 111	Auto Transmission Oil.
MOBIL:	ATF	Auto Transmission Oil.
CASTROL:	TQ DEXRON 111	Auto Transmission Oil.
ESSO:	PSF #91423	Power Steering Fluid
TEXACO:	TL-11872	Power Steering Fluid
	TL-15216	Power Steering Fluid

TOTAL OIL VOLUME in Litres	USED ON JET MODEL
1	HJ213 HJ241
1.2	HJ273
1.2	HJ291

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

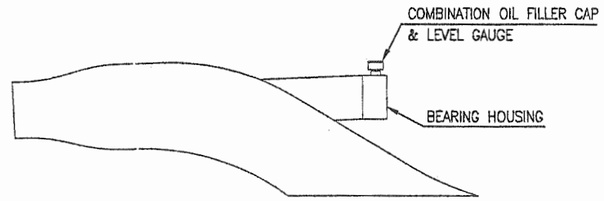
GREASE LUBRICATED



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
CL	G	J.W.	18.8.99	HSRX FLUID DETAILS ALTERED. HM651-721-811 VOLUMES AMENDED.
CL	G	R.J.L	18.08.99	Sht.1 REMOVED FROM DRG.No, Sht.2 NOW OBSOLETE ON NEW DRG.B5113
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.

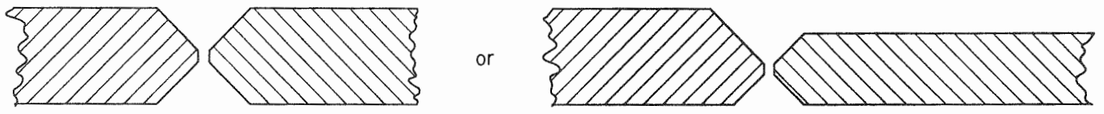
5. Welding Process: – M.I.G.

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

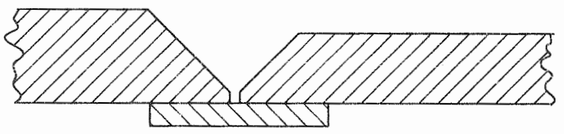
7. Shield Gas: – Argon or helium..

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
	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

MATL CERT

DESIGNED — DATE

DRAWN P.A.S. 6/6/95

CHECKED

APPROVED [illegible] 30-10-96

√ = N9 EXCEPT AS STATED

UNLIMITED DIMENSIONS TO BE ±

NAME

SCALE

WELD PROCEDURE for WELDING CAST INTAKEBLOCKS into ALUMINIUM HULLS

No. A3–85080

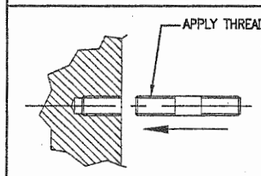
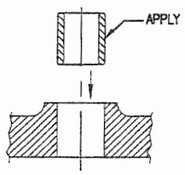
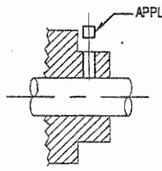
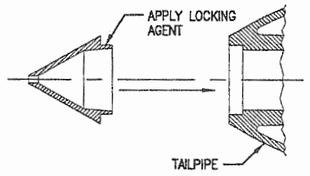
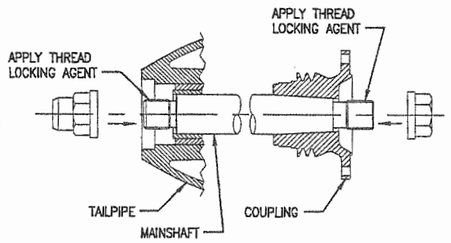
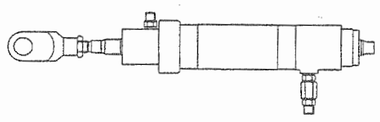
B

PROJECTION

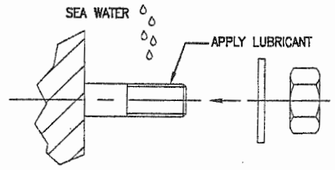
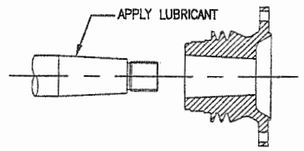
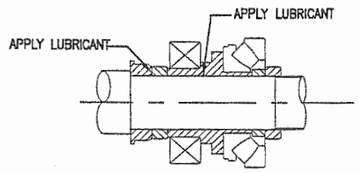
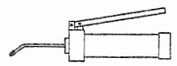
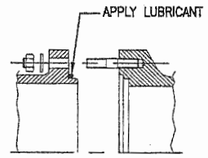
JET 211 212 213 241 273 272 291 321 363 391

PROJECTION

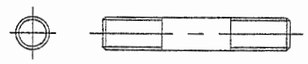
THREAD & JOINT LOCKING

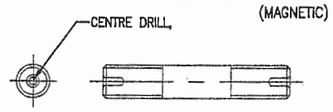
STUDS AND THREADED BUSHES	LOCKING AGENT
	
BUSHES & SLEEVES	
	
SET SCREWS & GRUB SCREWS	**LOCKING AGENT**
	
TAILPIPE FAIRING *(WITHOUT LOCKING DEVICE)*	**LOCKING AGENT**
	
MAINSHAFT NUTS *(WITHOUT LOCKING DEVICE)*	**LOCKING AGENT**
	
HYDRAULIC FITTINGS & CYLINDERS	**LOCKING AGENT**
	

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

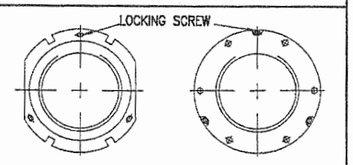
SIZE	N.m	lbs.ft	GRADE 316 STAINLESS STEEL STUDS
M6	5	4	(NON MAGNETIC)
M8	12	9	
M10	24	18	
M12	40	30	
M16	60	45	
M20	120	90	

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	

					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	NAME RECOMMENDATIONS for FASTENER LOCKING, TORQUES & THREAD LUBRICATION.
					DESIGNED / DATE	
CL	0	R.J.L	18.08.99	ISSUED FOR PRODUCTION.	DRAWN R.J.L 18-08-99	
REF	NO.	BY	DATE	AMENDMENTS	CHECKED	
JET					APPROVED	SCALE N/A No: A3-85113 0

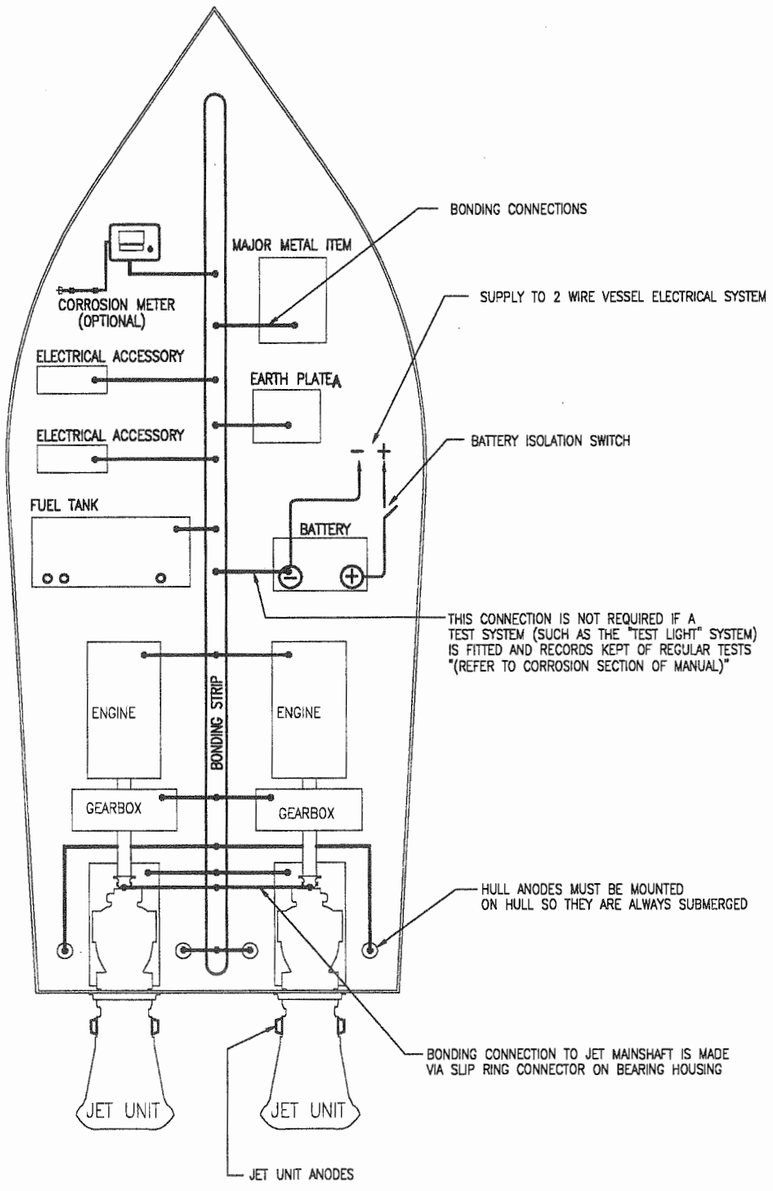
0

85113

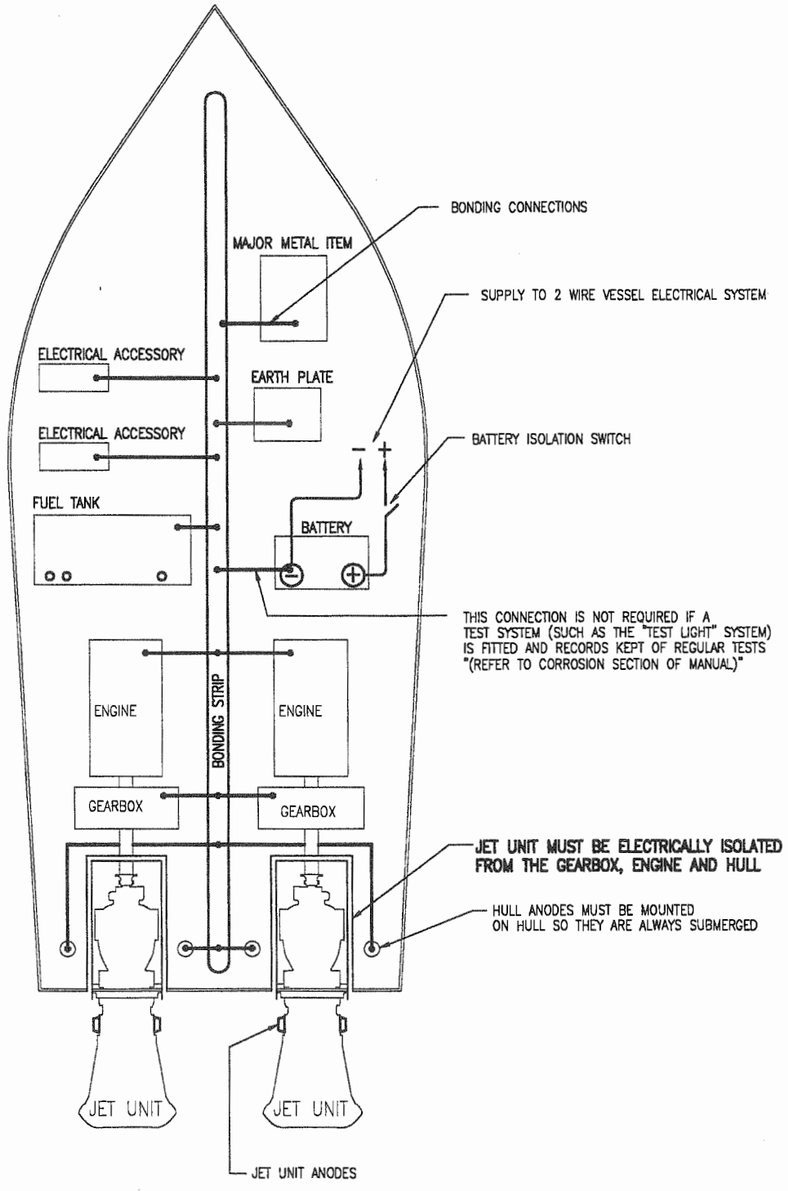
DO NOT SCALE THIS DRAWING.

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	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

MAT'L CERT

DESIGNED | DATE

DRAWN R.J.L 18-08-99

CHECKED L.E.A 18-08-99

APPROVED K.V.E

✓ = N9 EXCEPT AS STATED

UNLIMITED DIMENSIONS TO BE ±

NAME
EARTH BONDING SYSTEM RECOMMENDATIONS AND LAYOUT

SCALE -

No: A2-85114 A